GP3/72

MANITOBA

DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT

MINES BRANCH

GEOLOGICAL PAPER 3/72

SUMMARY OF GEOLOGICAL FIELD WORK 1972

1972

GP3/72

MANITOBA

DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT

MINES BRANCH

GEOLOGICAL PAPER 3/72

SUMMARY OF GEOLOGICAL FIELD WORK 1972

1972

PREFACE

Excellent progress was maintained in the Provincial geological survey operations over the past summer. For the most part, the programme was concerned with projects begun in 1971, but also included significant new investigations particularly in the fields of geochemistry and pegmatite deposits.

Of the three major Precambrain projects, Kasmere, Burntwood and Greenstones, the field work for the Kasmere project was completed, and initial coverage for much of the other two project areas was accomplished. However, some mapping, as well as detailed studies on selected areas, remains to be done in the Greenstones and Burntwood areas. Detailed gravity studies by University of Manitoba personnel were again carried out in conjunction with all three projects.

Part of the Kasmere project area was selected as the initial site for a new geochemical sampling programme designed to evaluate certain geochemical techniques applicable to mineral exploration and to supplement the geological mapping in this largely drift-covered area.

Continued acquisition of data on the ultramafic rocks in the Province was concentrated in the Superior province, specifically on the Bird River sill, the Beaver Hill Lake complex, Knee Lake and the Fox River sill. The study of the Fox River sill was given an enormous boost through the courtesy and generosity of The International Nickel Company of Canada, Limited who granted access to core acquired during their recent drilling programme. Investigations in the Bird River area were extended to include a compilation and revision of the geology of the entire region between Lac du Bonnet-Cat Creek and the Manitoba-Ontario boundary.

A study of pegmatite deposits was begun in southeastern Manitoba with an examination of 67 pegmatites in the Falcon Lake, Winnipeg River, Bernic Lake and Bird Lake areas. Although many of the pegmatites are known, this project is designed to provide the first complete catalogue and description of them.

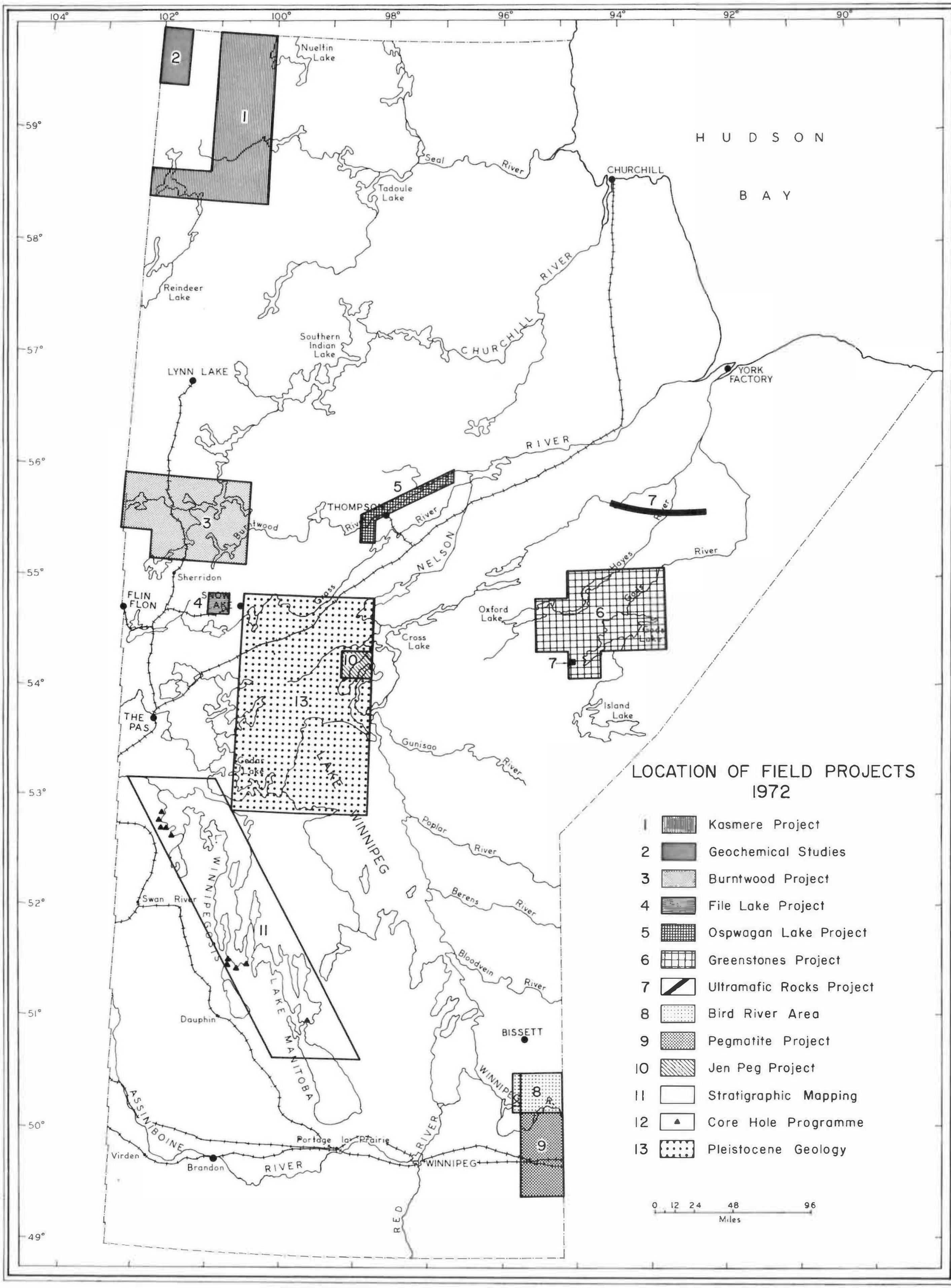
Inundation of outcrops in the Ospwagan Lake-Burntwood River and Jen Peg-Kiskitto Lake areas, as a result of Manitoba Hydro's proposed Churchill River diversion and Lake Winnipeg regulation, necessitated mapping programmes in these areas to retrieve as much geological data as possible. Financial support for these projects is being provided by the Lake Winnipeg, Churchill and Nelson Rivers Study Board.

Stratigraphic studies in southwestern Manitoba were directed primarily towards a detailed examination of the Devonian outcrop belt. Most of the known outcrops were sampled for detailed laboratory studies, and the stratigraphic core hole programme was utilized to obtain additional data in structurally and/or stratigraphically anomalous areas. The purpose of this project is to obtain an understanding of the complex structural and facies variations associated with salt deposition, salt solution and collapse, and Winnipegosis reef development. Geochemical studies will assist in evaluating the mineral potential of the Devonian formations.

A study of Pleistocene deposits in the Grand Rapids-Ponton areas was concluded with additional data obtained in the Wekusko Lake, Minago River and Playgreen Lake areas.

I. Haugh
Chief Geologist

October 3rd, 1972



LOCATION OF FIELD PROJECTS
1972
1 Kasmere Project
2 Geochemical Studies
3 Burntwood Project
4 File Lake Project
5 Ospwagan Lake Project
6 Greenstones Project
7 Ultramafic Rocks Project
8 Bird River Area
9 Pegmatite Project
10 Jen Peg Project
11 Stratigraphic Mapping
12 Core Hole Programme
13 Pleistocene Geology
0 12 24 48 96
Miles
HUDSON
BAY
CHURCHILL
YORK FACTORY
Nueltin Lake
Seal River
Tadoule Lake
Reindeer Lake
Southern Indian Lake
CHURCHILL RIVER
LYNN LAKE
NELSON RIVER
THOMPSON
Burntwood
Sherridon
FLIN FLON
THE PAS
Cross Lake
Oxford Lake
Hayes River
Gods Lake
Island Lake
Gunisao River
Cedar Lake
LAKE WINNIPEG
Poplar River
Berens River
Bloodvein River
L. WINNIPEGOSIS
LAKE MANITOBA
Swan River
Dauphin
BISSETT
WINNIPEG
ASSINIBOINE RIVER
Portage la Prairie
Virden
Brandon
RED RIVER
104°
102°
100°
98°
96°
94°
92°
90°
59°
58°
57°
56°
55°
54°
53°
52°
51°
50°
49°

TABLE OF CONTENTS

(1) KASMERE PROJECT

INTRODUCTION

by W. Weber

An area of 4400 square miles was mapped during the summer of 1972 as an extension of the initial project area covered in 1971 (Figure 1-1). The mapping was carried out at a scale of 1:50,000 by four field parties.

At the beginning of the field season, outcrops were located by an aerial survey along flight lines spaced two miles apart. This facilitated the subsequent mapping in this extensively drift-covered region. A G4A helicopter was used during a two-month period to visit the less accessible parts of the area.

The main results of the 1972 field work are:

(i) Geologically unknown areas were greatly reduced and the interpretation of the geology was extended into drift-covered areas mainly on the basis of aeromagnetic maps (Figure 1-1; Lamb, 1972, Schledewitz, 1972, Thomas, 1972, Weber, 1972).

(ii) The map-area is underlain by granitic and metasedimentary rocks (Figure 1-1). Some of the granitic rocks (8, 9, 10?)* were possibly intruded during the Archean.

Most of the metasedimentary rocks can be correlated with the Daly Lake Group of the Wollaston Lake belt as defined by Money (1968). Aluminous pelitic rocks predominate in the central part and arkosic rocks in the southeastern section of the area.

In the northern part of the area, rocks of possible Hurwitz Group (3a) appear to be gradational into, and to overlie rocks of the Daly Lake Group. However, the relationship of the Wollaston Lake belt and the Hurwitz Group requires further study.

(iii) Minor mineralization occurs sporadically; malachite and galena in meta-arkose (5b), molybdenite in pegmatite, and pyrrhotite in a meta-iron formation. Sulphide mineralization in association with calc-silicate rock, as observed in last year's map-area, was not observed in 1972.

Preliminary Interpretation of the Geology

Geological and stratigraphic cross-sections (Figures 1-2 and 1-3) through the entire Kasmere Project area, show a preliminary interpretation of the geology. The stratigraphic cross-section (Figure 1-2) indicates facies changes from the southeastern to the central part of the area suggesting proximity to a highland of granitic rocks in the southeast, the source of the arkosic rocks (3b). In the east, the arkosic facies is underlain by a conglomerate (3c) which contains fragments of the upper part of the pelitic gneiss sequence (1), indicating uplift and subsequent erosion of the eastern margin of the sedimentary basin. Arkose and arkosic gneiss (5a) of the Hurwitz Group are taken to be contemporaneous with the meta-arkose (5b) of the Daly Lake Group, although the two rock types are not connected on the geologic map. Unit 5a appears to extend further to the west (Munday, 1971) but not to the north (Eade, 1971). However, it is probably correlative with Eade's meta-arkose (3b) west of Nueltin Lake. Units 6 and 7 are equivalent to Eade's (op. cit.) units 8 and 9.

The preliminary interpretation suggests that the sediments of the Hurwitz Group were deposited on rocks of the Daly Lake Group, and that Hurwitz Group sedimentation outlasted that of the Daly Lake Group.

Deformation and anatexis were most intense in a zone through the central part of the region (Figure 1-3). This zone trends in a northeasterly direction and is part of the Wollaston Lake belt (Money, 1968). The belt appears to lose its structural characteristics in the Nueltin Lake area.

---

*Numbers in parentheses refer to rock-units shown in the legend for Figure 1-1.

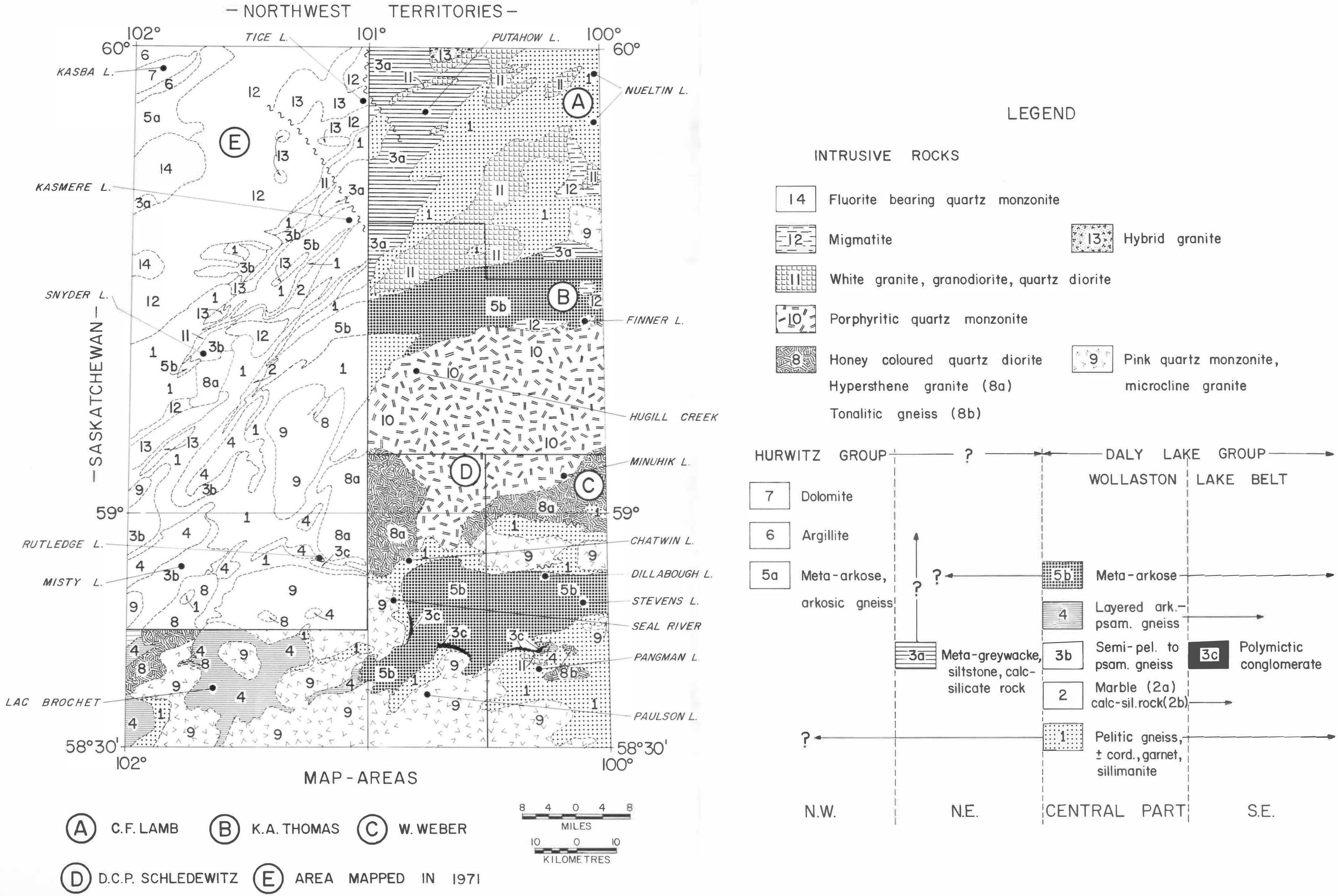


Figure 1-1 : Geology of the Kasmere Project Area.

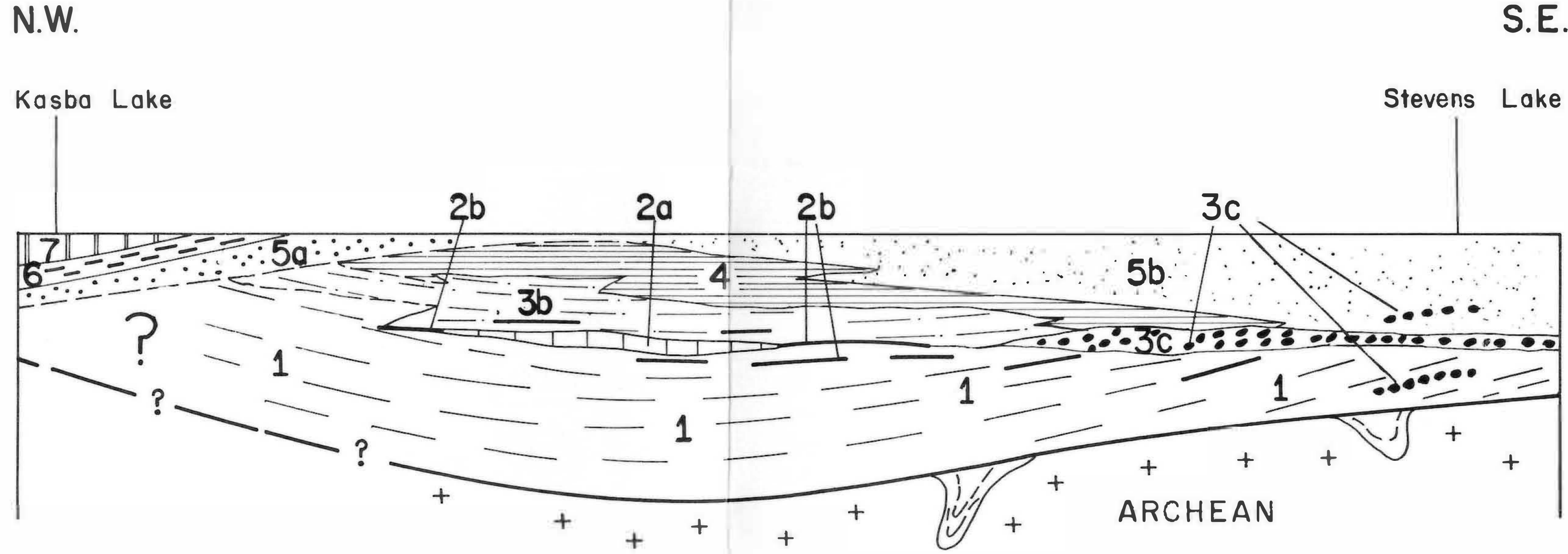


Figure I-2: Schematic stratigraphic cross-section of the Kasmere Project area.

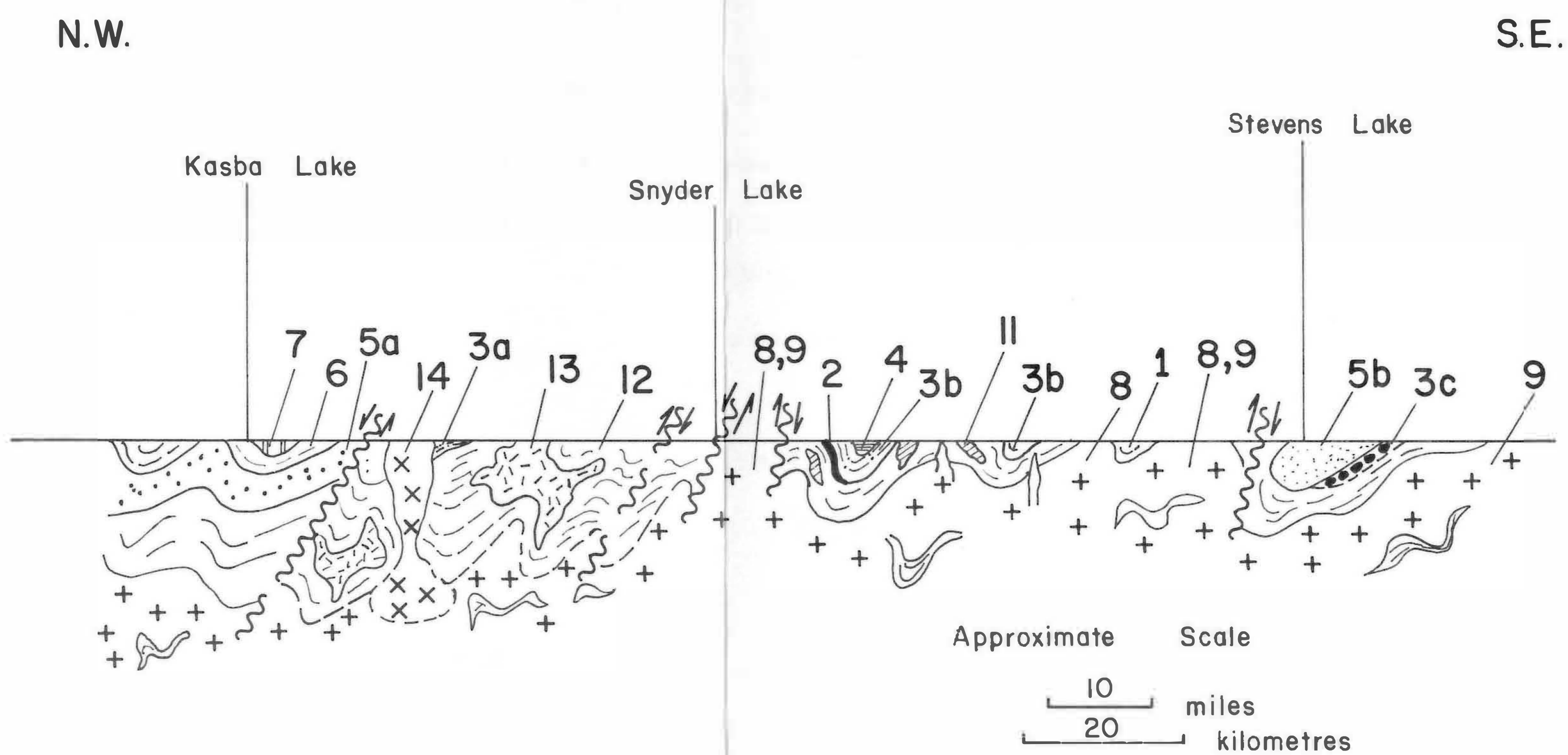


Figure I-3: Schematic geologic cross-section of the Kasmere Project area.

