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MANITOBA

DEPARTMENT OF MINES, RESOURCES AND ENVIRONMENTAL MANAGEMENT

MINES BRANCH

GEOLOGICAL PAPER 2/73

SUMMARY OF GEOLOGICAL FIELD WORK 1973

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PREFACE

Field work by the Provincial Geological Survey in 1973 resulted in the consolidation of progress made in the previous two years, and completion of the field component for most of the current projects.

Field work for the three major regional mapping projects was completed on schedule: a final report on the Kasmere project is now in preparation, and reports on the Burntwood and Greenstones projects will be prepared following completion of data analysis.

Geochemical investigations were hampered by continuing delay in the establishment of new laboratory facilities. Field sampling, however, was carried out on brine springs in the Lake Winnipegosis area and in the Fox and Ruttan Mines, the latter through the courtesy of Sherritt Gordon Mines Limited.

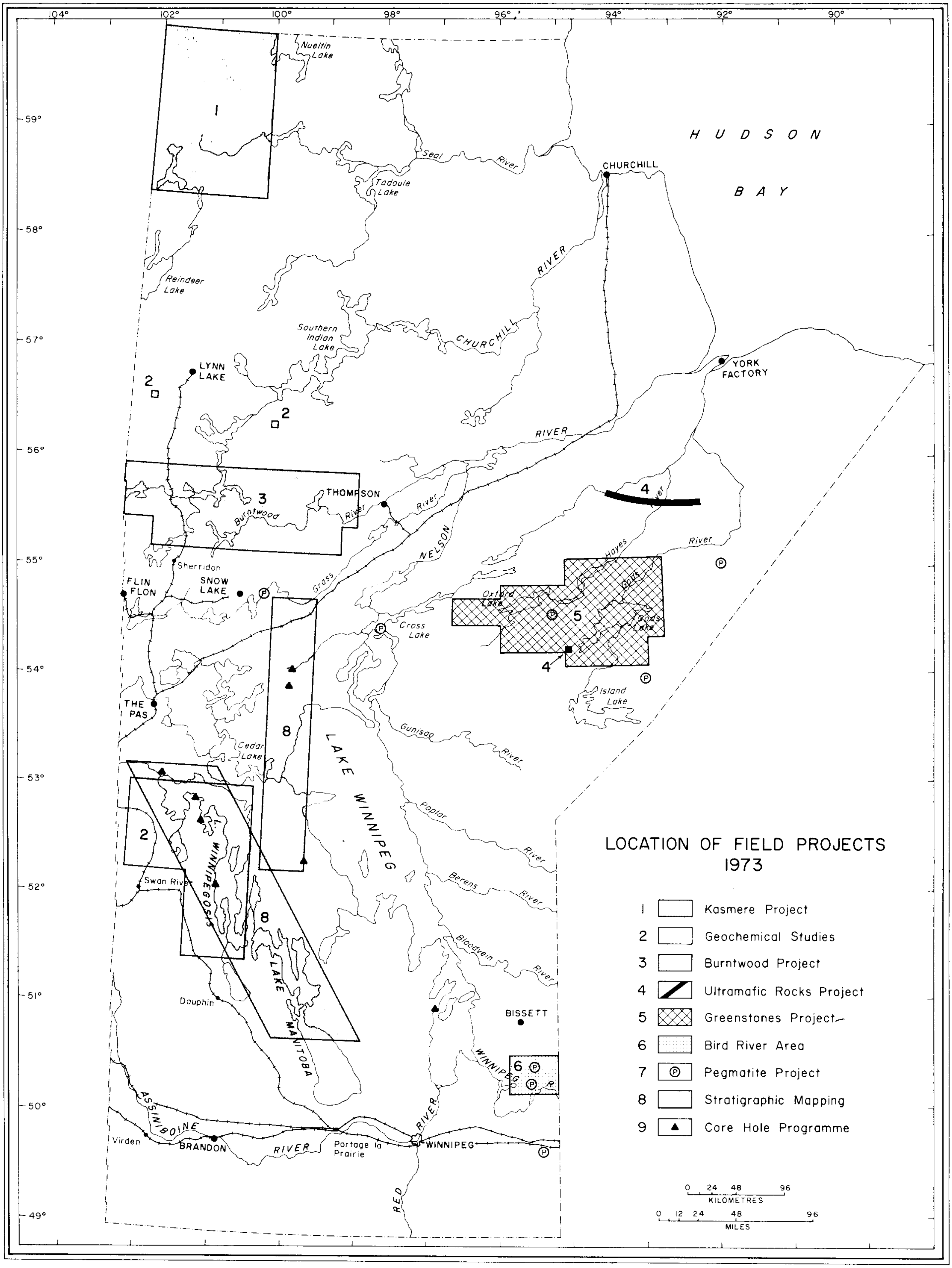
Sampling and preliminary examination of approximately 80,000 feet of diamond drill core from the Fox River sill was completed. This project, commenced in 1972, comprises the major part of an ongoing study of the Fox River sill and its environment, and was made possible through the courtesy of The International Nickel Company of Canada, Limited.

Investigation of the pegmatites containing rare element minerals was expanded to the northern part of the province and an additional 31 pegmatite deposits were examined.

Stratigraphic studies comprised a continuation of the Devonian mapping project begun in 1972, together with detailed mapping in the Grand Rapids area to define more accurately the distribution of Silurian and Ordovician strata. The stratigraphic core hole programme was utilized to obtain additional data in both these projects.

