GP2/74

MANITOBA

DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT

MINERAL RESOURCES DIVISION

EXPLORATION AND GEOLOGICAL SURVEY BRANCH

GEOLOGICAL PAPER 2/74

SUMMARY OF GEOLOGICAL FIELD WORK 1974

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PREFACE

Field work by the Provincial Geological Survey in 1974 comprised projects in the Churchill and Superior provinces, on the consolidated Phanerozoic rocks of southwestern Manitoba and on unconsolidated deposits in northern Manitoba.

In the Churchill province mapping was conducted in the Seal River, Karsakuwigamak Lake, and Kadeniuk Lake areas. In addition, detailed mapping and sampling of the Lynn Lake greenstone belt east of Lynn Lake was carried out.

The Kettle Rapids-Long Spruce portion of the Nelson River was examined to record available geological data prior to flooding of the Long Spruce Rapids forebay.

In the Superior province, mapping was conducted in the Utik-Bear Lakes area and a program to map unmapped portions and to re-examine previously mapped areas of southeastern Manitoba was initiated.

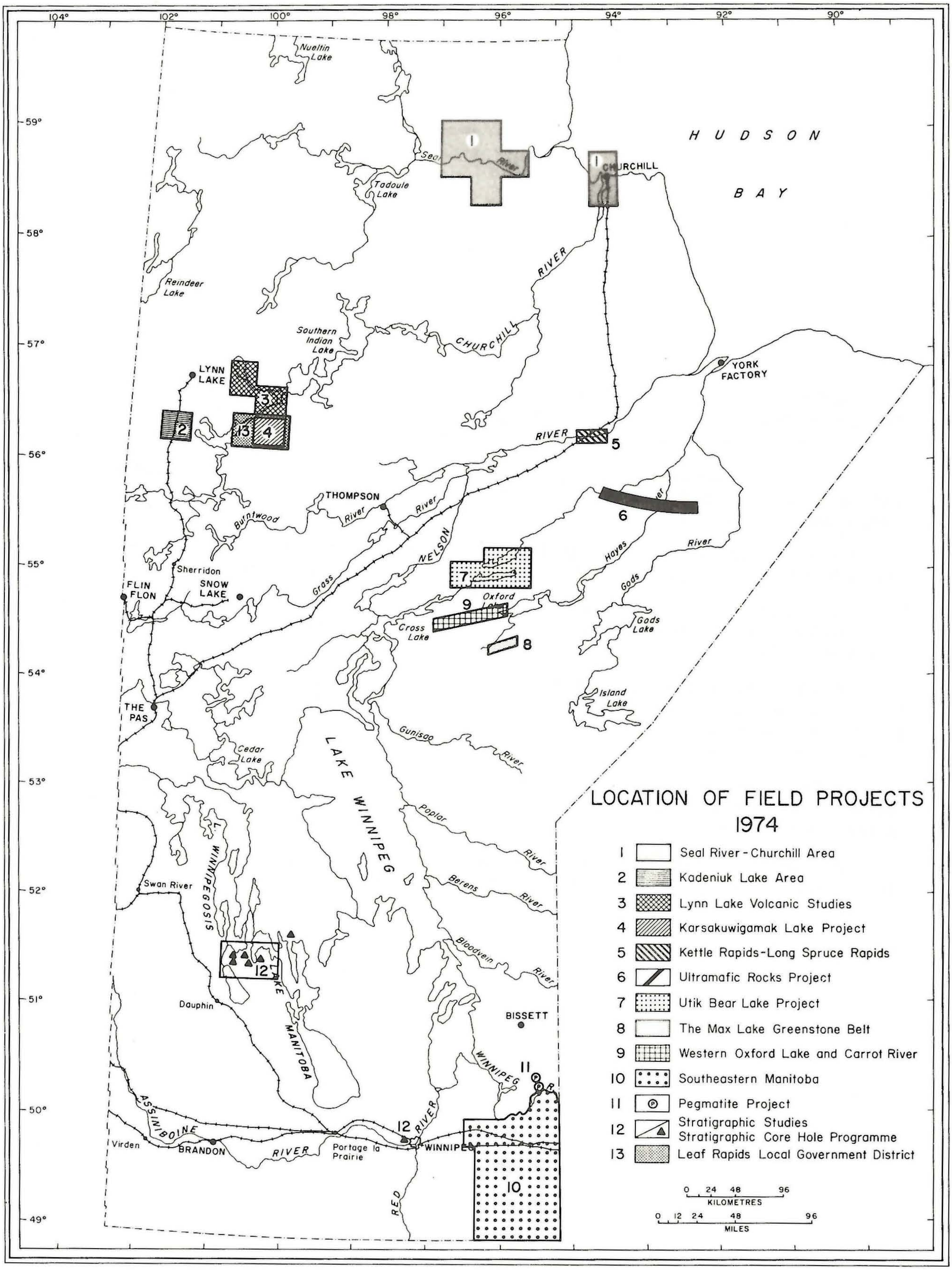
An examination of the geology and mineralization of the Western Oxford Lake and Carrot River area was undertaken and as a result of this work two subeconomic zones of porphyry copper mineralization were found. The zones which contain chalcopyrite and molybdenite form the cores of trondhjemite stocks.

Studies of Devonian stratigraphic core hole data and previously obtained field data continued, with emphasis on attempting to define the structure and stratigraphy of Devonian strata in the Winnipegosis area.

An examination of the sand and gravel resources of the Leaf Rapids local government district was completed and good sources of aggregate were found in the esker deposits.

October 4, 1974

R. F. J. Scoates
Acting Director


HUDSON BAY
CHURCHILL
Nueltin Lake
Tadoule Lake
Seal River
Reindeer Lake
Southern Indian Lake
CHURCHILL RIVER
LYNN LAKE
YORK FACTORY
THOMPSON
Burntwood River
Grass River
NELSON RIVER
Hayes River
Gods River
Gods Lake
Oxford Lake
Cross Lake
Island Lake
Sherridon
FLIN FLON
SNOW LAKE
THE PAS
Cedar Lake
LAKE WINNIPEG
Gunisao River
Poplar River
Berens River
Bloodvein River
L. WINNIPEGOSIS
LAKE MANITOBA
Swan River
Dauphin
BISSETT
WINNIPEG RIVER
ASSINIBOINE RIVER
Virden
BRANDON
Portage la Prairie
WINNIPEG
RED RIVER
LOCATION OF FIELD PROJECTS
1974
1 Seal River - Churchill Area
2 Kadeniuk Lake Area
3 Lynn Lake Volcanic Studies
4 Karsakuwigamak Lake Project
5 Kettle Rapids-Long Spruce Rapids
6 Ultramafic Rocks Project
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(1) SEAL RIVER AND CHURCHILL AREAS

(64I-15, 15; 64P-1, 2; 54L-9, 13, 16)

By D. C. P. Schledewitz

Geologic mapping of the 16,000 square km project area, located along the Seal River, was begun in the northwest quarter and also in the immediate area of Churchill (Figure 1-1).

At the beginning of the field season outcrops were located from fixed wing aircraft by flying lines on 1½ mile spacing in four map-areas (64I-15, 16 and 64P-1, 2). About 90 per cent of the outcrops were located in 1½ days of flying. Ground traversing was effective in the area around and north of Great Island. South and east of Great Island, minimal ground traversing was possible because of widely spaced outcrops, poor accessibility and very poor walking conditions. The use of fixed wing support is also limited south and east of Great Island due to the blackness of the water and the boulder filled, shallow nature of the lakes. Helicopter support appears to be the most efficient and productive approach to mapping in 70 per cent of the project area. The results of the project to date are as follows:

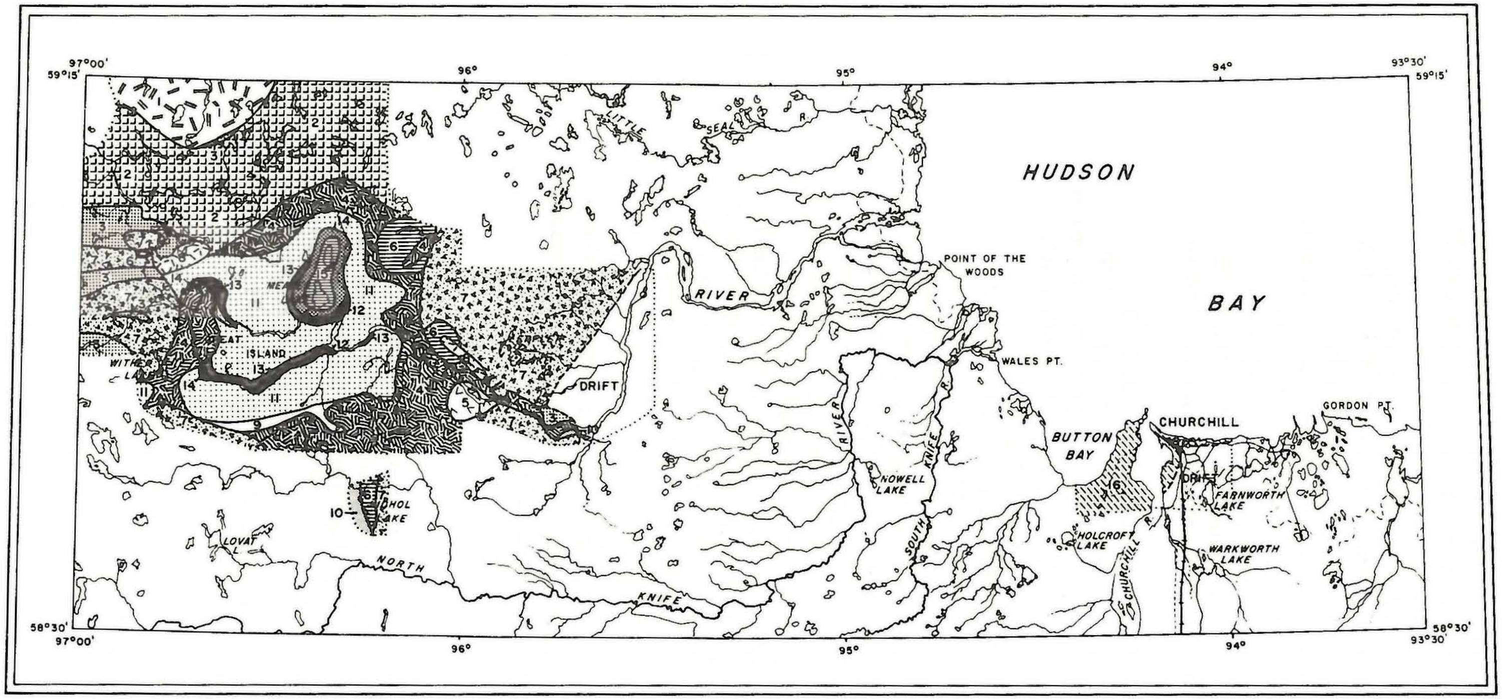
1) Geologically unknown areas on previous maps of the region were reduced by one-third.
2) A redefinition was made of rock units in the Great Island Group comprising a stratigraphic sequence indicative of platform sedimentation starting with shallow water sedimentation and changing stratigraphically upward to deeper water sedimentation.
3) The volcanic rocks are more extensive than previously indicated. The metasedimentary rocks of the Great Island Group in general directly overlie the volcanic rocks.
4) Mineralization in the form of disseminated pyrite and pyrrhotite is common in the volcanic rocks and gabbro. Pyrite occurs in the black shales as disseminated grains and fracture fillings. Pyrite and pyrrhotite also occur in the amphibolites.

The geology was previously described by Johnston (1935); Milligan (1955); Taylor (1958); Bostock (1967, 1969); and Davison (1967). Glacial deposits are extensive and bedrock exposures in general are 1 to 2 per cent of the area.

The area is underlain by Precambrian rocks showing a wide range of lithology and metamorphic grades. The least metamorphosed rocks are those of the metasedimentary Great Island Group which are generally considered to be of Aphebian age. Mineral assemblages within the shale units indicate conditions of metamorphism well within the middle greenschist facies.

Underlying the metasedimentary Great Island Group rocks is a suite of volcanic rocks. The volcanic rocks comprise a sequence of andesitic flows, in part pillowed; basic to intermediate agglomerates; interlayered andesitic flows and intermediate tuffs. Intermediate crystal and lapilli tuffs are exposed mainly along the Seal River at the west end of Great Island and along the Seal River in the Eppler Lake map-area (54L-13). Volcanic rocks of apparent dacite and rhyodacite composition were observed mainly south of the southeast end of Great Island.

The volcanic rocks are intruded by dense grey feldspar porphyry with acicular amphibole crystals, gabbro, red to deep pink feldspar porphyry and a quartz monzonite of large areal extent. The oldest phase, the grey feldspar porphyry (unit 5), occurs locally as dykes within the crystall lapilli tuffs along the Seal River (Eppler Lake, 54L-13).The gabbro (unit 7) occurs as three stocks; one on the Seal River 15 km east of the east end of Great Island; another in the southwest corner of the Hebner Lake map-area (64P-1) within the volcanic rocks; and the third along Nichol Lake (64I-9). Single dykes of gabbro have also been observed within the volcanic rocks. Dykes of the reddish pink feldspar porphyry (unit 6) were observed to crosscut the two previous intrusive phases in outcrops along the Seal River (Eppler Lake, 54L-13). The red feldspar porphyry also occurs as two small stocks, one on "Gauntlet Lake" (Meades Lake, 64I-16) and a second on the south bank of the Seal River, 19 km east of the east tip of Great Island. The final phase of intrusive activity is represented by the quartz monzonite (unit 8) which occurs as dykes in the volcanic rocks along the Seal



16	Churchill quartzite with interbedded conglomerate, sub-greywacke. Frequency and thickness of conglomerate beds increase to east
15	Shale, slate and biotite schist
14	Meta-greywacke
13	Shale grey to black; slate; grey-green phyllite ± garnet ± biotite porphyroblasts ± pyrite
12	Meta-dolomite
11	Quartzite-orthoquartzite, interbedded grey-green silty shale, sub-greywacke
10	Quartzite and quartz sericite schist
9	Conglomerate mainly quartzite and quartz pebble conglomerate sporadically polymictic
8	Quartz porphyry
7	Quartz monzonite with minor granodiorite phases
6	Gabbro
5	Pink feldspar porphyry
4	Intermediate volcanic rocks
3	Migmatites, gneisses and granitoid rocks
2	Foliated quartz monzonite
1	Hypersthene granulite

8 6 4 2 0 8 16 Miles

8 4 0 8 16 Kilometres

SYMBOLS

.... Limit of mapping

– – – – Drift

Figure 1-1. Geology of the Seal River project area.

River (Eppler Lake, 54L-13) and as the main rock type in the Eppler Lake map-area (54L-13) and in the west half of the Wither Lake map-area (64I-9).

The volcanic rocks almost everywhere are overlain by the Great Island Group. The contact between the volcanic and metasedimentary rocks was not seen and consequently its nature was undetermined. Stratigraphic or structural criteria which might be used to define the conformable or unconformable nature of the contact are either not available or unreliable. The absence of quartz monzonite (8) dykes in the Great Island Group compared to their common occurrence in the volcanic sequence may indicate a break between the volcanic and sedimentary groups of rocks.

Stratigraphically, the lowest beds of the overlying Great Island Group are quartzites and subgreywacke (12). These rocks are grey to pink in colour and massive to well layered. Ripple marks and crossbedding are present but not pervasive within the quartzite. Discontinuous beds of grey-green silty shale are common within the quartzite. Conglomerate and orthoquartzite are present south of Great Island. However, these rocks have been treated as rocks of uncertain affinity since a direct correlation with the quartzite at Great Island could not be established. The conglomerate is both oligomictic with quartz pebbles and polymictic with quartzite, quartz and grey to dark grey pebbles which may be clasts of volcanic derivation.

The only other conglomerate observed occurs near Churchill as part of a highly crossbedded subgreywacke to orthoquartzite sequence. The frequency and thickness of the conglomerate beds appear to increase towards the east. The pebbles in the congolmerate are quartz and quartzite. Rare, highly chloritic pebbles were also observed but could not be sampled. The stratigraphic position of the conglomerate, though uncertain, may be equivalent to or is above the conglomerate in the Seal River area south of Great Island.

The Great Island Group basal quartzite (12) is overlain by a discontinuous pink saccharoidal meta-dolomite. The meta-dolomite is overlain by hematitic shale or black pyritic shale, grey shale and a grey-green phyllite. A distinctive black garnet-amphibole schist with variable pyrite content occurs sporadically within the shale sequence. The shales are overlain by a greywacke containing widely spaced discontinuous grey siltstone and silty shale lenses. These in turn are overlain by a grey shale to black biotite schist, completing the exposed succession of the Great Island Group. The full sequence is exposed along a section from the north shore of Great Island northwards to the south shore of Meades Lake (64I-16). Only part of the sequence is repeated along the Seal River at the southeast tip of Great Island. At this location the quartzite overlies the meta-dolomite and pyritic shale. The occurrence of quartzite at this horizon may be due to overthrusting of the upper contact of the pyritic shale.

The rocks showing the highest metamorphic grade are possibly the oldest rocks in the area and occur in the northwest corner of the Wither Lake map-area (64I-15) and the north halves of the Hebner and Kesselman Lake map-areas (64P-1, 2). This suite comprises biotite gneiss (unit 3a), granite gneiss (3b), amphibolite (3c), foliated quartz monzonite (unit 2) and foliated hypersthene granulite (unit 1).

Structural geology

The major folds in the area trend east and north. A period of folding about steeply dipping easterly axial planes, which was postdated by later folding about steeply dipping axial planes at 210 degrees, is indicated by minor structures. East-trending axial planar slaty cleavages are folded about an axial plane oriented at 210 to 230 degrees. The easterly trending axial planar cleavages are also intersected by a younger cleavage at 210 to 230 degrees. This interference has resulted in a system of culminations and depressions which trend north-northeast and east.

Economic geology

Mineralization in the map-area was observed within:

i) the shale unit 14b;
ii) the garnet amphibole schist;
iii) the volcanic rocks;
iv) the basic zones of the gabbro;
v) the granite gneisses; and
vi) the amphibolites.

Pyrite occurs as disseminations in the shales and garnet schists and as fracture fillings in the black shales. Disseminated pyrite and pyrrhotite are common in the volcanic rocks with localized concentrations in shear zones. The pyrite and pyrrhotite occur mainly within the more basic zones in the gabbro as disseminated grains and along shear surfaces constituting 0.5 to 1 per cent of the rock.

Sulphides also occur in the metamorphic rocks. Minor chalcopyrite and malachite were observed on fractures and in shears in the granite gneiss within an area of quartz monzonite (8) along the Seal River in the Eppler Lake map-area (54L-13). The amphibolite in the northwest corner of the Wither Lake map-area (64I-15) is commonly mineralized by up to 1 per cent pyrite and pyrrhotite.

Average radioactivity levels for the rocks in the area range from 50 to 80 cpm with the highest readings at 200 cpm recorded in the Churchill quartzite in the Churchill area. Readings were made with a hand held Geiger counter.

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(2) THE GEOLOGY OF THE KADENIUK LAKE AREA

(64C-6)

By D. A. Baldwin

Introduction

The Kadeniuk Lake area comprises N.T.S. map-sheet 64C-6 bounded by latitudes 56°15' and 56°30' and longitudes 101°00' and 101°30'. Mapping was conducted on a scale of one-half inch to the mile. Outcrop is abundant and access is good.