An easterly trending belt branches off the main Wollaston Lake trend in the Misty Lake region. This subsidiary belt contains rocks of the Aphebian Daly Lake Group which although folded about east-trending axes, must nevertheless constitute an Hudsonian fold-belt.

References

Bell, R.T.

1970: The Hurwitz Group — A prototype for deposition on metastable cratons; *in* Symposium on Basins and Geosynclines of the Canadian Shield; A.J. Baer, ed.; *Geol. Surv. Can.* Paper 70-40: pp. 159-169.

Eade, K.E.

1971: Geology of Ennadai Lake map-area, District of Keewatin *Geol. Surv. Can.* Paper 70-45.

Lamb, C.F.

1972: Putahow Lake, Bagg Lake, Sucker Lake, Turner Lake; *Man. Mines Br.* Prelim. Maps 1972K-1, 2, 3, 4.

Money, P.L.

1968: The Wollaston Lake fold-belt system, Saskatchewan-Manitoba; *Can. Jour. Earth Sci.*, 5: pp. 1489-1504.

Schledewitz, D.C.P.

1972: Whitmore Lake, Chatwin Lake, Lac Brochet, Chipewyan Falls and Paulson Lake; *Man. Mines Br.* Prelim. Maps 1972K-7, 9, 11, 12, 13.

Thomas, K.A.

1972: Sucker Lake, Hugill Creek, Finner Lake, Whitmore Lake, Minuhik Lake; *Man. Mines Br.* Prelim. Maps 1972K-3, 5, 6, 7, 8.

Weber, W.

1971: Kasmere Project, Introduction; *in* Summary of Geological Field Work 1971; *Man. Mines Br.* Geol. Paper 6/71.

1972: Minuhik Lake, Burnie Lake, Pangman Lake; *Man. Mines Br.* Prelim. Maps 1972K-8, 10, 14.

Munday, R.J.C.

1971: Dutton Lake (East Half); *in* Summary Report of Geological Investigations in the Precambrian Area of Saskatchewan; pp. 16-19.

PUTAHOW-NUELTIN LAKES AREA

(64N-9, 15, 16, and part of 10)

by C.F. Lamb

General Geology

Northeasterly to easterly trending pelitic gneiss (1) and irregular white granodiorite (11) bodies form the major rock types (Figure 1-1). They are flanked to the northwest by meta-greywacke and minor siltstone with local calc-silicate bands (3a), and to the southeast by microcline-quartz monzonite (9), migmatite (12), and meta-arkose (5b). Units 1, 5b, 11, and 12 are probably part of the Wollaston Lake belt whereas unit 3a may belong to the sedimentary sequence of the Hurwitz Group (Eade, 1971).

Structure

A regional foliation has been superimposed parallel to the layering in the metasedimentary rocks and gneisses. Regionally, the pelitic gneiss (1) strikes to the northeast (east near Nueltin Lake) and minor folds indicate that folding has taken place along northeast to east-trending axes. However, on many outcrops the foliation and layering show highly irregular folding.

Eade (1971) suggests that the fault mapped in the Ennadai Lake area extends southward and forms the western boundary of the meta-greywacke (3a) in the area west of Putahow Lake. The aeromagnetic maps indicate the existence of such a fault which would explain the sharp contact between the meta-greywacke (3a) and the migmatites north of Tice Lake (Lamb, 1971).

Metamorphism

The metamorphic grade within the area ranges from upper greenschist to upper amphibolite facies. The lower grade rocks are the metasediments (3a) in the northwestern and southeastern parts of the area. Upper amphibolite facies assemblages are present in the garnet-cordierite-sillimanite-bearing pelitic gneiss (1) which is intruded by anatectic white granodiorite (11).

Aeromagnetic Interpretation

The broad northeasterly trending "low" on the Geological Survey of Canada aeromagnetic maps 1037G, 1038G, 1043G, 1044G corresponds to pelitic gneiss (1), meta-greywacke (3a), and white granodiorite (11), which form a continuation of similar rocks mapped by Thomas (1971) to the southwest. In the northwestern part of the map-area, the meta-greywacke (3a) shows a higher magnetic expression. This is probably caused by more highly magnetic migmatites and granitic rocks which were mapped to the west (Lamb, 1971) but which dip under the meta-greywacke (3a).

The cause of the small elongate magnetic "highs" within the broad low area has not been positively identified, but granitization of rocks near these areas would appear to suggest that there are granitic intrusions (13) in these areas.

The higher magnetic signature in the area south of Nueltin Lake is caused by the presence of magnetite (1-2%) in the quartz monzonite (9).

References

Eade, K.E.

1971: Geology of Ennadai Lake map-area, District of Keewatin; *Geol. Surv. Can.* Paper 70-45.

Lamb, C.F.

1971: The Kasba-Kasmere Lakes area; *in* Summary of Geological Field Work 1971; *Man. Mines Br.* Geol. Paper 6/71.

1972: Putahow Lake, Bagg Lake, Sucker Lake, Turner Lake; *Man. Mines Br.* Prelim. Maps 1972 K-1, 2, 3, 4.

Geological Survey of Canada

1961: Turner Lake, Sucker Lake, Putahow Lake, Bagg Lake; Aeromagnetic Series, Maps 1037G, 1038G, 1043G, 1044G.

Thomas, K.A.

1971: The Kasmere-Snyder Lakes area; *in* Summary of Geological Field Work 1971; *Man. Mines Br.* Geol. Paper 6/71.

HUGILL CREEK – FINNER LAKE AREA

(64N-7, 8, parts of 1, 2, and 10)

by K.A. Thomas

General Geology

Most of the map-area (Figure 1-1) is covered by glacial overburden, and bedrock exposure is less than one per cent. Shoreline outcrops are scarce with the exception of Finner Lake. East of the metasedimentary sequence, mapped in 1971 (Thomas, 1971), a large drift-covered area with no exposure extends over approximately 100 square miles. Further east in the Hugill Creek area, two main rock types are dominant:

(i) A porphyritic quartz monzonite batholith (10) occurs in the southern and central portions of the map-area. The phenocrysts (up to 5 cm long) consist of perthite. The dark grey matrix is composed of quartz, plagioclase and biotite.

(ii) Meta-arkose (5b) is found in the northern part of the area. It is locally layered, and consists of equigranular aggregates of quartz, plagioclase, microcline, minor biotite, hornblende, actinolite and accessory magnetite (1%).

Three individual bodies of migmatite (12), which occur within the meta-arkose (5b), consist of pelitic biotite gneiss with concordant layers of coarse-grained to pegmatitic quartzo-feldspathic material. These granitic *lits* form between 25 and 75 per cent of the outcrop.

Quartz monzonite (10) and arkose (5b) both have similar aeromagnetic expressions (1900-2800 gammas; Geological Survey of Canada, 1961), but the contact between the two units appears to be well defined by the southern boundary of a linear "low" (2200-2400 gammas) striking east to northeast. Correlation of the migmatite (12) with the aeromagnetic maps is poor except that unit 12 generally corresponds to areas of slightly lower magnetic expression (2100-2300 gammas).

The metamorphic grade ranges from middle to upper amphibolite facies of regional metamorphism. A retrograde event is suggested by the presence of muscovite and sericite in the arkose.

The major regional structural feature is the continuation of the northeast trend of the Wollaston Lake fold belt from the Snyder-Kasmere Lake area (Thomas, 1971) into the western part of this year's map-area. In the eastern part the trend changes to an easterly direction.

No mineralization was found during the 1972 field season.

References

Thomas, K.A.
1971: The Kasmere-Snyder Lakes area; *in* Summary of Geological Field Work, 1971: *Man. Mines Br.* Geol. Paper 6/71.

Thomas, K.A.
1972: Sucker Lake, Hugill Creek, Finner Lake, Whitmore Lake, Minuhik Lake; *Man. Mines Br.* Prelim. Maps 1972 K-3, K-5, K-6, K-7, and K-8.

Geological Survey of Canada
1961: Minuhik Lake, Whitmore Lake, Hugill Creek, Finner Lake, Sucker Lake; Aeromagnetic Series, Maps 1029G, 1030G, 1035G, 1036G, 1038G.

MINUHIK-PANGMAN LAKES AREA

(64K-9, 10, and part of 64N-1)

by W. Weber

General Geology

The area mapped in 1972 is shown in Figure 1-1. Previous mapping was conducted by K.L. Currie (1960) and J.A. Fraser (1962). In the northern part of the area the bedrock exposure is between 5 and 10 per cent, whereas in the southern part it is 1 per cent or less.

The northern section of the map-area is underlain by porphyritic quartz monzonite (10) which intrudes potassium-rich cataclastic hypersthene granite (8a). The latter grades into pink quartz monzonite to granite (9) which appears to have been derived from unit 8 by intensive cataclasis and subsequent recrystallization.

The aluminous pelitic gneiss (1), in contact with unit 9, is intruded by leucocratic granitic mobilizate (11) in sills and stocks.

Conglomerate (3c), layered arkosic-psammitic gneiss (4) and meta-arkose (5b) overlie the pelitic rocks (1). Top determinations from graded bedding and cross-bedding in the pelitic and arkosic sequences, together with the type of clasts in the conglomerate, were used as evidence for the relative ages of units 1, 3c, 4, 5b.

Structure

The major structural feature is a synform in the meta-arkose (5b) west of Stevens Lake. Minor structures suggest that intense tight folding about steep east-trending axial planes and under high temperatures, largely transposed the original bedding into a metamorphic layering, and was accompanied by mobilization and redistribution of the quartzo-feldspathic components.

The sequence of deformational events in the Minuhik-Pangman Lake area is:

D_1 Development of a cataclastic foliation, F_1, in hypersthene granite (8a). The foliation generally strikes northeast.

D_2 Foliation, F_2, in unit 9 produced by cataclasis and subsequent recrystallization. The foliation strikes east and dips steeply. Folding and transposition of bedding in the meta-arkose (5b) and pelitic gneiss (1), and development of metamorphic layering and foliation, F_2, trending east. Quartzites and other more competent layers folded about east-trending axial planes.

D_3 Local development of a cataclastic foliation, F_3, and zones of cataclasis, transecting F_1 and F_2. F_3 strikes northeast and dips steeply.

Metamorphism

As in the other areas of the Wollaston Lake belt in Manitoba, the regional metamorphism produced upper amphibolite facies assemblages. Garnet-cordierite-sillimanite is the typical indicator mineral assemblage.

Economic Geology

Malachite, in small specks, was found in meta-arkose (5b) in one outcrop on the south shore of Dillabough Lake, northwest of Stevens Lake. Disseminated grains of galena were observed in a few places in the meta-arkose (5b) west of Stevens Lake. Assay results are not yet known.

References

Currie, K.L.

1960: Whiskey Jack Lake, Manitoba; *Geol. Surv. Can.*, Map 52-1960.

Fraser, J.A.

1962: Kasmere Lake, Manitoba; *Geol. Surv. Can.*, Map 31-1962.

Weber, W.

1972: Minuhik Lake, Burnie Lake, Pangman Lake; *Man. Mines Br.* Prelim. Maps 1972K-8, 10, 14.

LAC BROCHET-CHATWIN LAKE AREA

(64K-10, 11, 12, 15, and part of 64N-1)

by D.C.P. Schledewitz

General Geology

The geology was previously described by J.A. Fraser (1962) and K.L. Currie (1960). Glacial deposits are extensive and bedrock exposures in general comprise less than 5 per cent of the area. An exception is the Lac Brochet map-area (64K-12) where the exposure reaches 10 per cent.

Much of the area is underlain by a sequence of Precambrian metasediments consisting of pelitic gneiss and minor quartzite (1), overlain by meta-arkose (4, 5b). The latter contains variable amounts of magnetite and ferromagnesian minerals. Discontinuous lenses of conglomerate (3c) occur between the two major rock types in the Chatwin Lake (64K-15) and Paulson Lake (64K-10) map-areas. The metasedimentary sequence has been intruded by intermediate to acid igneous rocks (8, 9, and 10).

Structure

As in the Misty-Rutledge Lake map-area to the north (Schledewitz, 1971), the Lac Brochet-Chatwin Lake map-area exhibits two distinct major structural trends: northeast and east.

(i) In the western part of the map-area (Lac Brochet area 64K-12(W)), the metasediments have been folded about axial planes that dip steeply to the northwest. Based on the morphology of minor folds, the major folds appear to be tight to isoclinal, and plunge moderately to the northeast and southwest.

(ii) The arkosic rocks in the eastern part of the map-area (64K-10 (south half) and 64K-15 (north half)) are deformed into a major synform, the Chatwin-Paulson Lake synform, which extends into the adjacent map-area (Weber, this publication). The axial plane of the synform is vertical and strikes east.

The region between these two areas and south of the Chatwin-Paulson Lake synform has been intruded extensively by quartz monzonite (9).

North of the Chatwin-Paulson Lake synform, two rock types predominate: moderately to well foliated hypersthene granite (8a); and massive porphyritic quartz monzonite (10). The hypersthene granite (8a) appears to form a dome which continues westward into the Rutledge Lake area. The contact with unit 1 suggests an intrusive relationship; however, the hypersthene granite may represent a mobilized basement rock. The porphyritic quartz monzonite (10) is mainly massive and contains inclusions of hypersthene granite (8a) and pelitic gneiss (1).

Metamorphism

The mineral assemblages in the pelitic gneiss (1) are indicative of the cordierite-amphibolite facies of Abukuma-type regional metamorphism. Superimposed on the regional metamorphism is a contact metamorphism related to the emplacement of the quartz monzonite (9). The mineral assemblages in the contact zone are indicative of the K-feldspar-cordierite hornfels facies.

Economic Geology

No significant mineralization was observed in the map-area. A minor gossan was observed in a meta-iron formation (Schledewitz, 1972, Map 1972K-11) in the southwestern part of Lac Brochet (UTM E 336600, N 6498450). Minor pyrite and pyrrhotite was observed in float derived from this rock type.

An occurrence of molybdenite was observed in a small outcrop of quartz monzonite (10) along the Seal River, (Schledewitz, 1972, Map 1972K-9, Chatwin Lake). The molybdenite forms small clots of minor extent.

A radioactive background of 75-200 cpm was established for the rocks of the map-area, using a small portable scintillometer. A reading of 600 cpm was observed in a pink to white pegmatite in the southwest part of Lac Brochet (UTM E 339250, N 6506300). The pegmatite occurs at the contact between quartz monzonite (10) and pelitic gneiss (1). No uranium minerals or uranium weathering products were observed.

References

Currie, K.L.
1960: Whiskey Jack Lake, Manitoba; *Geol. Surv. Can.*, Map 52-1960.

Fraser, J.A.
1962: Kasmere Lake, Manitoba; *Geol. Surv. Can.*, Map 31-1962.

Schledewitz, D.C.P.
1971: Misty-Rutledge Lakes area; *Man. Mines Br.* Geol. Paper 6/71, pp. 17-19.
1972: Whitmore Lake, Chatwin Lake, Lac Brochet, Chipewyan Falls, and Paulson Lake; *Man. Mines Br.* Prelim. Maps 1972K-7, 9, 11, 12, and 13.

(2) GEOCHEMICAL STUDIES

Veal-Wolk Lakes area (64N-12 and 13)

by J.F. Stephenson

Introduction

Three geochemical sampling projects conducted during the 1972 field season mark the beginning of research into this branch of the earth sciences by the Manitoba Mines Branch.

The Veal-Wolk Lakes area was chosen as a suitable location in which to evaluate certain geochemical methods applicable to mineral exploration, and to supplement geological mapping in drift-covered regions of northern Manitoba. Lake waters and sediment, esker material and two plutons were sampled by one 2-man party over a 10-day period in June (Figure 2-1). Most of the sampling was conducted with helicopter support in an area which is otherwise inaccessible. The more than one hundred interconnected small lakes in the Veal Lake map-area provided adequate distribution for lake sampling. However, bedrock exposure is less than one per cent.

General Geology

The area is underlain by (?) Hurwitz Group sediments, comprising arkose, argillite and dolomite, a large migmatite gneiss complex and two fluorite-bearing quartz monzonite plugs (Lamb, 1971). Radiometric anomalies near the centre of the Veal Lake map-area are associated with local calc-silicate rocks and pegmatite.

Glacial drift consisting of unsorted ground moraine, approaching a thickness of 30 m in places, covers most of the area. Several long sinuous eskers, 10 to 20 m high, have been deposited in a southwesterly direction and generally follow topographic 'lows'.

Lake Sampling

The purpose of this project is to test the concept of secondary elemental dispersion through glacial overburden, and the degree to which the chemistry of lake waters and inorganic sediments reflect the composition of the underlying bedrock. Lake sampling was carried out with helicopter support and combined with sampling of the major rock units in the Veal Lake area. Water, sediment and rock samples will be chemically analyzed and compared.

The lakes were sampled on a grid basis within a 784 square km (306 square miles) area corresponding to the Veal Lake map-sheet. A total of 81 sample locations provided a sampling density of one station per 9 square km (3½ square miles). Samples were taken in the vicinity of lake outlets where the silt to sand fraction is greatest, and where the lake's total catchment area is considered to be best represented.

Two litres of water and a minimum of 50 gms of inorganic sediment were collected at each site in four polyethylene bottles. The containers were clamped together and filled simultaneously with near-surface lake water. The samples will be analyzed to provide the following data: a) 1 litre of untreated water for major anion and cation content, pH, conductivity and suspended solids content; b) 500 millilitres of acidified (concentrated HNO_3) water for trace element abundances and; c) two 250 millilitres of acidified (concentrated HCl) water for mercury levels.

The lake sediment was obtained by using a specially designed weighted core tube (developed by the Geochemical Division, Geological Survey of Canada). The device is attached to a line and allowed to fall freely to the lake bottom into unconsolidated, but cohesive, sediment. The core tube is then retrieved from depths of up to 6 m below water surface and the sediment later air dried in high wet-strength paper sample bags.

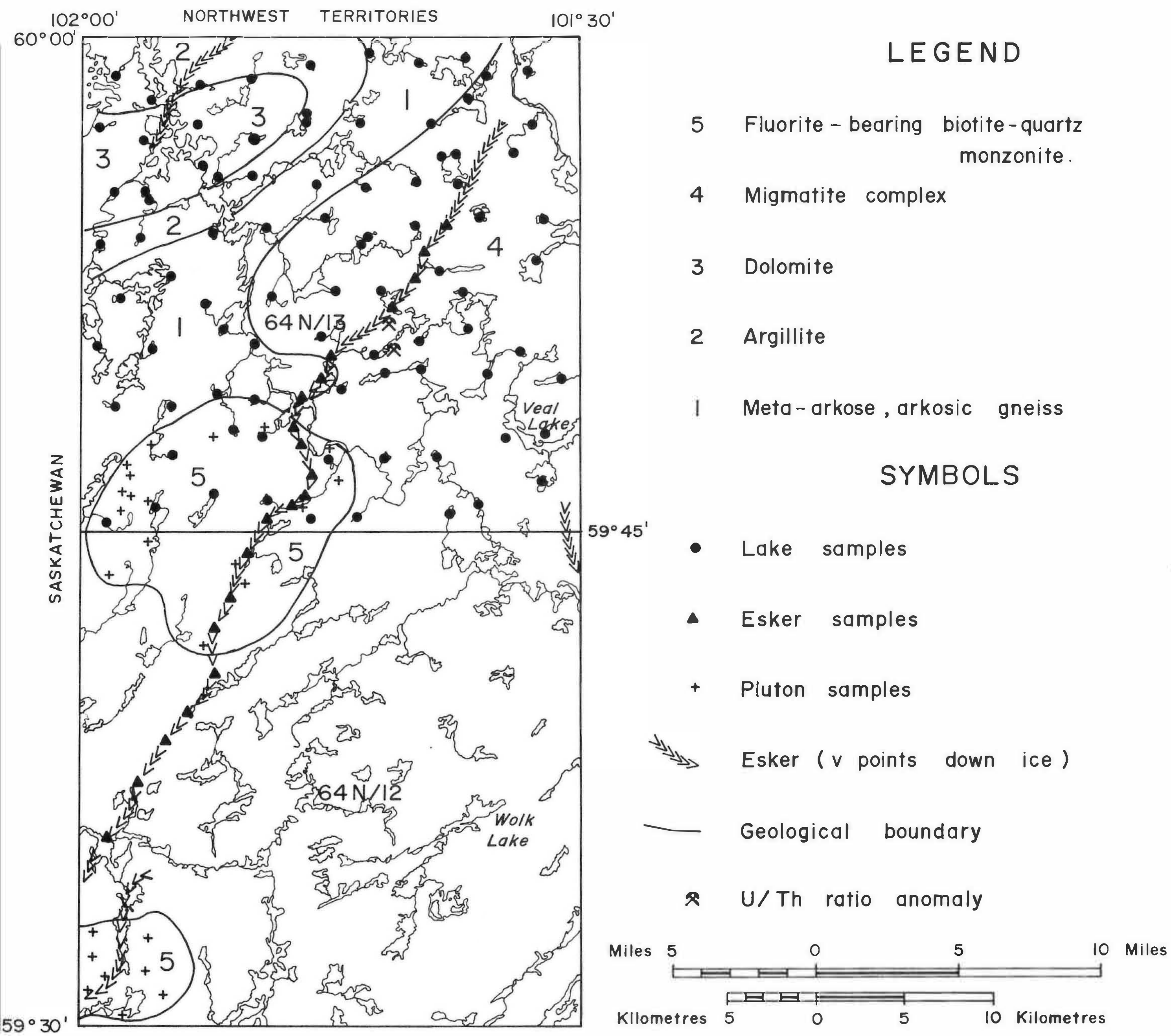


Figure 2-1: Geochemical sample locations in the Veal – Wolk Lakes area.

The entire sampling procedure was conducted from the passenger seat of a Bell G4A helicopter and averaged 10 minutes per station, including flying time.

