GP4/70

MANITOBA

GEOLOGICAL SURVEY

MINES BRANCH

DEPARTMENT OF MINES AND NATURAL RESOURCES

SUMMARY OF GEOLOGICAL FIELD WORK 1970

Geological Paper 4/70

Winnipeg 1970

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PREFACE

We are pleased to present the third of our annual summaries of field work. The expanded scale of our projects begun in 1969 continued into 1970 and is reflected once again in the broad range of activities presented below.

Precambrian field investigations in 1970 were concerned mostly with the completion or continuation of projects carried over from 1969. Twelve field parties operated for the duration of the summer, ten of them on the Southern Indian Lake project whose field component was completed. A total of approximately 6,500 square miles has now been mapped in the Southern Indian Lake area.

Field studies continued along the Moak-Setting Lakes belt with special emphasis on the regional setting of the nickel deposits.

Final details of the mapping were completed in the Guay-Wimapedi Lakes area north of Snow Lake, and a new project was begun in the contiguous File Lake area further to the southwest.

In the continuing collection of information on ultramafic rocks, visits were made to several localities throughout the Province, including the Bird River Sill and Iskwasum Lake.

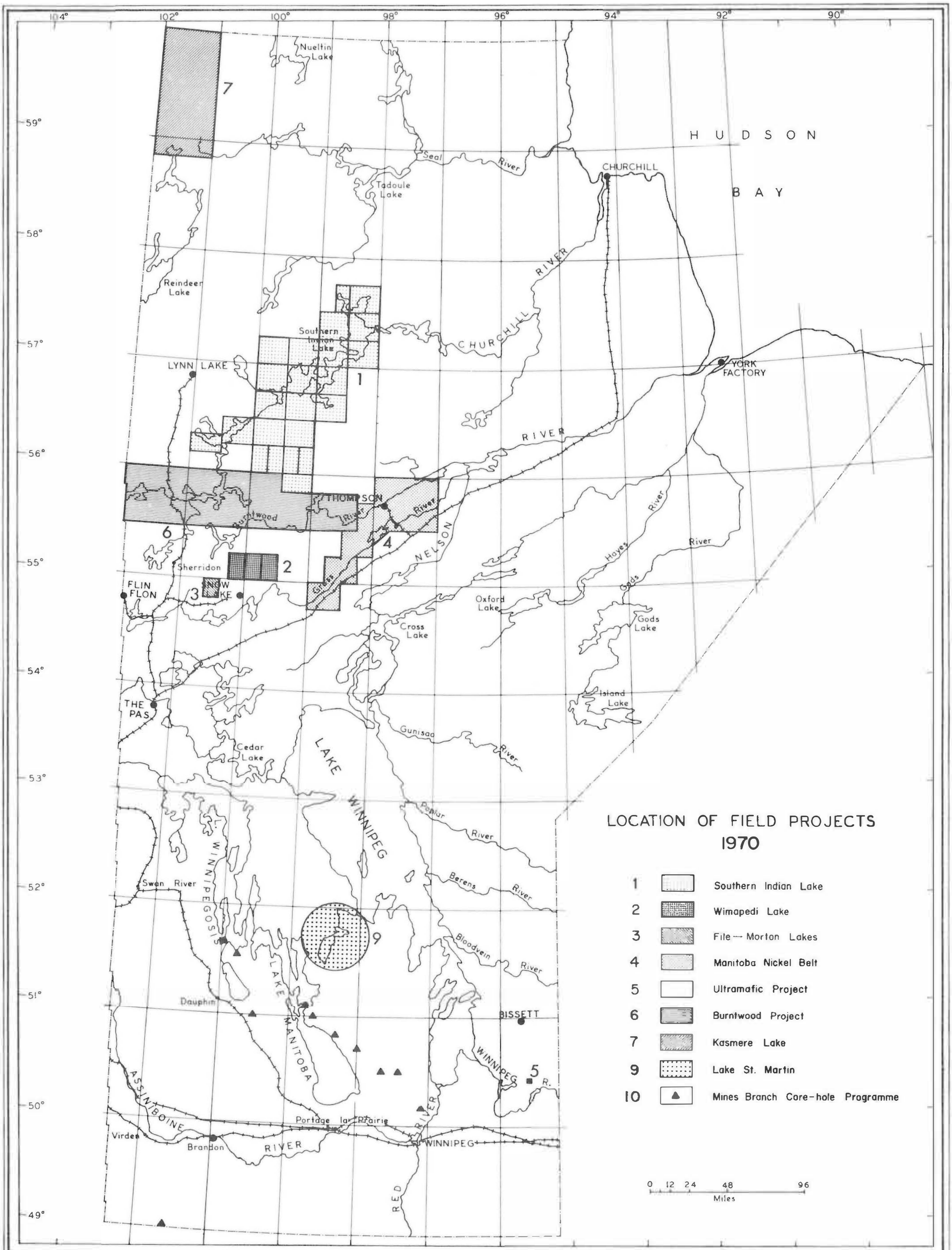
With the Southern Indian Lake project entering its final phase, reconnaissance feasibility studies were undertaken in the Burntwood River and Kasmere Lake areas with a view to beginning new projects in these areas in 1971. In each area small mobile field parties gathered information which will be used to evaluate and plan future projects.

Preliminary studies of samples from the Lake St. Martin crypto-explosion structure were completed. The occurrence of intense shock metamorphic features was confirmed, and the distribution of late Paleozoic (Devonian ?) slump breccias within the crater was found to be more widespread than previously believed.

The Mines Branch core hole programme concentrated on obtaining Devonian structural and stratigraphic data, especially regarding the distribution of limestone beds. Data from this drilling will be incorporated into a report on high-calcium limestone deposits of Manitoba. Core was also obtained from Jurassic (shale and limestone) and Paleocene (shale, sandstone and lignite) strata.

Compilation of subsurface geological data continued, and revision of most stratigraphic maps and data tables will be completed by year end. A new table of Lower Paleozoic Formation Water Analyses will be issued shortly.

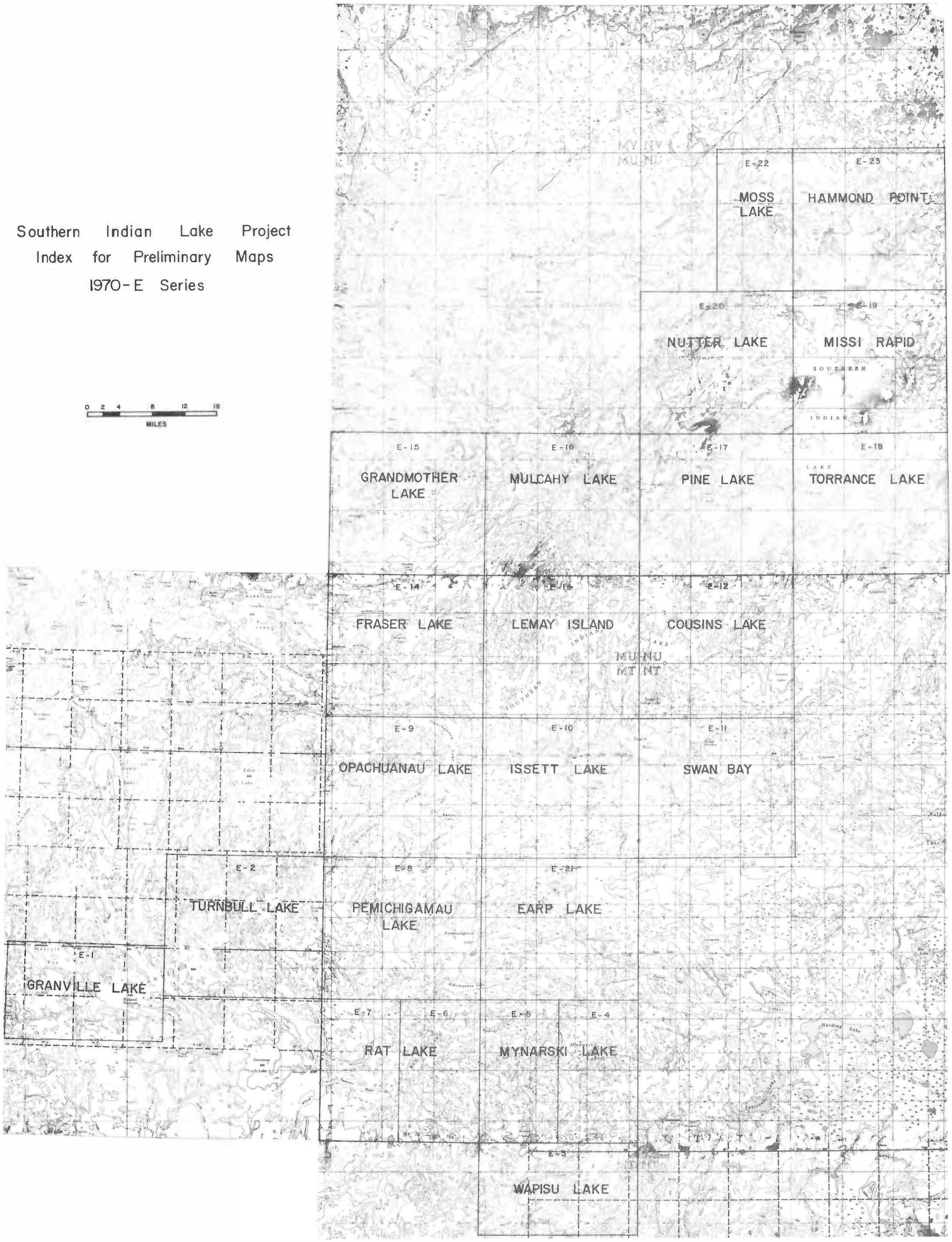
J.S. Roper
Director of Mines



LOCATION OF FIELD PROJECTS
1970
1 Southern Indian Lake
2 Wimapedi Lake
3 File — Morton Lakes
4 Manitoba Nickel Belt
5 Ultramafic Project
6 Burntwood Project
7 Kasmere Lake
9 Lake St. Martin
10 Mines Branch Core-hole Programme
HUDSON BAY
CHURCHILL
YORK FACTORY
LYNN LAKE
THOMPSON
FLIN FLON
SNOW LAKE
Sherridon
THE PAS
Nueltin Lake
Tadoule Lake
Reindeer Lake
Southern Indian Lake
Seal River
CHURCHILL RIVER
NELSON RIVER
Burntwood River
Grass River
Hayes River
Gods River
Gods Lake
Oxford Lake
Cross Lake
Island Lake
Gunisao River
Cedar Lake
LAKE WINNIPEG
L. WINNIPEGOSIS
LAKE MANITOBA
Poplar River
Berens River
Bloodvein River
Swan River
Dauphin
BISSETT
WINNIPEG R.
ASSINIBOINE RIVER
RED RIVER
Virden
Brandon
Portage la Prairie
WINNIPEG
0 12 24 48 96
Miles
104° 102° 100° 98° 96° 94° 92° 90°
59° 58° 57° 56° 55° 54° 53° 52° 51° 50° 49°

TABLE OF CONTENTS

Southern Indian Lake Project
Index for Preliminary Maps
1970-E Series



(1) SOUTHERN INDIAN LAKE PROJECT

INTRODUCTION

by I. Haugh

Geological mapping of the 6,500 square mile project area was completed between June 1 and August 31, 1970. The work was carried out by ten field parties led by Mines Branch geologists, two more than in 1969. The individual reports of these geologists appear in the pages that follow.

Three crews were concerned primarily with the northern gneissic complex which extends north from the vicinity of South Indian settlement. Two crews mapped the important Rusty Lake-Karsakuwigamak greenstone belt and revised the previous Mines Branch maps of this area. The intervening Opachuanau Lake gneissic belt was mapped by a single crew as was the Turnbull Lake batholithic zone which cuts off the Karsakuwigamak greenstone on its western side. In the southern part of the area, two crews completed the mapping of the belt of sedimentary gneisses through Rat and Mynarski Lakes. The remaining field crew concluded important stratigraphic investigations on the Sickle and Wasekwan Group rocks and particularly the nature and extent of the contact between them.