October 10, 1973

I. Haugh
Chief Geologist



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Southern Indian Lake
LYNN LAKE
YORK FACTORY
RIVER
THOMPSON
Burntwood River
Nelson River
Hayes River
Sherridon
FLIN FLON
SNOW LAKE
Grass River
Oxford Lake
Gods Lake
Cross Lake
Island Lake
THE PAS
Cedar Lake
Gunisao River
LAKE WINNIPEG
Poplar River
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Swan River
Berens River
Bloodvein River
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ASSINIBOINE RIVER
Virden
BRANDON
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(1) KASMERE PROJECT

(64N and northern half of 64K)

by W. Weber

A brief visit was made into the project area to inter-relate regions mapped by the four project geologists during the two previous summers, and to check critical and problematic locations.

It is planned to prepare the results of the Kasmere project for publication in the spring of 1974. The publication will consist of a single report covering the areas mapped by the four project geologists; 24 maps at a scale of 1:50,000; one compilation map at a scale of 1:250,000, and several special maps.

(2) GEOCHEMICAL STUDIES

by J.F. Stephenson

Two geochemical sampling projects were undertaken by a 3-man party during the 1973 field season. A surficial geochemical survey was conducted on the mineral springs of western Manitoba as a means of evaluating the base metal potential of the Paleozoic Formations especially the Devonian in that region. The sampling of the springs is being carried out in conjunction with trace element analysis of Paleozoic outcrop and drill core material collected during the Stratigraphic Mapping Programme conducted by H.R. McCabe. Rock geochemical sampling across the massive copper-zinc sulphide orebodies and host rocks at the Ruttan Lake and Fox Lake mines in the Lynn Lake district was undertaken for elemental abundance analysis and mineralogical studies.

Mineral spring sampling

Approximately 50 saline mineral springs, discharging from the Devonian outcrop belt, are distributed along the west shores of Lakes Winnipegosis and Manitoba. The springs extend in a southeasterly direction from Dawson Bay to 30 km southeast of Winnipegosis, a distance of about 210 km. The area of investigation is enclosed by latitudes 51°30' and 53°05', and longitudes 99°40' and 101°30' (Figure 2-1). A total of 46 spring and seepage locations were examined and sampled.

The purpose of this project is to evaluate the base metal potential of the Paleozoic carbonates and especially the Middle Devonian Winnipegosis and Dawson Bay Formations through trace element analysis of the brine samples. The springs apparently issue mainly from the Dawson Bay Formation although a cover of glacial overburden which blankets most of the Devonian outcrop belt makes identification of the bedrock source uncertain. Barren "salt flats" surrounding the discharge vent or seepage areas characterized most springs. The flats, consisting mainly of unconsolidated glacially derived boulders, sand-sized carbonates, and mud, weather a distinctive buff or reddish brown colour and are readily identifiable on aerial photographs. The springs are connected to subterranean flow systems which, because of their low discharge temperatures, probably circulate at shallow depths. The brines, of formational origin, can be considered large scale natural samplers of carbonate aquifer and evaporite beds. The Dawson Bay and Winnipegosis Formations, comprising mainly limestone, dolomite and minor red shale, have structural characteristics which, particularly in the Dawson Bay-Pelican Bay area, might be favourable to Mississippi Valley-type lead-zinc deposits. In this region salt solution has produced slumping of the Dawson Bay and younger Formations resulting in gentle to pronounced folds, fracturing and brecciation around Winnipegosis reefal structures. The area of most pronounced disturbance is located over the Birdtail-Waskada Axis (McCabe, 1967)[1] which coincides with the extension of the Precambrian Churchill-Superior Boundary. The lead-zinc deposits of Pine Point occur in the Presqu'ile Formation which correlates approximately with the Dawson Bay Formation.

Most of the mineral spring localities could be reached by provincial and section roads. The remainder were reached by boat and inland traverses. At each sample site, 1 litre of brine, a minimum of 100 gm of salt precipitate, and 500 gm of black, organic-rich silty soil from below the zone of surface oxidation were collected. The brine was stored in polyethylene bottles and the salt crystals and soil were stored separately in high wet-strength paper sample bags and air dried in the field. Gas, which bubbles from most springs, was collected from four localities and the red salt plant *Salicornia heribacea*, which grows around the discharge vents, was collected from ten. Brine temperatures, measured at the point of discharge, ranged between 5 and 7 degrees centigrade. Flow rate estimates for most springs were less than 10 litres per minute and appeared to be well below the maximum at the time these estimates were made (June and July, 1973). The samples will be analyzed primarily for Cu, Zn and Pb, but the concentrations of Cl, S, Na, Ca, Mg and K in the brines and precipitates will also be analyzed as a means of determining their salt composition and possible source.

Previous analyses of the brines (e.g. Cole, 1930)[2] indicate total dissolved solids of between

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[1] McCabe, H.R. (1967): Tectonic Framework of Palaeozoic Formations in Manitoba; *In:* G.A.C. Guidebook, Field Trip No. 6, 23rd Ann. Meeting, Univ. Manitoba, Winnipeg, Canada, 1970.

[2] Cole, L.H. (1930): The Salt Industry of Canada; Mines Br., Dept. Mines, Ottawa, Bull. No. 716.

3 and 9 per cent, too low to be of commercial value. The solutes are mainly Na and Cl with minor S, Ca, Mg and K. Traces of Br, Fe, Al and I were reported for some brines. Salt was, however, produced from Monkman's Salt Works north of Winnipegosis throughout much of the nineteenth century. This was the first recorded mineral production for Manitoba (Tyrrell, 1892) [3]

Rock geochemical sampling

A series of samples were collected on single traverses across the massive copper-zinc sulphide orebodies and host rocks at the Ruttan Lake and Fox Lake mines. The purpose of this project is to study the extent and nature of the sulphide haloes and wall-rock alteration through elemental abundance profiles and mineralogical studies. Sampling at 20 to 100-foot intervals for a total distance of 1,100 feet was conducted across the west end of the Ruttan Lake orebody exposed by the open pit operation. Similar sample intervals were used for a total distance of 1,700 feet across the Fox Lake orebody on the 2,100-foot level crosscut. The courtesy and assistance extended to the writer by Sherritt Gordon Mines Limited during this sampling programme is greatly appreciated.