Esker Sampling

Two eskers were sampled in the Veal Lake and Nueltin Lake (NTS area 64N-14) areas to test the concept of limited down-ice transport of esker material, and its application to mineral exploration. Although the mechanism of esker formation is still a point of debate, it has been found that specific heavy minerals within esker sands can be traced back to their source over a distance of between 10 and 20 km (Lee, 1965). Eskers are widely distributed over northern Manitoba and these deposits can be easily sampled because of their unconsolidated nature and common lack of soil development.

The Veal Lake esker was sampled with helicopter support at 21 points along its length, at intervals of 1 to 2 km. The esker traverse crosses a uranium/thorium ratio anomaly (4 times the normal background value of approximately 6:5) which was recently drilled by Yukon Antimony Corporation (open file). The traverse continues southwest across the larger of the two fluorite-bearing quartz monzonite plugs. Heavy mineral separates of the esker sand and gravel are expected to contain above background concentrations of diagnostic radioactive material and fluorite at some point down-ice from their bedrock source.

The Nueltin Lake esker was sampled at 18 points in a similar manner. This deposit occurs 100 km east of Veal Lake along the west shore of Nueltin Lake and strikes predominantly north-south. The esker crosses a prominent easterly trending aeromagnetic anomaly, the cause of which is unknown due to poor exposure, but which may be revealed in heavy mineral separates of the esker sample material.

Duplicate samples of 5 kilograms each were dug (5 to 10 m apart) from exposed areas along the crest of the eskers. The sampling procedure averaged six minutes per station including flying time between stations.

Pluton Sampling

Two fluorite-bearing biotite-quartz monzonite plugs were sampled in order to determine whether elemental abundances, trends and correlations that may exist within these bodies could be of economic significance. These late-stage, volatile-rich intrusions are of particular interest because acidic granitoids of similar composition and mode of emplacement in other parts of the world commonly contain genetically related tin, tungsten, silver, lead, zinc, copper and molybdenum deposits.

The quartz monzonite is fresh, coarse-grained, massive, and holo-crystalline, and consists of potassium feldspar, plagioclase and quartz, with biotite (5-15%) and in places minor hornblende. The accessory minerals include fluorite (0.2-2%), allanite, apatite, magnetite and zircon. A weak aeromagnetic feature outlines the margins of the plutons, and indicates that the smaller body extends into Saskatchewan. Portable geiger counter readings in the field registered about 200 counts per minute which is generally twice the level of radioactivity in the adjoining psammitic gneisses and meta-arkoses.

Scarcity of outcrop prevented systematic sampling on a grid basis, and much of the exposed bedrock sampled was frost heaved. The large and small plutons were sampled at 17 and 8 locations respectively with duplicate rock specimens obtained several metres apart at each site. Duplicate sampling will provide a more representative average of the chemical composition, particularly of trace element abundances which can vary widely at the outcrop scale. Approximate sampling time, which includes flying between stations, averaged 30 minutes per station. Quantitative petrographic analysis will be performed on the pluton samples in addition to chemical analysis and statistical treatment of the data.

References

Lamb, C.F.
1971: The Kasba-Kasmere Lakes area; *Man. Mines Br.*, Geol. Paper 6/71.
Lee, H.A.
1965: Investigation of Eskers for Mineral Exploration; *Geol. Surv. Can.*, Paper 65-14.

(3) BURNTWOOD PROJECT

(63N 6-16)

by W.D. McRitchie, T.G. Frohlinger, D.A. Baldwin, and H.V. Zwanzig

Introduction

Geological mapping, during 1972, was conducted in the Pukatawagan-Nelson Lake region as an extension of the 1971 investigation in the Nelson House area. Eleven 30-minute sheets comprising 3,750 sq. miles, were mapped in varying detail at a scale of 2 inches to one mile (Figure 3-1 and Figure 3-2).

Field work in the entire project area (630 + 63N) is scheduled for completion at the end of the 1973 season, during which concluding studies will be made on specific aspects of the structure, metamorphism, plutonism, mineralization and stratigraphy in addition to consolidation of the mapping.

The Churchill, Kississing and Burntwood River systems provided excellent access throughout the area, though large areas of partial burn and deadfall proved a considerable hindrance to traversing and helicopter support.

General Geology

Much of the area is underlain by well bedded psammitic to semipelitic gneissic meta-greywackes that have been variously recrystallized to middle or uppermost amphibolite facies assemblages, including garnet, cordierite, sillimanite, ubiquitous graphite and rare hercynite (Table 3-1). Isolated units of arkosic gneisses have been outlined near the northern and southern limits of the area. The southern occurrence, north of Kississing Lake consists of weakly magnetic, biotite and hornblende-bearing subarkosic gneisses mantled around the flank of a large gneissic quartz diorite dome. The most western of the northern occurrences consists of massive and layered, pink and yellowish grey, garnet, magnetite and locally cordierite-bearing arkosic gneisses exposed in structural basins overlying the greywackes of unit 3. The arkosic gneisses, in part, are reminiscent of similar units encountered during 1971 in the Odei River region.

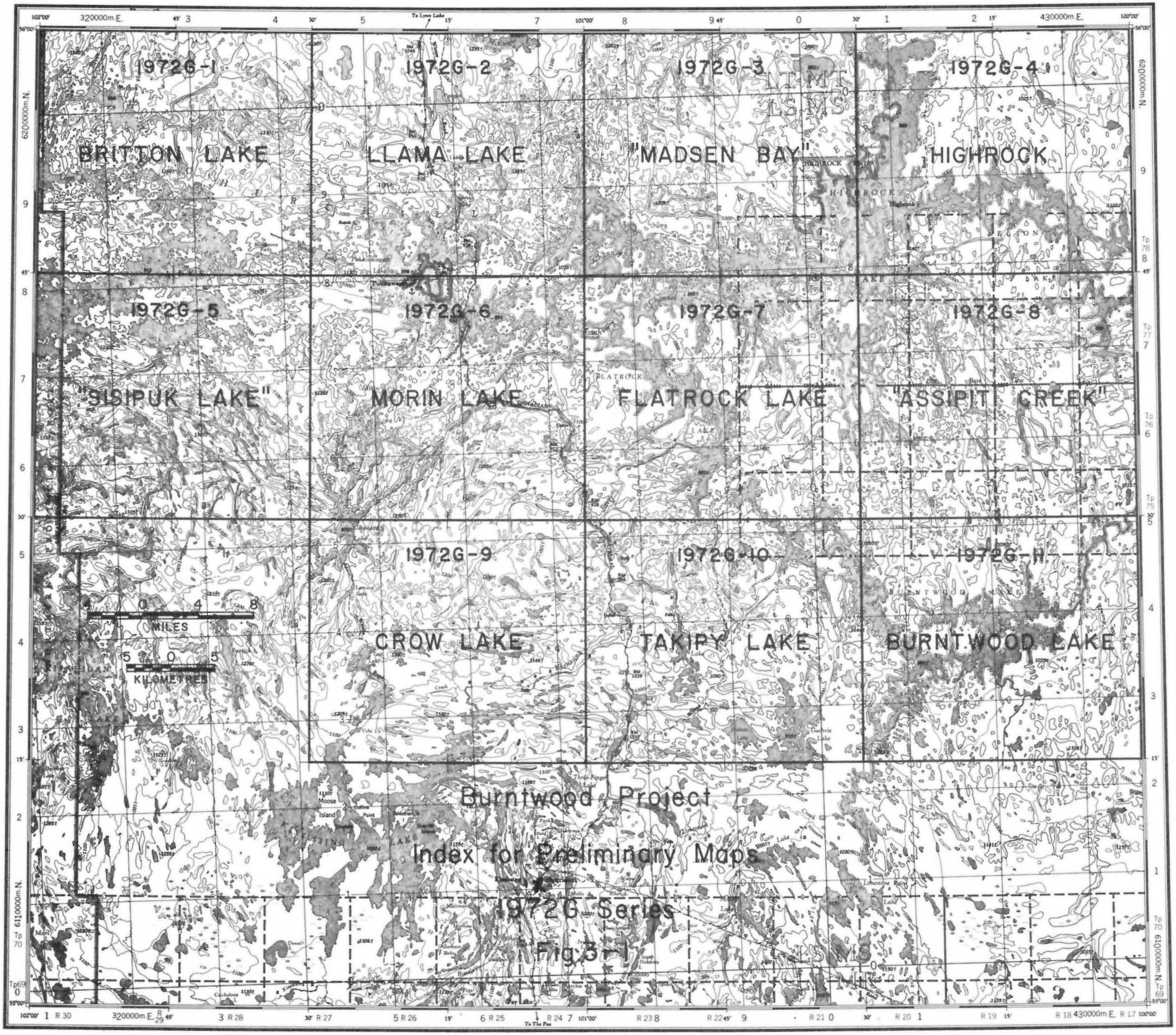
As a result of metamorphism, the sediments have been converted to a variety of *lit-par-lit* gneisses, diatexites, and wholly or partially anatectic and nebulitic granites and quartz monzonites. Age relations among the intrusive units present have been established on their position in the overall sequence of metamorphism and deformation (Table 2).

One to five mile wide tracts of orthopyroxene-bearing meta-diorite to meta-tonalite (unit 9a) can be traced for over 30 miles north and west of Guthrie Lake. This intrusive unit is thought to be genetically related to the scattered occurrences of anorthositic gabbro found elsewhere in the region (McRitchie, 1971; Frohlinger, 1971). Where subjected to later metamorphism, the meta-diorite can be traced along strike into a completely recrystallized tonalitic-granodioritic gneiss (unit 11). This in turn, through increasing quantities of potassium feldspar megacrysts, grades directly into an intrusive porphyritic quartz monzonite (unit 12).

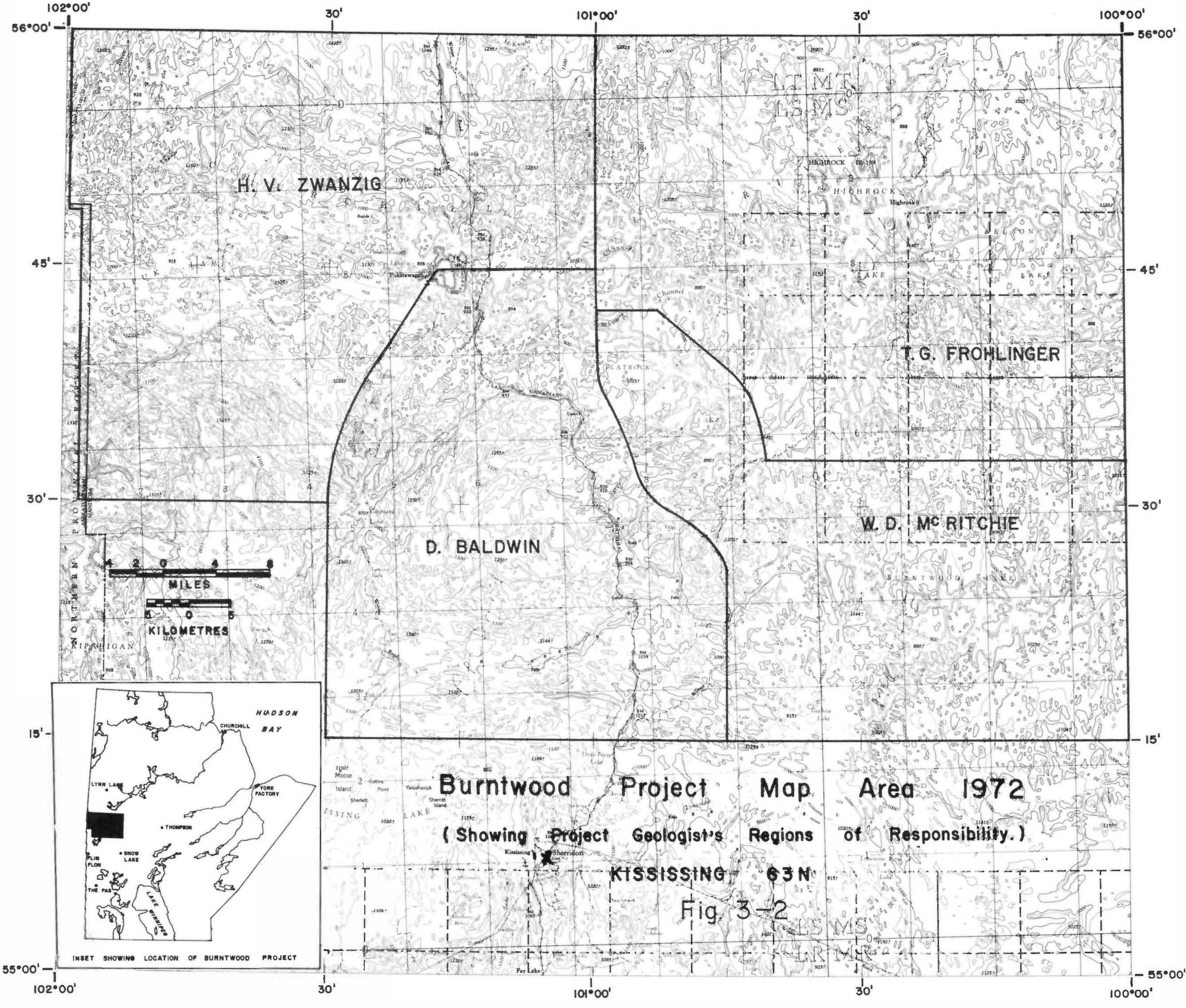
A complex of granite, quartz monzonite, pegmatite and aplite (unit 17) is the most extensive of the later intrusive units, especially in the south and west; andalusite appears as an accessory in the pegmatitic phases of this group.

Structure

A preliminary analysis of the metamorphic, deformational, and plutonic history (Table 3-2) suggests a sequence very similar to that found in the Nelson House area (Baldwin, 1971; Frohlinger, 1971; McRitchie, 1971). There are, however, indications of structural domains in which one or other of the events occurred with greater or less intensity or at slightly different times.



1972G-1
1972G-2
1972G-3
1972G-4
BRITTON LAKE
LLAMA LAKE
"MADSEN BAY"
HIGHROCK
1972G-5
1972G-6
1972G-7
1972G-8
"SISIPUK LAKE"
MORIN LAKE
FLATROCK LAKE
"ASSIPIT CREEK"
1972G-9
1972G-10
1972G-11
CROW LAKE
TAKIPY LAKE
BURNTWOOD LAKE
MILES
KILOMETRES
Burntwood Project
Index for Preliminary Maps
1972G Series
Fig. 3-1



102°00'
30'
101°00'
30'
100°00'
56°00'
45'
30'
15'
55°00'
H. V. ZWANZIG
D. BALDWIN
T. G. FROHLINGER
W. D. Mc RITCHIE
MILES
KILOMETRES
HUDSON BAY
CHURCHILL
LYNN LAKE
YORK FACTORY
THOMPSON
SNOW LAKE
FLIN FLON
THE PAS
LAKE WINNIPEG
INSET SHOWING LOCATION OF BURNTWOOD PROJECT
Burntwood Project Map Area 1972
(Showing Project Geologist's Regions of Responsibility.)
KISSISSING 63N

Fig. 3-2

TABLE 3-1 COMPOSITE TABLE OF FORMATIONS: BURNTWOOD PROJECT, WESTERN AREA

Intrusive Rocks (arranged in order of development, with exception of units 19 and 10)

19 Meta-quartz diorite: white, coarse grained and foliated with biotite and local hornblende (restricted in occurrence to the Kississing Lake area)
18 Quartz monzonite-granodiorite: white-pink, fine grained; homogeneous dykes and flat lying minor intrusions
17 Pegmatite-granite-aplite complex: pink, heterogeneous, foliated and alaskitic
(a) granodiorite-pegmatite; (b) granitic pegmatite;
(c) pink highly sheared complex with muscovite-hematite-sillimanite, chlorite-sericite schistosity; (d) speckled granodiorite
16 Quartz monzonite-granodiorite gneiss: (not encountered during 1972 season)
15 Quartz monzonite-granite: hornblende and biotite-bearing with high magnetic signature
14 Quartz monzonite: low magnetic signature
13 Quartz monzonite-monzonite: coarsely porphyritic, variably foliated (a) syenite
12 Porphyritic quartz monzonite-granodiorite: coarsely porphyritic with potassium feldspar phenocrysts, flow oriented near margins: gradational into unit 11
11 Quartz diorite-granodiorite: white, medium to coarse grained, variably foliated, homogeneous, garnet-bearing; at least in part a metamorphic derivative of unit 9: with increasing potassium feldspar megacrysts, gradational into unit 12;(a) sheared with hematite, sillimanite, muscovite schistosity
10 Quartz diorite-granodiorite: white, fine to medium grained with garnet clots and local irregular pegmatite patches; gradational into unit 17 and locally marginal to unit 11;(a) pegmatite dominant;(b) sheared with strong hematite, sillimanite, muscovite foliation
9 Anorthositic gabbro;(a) orthopyroxene-bearing meta-diorite and meta-tonalite (metamorphosed derivatives gradational into unit 11); (b) meta-granodiorite

Meta-arkose Group

8 Diatexite-anatexite
7 Arkosic gneiss-metatexite; (a) white arkosic gneiss;(b) pink-yellowish grey arkosic gneiss with local faserkiesel, and local cordierite and magnetite-bearing layers; (c) sub-arkosic gneiss
6 Arkosic gneiss;(a) meta-greywacke
5 Marker amphibolite: (not encountered during 1972 field season)

Meta-greywacke Group

4 Amphibolite: discontinuous layers and boudins
(a) pyroxene amphibolite
(b) hornblende-plagioclase gneiss
3 Diatexite-anatexite: anatectic mobilizate dominant, with rafts of restite: grades into units 10, 11, 12
2 Metatexite: 15-75 per cent anatectic mobilizate as granitic *lit* alternating with meta-greywacke restite
1 Meta-greywacke-paragneiss: variably dominant psammitic and semipelitic gneiss with less than 15 per cent granitic mobilizate

For a more complete description of all units, see McRitchie (1971); Frohlinger (1971); and Baldwin (1971)

TABLE 3-2 SUMMARY OF DEFORMATION, PLUTONISM AND METAMORPHISM

D_6 Regional faulting of several ages with associated low grade retrogressive metamorphism
EW)
NS) possible sequence
NNW)

Intrusion of dolerite dykes in Odei River region (unit 21 of 1971 report)

D_5 Flexural folding about N and NE trending axes — gentle undulatory and kink folding of D_4 fault zones

Intrusion of quartz monzonite dykes and minor intrusions (unit 18)

M_3 Recrystallization and annealing of earlier cataclastic textures followed by renewed growth of garnet and sillimanite

D_4 Faulting in narrow well defined zones or as regionally penetrative cataclastic foliation and muscovite, sillimanite, hematite, schistosity

D_3 Flexural folding about NW trending axes — may culminate in D_4

Intrusion of gabbro (single dyke northwest of Burntwood Lake)

Intrusion of granite-pegmatite-aplite complex (unit 17). Recrystallization of meta-diorite/tonalite (unit 9) to tonalite/granodiorite (unit 11) adjacent to dykes of unit 17 = M_2?

M_2 Main anatectic and metamorphic event; mobilization and introduction of granodiorite and quartz monzonite intrusions, commonly parallel to axial planes of D_2 folds.

Recrystallization of M_1 cordierite and concentration of it in mobile fraction. Partial or complete conversion of units 1, 2, and 9, to units 10, 11, and 12

Intrusion of minor quartz monzonite-tonalite dykes (in part unit 10)

D_2 Intense asymmetric folding (isoclinal) with formation of penetrative, strain slip axial planar foliation (S_2). Deformation of M_1 garnets in plane of S_2.

Intrusion of orthopyroxene-bearing anorthositic gabbro, diorite and tonalite (unit 9)

M_1 Middle to uppermost amphibolite facies metamorphism with initial anatexis. Growth of early garnet, cordierite and cordierite-sillimanite porphyroblasts

D_1 Isoclinal folding with attendant development of S_1 axial planar foliation; probably E-W axial traces

The regionally dominant WNW trend of the gneissic belt is locally obscured by subsequent tectonic overprinting on north and northeast-trending axes. Northwest and northeast-trending ellipsoidal or tadpole shaped bodies, many of which bottom out at very shallow depths, have resulted from the local superimposition of the later fault and fold structures.

Dips, especially in the south and west, are shallow (10-45^{o}) to the north and northeast; the main exceptions occur in direct association with later interference structures such as those at Highrock Lake and east of Burntwood Lake.

Tectonic transport during the early stages of development of the gneissic belt appears to have been to the south and southwest with the possible formation of a number of southwesterly verging overthrust, or overfolded nappe-like structures such as those intimated in the Russick and Duval Lakes regions (Pollock, 1964, 1965).

Mineralization

Numerous sulphide zones were encountered in the eastern and south central regions of the project area. Most showed evidence of previous exploration, such as trenching, etc. Pyrite and pyrrhotite constitute the main sulphides in zones whose widths vary between several inches and 200 feet. Molybdenite is suspected in several showings near Highrock Lake.

The mineralization in some cases appears stratigraphically controlled and developed in association with amphibole-rich horizons in the meta-greywackes. North of Derby Lake, pyrrhotite, pyrite, chalcopyrite, bornite, molybdenite and graphite occur in a well developed zone at the contact between the arkosic and meta-greywacke groups. Elsewhere, the gossans are developed in direct association with highly sheared cataclastic fault zones.

Samples from most showings are currently being assayed.