As well as permitting completion of the mapping coverage, this second year of operations in the area allowed some of the basic geological problems in the region to be identified, and attention focused on them. This in turn resulted in a much improved understanding of the tectonic, metamorphic and plutonic history of the region.

The field crews were again serviced from Lynn Lake by fixed-wing aircraft. Helicopter support for the mapping was used throughout the entire field season.

TURNBULL LAKE AREA (63C-8); SICKLE-WASEKWAN CONTACT, LYNN LAKE AREA

by F.H.A. Campbell

Mapping in the Turnbull Lake-Granville Lake area was completed this year. Preliminary structural interpretations have delineated a major pre-Sickle fold in the latter area and an early series of tight, near-isoclinal folds in the Turnbull Lake Area (see Preliminary Map 1970 E-2).

The contact between the Sickle and Wasekwan Groups was examined along its exposed length, from Suwannee Lake in the southeast to Laurie Lake in the west. Clear evidence of an erosional unconformity has been located at several localities. This evidence will be published in detail later (Campbell, in prep.). One location is described in the Geological Association of Canada Field Trip Guidebook (No. 2), 1970.

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Campbell, F.H.A. and Kendrick, G. 1970: Turnbull Lake Area; Manitoba Mines Branch Preliminary Map 1970 E-2.

MYNARSKI-NOTIGI LAKES AREA

(64B-3 and 630-14)

by S. C. Elphick

The area mapped is approximately delineated by latitudes 55°52'N and longitudes 99°00'W to 99°20'W. The corresponding preliminary maps of the area, at a scale of two inches to the mile, are 1970 E-3, E-4, E-5. Within this area outcrop is good, although generally restricted to high ground and the lake shores. Geological contacts are generally obscured, for, as a rule, these follow depressions between outcrops, and are covered by overburden. Many of the linear depressions also probably mask small faults, although these are not recorded as such unless displacement on surrounding units could be proven.

General Geology

On the basis of 1970 field-work, several minor alterations have been made to the position of contacts established in 1969. These include further delineation of units north of Mynarski Lakes, and south of the easterly of the two Mynarski Lakes, shown on Preliminary Map 1970 E-4. Classification of units is based on the 1969 Preliminary Report for this area (Manitoba Mines Branch Geological Paper 4/69). Unit 1b has been deleted from the Mynarski Lake sheet, as it is a variant of the normal pelitic gneiss, with no lateral continuity.

Metamorphism

The rocks of the Mynarski Lakes area have undergone several metamorphic events. At least one of these events was of upper amphibolite grade, under conditions of high temperatures and low to moderate pressure (Abukuma type). This is indicated by the presence of cordierite and sillimanite throughout the area.

A second high grade event is suggested by textures seen on outcrop. In most of the Mynarski Lake-Notigi Lake area, biotite and ellipsoidal cordierite are elongate parallel to the gneissic layering in the pelitic gneiss. This is particularly well seen around Fold Lake and Notigi Lake. In the area approximately five miles northeast of Misinagau, however, a distinct biotite cross-schistosity is developed, at a high angle to the gneissic layering. Both sillimanite and cordierite have been rotated, indicating this re-organization of fabric occurred at a high grade of regional or thermal metamorphism.

Thermal metamorphism is mentioned because of the extensive outcrops of magnetite-bearing tonalitic granite on the west side of the Rat River, directly north of Misinagau (Preliminary Map 1970 E-5). No age relationships have yet been deduced for this granite body. It was possibly intruded late in the metamorphic history of the area, and may have produced strong local thermal effects. Certainly, the foliation, which generally trends north-west across the area, has been deflected into parallelism with the intrusive margins. Intrusion of this granitic body may have caused the biotite cross-schistosity noted above, but detailed thin-section work is required to confirm this.

A later retrogressive or low-grade event is indicated throughout the area around the two Mynarski Lakes by secondary muscovite, chlorite, and carbonate, especially well developed around the westerly of the two lakes.

Stratigraphy

The most important marker horizon in the Mynarski Lakes area is a thin amphibolite lying between the pelitic and arkosic gneisses, either directly below, or just inside the latter. The amphibolite shows intermittent gossan zones, and, because of its remarkable continuity, is regarded as volcanic in origin.

When the true thickness of the units on either side of the marker amphibolite is considered, the amphibolite is found to cross-cut the acid gneiss at a low angle in some localities. This must indicate primary sedimentary changes across the map-area. Variations in the thickness of other units has been noticed, but further work is required before a paleosedimentation map can be drafted.

Structure

At least two, and possibly three, periods of folding can be recognized in the field. One fold set generally has axial planes striking northeast, with high dip. Lineations corresponding to this set generally plunge about 40 degrees to the northeast.

Economic Geology

The Mynarski Lakes and Wapisu Lake areas are recommended for detailed investigation. Especially notable is the electromagnetic INPUT anomaly recorded (during the 1968 survey) due west of Mynarski Lake, north of Misinagau (99°20'W, 56°07'N). This is associated with mineralization both in quartz veins and discrete shears. Further work is recommended in this area, for although the anomaly is associated with graphite, gossan zones are found in the arkosic gneiss. This is unusual in this map-area. All linears in the map-area should be checked for electromagnetic anomalies, especially a strip 7 miles wide running east-west directly south of Mynarski Lakes. This strip is bounded approximately by latitudes 56°05'N and 56°10'N. This area is recommended because of the amount of amphibolite, as seen on Preliminary Map 1970 E-4. This amphibolite is cross-cut by major lineaments trending north-northeast, and often carries gossans, especially near these lineaments.

All gossans found in the arkosic gneiss group should be checked. Layered gossans in the pelitic gneiss are very numerous, especially west of Notigi Lake, but most of them are due to graphite and hematite with minor pyrite.

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Elphick, S.C. 1969: Mynarski-Notigi Lakes Area; in Summary of Geological Fieldwork 1969: Manitoba Mines Branch Geological Paper 4/69.

Elphick, S.C. 1970: Mynarski Lake; Manitoba Mines Branch Preliminary Maps 1970 E-3, E-4, E-5.

RAT LAKE

(64B-4)

by D. C. P. Schledewitz

The area of investigation lies between latitudes 56°00′ and 56°18′ and longitudes 99°55′ and 100°00′ and comprises approximately 500 square miles. The field mapping was completed in 1970 and the preliminary maps covering the area are 1970 E-5, E-6 and E-7.

General Geology

During 1969 a gneissic sequence was established; these units are described in the Summary of Geological Fieldwork, 1969. During the 1970 field season it was found that the following gneisses form a consistent sequence in the southern half of the map-area:

(i) Pelitic gneiss (map-unit 1)

(ii) Amphibolites (map-unit 2)

(iii) Arkosic gneiss, weakly magnetiferous (map-unit 4)

(iv) Interlayered magnetiferous arkosic gneisses and hornblende-microcline-plagioclase-biotite-quartz gneiss (map-unit 7).

There is no inference of age in this sequence since no tops could be determined, but the order of these units as listed above is consistent. In the northern area the rocks of this gneissic sequence are still present but the order is obscured by deformation, intrusion and potash metasomatism.

The rocks of the above gneissic sequence were first intruded by a granodiorite to quartz diorite with associated ultrabasic rocks. A later tonalitic to monzonitic batholith appears to be syntectonic. The intrusive sequence ends with an intrusion of potash granite. All the gneisses show signs of partial anatexis; anatectic tonalites in the pelitic gneiss and granites in the arkosic gneisses form irregular and *lit-par-lit* bodies. The regional metamorphism appears to have reached upper amphibolite facies.

Structurally the main map-area can be divided into four subareas. The northeast sector of the map-area has a dominant eastwest direction for axial planes, plunges and foliations. The southeast sector is a complex system of basins and what appears to be elongated folds; all these have a northeast dip and represent overturned folds. Intense shearing and faulting are common along a belt which runs through this southeast sector in a north to northwesterly direction. The southwest corner of the map-area is mainly pelitic gneiss which has a monotonous character and does not reveal any systematic picture in the axial planes, layering and foliation directions. The northwest sector of the map-area is dominated by a northwest foliation direction. Granodiorite and related ultrabasic intrusions, and doming by a hornblende granite, locally deflect this trend.

Economic Geology

The amphibolite rocks at or near the boundary between the pelitic gneiss and arkosic gneiss are in places mineralized with pyrrhotite, arsenopyrite, chalcopyrite and minor molybdenite. Faults and shear zones within the pelitic gneiss are sporadically mineralized with graphite, chalcopyrite and pyrite.

Anomalies revealed by the airborne electromagnetic INPUT survey (conducted in 1968) within the arkosic gneisses are likely areas of investigation. As graphite is not a major accessory as in the pelitic gneiss, anomalies in the arkosic gneiss may therefore be readily related to mineralization. One anomaly of this type that was investigated was found to coincide with a large quartz vein mineralized with pyrite, graphite and possibly arsenopyrite.

Molybdenite, though very limited in extent, forms large spectacular clots in silicified zones in arkosic and granitoid gneisses. Three such occurrences are marked on the Preliminary Map 1970 E-7.

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TURNBULL LAKE-PEMICHIGAMAU LAKE AREAS

(Parts of 64B-5 and 64C-8)

by G. Kendrick

The area mapped is bounded approximately by the following parallels of latitude and meridians of longitude: 56°15′ and 56°30′N and 99°50′ and 100°15′W respectively.

The entire area has been mapped previously by Henderson (1932), Norman (1933) and Downie (1935) at a scale of four miles to the inch. A compilation map of their work, map 344A, has been published by the Geological Survey of Canada.

General Geology

The solid geology is dominated by an extensive area of granitic rocks (subunit 6a and unit 12) in which there are three zones of Wasekwan metasedimentary and metavolcanic rocks (unit 1 and subunit 2). The latter constitute the oldest known rocks in the area.

Unit 1 occurs as a discontinuous migmatitic belt at the northern end of the Granville Lake and also east of Leaf Rapids. Unit 1 at this location is a complex assemblage of garnetiferous semi-pelitic gneisses and schists, greywackes, iron formation and amphibolites which were extensively migmatized and granitized. Sulphides were found in this unit.

Elsewhere, unit 1 outcrops on the east shore of Granville Lake and on the east and southern shores of a lake near the eastern boundary of the area mapped. Unit 1 is traceable for a short distance east of these two lakes, but a continuation southeast from Granville Lake (suggested by the aeromagnetic feature on Federal-Provincial Maps 2384G and 2388G) could not be confirmed in the field.

Unit 2 consists of fine-grained amphibolite and probably metavolcanic rocks, and outcrops near the eastern boundary of the area mapped.

Rocks referred to as unit 3 form mappable bodies in the northern part of the area. Commonly a metagabbro core (3a) is enveloped by a zone of migmatitic diorite and quartz diorite (3b). At one locality, large porphyroblasts of feldspar two inches long occur in the metagabbro. Unit 3 may pre-date the Sickle Group as the rocks are similar to Pre-Sickle intrusions mapped by Campbell (1969) west of the map-area.

A band of fine-grained garnetiferous amphibolite, interlayered with diorite, biotite gneiss, tonalitic gneiss and granodiorite (subunit 4c) occurs near the extreme southwestern corner of the area. It is correlated with rocks of the Sickle Group (Preliminary Map 1969 E-2).

Subunit 6a consists of a syntectonic granodiorite-quartz monzonite complex which contains numerous xenoliths of amphibolite and greywacke. The unit was foliated prior to the emplacement of numerous aplite and pegmatite dykes and veins that exhibit contrasting age relationships. Also irregular bodies of grey to pink, medium-grained granite and pegmatite occur. Zones of cataclasis, trending north-northwest, are well-developed, particularly in the southwest portion of the area; they are characterized by augen of pink microcline. Microclinization of plagioclase has been observed in zones of cataclasis and adjacent to joint planes.