General geology

The area is underlain by Precambrian arkosic and greywacke metasedimentary rocks. The rocks have been subjected to polyphase deformation, metamorphism and intrusion by acid to intermediate plutonic rocks.

The arkosic rocks are assigned to the Sickle Group and the greywacke rocks to the Burntwood River Supergroup.

Deformation, metamorphism and plutonism appear to be post-Sickle lithification in age.

Rock description

General

The greywacke metasedimentary rocks (psammites, semi-pelites and pelites) are the oldest rocks in the area. (Table 2-1) They comprise schists containing quartz, plagioclase, biotite ± hornblende ± garnet, paragneisses and metatexites.

Semi-pelitic paragneisses are most abundant with only minor amounts of interlayered psammite and pelite. Outcrops of psammite and/or pelite are sporadic.

Layering is pronounced and defined by change in rock type and/or by thin biotite concentration on bedding planes.

Interlayered amphibolites occur within the group and in part may have a volcanic origin. Generally the amphibolite layers are thin (3 cm to 10 cm), black, homogeneous, fine grained and equigranular. Layering and primary structures are absent. They contain plagioclase, hornblende ± minor biotite.

Amphibolite sequence

A pronounced, thinly layered (2 cm to 4 cm) garnet-rich amphibolite (unit 4) appears to mark the base of this sequence. Garnet is abundant as deformed porphyroblasts, aggregates and almost monomineralic layers. In outcrop the unit is a striking contrast of dark green, pale green and brown-red. Mineralogically the rock is constituted by quartz, plagioclase, hornblende, garnet and epidote.

Overlying the garnet amphibolite is a white, equigranular, massive to faintly foliated quartzite (unit 5). Quartz, plagioclase, minor biotite and very minor pyrite occur. The quartzite is gradational into a unit of thinly layered amphibolite, quartzite and marble (unit 6) in which differential weathering is a diagnostic feature. The amphibolite and quartzite layers are similar to those described above. The marble is medium grained and contains calcite and diopside.

Arkose group

The arkose group comprises arkose and subarkoses, derived granitoid gneisses and minor interlayered meta-greywacke.

The meta-greywacke (unit 7), which appears to mark the base of the arkosic group, is identical to the blastic metatexites of the greywacke group except that it grades into the pink arkosic gneisses. The gradation zone (unit 8) is defined by the first appearance of thin boudianged and lensoid layers of arkosic material within the greywacke.

Arkosic to subarkosic metatexite (unit 9a) and diatexite (9b) occupy most of the north central part of the area. The rocks are well layered, red, pale pink to buff cream, equigranular gneisses with variable amounts of red pegmatitic mobilisate. The gneisses are medium

Table 2-1 Table of formations

PLEISTOCENE AND RECENT	Sand, gravel, till, clay, boulders	
	Great unconformity	
PRECAMBRIAN	Plutonic rocks	Tonalite, monzonite, quartz monzonite, granite and pegmatite
	Instrusive contact	
	Arkose group (Sickle Group)	9. Arkose and subarkose — biotite, biotite + magnetite, biotite + hornblende, hornblende + magnetite, quartz, feldspar gneisses (with or without quartz-sillimanite knots) 8. Arkose with minor interlayered greywacke 7. Greywacke
	Sharp contact	
	Amphibolite sequence	6. Interlayered amphibolite, quartzite and marble 5. Quartzite 4. Garnet amphibolite
	Sharp contact	
	Greywacke group (Burntwood River Supergroup)	3. Blastic biotite schist 2. Amphibolite — in part volcanic 1. Biotite, biotite + garnet and biotite + hornblende greywacke paragneiss and metatexite

grained and contain biotite, biotite + magnetite, biotite + hornblende, hornblende + magnetite, quartz, plagioclase, potassium feldspar.Quartz sillimanite knots, deformed in the plane of the foliation and measuring up to 25 cm long, are commonly present in one layer within the unit.

Plutonic rocks

A large body of medium-grained, equigranular, well foliated, buff white to pale red, biotite tonalite (unit 10) occupies the northeast part of the map-area. The large inclusions of arkosic and amphibolitic rock contained in this body make it possible to trace a ghost stratigraphy through the pluton.

The hornblende monzonite (unit 11) intrudes the greywacke group in the Laurie River region. The rock is equigranular, medium grained, buff cream coloured, and contains hornblende as the only mafic mineral. Exotic ellipsoidal hornblende-rich inclusions are common. The large body on the Laurie River is massive to faintly foliated whereas the ones to the west of the Laurie River have a pronounced shear foliation.

Rocks of quartz monzonite to granodiorite composition (unit 12) occur in irregular bodies of various sizes. Characteristically they are white to pale pink, medium grained, homogeneous and variably foliated.

The granodiorite (unit 13) occurs as irregular bodies in the Kadeniuk Lake region. It is fine grained, homogeneous, equigranular, massive to weakly foliated, and weathers to a bright white colour.

Coarse-grained, buff cream pegmatite (unit 10) occurs in fold noses. It is coarse grained, equigranular, massive and commonly contains minor inclusions of greywacke (unit 1).

Metamorphism

Metamorphic grade increases gradually from east to west.

In the extreme eastern part of the area the rocks lack mobilisate and are fine-grained schists in which garnet is virtually absent. The mineral assemblage comprises quartz-plagioclase-biotite-hornblende.

To the west the rocks show a higher degree of recrystallization. They contain sills of mobilisate; garnet is quite prevalent and hornblende absent.

The rocks in the extreme western part of the area have been recrystallized in the cordierite-muscovite-almandine subfacies of the cordierite-almandine facies of Abukuma-type metamorphism. The mineral assemblage comprises quartz-plagioclase-biotite-garnet-sillimanite ± cordierite.

The greywackes surrounding the large hornblende monzonite body on the Laurie River have been recrystallized in the hornblende hornfels facies.

Structure

Three phases of folding and one major period of faulting have been recognized. The *first phase* produced upright isoclinal structures with the imposition of a strong fabric parallel to the axial planes. The *second phase* of folding produced open synclines and anticlines which refolded the F_1 structures with only a local development of a synchronous schistosity. Emplacement of much of the mobilisate was up the F_2 axial planes. The *final phase* is locally developed and causes a gentle warping of the earlier folds into relatively flat structures.

Minor faulting was synchronous with F_1 and F_2. The major faulting was post F_3 and strikes 340° to 350° azimuth. Both lateral and horizontal displacement are suspected.

Mineralization

Very few mineralized zones were found. Those that are present have the mineralogy (1) pyrite, chalcopyrite, bornite or (2) pyrite, pyrrhotite.

(3) LYNN LAKE VOLCANIC STUDIES

(64B-12; 64C-9, 15, 16)

By H. V. Zwanzig

Several stratigraphic sections across the Lynn Lake greenstone belt were mapped and sampled east of Lynn Lake to provide updated information on volcanic, sedimentary and plutonic rocks. Some critical areas of granitic and gneissic rocks were examined between Lynn Lake and Opachuanau Lake. The latter work was aimed at a regional tectonic synthesis for resource evaluation.

The geology of the Lynn Lake belt is known largely from previous maps and reports of the Manitoba Mines Branch including those of Steeves and Lamb (1972), Hinds (1972), Crombie (1948), Stanton (1948), Allan (1948), and from the compilation of Milligan (1960). The bedrock comprises a variety of metavolcanic and metasedimentary strata exposed in narrow belts which are separated by large ovate bodies of tonalite and granite, and smaller mafic intrusions. The rocks constitute a volcano-plutonic belt which is flanked by the Kisseynew sedimentary gneiss belt on the south and by other greywacke-derived gneisses on the northeast. Most of the volcanic and sedimentary rocks belong to the Wasekwan Group which is unconformably overlain by the Sickle Group of sediments. They have an uncertain Precambrian age.

The main sections examined, traverse parts of the belt with low and medium metamorphic grades. The structure consists of relatively simple east-trending belts of steep, northerly dipping strata (Figure 3-1). The northern homoclinal belt of rocks between Lynn Lake and Barrington Lake faces north on the evidence of sporadic pillow tops. Another more complex belt of sedimentary and volcanic strata lies south of a string of plutons that passes through Hughes and Cockeram Lakes. The structure of the southern belt is not fully understood. At Hughes Lake it is joined to the northern belt by a triangular syncline compressed between three plutons.

Northern volcanic belt

The northern belt provides a coherent stratigraphic section through the Wasekwan Group. It is most complete between Eagle and Muskeg Lakes but best exposed at Barrington Lake. Revised stratigraphic divisions are given in the stratigraphic column (Table 3-1).

Changes from Eagle Lake to the east side of Barrington Lake include:

1) an increase in felsic volcanics;
2) an increase in mafic and felsic intrusions;
3) a slight increase in metamorphic grade.

On the southeast tip of Barrington Lake there is a small felsic body with a quartz-feldspar porphyry core rimmed with felsic flow rock and breccia. A thinner felsic body to the north contains the copper-zinc mineralization which was previously trenched. Immediately east of this body there is a granitic stock which seems to be subvolcanic in origin. The stock is flanked by felsic volcanics and is cut by dykes similar to the overlying porphyritic flows. Copper-molybdenum mineralization has been recorded on the southern margin of the stock.

The large differentiated body of gabbro (Tow Lake gabbro) south of Barrington Lake faces north and underlies the felsic bodies and the intermediate volcanics. South of this pluton is a belt of more highly metamorphosed and granite-injected greywacke underlain by more metavolcanic and amphibolite strata. This succession is tentatively correlated with the lower divisions in the Wasekwan Group. Further investigations would be necessary to ascertain the probable existence of a volcanic centre. The distribution of iron formation, pillows, epidote alterations and large amygdales suggests that the volcanic pile may have been partly emergent and partly flanked and underlain by deeper-water greywackes and pillow basalts.

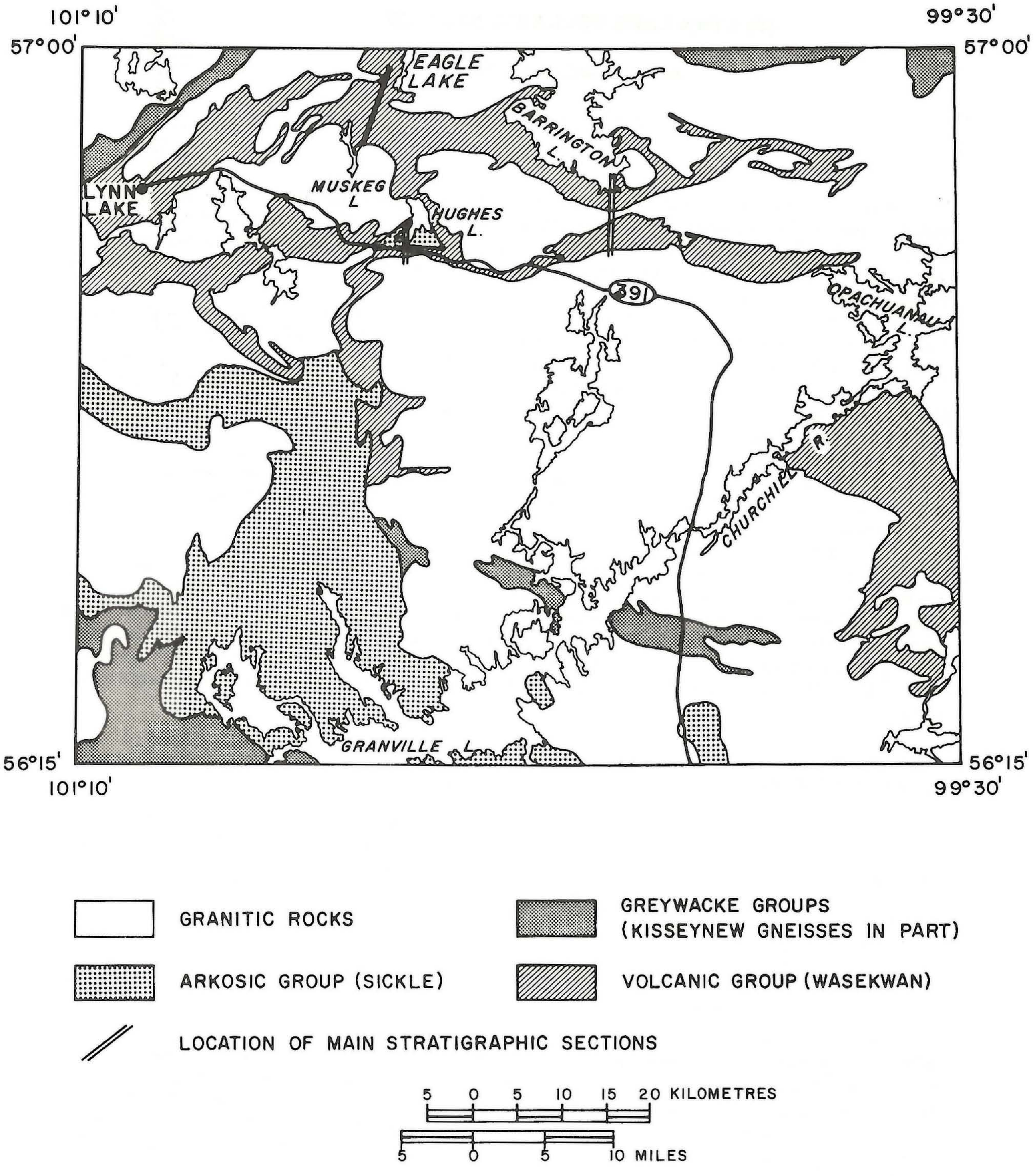

Figure 3-1. Geology of the Lynn Lake-Granville Lake area.

Table 3-1. Stratigraphic column (complete only at Eagle Lake)

Division	*Thickness*	*Description*
		Position of top not known, injected by granite
5	4000 ft. (1300 m)	Mafic to intermediate flows and pyroclastics (andesite ?) containing small (2 mm) plagioclase phenocrysts, local amygdales (up to 4 cm), few small pillows and broken pillows; epidote alterations and stockwork of basaltic (?) dykes are at the base.
		Gradational change
4	6000 ft. (2000 m)	Mafic to intermediate breccia, tuff and flows (andesite-dacite); felsic flows, dykes and breccia, commonly with plagioclase± mafic phenocrysts (1-10 mm); local amygdales and epidote alteration are near the top. Felsic rocks lense out towards the west and their place is taken by thin marker beds of magnetic argillites and local magnetite-hematite-chert iron formation. Felsic zones contain pyrite and local pyrrhotite, chalcopyrite, sphalerite and gossans. The showings are known and trenched.
		Contact not exposed
3	4000 ft. (1300 m)	Mafic pillowed flows (basalt ?). (Basalt (?) is found only west of Muskeg Lake but it may be correlated with gabbro at Barrington Lake.)
		Top interlayered
2	1500 ft. (500 m)	Monotonous dark grey arenites, black, cherty, thinly bedded (4 cm) sediments.
		Injected by granite
1		Inclusions of amphibolite and metavolcanic rafts in granitic rock.

Southern volcanic-sedimentary belt

The structure and stratigraphy of the southern belt is more complex. Preliminary conclusions are less reliable and chemical work must be delayed until the geological problems are solved. The belt was examined at Hughes Lake and along Highway 391 where the upper part of the Wasekwan Group is overlain by the Sickle Group.

Volcanic and sedimentary rafts are enclosed in tonalite and granite at the structural base of the belt south of Hughes Lake. East and west of Hughes Lake intermediate and felsic flows and breccias can be correlated with and are partly in structural continuity with the rocks of Division 4 of the northern belt. They are overlain, apparently unconformably, by the Sickle Group comprising arkose, quartz wacke, grit and basal conglomerate. South of Hughes Lake the Sickle Group rests on a sedimentary succession of about 2000 feet (700 m) of dolomitic or ankeritic phyllite, black pyritic argillite, meta-siltstone and wacke. It appears that the arkosic rocks at Hughes Lake were deposited on the south flank of a volcano-plutonic belt where they overlie volcanic rocks and unroofed plutons, as well as the sediments on the south slope of the belt. These underlying sediments are tentatively correlated with mainly volcanic rocks of Division 4 in the north. The calcareous rocks may be lateral equivalents with the iron formation. They contain pyrite and gold-copper showings which have been investigated. They are underlain by volcanics of Division 4 and by granites with mylonitic contacts. Faulting may have occurred at the contacts of these sediments.

Southern granite belt

Reconnaissance traverses of the granitic rocks at Eden Lake and along Highway 391 crossed parts of a second, east-trending string of ovoid-shaped plutons. They structurally underlie the southern sedimentary and volcanic belt and contain rafts of these rocks. At Eden Lake the plutons are relatively simple. They comprise foliated and porphyritic tonalite and quartz monzonite. At Opachuanau Lake their foliated members have been mapped as the Opachuanau gneisses by Hinds (1972) and Steeves and Lamb (1972). A foliated tonalite (unit 10a of the Opachuanau gneisses of Steeves and Lamb) contains partly assimilated oval inclusions of plagioclase amphibolite that attest to the plutonic origin of their host. Along the Churchill River some interesting outcrops of Sickle conglomerate contain distinct boulders of the underlying tonalite. Some of the boulders have an epidote alteration which is interpreted as paleo-weathering. Similar alterations occur in a granitic rock below the basal Sickle conglomerate at Hughes Lake. However, Gilbert (personal communication) interprets the contact on the Churchill River as intrusive.

The northern contact of the granitic chain is extensively mylonitized. A large screen of Sickle conglomerate was recognized southwest of Hughes Lake. It faces north and suggests that the plutons contain various fault slivers. Quartz veins with pyrite and gold are reported from pits on Cartwright Lake north of the fault zone.

Mineralization

Some environments for potentially economic mineralization can be suggested from showings and the preliminary stratigraphic work, but no detailed work has been done. These environments include:

1) the felsic layers in Division 4;

2) the subvolcanic granitic pluton at the top of Division 4;

3 the dolomitic phyllite in the upper part of the Wasekwan Group underlying the Sickle Group;

4) the fault zone along the north flank of the southern chain of plutons.

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(4) KARSAKUWIGAMAK LAKE PROJECT

(64B-5)

By H. P. Gilbert

Introduction

The project was undertaken as a result of the Rat River system water level adjustment scheduled by Manitoba Hydro to begin in 1974. The objectives of the project were:

1) to establish a stratigraphic column in the area as an aid to regional correlation;
2) to identify rock units of possible economic interest, and investigate all significant mineralization;
3) to add to the mapping information already published.

Field work involved:

1) examination of shoreline outcrop on major lakes between Pemichigamau and Opachuanau Lakes, with priority to Karsakuwigamak Lake;
2) inland traversing;
3) reconnaissance mapping to investigate the eastern extremity of the Rusty Lake greenstone belt.

Stratigraphy of the Rusty Lake Greenstone Belt

Investigation of the stratigraphy of the Rusty Lake greenstone belt was based on the area between Karsakuwigamak Lake and "Eagle" Lake, which contains the thickest and best exposed sequence of the belt (Figure 4-1). Segments of the succession were selected for mapping on the basis of availability of outcrop, and the information compiled in a stratigraphic column.