References

Baldwin, D.A.
1971: Apeganau Lake Area; *in* Summary of Geological Field Work, *Man. Mines Br.* Geol. Paper 6/71.
Frohlinger, T.G.
1971: Hall Lake-Wapisu Lake Area; *in* Summary of Geological Field Work, *Man. Mines Br.* Geol. Paper 6/71.
McRitchie, W.D.
1971: Burntwood Lake Area; *in* Summary of Geological Field Work, *Man. Mines Br.* Geol. Paper 6/71.
Pollock, G.D.
1964: Geology of the Duval Lake Area, Manitoba; *Man. Mines Br.* Publ. 61-6.
1965: Geology of the Russick Lake Area, Manitoba; *Man. Mines Br.* Publ. 63-2.

(4) FILE-MORTON-WOOSEY LAKES AREA

(63K-16W; 63K-15W)

by A.H. Bailes

During the summer of 1972 one 2-man field party spent one month in the File-Morton-Woosey Lakes region examining areas where special problems and inadequate mapping necessitated further investigations. The field studies for this area, begun in 1970, are now complete. The project was initiated to provide a detailed geological map of the File-Morton-Woosey Lakes area and to study three problems:

a) the relationship between the Kisseynew gneisses and the Amisk-Missi volcanic and sedimentary rocks;

b) the stratigraphic 'control' of copper-zinc sulphide ore bodies;

c) the detailed metamorphic and kinematic history of this region.

The results of the 1970 and 1971 field mapping programmes have already been published (Bailes, 1970, 1971a and 1971b). The 1972 field programme has indicated a number of errors in the 1971 preliminary maps and it has provided some new information on a number of topics. Some of the results of the 1972 field programme are:

a) the rocks, one mile north of Dummy Bay on File Lake, shown as rhyolites of unit 4 on the 1971 preliminary maps (Bailes, 1971b) are metamorphosed dacitic volcanic rocks and, as such, belong to unit 1;

b) the large island in Morton Lake comprises massive rhyolite flows and belongs to the acid volcanic rocks of unit 4 rather than to the intrusive quartz porphyry of unit 14. The rhyolites are pillowed in one small exposure and are locally fragmental;

c) the hornblende diorite on the second largest island in Morton Lake probably belongs to unit 13 and not unit 14a as was indicated on the 1971 preliminary maps;

d) many of the islands in the northeast arm of File Lake previously mapped as psammitic gneisses of unit 8 comprise leucocratic metamorphosed quartz diorite of unit 13. When metamorphosed the leucocratic varieties of unit 13 are virtually indistinguishable from metasedimentary gneisses;

e) the large northerly trending quartz diorite batholith east of File Lake is older than previously believed. Fabric data indicate that it was intruded prior to or simultaneously with the major metamorphic-deformational pulse in this region. It appears to be equivalent in age to the granitic component of the 'Kisseynew' migmatite terrain to the north. Both the File Lake body and the granitic rocks of the migmatite terrain have similar compositions and textures, except that the File Lake body is larger, less potash-rich, more homogeneous, and has well defined intrusive contact relationships with the surrounding rocks. The quartz diorite batholith on File Lake may have been generated by anatexis and metasomatism during regional metamorphism. This is the most probable origin for the granitic component of the migmatite terrain;

f) the metamorphism of the rocks on Woosey Lake is anomalous for two reasons:

i) the grade of metamorphism of the gneisses on Woosey Lake is abnormally high. They locally contain sillimanite, which does not appear in similar rocks in either the File Lake or Snow Lake area (Moore and Froese, 1972) until seven miles further north across a northerly increasing metamorphic gradient; the metamorphic isograds trend east;

ii) a moderate temperature and low pressure metamorphism, preceding a moderate to high pressure metamorphism, has occurred in the Woosey Lake area. The low pressure metamorphism is recorded by andalusite, which has been largely converted to muscovite plus staurolite, probably by reaction with biotite, during the second higher pressure metamorphism. To date, the lower pressure metamorphism has only been noted in the Woosey Lake area, where it may be a contact effect produced during emplacement of the numerous stocks and plugs of quartz diorite.

References

Bailes, A.H.

1971a: File-Morton-Woosey Lakes area, Manitoba; *in* Summary of Geological Field Work, 1971; *Man. Mines Br.*, Geol. Paper 6/71: 49-50.

1971b: File-Morton-Woosey Lakes area, Manitoba; *Man. Mines Br.*, Prelim. Maps 1971B-1, 1971B-2.

Moore, J.M., Jr., and Froese, E.

1972: Tectonic and metamorphic environment of mineral deposits in the Snow Lake area, Manitoba; paper presented at the 74th Annual General Meeting of the C.I.M. in Ottawa, April, 1972.

(5) OSPWAGAN LAKE PROJECT

(630-9E)

by J.F. Stephenson

Ospwagan Lake lies 20 km southwest of Thompson. Geological mapping of an area covering 480 square kilometres was completed during the 1972 field season (Stephenson, 1972). In addition shoreline mapping of the lower Burntwood River from Opegano Lake downstream to Split Lake, 100 km northeast of Thompson, was undertaken in the latter part of the season.

The object of this study is to elucidate the complex tectonic history of the 'Manitoba Nickel Belt' as it applies within the project area, and to determine its relationship to the adjoining geologic provinces. Meaningful interpretation of the field data awaits the results of structural and petrographic studies.

Some problems receiving particular attention in the area include:

1) the nature and origin of juxtaposed high and low grade regionally metamorphosed rocks within the geologically distinct Wabowden Subprovince (Bell, 1971), in the southeastern part of the map-area;

2) the relative age of the main metamorphic events with respect to regional faulting. The latter is represented by a broad zone of cataclasis which separates the Wabowden Subprovince from the Churchill Province to the northwest;

3) the nature of the fault boundary between the layered gneisses of the Wabowden Subprovince and the granulite facies rocks of the Pikwitonei Province (Bell, 1971) to the southeast.

Field work on Upper and Lower Ospwagan Lakes confirms the findings of Alcock (1921) and Quinn (1955) that the narrow northeast trending greenstone belt within the Wabowden Subprovince is volcanic in origin. These rocks are predominantly basaltic in composition and comprise massive, pillowed, amygdaloidal, vesicular and, rarely, porphyritic flows (Plate 5-1). They are rich in chlorite and belong to the greenschist facies of regional metamorphism. Stratigraphic 'top' determinations on well defined pillows indicate that the extrusive rocks underlie the metasedimentary unit.

Siliceous rocks fringing the northwest margin of the metavolcanic unit have been mapped as metasediments comprising quartzite, meta-arkose and meta-greywacke. The latter were considered by Alcock (1921) to be tuffaceous in origin, but since these rocks have suffered varying degrees of cataclasis their origin is questionable. All primary structures have been obliterated in the process; bedding may be represented in thinly laminated layers but these may have been equally well produced by the cataclasis.

The broad zone of cataclasis which represents part of the main fault zone between the Churchill Province and the Wabowden Subprovince, has gradational contacts with the metasediments to the southeast and the gneisses to the northwest. Mafic boudins within the cataclastic zones show an increasing grade of metamorphism in a northwesterly direction across the fault zone from greenschist to amphibolite facies. Cataclasis appears to have postdated the major deformational and thermal events, as shown by evidence of local retrogressive metamorphism associated with the dislocation zones.

The metavolcanic belt and associated metasediments may be a down-faulted block of preserved low-grade regionally metamorphosed terrain between adjoining higher grade gneisses. This is supported by the fact that the entire volcano-sedimentary belt is bounded by cataclastic rocks (Plate 5-2), and that linear structures within these zones generally plunge steeply, suggesting a predominantly vertical component of movement.

The relationship of the economically significant ultramafic bodies to the enclosing host rocks is difficult to determine in the field because of the lack of exposed contacts. Their general outline drawn from aeromagnetic anomalies and other sources (Quirke *et al.*, 1970) suggests a conformable attitude with the adjoining metasedimentary and metavolcanic units in the Ospwagan Lake area. Disseminations of pyrrhotite, pyrite and chalcopyrite are commonly observed as rust zones in adjoining sheared metasedimentary rocks.

Three-quarters of the Ospwagan Lake map-area is underlain by undivided Churchill Province rocks northwest of the fault boundary. These rocks comprise a monotonous sequence of garnetiferous biotite paragneiss and migmatite surrounding relatively homogeneous bodies of anatectic and intrusive granodiorite, quartz diorite and diorite gneiss. The paragneiss contains 20 to 50 per cent mauve garnets in the plagioclase-quartz-biotite restite. Cordierite is commonly concentrated in the mobilizate fraction. These gneisses are considered to be greywacke derivatives equivalent to the Nokomis group of the Kisseynew gneissic complex to the east. Four and possibly five phases of deformation (Plates 5-3 and 5-4) have been recognized ending with northeast-trending regional faulting and associated retrogressive metamorphism. The time relationship of this late adjustment to the parallel zone of cataclasis on the fault boundary is not known.

The Wabowden Subprovince and the Pikwitonei Province to the southeast are separated by a near-vertical cataclastic zone, evidence of which was observed at several localities on the Burntwood River 18 to 40 km downstream from Thompson. The position of the fault boundary was found to be essentially in agreement with Patterson (1963).

References

Alcock, F.J.
1921: Ospwagan Lake-Burntwood River area, Northern Manitoba; *Geol. Surv. Can.*, Summ. Rept. 1920, Pt. C: 1-6.

Bell, C.K.
1971: Boundary Geology, Upper Nelson River Area, Manitoba and Northwestern Ontario; *Geol. Assoc. Can.*, Special Paper No. 9: 11-39.

Patterson, J.M.
1963: Geology of the Thompson-Moak Lake area; *Man. Mines Br.*, Publ. 60-4.

Quinn, H.A.
1955: Nelson House, Manitoba; *Geol. Surv. Can.*, Paper 54-13.

Quirke, Jr., T.T., Cranstone, D.A., Bell, C.K., and Coats, C.J.A.
1970: Geology of the Moak-Setting Lakes area, Manitoba, (Manitoba Nickel Belt); *Geol. Assoc. Can.*, Guidebook, Field Trip No. 1, 23rd Ann. Meeting, Winnipeg.

Stephenson, J.F.
1972: Ospwagan Lake; *Man. Mines Br.*, Prelim. Map 1972D-1.

Plate 5-1. Flattened pillows of meta-basalt (unit 1). Island near south shore of Ospwagan Lake. Stratigraphic 'top' towards upper edge of photograph.

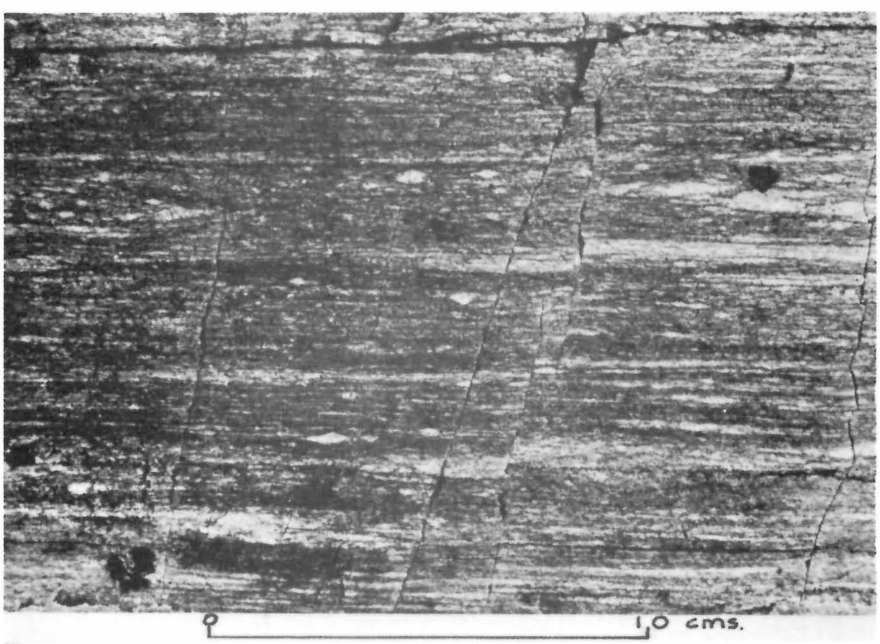


Plate 5-2. Cataclastic augen gneiss (unit 6) striking northeast and containing crushed and rolled K-feldspar porphyroclasts. East shore of Ospwagan Lake.

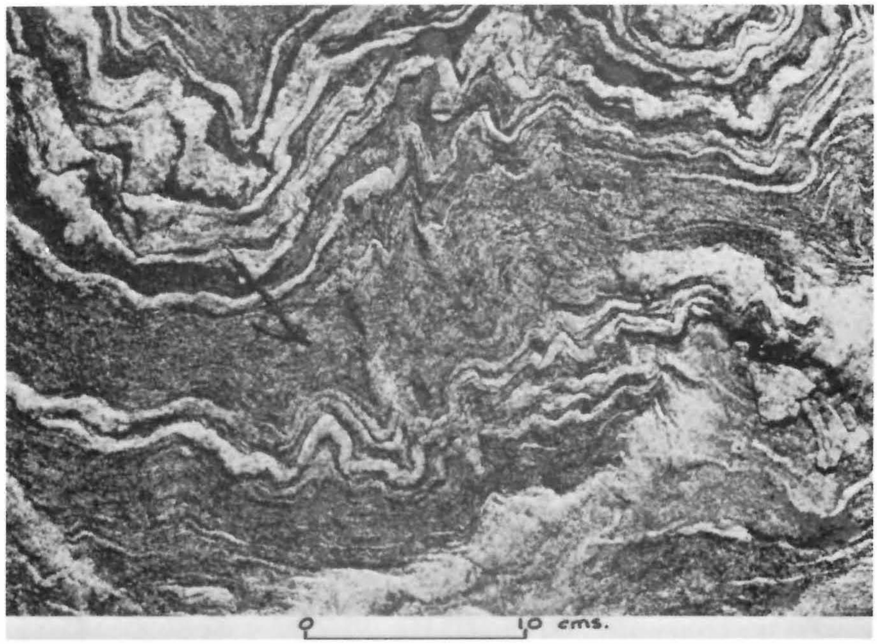


Plate 5-3. Intense asymmetric flexural slip folding displayed by garnetiferous biotite paragneiss (unit 5). North of Birch Tree Brook. 15 km northwest of Ospwagan Lake.

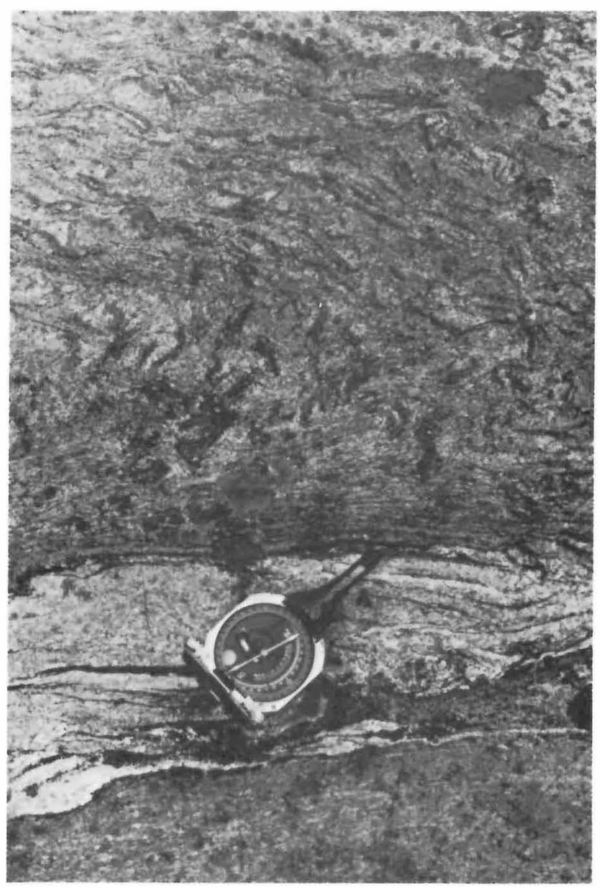


Plate 5-4. Streaked out and asymmetrically folded garnet porphyroblasts (dark patches) in biotite paragneiss (unit 5). 20 km north-northwest of Ospwagan Lake.

(6) GREENSTONES PROJECT

INTRODUCTION

by F.J. Elbers

Field work during the summer of 1972 was conducted in an area bounded by longitudes 93°30' and 95°30' and latitudes 55°15' and 54°15' (see Figure 6-1). Mapping in this area in 1971 was mainly confined to lakeshores. This year extensive pace and compass traversing and helicopter assisted surveys of interior areas has resulted in nearly complete coverage. In this way approximately 10,000 square kilometres have now been mapped at a scale of one-half mile to the inch (1971H and 1972H Preliminary Map Series).

The major objectives in 1972 were the investigation of the 'anatomy' of the volcano-sedimentary series of the project area, their relation to the interjacent 'granitoid' areas, and the infrastructure of the interjacent areas.

Three successive basic to acid volcanic cycles have been recognized in the Knee Lake area. In the Munro Lake and Beaver Hill Lake-Goose Lake areas intermediate to acid flows and pyroclastics are the final products of the volcanic cycles. Acid volcanic rocks in the Gods Lake area apparently comprise only a minor part of the volcanic sequence, although it is possible that acid volcanics are more extensive beneath Gods Lake. In concert with the proposal of Campbell, Elbers and Gilbert (1972) rocks of the greenstone belts have been stratigraphically subdivided into the Gods Lake, Knee Lake and Oxford Lake Subgroups.

Contacts between greenstone belts and adjacent 'granitic-gneissic' terrains are predominantly intrusive. However over large areas conformable depositional contacts with older metasediments have been mapped. These paragneisses are dominantly tonalitic (meta-arkoses) with minor protoquartzite. In a few places fault contacts between the volcano-sedimentary sequence and the 'granitoid' terrain have been recorded.

The 'granitoid' complexes consist predominantly of intrusive rocks: orthogneisses and younger granites. Tonalitic paragneisses constitute a minor part of the complexes. The orthogneisses (tonalites and granodiorites) and younger granites are intrusive into both the tonalitic paragneisses and the volcano-sedimentary sequence. It is possible to distinguish between prekinematic, synkinematic and postkinematic intrusions. The correlation between the intrusions and the deformational history of the paragneisses and volcano-sedimentary sequence will be the subject of further study.

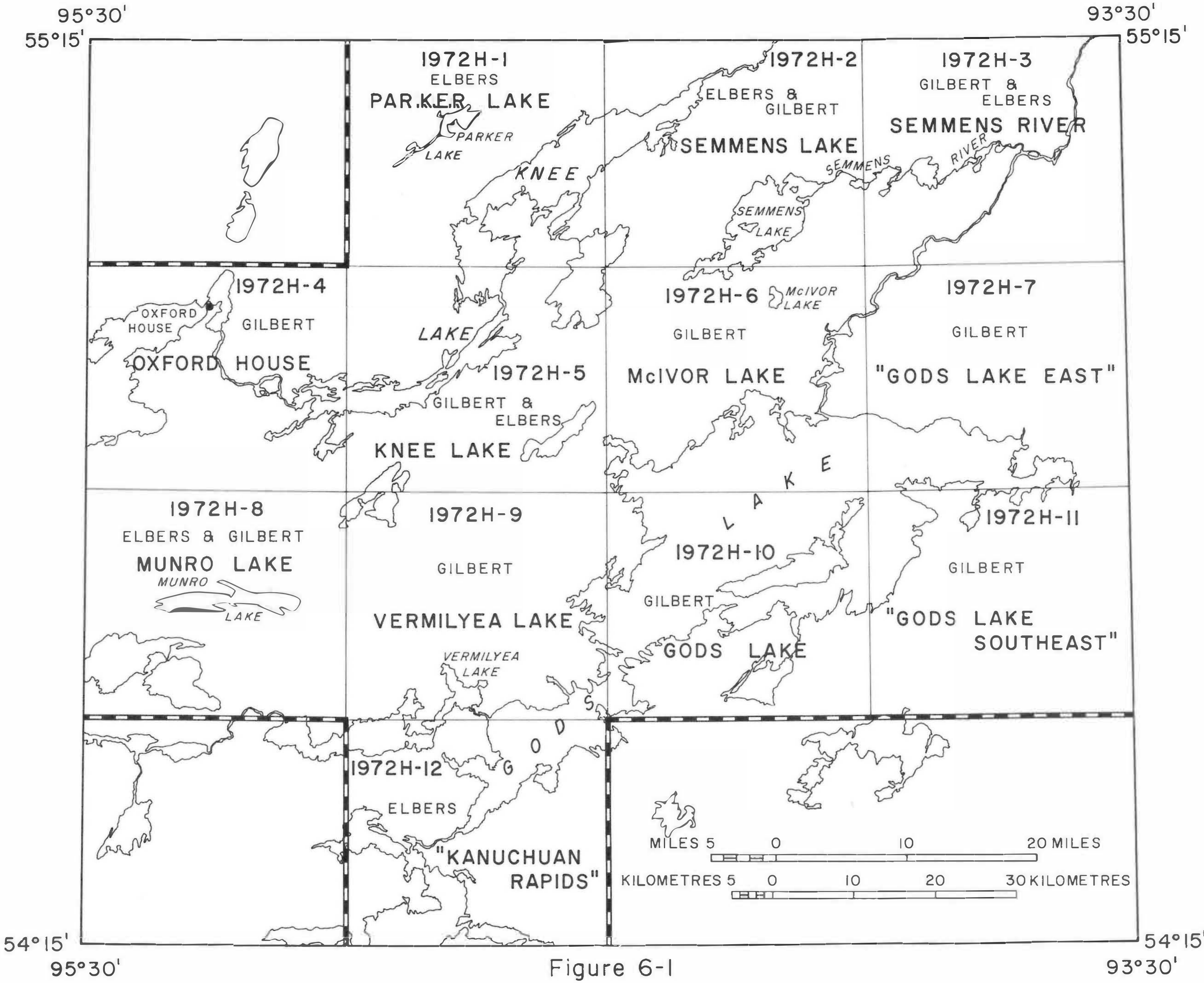


Figure 6-1

GREENSTONE PROJECT MAP LOCATIONS 1972

PARKER LAKE-KNEE LAKE-OXFORD HOUSE AREA

(53M-2, 53L-15, 53L-14)

by H.P. Gilbert and F.J. Elbers

Gods Lake Subgroup

Three major cycles of volcanism have been identified in the vicinity of Southern Knee Lake (Figure 6-2). Each cycle is characterized by a lower unit of basalt and andesite overlain by rhyolite, dacite, and fragmental volcanic rocks. The upper unit becomes progressively thicker and petrologically more diverse from cycle one to cycle three.