Pink coarse-grained weakly-foliated granitized gneiss forms unit 5, possibly derived from Sickle-type metasediments.

Pink, homogeneous, leuco-granite (subunit 6e) forms a distinct intrusive body east of Turnbull Lake. Xenoliths of Wasekwan-type rocks occur near the eastern boundary of the body.

Economic Geology

Sulphide mineralization as located during the field season is confined to Wasekwan rocks. Magnetite is ubiquitous.

Pleistocene glacial deposits occur in the area. A well-developed north-south esker ridge composed of sand and gravel, and extending north of the map-area, terminates a few miles south of Turnbull Lake. At its southern termination, the esker forms a prominent ridge and contains numerous pebbles and cobbles. This esker has been utilized in the construction of the Lynn Lake - Thompson highway which crosses the map-area. Another north-south esker ridge is found in the southwest portion of the area and is flanked by a series of small lakes on its eastern side. Stands of poplar, balsam fir and jackpine with a girth greater than 8 inches are found on this ridge. Elsewhere, glacio-fluvial deposits are quite common and give rose to sand plains supporting jackpine. Sandy till is thin and mainly confined to low-lying areas in the northern part of the area. Spectacular boulder heaps, commonly 20 feet high, are found in the area north of the southern termination of the central north-south esker and may be part of a terminal moraine complex. The southern part of the map-area consists of barren rugged high ground where outcrop is plentiful. Thin spreads of gravel and sand were washed by glacial meltwater into depressions in this region.

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Henderson, J.E., Norman, G.H.W. and Downie, D.L. 1936: Granville Lake, (East half), Manitoba; Geol. Surv. Can., Map 344A.

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OPACHUANAU LAKE-ISSETT LAKE-PEMICHIGAMAU LAKE AREA

(Parts of 64B-5, 11 and 12)

by M. A. Steeves

Field work during the 1970 field season was concerned with completion of the re-examination of the Rusty Lake greenstone belt and its relationships with the intrusive rocks and gneissic rocks which bound it to the south and north respectively. The greenstone belt was traced by the writer to its southern margins north of Pemichigamau Lake and as far west as the boundary between the Eden Lake and Opachuanau Lake map sheets. Mapping of the greenstone belt in the Issett Lake (East half) area was carried out by C. F. Lamb.

General Geology

As a result of the 1970 field work it now appears that two separate extrusions of basic volcanic rocks occurred in the area. The first comprises what are probably the oldest rocks in the area, and these are overlain by a group of volcaniclastic rocks. The second extrusion of basic volcanic rocks post-dated deposition of the metasediments and cross-cutting relationships are not uncommon. The rocks of this second extrusive event are generally much fresher looking than those of the first, and primary features are more readily recognizable. Ryholitic and dacitic rocks seem to be confined to the first major extrusive episode, and are not found in the metasedimentary rocks of the Rusty Lake Group or in the later group of basic extrusive rocks.

To the north, the greenstone belt is bounded by gneisses that extend east from the border of the Opachuanau Lake and Eden Lake map sheets to the western shore of South Bay (of Southern Indian Lake) on the Issett Lake map sheet (East half). These gneisses have been subdivided mainly into biotite and hornblende-rich units.

The intrusive rocks of the area range from ultramafic dykes and plugs to small plugs of leucocratic granites. Determination of age relationships among the different intrusive rocks is difficult, as contacts are commonly drift-covered.

Structural Geology

Two types of minor folds occur in the Opachuanau Lake - Issett Lake - Pemichigamau Lake area. The first type is an easterly plunging series of similar folds, while the second is a more open concentric style of folding that plunges to the north.

Most of the faults, both minor and major, trend in a northeast to northwest direction. The apparent movement on these faults is both left and right lateral. Another series of faults strikes in an easterly direction and shows apparent normal dipslip movement.

Economic Geology

Almost every rock unit in the Opachuanau Lake - Issett Lake - Pemichigamau Lake area contains at least some mineralization, generally in the form of disseminated pyrite. In the rocks of the greenstone belt, however, pyrrhotite, chalcopyrite and sphalerite (var. "blackjack") are also found, occurring mainly in east-west shears or disseminated in thin beds of tuffaceous or metasedimentary rocks. The Ruttan Lake deposit is situated in the southern part of the Rusty Lake Group and appears to follow a shear zone trending roughly northeast.

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SOUTHERN INDIAN LAKE: CENTRAL PORTION

(64B-15, 64G-2 and 7; and parts of 64B-10, 11, 14 and 64G-3)

by Thomas G. Frohlinger

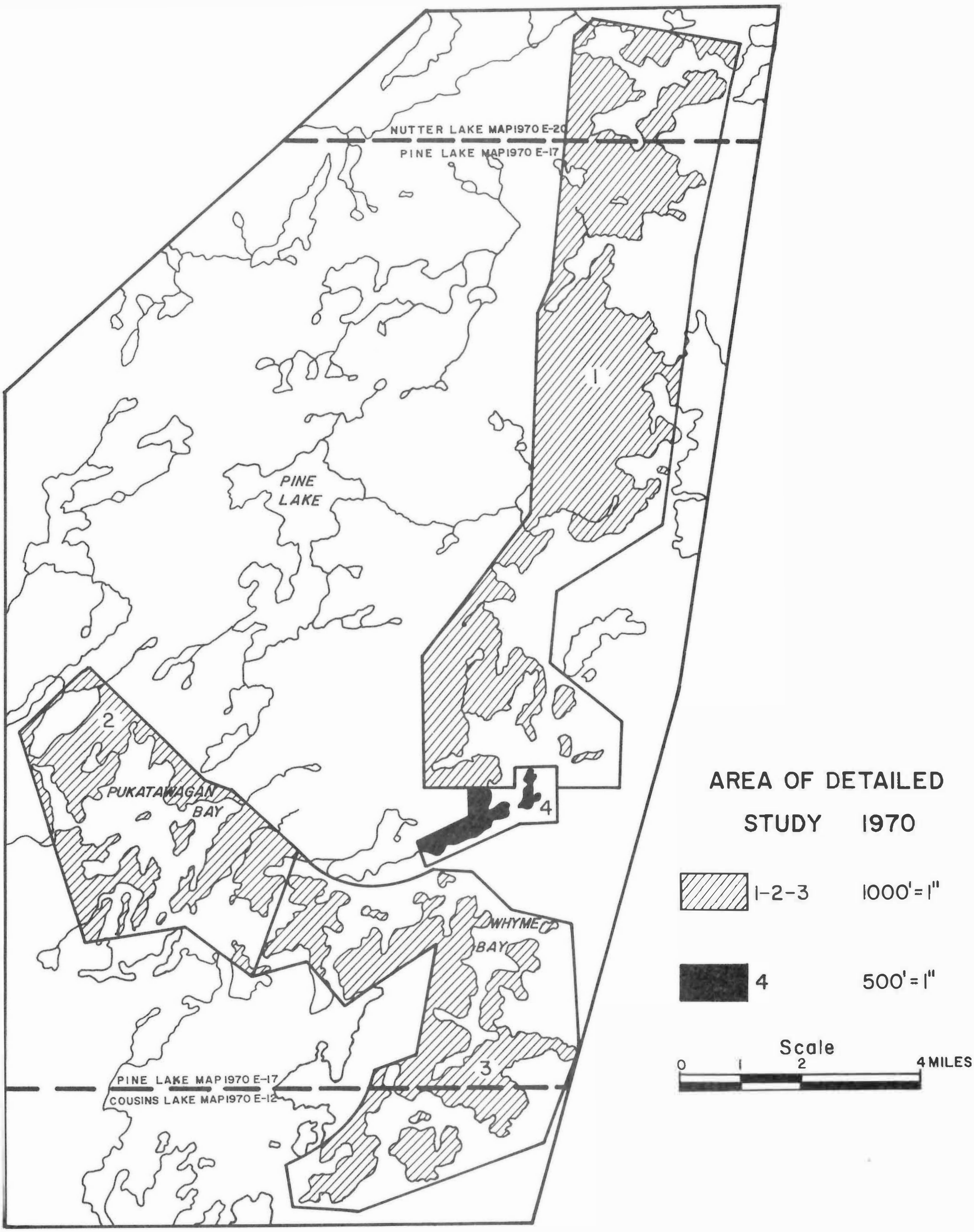
An area of approximately 1000 square miles was mapped by the writer in 1969-70. It includes Nutter Lake (Preliminary Map 1970 E-20), Pine Lake (1970 E-17), Cousins Lake (1970 E-12), and parts of Mulcahy Lake (1970 E-16), Lemay Island (1970 E-13), Issett Lake (1970 E-10) and Swan Bay (1970 E-11). Limits of mapping are defined by latitudes $56^{\circ}41'$ and $57^{\circ}30'$ and longitudes $98^{\circ}38'$ and $99^{\circ}10'$.

The scale of mapping was one-half mile to the inch, supplemented by greater detail where necessary. Detailed studies were made of metasediments, metavolcanics and migmatized paragneisses (Pine Bay and Cousins Lake sheets). As a result of these studies, the paragneisses have been broken into eight subunits based on both mineralogy and relative amounts of mobilized fractions. The amphibolites have been identified as metavolcanics. The granites have been subdivided on the basis of mineralogy and fabric.

Since preliminary specific gravity studies on 1969 samples had proved useful, specific gravities were recorded for all stations during the 1970 season. Over 3000 specific gravities have now been recorded and are being processed with the aid of a computer.

The following interpretations regarding the plutonic, tectonic and metamorphic history are strictly tentative. The metasediments, paragneisses and migmatites appear to have been derived from a thick sedimentary pile of predominantly greywacke composition. The burial metamorphism was accompanied by passive flow folding with the development of axial planar foliation. Faulting, uplift and igneous extrusion and intrusion followed. This was accompanied by localized thermal metamorphism and flexural slip and flow of the gneisses, metasediments and metavolcanic rocks. Renewed basic intrusive activity was then followed by further faulting and shearing prior to the injection of the granodiorite. Subsequent sedate emplacement of granite plutons was accompanied by minor folding and fracturing, some retrograde metamorphism and late hydrothermal activity. The younger diabase and lamprophyre dykes are post-tectonic and post-metamorphic. At least three ages of pegmatites have been inferred, but as their precise age relations are still in doubt, they have been treated as a separate unit.

Again, in 1970, as many as possible of the electromagnetic anomalies defined by the 1968 INPUT survey were examined. The numerous long conductors on the Nutter Lake sheet appear to be caused by graphite distributed in the paragneiss. The mineralized zones associated with the electromagnetic anomalies appear to be shear zones. A number of sulphide occurrences not associated with anomalies were also noted. These zones, occurring in the metavolcanics, contained primarily pyrite and pyrrhotite with minor chalcopyrite, and in one case malachite and bornite. Assays are not as yet available.


NUTTER LAKE MAP 1970 E-20
PINE LAKE MAP 1970 E-17
PINE LAKE
1
2
PUKATAWAGAN BAY
4
WHYME BAY
3
PINE LAKE MAP 1970 E-17
COUSINS LAKE MAP 1970 E-12
AREA OF DETAILED STUDY 1970
1-2-3 1000'=1"
4 500'=1"
Scale
0 1 2 4 MILES

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SOUTHERN INDIAN LAKE: SOUTHWEST AREA

(Parts of 64B-13 and 14, and parts of 64G-3 and 4)

by K. A. Thomas

The map-area lies between longitudes 99°02′ and 99°42′, and latitudes 56°46′ and 57°11′. The area is approximately 90 miles northwest of Thompson and 60 miles east of Lynn Lake. Mapping of this area was commenced in the summer of 1969. During the summer of 1970 mapping was completed with a re-examination of previous work done by the author (1969) and some detailed mapping in the northwest part of the area (Preliminary Map 1970 E-15).