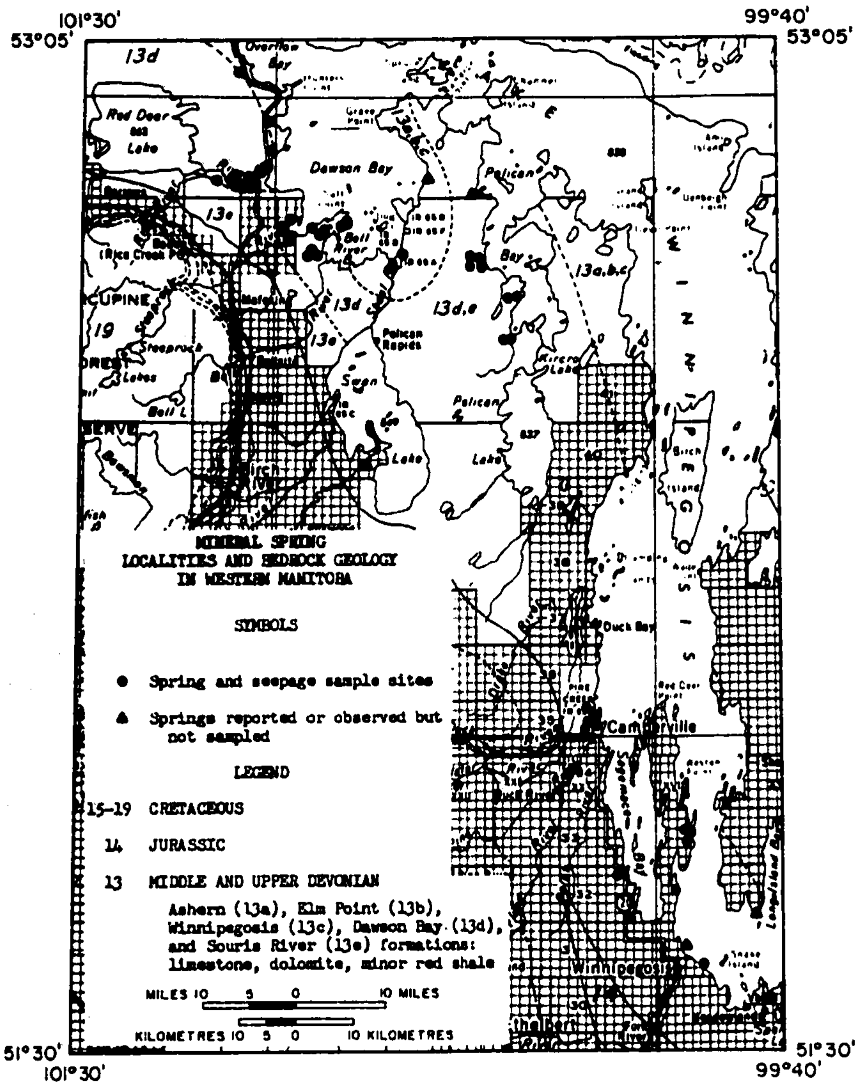

Figure 2-1

[3]Tyrrell, J.B. (1892): Report on North-Western Manitoba with portions of the adjacent districts of Assiniboia and Saskatchewan; Geol. Surv. Can., Ann. Rept., vol. V, Pt. I, p. 219E.

(3) BURNTWOOD PROJECT

(63N, 63O)

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

General

Field activities in the Pukatawagan-Nelson House region were largely directed toward completing the mapping of the project area, and enhancing the coverage obtained during 1971-72 (Figure 3-1).[1] In the west additional data were obtained along the CN rail line between Takipy and Atomic Lakes and along the Churchill River between Pukatawagan and Shaving Point. Additional traverses were also made to the south and north of Sisipuk Lake to augment the existing coverage. Particular emphasis was placed on defining the structures in the Loon River and Morin Lake cross fold zones and in relating these to the earlier west and southeast trends.

Several large sill-like bodies of gneissic norite, quartz norite and ferrohypersthene diorite, identified west of Burntwood Lake during 1972, were traced continuously a further 30 km west to Girouard and Morin Lakes. Local orthopyroxene-rich pyroxenite phases were identified downriver from Pukatawagan and south of Rafter siding on the CN railway.

Scattered occurrences of cordierite were identified within outliers of arkose-derived gneisses near Pearson Lake. These gneisses are correlated with the Sickle Group although cordierite is atypical in the normal Sickle rocks. An additional small outlier of meta-arkosic rocks, with associated basal amphilobile, was identified west of Llama Lake. New localities exposing the Sherridon-Nokomis contact, and two structural domes within the Sherridon, were recognized north and east of Kississing Lake.

To the east, freshly blasted sulphide occurrences of local extent[2] in and around Highrock Lake were re-examined and are the subject of a continuing study. In the same region intensified coverage helped define (a) the limits of the quartz dioritic-granodioritic complex at Highrock Lake; (b) the complex cross fold relationships near Hall Lake; and (c) the relative age and significance of the brittle zones of cataclasis and mylonitization.

Detailed mapping in the Notigi Lake area was conducted to augment the existing information[3] and in order to integrate this area with the regional structural and stratigraphic synthesis.