The oldest volcanic rocks in the area are basalts (3a)* which have been intruded by a granite pluton (12a) to the west of Central Knee Lake and to the north of Southern Knee Lake. Due to this intrusion the original thickness of the lower part of the first cycle cannot be estimated. Porphyritic basalt (3c) with up to fist-size phenocrysts of plagioclase at the southern shore of Cinder Lake constitutes a spectacular part of the lower basic unit. A lensoid unit, 7,000 m long and up to 600 m thick of rhyolite, dacite, and acid fragmental rocks (3d) outcrops east and south of Cinder Lake. Recent drilling of an associated anomaly led to the discovery of a non-economic massive sulphide deposit (Jagodits, 1972). The acid unit has been interpreted as the upper unit of the first basic to acid cycle. The rocks are overlain by pillowed basalt, andesite and porphyritic basalt of the second cycle. Less than 150 m of pillowed rhyolite outcrops northeast of Pain Killer Bay within the second cycle lower unit (Gilbert and Elbers, 1972a). The rhyolite has no proven lateral extent but may represent a poorly developed acid unit of an extra cycle. Acid porphyry dykes (3d), which intrude the second cycle basic rocks, are feeders to the overlying rhyolite and dacite. Acid flows of the second cycle are over 1,700 m thick at Pain Killer Bay; these rocks grade laterally eastwards to an assemblage of acid to intermediate pyroclastics (3e), which becomes finer grained northwards, and grades into acid crystal tuff (Gilbert and Elbers, 1972a). The fragmental rocks are intruded by diabase which may belong to the third volcanic cycle.

Third cycle volcanism culminated in a mixed assemblage of acid to basic fragmental volcanics (3h), porphyritic (locally pillowed) dacite (3k), and minor greywacke (3j). The coarsest agglomerate in this cycle, commonly with boulder-size bombs, is found on islands south of the western end of Long Island, where the upper unit is approximately 2,300 m thick.

Iron formation outcrops between the lower and upper units of the second cycle five miles east of Pain Killer Bay (Gilbert and Elbers, 1972a). The formation consists of 5 m of interbedded magnetiferous chert and argillite, underlain by 20 m of chert. Iron formation also outcrops within basalt of the second and third cycles, and between lower and upper units of the third cycle on the south shore of Long Island (Gilbert and Elbers, 1972a).

Subarkose is associated with mafic greywacke, slaty argillite and andesite (3g, 3f) on islands in the central part of Southern Knee Lake. These sediments, formerly classified in the Oxford Lake Subgroup, are now treated as a minor sedimentary facies within the volcanic sequence, and are thus assigned to the Gods Lake Subgroup. The subarkose contains pebbles of 'quartz-eye' rhyolite at one locality, and 'quartz-eyes', similar to those in the rhyolite to the northwest, are common in the subarkose.

Knee Lake Subgroup

Greywacke, slate, and minor tuff (4a) outcrop at the Southern Narrows at the eastern end of Southern Knee Lake (Gilbert and Elbers, 1972a). These rocks are assigned to the Knee Lake Subgroup, although they may be equivalent in age to the rocks of the upper unit of the third volcanic cycle. The largely pyroclastic unit of the third cycle was formerly assigned to the Knee Lake Subgroup (Elbers and Gilbert, 1971). However, since these rocks are now recognized as an integral part of the underlying volcanic sequence, they have been reclassified as part of the Gods Lake Subgroup.

Sediments and tuff at the Southern Narrows pass laterally into more mafic greywacke and siltstone south of Seller Lake.

*Numbers in parentheses refer to rock unit numbers on 1972 Preliminary Maps.

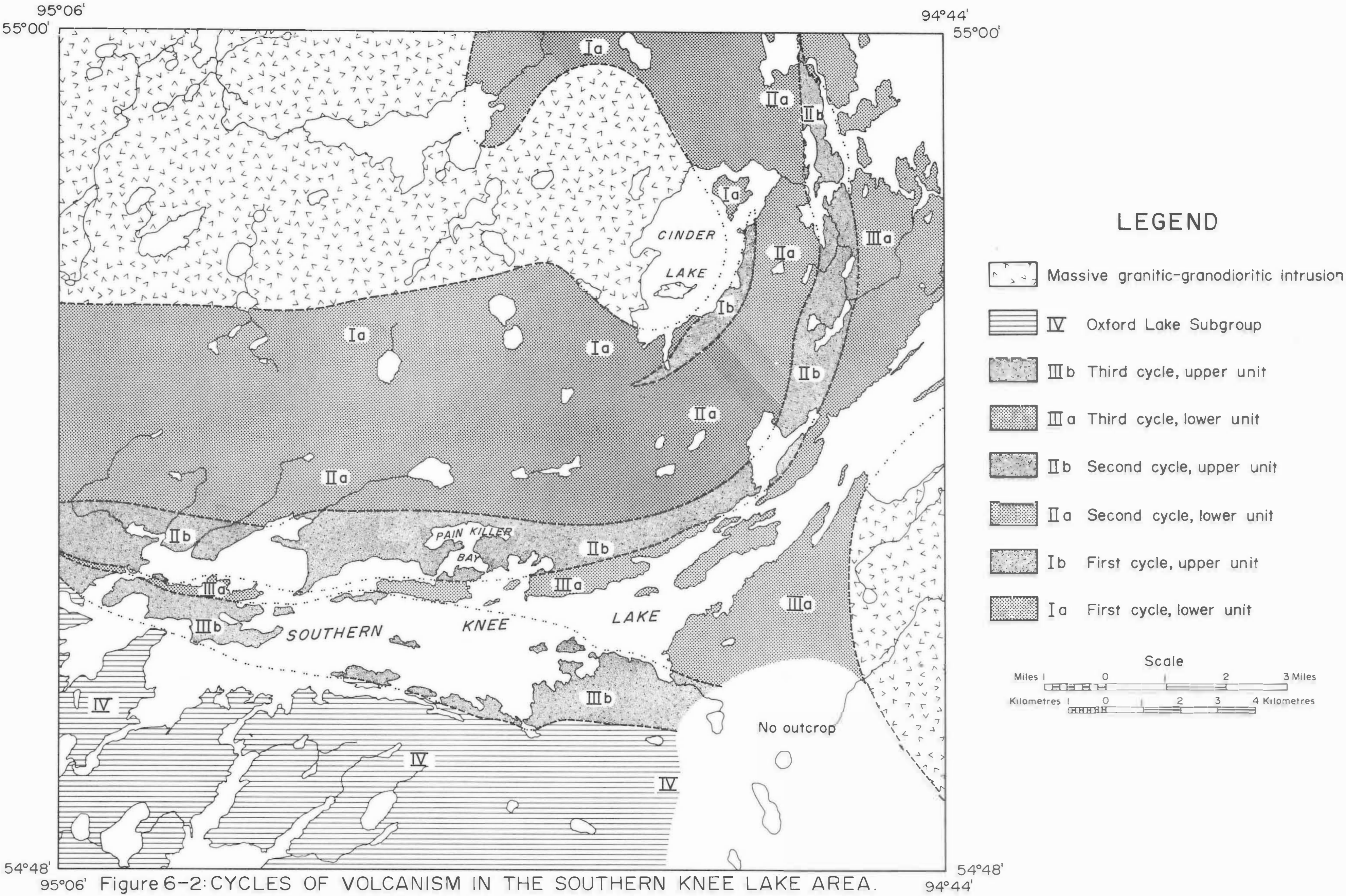


Figure 6-2: CYCLES OF VOLCANISM IN THE SOUTHERN KNEE LAKE AREA.

Oxford Lake Subgroup

Greywacke of the Oxford Lake Subgroup overlies volcanic rocks of the third cycle in Southern Knee Lake. The basal 300 m of greywacke is interbedded with chloritic tuff.

Greywacke and feldspathic greywacke (7b) are the most extensive rock types, intercalated with lenses of conglomerate (7a, 7c) up to 1,500 m thick. Between 300 and 800 m of pillowed basalt (7e) outcrops immediately south of the gabbro sill west of Magill Lake (Gilbert, 1972a).

Mafic greywacke and siltstone (7f) can be traced for 40 km from the southern part of the Oxford Lake map-area to the area southeast of Hawkins Lake (Gilbert, 1972a, d). Close to the contact with gneissoid tonalite-quartz monzonite to the south the mafic sediments are cut by granitic veins.

Intrusive Rocks

Gabbro (8b) is common throughout the Gods Lake and Knee Lake Subgroups. The largest bodies occur at the contact between the lower and upper units of the third volcanic cycle west of Long Island, at the contact between the second and third cycles five miles east of Pain Killer Bay, and between the Gods Lake and Knee Lake Subgroups five kilometres east of Cinder Lake (Gilbert, 1972a; Gilbert and Elbers, 1972a). A series of lensoid bodies of serpentinized peridotite and serpentinite (8a) outcrops in a zone which extends from the western end of Southern Knee Lake, through Pain Killer Bay to the southwestern part of Central Knee Lake. Each ultramafic body is contiguous with a lensoid gabbro intrusion.

Gneissoid granodiorite and tonalite (10) outcrops in the northern part of Michikinabish Lake and to the east (Gilbert, 1972a). Outcrops of greywacke within this unit, close to the margins of the intrusive, are interpreted as pendant bodies. The contact of the granodiorite-tonalite with the gneiss complex (1) to the south is gradational, and some orthogneiss within the gneiss complex is considered to be related to the gneissoid granodiorite and tonalite. Rocks of the gneiss complex are described in the section on the Munro Lake area (this report). Limited outcrop of gneissoid granodiorite and older gneisses occurs on the east central shore of Seller Lake (Gilbert and Elbers, 1972a).

Massive granodiorite (12d) comprises approximately one-half of the Knee Lake area (Gilbert and Elbers, 1972a). The composition of the intrusions is locally variable from quartz monzonite to tonalite. At Seller Lake and Bayly Lake the plutons are postkinematic, although very slight traces of a flow foliation are present. At Magill Lake, dykes associated with the granodiorite are folded and disrupted, and the pluton locally displays a weak foliation, indicating a prekinematic age of intrusion.

At Cinder Lake a protrusion of the granite batholith (12a) to the west has intruded the first cycle basic volcanics. Dark grey, fine-grained foyaite (12b) has been mapped as the outer rim of the protrusion, and appears to be a marginal facies of it (Gilbert and Elbers, 1972a). Alkali syenitic pegmatite (13b) occurs as a large body at the eastern shore of Cinder Lake, and as dykes in the basalts along the shore. Black melanite garnets, up to fist-size, and rimmed by magnetiferous haloes, are conspicuous within the pegmatite body. To the southeast of Parker Lake the marginal facies of the granite is granodiorite (12c), possibly due to assimilation of basic volcanic rocks.

Tourmaline and garnet-bearing pegmatites (13a) are confined to the Oxford Lake Subgroup. Spodumene is present in a dyke on the lake in the south-central part of the Oxford House map-area. Later, foliated diabase dykes (14) intrude the volcanic sequence, the overlying greywacke of the Oxford Lake Subgroup, and the massive granodiorite.

Due to thick overburden, outcrop to the west and north of Knee Lake is scarce to absent. The mapped geology (Elbers, 1972a) is based largely on interpretation of aeromagnetic anomalies. The high, horse-shoe shaped anomaly to the southeast of Parker Lake has been interpreted as broadly folded iron formation. Volcanogenic conglomerate, similar to that at Northern Knee Lake (unit 7a, Elbers and Gilbert, 1972b), outcrops at the shoreline of Parker Lake. A continuation of the aeromagnetic expression of the greenstones in Northern Knee Lake towards the east has been used as the basis for greenstones mapped to the north of the inferred iron formation. The abrupt change in the aeromagnetic expression at the northern side of Parker Lake to a plateau of low magnetic intensity, has been interpreted as the contact with a granite-gneiss terrain. At the northern rim of the map-sheet a few outcrops of migmatitic, tonalitic gneiss have been found.

Structure

Abundant and well developed pillow structures provide an important tool in the structural analysis of the Knee Lake greenstone belt. In Central Knee Lake the greenstone belt is a synclinorium with intensely folded Knee Lake Subgroup sediments constituting the youngest rocks in the central part of the belt. No folding has been found in the thick eastern and western flanks of the belt. Consequently, the section from Cinder Lake to Southern Knee Lake, showing three successive basic to acid cycles, is stratigraphically continuous. The major axis of the synclinorium does not extend through Southern Knee Lake, where faulting seems to be the dominant deformational mechanism. The general trend of the belt runs parallel to the contact with the granite batholith to the northwest of Knee Lake, and its direction may have been largely controlled by this intrusion.

Most of the rocks of the belt are massive or display a weak schistosity (S_1), which has been folded (F_2). Both F_1 and F_2 folds have been found in the area; the second deformation phase is responsible for the synclinal nature of the belt.

Metamorphism

The Knee Lake greenstone belt is in general of low metamorphic grade: chlorite and biotite zone of the greenschist facies. Close to the intrusive contacts of the belt the metamorphism increases to lower amphibolite facies, and this metamorphism is probably of contact metamorphic character.

Rocks of the Oxford Lake Subgroup southwest of Southern Knee Lake are generally of higher metamorphic grade than the older volcanics. Garnet, staurolite and cordierite porphyroblasts have been recorded.

SEMMENS LAKE-SEMMENS RIVER AREA

(53M-1, 53N-4)

by F.J. Elbers and H.P. Gilbert

The eastward extension of the Knee Lake greenstone belt is about 2 km wide and best exposed in the northeastern part of Northern Knee Lake, where it consists of pillowed basalt, greywacke and conglomerate, with minor intermediate tuffs and pyroclastics (Elbers and Gilbert, 1972b). Only one outcrop of pillowed basalt has been found between Northern Knee Lake and Semmens River. Mapped geological contacts in this area are a result of interpretation of aeromagnetic anomalies. To the north of the volcanic belt a terrain of migmatitic, tonalitic gneisses (1a) occurs, which is best exposed in the Hayes River. At the south side of the belt, massive granite (12a) has intruded the volcanics. In Seller Lake and in the area to the northeast, several exposures of tonalitic gneisses occur. Due to the scarcity of outcrop in the map-area (53M-1) the inter-relationships of the volcano-sedimentary sequence and the granite with the tonalitic gneisses could not be established. Pillowed basalt (3a) with minor basic to intermediate tuff is well exposed in the Semmens River and at the shores of Fish Lake and the lake due southwest of it (Gilbert and Elbers, 1972b). In the southernmost bay of the Semmens River crossbedded mafic greywacke (2a) underlies the volcanic rocks. Orthogneiss with pink K-feldspar 'augen' (10) outcrops at the south side of this bay, and possibly underlies the greywacke.

The greywacke is found further east on Gods River, where it is flanked to the north and south by gneissoid granodiorite and tonalite. Approximately 2,500 m of northward facing pillowed basalt and minor tuff (3a) outcrops within the tonalite to the north. In the northeast part of the map-area, greywacke with crossbedding and graded bedding faces north. These sediments are tentatively assigned to the Oxford Lake Subgroup.

MUNRO LAKE AREA

(53L-11)

by F.J. Elbers and H.P. Gilbert

Part of the geology of the Munro Lake area has been mapped by Barry (1962). The geology of Barry's map-area has now been re-examined and partly re-interpreted, and the adjoining 15' map-sheet to the west has been mapped (Elbers and Gilbert, 1972b). Previous mapping of this area was done on a reconnaissance scale by Wright (1932) and compiled by Currie (1961).

Basic lavas (3a) and abundant basic tuffs (3b), interpreted as part of the Gods Lake Subgroup, comprise the major part of the Munro Lake greenstone belt. Mafic tuffs are especially abundant at the south side of the belt where they form a unit which overlies tonalitic metasediments. In turn these mafic tuffs are overlain by basalts to the north. Both rock types have been completely recrystallized to well-foliated amphibolites, in general with obliteration of primary structures. Distinction between both rock types has been made on the basis of (i) layering and (ii) differential weathering of the tuffs, as opposed to the more massive character of the basic flows. Pillowed lavas comprise a minor part of the volcanic pile. Massive lavas occur within the tuff unit, and layered, differentially weathered tuffs occur within the basalts. The contact between the two lithologic units is transitional, and, in places, arbitrary. These basic volcanic rocks attain a maximum thickness of 2.5 km and are overlain by up to 800 m of dominantly acid volcanic rocks (3e) which extend laterally for 8 km. Acid tuffs and acid volcanic breccia constitute the major part of this unit; rhyolite and basic tuff are minor constituents. This unit is interpreted as the product of the final phase of a basic to acid volcanic cycle, and the youngest part of the Gods Lake Subgroup in this area.

Greywacke and argillite (4a) conformably overlie the Gods Lake Subgroup rocks and have been assigned to the Knee Lake Subgroup. A 100 m thick, mafic, volcanogenic pebble-cobble conglomerate (4c) occurs mainly within this sedimentary suite, but in the centre of the belt it directly overlies the acid pyroclastics of the Gods Lake Subgroup.

A unit of basalt with minor mafic tuffs (4e) overlies the sediments and indicates renewed volcanism. Acid products of this phase have not been found.

Gabbro sills (8b) are abundant in the volcano-sedimentary sequence; ultramafic sills (8a) have been found in two localities.

The Munro Lake greenstone belt is flanked to the north and south by tonalitic metasediments (1a). The contact between tonalitic metasediments and mafic tuffs is exposed at the southern side of the belt; its character is depositional, conformable and abrupt. Because of the synclinal nature of the greenstone belt (see Structure) the metasediments underlie the volcanic rocks. The metasediments, which are gneissic, are interlayered with amphibolite, most of which is also probably metasedimentary. Intrusive tonalite sills and veins (10) are abundant in this terrain, but these rocks also occur in the greenstone belt, especially at the southern shore of Munro Lake where numerous tonalite sills have intruded gabbro and mafic tuff. A 9 km long, 1 km wide intrusive body of tonalite occurs at the eastern side of the belt.

The Colen Lakes are underlain by a massive granite (12a) with a high proportion of paragneiss xenoliths. This granite is intrusive into both the greenstone belt and the gneiss complex, and truncates the greenstone belt at its western side.

Rocks of the gneiss complex (1) are well exposed at Michikinabish and Rat Lakes. Granodioritic paragneiss and gneissoid granodiorite and tonalite are the most abundant rock types. The paragneiss is migmatitic in places, and it is likely that some, at least, of the orthogneiss is anatectically derived. Amphibolite comprises 10 to 15 per cent of the gneiss complex. Layered amphibolite of sedimentary origin, and prekinematic gabbro are found on the western shore of Rat Lake. Elsewhere the origin of amphibolite (1b) is uncertain. Disrupted blocks and boudined layers of amphibolite are intruded by gneissoid granodiorite and tonalite in some places.

Two ages of basic dykes can be distinguished. Foliated, disrupted dykes occur in the gneisses at Michikinabish Lake, and late, massive diabase (15) outcrops on the peninsula in the centre of Michikinabish Lake. Two phases of pegmatite intrusion (13a) have been identified between the two phases of basic intrusion.

Structure

Top directions interpreted from graded bedding in the greywacke, pillows in basalt, and the basic to acid volcanic sequence indicate that the Munro Lake greenstone belt is synclinal. The same lithologic sequence: tonalitic metasediments-mafic tuffs-basic lavas-greywacke-basic lava is found approaching the centre of the belt either from the north or from the south. The belt is asymmetrical because the southern limb is thicker than the northern one, and because acid volcanic rocks and conglomerate have been found only on the southern limb.

The convergence of the lithologic units at the east end of the greenstone belt suggests an approach to the hinge of the syncline, although scarcity of outcrop prohibits a reliable interpretation.

Except for the granite (12a) all mapped rocks exhibit a moderate to strong schistosity (S_1) which has a general easterly strike, and parallels the bedding. Folding (F_2) of the bedding and schistosity has resulted in the present synclinal structure of the greenstone belt. F_2 folding has also been observed in the gneiss complex where it has a much more open style. Except for a local, rather weak fracture cleavage, no axial planar (S_2) schistosity has been developed.

In the Michikinabish Lake area the paragneisses have undergone at least three periods of folding. The location of fold axial traces shown on the map (Elbers and Gilbert, 1972b) are based on the symmetry of parasitic folds of the third fold phase.

Metamorphism

Both the paragneisses and the greenstones exhibit metamorphic mineral assemblages of middle amphibolite facies. The characteristic assemblage in the gneisses is: hornblende-oligoclase-epidote-sphene-biotite-quartz. Basic volcanic rocks and gabbro have been recrystallized to amphibolite; acid volcanic rocks contain garnet. Mafic greywackes are represented by amphibolites with cordierite, andalusite, and garnet porphyroblasts. Cordierite gneisses (4d) are conspicuous members of the volcanogenic sediment series. Locally cordierite porphyroblasts attain the size of pigeon eggs.

GODS LAKE-McIVOR LAKE-VERMILYEA LAKE AREA

(53L-9, 10, 16, 53K-12, 13)

by H.P. Gilbert

Gods Lake Subgroup

The volcanic sequence at the eastern end of Gods Lake is underlain by 200 m to 600 m of mafic greywacke and tuff, the base of which is in intrusive contact with gneissoid tonalite (Gilbert, 1972c). Pillowed basalt is by far the most abundant rock type in the volcanic sequence at Gods Lake (Gilbert, 1972b, c, e, f). Porphyritic basalt can be traced in some areas (e.g. in the southern part of the Gods Lake map-area), but also occurs sporadically throughout the sequence.