Details of the stratigraphy cannot be reliably established since the structural interpretation of the area is speculative. Milligan (1964) suggested that the area may comprise one limb of a large fold, and noted that evidence for large scale folding within the section was absent. Pearse (1964) identified an anticline-syncline structure in the area immediately to the west of the Karsakuwigamak-"Eagle" Lake section; the evidence for this structure, however, was described as "of questionable value" (Pearse, 1964, p. 13). Steeves and Lamb (1972) infer a true thickness of half the thickness of the existing section, and attribute the thickening to isoclinal folding. Although there is evidence for small scale folding in the Karsakuwigamak-"Eagle" Lake section, there is no indication that the repetition of lithologic units is a result of folding. Reliable indications of top direction were observed only in the southern half of the section, where crossbedding and graded bedding indicate tops to the north-northwest and to the north-northeast respectively. The section may, therefore, comprise the southern limb of a single fold structure, of which the northern limb may have been displaced by the granitic intrusives north of "Eagle" Lake.

The rocks of section AF (Figure 4-2), with the exception of one member, were assigned to the Wasekwan Series by Milligan (1964) and Bristol (1966). Pearse (1964) subdivided the Wasekwan into "Lower and Upper Series". Steeves and Lamb (1972) defined the Lower and Upper Wasekwan Group. This subdivision is used in the present classification in which the Lower Wasekwan is further subdivided into an older volcanosedimentary sequence and a younger, largely volcanic succession.

The lower part of the Lower Wasekwan (exposed thickness 1590 m) outcrops on the northern and northwestern shores of Karsakuwigamak Lake (section AB, Figure 4-1). The oldest rocks are (locally garnetiferious) amphibolite and schist. These are intruded at their base by gneissoid porphyritic granodiorite. The amphibolite is overlain by a variety of sedimentary rocks interlayered and intercalated with basalt and gabbro. The sedimentary rocks include arkose, conglomerate, greywacke, siltstone and impure quartzite. Staurolite schist comprises a thin but distinctive member of the sequence. The upper part of the Lower Wasekwan (exposed thickness 26,200 feet or 8,000 m) underlies the area immediately north of Karsakuwigamak Lake (section BD[1], Figure 4-1). The predominantly volcanic sequence is characterized by a rapid alternation of basalt and related gabbro, acid volcanics and

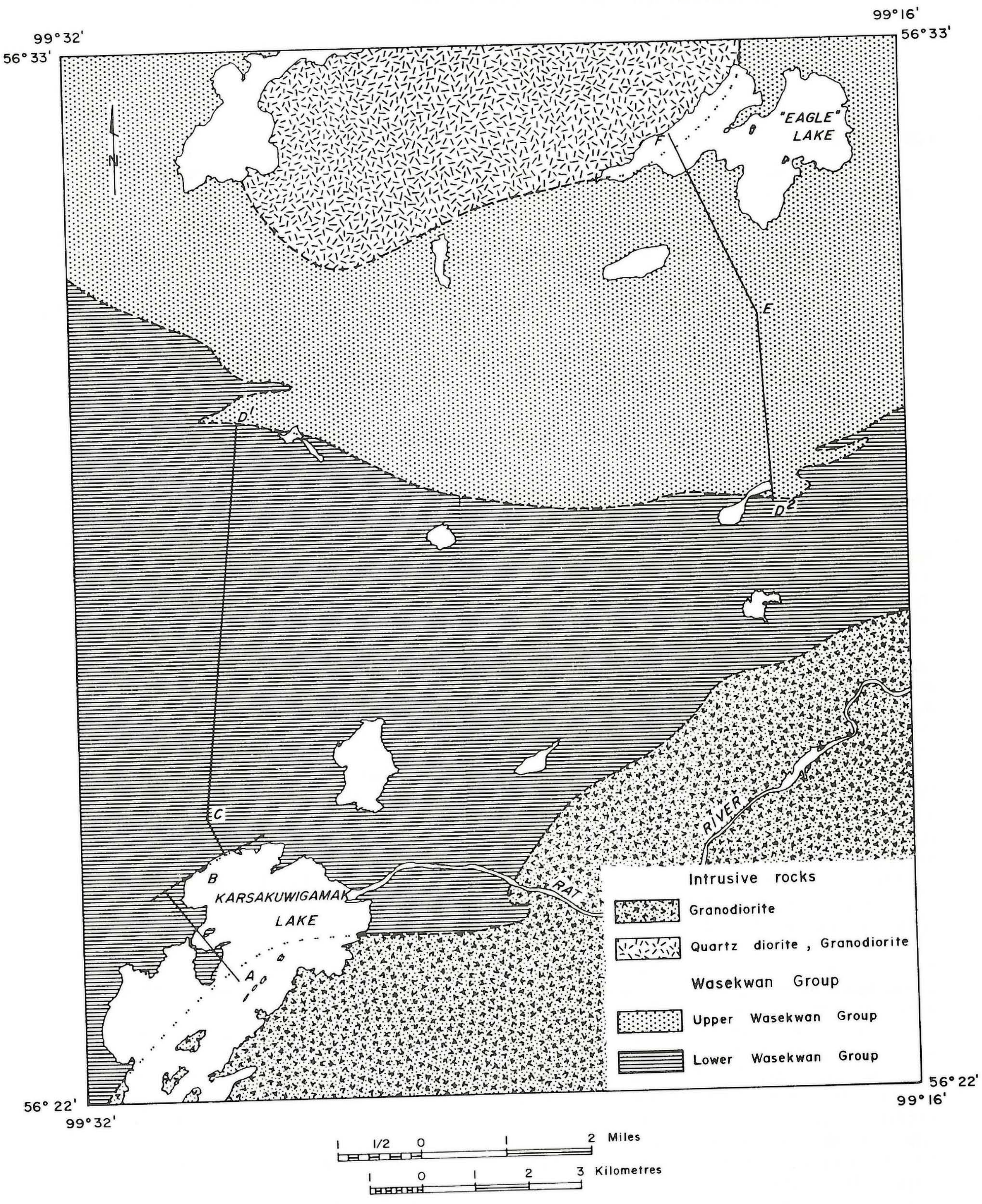

Figure 4-1. General geology and plot of stratigraphic section, Karsakuwigamak-"Eagle" Lake area.

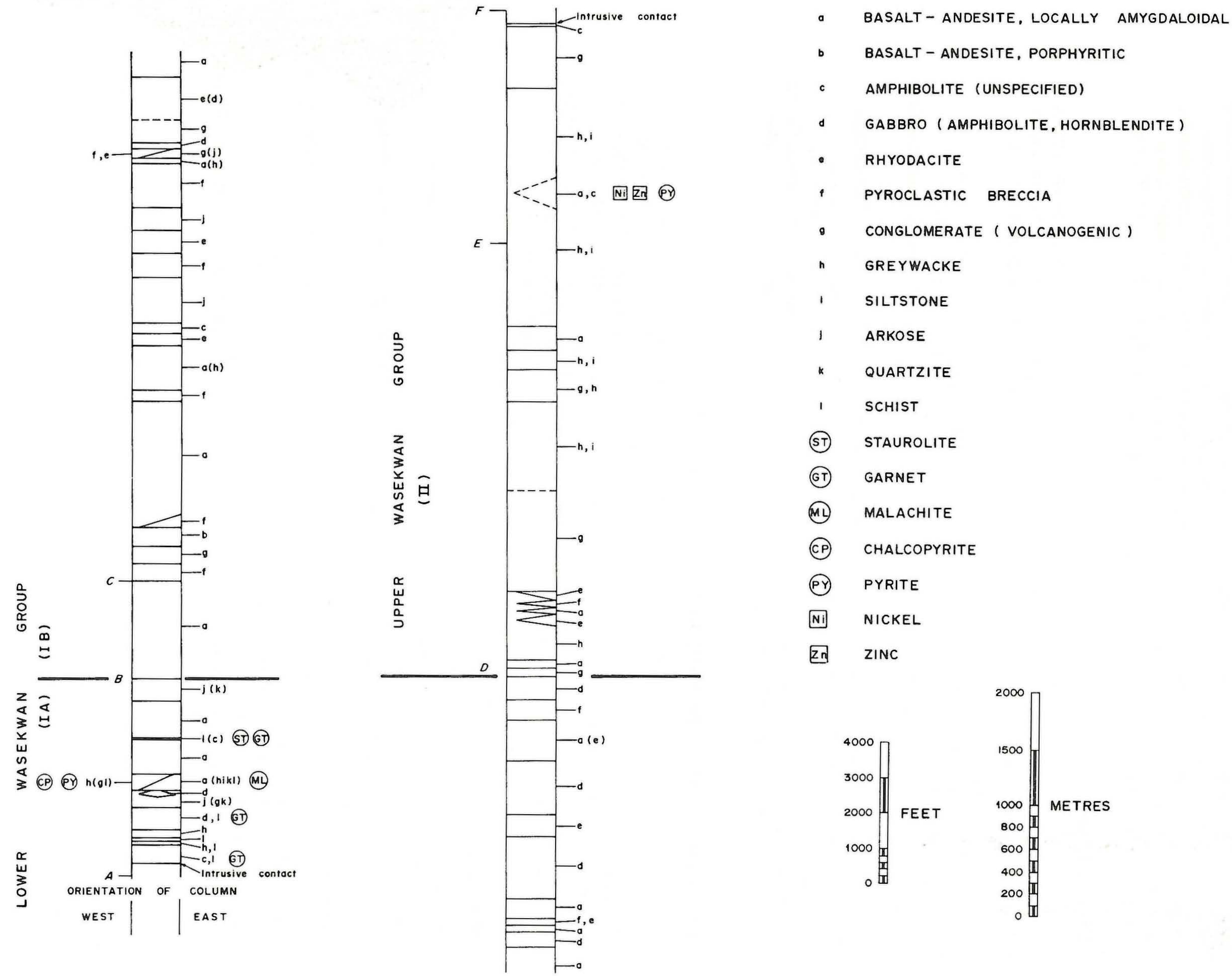

Figure 4-2. The stratigraphy of the Wasekwan Group in the Karsakuwigamak Lake area.

pyroclastic breccia, with subordinate conglomerate, arkose and greywacke. These rocks are followed northwards to "Eagle" Lake by the predominantly sedimentary Upper Wasekwan Group (section D_2F, Figure 4-1). The Upper Wasekwan is comprised of greywacke, siltstone and volcanogenic conglomerate, with subordinate acid to basic volcanic interlayers and lenses, which are largely confined to the lower quarter of this segment of the stratigraphy. A thin basalt unit, comprising the uppermost member of the group, is intruded by quartz diorite to granodiorite, which outcrops extensively to the north of "Eagle" Lake. The exposed thickness of the Upper Wasekwan is approximately 18,700 feet (5,700 m).

Mineralization

1. Chalcopyrite-pyrite showings are found at several localities in Lower Wasekwan rocks exposed on Karsakuwigamak Lake. The mineralization, occurring in sedimentary and volcanic rocks, is commonly associated with silicification. One mineralized zone is associated with garnetiferous schist.

   Pyrite-pyrrhotite showings are reported from the Upper Wasekwan Group, especially in the area to the east of "Eagle" Lake (Steeves and Lamb, 1972). A grab sample from one showing at the southern extremity of "Eagle" Lake assayed 0.02 per cent Ni. and 0.09 per cent Zn.

2. Uranium mineralization occurs in massive pegmatite on the north shore of Pemichigamau Lake, west of the mouth of the Rat River. The mineralization, consisting of a yellow bloom of a secondary uranium mineral, was observed in only one location. Related pegmatite intrudes Sickle Group metasediments and later granodiorite at Pemichigamau Lake (Schledewitz, 1972), and granitoid rocks in the southern part of Karsakuwigamak Lake (Steeves and Lamb, 1972).

Eastern extremity of the Rusty Lake Greenstone Belt

A broad aeromagnetic anomaly extends from the Karsakuwigamak-"Eagle" Lake area eastwards to the area south of Uhlman Lake (Map 7026G, Uhlman Lake, Federal-Provincial Aeromagnetic Series). The anomaly corresponds to Wasekwan Group rocks in the west. To the east of latitude 99°, mafic zones within gneissoid quartz diorite and granodiorite are responsible for the anomaly. The zones may represent Wasekwan Group rocks which have been intruded and partly assimilated by the granitoid rocks. Pillow structures were observed in one outcrop within the zone at latitude 99°12'.

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(5) GEOLOGY OF THE KETTLE RAPIDS-LONG SPRUCE RAPIDS AREA

(54D)

By T. G. Frohlinger

Introduction

In July 1974, a three-week geological examination was conducted along the Nelson River, downstream from Manitoba Hydro's Kettle Rapids dam to the proposed axis of the Long Spruce Rapids dam. The purpose of the study was to record available geological data prior to flooding of the Long Spruce Rapids forebay area. Geological mapping was conducted at a scale of 1000' = 1". A helicopter was utilized throughout this study to facilitate access.

The map-area, which lies 3 miles northeast of the town of Gillam (Figure 5-1), comprises a 10 mile corridor along the Nelson River. The central part of the area is located at latitude 56°24' and longitude 94°30'. Exposure in the area is restricted to the confines of the Nelson River and its tributaries. Elsewhere bedrock is covered by up to 200 feet (60 m) of glacial debris, consisting predominantly of clay, sand and till. High water conditions (flow of approximately 150,000 cfs) at the time of investigation obscured significant amount of exposure, especially in the upper portions of Long Spruce Rapids. Along the river only two areas provide adequate exposure for reliable geological extrapolation. Approximately 2 miles of exposures occur along both banks of the river and as numerous small islands and rock reefs downstream from the railroad bridge at Kettle Rapids. Extrapolation of lithological contacts at Long Spruce are based on limited sparse outcrop data, aeromagnetic interpretation, and subsurface drill hole data made available by Manitoba Hydro.

It is a pleasure to acknowledge the courtesies extended to the author by the personnel of Manitoba Hydro and Crippen Acres Engineering at the Long Spruce site. Enthusiastic and capable assistance rendered by Greg Smith throughout all phases of this study is gratefully acknowledged.

General geology

Five major rock units (Table 5-1) were encountered during this study. They comprise a complexly folded and faulted sequence of highly metamorphosed (upper amphibolite facies, Abukuma type) and migmatized sediments intruded by acid and basic rocks. Although the sedimentary rocks have been divided into three major units, due to lack of definitive exposures and way-up structures, their order of deposition cannot be established. The acid intrusive rocks clearly postdate the metasediments and in turn are themselves postdated by numerous diabase dykes and sills.

The rock units of this map-area can be readily correlated with those mapped by Haugh and Elphick (1968) immediately to the west in the Kettle Rapids-Moose Lake area (Table 2). Both of these sequences are comparable to deformed and metamorphosed sequences derived from arkoses and greywackes encountered elsewhere in the Churchill Province of the Manitoba Precambrian Shield. Although absolute ages for rocks exposed in the area of study are lacking, their striking similarities to 'Churchill-type' gneissic rocks should be considered in delineating the location of the Churchill-Superior boundary.

Magnetic correlation similar to that described by Haugh and Elphick (1968) was established and used to extrapolate units in the eastern (Long Spruce Rapids) portion of the study area. Due to the limited thickness of units and their complex and frequent repetition, the magnetic correlation in the western (Kettle Rapids) area proved to be only approximate, and could not be used for extrapolation.

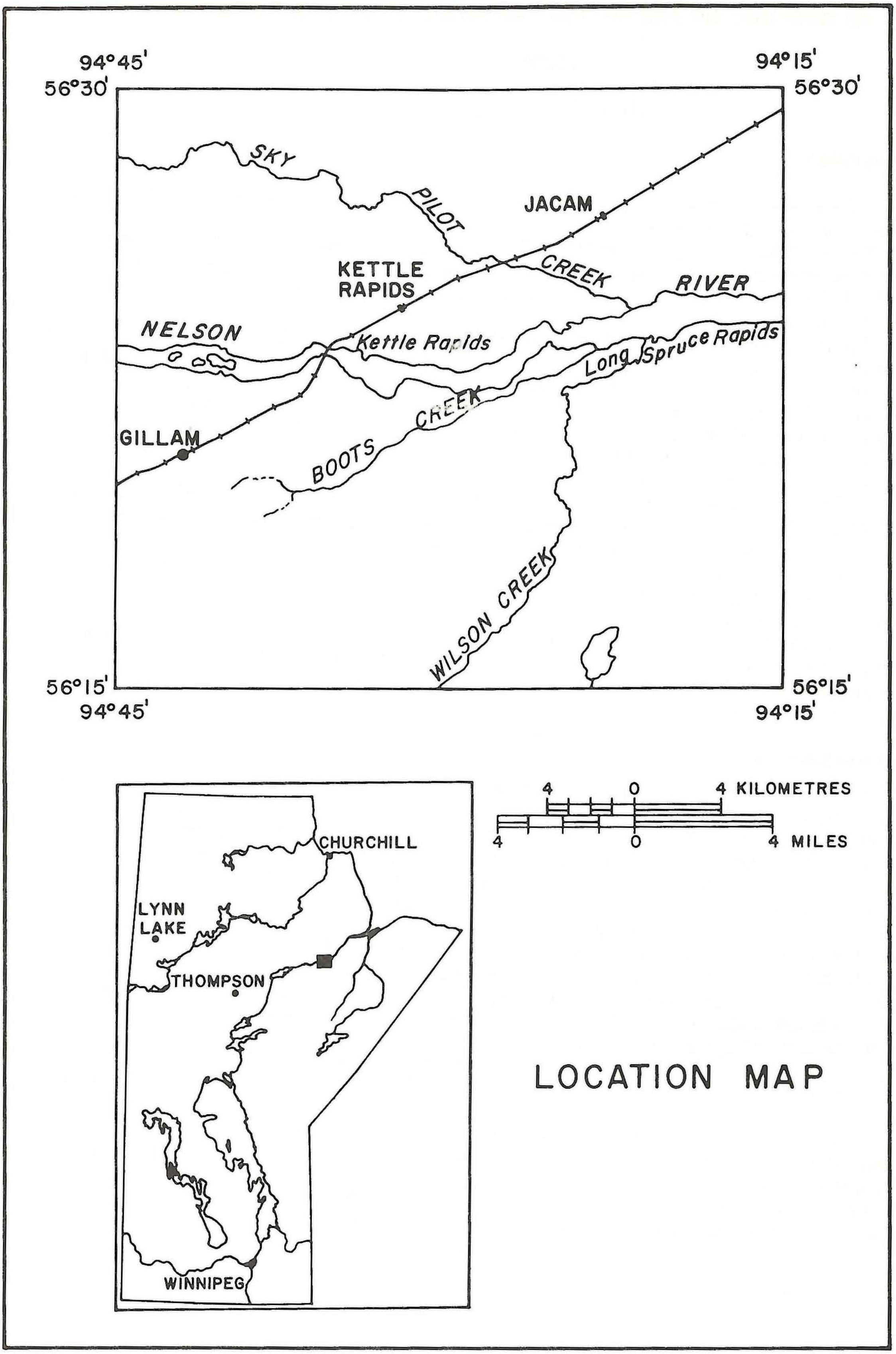

Figure 5-1. The Kettle Rapids-Long Spruce Rapids area.