Principal Rock Types

Metasedimentary rocks, paragneisses

Recognizable metasedimentary rocks, consisting of metasandstone, quartzite, meta-greywacke and meta-calcareous rocks occur within and locally grade into plagioclase paragneisses. Primary layering is rare in the metasedimentary rocks and no top determinations could be made. The sediments have been metamorphosed to the upper amphibolite facies and are locally migmatitic.

The plagioclase paragneisses are predominantly dark to light grey, variably layered rocks composed of plagioclase, quartz and biotite. The plagioclase gneisses found on the northwest boundary (Preliminary Map 1970 E-15) contain garnet and hornblende.

Migmatites

Paragneisses in which the amount of mobilization exceeds 30% were mapped as a separate unit. The contact between the migmatitic and non-migmatitic gneisses is gradational and irregular.

The migmatites are sub-divided according to the amount and state of mobilization as follows:

(a) Metatexite: rocks which have undergone partial mobilization with geochemically mobile and immobile portions recognizable; arbitrary limits of 30% to 75% mobilized material have been set.

(b) Diatexite: rocks with greater than 75% mobilized material in which former mobile and immobile portions are no longer distinguishable.

(c) Anatexite: a group of rocks which have undergone melting to produce a fairly homogeneous rock of granitic appearance.

Quartz diorite

Three outcrops of this unit were found in the southern part of the map-area (Preliminary Map 1970 E-13). The intrusive is of quartz diorite composition and is cut by granitic rocks.

Granodiorite

A batholith of gneissic granodiorite forms a prominent feature in the northwest part of the map-area (Preliminary Map 1970 E-14 and E-15). The batholith covers approximately 50 square miles and is of uniform composition. The foliation is due to parallel orientation of biotite aggregates which have a nuclei of magnetite. A second unit of granodiorite is found in the central part of the map-area on many of the islands in Southern Indian Lake (Preliminary Map 1970 E-13). This unit intrudes the paragneisses and is in turn intruded by a pink, fine-grained granite. This body has weak foliation, is non-magnetic and contains remnants of paragneiss.

Granitic Rocks and Pegmatite

Over 60% of the map-area are granitic and include, as subunits, porphyritic quartz monzonite, pink to white granite and a reddish-pink fine-grained granite. The pink to white granite is cut by the porphyritic quartz monzonite which is intruded by the fine-grained pink granite. All of these units are cut by a pink granite pegmatite.

Diabase

A small diabase dyke was found just south of Barlow Lake on the shore of a long bay (Preliminary Map 1970 E-14). This dyke cuts both the pink granite and the pegmatite.

Structural Geology

The major features of the area are two domes of granitic material enveloped by foliated paragneisses. The overall foliation has a predominant northeast trend.

Air photo lineaments were found in the field to correspond to local shear zones, on which there is no obvious evidence of displacement.

Two types of minor folds were recognized in the map-area:

(1) isoclinal folds with axial planes trending parallel to the regional foliation;

(2) open style folds trending across the foliation to the southeast.

Economic Geology

A number of gossans were found in meta-calcareous rocks and in altered amphibolites occurring as large xenoliths in white pegmatitic granite. No signs of mineralization were seen in the pink porphyritic granite.

Isolated occurrences of pyrite and pyrrhotite are present throughout the metacalcareous rocks but none assayed more than 0.1% nickel or copper. Their locations are shown on the Preliminary Maps.

References Cited:

Frohlinger, T.G., Hinds, R.W., and Thomas, K.A. 1970: Lemay Island; Manitoba Mines Branch Preliminary Map 1970 E-13.

Hinds, R.W., and Thomas, K.A. 1970: Fraser Lake; Manitoba Mines Branch Preliminary Map 1970 E-14.
Grandmother Lake; Manitoba Mines Branch Preliminary Map 1970 E-15

Tedlie, W.D. 1958: Geology of the Barlow Lake Area, Manitoba Mines Branch Publ. 57-2.

Thomas, K.A. 1970: Mulcahy Lake; Manitoba Mines Branch Preliminary Map 1970 E-16.

OPACHUANAU LAKE - SOUTHERN INDIAN LAKE AREA

(Parts of 64B-4, 11, 12, 13, 14)

by R. W. Hinds

The area mapped during the 1970 field season extends the previous map-area mainly to the east and west. The map-area now includes all of the southern shore of Southern Indian Lake and most of Opachuanau Lake. The east-west trending amphibolite and intermediate gneiss belt has been extended to the east as far as South Bay, and to the west to correlate with Kilburn (1955). Local areas of the gneissic belt have been mapped in detail to attempt to find a pattern in the seemingly homogeneous gneisses. Attention was given to the relationship of the granite bodies in the north to the amphibolites and gneisses. Remnants and inclusion bands of the latter in the granitic areas have been closely examined in an attempt to classify them.

Review of rock types

The amphibolites are mainly fine to medium-grained and contain an abundance of hornblende and plagioclase and little or no quartz. Some of the medium-grained amphibolites have a gabbroic texture. Where quartz becomes more abundant, the rock has been termed a hornblende-plagioclase-quartz gneiss. This gneiss commonly contains remnants or inclusions of amphibolite. Throughout the belt, the hornblende is commonly altered to biotite. When biotite predominates, the rock is termed a biotite-plagioclase-quartz gneiss. The hornblende gneiss differs from the quartz diorite in having a well-developed gneissosity. A migmatite band parallel to the gneissosity in the main gneissic belt consists mainly of bands of leucocratic material in fine to medium-grained hornblende gneisses. Its unusually straight trend suggest that it may have been a shear zone. The migmatites in the eastern part of the map-area around Narrow Bay consist of amphibolite and gneiss inclusions in non-foliated quartz monzonite or pegmatite. The acid or siliceous gneisses with numerous inclusions differ from the migmatites in that the introduced siliceous material has a gneissic texture. They occur mainly in contact zones, the foliation parallel to the contact. The medium to coarse-grained ultramafic rock contains 85 to 100 per cent hornblende partially altered to biotite. It occurs as small to very large dykes commonly parallel to the foliation. Four granitic bodies have been mapped in the area. Their relative ages have been determined by their relationship to the gneissic belt. Pegmatites have been grouped as one unit for the preliminary report although at least two distinct types are present.

A number of gossan zones have been located in north-south trending amphibolite bands in the quartz monzonite south of Lemay Island.

References Cited:

Hinds, R.W. 1969: Opachuanau Lake - Southern Indian Lake Area; in Summary of Geological Fieldwork, 1969; Manitoba Mines Branch Geological Paper 4/69.

Kilburn, L.D. 1955: Geology of the MacBride Lake Area; Manitoba Mines Branch Publication 55-2.

SOUTHERN INDIAN LAKE : NORTHERN AND EASTERN AREAS

(64G-1, 64G-8, 64G-9 and parts of 64B-15, 64G-2, 64G-7, 64G-10)

by J. R. Cranstone

The northeastern portion of Southern Indian Lake is situated approximately 100 miles east of Lynn Lake, and 100 miles north of Thompson. The map-area comprises nine fifteen-minute map sheets, covering some 1500 square miles on and surrounding the north-east end of the lake.

Mapping on a semi-reconnaissance scale was commenced in 1969. During 1970, field-mapping was completed, with a considerable portion of the summer's work being devoted to re-examining problem areas, and mapping in greater detail where exposure permitted. Preliminary results of the 1969 field-work were published in Manitoba Mines Branch Preliminary Maps 1969 E-18 and E-19. Additional information gained, and revisions made during 1970 appear in Mines Branch Preliminary Maps 1970 E-12, E-17, E-18, E-19, E-20, E-21 and E-22. Publication of the final report and final map on a scale of 1 inch to a mile will follow sometime in 1971.

The reader is referred to the preliminary maps described above, and Cranstone (1969), for a more detailed description of the geology than will be presented here.

General Geology

Simply stated, the map-area appears to represent a number of gneissic domes which are overturned to the south. Highly mobilized, potassium-feldspar-deficient granitoid rocks comprise the core regions, while progressively less-mobilized rocks occur in the inter-domal areas. Large volumes of late kinematic hornblende and biotite-quartz monzonites have intruded this sequence.

Paragneisses in the area have been divided into two major compositional units, on the basis of the presence, or absence, of potassium-feldspar. These units have then been subdivided, using the degree of mobilization and/or injection exhibited by each. When preserved as recognizable metasediments, the potassium-feldspar-bearing units are usually sandstone, arkose, and granite pebble conglomerate. The non-potassium-feldspar-bearing units apparently represent original impure sandstone and greywacke-type sediments. In general, K-spar-bearing units are also magnetite-bearing, and therefore readily distinguishable on aeromagnetic maps. Each unit shows a general decrease in magnetic strength with increasing mobilization.

Owing to a lack of inland outcrop, and the large water-covered portion of the area, these magnetic properties, when combined with the limited inland exposure, proved quite useful in delineating the continuity of rock units.

Economic Geology

No sulphide showings of significance were observed. Mineralization, consisting of disseminated pyrrhotite with very minor chalcopyrite, commonly occurs within somewhat sheared graphitic horizons in the plagioclase migmatites and plagioclase gneisses. Assays indicate that some of these mineralized horizons and a few scattered pegmatites carry insignificant amounts of MoS_2.

References Cited:

Cranstone, J.R.
1969: Manitoba Mines Branch Preliminary Maps 1969 E-18, E-19.

Cranstone, J.R.
1969: Torrance Lake and Missi Rapid Area; in Summary of Geological Fieldwork, 1969; Manitoba Mines Branch Geological Paper 4/69.

Cranstone, J.R.
1970: Manitoba Mines Branch Preliminary Maps 1970 E-18, E-19, E-22, E-23.

Frohlinger, T.G. and Cranstone, J.R.
1970: Manitoba Mines Branch Preliminary Maps 1970 E-12, E-17 and E-20.

ISSETT LAKE - KARSAKUWIGAMAK LAKE AREA

(Parts of 64B-5, 6, 10 and 11)

by C. F. Lamb

During the 1970 field season, geologic mapping was carried out at a scale of one-half mile to the inch in the east half of the Issett Lake sheet, south of the twenty-third base line; in the northern portion of the Earp Lake sheet; in the southwest corner of the Swan Bay sheet; and in a small portion of the Pemichigamau sheet on the west shore of Karsakuwigamak Lake (Preliminary Map 1970 E-8). Previous mapping in the area was done by Wright (1953) at a scale of 4 miles to the inch and by Milligan (1964) and Bristol (1966) at a scale of 1 mile to the inch. The area adjoins that mapped by Steeves (1969 and 1970) to the west, and by Hinds (1969 and 1970) to the north.

More than one-third of the map-area is covered by overburden and swamp, and shoreline outcrops are scarce. Access is poor since there is an absence of large lakes and only the Rat River flows through the area. The area was mapped by inland traversing at a spacing of approximately one-half mile. A helicopter was used to fly over all drift areas and large areas of granite.

Gneisses in the northern part of the map-area (Preliminary Map 1970 E-10) are separated from the greenstones in the south by coarse-grained tonalite. The greenstones are bounded on the south by granitic rocks (Preliminary Map 1970 E-21).

The greenstones are a continuation of the Rusty Lake greenstone belt mapped by Steeves (1969). The belt was found to extend eastward into the Swan Bay map sheet (Preliminary Map 1970 E-11) where it is bounded to both north and south by granite. In the east half of the Issett Lake sheet (Preliminary Map 1970 E-10), there is an increasing amount of hornblende diorite on either side of the greenstone belt.

Some bedding was observed in the sediments, and in the volcanics, amygdales were found at one locality and pillows at another. From the limited primary structures, tops are probably to the north in the eastern portion of the greenstone belt. No major folding has been determined. One fault has been assumed in the Earp Lake map-area (Preliminary Map 1970 E-21).