Acid to intermediate volcanic rocks are most extensive 11 km north of Hopkins Lake (Gilbert, 1972e), west of Gods River (Gilbert, 1972b), and in the area where the three Gods Lake maps join (Gilbert, 1972c, e, f). North of Hopkins Lake basic to acid tuff and agglomerate (3h) are interlayered with greywacke and basalt. The pyroclastics are more acidic close to the contact with gneissoid rocks to the north. West of Gods River 370 m of acid tuff (3e) occurs within a sequence of mafic greywacke and argillite (3j), minor conglomerate (3m) and minor basalt (3l). In the northeastern corner of the Gods Lake map-area (Gilbert, 1972) more than 380 m of acid to intermediate tuff, crystal tuff, and agglomerate (3e) is truncated to the south by porphyritic gabbro. Two kilometres to the northeast, at least 100 m of greywacke and acid to intermediate tuff outcrop between older pillowed basalt (3a) and younger massive granodiorite (12d). Seven kilometres further east, acid to basic tuff is associated with iron formation and basalt in a lensoid deposit approximately 150 m thick. Elsewhere on Gods Lake, sediments and fragmental volcanic rocks (3n) are confined to minor layers (generally less than 3 m thick) within pillowed basalts.

Knee Lake Subgroup

On Southern Knee Lake the youngest rocks of the volcanic sequence have been reassigned to the Gods Lake Subgroup (Gilbert, this paper). In keeping with this classification, volcanic rocks and associated sediments of the following areas have been reclassified in the same way:

1. west of Gods River;
2. in the northwestern part of the Gods Lake Southeast map-area;
3. 11 km north of Hopkins Lake (Gilbert, 1972e).

Oxford Lake Subgroup

The only occurrence of rocks of this subgroup within the area mapped on Gods Lake is on the south side of the island 11 km north of the northwestern corner of Chataway Lake. Five metres of boulder conglomerate (7a), containing granodioritic and basic volcanic clasts, directly overlie pillowed basalt (3a).

Minor lenses of conglomerate (7a) are intercalated with greywacke (7b) on the south shore of Magill Lake (Gilbert, 1972d). A large pendant of mafic greywacke and siltstone (7f) has been mapped within the granodiorite pluton (12d) on the central peninsula of Magill Lake (Gilbert, 1972d).

Intrusive Rocks

Plagioclase and quartz porphyries and porphyritic granodiorite (5 and 6) intrude only the Gods Lake Subgroup rocks. The conglomerate (7a) on Gods Lake contains clasts of the quartz porphyry.

Sills of gabbro and hornblendite (8b) are common throughout the Gods Lake Subgroup, especially within the pillowed basalts. Pseudo-hexagonal plagioclase phenocryst aggregates up to 30 cm in diameter are present in some bodies.

Three occurrences of 'dyke breccia' up to 250 m thick have been recorded within the Gods Lake Subgroup on Gods Lake. The locations are as follows:

1. lat. 54°43'8" north, long. 94°19' west (Gilbert, 1972e);
2. lat. 54°42'20" north, long. 94°20'25" west (Gilbert, 1972e);
3. lat. 54°47'8" north, long. 93°13'15" west (Gilbert, 1972c).

The breccias are composed of a heterogeneous assemblage of foliated, angular clasts (derived mainly from rocks of the Gods Lake Subgroup) within a matrix of massive tonalite. The breccia is intruded by lamprophyre (14).

Gneissoid granodiorite (9) intrudes mafic greywacke and pillowed basalt on islands in the eastern arm of Gods Lake (Gilbert, 1972c). Locally the granodiorite grades to diorite. These rocks are intruded by late, gneissoid tonalite and granodiorite (10) to the east and west (Gilbert, 1972b, c). Xenoliths of basalt and amphibolite up to 4 m long by 1 m wide, and large pendant bodies are common in the peripheral zones of these intrusions on Gods Lake. On Gods River a sill of gneissoid granodiorite (10) lies between pillowed basalt to the south and 1,300 m of amphibolite (derived from the Gods Lake Subgroup) to the north. The contact between gneissoid tonalite and granodiorite (10) and massive rocks of similar composition (12d) south of Gods River, and at the eastern extremity of Gods Lake, is ill-defined and possibly gradational.

South of Hawkins Lake gneissoid quartz monzonite and granodiorite (10) intrudes mafic greywacke (7f) to the north, and has a gradational contact with rocks of the gneiss complex (1) on the south side (Gilbert, 1972d). The intrusive rock is well sheared and contains boudined layers of amphibolite which are probably related to the greywacke to the north. Outcrops of paragneiss within gneissoid granodiorite on the east shore of Hawkins Lake, south of Hawkins Lake, and in the western part of Gods Lake are interpreted as part of the gneiss complex (1).

Foliated and disrupted diabase dykes (11) intrude gneissoid granodiorite 10 km southeast of Hawkins Lake (Gilbert, 1972d).

Massive quartz monzonite to tonalite (12d) outcrops on the western shore of Gods Lake, south of Gods River, and southeast and east of Gods Lake (Gilbert, 1972b, c, e, f). The plutons are generally homogeneous, but rarely a flow foliation is present at the margins of the bodies. Contacts between the quartz monzonite to tonalite and the greenstones are generally abrupt, but in places a contact zone is present, as in the east-central part of the Gods Lake map-area.

Slightly foliated diabase dykes (14) intrude both the greenstones and the granitoid rocks. Later, massive, fresh-looking diabase dykes (15), up to 20 m thick, are found in the eastern part of Gods Lake (Gilbert, 1972c, f).

Structure

Basalt pillow top directions indicate two major, easterly trending fold axes in the eastern arm of Gods Lake. Units of porphyritic basalt and a feldspar porphyry dyke outline the closure of the southern, anticlinal fold. The same fold is also outlined by a high aeromagnetic anomaly which is associated with iron formation. The major northeast-trending syncline in the Gods Lake map-area (Gilbert, 1972e) has been confirmed, and the axial trace has been located more accurately than originally indicated (Gilbert, 1971). Three minor fold axes have been mapped in the area where the three Gods Lake map-sheets adjoin (Gilbert, 1972c, e, f). Two northerly trending folds west of Gods River are based upon the symmetry of associated parasitic folds.

Metamorphism

Rocks of the Gods Lake Subgroup have been metamorphosed to the upper greenschist and lower amphibolite facies. Tremolite-actinolite and green hornblende are typical minerals. The metamorphic grade of the greenstones increases towards the contact with the gneissoid granodiorite (10, 12). Garnet is present in sediments and tuffs west of Gods River and in the northwestern part of the Gods Lake map-area (Gilbert, 1972e), where andalusite is also present.

BEAVER HILL LAKE-GOOSE LAKE AREA

(53L-7)

by F.J. Elbers

The most conspicuous feature of the greenstone belt in the Beaver Hill Lake area is the occurrence of a Z-folded, differentiated gabbro body (8b) approximately 12 km long and 500 m wide. The lower part of the intrusion consists of serpentinized peridotite (8a). A more detailed description of this intrusion is given by Macek and Trueman (this publication). The body has intruded basalts (3a), acid feldspar crystal tuffs (3e), and mafic tuffs (3b). The acid tuff unit also contains minor acid volcanic breccia; minor rhyolite has been found at the northern shore of the northwestern bay of Beaver Hill Lake.

Additional mapping in the interior area of the belt has revealed a unit of intermediate to acid tuff, and minor rhyolite (3e) in the central part of the map-area (Elbers, 1972b). The unit is lensoid, 1.5 km thick and 3 km long, and is truncated by intrusive granite.

North of Beaver Hill Lake the greenstone belt is bordered at its northern and southern side by intrusive granite. Its width there is only 3 km. Northwest of Goose Lake the belt is intruded on its southern side by the same granite, but to the north the volcano-sedimentary series is in conformable, depositional contact with underlying, well crossbedded, fresh proto-quartzite. The contact is exposed in the bay just east of the south-trending esker which forms an 'island trail' in the northeastern part of Beaver Hill Lake.

Outcrop to the north of the greenstone belt is scarce to absent. A few outcrops were found during the helicopter survey. One outcrop of pebble-cobble conglomerate within the quartzite shows 90 per cent massive tonalite clasts.

Due to strong flattening, multiple deformation, and middle amphibolite facies metamorphism, most rocks of the Beaver Hill Lake-Goose Lake greenstone belt have lost their original characteristics. Basalt, mafic tuff, mafic greywacke and gabbro have all recrystallized to amphibolite and are hard to distinguish. The unit of acid volcanic rocks northeast of Beaver Hill Lake consists mainly of quartz-biotite schist.

References

Barry, G.S.
1962: Geology of the Munro Lake area; *Man. Mines Br.*, Publ. 61-1.
Campbell, F.H.A., Elbers, F.J., and Gilbert, H.P.
1972: The Stratigraphy of the Hayes River Group in Manitoba — A Preliminary Report; *Man. Mines Br.*, Geol. Paper 2/72.
Currie, K.L.
1961: Map 21-1961, Oxford House, Manitoba; *Geol. Surv. Can.*, Prelim. Series, Sheet 53L.
Elbers, F.J.
1972a: Parker Lake; *Man. Mines Br.*, Prelim. Map 1972H-1.
1972b: "Kanuchuan Rapids"; *Man. Mines Br.*, Prelim. Map 1972H-12.
Elbers, F.J., and Gilbert, H.P.
1971: Knee Lake; *Man. Mines Br.*, Prelim. Map 1971H-6.
1972a: Munro Lake; *Man. Mines Br.*, Prelim. Map 1972H-8.
1972b: Semmens Lake; *Man. Mines Br.*, Prelim. Map 1972H-2.
Gilbert, H.P.
1971: Gods Lake; *Man. Mines Br.*, Prelim. Map 1971H-10.

1972a: Oxford House; *Man. Mines Br.*, Prelim. Map 1972H-4.
1972b: McIvor Lake; *Man. Mines Br.*, Prelim. Map 1972H-6.
1972c: "Gods Lake East"; *Man. Mines Br.*, Prelim. Map 1972H-7.
1972d: Vermilyea Lake; *Man. Mines Br.*, Prelim. Map 1972H-9.
1972e: Gods Lake; *Man. Mines Br.*, Prelim. Map 1972H-10.
1972f: "Gods Lake Southeast"; *Man. Mines Br.*, Prelim. Map 1972H-11.

Gilbert, H.P., and Elbers, F.J.
1972a: Knee Lake; *Man. Mines Br.*, Prelim. Map 1972H-5.
1972b: Semmens River; *Man. Mines Br.*, Prelim. Map 1972H-3.

Jagodits, F.L.
1972: A case history for geophysical exploration for base metals in the Canadian Precambrian Shield (abstract); *Intern. Geol. Congr.*, 24th Session, Sec. 9, 82.

Wright, J.F.
1932: Oxford House area, Manitoba; *Geol. Surv. Can.*, Summ. Rept., Pt. C.

(7) ULTRAMAFIC ROCKS PROJECT

by R.F.J. Scoates, D.L. Trueman and J.J. Macek

Field investigations of ultramafic rocks were conducted in the Beaver Hill Lake and Knee Lakes area (Figure 7-1). In addition approximately thirty thousand feet of diamond drill core from the Fox River sill was examined and sampled.

BEAVER HILL LAKE

(53L-7NW)

The Beaver Hill Lake mafic complex (1)* (Macek and Trueman, 1972) comprises serpentinized peridotite, clinopyroxenite and gabbro. Descriptions of these rock types and the adjacent country rocks have been given previously by Scoates (1971) and Elbers and Campbell (1971).

The Beaver Hill Lake mafic complex is deformed into a broad dextral fold. The complex pinches out on the southeast limb and is open to the northwest. Stratigraphic correlation of the rocks in the complex and their relationship to the country rocks is difficult to resolve because of the complexity of the structure and the limited exposure. The apparent relationships however suggest that the mafic complex is largely discordant.

Within the complex a well developed, near vertical, foliation parallels the igneous layering both in the flanks and crestal areas of the dextral fold and is itself apparently transected by a later foliation which parallels the axial plane of the fold.

Axial planar faults, which postdate the folding, yield minor offsets, and faults in a northeasterly direction trauncate rock units and further complicate the stratigraphy.

KNEE LAKE

(53L-15NW)

Three new occurrences of ultramafic rocks were investigated in the Knee Lake area in 1972 (Figure 7-2). All three of the bodies (2, 3, 4) comprise serpentinized peridotite and serpentinite, and are associated with an assemblage of volcanic breccia, mafic to intermediate lavas, and gabbro.

Greenish serpentinite and rusty weathering to black serpentinized peridotite are medium to coarse grained and massive to weakly schistose. Primary textures are well preserved in the serpentinized peridotite; olivine and olivine pseudomorphs are poikilitically enclosed in clinopyroxenes which impart a knotted appearance to weathered surfaces.

Blocky joint and fracture surfaces are commonly marked by serpentine-carbonate-magnetite assemblages. Coarse picrolite is rare in all of the bodies, and a single occurrence of talc was noted.

Sulphides in the three bodies are sparsely disseminated and constitute less than one per cent of the rock.

---

*The numbers in the text refer to locations of the bodies in Figures 7-1, and 7-2.

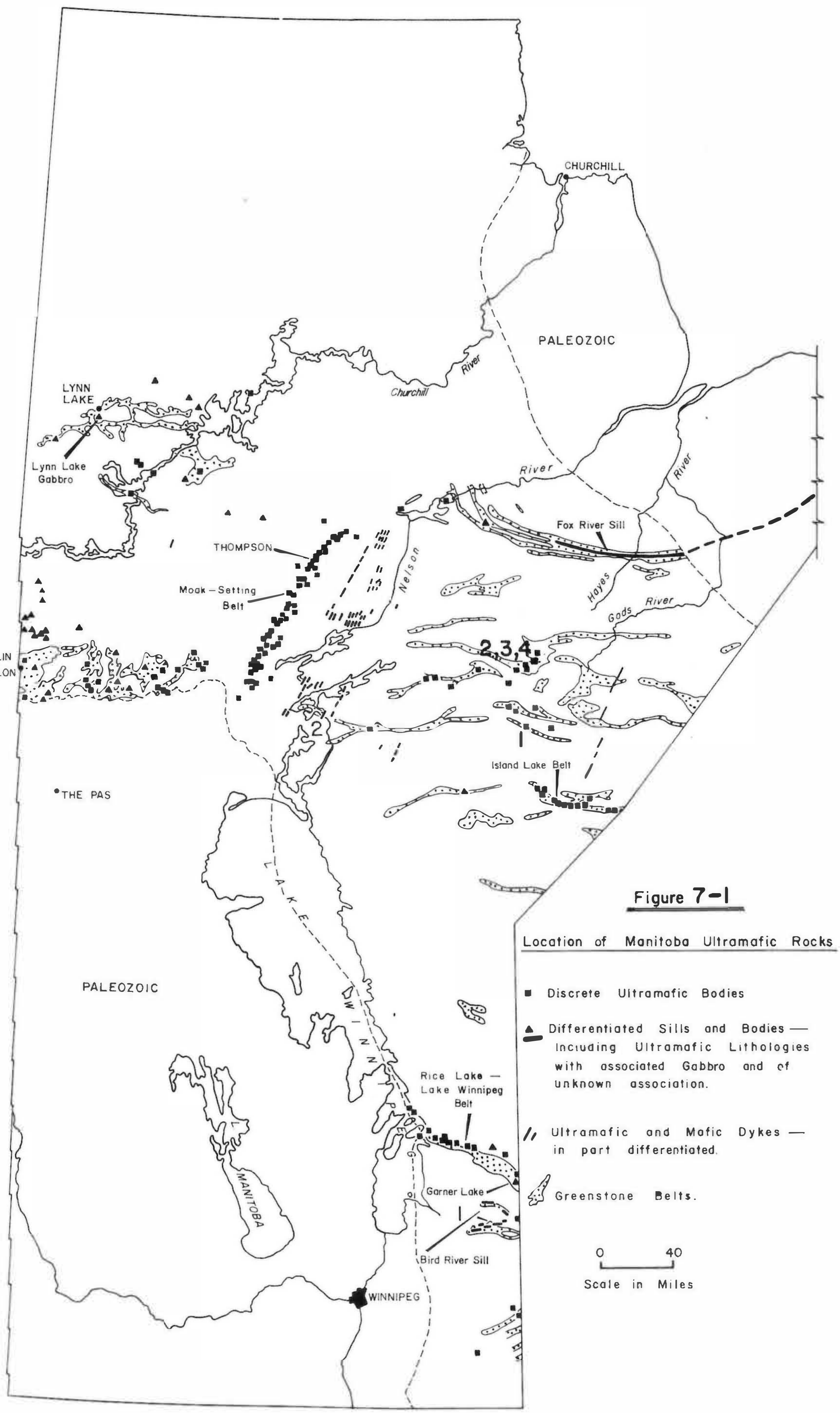


Figure 7-1

Location of Manitoba Ultramafic Rocks

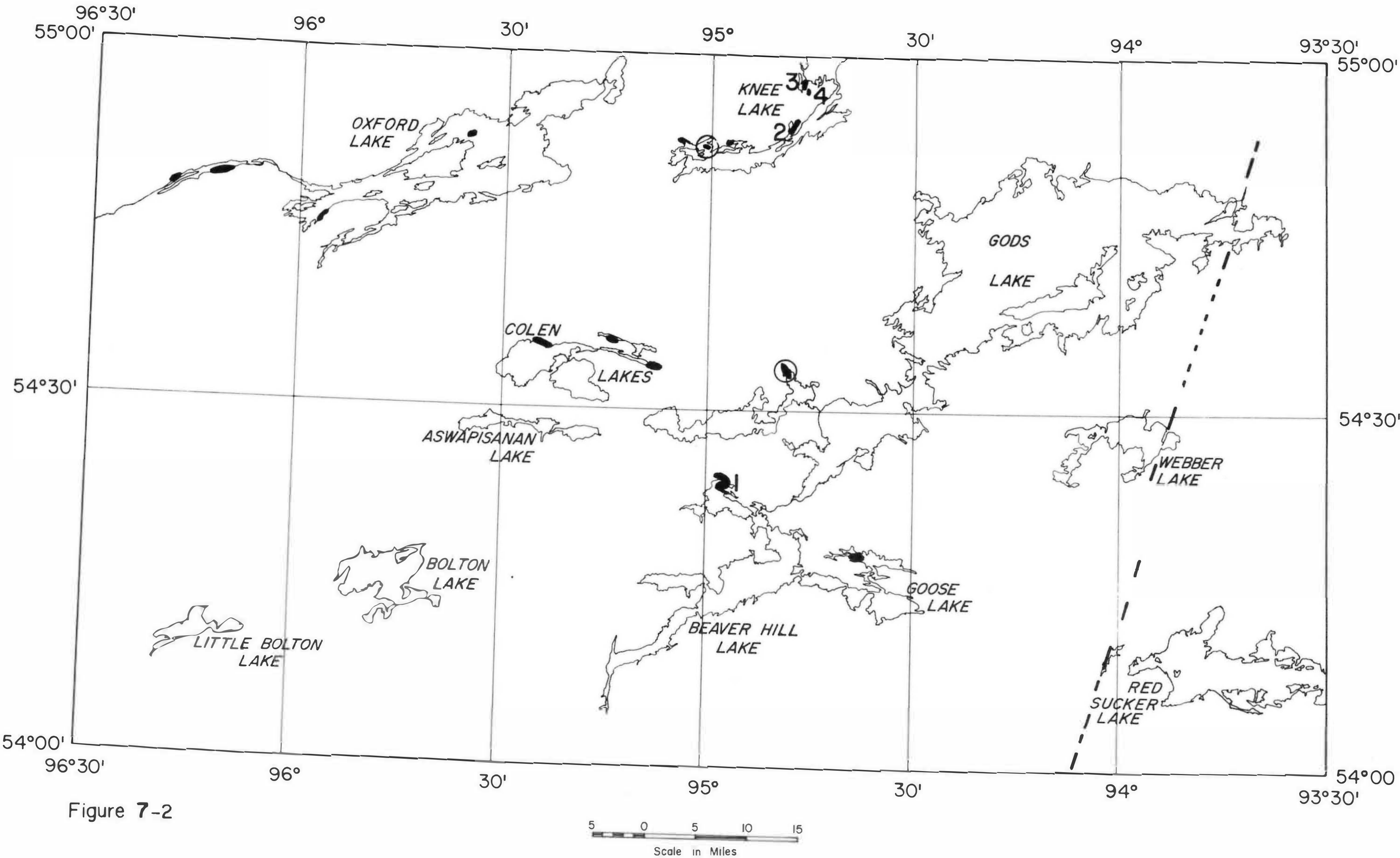


Figure 7-2

Location of Gods Lake Area Ultramafic and Gabbroic Rocks

Ultramafic and/or gabbroic rocks

Ultramafic rocks reported in cancelled assessment files

FOX RIVER DRILL CORE STUDIES

The International Nickel Company of Canada Limited has generously arranged for the Manitoba Mines Branch to have access to the diamond drill core recovered from the Fox River sill. Detailed studies can now be made of this very large ultramafic complex. To date, drill core, representing approximately 30,000 feet of drilling has been examined and sampled. Statements on the structure and lithologic variation in the complex must however await further data compilation.

References

Elbers, F.J., and Campbell, F.H.A.
1971: Kanuchuan Rapids; *Man. Mines Br.*, Prelim. Map 1971H-12.
Macek, J.J., and Trueman, D.L.
1972: Beaver Hill Lake mafic complex; *Man. Mines Br.*, Prelim. Map 1972A-1.
Scoates, R.F.J.
1971: Ultramafic Rocks Project; *in* Summary of Geological Field Work; *Man. Mines Br.*, Geol. Paper 6/71.