Table 5-1. List of rock units

6	Diabase
5	Microcline granite, pegmatite and aplite
4	Tonalite to quartz monzonite a) Granodiorite-tonalite b) Quartz monzonite-granodiorite c) Pegmatitic granodiorite
3	Arkosic gneisses a) Acid biotite-magnetite gneiss b) Laminated gneiss c) Quartzite d) Nodular gneiss
2	Amphibolites a) Layered amphibolite b) Feldspar-quartz amphibolitic gneiss c) Garnetiferous amphibolite
1	Pelitic to psammitic gneisses and migmatites a) Garnetiferous biotite gneiss (pelitic gneiss) b) Biotite gneiss (psammitic gneiss) c) Transitional gneiss

Description of units

Pelitic to psammitic gneisses and migmatites (1)

The gneiss is equigranular, fine to medium grained and weathers buff grey to white. It consists of plagioclase, quartz and biotite, with subordinate sillimanite, garnet, hornblende, muscovite, graphite, and rarely magnetite and pyrite. A characteristic feature is the presence of white inequigranular *lits* and irregular pods of white pegmatite. The pelitic layers (1a) are characterized by ubiquitous porphyroblasts of garnet and lensoid aggregates of sillimanite, muscovite and quartz lying in the plane of foliation. Finely disseminated cordierite also occurs locally in these layers. The pegmatitic fraction contains euhedral garnet and cordierite porphyroblasts up to 2 cm in diameter. The psammitic members (1b) are fine grained and are characteristically lower in mafic content. The transitional gneiss (1c) is similar to both units (1a) and (1b) but contains magnetite. This unit occurs only near the contact of the arkosic gneiss and pelitic — semi-pelitic gneiss and represents a gradation from one sequence to the other. Its contacts with either sequence are indistinct, and its width is variable.

Amphibolites (2)

The amphibolites form a highly discontinuous horizon marking the contact between the arkosic and pelitic gneisses. Within the study area, their occurrence is restricted to only this position in the sequence, although evidence presented by Elphick (1970, p. 34) shows the amphibolite to be locally interlayered with the acid biotite-magnetite gneiss. He notes the above relationship to be anomalous, and it is possible that a structural solution to the interlayering may be proposed.

The amphibolite comprises hornblende, biotite, plagioclase and quartz with local minor diopside, epidote, magnetite (sometimes surrounded by plagioclase), garnet and finely disseminated pyrite. The rock is equigranular fine-grained to extremely coarse-grained porphyroblastic (hornblende phenocrysts up to 2 cm long). The layered amphibolite (2a) consists of discontinuous fine to medium-grained feldspar-rich layers 1-10 cm wide alternating with fine-grained hornblende-rich layers of similar thickness. The feldspar-quartz amphibolite gneiss (2b) has a distinct "salt and pepper" granular texture. It occurs as isolated, thick layers in the layered amphibolite sequence. In one occurrence, within Long Spruce Rapids, it contains porphyroblasts of magnetite armoured by feldspar. The porphyroblasts are up to 5 mm in diameter, with a 1 mm feldspar rim. Garnetiferous amphibolite (2c), which occurs only at Long Spruce Rapids, is a massive, medium-grained hornblende amphibolite with garnet porphyroblasts up to 3 cm in diameter. Locally garnets comprise up to 25 per cent of the amphibolite. Although the garnetiferous amphibolite is exposed in two locations, the true thickness of this unit is indeterminate.

Arkosic gneisses (3)

Arkosic gneisses in the study area are characterized by ubiquitous magnetite, the absence of granitic sills, and the common absence of garnet (although scattered pinhead garnets occur near the pelite-arkose contact). The arkoses weather grey to pinkish grey and are comprised of plagioclase, quartz, biotite, magnetite, and locally hornblende, sillimanite, and muscovite. The most common member of the arkose sequence is a fine to medium-grained, thickly layered (layers > 2 m) acid biotite magnetite gneiss (3a). Several occurrences of a finely laminated (layers < 2 cm thick) arkosic gneiss (3b), without an apparent systematic distribution, have been documented. The laminations consist of fine-grained, tan, quartz-rich layers alternating with medium-grained pinkish grey feldspar-rich layers. These gneisses may be traced for up to 2 km along strike. The continuity and the uniform thickness of the layers readily distinguish this unit. Quartzite (3c) comprises a minor fraction of the arkosic suite. It consists of medium to coarse, equant quartz grains with subequal interstitial plagioclase and microline and minor biotite. The unit is well foliated, the foliation defined by distribution of feldspars and the biotite. The nodular gneiss (3d) consists of a matrix resembling the acid biotite-magnetite gneiss and large (up to 5 cm) ellipsoidal knots of sillimanite, muscovite, feldspar, quartz and minor magnetite. The knots comprise up to 20 per cent of the bulk of this unit and their presence is restricted to distinct horizons which could only tentatively be identified as original bedding. In several instances individual knots cut across and incorporate laminations without appreciably distorting them (interpreted as bedding planes).

Tonalite to quartz monzonite (4)

Microcline granite, pegmatite and aplite (5)

Due to a lack of continuity of outcrop through the study area granite relationships were not defined and the granitic rocks have been grouped.

The eastern section of the Long Spruce Rapids area comprises a stock of homogeneous, grey, coarse-grained, equigranular, foliated granodiorite to tonalite (4a). To the east (Quarry # 1) the granodiorite grades over several thousand feet into a quartz monzonite with similar texture. Local irregular patches of pegmatite (4c) with gradational contacts occur in both rock types.

The tonalite to granodiorite comprises plagioclase, quartz, biotite, and magnetite, with minor hematite, apatite, hornblende, chlorite and epidote. It contains numerous gneissic xenoliths (1b) of variable size (5 cm-10 m) in various stages of assimilation. Elsewhere in the area, dykes and sills of both rock types are present. Generally the quartz monzonite occurs as well foliated thick sills, whereas the granodiorite occurs as patchy irregular pods and as thin sills in the pelitic gneisses. Although the relative age of the sills is not established they are grouped with the granodiorite because of their compositional and textural similarity.

Structure

All rocks excepting the microcline granites and diabase are foliated. Much of the foliation, especially in the acid intrusive rocks, is interpreted to be cataclastic, and is associated with northwesterly trending faults. Foliation and layering in the gneisses also trend northwesterly, but in numerous instances they are at a slight angle to, and are cut by a later schistosity. This later schistosity is correlated with the northwest faulting.

Three different styles of minor folding have been observed. Although two are alike in geometry, they have been identified as comprising separate folding events because they affect different penetrative fabric and because of interference. The earliest minor folds (F_1) are tight, isoclinal, near similar folds with a well developed axial planar schistosity (S_1). The folds deform layering which can be interpreted as relict bedding (S_0). F_1 fold closures are rare, but where they are mapped, they are invariably folded, along with their axial planar foliation into tight, near isoclinal Z folds (F_2). These Z folds possess a weakly developed axial planar schistosity (S_2). The F_2 folds are often sheared parallel to their axial planes with an attendant development of a strong cataclastic foliation (S_{2c}). Relative age of the shearing with respect to F_2 folds has not yet been clearly established. The presence of sheared F_2 axial planar dykes of white pegmatitic granodiorite implies the following sequence:

1) formation of F_2 folds;
2) injection of dykes along axial planes;
3) shearing parallel to axial planes.

However, the dykes may be synchronous with the faulting and, therefore, it is not clear whether F_2 forms as the result of major faulting in the northwest direction, or whether the faulting is later and was localized in the plane of weakness provided by F_2 axial planes. An open, very broad set of parallel minor folds with steep northeasterly plunge represent the last folding event (F_3). These folds are characterized by what can best be termed undulations in the layering and in both the axial planar and cataclastic foliations.

Additional structural features such as persistent boudinage of quartz-rich layers, the flattening of sillimanite-quartz knots, and the local crosscutting relationship of long axes of sillimanite knots and regional foliation (S_1) were common but their relationship within the framework of the above synthesis has not yet been established.

Economic geology

No significant mineralization was observed in the study area. Disseminated (< 2%) pyrite and pyrrhotite (?) occur in the amphibolite. Magnetite, which is characteristic of units 1c, 2, 3, 4 and 5, rarely exceeds 10 per cent.

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(6) ULTRAMAFIC ROCKS PROJECT

(53M-15, 16; 53N-11, 12, 13, 14)

By R. F. J. Scoates

Three weeks were spent filling in gaps in the sampling of International Nickel Company of Canada, Limited diamond drill core from the Fox River sill (Scoates, 1973). The basic logging and sampling of this core is now complete. Evaluation and compilation studies are continuing in an attempt to develop and refine a model of the sill and its relationship to the metavolcanic and metasedimentary rocks of the Fox River greenstone belt. Various petrographic, mineralogical and structural studies are in progress.

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(7) UTIK LAKE-BEAR LAKE PROJECT

(53M-4, 5S½; 63P-1, 2E½; 64P-8SE¼)

By W. Weber

The Utik Lake-Bear Lake area forms the northwesterly extension of the region investigated by the Greenstones Project (Elbers *et al.*, 1973, p. 13). This area was last investigated over 20 years ago (Allen, 1953, 1954; Milligan, 1952; Milligan and Take, 1954).

The present mapping project was undertaken:

a) to upgrade information on this part of the Province in the light of recent developments in Archean greenstone belt geology;

b) to study the lithostratigraphy of the supracrustal rocks and compare them with the adjacent region to the southeast;

c) to initiate a long term study of the relationship of the northern Manitoba Superior greenstone belts with the Thompson nickel belt.

The Utik-Bear Project (Figure 7-1) is part of a two-year mapping project to investigate, in particular, the small greenstone "keels" in the northwestern corner of the Superior Structural Province, to determine

i) their relationships with the wider greenstone belts to the southeast, and

ii) the factors controlling their present disposition.

The previous mapping by the Manitoba Mines Branch on the scale of 1 inch to one-half mile was found to be generally accurate as far as separation of major rock units is concerned. It was, however, possible to sub-divide the "greenstones" into several units and subunits which have significance for greenstone belt stratigraphy and mineral exploration.

Utik Lake area

The Utik Lake greenstone belt appears to be a supracrustal remnant within younger granites. In addition, faulting appears to be the cause of the pinching out of supracrustal rocks to the west. The greenstone belt is composed of a homoclinal, south facing metavolcanic-metasedimentary sequence. The rocks have been regionally metamorphosed in the hornblende-hornfels facies. Low pressure conditions of metamorphism are indicated by the mineral assemblages and the extremely well preserved primary volcanic and sedimentary structures.

The volcanic sedimentary sequence appears to be structurally, and possibly also stratigraphically, a lateral extension of the Knee Lake greenstones (Hayes River Group).

The oldest rocks are a sequence of largely intermediate to acid agglomerates which are overlain by an iron silicate/chert iron formation up to 300 feet (100 m) thick. This sequence most likely represents the felsic differentiate of a volcanic cycle which was intruded by the granitic pluton in the north and has mostly disappeared.

This older cycle was superseded by basic volcanism which took place in several pulses. The breaks between individual extrusions are marked by a number of banded iron formations (chert-magnetite-iron silicate), volcanogenic metasediments (cordierite gneiss) and conglomerates (Weber, 1974a, b, c, d). The volcanism shows no significant differentiation. The flows are pillowed or massive meta-basalts, some of which are porphyritic.

Of interest are alteration phenomena in the form of crosscutting pipes and stratigraphically controlled zones below iron formations and below flow tops (Figure 7-2). These alteration zones appear to be related to fumarolic activity resulting in metasomatism of the basalt (removal of calcium). The altered volcanic rocks contain garnet, and/or anthophyllite, or cordierite (see Weber, op. cit.). They could easily be misinterpreted as metasedimentary rocks, particularly under poor exposure conditions. Alteration pipes are made up of fine grained rusty rock. Although no sulphide mineralization was observed in these alteration zones and pipes they are considered potential exploration

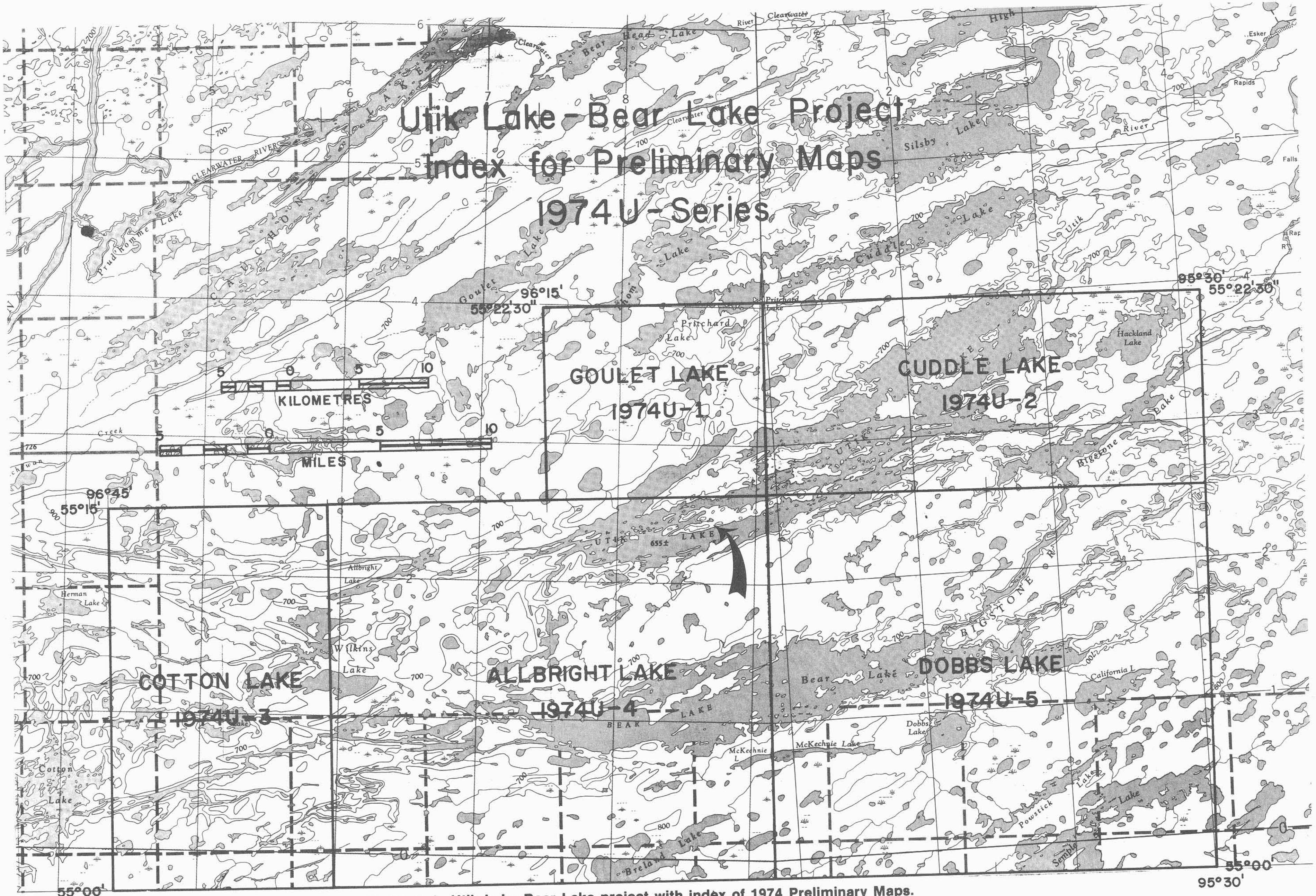
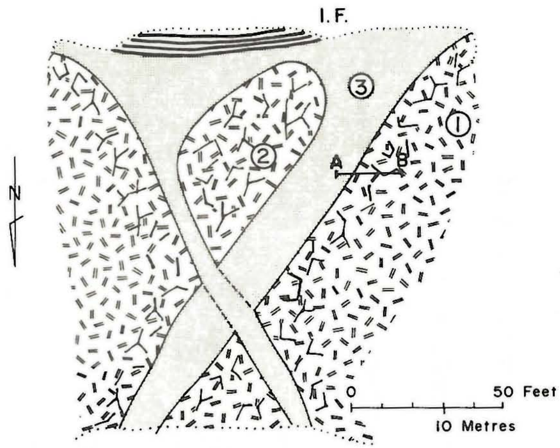
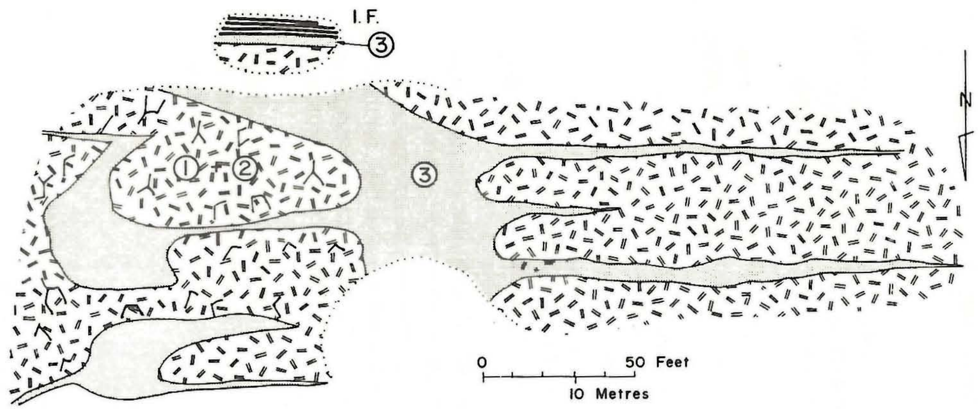
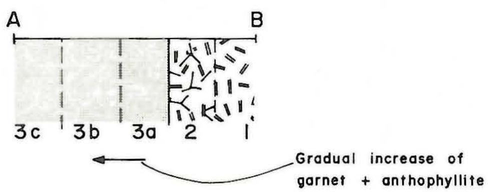


Figure 7-1. Utik Lake-Bear Lake project with index of 1974 Preliminary Maps.





SCHEMATIC CROSS SECTION
A – B



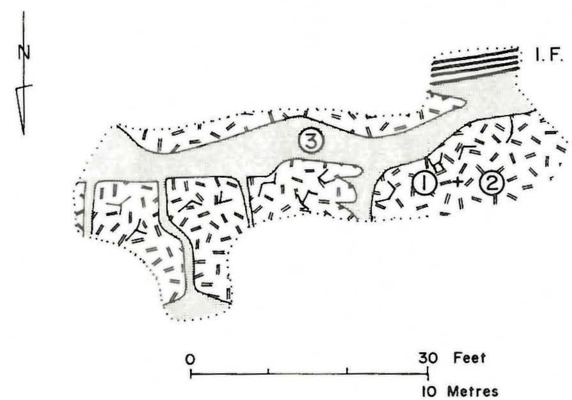
1 Massive porphyritic basalt, unaltered, dark green

2 Porphyritic basalt with leucocratic alterations along fractures (1-2 feet)

3a Altered porphyritic basalt, grey, with garnet + anthophyllite (1-2 feet)

3b Garnet + anthophyllite fels (1-2 feet)

3c Grey and rusty highly altered material with garnet + anthophyllite, or cordierite, party zoned



LEGEND

① Massive porphyritic basalt

② Basalt with leucocratic alterations along fractures

③ Alteration zone or "pipe" with garnet + anthophyllite, or cordierite

I.F. Iron formation (Iron silicate / chert)

...... Outcrop boundary

Figure 7-2 Alteration zones and "pipes" in meta-basalt at Utik Lake (location indicated on Figure 7-1).

targets. Lenses of pyrrhotite and pyrite are in a few places associated with the iron formation (Weber, op. cit.).

The metavolcanic-metasedimentary sequence is intruded by gabbro sills up to 600-900 feet (200-300 m) thick and thin feldspar porphyry sills up to 10 feet (3 m) thick. Pillowed mafic flows are locally partially altered along fractures in pillows and/or in the outer part of pillows to a light green rock with much lower mafic content. Such alterations are interpreted as a result of metasomatic interaction between basalt and sea water.