Numerous pyritic gossans, with pyrrhotite, and in places minor chalcopyrite, were observed in the greenstones during the present mapping, especially in tuffaceous beds and epidotized basic volcanics. Traces of pyrite were observed in the gneisses and intrusive rocks. No sulphides were found in the pegmatite or diabase.

Aeromagnetic maps were found to show only minor correlation with geologic contacts and so could not be used to assist in defining obscured contacts.

References Cited:

Bristol, C. C. 1966:	Geology of the Issett Lake Area, Manitoba; Manitoba Mines Branch Publ. 63-4.
Hinds, R.W. 1969:	Opachuanau - Southern Indian Lake Area; in Summary of Geological Fieldwork, 1969; Manitoba Mines Branch Geological Paper 4/69.
Lamb, C.F., Schledewitz, C.D.P., and Steeves, M.A. 1970:	Earp Lake; Manitoba Mines Branch Preliminary Map 1970 E-21.

Milligan, G.C.
1964: Geology of the Earp Lake Area, Manitoba; Manitoba Mines Branch Publ. 61-2.

Steeves, M.A.
1969: The Opachuanau Lake - Ruttan Lake - Issett Lake - Swan Bay Area; in Summary of Geological Fieldwork 1969; Manitoba Mines Branch Geological Paper 4/69.

Steeves, M.A., Frohlinger, T.G., and Lamb, C.F.
1970: Swan Bay; Manitoba Mines Branch Preliminary Map 1970 E-11.

Steeves, M.A., Kendrick, G., Schledewitz, D.C.P., and Lamb, C.F.
1970: Pemichigamau Lake; Manitoba Mines Branch Preliminary Map 1970 E-8.

Steeves, M.A., Lamb, C.F., Hinds, R.W., and Frohlinger, T.G.
1970: Issett Lake; Manitoba Mines Branch Preliminary Map 1970 E-10.

Wright, G.M.
1953: Uhlman Lake Map-Area, Manitoba; Geol. Surv. of Can., Paper 53-12.

(2) GUAY LAKE - WIMAPEDI LAKE AREA

(63N - 1E; 630-4)

by A. H. Bailes

Mapping of the Guay Lake - Wimapedi Lake area, located north of Snow Lake, was completed during the summer of 1970. Mapping of this 550 square mile area, for publication at a scale of 1 inch to 1 mile, was commenced in the summer of 1968. Preparation of final maps and a report will be completed by the spring of 1971. Preliminary Maps (1969 B-1, 1969 B-3, 1970 B-1) with descriptive marginal notes of the Guay Lake - Wimapedi Lake area are available; and a brief account of the geology of the area is contained in Manitoba Mines Branch 'Geological Paper 4/69'.

(3) FILE - MORTON LAKE AREA

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

by A. H. Bailes

The File - Morton Lakes area is 10 miles west of the town of Snow Lake. Field studies were begun in this area during part of the 1970 field season with the objective of examining certain aspects of the geology that are fundamental to understanding the complex geological history of the entire Snow Lake - Flon Flon - Sherridon region. The problems which are receiving particular emphasis, and for which the File - Morton Lake area is well suited, are:

(1) **The relationship between the Kisseynew sedimentary gneiss complex and the Amisk-Missi volcanic and sedimentary complex:**

The File - Morton Lake area includes a portion of the controversial 'Kisseynew Lineament' and both the Amisk-Missi and Kisseynew sequences are well exposed in the area. The grade of metamorphism is low enough that many of the primary textures and structures of the Kisseynew paragneisses are preserved, so that meaningful comparisons with similar rocks within the Amisk sequence can be made.

(2) **The stratigraphic 'control' of copper-zinc sulphide orebodies:**

A knowledge of the stratigraphy of both the paragneisses and volcanic rocks is essential, not only in the structural interpretation of the File - Morton Lake area, but also because there is a great deal of evidence indicating that mineralized deposits, of the Cu-Zn variety, are stratigraphically associated with acid volcanism in the Amisk sequence and with calcareous-carbonaceous horizons in the Kisseynew sequence.

(3) **The detailed structural history of the File - Morton Lake area:**

The Snow Lake - Flin Flon - Sherridon region has been completely mapped at a scale of 1 inch to 1 mile, but in spite of this, the structural and metamorphic history of this area has not been adequately determined. This may be due in part to a previous lack of emphasis on this subject, but it is also quite evident that the subtle interrelationships of metamorphism and deformation cannot be recognized except by detailed examination of small areas.

Field studies in the File - Morton Lakes area during the summer of 1970 have indicated that:

(1) The Amisk sedimentary rocks along the shore of Morton Lake are a spectacular sequence of turbidites. Primary structures commonly observed are graded bedding, scour and fill channels, convolute bedding, rip-up fragments, load cast structures and flame structures. There is a total lack of fissility along bedding surfaces and consequently it was not possible to determine whether bedding plane features such as flute casts, sole marks and groove casts are present.

(2) The grade of metamorphism increases from south to north. The basal meta-greywacke-argillite sequence of the File Lake area, regionally belonging to the Nokomis group of the Kisseynew complex, appears to be the more highly metamorphosed equivalent of the turbidite sequence on Morton Lake. The 'Nokomis' group rocks of the File Lake area have recognizable graded bedding, rip-up fragments, flame structures and scour and fill channels. The graded bedding and scour and fill channels can be recognized in the metamorphic rocks of the File Lake area up to, and even above, the sillimanite isograd.

(3) Vertical tectonics has played a major role in deformation of the rocks of the File - Morton Lakes area. Clasts in the rocks are vertically elongated 4 to 10 times their maximum horizontal dimension.

(4) Tight shear folding, and the development of a strong axial planar foliation, constituted the earliest discernable structural event in the area. Porphyroblasts of staurolite and hornblende in the File Lake gneisses are randomly oriented and have overprinted the foliation, indicating static growth during a major metamorphic event following the shear folding. The early foliation was subsequently folded by broad major flexural folds.

(5) There is a distinct possibility that many of the rocks west of Morton Lake mapped by Harrison (1949) as gabbro, are actually altered and recrystallized sedimentary rocks.

Reference Cited:

Harrison, J.M. 1949: Geology and mineral deposits of the File-Tramping Lakes area, Manitoba; Geol Surv. Can. Mem. 280.

(4) MANITOBA NICKEL BELT

by D. A. Cranstone

The writer's study of the Moak Lake - Setting Lake nickel area of northern Manitoba continued through the 1970 field season. Field work during 1970 was between Orr Lake in the northeast and Pakwa Lake in the southwest, and concentrated on (a) re-interpretation of the geology of the nickel belt; (b) studies of the metamorphic history of the nickel belt area; (c) studies of local geological setting of some of the nickel deposits. Meaningful results of this fieldwork await conclusion of petrographic studies which are currently underway.

During the 1970 field season the writer and other geologists familiar with the geology of the Moak-Setting Lakes area were engaged in preparation of a geological map of a portion of this area. This map has been published at a scale of 1:100,000 in the guidebook for a Geological Association of Canada - Mineralogical Association of Canada geological field trip (Quirke, Cranstone, Bell and Coats, 1970), and the reader is referred to it for the most current and comprehensive geological map of the Moak-Setting Lakes area. For further details of the geology of the Manitoba Nickel Belt the reader is referred to Cranstone (1969).

A portion of Paint Lake, comprising the northwest corner of N.T.S. area 63P-5 (Wintering Lake) was mapped for the writer during the latter part of the summer of 1970 by Miss Barbara Roy (Figure A). The purpose of this mapping was to trace the northeast continuation of map unit 2 of Godard (1966) and to determine the northeasterly extent of the pyroxene granulite facies rocks which make up a portion of the rocks of Godard's unit 2. Figure A shows the areal extent of these rocks in the 1970 Paint Lake map-area. This mapping, and the writer's geological investigations covering a wider area, indicate that to the northeast of the area shown in Figures A and B, possible pyroxene granulite facies rocks of the Paint Lake area extend only a short distance into the southwest corner of the map-area of Patterson (1963), where they underlie an area of about two square miles.

Map units 1a, 1b, 1c, and 1d in Figure A are, with a few exceptions, somewhat arbitrary and gradational. Lithology of shoreline outcrops is approximately as delimited in this figure, but distinctive lithological differences among all outcrops shown as different map units is not necessarily implied. One possible interpretation of the geology of the area is given in Figure B.

Completion of the field work for the writer's study of the Manitoba Nickel Belt is planned for the 1971 field season.

References Cited:

Cranstone, D.A. 1969: Manitoba Nickel Belt; in Summary Geological Fieldwork 1969; Manitoba Mines Branch, Geological Paper 4/69, pp. 84 - 89.

Godard, J.C. 1966: Geology of the Hambone Lake area; Manitoba Mines Branch, Publ. 63-1.

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

Quirke, T.T., Jr., Cranstone, D.A., Bell, C.K., and Coats, C.J.A. 1970: Geology of the Moak-Setting Lakes area of Manitoba (Manitoba Nickel Belt); Guidebook for Field Trip No. 1, Joint Annual Meeting 1970, Geological Association of Canada - Mineralogical Association of Canada, 56 p. and illustrations.

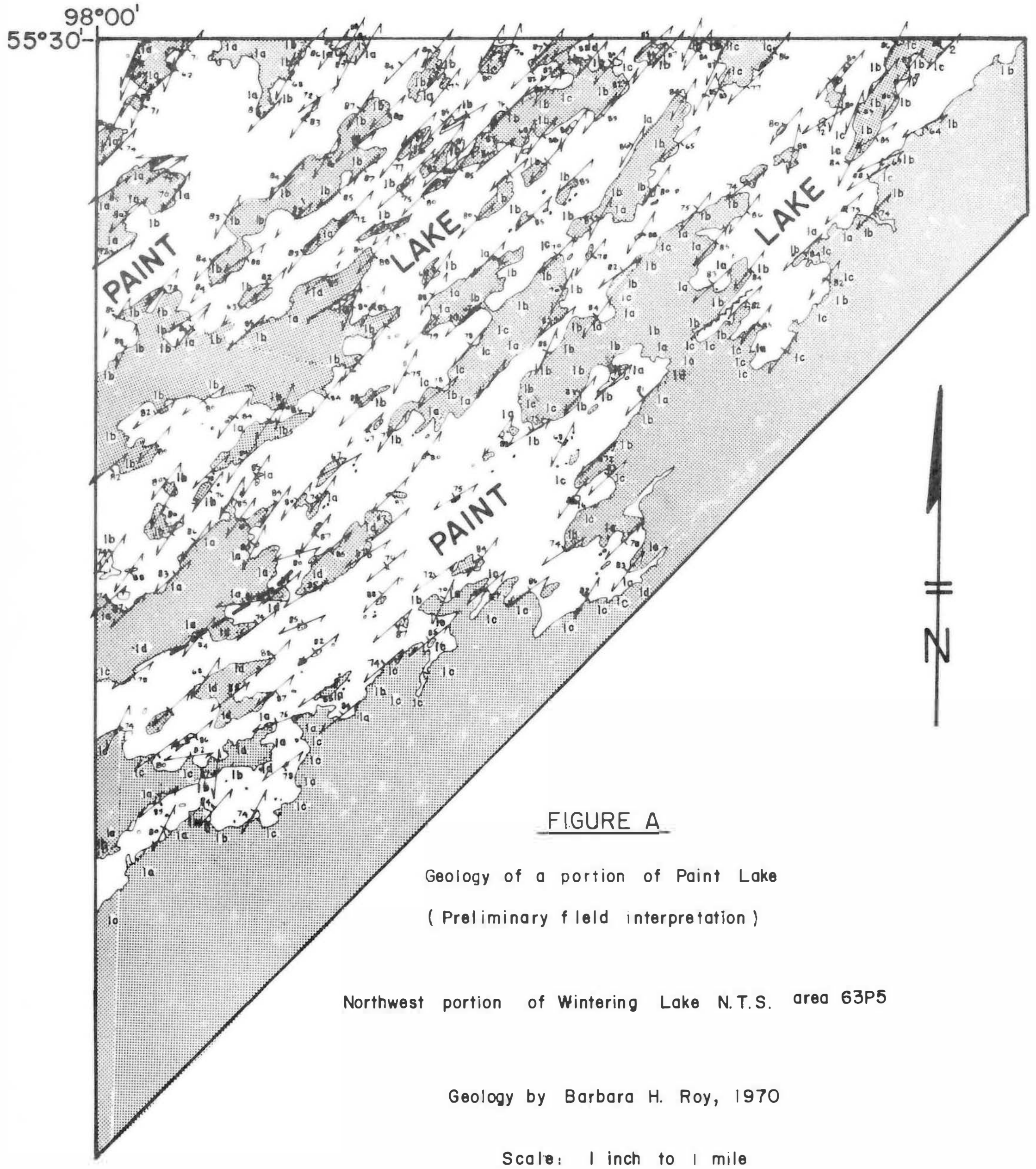

FIGURE A

Geology of a portion of Paint Lake

(Preliminary field interpretation)

Northwest portion of Wintering Lake N.T.S. area 63P5

Geology by Barbara H. Roy, 1970

Scale: 1 inch to 1 mile

LEGEND

SYMBOLS

Strike and dip

Geological contact

Shoreline outcrops

ROCK TYPES (not necessarily in chronological order)

2 Magnetite granite

Coarse grained pink magnetite granite and pegmatite. Intrusive into country rocks.