Tectonic synthesis

The following events, listed in sequence, have now been identified in the project area:

(1) early east-trending folds that parallel the gross stratigraphy;

(2) northwest-trending, shallow-plunging, recumbent nappe-like folds with granitic dyke and sill complexes intruded along the northeast-dipping axial planar foliation;

(3) northeast-trending zones of large Z-asymmetrical cross folds that plunge at moderate angles to the northeast. The northeast-trending belts are marked by: (i) locally well developed and steeply dipping axial planar foliation; (ii) local, large porphyritic quartz monzonite intrusions emplaced as batholiths and dyke complexes along the axial planes of the cross folds; (iii) northeast-trending cataclastic zones flanking these intrusions; (iv) late stage, more northerly trending faults with associated zones of intense cataclasis 50 cm - 3 m wide. The northwest-trending recumbent folds are not a dominant structural feature east of Highrock Lake and consequently the northeast-trending Z-asymmetrical folds overprint the early east-west structures and stratigraphy directly. These cross fold zones become increasingly prominent toward Thompson and culminate in the Thompson break;

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[1] McRitchie, W.D. (1971): Burntwood Project; *in:* Summary of Geological Field Work 1971; Man. Mines Br., Geol. Paper 6/71.

McRitchie, W.D., Frohlinger, T.G., Baldwin, D.A., and Zwanzig, H.V. (1972): Burntwood Project; *in:* Summary of Geological Field Work 1972; Man. Mines Br., Geol. Paper 3/72.

[2] Frohlinger, T.G. (1972): Madsen Bay; Highrock; Flatrock Lake; and Asippitti Creek, Manitoba; Man. Mines Br., Prelim. Maps 1972G-3, 1972G-4, 1972G-7 and 1972G-8.

[3] Elphick, S.C. (1972): Geology of the Mynarski-Notigi Lakes Area; Man. Mines Br., Publ. 71-2C.

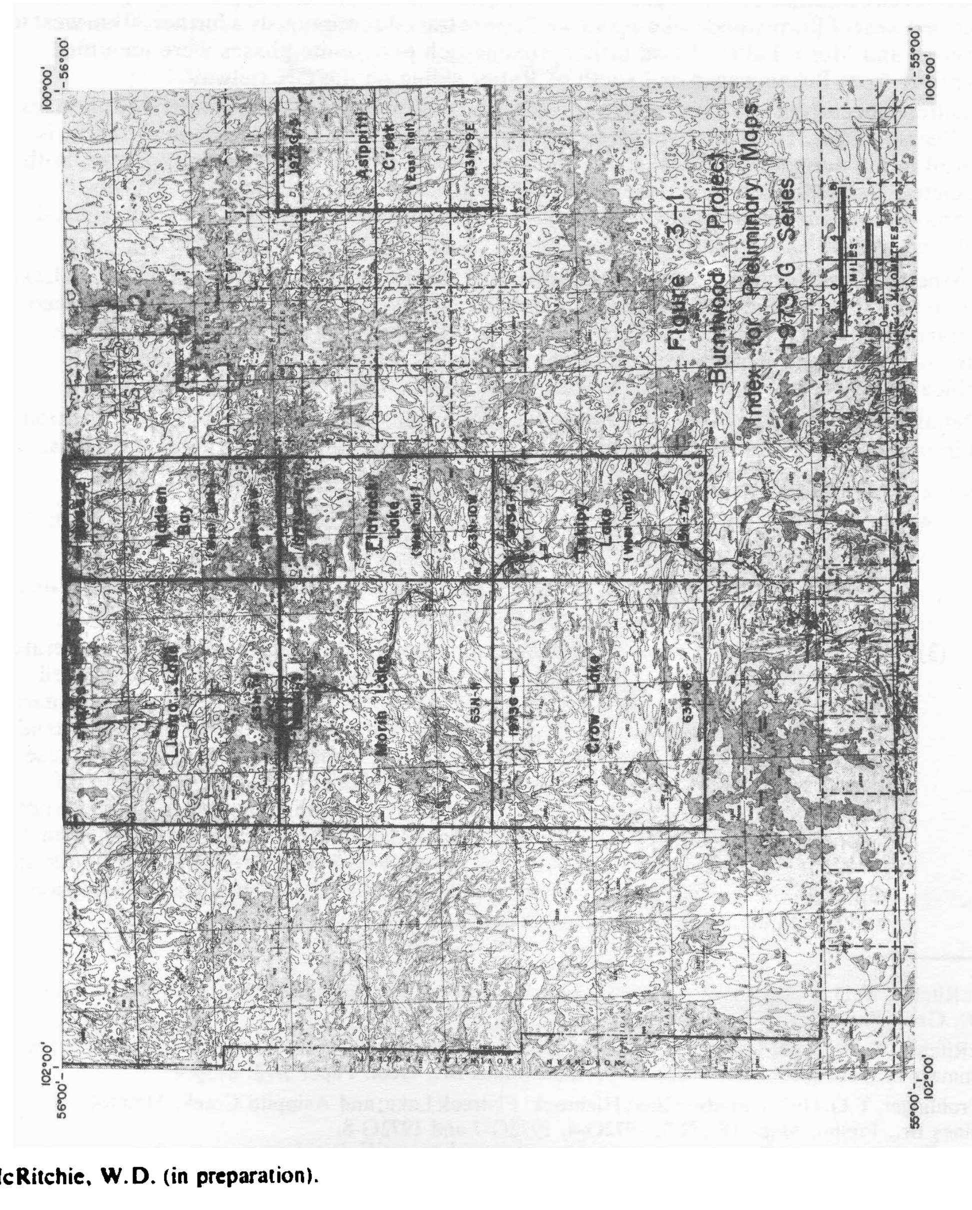
(4) broad open flexuring of the gneissic belt and associated small, open, concentric minor folds have been identified as the final phase of folding in the Highrock Lake and Nelson House regions.

Differential movement during late brittle deformational events has been identified and integrated into the regional sequence.