Bear Lake area

The Bear Lake greenstone belt is structurally connected with the greenstones in the Oxford Lake area. The greenstone belt pinches out to the west as a combined result of granite intrusion, faulting and folding about axes which plunge at shallow angles to the east.

The rocks in the Bear Lake area comprise a homoclinal, south facing metasedimentary-metavolcanic sequence. In contrast to the Utik Lake belt, the sequence shows some isoclinal folding in the central part of the belt.

The sequence consists of mafic pillowed volcanic rocks along the northern and southern portion of the belt. The central part comprises a 5-mile (8 km) wide meta-greywacke/argillite sequence, interlayered with felsic pyroclastic material (mainly crystal tuff). The influx of pyroclastics increases stratigraphically upward along with an increase in the fragment size. The top of this cycle is marked by a thin exhalite formation and associated altered metavolcanic rocks containing garnet and cordierite (Weber, 1974c).

The overlying meta-basalts are part of a younger cycle which extends easterly into the Semple Lake and Oxford Lake area. Intercalations of contemporaneous, thin, fine to medium-grained gabbro sills are common in the Powstick-Semple Lakes area.

Kyanite-bearing gneisses along the northern margin of the Bear Lake belt are unique. They may represent an alteration zone comparable to the garnet and cordierite-bearing metavolcanic rocks, but which has attained a higher grade of metamorphism than the rest of the Bear Lake belt.

A northeasterly trending gabbroic dyke in the Bigstone Lake area resembles similar gabbroic dykes described by Scoates (1969) from the Pikwitonei subprovince. The dyke contains only scattered specks of sulphides. Aphanitic thin olivine diabase dykes trend more northerly and are possibly younger.

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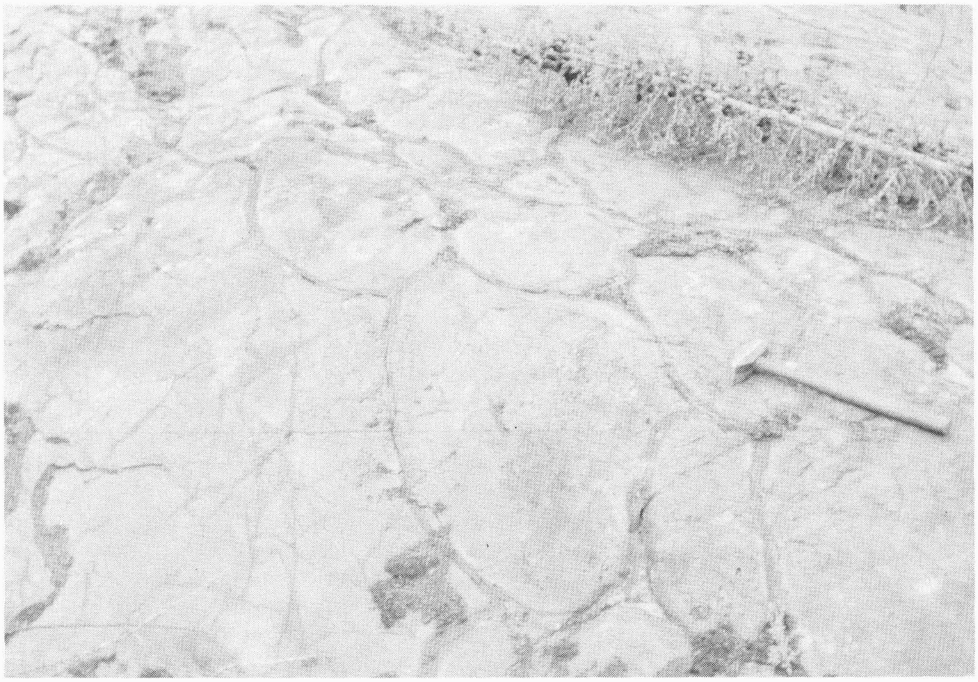

Plate 7-1. Undeformed pillowed meta-basalt (unit 6). Utik Lake.

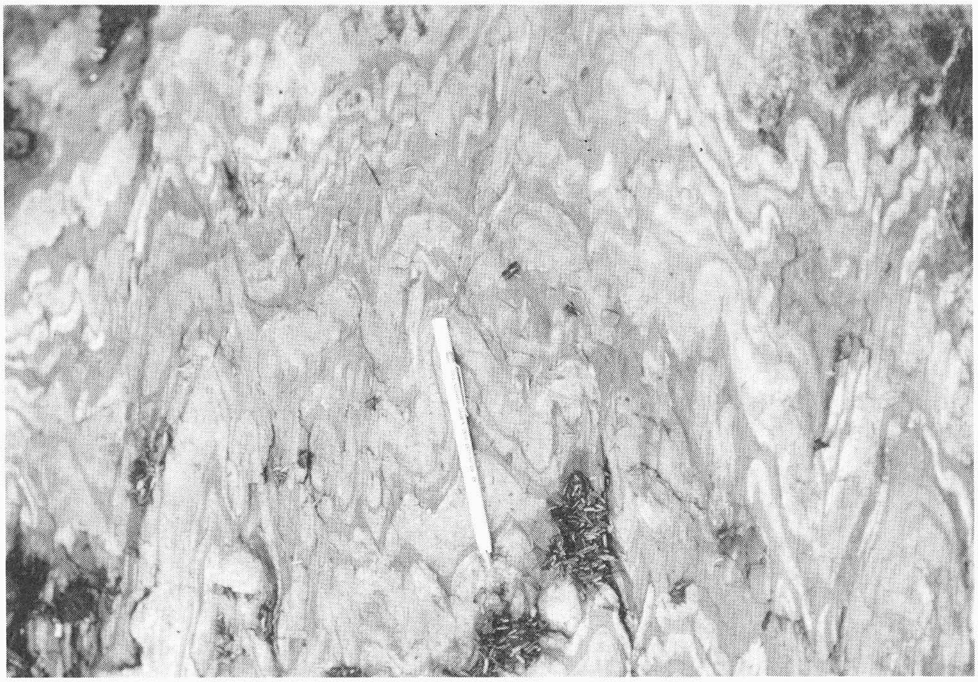

Plate 7-2. Folded magnetic-chert iron formation (unit 8).

Plate 7-3. Graded meta-greywacke (unit 9). West end of Bear Lake.

Plate 7-4. Felsic tuff breccia (unit 10). West end of Bear Lake.

(8) THE MAX LAKE GREENSTONE BELT

(Parts of 53L-12 and 63I-9)

By J. J. M. W. Hubregtse

The Max Lake greenstone belt (Figure 8-1) extends approximately between longitudes 96°5' and 95°21' and latitudes 54°29'30" and 54°34'30". The eastern part of the belt is shown on Preliminary Map 1973H-7 and has been briefly mentioned by Hubregtse (1973b).

This east-northeast striking belt is underlain by meta-basalts, which flank a central unit of layered metasediments. Two ultramafic layers occur along the southern margin. A quartzo-feldspathic gneiss layer, approximately 150 feet (50 m) thick, which has been interpreted as metarhyolite, outcrops on the southwestern shore of the lake. At the east end of the lake the thickness of the greenstone belt is about 4,900 feet (1500 m).

Diagnostic minerals indicate at least two periods of mineral growth in the amphibolite facies during low-pressure metamorphism. Pertinent assemblages in the metasediments are (anthophyllite-)garnet-cordierite and (andalusite-)staurolite-cordierite-garnet. The basalts are metamorphosed to amphibolites which sometimes contain either garnet or cummingtonite. Pillow structures are locally preserved. Calc-silicate rocks, comprising streaky diopside-epidote hornblendites, are particularly abundant in a basaltic unit at the east end of the lake. The western ultramafic body is a serpentinite. The ultramafic rocks at the east end of the lake, which include olivine hornblendite, are of a higher grade of metamorphism than those to the west.

The surrounding layered gneiss complex largely consists of quartz-diorite and quartz-monzonite gneisses; granodiorite and trondhjemite compositions were less frequently encountered. Younger aplite, pegmatite. diorite and gabbro dykes are abundant.

The southern contact of the greenstones with the gneiss complex is represented by a 300-foot (100 m) wide zone in which there is alteration of gneiss and basalt. The northern contact is similar but much wider, being approximately 4,900 feet (1500 m).

On structural and metamorphic evidence, there is no indication that the gneisses are older than the greenstones (see also Marten, 1973). Whether the gneisses were derived from a remobilized sialic basement or relatively younger tonalitic intrusives, remains a problem to be solved.

The Max Lake belt lies along the strike of the Munro Lake greenstone belt (Elbers, F. J., and Gilbert, H. P., 1972a, 1972b). Both belts are separated by younger granites in the Colen Lakes and Laidlaw Lake area. Many coarse-grained pegmatite offshoots from this granite were encountered at the east end of Max Lake.

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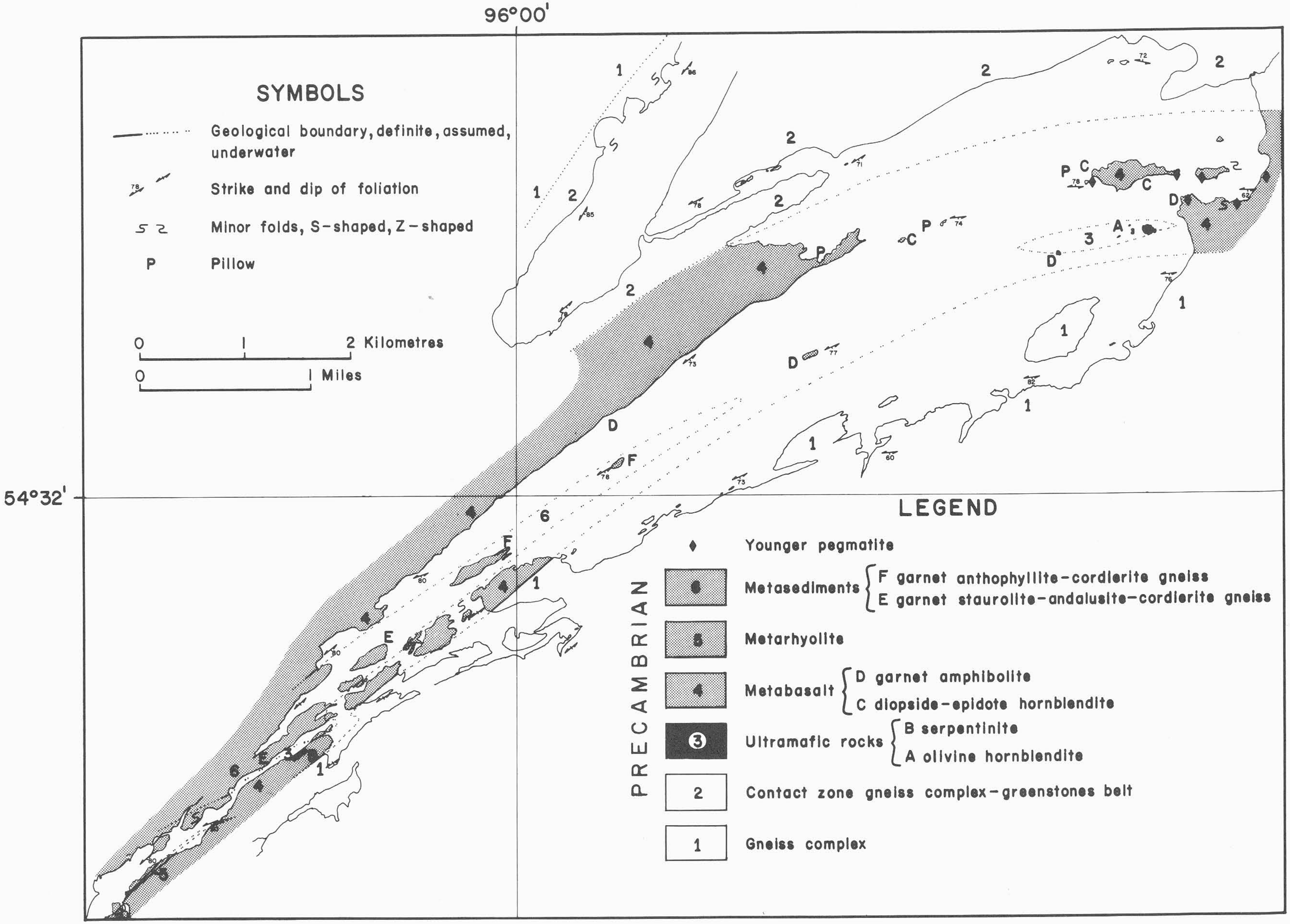

Figure 8-1 The Max Lake Greenstone Belt.

(9) GEOLOGY AND MINERALIZATION OF WESTERN OXFORD LAKE AND CARROT RIVER

(53L-13; 63I-16S, 9N)

By R. A. Haskins and J. F. Stephenson

The season's activities were in the Western Oxford Lake and Carrot River areas. The base and precious metal potential of the region was investigated and detailed mapping of the Lynx Bay-Hyers Island area was undertaken to define the relationships of the intrusive rocks, the volcanic rocks, and the hydrothermal mineralization in the area. Most investigations were confined to the area recently withdrawn from claim holding. Mapping in the Lynx Bay area, with more intense coverage of the batholithic complex, has resulted in a better understanding of the batholithic and volcanic suites. Diamond drilling was carried out on mineral showings which appear to have the highest potential, notably the stibnite and copper-zinc deposits at the east end of Hyers Island and an extensive sulphide conductor at the west end of the Carrot River. Five holes drilled in four locations totalled 399 feet (122 m). Thirty-six assays for Au, Ag, Cu, Zn (Ni, Mo, Sb in some) were carried out on samples from the showings examined and 30 on the drill core obtained from the four drill sites.

Two porphyry copper type bodies, containing subeconomic quantities of copper and molybdenum, were discovered on Lynx Bay and to the northwest of the bay. This form of mineralization had been predicted on the basis of the geological environment determined through mapping by previous survey personnel in the area (Elbers, 1973 and Hubregtse, 1973). The area has also been investigated and mapped by Campbell, Elbers and Gilbert (1971); Scoates (1971); Bell (1962); Barry (1960); and Wright (1931).

Batholithic complex

The Lynx Bay region is underlain by a tonalite batholithic complex of calc-alkaline affinity. To the south of Lynx Bay, the batholith comprises gneissic tonalite and adjoins massive equigranular tonalite to the north. Separation between the two textural types lies approximately east-west along north latitude 54°44'32". This boundary can be traced inland to the west of Lynx Bay for at least 9 miles (14.5 km). The massive tonalite is porphyritic along its margins with the Lynx Bay dacitic volcanic rocks and their derived sedimentary rocks, and along its margin on the south shore of the Carrot River. Dacitic volcanic rocks occur 10 km west of Lynx Bay and are surrounded by plutonic phases of the batholith. The volcanics center on north latitude 54°45'27" and west longitude 96°12'00" and correspond to an elliptical magnetic high.

A small complex of peridotite and dunite intrudes the gneissic tonalites in the southeast of Lynx Bay.

Several trondhjemite bodies intrude both gneissic and massive phases of the tonalite suite. In the Lynx Bay area, the trondhjemites have caused extensive hydrothermal alteration and chalcopyrite-molybdenite mineralization of the porphyry copper variety (see Figure 9-1).

Porphyry copper mineralization

Two zones of porphyry copper mineralization were found. Both carry chalcopyrite and minor molybdenite. Both are elliptical in shape and form the core of trondhjemite stocks that intrude the massive tonalites.

One body is located on the northwest side of Lynx Bay (18-74-459) (see Table 9-1 and Figure 9-1). The core zone is 200 feet by 500 feet (60 m by 152 m) from the shore inland, but is obscured by overburden to the west and northwest. This zone contains a closely spaced fracture system that strikes north and dips shallowly to the west. The fractures are filled with chlorite and chalcopyrite, and in places, with minor molydenite. This core zone is surrounded by a halo of epidote-chlorite-pyrite alteration, which is at least 2,000 feet (610 m) wide and affects both the trondhjemites and the surrounding tonalites. Within this alteration halo the plagioclase has been destroyed by saussuritization. The true dimensions of the halo are not known as it enters a large muskeg bog to the west and north.

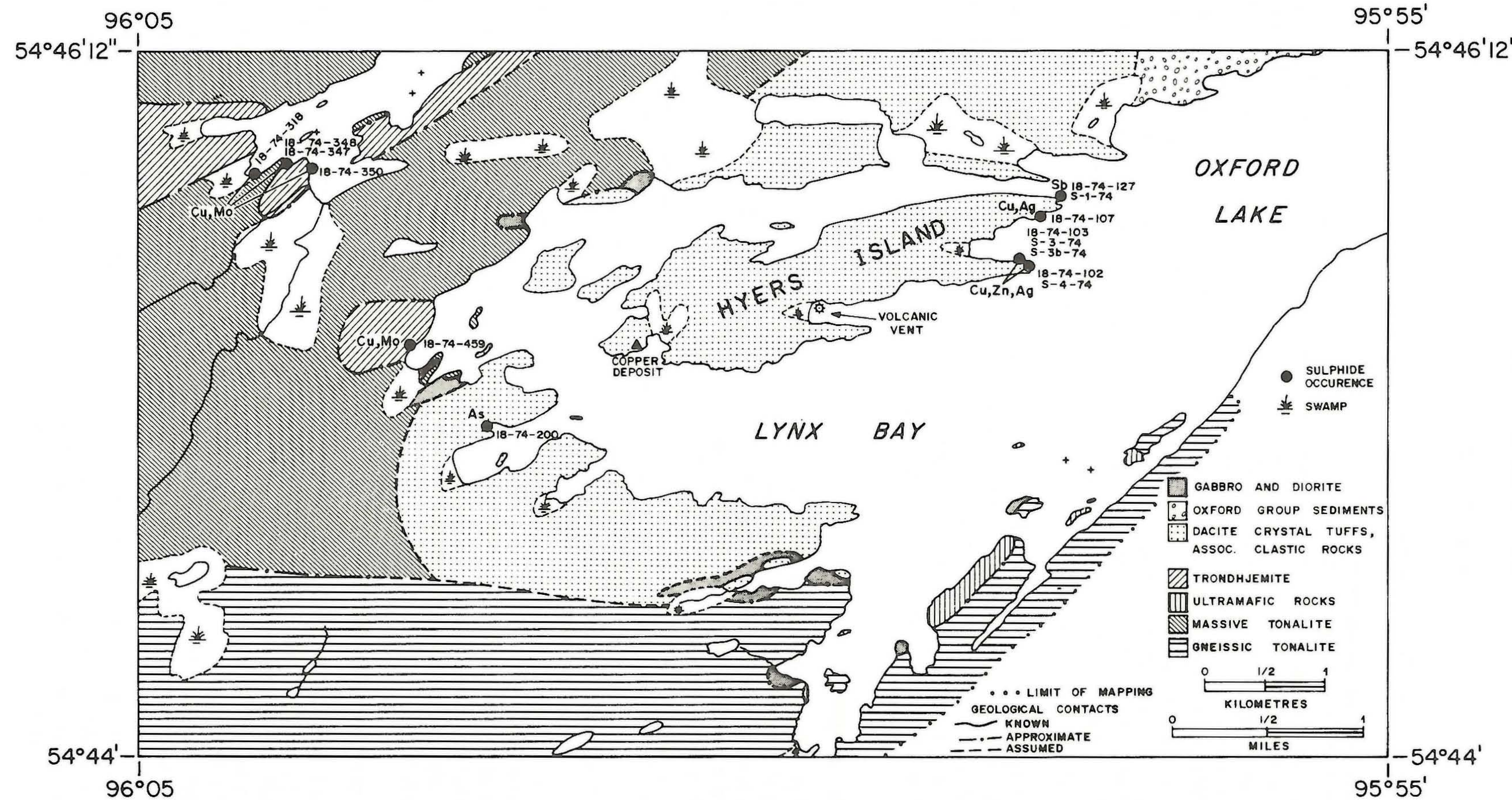

Figure 9-1 General geology of Lynx Bay area, western Oxford Lake, showing sulphide occurrences and diamond drill locations. Geology modified from Hubregtse (1973).