Id Gneissic granodiorite

Fine to medium grained grey to buff gneissic granodiorite.

Ic Granitized gneiss

Highly granitized gneisses intermediate in texture and composition between map units Ib and Id.

Ib Granodioritic to tonalitic gneiss

Layered fine to medium grained, light to medium grey biotite granodioritic to tonalitic gneiss with remnant inclusions and layers of amphibolite. Locally contains garnets. Probably includes some pyroxene granulite facies rocks. Many outcrops contain many lit-par-lit granitic layers.

Ia Mafic gneisses and pyroxene granulites

Fine to medium grained, dark grey hornblende-plagioclase-quartz gneisses, layered gneissic amphibolites; considerable garnet in some outcrops. Includes many less mafic layered rocks which are probably of pyroxene granulite facies.

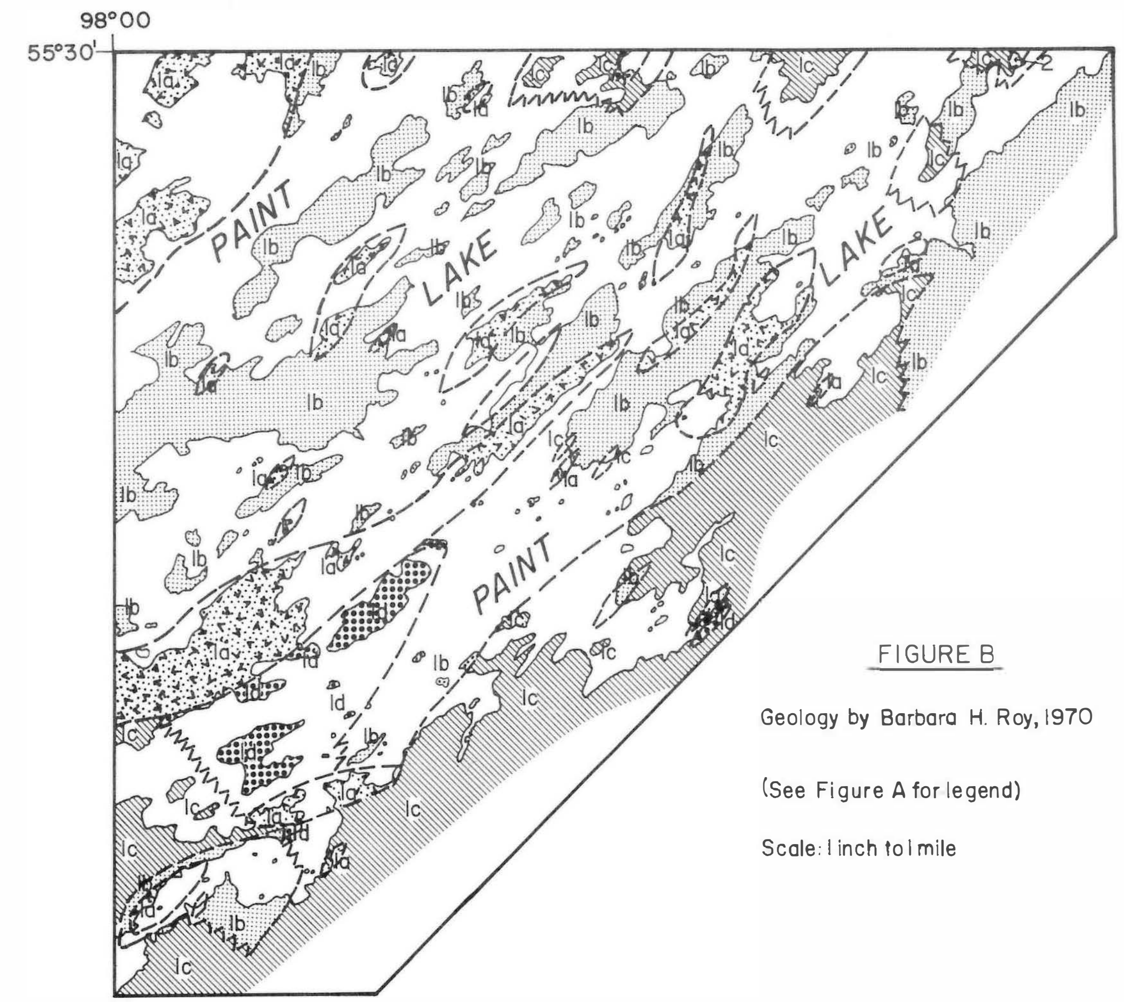

FIGURE B

Geology by Barbara H. Roy, 1970

(See Figure A for legend)

Scale: 1 inch to 1 mile

(5) ULTRAMAFIC PROJECT

by R. F. J. Scoates

As a result of involvement with the GAC/MAC meetings the field and laboratory studies of Manitoba ultramafic rocks have been somewhat interrupted. One field party led by D. L. Trueman initiated work on the Bird River Sill during the 1970 field season. An area covering the Chrome and Page properties along the south limb of the sill has been mapped at a scale of 1 inch to 1,320 feet. A detailed section of part of the Chrome property has been mapped at a scale of 1 inch to 330 feet. In the area mapped, 10 layers comprising eight units have been assigned to the 2,500 feet thickness of the sill. In addition 18 chromitite-chromiferous periodotite layers have been recognized.

Occurrences of talc schist on Iskwasum Lake found during the 1969 field season were investigated in conjunction with B. B. Bannatyne, Industrial Minerals Geologist. Details of this investigation may be found in the Industrial Minerals section of this publication.

Present plans for 1971 are:

1) to extend the work initiated on the Bird River Sill in order to map the north and south limbs. The mapping will be continued at a scale of 1 inch to 1,320 feet and in more detail where warranted.
2) to investigate the ultramafic bodies of the Oxford-Knee Lakes, Carrot River and Cross Lake areas.
3) to map exposures of the Fox River Sill, described in the 1969 Summary of Field Work, at a scale of 1 inch to 660 feet.
4) to study ultramafic bodies associated with gabbroic rocks in the Reed Lake area and the small ultramafic bodies of the Duval-Russick Lakes area.
5) to continue laboratory studies and compilations now in progress.

References Cited:

Scoates, R.F.J. 1969: Ultramafic Project; in Summary of Geological Fieldwork 1969, Manitoba Mines Branch, Geol. Paper 4/69.

Trueman, D.L. 1970: Geology of the Chrome and Page Properties: Bird River Sill; Manitoba Mines Branch Preliminary Map 1970A.

(6) BURNTWOOD PROJECT
PRELIMINARY INVESTIGATIONS OF THE
NELSON HOUSE-PUKATAWAGAN REGION, MANITOBA (63N, 630)

by W. D. McRitchie

During parts of June and July a four-week feasibility study was conducted in the Nelson House-Pukatawagan region, with the aim of evaluating the validity of existing information, the economic potential and the geological setting of the area. Two weeks were spent in shorelining the Churchill River between Nelson Lake through Pukatawagan to Britton Lake, and a further ten days, based at Nelson House, in shorelining and flying the Rat, Footprint and Burntwood Rivers region. Particular attention was directed throughout the investigation to electromagnetic and aeromagnetic anomalies, mineral occurrences and established lithological units.

Regional Geological Setting

The Nelson House-Pukatawagan region is characterized by an aeromagnetic plateau that shows little or no variation over the whole area. Isolated highs near Nelson House are developed in association with magnetite-bearing pink, potassic, synkinematic pegmatite, quartz monzonite, granodiorite and aplite.

In contrast to the report by Harrison (1949) the entire Nelson Lake-Sisipuk Lake belt appears to be predominantly paragneissic in composition. In view of the fact that most of the exposures examined were lake-side and river-side outcrops, a bias could have influenced the proportions of granite and gneiss that were exposed. This appears doubtful however, if reference is made to the more thoroughly mapped regions to the south. Here the development of lakes and rivers appears almost independent of the underlying lithologies. Consequently a continuous belt of variously metamorphosed sedimentary gneisses exists between Thompson and the Saskatchewan border, in an east-west direction, and between the metavolcanic belts of Lynn Lake and Flin Flon, in a north-south direction. Considerable revision of existing maps and regional concepts of the distribution of the Churchill block metasedimentary environments is, therefore, required.

Barry (1965, 1966), in mapping the trophy and Suwannee Lakes regions to the north, concluded that the high grade gneisses in the southern parts of those areas were derived from the Wasekwan sediments and, therefore, underlay the Sickle-Wasekwan unconformity. These gneisses, in composition, texture and structure, appear directly continuous with those mapped in the present area at Highrock Lake. Consequently it seems reasonable to tentatively correlate the gneisses of the Nelson House-Pukatawagan region with the Wasekwan, since no major structural or stratigraphical discontinuity has been observed. In the south, correlation is less definite, and the gneisses may simply be referred to the Kisseynew gneissic complex with affinities to the Nokomis rather than Sherridon (Pollock, 1964, 1965).

The following units were encountered during the course of the present study. Their distribution is illustrated in Preliminary Maps 1970G-1, 2, 3 and 4.

1) Metasedimentary psammitic to semi-pelitic greywacke.
2) Granitized migmatitic paragneisses and schist.
3) Anorthositic gabbro.
4) Gneissic granodiorite - tonalite.

5) Porphyritic granodiorite (metamorphosed).
6) Quartz monzonite and pegmatite.
7) Pegmatite.
8) Felsitic granodiorite dykes.
9) Hornblende-biotite quartz monzonite.
10) Ultramafic dyke.

Mineralization

All occurrences of mineralization indicated by Quinn (1954) were verified during the present study. A sample taken from pits approximately located at latitude $98^{o}50'$ and longitude $55^{o}52'$ assayed Ag nil, Ni. 0.03%, Zn 0.02%. Several new locations of sulphide mineralization were recorded in the west on Highrock Lake and the Churchill River. Most have been previously sampled and a few pitted. Pyrite, pyrrhotite, magnetite and graphite were the most common minerals found. Throughout the area the mineralization appeared in part to be dependent on the original composition of the host rocks in which it was developed. In particular, mineralization is commonly associated with hornblende-rich varieties of the paragneisses.

Structure and Metamorphism

The predominant trend of the layering varies between west-northwest and east-northeast. Dips are frequently shallow for the Precambrian (0 - 50^{o}) and mainly to the north and northeast. Locally the foliation and layering swing around the noses of synformal basins that are elongated parallel to the main strike of the layering. A repeated, zonal, monoclinal Z warping is present throughout the western area, and culminates at Highrock Lake, where the main trend swings sharply to the southeast and south. To the east, the west-northwest trend is repeatedly obscured by cross folding of increasing intensity on northeast-southwest axes, and a series of tightly folded alternating domes and basins more characteristic of the Kisseynew gneisses and the Snow Lake area is developed. The frequency of these late fold axes increases to the east of the mapped area, and appears to culminate in the "Thompson Axis".