In places, where definable, the early east-west cryptic stratigraphy can be traced through the strongly transposed northeast-trending zones of disturbance and through intrusive complexes without marked dislocation, or deflection of regional trend.

Stratigraphic nomenclature

The steady growth of emphasis on stratigraphic investigations in the Nelson House-Pukatawagan region prompted a re-examination of Sickle-Wasekwan relations and a comprehensive review[4] of this topic. As a result several revisions of terminology will be proposed in the interest of establishing a correlative base for further studies in the Lynn Lake-Flin Flon region.



[4]McRitchie, W.D. (in preparation).

(4) ULTRAMAFIC ROCKS PROJECT

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

by R. F. J. Scoates

Diamond drill core from the Fox River sill and associated metavolcanic and metasedimentary rocks of the Fox River greenstone belt was logged and sampled during the 1973 field season. This completes the collection of diamond drill hole data initiated in 1972. Access to the diamond drill core was generously arranged by The International Nickel Company of Canada, Limited. A total of 100 diamond drill holes has been examined and more than 8,000 samples collected. Visual geological logs as well as visual sample descriptions have been made for each hole examined.

Twenty-five lithologic units have tentatively been assigned to the Fox River sill. The rock types range from dunite to varieties of gabbro. Four primary minerals: olivine, clinopyroxene, orthopyroxene and plagioclase (together with their alteration products), constitute 90-95 per cent of the rocks. Chromite is a common accessory mineral. Olivine and clinopyroxene (and chromite) are the dominant cumulus minerals; orthopyroxene and plagioclase occur commonly as intercumulus minerals, although, locally they have been recognized as cumulus minerals.

The alteration products are serpentines (± associated magnetite) with lesser amounts of talc, tremolite, chlorite and unidentified micas. The serpentines are most commonly middle to dark apple green varieties. Some development of cross-fibre, asbestos-like serpentine has been noted in a few holes. Hematization of units, noted in several holes, appears to be related to zones of movement. The zones of movement are characterized by picrolite (brittle serpentine)-carbonate breccia and to a lesser extent by foliated serpentinite.

Pyrrhotite, the dominant sulphide mineral present, is most commonly associated with picrolite zones and picrolite-carbonate breccia. It has also been observed as a primary, intercumulus mineral. Other sulphide minerals noted are chalcopyrite, pyrite, pentlandite, galena and sphalerite. The latter two minerals are rare and occur in vugs in carbonate zones.

The primary textures are for the most part moderately to extremely well preserved despite the fact that the rocks are generally highly recrystallized. Primary features common to mafic igneous layered rock sequences have been observed, and include phase contacts (marked by the appearance or disappearance of a cumulus mineral), form contacts (marked by a sharp change in the physical properties of a cumulus mineral such as size or habit), planar lamination (platy parallelism of one or more cumulus minerals in a cumulate) and size-graded layers (characterized by a gradational stratigraphic change of grain size of one or more cumulus minerals). The definitions in parentheses are those of Jackson (1967).[1] Repetitive layered cycles have been documented from most parts of the sill.

The country rocks consist of intermediate to mafic metavolcanic flow rocks, and a sequence of fine-grained metasedimentary rocks. The metasedimentary rocks lie south of, and in places are intercalated with the metavolcanic sequence. The mafic metavolcanic rocks are dominantly homogeneous and are characterized by a fine-grained hypidiomorphic granular texture. The intermediate metavolcanic rocks are as described above but with a variable quartz content. The metasedimentary rocks consist of argillite, greywacke, iron formation, quartzite, crystalline limestone and marble, and carbonaceous rocks.

Minor ultramafic sills occur north and south of the Fox River sill within the country rocks described above. These sills are differentiated but for the most part do not display the well developed layering characteristic of the Fox River sill. As a result the minor sills contain a much smaller number of lithologic units.

Contact relationships between the Fox River sill (and the minor sills) and the country rocks are sharp and uncomplicated in some areas and poorly exposed in strongly foliated and brecciated rocks in other areas. The country rocks adjacent to the sill(s) tend to be hornfelsic equivalents of the rocks already described, and in many cases they display an extremely well developed fissility.

Continuing studies of the data collected to date include lithologic correlation of units within the Fox River sill and country rocks, structural studies, compilation and interpretation of the basic diamond drill hole information, as well as petrological and mineralogical studies.

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[1]Jackson, E.D. (1967): Ultramafic cumulates in the Stillwater, Great Dyke, and Bushveld instrusions; *in:* Ultramafic and Related Rocks; Peter J. Wyllie, Ed., John Wiley & Sons, Inc., New York.

(5) GREENSTONES PROJECT
INTRODUCTION

by F. J. Elbers

During the summer of 1973 complete coverage was obtained of the initial project area, and extensions towards the west (Carrot River area) and towards the east (Webber Lake-Sharpe Lake area) have been mapped. The 1972 and 1973 Preliminary Map Series give a complete map coverage of the project area at the scale of one-half mile to one inch (Figure 5-1). This year the mapping was carried out by four field parties, with emphasis on maximum integration of the various geological analyses. High density observations were made in the volcano-sedimentary belts by detailed shorelining and pace and compass traversing; lower density coverage of the granite-gneiss terrains was obtained by extensive helicopter support during a 6-week period. The density contrast in the observations is also controlled by outcrop distribution; in general outcrops are abundant in the greenstone belts and scarce in the interjacent granitoid terrain.