Table 9-1. Assays to Hyers Island-Lynx Bay showings

Sample Number	UTM		Mineralization	Host Rock	Assay lab Number	Assay Results†					
						oz/ton		Per cent			
	Northing	Easting				Au	Ag	Cu	Zn	Mo	Sb
18-74-102	6073390	309330	Pyrite Chalcopyrite Sphalerite	Quartz vein in sheared agglomerate	M6275	0.11	6.7	2.46			
					M6297	0.04	1.30	0.47			
					M6298	0.01	0.50	0.06			
					Average	0.05	2.83	1.00			
18-74-103	6073430	309300	Pyrite Chalcopyrite Sphalerite	Quartz vein in sheared agglomerate	M6299	0.01	0.45	0.34			
18-74-107	6073750	309430	Chalcopyrite Pyrite	Quartz carbonate vein in sheared dacite crystal tuff	M6365	0.04	0.5	1.50			
18-74-127 (5)*	6073880	309590	Stibnite Pyrite	Quartz carbonate vein in sheared dacite crystal tuff	M6288	0.01	0.6	Tr.			2.45
					M6289	Tr.	Nil	Tr.			4.4
					M6290	Tr.	0.8	Tr.			3.1
					M6291	Tr.	Nil	Tr.			1.2
					M6292	Tr.	0.10	Tr.			2.7
					M6293	Tr.	Nil	0.02			6.15
					Average	Tr.	0.4	0.003			3.33
18-74-200	6071852	290850	Arsenopyrite Pyrite	Sheared dacite crystal tuffs and agglomerate	M6294	0.05	0.10				
					M6295	0.03	Tr.				
					M6296	Tr.	Tr.				
					Average	0.025	0.03				
18-74-318	6073800	288690	Chalcopyrite Molybdenite Pyrite	Sheared tonalite adjacent to fractured porphyritic trondhjemite	M6306	Nil	Tr.	0.02	Tr.	Tr.	
					M6307	Nil	Nil	0.03	Tr.	Tr.	
					M6314	Nil	Nil	0.02		Nil	
					M6315	Nil	Nil	0.02		Nil	
					Average	Nil	Nil	0.02	Tr.	Tr.	
18-74-347	6073950	289000	Chalcopyrite	Fractured porphyritic trondhjemite	M6323	Tr.	Nil	0.02		Nil	
18-74-348	6073950	288950	Molybdenite		M6324	Tr.	0.10	0.15		Tr.	
18-74-350	6073860	288925	Pyrite		M6325	Nil	Nil	0.02		Tr.	
18-74-459	6072490	290125	Chalcopyrite Molybdenite Pyrite	Fractured porphyritic trondhjemite	M6362	Nil	Nil	0.18		Nil	
					M6363	Nil	Nil	0.25		Tr.	
					M6364	Nil	Nil	0.15		Nil	
					Average	Nil	Nil	0.19		Tr.	

*Barry, G. S. (1960): "Geology of the Western Oxford Lake-Carghill Island Area"; Man. Mines Br., Publ. 59-2,pp. 34-35.
†Tr. ≤ 0.005%

Another porphyry copper body is located on the west and south shore of a lake 6,000 feet (1.89 km) north-northwest of the first porphyry copper body (18-74-318, -347, -348, -350)) (see Figure 9-1 and Table 9-1). This is a narrow elliptically shaped body that trends east-northeast and has two core zones, one at each end of its exposed length. The body is a trondhjemite intruding tonalite. Its dimensions are at least 6,000 feet by 1,000 feet (1820 m by 310 m). Its possible extension to the east is concealed by overburden. The western core zone contains fracture controlled chalcopyrite mineralization with some minor molybdenite. This mineralization extends outward into the tonalites as well. The size of this core zone is 600 feet by 200 feet (182 m by 61 m). The two core zones are possibly continuous beneath the lake. The limits of the alteration halo which surround the core zones are not fully defined at present. However the known extent of the halo corresponds to the outline of the trondhjemite. This alteration halo also contains epidote-chlorite and in places pyrite, thereby closely resembling the Lynx Bay body.

Lynx Bay-Hyers Island mineralization

The Lynx Bay-Hyers Island area of Western Oxford Lake was the major focus of activitiy for the 1974 field season. Mineral assessment work was carried out on known deposits on Hyers Island and other showings were examined in the Lynx Bay region. The Lynx Bay area is underlain by dacitic volcanic rocks of calc-alkaline affinity with associated locally derived volcanic sediments. Because it was a center of intense volcanism, it was also a center of intense hydrothermal activity in the form of hydrothermal veins. The veins are of two types. The earliest are quartz-carbonate-chlorite veins that contain pyrite. On the former New Falu claim, stibnite also occurs in this type of vein as shown by antimony values (18-74-127) (S-1-74). These veins have intense alteration halos in their wall rocks. The alteration sequence from the vein outwards is chloritization, silicification, bleached zone, and carbonatization of the host rocks. The second type of vein is a quartz sulphide vein which contains pyrite, chalcopyrite, and sphalerite, and give copper, zinc and silver values (18-74-102, -103, -107) (S-3-74, S-3B-74, S-4-74). These occur on the former Mora claim on Hyers Island.

The largest and most attractive veins occur in shear zones that trend 090 degrees to 110 degrees and dip vertically. All veins were sampled and assayed (18-74-102, -103, -107, -127) and the results are given in Tables 9-1 and 9-2. Two veins in the former Mora claim on the southeast peninsula of Hyers Island (18-74-102, -103) were drilled with a portable Winkie diamond drill, hole numbers S-3-74, S-3B-74, S-4-74 (see Figure 9-2). The mineralized sections of the core, which occur in quartz sulphide veins, were assayed and the results are given in Table 9-2 (see Figure 9-3). A diamond drill hole was put down on the former New Falu claim on the northeast peninsula of Hyers Island, hole number S-1-74 (see Figure 9-4). The mineralized sections were assayed and the results given in Table 9-2 (see Figure 9-5). The surface assays (18-74-127) are given in Table 9-1. Disseminated stibnite was observed in much of the core, and several stibnite stringers associated with small quartz-carbonate-chlorite veins were intersected in the lower portions of the hole.

Gossans and rust zones that occur in sheared dacites along the north shore of Lynx Bay were sampled and assayed but the results were negative. The pyrite-bearing talc-sericite schists contain only traces of copper, gold and silver.

Noranda Exploration Limited is investigating a small copper deposit at the southwest end of Hyers Island. The mineralized zone is a pipe-like body, 165 feet by 108 feet (50 m by 33 m) in diameter, plunging to the northwest at a steep angle. Estimates from extensive earlier drilling indicate that the chalcopyrite-pyrite body contains 400,000 tons of 2.56 per cent copper.

An arsenopyrite showing in a shear zone in southwest Lynx Bay (18-74-200) was sampled and assayed. The results are given in Table 9-1. The arsenopyrite is coarsely crystalline and randomly oriented in the shear zone. The shear zone cuts through agglomerate and dacitic volcanic rocks.

Carrot River mineralization

The Carrot River region was examined and evaluated for base and precious metal deposits (see Figure 9-6). Barry's (1960) showings were examined and sampled for assay, the results are given in Table 9-3.

Table 9-2. Assay results of diamond drill core from Hyers Island, Western Oxford Lake

Station No.: 18-74-127	Core Sample No.	Assayed footage: From	Assayed footage: To	Assayed footage: Inter-section	oz/ton: Au	oz/ton: Ag	Per cent: Cu	Per cent: Zn	Per cent: Sb	Combined assay footages (including non-assayed intervals): From	To	Total intersection: Appar-ent	Total intersection: True*	Averaged assay values oz/ton: Au	oz/ton: Ag	Per cent: Cu	Per cent: Zn	Per cent: Sb
DDH No.: S-1-74	S-1-74-1	56'4"	58'9"	2'5"	Nil	Nil	0.02		2.90	56'4"	63'6"	7'2"	5'1"	Nil	Nil	0.007		1.40
UTM: 309590E, 6073880N	S-1-74-2	61'4"	63'6"	2'2"	Tr.†	Tr.	0.25		1.40									
	S-1-74-3	76'0"	78'3"	2'3"	Tr.	Tr.	0.01		0.45	76'0"	88'6"	12'6"	12'6"	Tr.	Tr.	0.006		0.25
Azimuth: 355°	S-1-74-4	85'2"	88'6"	3'4"	Tr.	Tr.	0.15		0.65									
Angle: 45°																		
Length: 125'10"																		
Station No.: 18-74-103	S-3-74-1	5'6"	7'1"	1'7"	Tr.	0.7	1.02	3.46		5'6"	15'10"	10'4"	1'6"	0.002	0.27	0.33	0.57	
DDH No.: S-3-74	S-3-74-2	11'1"	13'0"	1'11"	0.01	0.9	0.62	0.14										
UTM: 309300E, 6073430N	S-3-74-3	14'2"	15'10"	1'8"	Nil	Nil	0.32	0.09										
Azimuth: 245°																		
Angle: 60°																		
Length: 39' 10"																		
Station No.: 18-74-103	S-3B-74-1	2'7"	8'9"	6'2"	0.01	0.3	0.46	0.03		2'7"	12'0"	9'5"	5'5"	0.008	0.25	0.44	0.10	
DDH No.: S-3B-74	S-3B-74-2	10'0"	11'4"	1'4"	0.01	0.4	1.04	0.60										
UTM: 309300E, 6073430N	S-3B-74-3	12'4"	12'11"	0'7"	Tr.	0.5	0.10	0.15		12'0"	20'0"	8'0"	4'0"	0.007	0.17	0.12	0.16	
	S-3B-74-4	14'10"	16'1"	1'3"	0.01	0.3	0.21	0.23										
Azimuth: 205°	S-3B-74-5	16'9"	17'3"	0'6"	Tr.	0.2	0.17	0.02										
Angle: 60°	S-3B-74-6	18'5"	19'4"	0'11"	Tr.	0.2	0.08	0.05										
Length: 59'9"	S-3B-74-7	19'4"	20'0"	0'8"	0.06	0.6	0.74	1.23										
	S-3B-74-8	32'2"	34'11"	2'9"	0.02	0.06	0.66	0.04		32'2"	41'2"	9'0"	4'6"	0.01	1.1	1.6	0.12	
	S-3B-74-9	36'0"	38'6"	2'6"	0.01	1.9	3.47	0.02										
	S-3B-74-10	38'6"	41'2"	2'8"	0.01	1.3	1.45	0.34										
Station No.: 18-74-102	S-4-74-1	5'2"	5'8"	0'6"	0.08	3.7	2.42	0.03		5'2"	5'8"	0'6"	0'4"	0.08	3.7	2.42	0.03	
DDH No.: S-4-74	S-4-74-2	18'5"	19'9"	1'4"	0.01	0.65	0.26	1.70		18'5"	26'0"	7'7"	5'4"	0.048	0.15	0.09	1.08	
UTM: 309330E, 6073390N	S-4-74-7	24'0"	24'7"	0'7"	0.04	0.40	0.54	10.20										
	S-4-74-3	27'9"	29'3"	1'6"	0.26	1.10	0.31	1.53		26'0"	33'0"	7'0"	4'11"	0.076	0.44	0.17	0.47	
Azimuth: 010°	S-4-74-4	32'2"	33'0"	0'10"	0.17	1.75	0.87	1.20										
Angle: 45°	S-4-74-5	53'4"	54'5"	1'1"	0.08	2.5	0.28	0.02		53'4"	63'3"	9'11"	7'0"	0.04	0.57	0.18	1.80	
Length: 70'2"	S-4-74-8	55'0"	57'1"	2'1"	0.10	1.40	0.64	4.74										
	S-4-74-9	57'1"	59'0"	1'11"	0.03	Tr.	0.04	3.80										
	S-4-74-6	62'5"	63'3"	0'10"	0.04	Tr.	0.07	0.79										

*Calculated from planar fabric orientation to core axis.
†Tr. ≤ 0.005%

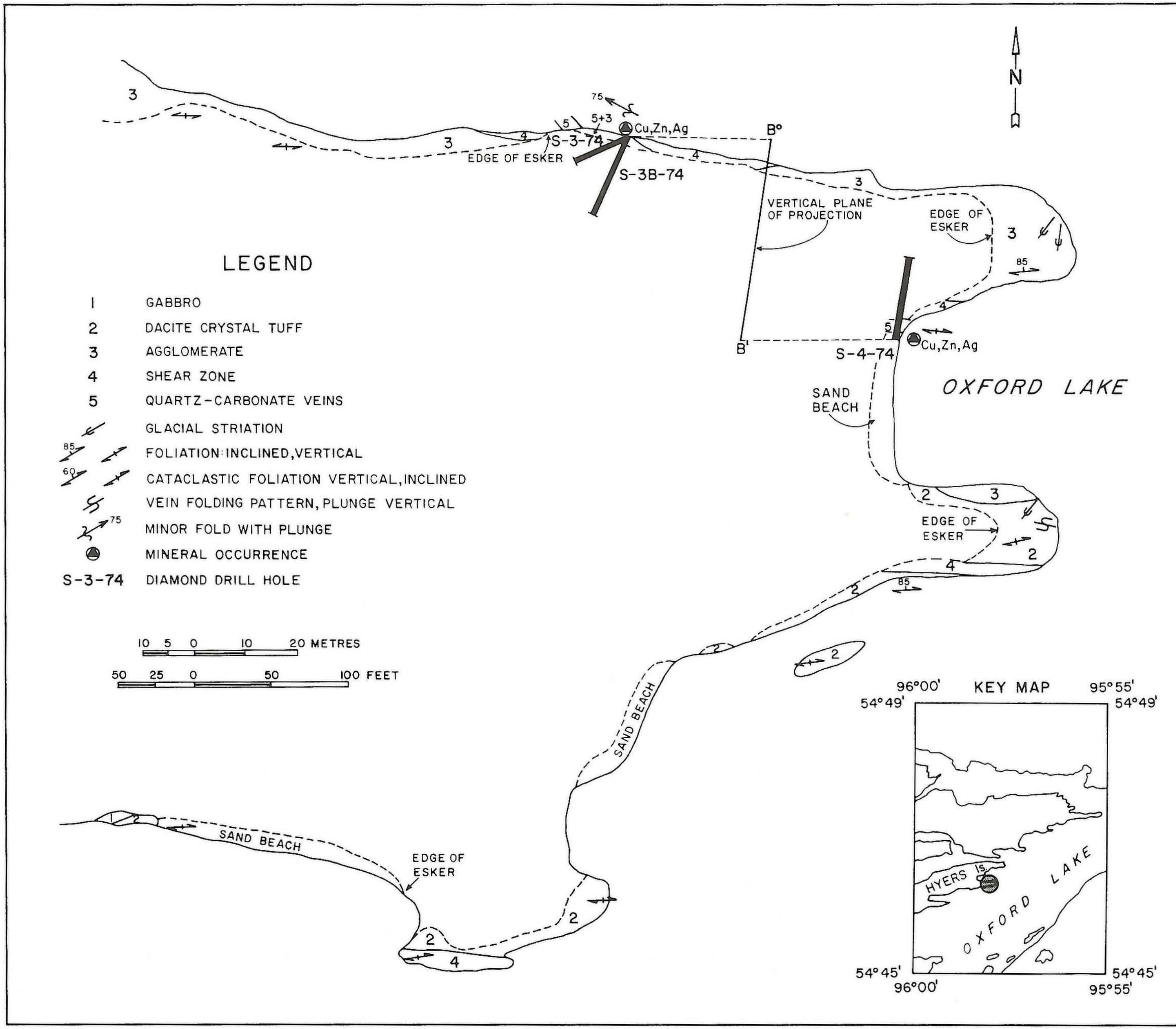

Figure 9-2. Geology and diamond drill locations at east end of Hyers Island (south peninsula on former "MORA" claim), western Oxford Lake.

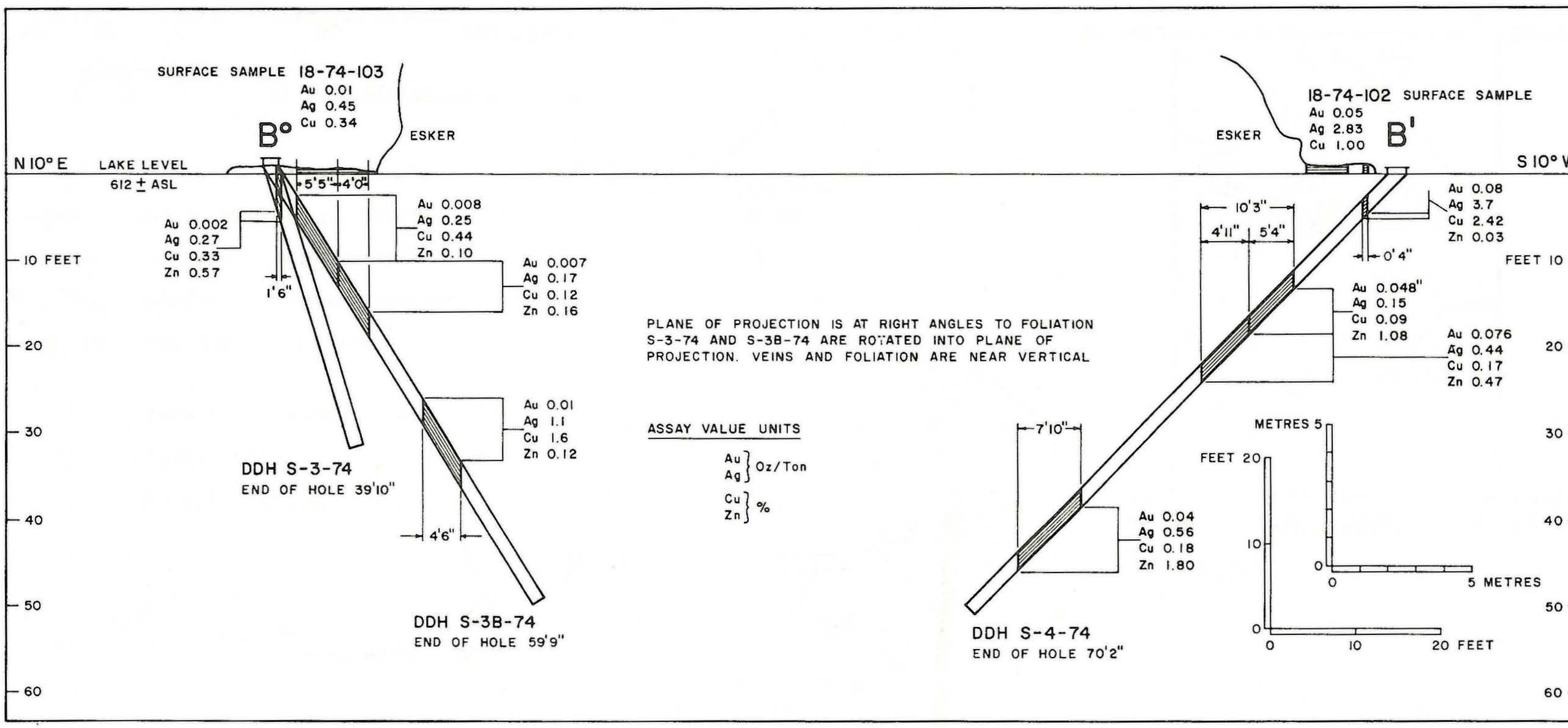

Figure 9-3 Vertical projection of diamond drill holes with assay results at east end of Hyers Island (former "MORA" claim), western Oxford Lake.