Faulting is predominantly north-south, with a tendency to be west of south in the west, and east of south in the east. A second set, less well developed, strikes at 070 - 090 and a third set, almost entirely confined to the west, strikes at 320. Retrogression associated with each fault zone has normally involved intensive granulation, development of chlorite, muscovite and sulphides, and pinking of feldspars.

With the exception of units 9 and 10 the rocks have all been metamorphosed to the upper or lower amphibolite facies. In most cases this has not resulted in the destruction of the original bedding, although matrix coarsening and recrystallization have inevitably obscured many of the original finer sedimentary textures and bedding-top criteria. The initial phase of recrystallization resulted in the ubiquitous generation of garnet porphyroblasts. In the east, considerable amounts of cordierite and lesser amounts of sillimanite developed at slightly higher grades. In the west cordierite and sillimanite are less abundant. Typical assemblages for the gneisses include:

Cordierite-almandine-sillimanite-microcline-An 30-40-biotite-quartz;

Almandine-biotite-andesine-quartz;

Microcline-sillimanite-almandine-An 12-quartz.

Subsequent to the initial recrystallization of the gneisses, intense symmetrical folding occurred about west-northwest trending axes and was accompanied by development of an intense axial planar fabric. On the Loon River these axes strike north-south and are marked by the occurrence of abundant white pegmatites emplaced parallel to the axial planes of the tightly folded migmatitic paragneisses.

Within schistose horizons a matrix coarsening and second generation of garnet accompanied the formation of the axial planar biotite foliation, and in the more quartzitic units *lit-par-lit* layering developed. Throughout the area vague traces of the original bedding can be observed on clean outcrops as elongate Z's and S's, sandwiched between and truncated by the axial planar metamorphic layering, the latter defined by pegmatitic and tonalitic *lit*. During the waning stages of this recrystallization, retrogressive biotite progressively replaced the earlier garnet. Advanced stages of garnet replacement are most evident near Wimapedi Lake in the south and Sisipuk Lake in the west.

The newly formed layering and foliation is itself refolded on northwest-trending axes. The short limbs of these folds give way to 320 faults preferentially developed in the west near Pukatawagan and Sisipuk Lake. Subsequent Z warping and folding on axes parallel to the Thompson belt predominated with increasing frequency in and to the east.

A brief, tentative history of deformation may be summarized as follows:

D_4 Faulting north-south

D_3 Folding and faulting northeast-southwest (Thompson Axis)

D_2 Folding and faulting northwest-southeast (320^o)

D_1 Folding and development of main axial planar foliation and layering

References Cited:

Harrison, J.M. 1949: Kississing Map-Area; Saskatchewan - Manitoba G. S. C. Map 970A.

McRitchie, W.D. 1970: Manitoba Mines Branch Preliminary Maps 1970 G 1, 2, 3 and 4.

Quinn, H.A. 1955: Nelson House, Manitoba; G. S. C. Paper 54-13: map with marginal notes.

(7) KASMERE LAKE PROJECT

(64N)

by W. Weber

Intensive exploration for uranium and base metals started a few years ago in the extreme northwestern corner of Manitoba (64N). Geologically this area covers the north-easterly extension of the Wollaston Lake belt (Money, 1968). The only available geological map of this area is a 1 inch to 4 mile G. S. C. Preliminary Map by Fraser (1961) which is insufficient for today's exploration activities. Prior to the start of a remapping program involving this area it appeared to be advisable to undertake a reconnaissance trip to clear some points, especially (i) quality of previous mapping, (ii) outcrop conditions, (iii) unusual geographical circumstances.

The reconnaissance was undertaken by the writer from July 29 - August 7, assisted by P. D. Hoffman. The area between Kasmere Lake, Hasbala Lake, Snyder Lake and Misty Lake was investigated by aircraft, boat and foot traverses. The findings are as follows:

(i) The quality of the previous mapping appears to be fairly good on that scale considering the short time available for the large area. However, it was found that certain areas mapped as granitic rocks are paragneiss-metasedimentary rocks which are of economic importance. The quality of mapping can be improved, in certain areas to a considerable degree.

(ii) Outcrops are generally very sparse. Owing to an extensive and thick glacial cover of sand, gravel and boulders, only about 1% or less of the area has bedrock exposure. Existing outcrops are usually large and good, but their distribution is irregular. Some areas have plenty of outcrop, while other large areas have none at all.

(iii) Many of the lakes are too shallow for aircraft to land on.

References Cited:

Money, P.C. 1968: The Wollaston Lake fold-belt system, Saskatchewan - Manitoba; Can. J. Earth Sci., 5:1489-1504.

Fraser, J.A. 1961: Kasmere Lake, Manitoba; Geol. Surv. Can., Preliminary Map 31 - 1962.

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

(8) PROJECT PIONEER

(52L-11, 12, 13, 14; 52M-3, 4; 62P-1)

by W. Weber and W. D. McRitchie

The maps and reports by the two authors are in the final stages of preparation, and are scheduled for publication in 1971 by the Manitoba Mines Branch. This publication will also contain contributions from the University of Manitoba, including summaries of M.Sc. and Ph.D. theses, and projects undertaken by the staff of the Department of Earth Sciences.

(9) LAKE ST. MARTIN - A CRYPTO-EXPLOSION OR CRATER STRUCTURE

by H. R. McCabe and B. B. Bannatyne

A preliminary report on the Lake St. Martin structure has been completed and is in press. Studies involved petrographic examination and more detailed correlation of carbonate strata. Occurrence of carbonate breccias around the rim of the structure is more extensive than previously believed, and almost certainly includes strata of Devonian or younger age. In particular, one 87-foot section of mottled high-calcium limestone in hole No. 6 appears identical to the Middle Devonian Elm Point limestone.

Petrographic studies of the St. Martin breccias, trachyandesite, and basement gneissic core confirmed the widespread distribution of shock-metamorphosed material, ranging from relatively low grade development of planar features to completely melted or glassy (isotropic, thetomorphic) phases of quartz and feldspar, accompanied by intense recrystallization. Although these shock metamorphic features are highly characteristic of meteorite impact craters and also occur at atomic test sites, some workers contend that shock metamorphism can also be caused by explosive volcanic activity. The present study has not resolved the controversy as to a meteoritic or volcanic origin of the Lake St. Martin crater.

The state of preservation of the crater structure and infill for the Lake St. Martin crater appears to be better than for any other Canadian crater. Although further studies will require additional drilling as well as detailed petrographic and mineralogic examination of the presently available material, the Lake St. Martin crater may eventually provide sufficient information to clarify the genesis of crypto-explosion craters of this type.

(10) MINES BRANCH CORE HOLE PROGRAMME FOR STRATIGRAPHY AND INDUSTRIAL MINERALS

by H. R. McCabe and B. B. Bannatyne

A core hole programme, utilizing Mines Branch staff and equipment, was initiated in 1969, and continued during 1970 with a total of 14 holes drilled or deepened, for a total drilled footage of 1430 feet. A summary table of drill results is attached. Drilling commenced May 20 and was terminated September 17. The objective of the programme was to obtain stratigraphic information not otherwise available because of the scarcity of outcrop. In addition, several test holes were located specifically to evaluate high-calcium limestone deposits, and also to test the capability of the rig to penetrate overburden and to recover core from poorly consolidated shale, sand and lignite deposits.

Four holes were drilled in the Ordovician and Silurian strata of the South Interlake Area to supplement the previous year's drilling and to obtain information for the stratigraphic project being carried out by J. Cowan (see under Stratigraphic Studies in this publication). One of the holes, M-1-70, intersected an 80-foot section of the upper dolomite unit of the Red River Formation (Fort Garry Member) consisting primarily of a compact sub-lithographic dolomite that could possibly provide an additional source of aggregate material for the Winnipeg area.

Two holes, M-2-70 and M-4-70, were drilled specifically to test the high-calcium limestone of the Elm Point Formation (see under Industrial Minerals in this publication). A good intersection was encountered in hole M-2-70, but hole M-4-70 showed only a poor development of limestone with most of the section consisting of dolomite and calcareous dolomite. This indicates that the Elm Point limestone grades laterally to dolomite (Winnipegosis facies) within the outcrop belt, and it seems probable that the Elm Point represents only a local inter-reef facies. Hole M-2-70 was drilled through a Winnipegosis reef structure in an attempt to determine if the reef is underlain by Elm Point limestone, but poor hole conditions caused premature abandonment before reaching the objective horizon.

Hole M-6-70 obtained an almost complete section of the Devonian Dawson Bay Formation, including some high-calcium limestone intersections. Holes M-7-70, M-8-70, and M-9-70a, b, tested the high-calcium limestone beds in the lower part of the Devonian Souris River Formation (Point Wilkins equivalent). Hole M-7-70, drilled 8 miles east of the limit of Jurassic cover, intersected the thickest section of Souris River strata yet obtained in the Manitoba outcrop belt; exceptional cavernous porosity was encountered in holes M-7-70 and M-8-70.

Holes M-10-70a, b, c were drilled to test the Jurassic shale section and the limestone section of the Jurassic Reston Formation. Good to excellent core recovery was obtained except where unconsolidated sand was encountered.

Hole M-11-70 tested the shale and lignite beds of the Turtle Mountain Formation (Paleocene). Core recovery was excellent and lignite intersections of 3 feet and 1 foot were encountered.

A by-product of the drilling programme has been the considerable interest shown by local residents in some areas as to the nature of the formation waters encountered. Some areas drilled (e.g. vicinity M-8-70) do not have a suitable water supply. Because of this, tests of formation fluids are being carried out to determine the salinity and potability of the formation waters. Hole M-6-70 encountered a strong flow of artesian water (estimated head: 25 feet) on penetrating a Winnipegosis reef; salinity, however, was approximately 8,000 ppm.

In summary, excellent recovery was reported from all formations drilled, and a minimum of technical difficulty was encountered. Drilling through overburden (hole M-1-70) has proven to be quite feasible, with the lightweight rig, and testing of shale and lignite deposits can be carried out satisfactorily. A continuation of the present drill programme is planned, but specific objectives will have to await more detailed studies of this year's results. A report on the results of the drilling is to be prepared and issued in the Geological Paper Series.

Summary Table of Core Hole Data

Hole No.	Location	Formation	Interval	Summary Lithology
M-1-70	27-13-3E	Red River	0- 22	Overburden
		Fort Garry Member	22-102	Dolomite sublithographic
		Selkirk Member	102-205	Dolomitic limestone
M-2-70	SE1-5-21-6W	Elm Point	0- 43	Limestone, high-calcium
		Ashern	43- 57	Argillaceous dolomite
M-4-69 (deepened)	11-18-1W	Stonewall	100-115	Dolomite
		Stony Mountain	115-129	Dolomite, argillaceous, sandy
M-3-70	NE15-24-10W	Winnipegosis	0- 80	Dolomite, reefoid
M-4-70	NE14-23-8W	Elm Point/Winnipegosis	0- 51	Dolomite and dolomitic limestone, interbedded
		Ashern	51- 54	Red argillaceous dolomite
M-8-69 (deepened)	3-7-20-4W	Interlake Group	120-181	Dolomite
M-5-70	SE14-18-2W	Interlake Group	0- 60	Dolomite
M-6-70	NE¼-16-30-17W	Dawson Bay	0-150	Limestone,dolomite,shale
		Winnipegosis	150-175	Dolomite (artesian salt water)
M-7-70	SE¼-16-31-18W	Souris River	0-158	Limestone,dolomite,shale
		Dawson Bay	158-195	Dolomite
M-8-70	13-34-32-20W	Souris River	0-105	Limestone, calcaerous shale, breccia
		Dawson Bay	105-164	Dolomite, calcareous shale
M-9-70a	15-29-44-25W	Souris River	0- 54	Limestone, dolomitic limestone (abandoned in sand-filled cave)
M-9-70b	3-32-44-25	Souris River	0- 59	Limestone, shale
M-10-70a	SE¼-21-23-15W	Swan River	0- 35	Silica sand
M-10-70b	5-22-23-15W	— —	0- 17	Overburden
M-10-70c	5-22-23-15W	Melita	0- 73	Shale, calcareous sandstone
		Reston	73- 94	Limestone, shale
M-11-70	8-25-1-24W	Turtle Mountain	0- 99	Shale, sandstone, lignite

(11) INDUSTRIAL MINERALS

by B. B. Bannatyne

a) High-calcium limestone project

In 1970, the locations of 7 of the Mines Branch core holes* were picked to provide additional information on Devonian and Jurassic limestone. This and other recent work has indicated the occurrence of high-calcium limestone beds in the Red River, Dawson Bay, Souris River and Reston Formations, as well as possible Devonian limestone associated with the Lake St. Martin crater structure.