Major developments during the 1973 field work were:

(i) a major unconformity between the Hayes River and Oxford Groups as defined by Wright[1] is indicated by structural discordance between the two groups. The stratigraphic terminology of Campbell *et al.*[2] is therefore revised:

Campbell *et al.*	Revised terminology	
HAYES RIVER GROUP	OXFORD GROUP	} Wright[3]
Oxford Lake Subgroup	HAYES RIVER GROUP	
Knee Lake Subgroup	Knee Lake Subgroup	} Campbell *et al.*[4]
Gods Lake Subgroup	Gods Lake Subgroup	

(ii) the majority of the tonalitic and granodioritic intrusions in the area are pre-Oxford in age;

(iii) a distinct group of porphyritic volcanic rocks with probable alkaline affinities occurs in eastern and northern Oxford Lake;

(iv) a new post-Hayes River but pre-Oxford Group of acid volcanic rocks has been recognized at the west end of Oxford Lake. This acid volcanism is genetically related to the pre-Oxford intrusion of sialic plutons into the Hayes River cover rocks;

(v) a major WNW-ESE striking mylonite zone crosses the project area and demarcates two terrains of different crustal level. This mylonite zone is best exposed in the Gods Lake Narrows area;

(vi) sulphide mineralization occurs in the acid volcanic belt in the Knife Lake area. The west side of Knife Lake is characterized by numerous pyrite showings in rhyolite and rhyolite breccia;

(vii) hydrothermal mineralization at the west end of Oxford Lake is genetically related to the post-Hayes River acid volcanism. Epithermal quartz-ankerite veins are abundant in this area, and associated chalcopyrite and stibnite veins have received attention in the past. The area appears to be also favourable for gold and silver mineralization.

[1] Wright, J.F. (1931): Oxford House Area, Manitoba; Geol. Surv. Can., Summ. Rept. Pt. C.

[2] 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.

[3] Wright, J.F. (1931): ibid.

[4] Campbell *et al.* (1972): ibid.

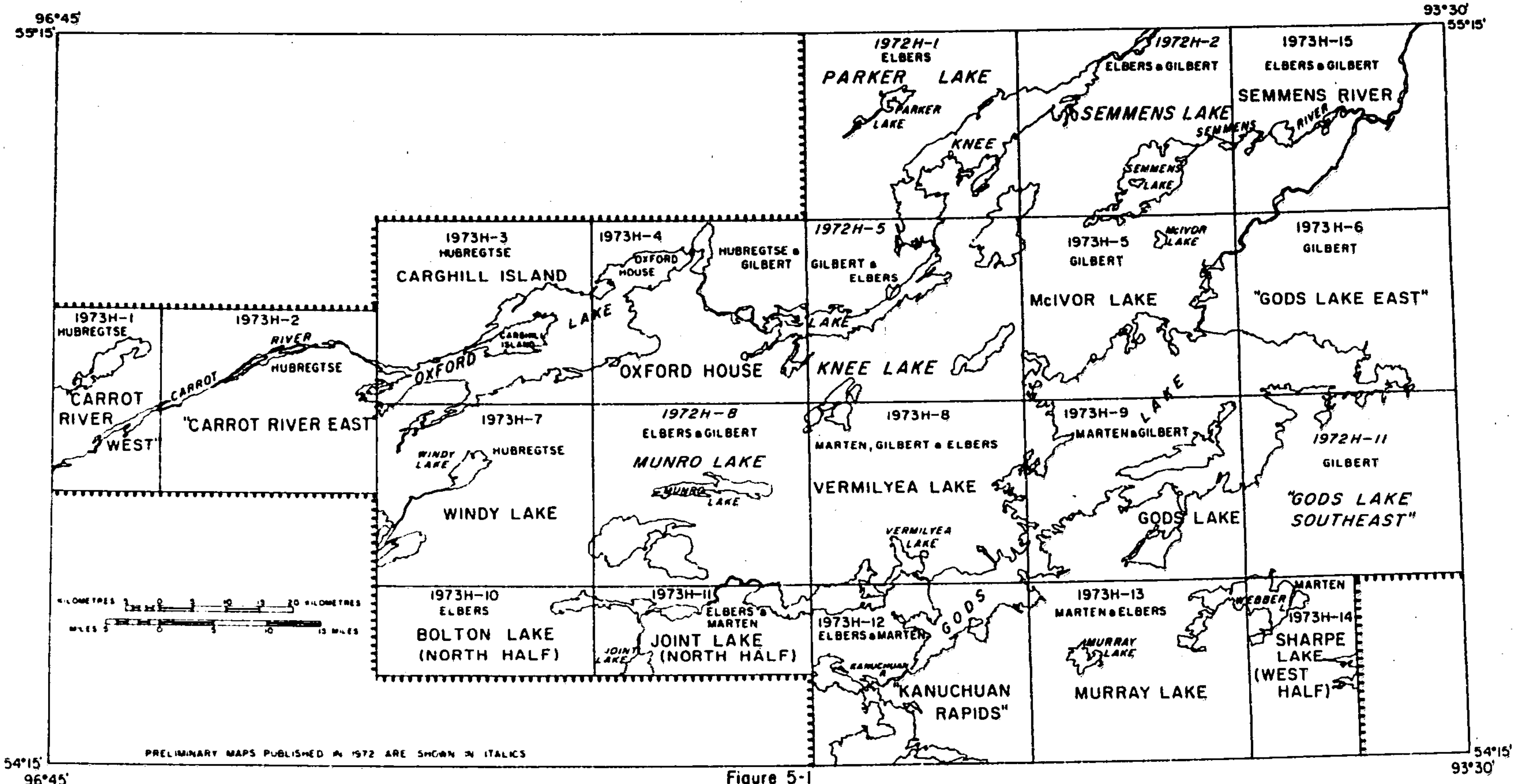

Figure 5-1
GREENSTONES PROJECT MAP LOCATIONS 1973

BOLTON LAKE NORTH

(53L-5N)

by F. J. Elbers

Outcrop is good in the area to the west of Aswapiswanan Lake. Numerous small to medium sized lakes with steep, rocky shorelines show continuous exposure of basalt and gabbro.[1] These two rock types comprise the major part of this greenstone belt which is characterized by high magnetic anomalies. The basic rocks have been metamorphosed to amphibolites; the gabbros are medium grained, weakly to strongly foliated and homogeneous; the meta-basalts are fine-grained amphibolites which in many places have undergone epidotization in layers parallel to the foliation. Gabbro, occurring as major bodies at the southern side of this greenstone belt, constitutes a surprisingly large part of the bedrock. Minor, white weathering, medium-grained feldspar-porphyry dykes occur in the basalts, and a few bodies of mappable size have been indicated on the map. This rock is characterized by white sub- to euhedral plagioclase crystals in a fine-grained matrix. Except for a few minor flows no acid volcanic rocks have been found in this area.