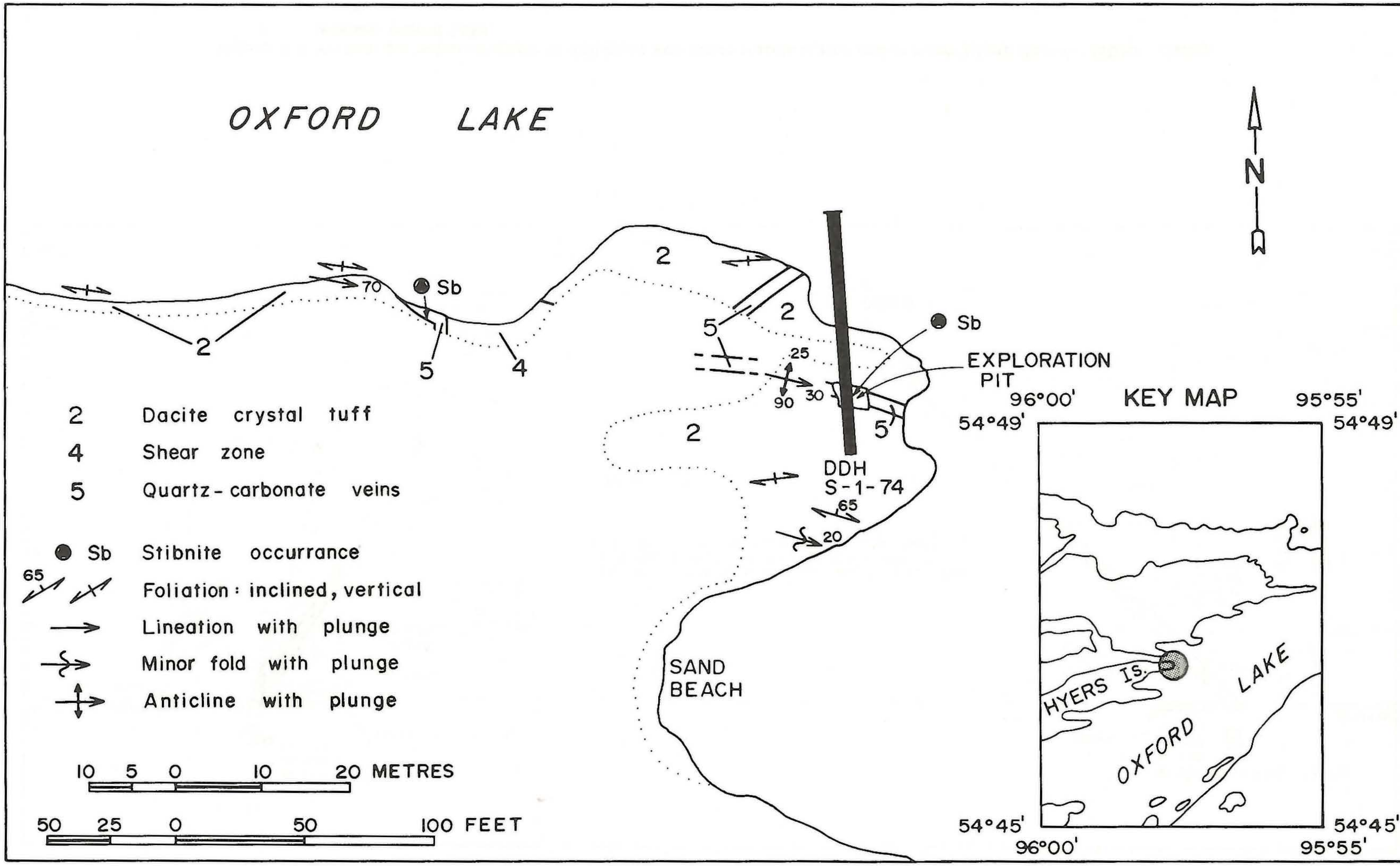

Figure 9-4. Geology and diamond drill location at east end of Hyers Island (north peninsula on former "NEW FALU" claim), western Oxford Lake.

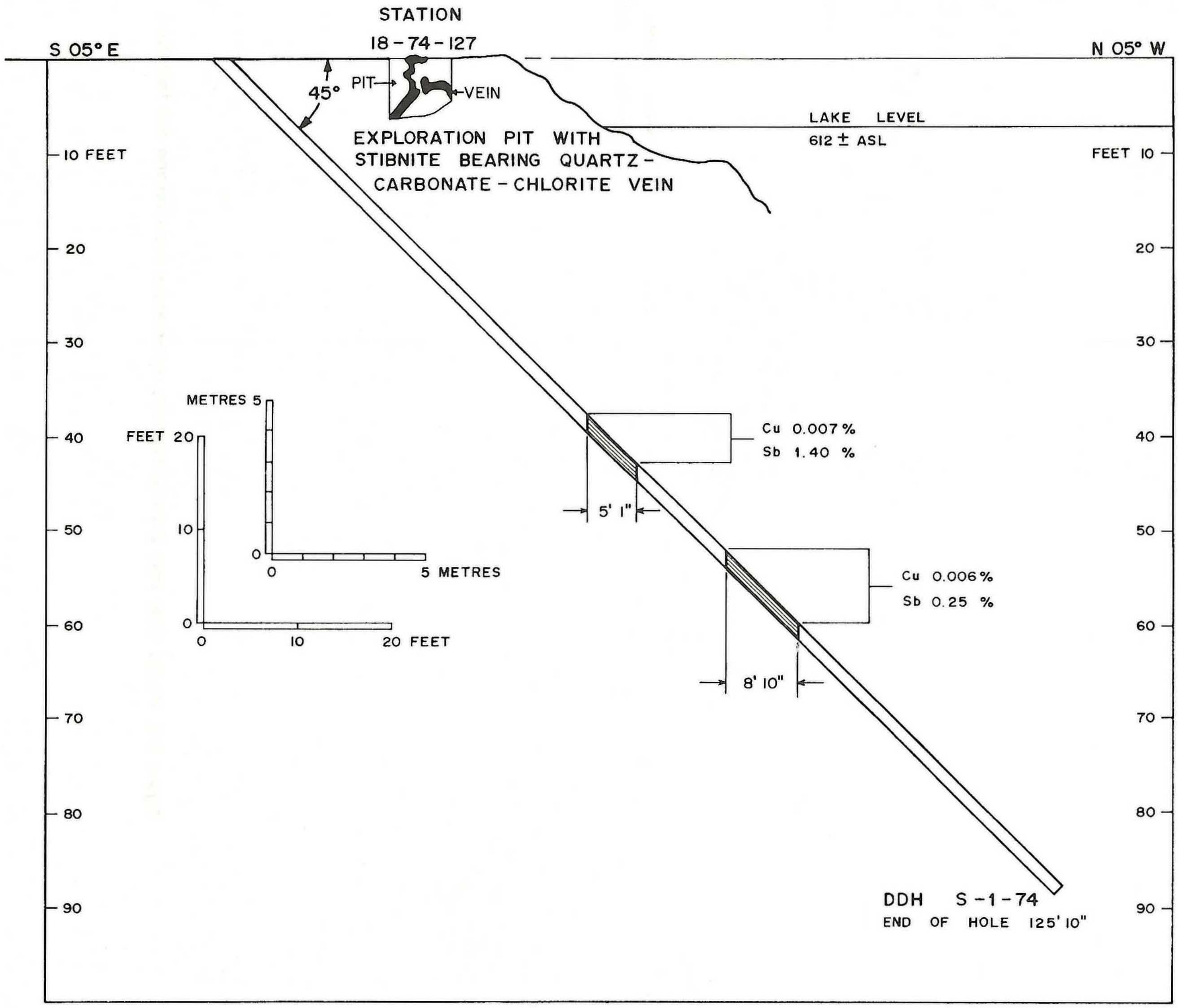

Figure 9-5. Diamond drill location with assay results at east end of Hyers Island (former "NEW FALU" claim), western Oxford Lake.

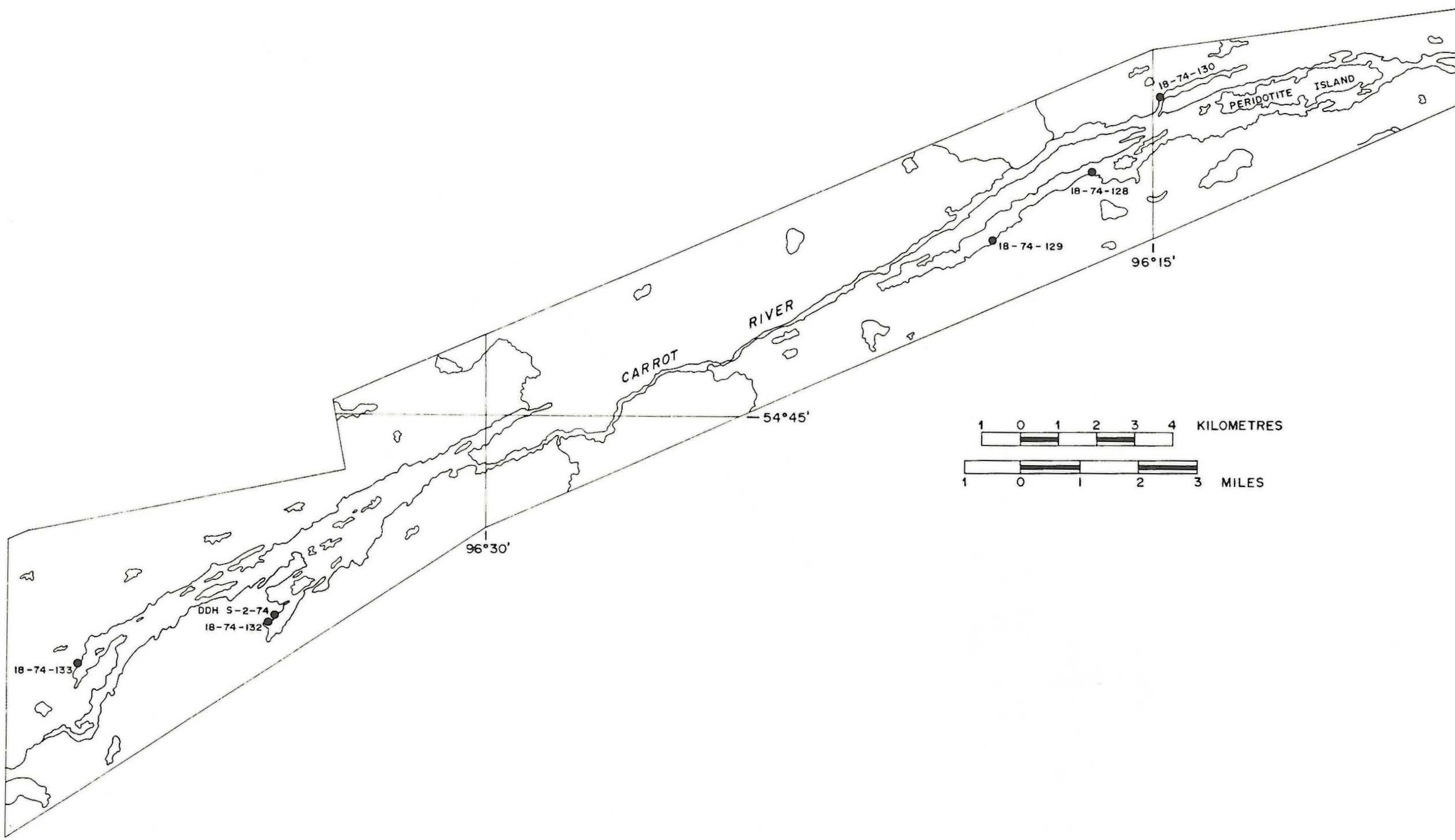

Figure 9-6. Carrot River area showing sulphide occurrences and diamond drill locations.

Table 9-3. Assay results of Carrot River mineral showings

Sample Number	Latitude (UTM) Northing	Longitude (UTM) Easting	Mineralization	Host Rock	Assay lab number	Assay Results oz/ton Au	Ag	Per cent Cu	Ni	Zn
8-74-128 *(12)	54°48'12" 6075950	96°16'05" 275500	Pyrite	Shear zone in basalt	M6276	Nil	Nil	0.02	—	—
18-74-129 (13)	54°47'18" 6074350	96°18'28" 273260	Pyrite	Shear zone in tonalite porphyry	M6277	Tr.	Nil	Tr.	—	—
					M6278	Nil	Nil	0.04	—	—
18-74-130 (11)	54°49'9" 6074850	96°14'33" 277180	Pyrite Pyrrhotite	Shear zone in carbonated felsic volcanics	M6279	Nil	Nil	Tr.	Tr.	—
18-74-132 (15)	54°41'20" 6064660	96°34'57" 255085	Pyrite Pyrrhotite	Felsic volcanics	M6284	Tr.	Nil	0.04	0.07	—
					M6285	Nil	Nil	0.06	0.06	—
DDH S-2-74 Total 103'10" (15)	54°41'26" 6064775	96°34'47" 255100	Pyrrhotite Pyrite	Silicified serpentinite in contact with tonalite porphyry	M6390 67'11'-70'10"	Nil	Nil	0.02	0.03	Tr.
					M6391 76'10"-79'5"	Nil	Nil	0.02	0.05	Tr.
18-74-133 (16)	54°41'10" 6063050	96°39'13" 251180	Massive banded pyrite	Andesite	M6286	Tr.	Nil	0.03	—	—
					M6287	Tr.	Nil	Tr.	—	—

*Barry, G. S. (1960): "Geology of the Western Oxford Lake-Carghill Island Area"; Man. Mines Br., Publ. 59-2, p. 35

At showing #15 (Barry, 1960) (our station 18-74-132), an EM16 survey disclosed a conductor approximately 2,000 feet (610 m) in length which was drilled with the portable Winkie unit to 104 feet (34 m) (Hole No. S-2-74). The hole penetrated a pillowed basaltic flow sequence which became increasingly garnetiferous with depth. At 68 feet (20 m) serpentinite was encountered which continued to 88 feet (27 m) where the drill penetrated tonalite porphyry. In the serpentinite a mineralized zone of pyrrhotite was encountered. In this zone the pyrrhotite occurs as veinlets and replacement fillings in the serpentinite and is associated with heavy silicification. The tonalite porphyry contains disseminated pyrrhotite and xenoliths of serpentinite. Assay results of the mineralized intersections of the core are given in Table 9-3.

A showing at Max Lake was examined and assayed. The results were not encouraging; only traces of copper, gold and silver were reported.

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(10) SOUTHEASTERN MANITOBA

(Parts of 52E; 52L; 62H; 62I)

By C. F. Lamb

Introduction

Part of the southeastern corner of Manitoba (Figure 10-1) has never been mapped systematically and the other areas were last mapped in the 1950's.

During the 1974 field season, systematic traversing by pace and compass along roads and trails with truck back-up, revealed little or no outcrop in the western and southern portions of the project area (Lamb, 1974). The bedrock is covered by extensive deposits of sand and minor gravel in the Sandilands Provincial Forest and by clay deposits along the watersheds of the Whitemouth and Birch Rivers. Large areas south of Falcon Lake are underlain by swamps. The abundance of outcrop increases (up to 75%) to the east and north in the Whiteshell Provincial Park.

A preliminary map for southeastern Manitoba (Lamb, 1974) has been compiled from this summer's field work, supplemented by information from Springer (1952), Davies (1954), Davies (1969) and McRitchie (1971).

General geology

Intrusive rocks predominate. Three east-trending, lithologically distinct subareas have been identified:

Northern (north of PTH 44).
Central (between PTH 44 and the Trans-Canada Highway).
Southern (south of the Trans-Canada Highway).

The northern subarea is bounded on the north by grey granitoid gneisses and on the south by similar grey gneisses and mixed metavolcanic and metasedimentary rocks. The gneisses and metavolcanic and metasedimentary rocks separate the northern and central areas of intrusive rocks. The central subarea is bounded on the south by the West Hawk Lake greenstone belt. The southern complex of intrusive rocks intrudes the Lake of the Woods greenstone belt and divides it into three smaller belts. These extend from Ontario into Manitoba where they appear to pinch out.

The greenstone belts are composed predominantly of basic volcanic rocks. Clastic metasedimentary rocks are found along the northern margin of the West Hawk Lake belt and rhyolite flows were observed in the Indian Bay area.

Aeromagnetic interpretation

Three regional aeromagnetic anomalies correspond to areas underlain by potassium-rich granodiorites and quartz monzonites (Lamb, 1974). Traces of hematite were commonly observed in these rocks. The anomaly in the Nutimik Lake-White Lake area ranges from 61,200 to 62,500 gammas and is higher over the margins of the batholith of porphyroblastic granodiorite. In the central area, the magnetic signature ranges from 61,200 to 62,300 gammas over microcline granite and quartz monzonite. To the south, a slight anomaly corresponding to pink granodiorite and quartz monzonite trends southwest to Whitemouth Lake.