Analysis of particularly good chip samples from a structure test hole drilled by Sun Oil Limited in SE¼-24-11-1WPM (Headingley area) indicated the presence of beds of high-calcium limestone in the upper, predominantly dolomitic part of the Red River Formation; this section, overlying the Selkirk Member, has recently been defined as the Fort Garry Member, which forms the bedrock under most of the Winnipeg area. Chemical analyses are being made to determine the extent of the limestone beds in the formation; preliminary indications are that these high-calcium limestone beds are of widespread distribution, but of variable thickness and quality. An analysis of the limestone from the Fort Garry Member from core hole LSM No. 11 in the Lake St. Martin area (obtained during the F.R.E.D. Interlake drillers' training programme) is shown in the table, sample 1. Another previously unknown high calcium limestone bed, 20 feet thick, occurs in the upper part of the Selkirk Member in the same core hole (table, samples 2 and 3); this is some of the purest limestone yet reported from Manitoba. Also in the Lake St. Martin area, and located within the crater structure in that area, a core of possible Devonian Elm Point limestone was intersected in LSM No. 6, from a depth of 70 to 150 feet. An average analysis is shown in the table, sample 4.

Cores of Devonian Elm Point, Souris River, and Dawson Bay Formations were obtained from 7 Mines Branch core holes. Initial assay results are summarized in the table for the Elm Point and Dawson Bay Formations; analyses for the Souris River Formation are currently being made. At the Lily Bay location, 16 feet of magnesian limestone is present (sample 5) overlying a 24.5-foot section of high-calcium limestone (sample 6). Analyses indicate the occurrence of at least a 40-foot section of high-calcium limestone within the Dawson Bay Formation (samples 7 and 8). Core of the Souris River Formation was obtained from 4 Mines Branch core holes (M-7-70, M-8-70, M-9-70, M-9B-70). Preliminary stain tests indicate two major high-calcium limestone zones, one 30 feet thick, the other over 50 feet thick, that are separated by a zone of mixed dolomite, limestone and shale. A typical analysis from an outcrop of this formation (sample 13 miles north of Mafeking) is 97.91% $CaCO_3$, 1.43% $MgCO_3$, 0.35% $Al_2O_3 + Fe_2O_3$, and 0.43% SiO_2.

One Mines Branch core hole intersected part of the Jurassic Melita and Reston Formations. Analyses of the limestone intersected are being made; a previous analysis from an outcrop sample from SW¼-4-24-15WPM showed 93.2% $CaCO_3$, 1.25% $MgCO_3$, 1.37% $Fe_2O_3 + Al_2O_3$, and 4.39% SiO_2.

* See "Mines Branch Core Hole Programme for Stratigraphy and Industrial Minerals" in this publication.

b) **Talc and soapstone**

An examination of talc deposits on the west arm of Iskwasum Lake was made, with R. J. F. Scoates, in July, 1970. Four occurrences were sampled; thin sections have been prepared and samples submitted for chemical analysis. Preliminary studies indicate that the talc-soapstone zones, which occur as border zones or shells around at least three discrete serpentinite bodies, are composed primarily of talc and carbonate with some magnetite, minor serpentinite and in places, red iron oxide. Talc and soapstone are used primarily in paint, rubber, ceramics, insecticides, paper, pharmaceuticals, and roofing. Development of these deposits, which are mineralogically fairly simple and should be amenable to beneficiation, will depend primarily on availability of markets.

c) **Other projects**

During the year, reports on the clay and shale deposits of Manitoba (Manitoba Mines Branch Publication 67 - 1), the Lake St. Margin crypto-explosion crater (co-authored with H. R. McCabe: Manitoba Mines Branch Geological Paper 3/70), bedrock topography map of southern Manitoba (co-authored with R. W. Klassen and J. E. Wyder, Geological Survey of Canada Map 25 - 1970), and an annotated bibliography of studies in the Lake Agassiz region (co-authored with S. C. Zoltai and M. J. Tamplin, Manitoba Mines Branch Geological Paper 2/70), either were published or are in press. A paper on the industrial mineral deposits of the sedimentary area of southern Manitoba was presented at the Geological Association of Canada/Mineralogical Association of Canada 1970 annual meeting in Winnipeg.

Core obtained in the Mines Branch core hole programme included 73 feet of variegated shale from the Jurassic Melita Formation, and 99 feet of silt, silty shale, and plastic shale from the Turtle Mountain Formation. In the latter hole, lignite beds, 3 feet thick and 1 foot thick, were intersected at depths of 88.9 feet and 94 feet respectively.

Table: Summary analyses of high-calcium limestone

Sample	1	2	3	4	5	6	7	8
SiO_2 %	0.50	0.45	0.22	0.92	1.20	1.09	2.67	6.53
Al_2O_3	0.31	0.31	0.28	0.21	0.22	0.16	0.27	0.56
Fe as Fe_2O_3	0.20	0.08	0.06	0.23	0.20	0.23	0.20	0.43
MgO	2.15	0.29	0.26	0.81	3.20	1.95	0.61	0.54
CaO	53.07	55.34	55.51	54.04	51.45	52.91	53.40	50.24
P_2O_5	Nil	Nil	0.31	0.08	0.01	0.01	0.01	0.04
S	n.d.	n.d.	n.d.	n.d.	0.09	0.09	0.12	0.17
LOI	43.86	43.59	43.68	43.28	43.66	43.48	42.80	41.20
Total %	100.09	100.06	100.32	99.57	99.74	99.92	100.08	99.71
$CaCO_3$	94.72	98.77	99.07	96.45	91.84	94.43	95.31	89.67
$MgCO_3$	4.50	0.61	0.54	1.69	6.69	4.08	1.28	1.13

1) LSM No. 11: SE¼ sec. 2, tp. 35, rge. 7WPM (20 miles NE of Gypsumville); 5 - foot section 192 to 197 feet; top of Fort Garry Member was picked at 176 feet.

2) LSM No. 11: 285 to 295 feet.

3) LSM No. 11: 295 to 305 feet.

4) LSM No. 6: SE¼, sec. 16, tp. 39, rge. 9WPM (2 miles SW of Gypsumville); average of 5 analyses made on the 80 - foot section of core from a depth of 70 to 150 feet.

5) Hole M-2-70: Lily Bay, SE l.s.d. 1, sec. 5, tp. 21, rge. 6WPM; depth 0 to 16 feet; Elm Point Formation.

6) Hole M-2-70: Depth: 16 feet to 40.5 feet; Elm Point Formation.

7) Hole M-6-70: Volga, NE¼, sec.16, tp. 30, rge. 17WPM; depth 66 feet to 86 feet; Dawson Bay Formation.

8) Hole M-6-70: Depth: 86 feet to 106 feet; Dawson Bay Formation.

ADDENDUM

Additional analyses indicate the zone from 0 to 8 feet in hole M-6-70 assayed 96.68% $CaCO_3$ and 0.83% $MgCO_3$ (Dawson Bay Formation); the zone from 0 to 29.5 feet in hole M-7-70 averaged 94.47% $CaCO_3$ and 1.46% $MgCO_3$, and the zone from 60 to 100 feet in the same hole averaged 96.52% $CaCO_3$ and 0.77% $MgCO_3$ (Souris River Formation).

(12) STRATIGRAPHIC STUDIES

by H. R. McCabe

Compilation of subsurface geologic data continued. As of October 1 a total of 55 oil wells (7 field, 48 wildcat) were released from the confidential files. Formation tops were determined for these wells and the data issued in the Schedule of Wells, by the Petroleum Engineering Division. Most of these data have been added to the Stratigraphic Map Series and all of the maps should be revised and up to date by year end. Data supplements for the "Table of Lower Paleozoic Formation Tops" and "Table of Lower Paleozoic Drill Stem Tests and Oil and Gas Shows" have been compiled and will be issued shortly. A "Table of Lower Paleozoic Formation Water Analyses" has also been prepared.

Oil exploration continued at a slow pace during 1970, with a total of only 13 wells drilled (6 wildcat, 7 field). Core for 4 wells and samples for 12 wells were added to the core and sample library. In addition, samples were received from the Water Resources Branch for 16 selected shallow test holes.

The most notable of the core holes was the Whitebear Creek No. 1 S.T.H., drilled on the shore of Hudson Bay a short distance north of York Factory. This is the third onshore well to be drilled in the Hudson Bay area of Manitoba; the hole was abandoned at a depth of 1401 feet, and provided a complete core of the lower Paleozoic section.

Two field trips were conducted in conjunction with the 1970 Annual Meeting of the Geological Association of Canada, held in Winnipeg. Field guide books were prepared for the following:

(1) Lower Paleozoic of the Interlake Area, Manitoba.

(2) Paleozoic and Mesozoic of the Dawson Bay Area and Manitoba Escarpment, Manitoba.

These field guides are to be published.

A report on the Ordovician and Silurian Stratigraphy of the South Interlake Area is presently being compiled by J. Cowan as part of a thesis project at the University of Manitoba. This study is utilizing all available core and outcrop data and is intended to provide more accurate correlation, improved definition of stratigraphic units, and a more complete description of the lithology of the various formations than was previously available from the limited outcrop section. This report will be issued in the Geological Paper Series.

(13) GEOLOGICAL ASSOCIATION OF CANADA MINERALOGICAL ASSOCIATION OF CANADA ANNUAL MEETING

WINNIPEG 1970

by R. F. J. Scoates

In January, 1967, the Department of Mines and Natural Resources extended an invitation to the Geological Association of Canada to hold its 1970 Annual Meeting in Winnipeg. The G. A. C. council subsequently accepted this invitation.

The meetings were held on the campus of the University of Manitoba from August 30 to September 2, 1970. A total of 125 scientific papers were presented during the three days of technical sessions. Some 380 geologists from across Canada and seven foreign countries attended.

The programme was highlighted by a symposium entitled Geoscience Studies in Manitoba. A total of 41 papers were delivered, touching on economic geology, Precambrian studies of various types, sedimentation and stratigraphy, geohydrology, permafrost and Quaternary geology, and geomorphology. Special sessions dealing with lunar geology, pegmatite minerals, history of Canadian geologists and the Science Council's special study of solid earth sciences in Canada were also held.

Seven field trips in various parts of Manitoba attracted 160 participants. Four trips to Precambrian areas covered the Moak-Setting Lakes belt, the Flin Flon - Snow Lake - Lynn Lake areas, the Bird River area and the Bissett - Lac du Bonnet area. Aspects of Precambrian structure and lithology, economic geology, and stratigraphy and sedimentation received a thorough discussion by the participants. Two trips were concerned with the Paleozoic and Mesozoic rocks of southern Manitoba and one trip involved the surficial geology and Pleistocene stratigraphy between the Red and Winnipeg Rivers.