(8) BIRD RIVER AREA

(52L-5, 6, 11, 12)

by D.L. Trueman

In 1972 field work was conducted in the Bird River area to facilitate compilation of the geology (Trueman, 1972) and to aid in the understanding of the geological environment of the Bird River sill (Trueman and Macek, 1971). The field work was combined with a compilation of existing maps and information contained in the cancelled assessment files of the Manitoba Mines Branch.

Precambrian metavolcanic and metasedimentary rocks in the map-area form an anastomosing greenstone belt that extends from under drift-cover in the Lac du Bonnet area eastwards into Ontario. The north and south limits of the greenstone belt lie in the Cat Creek-Maskwa River and Winnipeg River areas respectively, and the greenstone belt appears to lie within the boundaries of the English River Gneissic Belt.

Significant results of the present study (see also Preliminary Map 1972F-1 (Trueman, 1972)) are presented below.

1) Metavolcanic rocks in the Cat Lake area and the area north of Bird River consist predominantly of pillow lavas with minor tuffaceous intercalations. South of Bird River the metavolcanic pile displays a marked increase in the amounts of fragmental and tuffaceous rocks.
2) Rocks previously mapped in the Osis Lake-Ryerson Lake area as sediments (Springer, 1948), and included in later maps as volcanic (Davies, 1957), are fragmental volcanics, tuffs, and volcanic wackes.
3) Intermediate to acid volcanic rocks appear to be absent.
4) Many small map-units previously considered to be volcanic lavas, are featureless thickly bedded greywackes.
5) Conglomerate, containing trondhjemite clasts in the Booster Lake area changes facies near Bird Lake into a volcanic clast conglomerate. The latter marks the metavolcanic-metasediment contact to the west of central Bird Lake. The trondhjemite clast conglomerate also outcrops north of Davidson Lake and may reflect the closure of the Cat Lake-Bird River anticline.
6) Metamorphosed wackes and sandstones form the core of the Bird River syncline and exhibit passive folding in which bedding is oblique to the regional foliation.
7) Doming and warping of layering and foliation has occurred around the margins of the quartz diorite pluton centred on Birse Lake. Fractures and faults related to doming in the Cat Lake-Bird River anticline appear to have served as intrusion sites for later diabase dykes.
8) Pegmatite and pegmatitic granite in the Osis Lake area exhibit zoning parallel in attitude to layering and foliation of the host rocks. As deformation of these greenstones appears related to the intrusion of the major plutons it is suggested that the pegmatite and pegmatitic granite predate or are synchronous with the plutons.
9) Intrusion of the quartz diorite in the Marijane Lake area has resulted in an antiformal structure in the Booster Lake area (C.F. Lamb, personal communication). This event has in turn deformed the Bird River syncline so that its axial trace now passes through Booster Lake.

References

Davies, J.F.
1957: Geology of the Winnipeg River area; *Man. Mines Br.*, Publ. 56-1.
Springer, G.D.
1948: Geology of the Cat Lake-Winnipeg River area; *Man. Mines Br.*, Publ. 48-7.
Trueman, D.L.
1972: Geological compilation map of the Bird River area; *Man. Mines Br.*, Prelim. Map 1972F-1.
Trueman, D.L., and Macek, J.J.
1971: Geology of the Bird River Sill; *Man. Mines Br.*, Prelim. Map 1971A-1.

(9) PEGMATITE PROJECT

by B.B. Bannatyne

A study of pegmatites containing rare element minerals was begun in the summer of 1972. Field studies were made of 67 pegmatites in the Falcon Lake, Winnipeg River, Bernic Lake and Bird Lake areas (Figure 9-1). The more significant surface pegmatites were mapped in detail on scales ranging from 1 inch to 10 feet to 1 inch to 50 feet; other pegmatites were sampled, and zoning, mineralogy, dimensions, and field relationships were noted. Geological information was obtained on two major subsurface pegmatites in the Bernic Lake area.

a) Falcon Lake-West Hawk Lake Area

The spodumene-beryl-blue tourmaline Lucy pegmatite (1)* was mapped in detail. A major part of the outcrop consists of an aplitic phase, in places banded, and cut by tourmaline-quartz-feldspar stringers. Evidence of late alteration of spodumene and feldspar was noted in parts of the deposit.

The Molly pegmatite (3), and the Bendum pegmatite (3) along strike to the east, both originally contained large clusters of molybdenite flakes. Molybdenite was noted mainly in broken rock around pits in the pegmatites.

The 'Deer' pegmatite (8) near Crescent Beach, West Hawk Lake, was mapped and the outcrop was correlated with results from 10 drill holes. The dyke contains lepidolite and some spodumene.

Some of the reported radioactive occurrences in the Caddy Lake-Telford area were located. They occur along a complex contact zone between granodiorite and gneissic to schistose metasediments. The 'pegmatites' observed consist of irregular masses of coarse-grained granite and pegmatite within or near the contact zone. Radioactive minerals are sparsely distributed; some molybdenite was noted in two deposits (15, 12).

b) Winnipeg River-Greer Lake Area

Beryl pegmatites were observed in a belt extending from the K-1 claim (23) north of Pointe du Bois, eastward to near Pine Island (44) at the north end of Eaglenest Lake. The dykes are characterized by a lack of or only a small amount of tourmaline. The major beryl dykes are concentrated around the pegmatitic and banded aplitic leucogranite pluton in the Greer Lake area. Lithium mineralization occurs in several dykes, notably the Silver Leaf (37: spodumene, lepidolite, amblygonite) and the Top of the World (36: lithian muscovite) deposits. The pegmatite on the Grace 1 claim (32) contains abundant large beryl crystals, and is well zoned. Columbite-tantalite is a major accessory mineral in the Huron pegmatite (39) and is present in some of the pegmatites south of Greer Lake.

Only a brief examination of the Shatford Lake pegmatites (52 to 61) was made this year; more detailed work on the beryl-zinnwaldite-monazite dykes will be carried out at a later date. Some tantalite-columbite mineralization is also present in this area.

c) Bernic Lake-Rush Lake-Osis Lake Areas

The complexly zoned Tanco pegmatite (65), with ore concentrations of lithium, cesium, and tantalum minerals, is one of the major pegmatites of the world. Numerous studies, including detailed work by a group of mineralogists at the Department of Earth Sciences, University of Manitoba, have outlined the zonal structure and the variety of minerals present (Crouse and Černý, 1972). Recent drilling has extended the known limits of tantalum mineralization in a pegmatite underlying the main deposit. Small pegmatites exposed at surface showed cassiterite and beryl mineralization (62, 63).

---

* Numbers in parentheses refer to the pegmatite locations shown in Figure 9-1.

At the east end of Bernic Lake, petalite is abundant in one small surface pegmatite (74), and also in a large sheet-like subsurface pegmatite (75) which has a persistent shallow dip to the west; other lithium minerals, but only minor beryl, have been noted in this deposit. Eight other surface pegmatites containing lithium minerals and beryl are known; the easternmost pegmatites (70, 71) probably represent the outcrop of the main subsurface pegmatite. Some of the surface pegmatites are characterized by abundant tourmaline at their upper contact; in the subsurface pegmatite it is the footwall zone that has abundant tourmaline. Core from a 1956 drill programme was examined to determine the zonal structure of this pegmatite.

Other tourmaline-bearing dykes are present in the area west and north of Rush Lake. Spodumene (78), lepidolite (77), cassiterite (Odd (80) and Stannite (78) pegmatites), and a strongly radioactive mineral (one sample only, noted northwest of Rush Lake (77)) occur in this area. Only minor beryl mineralization was noted in the Rush Lake-Osis Lake area. Abundant tourmaline is present in pegmatitic-aplitic granite plutons east and northeast of Osis Lake. A zoned pegmatite with a core of rose quartz (85) outcrops on the Rose claim, near Birse Lake.

d) Bird River Area

Pegmatites containing both green and white spodumene outcrop southwest of the Bird River bridge (47, 48). The dykes have been deformed subsequent to their crystallization. Other pegmatites containing beryl, spodumene and molybdenite occur in the area (45, 46, 50).

Numerous reports on the pegmatites and regional geology of southeastern Manitoba have been published. The most recent pegmatite studies are those by Černý and Turnock (1971), and by Crouse and Černý (1972) to which the reader is referred for lists of references and descriptions of some rare minerals.

References

Černý, P., and Turnock, A.C.
1971: Pegmatites of southeastern Manitoba; *in* Geoscience Studies in Manitoba; *Geol. Assoc. Can.*, Special Paper No. 9: 119-127.

Crouse, R., and Černý, P.
1972: The Tanco pegmatite at Bernic Lake, Manitoba; I: Geology and paragenesis; *Can. Mineralogist*, 11: 591-608. (The same volume contains 7 other papers on mineralogical studies of the Tanco pegmatite, 609-727, and a bibliography, 728-734.)

RARE ELEMENT MINERALS IN PEGMATITES

Falcon Lake area: (Pegmatites 1 to 17)

1, 2	Spodumene, beryl
3, 4, 5, 6	Molybdenite
7, 8, 9	Li-minerals
10, 11, 13, 14, 16	Radioactive minerals
12, 15	Radioactive minerals (molybdenite)
17	Beryl

Winnipeg River-Greer Lake area: (18 to 44)

18 to 23, 28, 33, 35, 40, 42 to 44	Beryl
24, 25	Beryl (Nb-Ta, Sn)
26, 27, 29 to 32, 38	Beryl, (Nb-Ta)
34	Feldspar quarry
36	Beryl, Li-Mica (Sn)
37	Li-minerals (beryl, topaz, radioactive minerals)
39	Beryl, Nb-Ta, radioactive minerals
41	Beryl, Li-mica (Sn)

Bird River-Shatford Lake area: (45 to 61)

45 to 48, 52 to 54, 57, 58, 60, 61	Beryl
50	Beryl, molybdenite
51, 59	Cassiterite
55, 56	Beryl, Li-mica, topaz (Nb-Ta)

Bernic Lake area: (62 to 75)

62, 69	Cassiterite
63, 72	Beryl
65	(TANCO) Ta, Cs, Li, Rb, Be, Sn, Ge, Ga
66, 67, 74	Li-minerals
68	Li-minerals, beryl, cassiterite
70, 71, 73, 75	Li-minerals, beryl

Rush Lake-Birse Lake area: (76 to 85)

76, 77, 78	Cassiterite, Li-minerals (beryl)
77	(Radioactive minerals)
79	(Beryl)
80	Cassiterite
84, 85	Rose quartz

Maskwa Lake-Cat Lake-Cole Lake area: (86 to 93)

86, 87	Spodumene (Cs)
88, 89, 90, 91	Spodumene, beryl
92, 93	Molybdenite

Note: Minor occurrences of minerals containing the following elements have been reported (see Černý and Turnock, 1971, and their references): B, F, P, Ti, Zn, As, Sr, Y, Zr, Sn, Rare earths, and Bi.

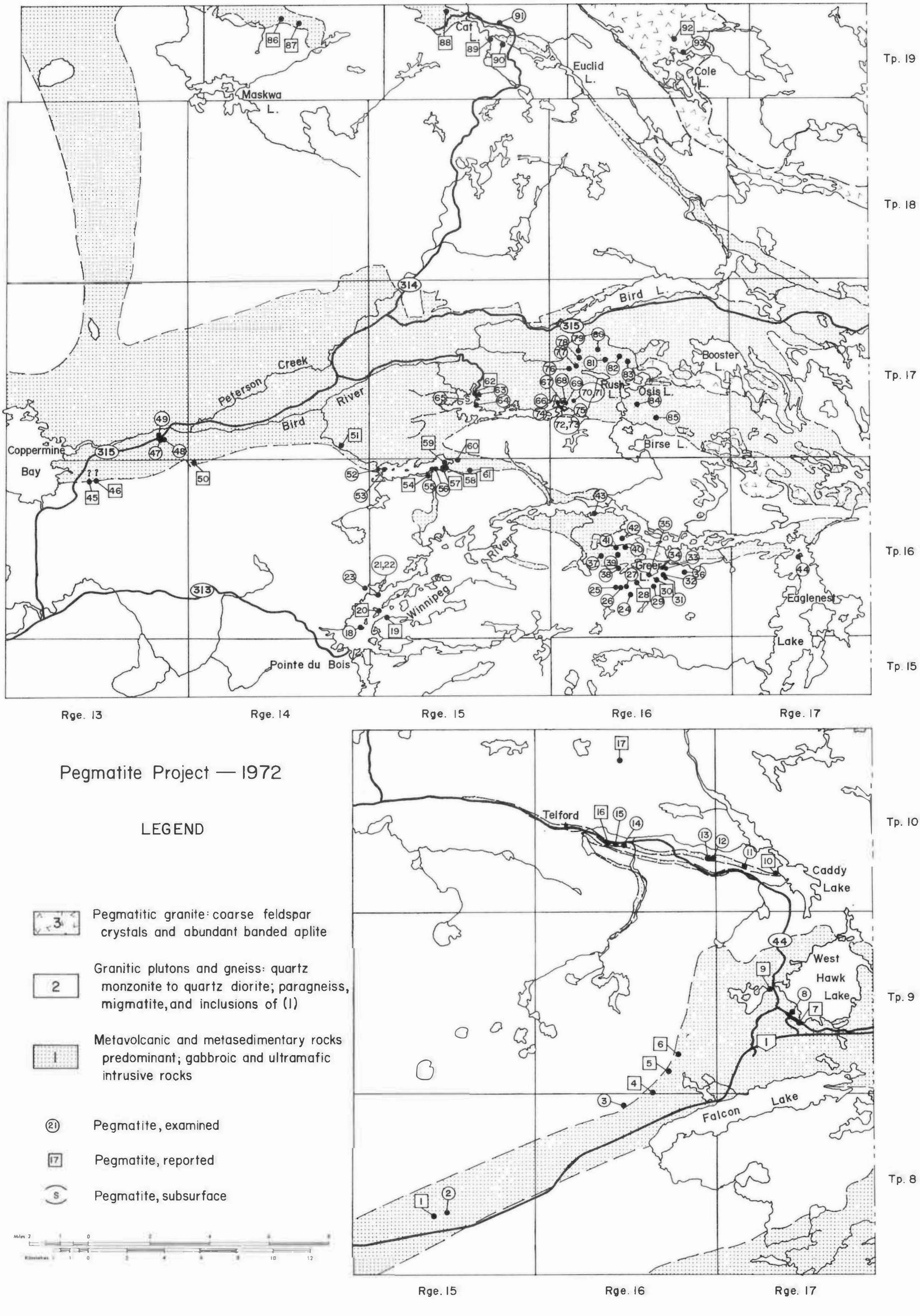


Figure 9-1: Pegmatites of the Falcon Lake — Winnipeg River — Bird Lake area

(10) JEN PEG PROJECT

(63J-8)

by K.A. Phillips

The object of the Jen Peg Project is to record and describe outcrops along the West Channel of the Nelson River that will be submerged when the Jen Peg hydro-electric scheme becomes operational. Relevant parts of the Channel that fall within sheet 63J-8 were thus mapped by shorelining during the summer of 1972. The effective limits of the field work were Metchanais Rapids, Kisipachewuk Rapids, Whiskey Jack Narrows and Manitou Rapids. The latter is situated near the northeast corner of the area and is one of a series of rapids that persist three miles north to the West Channel's outlet into Cross Lake where the Jen Peg dam is sited. The Cross Lake area was mapped by Rousell (1965), but the regions east, west and south of Metchanais Rapids are not well known geologically. The 1972 shorelining was extended about eight miles southwest of the West Channel into Kiskitto Lake in order to obtain supplementary data. In this way a northeast-trending zone twenty-six miles in length with an average width of about one and one-half miles was surveyed by the writer assisted by M. Milinkovic. In the following field summary, numbers in brackets refer to provisional map-units on Preliminary Map 1972L-1 (Phillips, 1972).

The principal topographic lineaments trend northeast and appear to be mainly controlled by faulting; subsidiary cross-faults are also common. Most of the rocks appear to be metamorphosed igneous types, and variable granitization effects are widespread. Near the southwest corner of the area meta-gabbro (1) is exposed on islands and on the north shore of Kiskitto Lake; these outcrops are believed to be located near the southern margin of a large basic mass suggested by a high aeromagnetic anomaly five miles to the north (Aeromagnetic Map 2588G). The gabbro contains partly absorbed inclusions of coarse anorthositic appearance. In places it is cut by veins of quartz and pink pegmatite, and garnets were observed locally. Dioritic rocks (2) near the meta-gabbro show more pronounced alteration owing to larger pegmatite intrusions. Small amphibolitic bodies, rarely large enough to map (3), are very common as relict bands and lenses in tonalite and granodiorite throughout the area. Mafic gneisses (4), that show marked colour banding owing to subsidiary felsic layers, are closely associated with the Kiskitto Lake meta-gabbro and diorite, and may possibly represent a marginal phase of the basic mass. One belt of the mafic gneisses (4) over ten miles in length strikes northeast through Kiskitto Lake and has an average width of one-half mile to one mile; it is separated from another belt, mapped north of Kisipachewuk Rapids, by a wedge of younger granodiorite. The latter belt (4), traced northeast along the West Channel for over six miles, contains abundant angular xenoliths of anorthositic gabbro, some of them a few metres in diameter; the xenoliths consist largely of coarse euhedral plagioclase crystals, commonly several centimetres in length. Remnants of mafic gneiss (4), rarely more than a mile in length, are common further northeast between Metchanais Rapids and Whiskey Jack Narrows. The predominant rock in this part of the West Channel, however, is a massive, grey, medium-grained feldspar porphyry (5) that weathers uniformly pale grey. From the general vicinity of Metchanais Rapids this map-unit (5) was traced northeast for about twelve miles to a point in the West Channel two and one-half miles south of Cross Lake where it was mapped by Rousell (1965) as feldspar porphyry gneiss. The rock is characterized by disseminated, euhedral, grey to buff feldspar porphyroblasts up to 2.5 cm in diameter; the groundmass is medium grained, quartzo-feldspathic and considerably foliated. Cataclastic effects in this unit include incipient compositional layering due to segregation of quartz into elongated aggregates, darkening of the matrix due to comminuted biotite, and formation of augen gneiss in restricted zones. Preliminary tests indicate major oligoclase and quartz with minor microcline and biotite, and a typical specific gravity of about 2.67. Some portions of the rock are more basic however, particularly where interlayered remnants of mafic gneiss (4) occur. All the preceding map-units have been slightly to highly granitized, with effects that range from minor pegmatite veining to partial assimilation.

The extensive granitic intrusions that occur in the area range in composition from tonalite to granite (6, 7). The tonalite/granodiorite (6) is a grey, medium to coarse-grained rock; it is particularly well exposed west of Metchanais Rapids. It is commonly gneissic and contains feldspar phenocrysts, up to 2.5 cm in length, which locally show a preferred orientation parallel to the foliation. The phenocrysts have been identified in thin section as altered calcic oligoclase; the groundmass of the rock consists of quartz, plagioclase, microcline (minor), biotite and hornblende. Elongated lenses of amphibolite, 3 metres or more in length, are common in the tonalitic rocks (6). The tonalite grades through granodiorite to coarse biotite-granite (7). Granite to granodiorite (7) which is well exposed two and one-half miles northwest of Kisipachewuk Rapids, contains pink phenocrysts (2.5 cm or more in diameter) of both microcline and sodic oligoclase.

References

Phillips, K.A.
1972: Metchanais Rapids; *Man. Mines Br.*, Prelim. Map 1972L-1. (1:50,000)

Rousell, D.H.
1965: Geology of the Cross Lake area; *Man. Mines Br.*, Publ. 62-4.

(11) STRATIGRAPHIC MAPPING

by H.R. McCabe

Stratigraphic mapping during 1972 involved examination of 154 outcrops of Devonian formations, mainly on and near the shores of Lakes Manitoba and Winnipegosis, from the area of The Narrows northwest to Dawson Bay (Figure 12-1). The purpose of the project was three-fold:

i) to familiarize the writer with the outcrop geology, particularly the structural setting;

ii) to obtain a detailed set of lithologic samples from all outcrops. One set of samples will be retained for geochemical (trace element) analyses to assess the possible potential for mineral deposits. A second set of samples will be used as a reference set for detailed lithologic correlation with samples obtained from the stratigraphic core hole programme;

iii) to obtain samples from salt springs and salt meadows along the Devonian outcrop belt. Water and/or soil samples obtained from 22 locations will be analyzed for trace element content.

A preliminary review of sample data indicates that, for most outcrops, fairly close stratigraphic correlation with available core holes is possible ($\pm$ 20 feet). However, a number of "anomalous" outcrops were noted; in these, the lithology indicates a markedly different stratigraphic position from that of nearby outcrops. Tentative stratigraphic correlations were made with these "anomalous" outcrops solely on the basis of lithology, and follow-up core holes were drilled at some locations. In most instances, core hole data indicated that the tentative correlations were correct (see report on Stratigraphic Core Hole Programme, this publication), but some problems became evident because of repetition of certain lithologies in several different stratigraphic units (e.g. hole M-6-72).

Outcrops of reefal Winnipegosis Formation generally pose no problem; they comprise hard, vuggy, variably fossiliferous dolomites occurring as isolated topographic domes — either massive or showing faint domal bedding. However, outcrops of massive to bedded fine granular dolomites are much more difficult to correlate. Prior to the Mines Branch stratigraphic core hole programme, the existence of extensive granular dolomite units other than those in the Winnipegosis Formation was virtually unknown. Drilling, however, has shown that several such dolomite units are present, both in the Dawson Bay and Souris River Formations. Consequently, correlation of some of the previously reported Winnipegosis dolomites may be open to question. Laboratory studies of these dolomites will be undertaken to determine whether significant lithological differences exist among these various dolomites.