The greenstones are bordered to the south by granodioritic to tonalitic, layered gneisses which have been intruded by white granodiorite and tonalite and pink adamellite. No discordant relationship between the layered gneisses and the greenstones has been observed.

[1]Elbers, F.J. (1973): Bolton Lake (North half); Man. Mines Br., Prelim. Map 1973H-10.

SEMMENS RIVER AREA

(53N-4)

by F. J. Elbers

A more detailed investigation of the eastward extension of the Knee Lake greenstone belt did not reveal any significant lithologic variation in this volcanic belt.[1] Outcrop is fair to good along Semmens River and at Fish Lake, and shows a monoclinal sequence of fresh pillowed basalt at least 7,500 m (22,500 ft.) thick. Minor gabbro occurs throughout the sequence, and some intermediate flows and pyroclastics have been found in the highest stratigraphic (northernmost) part of the pile. At Fish Lake the pillows are extremely well preserved and non-flattened, and on an island in the northern part of Fish Lake it is evident that pillows have rolled into unconsolidated carbonate sediment which now occurs as inter-pillow matrix and in layered pods.

The basalts are underlain by greywacke, and the top of the sequence is truncated by granite near Gods River. To the north of Fish Lake lack of outcrop prohibits the mapping of this basalt/granite contact.

Quartz veins with pyrite and minor chalcopyrite occur in gabbro on a reef in the small lake northwest of Fish Lake.

In the northeastern part of the map-sheet mafic greywacke is exposed at Gods River. This unit has a much higher aeromagnetic expression than the granite; the clear demarcation between the two rock types on the aeromagnetic anomaly map has been used as a basis for plotting the contact in the drift covered area.

[1]Elbers, F.J., and Gilbert, H.P. (1973): Semmens River; Man. Mines Br., Prelim. Map 1973H-15.

OXFORD LAKE-CARROT RIVER-WINDY LAKE AREA

(53L-12, 13, 14W; 63I-9N, 10NE, 15SE and 16S)

by J.J.M.W. Hubregtse

The area mapped during the summer of 1973 extends from latitude 95°15' to 96°45' and longitude 54°30' to 55°00'.

General geology

The area includes two roughly east-west striking greenstone belts, the Oxford Lake belt and the Carrot River belt, both of which are underlain and locally intruded by a granite-gneiss complex.[1,2] The narrow Carrot River belt is probably an extension of the wider Oxford Lake belt, but continuity between the two, as proposed by Barry (1960)[2], could not be established in the field. Near the mouth of the Carrot River both belts are separated by the granite-gneiss complex.

The narrow Max Lake greenstone belt crops out in the southern part of the area. A younger granite and drift cover obliterate its possible continuation with the Munro Lake greenstone belt (Marten, this report). The southernmost part of the map-area covers the northern edge of the Aswapiswanan Lake greenstone belt (Elbers, this report).

The major differences between the Oxford Lake and the Carrot River greenstone belts are as follows:

(i) peridotite and rhyolite are relatively more abundant in the Carrot River belt;
(ii) Oxford Group sediments are scarce in the Carrot River belt;
(iii) volcanic rocks in the Oxford Lake belt include porphyritic types;
(iv) deformation in the Carrot River belt is relatively more intense.

The Max Lake greenstone belt consists solely of basaltic rocks with rare serpentinite. Most of the greenstones in this belt are of amphibolite facies; pillow structures are however still visible.

Relation between greenstones and granite-gneiss complex

The granite-gneiss complex consists of: (i) rocks of tonalitic parentage which show various degrees of deformation, and include both gneisses and massive rocks; and (ii) younger granites and granodiorites. The latter cut older structures and intrude the greenstone belts. The relationship between the greenstones and the tonalitic rocks is more complex.

Massive and gneissoid tonalites, their porphyritic equivalents, and related quartz-feldspar porphyry dykes intrude rocks of the Hayes River Group. Erosion products of the tonalites, however, are found in rocks of the Oxford Group, which unconformably overlie the Hayes River Group rocks. These observations indicate a post-Hayes River but pre-Oxford age of intrusion.

The tonalitic gneisses to the south of Oxford Lake and the Carrot River can be subdivided into two mappable units:

(i) Layered tonalitic gneisses with concordant amphibolite layers, younger gabbroic dykes, and aplites and pegmatites;
(ii) homogeneous tonalitic gneisses of monotonous composition and containing some xenoliths.

The relationship between the tonalitic gneisses and the greenstones is obscure. The contact, where exposed, displays an alternation of layers of tonalitic gneiss and greenstone which are well sheared. This relationship may be indicative of either a sheared intrusive contact or tectonic interslicing.

The layered tonalitic gneisses might represent reconstituted basement, although no indication of a previous metamorphic cycle has been found in this part of the project area.

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[1]Barry, G.S. (1959): Geology of the Oxford House-Knee Lake Area; Man. Mines Br., Publ. 58-3.