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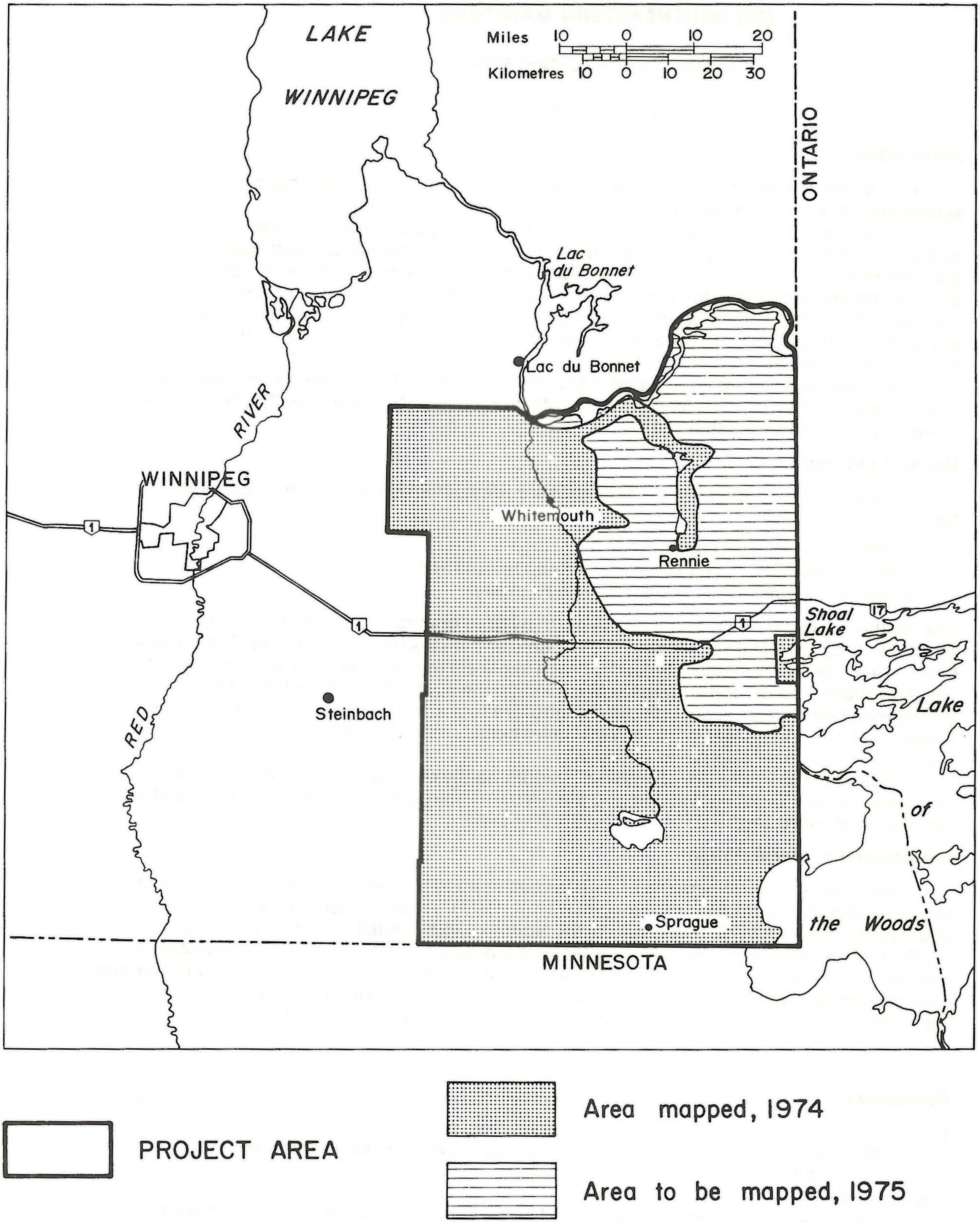

Figure 10-1. Location of project area, showing area mapped in 1974 and area to be mapped in 1975.

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(11) PEGMATITE PROJECT

By B. B. Bannatyne

Pegmatites in the Donner Lake area, 6 miles west of Cat Lake, and at the east end of Bernic Lake were examined. At Donner Lake, a 4-foot wide dyke, dipping 65°W, outcrops in the area between two major spodumene-bearing vertical dykes (86 and 87)*. The dyke contains masses of pollucite, in places cut by ¼-inch pink lithian muscovite stringers. Small crystals of tantalite also were identified in this dyke. At the east end of Bernic Lake, one of the eleven outcropping pegmatites contains a concentration of white beryl crystals (73).

The major work on the pegmatite project consisted of identification of selected mineral grains by X-ray powder photograph. This work was done by L. Solkoski, assisted by J. Tymchak, under the supervision of J. Macek. The minerals of special interest identified to date are listed in Table 11-1. It should be noted that all the minerals identified occur as one or a few grains only, and are mainly of mineralogical interest.

Table 11-1. Some recently identified rare materials in Manitoba pegmatites

Mineral	Pegmatite(s)*
Beryl	North of Birse Lake (between 74 and 75)
Bertrandite	Huron (39)
Cassiterite	Bernic Lake (75)
Columbite-Tantalite	Molly claim (3)
Huttonite (Thorite)	Greer Lake (25)
Hudrogene-autunite	Rush Lake, west end (77)
Ixiolite or pseudo-ixiolite	Molly (3), Lucky Jack claim (south of 4), Bernic Lake (73)
Rubellite (Elbaite)	Rush Lake (78, Stannite)
Tantalite†	Bendum (3), Lucky (22), Greer Lake (29), Shatford Lake (53), Rush Lake (78, 83), Donner Lake (87), Red Cross Lake (94), Cross Lake (98)
Tapiolite†	Shatford Lake (57)
Uraninite	Cross Lake (98)

*Numbers refer to pegmatites shown on index maps in previous summary reports, for 1972 (pegmatites 1 to 93) and for 1973 (pegmatites 94 to 116).

†These determinations are preliminary. More accurate X-ray methods (single crystal) are needed.

(12) STRATIGRAPHIC STUDIES

By H. R. McCabe

Field mapping activities were limited to checking of a number of localities for additional drill sites for the stratigraphic core hole program (this report). A number of these localities were drilled, and others will be drilled next year, in particular those sites intended to test the source of some of the brine springs in the Dawson Bay area.

Studies of Devonian stratigraphic core hole data and previously obtained field data continued, with emphasis on attempting to define the detailed structure and stratigraphy of Devonian strata in the Winnipegosis-Toutes Aides area (Figure 12-1). Structure in this area is proving to be extremely complex. Several outcrops that were not lithologically distinctive, and hence not correlatable with any degree of confidence, were drilled in order to ascertain their exact stratigraphic position. All were structurally lower than anticipated, consisting for the most part of Souris River strata rather than Dawson Bay beds.

Originally it had been hoped that detailed mapping of the fairly extensive outcrops in the Winnipegosis-Toutes Aides area would provide a detailed geologic and structural map, and hence a detailed picture of Winnipegosis reef distribution (all local structure is believed to be due to draping of upper Devonian beds over underlying Winnipegosis reefs as a result of solution of inter-reef salt beds). Recent core hole data, however, has shown that, in the Winnipegosis area, upper Dawson Bay and lower Souris River strata are very similar in lithology, and consequently it is not possible to correlate outcrops of these strata solely on the basis of lithology. Considerable additional drilling will thus be necessary to define the geology with any precision, but Figure 12-1 shows a preliminary map based on presently available data. This map has been drawn with no attempt to interpret the structure between indicated outcrops, although such structure is known to exist. It merely shows the distribution pattern of the various stratigraphic units.

In general, structurally low inter-reefs are more widespread than suspected, and the outcrop pattern probably should show a series of relatively small (¼ to 3 mile??) highs reflecting underlying patch reefs. In the western part of Twp. 30, Rge. 17WPM, however, a widespread area of apparently flat-lying stromatoporoid limestone, believed to belong to the upper member of the Dawson Bay Formation, suggests the presence of an underlying relatively uniform reef platform, with an estimated thickness of about 250 feet. The outcrops of lower Dawson Bay beds on the shore and islands immediately to the east all comprise small domal structures, reflecting small patch reefs rising 50 to 100 feet (15 m to 30 m) above the platform. The Souris River outlier (?) in Twp. 30, Rge. 16WPM probably represents a structurally low inter-reef area where the underlying Winnipegosis beds are only 100-150 feet (30 m to 45 m) thick.

Extensive brecciation of Souris River and upper Dawson Bay strata is evident in several holes drilled this year, and in one of the holes (M-4-74) this brecciation was accompanied by a relatively high degree of sulphide (pyrite) mineralization. Geochemical studies of these cores are being carried out (J. Stephenson, this paper).

Oil exploration continued in the Asamera et al. deep test hole program in southwestern Manitoba. All wells are to be drilled to Precambrian basement. Fifteen holes were drilled during the 1973-74 season, and ten more holes are to be drilled in the 1974-75 season. Close liaison was maintained with the drilling operatons. Compilation of data for wells to be released from confidential file has commenced, and the new data will be incorporated into the stratigraphic map series. Preliminary examination of the data indicates some minor changes in the maps, but to date no significant departures from the previously established regional trends have been noted.

Reorganization, inventory, and recatalogueing of well cores and samples stored in the Core and Sample Library was completed during the summer.

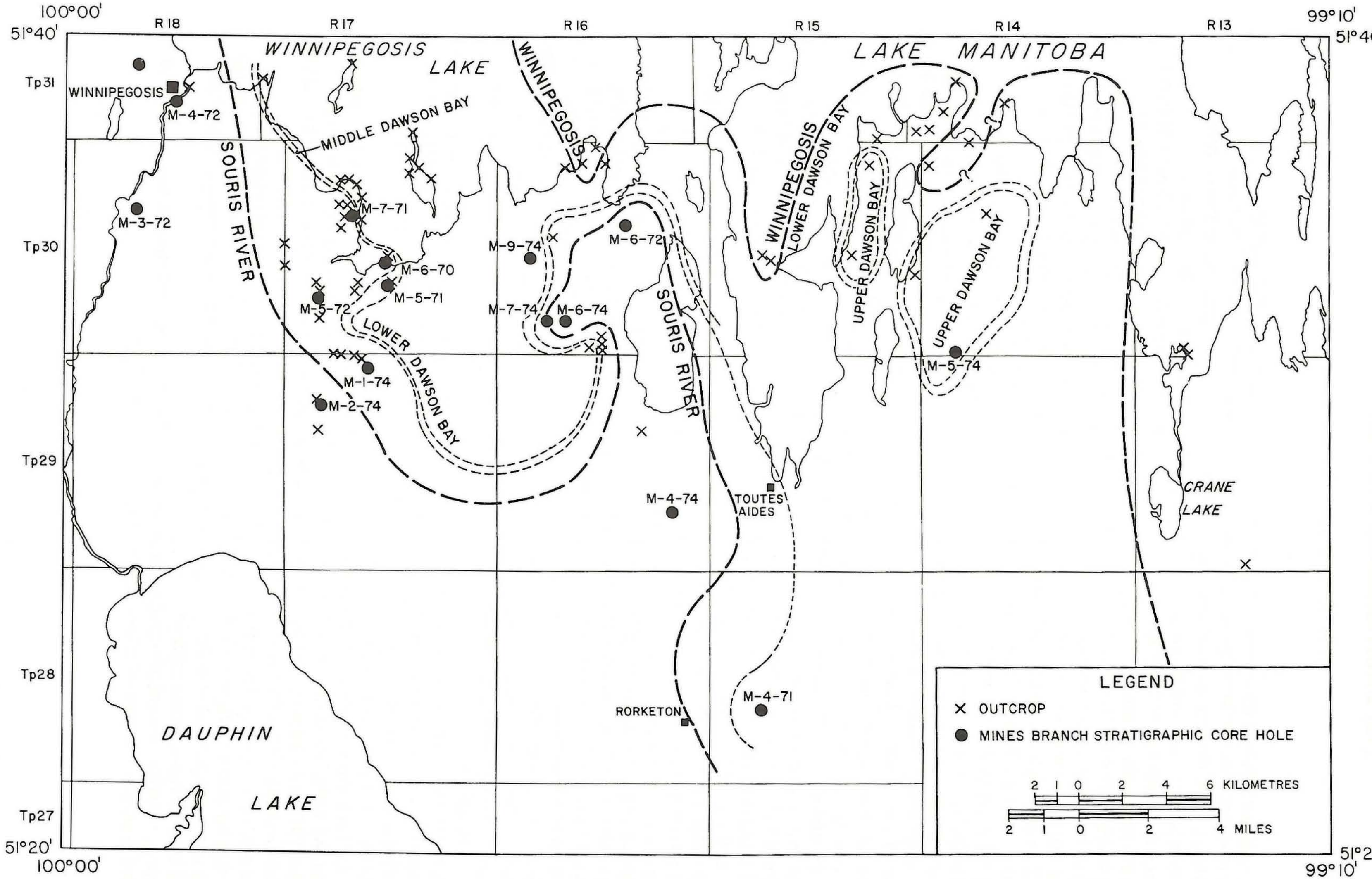

Figure 12-1. Devonian geology of the Winnipegosis-Toutes Aides area.

(12) STRATIGRAPHIC CORE HOLE PROGRAM

By H. R. McCabe

A total of 14 core holes were drilled in the period May 24 to September 13, of which 9 were stratigraphic test holes in southwestern Manitoba (Table 12-1). In a new undertaking this year, 5 Precambrian core holes were drilled in the Oxford Lake area in a geochemical study under the direction of J. Stephenson (this report). Total footage for the 14 holes drilled was 1,360 feet (415 m).

Seven of the stratigraphic test holes were drilled in the Winnipegosis-Toutes Aides area to obtain additional data for the Devonian mapping project (H. McCabe, this report). One test hole (M-3-74), located north of Headingley, was drilled to a depth of 340 feet (104 m), to evaluate a geochemical anomaly reported in this area (J. Stephenson, this report). This is the deepest hole yet drilled in the program. No problems were encountered, and holes of 400 to 450-foot (122-137 m) depth should be attainable in good ground, if required for detailed stratigraphic information. The M-3-74 hole intersected three zones of limestone in Ordovician strata, one at the top of the Fort Garry Member, one near the middle of the Fort Garry Member, and a third at the top of the Selkirk Member (Table 11-1). Detailed examination and analysis of these limestone zones will be necessary to ascertain if the limestones are of high-calcium grade.

Hole M-7-74, located immediately south of Basket Lake, and 22 miles northwest of Steep Rock, was drilled to test the northernmost accessible occurrence of the high-calcium limestone on the Devonian Elm Point Formation. A 32-foot section of mottled limestone was intersected, and preliminary visual estimates indicate a higher dolomite (magnesia) content than in the Steep Rock quarry area.

Table 12-1. Summary of core hole data

Hole No.	Location and Elevation (est.)	Formation/Member	Interval Feet	Summary lithology
M-1-74	NW11-33-29-17W	Dawson Bay — upper	0-36	Dolomite, minor limestone
	+850'	— middle	36-61	Calcareous shale, red, fossiliferous
M-2-74	SW12-29-29-17W	Souris River	0-17	Dolomite and limestone
	+870'	"First Red"	17-48	Limestone, dolomite, shale
		Dawson Bay — upper	48-60	Limestone, minor dolomite
			60-85	Dolomite
		— middle	85-125	Calcareous shale, red, fossiliferous
		— lower	125-135	Limestone, brachiopod biomicrite
M-3-74	SE1-21-11-1E	Overburden	0-19	Overburden
	+785'	Stonewall	19-38	Dolomite and red argillaceous dolomite
		Stony Mountain	38-62	Dolomite red, argillaceous, sandy
			62-106	Dolomite
		Gunn (shale)	106-180	Calcareous shale, fossiliferous
		Red River — Fort Garry	180-189	Limestone
			189-225	Dolomite, cherty, vuggy
			225-234	Limestone
			234-297	Dolomite, dense
		— Selkirk	297-319	Limestone, slightly dolomitic, cherty
			319-339	Dolomitic limestone to calcareous dolomite, mottled

Hole No.	Location and Elevation (est.)	Formation/Member	Interval Feet	Summary lithology
M-4-74	NE9-11-29-16W +850'	Souris River	0-57	Limestone and dolomite, brecciated
		"First Red"	57-102	Mixed shale, dolomite, limestone, brecciated
		Dawson Bay — upper	102-156	Limestone and dolomite, partly brecciated sulphides
		— middle	156-163	Calcareous shale, red, fossiliferous
M-5-74	SE1-6-30-14W +845'	Dawson Bay — upper	0-9.5	Limestone and dolomite
		— middle	9.5-51	Calcareous shale, red, fossiliferous
		— lower	51-58	Limestone, brachiopod biomicrite
M-6-74	NE16-5-30-16W +855'	Souris River	0-27	Dolomite, porous and limestone, dense
		"First Red"	27-44	Dolomitic shale, dolomite
		Dawson Bay — upper	44-86	Limestone and dolomite
		— middle	86-92	Calcareous shale, red, fossiliferous
M-7-74	NE14-5-30-16W +850'	Souris River or Dawson Bay ? ? ?	0-10	Limestone
M-8-74	SE4-18-32-11W +855'	Elm Point	0-32	Limestone, partly mottled, towards base
		Ashern	32-43	Dolomitic shale, reddish brown
		Interlake Group	43-52	Dolomite
M-9-74	NE9-18-30-16W +845'	Dawson Bay — lower	0-44	Limestone, fossiliferous, dolomitic towards base
		"Second Red"	44-56	Shale, dolomitic, grey to reddish brown

(13) SAND AND GRAVEL RESOURCES OF THE LEAF RAPIDS LOCAL GOVERNMENT DISTRICT

(64B and 64C)

By Susan Ringrose and Peggy Large

Mapping was undertaken in the area defined by the Leaf Rapids Local Government District boundaries to establish the distribution and stratigraphy of surficial deposits prior to an assessment of the potential of sand and gravel in the area for construction purposes.

Nine distinct units were recognized around Leaf Rapids, which include areas of exposed Precambrian bedrock which were subjected to glacial abrasion and limited deposition. Evidence of till is infrequent; till directly overlies the bedrock and consists mainly of angular crystalline pebbles in an unsorted sandy silt matrix.

A contemporaneous event led to the resorting of till by meltwater flow and the deposition of large eskers in the eastern and western parts of the area. Five eskers are recognized and they flow mainly to the south, southwest and west. They provide the main sources of aggregate in the area.

The eskers are flanked by laucustrine sands which, particularly on the western edge, form secondary terrace and ridge morphology. Washing has given rise to a surface layer of lag pebbles. The eskers are thought to have formed linear islands which were partially submerged and modified during a late glacial lacustrine phase.

Beyond the eskers glacial lake clay was deposited, predominantly in varved sequences. The clay covers at least half of the area and generally directly overlies bedrock. The clay wedges out towards the esker shoreline zone and laterally merges with silts towards the crest of the eskers.

There is, therefore, abundant evidence of extensive inundation by a cold, freshwater lake dammed by the retreating Laurentide ice in the northeast of the area. Evidence suggests that the lake was contiguous with the late stage glacial Lake Agassiz. Eolian sands were deposited in an upper late glacial or periglacial interval. The sands were derived from esker margins and now form dune-like accumulations on the periphery of the esker.

In the postglacial period, vegetative growth and decay led to the accumulation of thicknesses of peat. The peat occupies low lying depressions between bedrock ridges. The peat may either directly overlie lacustrine sands or clays. In many places frozen ground was encountered up to 40 cm through the peat. This has locally melted producing small scale collapsed palsas.

The present drainage channels are often associated with excessive areas of swamp, thick vegetation and alluvial deposits, including silts and clays. Many of these swamp areas occupy large troughs, through which only a narrow stream flows. The troughs, referred to as 'throughways', are thought to have resulted from glacial or late glacial stream erosion.

Good sources of aggregate are found in the esker deposits and associated sands. The five eskers were mapped and sampled in detail. The largest, most accessible deposit is referred to as the Leaf Rapids esker and contains an estimated 18,500,000 cu. yds. (14,200,000 cu. m) of granular material.

Highway 391 and the Leaf Rapids townsite have been built on this. About 100,000 cu. yds. (76,400 cu. m) are extracted annually from the deposit for use on driveways in the townsite and as shot crete and concrete for Ruttan Lake Mines. At the current rate of extraction, the higher quality reserves should, therefore, last about 185 years. Much of this consists of large cobbles which have to be crushed.

The smaller eskers in the east are referred to as the 'Grass Lake', 'Esker Lake', and 'Penguin Lake' eskers which combined probably contain similar quantities of aggregate to that of the Leaf Rapids esker. The quality has yet to be assessed. In the exposed accessible areas, the 'Grass Lake' esker has been quarried for highway construction. Much of the remaining good quality gravel lies under 30 feet (10 m) of silt in the Grass Lake area. The Esker Lake and Penguin Lake eskers contain high quality gravel, and are so far inaccessible. The Rat River esker is being submerged by the increased water levels on the Rat River due to the Notigi control structure.

Fifty channel samples were taken throughout the length of the eskers to evaluate the use and potential use of the deposists in the construction industry. One hundred and fifty borrow pits in sand, sand and gravel and clay were examined to determine the amount and quality of material removed and estimates of the remaining extent of the deposits are being made.