The brachiopod biomicrite limestone of the middle Dawson Bay Formation (B member) has proved to be one of the most consistent, and also the most common of the Devonian outcrop units. It occurs for the most part as structural-topographic domes, with the structural configuration apparently preserved because of selective erosion of the overlying soft shaly beds.

The red or green calcareous fossiliferous shales of the middle Dawson Bay Formation (C member) are known only from one or two outcrops, but core hole drilling has shown this unit to be the most persistent, diagnostic and uniform of any of the Devonian strata in the outcrop belt. This unit provided the marker or target horizon for much of the core hole drilling. It must be noted, however, that this unit appears to be limited to the general area of the outcrop belt and does not extend for any great distance to the southwest.

The upper Dawson Bay Formation (D member) consists primarily of saccharoidal dolomite with widespread but discontinuous development of a dense, hard, stromatoporoid-coral limestone facies. Outcrops are limited primarily to the resistant limestone facies, although as noted above, some of the "Winnipegosis" type dolomites may in fact belong to this unit.

The stromatoporoid beds were thought to be quite distinctive and diagnostic of this unit, but core hole M-6-72 showed that a virtually identical sequence of stromatoporoid limestone/ saccharoidal dolomite also occurs in places in the overlying Souris River strata. Correlation of these stromatoporoid beds on a purely lithologic basis is thus open to doubt in some areas.

Souris River strata in the northern, Mafeking, area show a relatively uniform lithology, comprising a reasonably distinctive sublithographic fossiliferous micrite. A small outcrop of Souris River type micrite was noted 8 miles north of the previously defined limit of the Souris River outcrop belt, almost at the limit of the known occurrence of Dawson Bay strata. Drilling at this locality (M-11-72) confirmed the lithologic correlation and indicated a minimum local structural relief of at least 220 feet. To the south, however, in the Winnipegosis area, the Souris River strata are markedly different and consist of a highly variable sequence of dolomites, stromatoporoid and coral limestones, etc. At present, lithologic correlation of stratigraphic units within the Souris River Formation is not possible in this area.

Microfossil (spore) studies of black lignitic shales recovered from Husky Baden Core Hole No. 2 (4-33-44-26) indicate a Lower Cretaceous (Aptian) age (A.W. Norris, personal communication). This hole was located north of the presumed Cretaceous/Devonian contact. From 125 feet to as much as 300 feet of shale, siltstone and sandstone were encountered in three of the four Husky holes drilled in this area. This indicates relief of up to 300 feet on the pre-Mesozoic erosion surface in this area. This "structure" may be due to either late solution of salt from the Devonian Prairie Evaporite, or deep erosional channeling of the Devonian strata. Such channeling would further complicate the already complex pattern of the Devonian outcrop belt.

In summary, outcrop and core hole data acquired during 1972 confirm the extreme structural irregularity of the Devonian outcrop belt, and indicate the possibility of local structural relief of at least 220 feet throughout the outcrop belt, from Meadow Portage to Dawson Bay. Because of this extreme irregularity, it appears unlikely that an accurate structural or outcrop map of the Devonian formations can be compiled with the data available, despite the fact that 75 per cent or more of the known outcrops can be correlated to within about 15 or 20 feet of true stratigraphic position.

Future mapping and core hole drilling for the Devonian project will be directed primarily towards the more remote areas such as the northeastern part of Lake Winnipegosis, the Swan Lake area, and the area of sparse outcrop between Winnipegosis and Dawson Bay. In addition a number of other areas of probable outcrop remain to be checked in the Winnipegosis-Meadow Portage-Toutes Aides area.

SUBSURFACE STRATIGRAPHIC STUDIES

by H.R. McCabe

As of September, 10 oil well test holes had been licensed in Manitoba during 1972; none of these was completed as a producer. Data for 9 wells were released from confidential file and will be added to the Stratigraphic Map Series. Three of these wells tested pre-Mississippian strata, and one of them, Whitebear Creek, was drilled on the shore of Hudson Bay. This well was completely cored, and encountered Precambrian basement at an unexpectedly shallow depth of 1,298 feet; the depth to basement had been estimated as being up to 3,100 feet. No oil shows were reported.

Core and/or samples were received for 6 oil wells; these were processed, and added to the Mines Branch Core and Sample Library located on the University of Manitoba campus. A large volume of Precambrian field samples were also added to the Library, as well as Paleozoic cores from a number of mineral exploration holes in the Grand Rapids area. Part of the Core Library building has now been reconstructed to provide improved core and sample examination and processing facilities.

Selected core and outcrop samples of Ordovician strata are being examined by Dr. C.R. Barnes, University of Waterloo, for microfossil (conodont) content. Results of these studies will be released at a later date.

(12) STRATIGRAPHIC CORE HOLE PROGRAMME

by H.R. McCabe

The stratigraphic core hole programme is a continuing Mines Branch project, which was initiated in 1969. During the period June 2 to September 2, 11 core holes were drilled for a total of 1,072 feet. Cumulative drilling since 1969 now amounts to 49 holes for a total of 4,946 feet. In general, holes drilled in 1972 were designed to fill in some of the remaining gaps in the Devonian stratigraphic column, to delineate possible facies changes in the various stratigraphic units, and to check specific outcrops where correlation was uncertain. Table 12-1 and Figures 12-1 and 12-2 summarize the drilling results. Pump tests were taken for all core holes and water samples retained for geochemical analysis.

Hole 1 was drilled to check on the relationship between the Elm Point and Winnipegosis Formations. Previous data had suggested that the Elm Point limestone was an inter-reef facies and probably was not present beneath the Winnipegosis reefs. The hole was collared in reef flank dolomites of the Rosehill reef. Mottled calcareous dolomite and dolomitic limestone was intersected at 88 feet; these beds are similar in appearance to the Elm Point limestone, but show a much higher degree of dolomitization. It thus seems probable that the Elm Point "facies" is an older platform type of deposit on which the younger Winnipegosis reefs were developed; however, a much higher degree of dolomitization of Elm Point strata has occurred in the vicinity of the reefs.

Holes 2 and 3 were drilled to intersect a maximum thickness of Souris River strata. The outcrop at this location is the most southwesterly outcrop known, and hence potentially the highest or youngest occurrence of Devonian strata in the outcrop belt. The lithology of the outcropping dolomite is not distinctive or diagnostic. Poor ground conditions caused abandonment of Hole 2, but Hole 3, at the same location, encountered a relatively thin section of Souris River strata, indicating that the area is structurally high.

Hole 4 was drilled in a structurally complex area at the town of Winnipegosis. The outcropping strata show a dip of approximately 45 degrees, and the limestone lithology is not diagnostic. Core recovery indicated a continuation of the structural deformation at depth, with some extreme brecciation. A relatively thick succession of Souris River strata was intersected, but no marker beds were encountered before poor ground conditions necessitated abandonment of the hole. This area is structurally low despite the presence of structural domes in the area.

Hole 5 was drilled to obtain additional samples of the upper Dawson Bay Formation (D member) and to check for lithofacies changes in this unit.

Hole 6 was drilled to check one of the more eastern occurrences of what was thought to be the upper Dawson Bay stromatoporoid limestone and dolomite unit (D member). In this case, the postulated correlations proved to be incorrect, and the outcropping strata were found to comprise a sequence of Souris River beds essentially identical in lithology to the upper Dawson Bay beds. The latter beds were intersected at a depth of 52 feet.

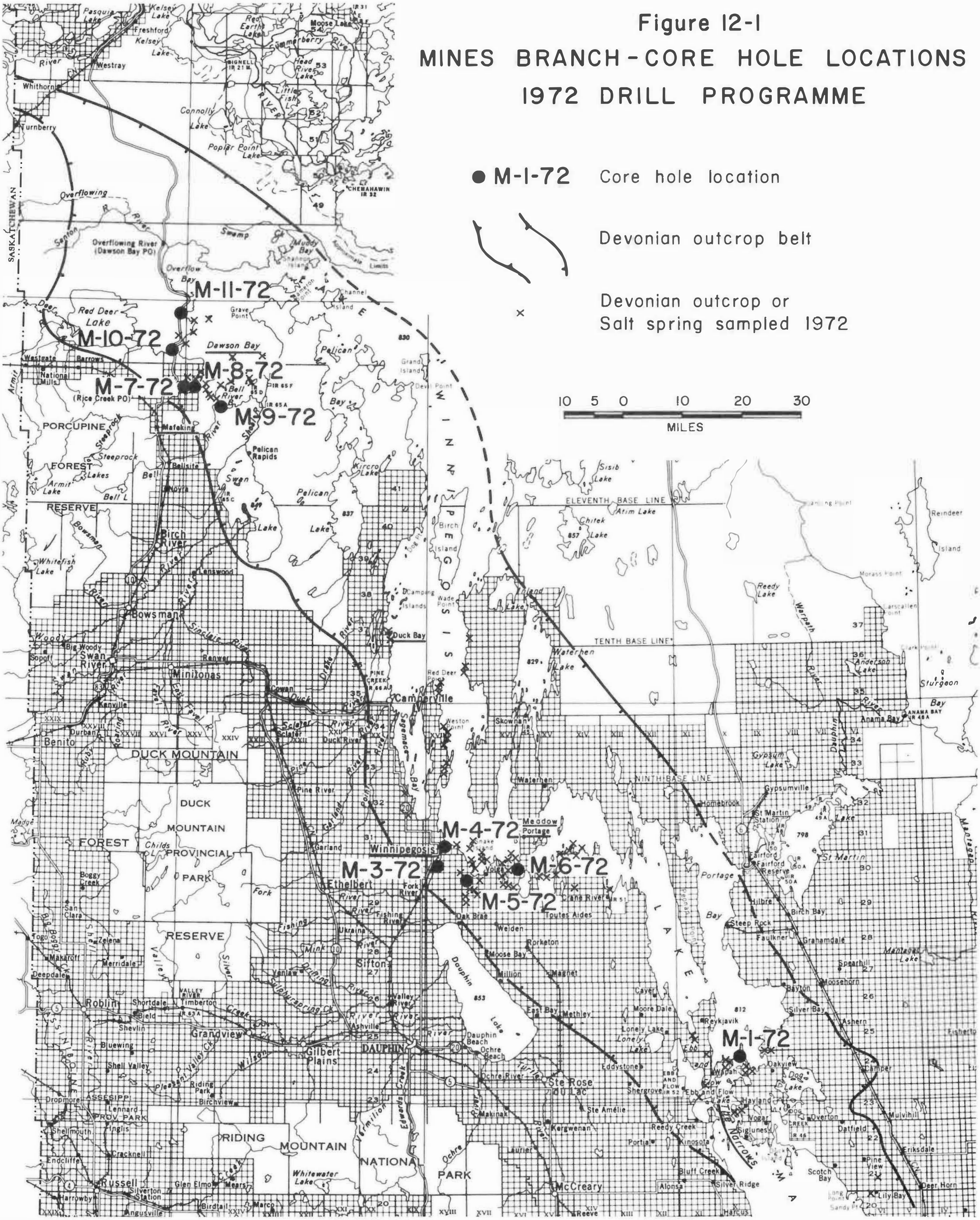
Hole 7 was collared in beds correlated lithologically with the upper Dawson Bay limestone (D member), and was drilled to obtain an almost complete section of the Dawson Bay Formation; the lithologic correlations proved to be correct, and a complete section was obtained down to the top of the Winnipegosis Formation.

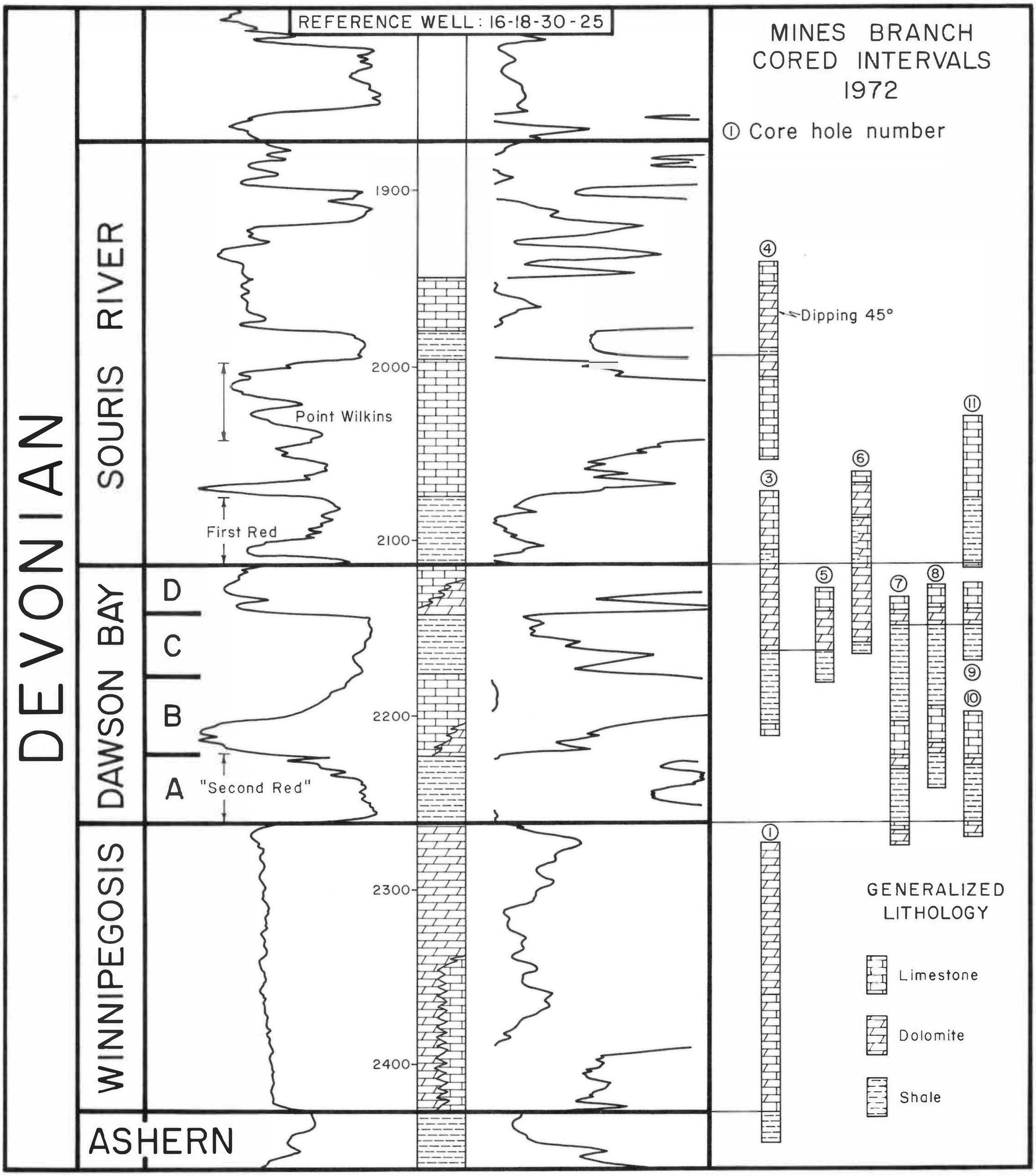
Hole 8 was drilled on the flank of a structural-topographic dome consisting of lower Dawson Bay limestone (B member). Dip on the flank of the dome is approximately 20 degrees, and the hole was located about 250 yards from the crest of the dome, in what appeared to be upper Dawson Bay limestone. Drill results confirmed the lithologic correlation and indicated a minimum local structural relief of 140 feet for the dome.

TABLE 12-1. CORE HOLE DATA

Hole No.	Location and Approximate Elevation	Formation	Interval	Summary Lithology
M-1-72	16-26-24-10W	Winnipegosis	0-88	Saccharoidal dolomite
	820 feet	Elm Point (?)	88-154	Dolomitic limestone, calcareous dolomite
		Ashern	154-171	Shale, red and grey
M-2-72	SE2-29-30-18 W	Souris River	0-24	Dolomite
	860 feet			(Hole abandoned in broken ground)
M-3-72	SE2-28-30-18W	Souris River	0-35	Dolomite, limestone
	860 feet	(First Red)	35-42	Shale, limestone, dolomite
		Dawson Bay (D)	42-94	Dolomite, saccharoidal
		(C)	94-137	Calcareous shale
		(B)	137-141	Limestone, biomicrite
M-4-72	C2-10-31-18W	Souris River	0-16	Limestone
	840 feet		16-50	Dolomite
			50-55	Shale
		(Point Wilkins ?)	55-68	Dolomite
			68-114	Limestone
M-5-72	SE9-7-30-17W	Dawson Bay (D)	0-14	Limestone
	855 feet		14-34	Dolomite
		(C)	34-53	Calcareous shale
M-6-72	10-22-30-16W	Souris River	0-7	Limestone
	845 feet		7-27	Dolomite
		(First Red)	27-52	Shale, argillaceous dolomite, limestone
		Dawson Bay (D)	52-99	Dolomite, minor limestone
		(C)	99-106	Calcareous shale
M-7-72	NW7-14-44-25W	Dawson Bay (D)	0-9	Limestone
	905 feet		9-17	Dolomite
		(C)	17-72	Calcareous shale, argillaceous limestone
		(B)	72-91	Limestone, biomicrite
			91-100	Dolomite, argillaceous
		(Second Red) (A)	100-130	Shale, red and grey
		Winnipegosis	130-136	Limestone, shale
			136-142	Dolomite
M-8-72	SW5-13-44-25W	Dawson Bay (D)	0-13	Limestone
	835 feet		13-22	Dolomite
		(C)	22-69	Calcareous shale, fossiliferous
		(B)	69-91	Limestone, biomicrite
			91-97	Dolomite, argillaceous dolomite
		(Second Red) (A)	97-117	Shale, red and grey
M-9-72	NW16-27-43-24W	Dawson Bay (D)	0-15	Limestone, strome
	890 feet		15-23	Dolomite, limestone
		(B)	23-44	Calcareous shale, grey
M-10-72	NW8-17-45-25W	Dawson Bay (B)	0-27	Limestone, biomicrite
	850 feet		27-30	Dolomite
		(Second Red) (A)	30-62	Shale, grey and red
		Winnipegosis	62-72	Limestone
M-11-72	NW2-21-46-25W	Souris River	0-47	Limestone, argillaceous limestone
	875 feet	(First Red)	47-86	Red and black shale
		Dawson Bay (D)	86-88	Limestone

Figure 12-1
MINES BRANCH - CORE HOLE LOCATIONS
1972 DRILL PROGRAMME





REFERENCE WELL: 16-18-30-25
MINES BRANCH
CORED INTERVALS
1972
① Core hole number
DEVONIAN
SOURIS RIVER
DAWSON BAY
WINNIPEGOSIS
ASHERN
D
C
B
A
1900
2000
2100
2200
2300
2400
Point Wilkins
First Red
"Second Red"
Dipping 45°
GENERALIZED
LITHOLOGY
Limestone
Dolomite
Shale

Figure 12-2

Hole 9 was located on a small outcrop that was correlated lithologically with the upper Dawson Bay limestone. This location is within an area characterized by numerous structural topographic domes all consisting of lower Dawson Bay limestones. Core data confirmed that the outcropping beds belong to the upper member of the Dawson Bay Formation, and indicated the possibility that much of the area between the lower Dawson Bay domes may be underlain by upper Dawson Bay beds or possibly even Souris River beds.

Hole 10 was drilled to locate more accurately the stratigraphic position of the fossiliferous limestones used by McCammon (1960) as one of the reference sections in her study of the fauna of the Manitoba Group. Core confirmed that these beds belong to the lower part of the Dawson Bay Formation (B member).

Hole 11 was drilled to check what appeared to be an outlier of Souris River strata occurring near the northern limit of the Dawson Bay outcrop belt. Drill results confirmed the presence of strata correlative with the Point Wilkins Member of the Souris River Formation. The proximity of this outcrop to the outcrop belt of the Winnipegosis Formation provides a good indication of the structural complexity of this area.

Reference

McCammon, Helen
1965: Fauna of the Manitoba Group; *Man. Mines Br.*, Publ. 59-6.

(13) PLEISTOCENE GEOLOGY OF THE PONTON-GRAND RAPIDS AREA

by S. Ringrose

A six-week field programme was carried out to complement the results of the previous year's work (Ringrose, 1971). An age determination on shell material from the Minago Beach ridge, indicating a younger age than what would have been expected from previous work, will result in a revised chronology for the late stages of glacial Lake Agassiz in north central Manitoba.

Washed end moraine material was noted in the Soab Lake area, and contorted and faulted deposits are interpreted as possibly resulting from differential melting of an ice core.

The speculative glacial chronology of the area as determined to date may be summarized as follows:

Stage 1 Ice-front position stationary at The Pas moraine, (?) Valders age, 10,700 B.P.; glacial Lake Agassiz at the Campbell Beach level.

Stage 2 Ice-front position at Minago moraine for brief period, about 8,000 B.P.; water level at 1060-1075 feet; thick late clays deposited to the south.

Stage 3 Laurentide lobe becomes bi-lobate; Reindeer Lake lobe to the north; the eastern lobe also split, following the Nelson River and Churchill River valleys; maximum northern extent of glacial lake(s); formation on Minago Beach ridge.

Stage 4 Re-advance of Nelson sub-lobe; increase in water level, and possible overspill channel draining southwest utilizing part of the Minago River system; some contortion of previous deposits; formation of Pipun moraine-delta complex.

Stage 5 Ice stagnation, probably until 7,000 B.P.; deposition of bedded silts and gravels over till; gradual decrease in glacial lake area.

Reference

Ringrose, Susan
1971: A study of late glacial deposits in the Grand Rapids-Ponton area; *Man. Mines Br.*, Geol. Paper 6/71, 66-68.