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

Locally, where conditions were favourable, the intrusion of quartz-feldspar porphyry dykes caused garnet blastesis in the mafic volcanics. In places biotitic rocks were formed as hybridization products of the porphyry dykes and the volcanics. These rocks had previously been misinterpreted as sediments.[3] Where no hybridization has occurred, the contact zone consists of an alternation of basaltic and gabbroic rocks of the Hayes River Group, and quartz-feldspar porphyry dykes and sills. Wherever this zone is sheared, as in the Carrot River belt and at southern Oxford Lake, it shows sulphide mineralization and development of gossan.

Hayes River Group

The volcanic rocks in the Oxford Lake area can be subdivided into a basalt-rhyolite suite (1) and a suite of porphyritic flows and breccias (2), the latter recognized here for the first time. The chemistry of the porphyritic suite (2) probably has alkaline affinities. The main rock types recognized are andesites with trachytic textures, latitic basalts, minor rhyolites and acid and intermediate breccias.

The basalt-rhyolite suite (1) crops out on Carghill Island and on southern Oxford Lake. Its eastward extension merges with the Knee Lake belt north of Oxford House. West of Carghill Island, the extension is truncated by east-striking, converging faults. Rocks of the basalt-rhyolite suite are also found in the Carrot River area.

The porphyritic suite (2) is exposed between Jackson Bay and Eight Mile Point, and also along the northern shore of Carghill Channel, where the suite constitutes a tectonic slice, "pinching out" westwards.

The basalt-rhyolite suite consists largely of pillowed basalts. Rhyolites are rare. Some evidence has been found for an ultramafic base. A peridotite layer in southwestern Oxford Lake shows spinifex textures, indicative of either an ultramafic flow or a very shallow intrusion. The peridotite underlies variolitic pillowed basalt. The same relation has been found elsewhere in Carghill Channel. Ultramafic rocks in Lynx Bay, associated with melanogabbro, display an east-west directed fabric and bear a strong resemblance to the ultramafics already described in Oxford Lake and those of the Carrot River belt, where two ultramafic bodies were mapped.

The age relationship between the volcanics of suites (1) and (2) is obscure, because both suites crop out in separate, fault bounded areas. The presence of small dykelets of andesite with trachytic texture crosscutting basalts of suite (1) provides evidence of a younger age for suite (2).

Hayes River Group-Oxford Group unconformity

An angular unconformity between the basalt-rhyolite suite and the Oxford Group is well exposed on an island south of Carghill Island. East-southeast-facing conglomerate overlies north-facing pillowed basalt. The unconformity between the Oxford Group and the porphyritic suite is best developed in the area south of Eight Mile Point. There, youngest rocks of the Hayes River Group consist predominantly of flow breccias. Locally these breccias have been reworked to sedimentary breccias which grade into the basal Oxford conglomerate.

Oxford Group

Greywacke and conglomerate at Jackson Bay are reinterpreted as Oxford Group sediments (cf. Campbell, 1971a).[4] Rocks underlying southern Carghill Island and Traverse Island, which were formerly assigned to the Hayes River Group,[5,6] are also reinterpreted as Oxford Group. These rocks are also predominantly greywacke and conglomerate. However in some cases the fragmental rocks could be either epiclastic or pyroclastic. Presently they are considered as a basal member of the Oxford Group, which is characterized by reworked pyroclastics of the Hayes River Group.

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[3]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.

[4]Campbell, F.H.A. (1971a): Oxford House (West); Man. Mines Br., Prelim. Map 1971H-4.

[5]Barry, G.S. (1960): ibid.

[6]Campbell, F.H.A. (1971b): Carghill Island; Man. Mines Br., Prelim. Map 1971H-3.

Lynx Bay region

The geology of the Lynx Bay area has been reinterpreted. The rocks were formerly mapped as part of the sedimentary Oxford Group.[7,8] However, these rocks are of volcanic origin and consist largely of "quartz-eye" rhyolites and acid pyroclastics. The acid volcanism appears to be related to porphyritic tonalites and quartz-feldspar porphyries which surround Lynx Bay. The irregular shape of the volcanic bombs and the paucity of water-reworked pyrobreccias provide evidence for a sub-aerial rather than a submarine type of volcanism. The only confirmed sediments in the sequence are arkoses derived from the acid volcanics and the tonalitic rocks. The apparent relationship between the volcanism and the tonalitic plutonism, and the occurrence of clasts of the acid volcanics in the Oxford conglomerate designate this volcanism as a "post-Hayes/ pre-Oxford" event.

[7]Barry, G.S. (1960): ibid.
[8]Campbell, F.H.A. (1971b): ibid.

TOUCHWOOD LAKE-GODS LAKE-SHARPE LAKE AREA

(53L-6N, 7, 8, 9, 10; 53K-5W)

by B. E. Marten

An area of approximately 2,800 square km, centred on the southern half of Gods Lake, and extending to Touchwood Lake in the west and Sharpe Lake in the east, was mapped at a scale of 1 inch to one-half mile. The area is divided into two structurally distinct terrains by a major east-southeast-trending shear belt that passes through Gods Narrows. The northern terrain is underlain by a thick, relatively weakly deformed volcanic sequence, assigned to the Hayes River Group, intruded on the west by a tonalite-quartz monzonite complex. The terrain south of the shear belt is characterized by a well defined structural grain parallel to the shear belt, and by the occurrence of intensely deformed rocks of the Hayes River Group in two narrow continuous linear belts flanked by wide tracts of granitoid, migmatitic and gneissoid rocks.

Tonalitic gneiss

Grey, thinly layered tonalitic gneiss (1)* occurs on the southern contact of the Monro Lake-Murray Lake greenstone belt. The gneiss alternates with units of hornblende-schist derived from pillow basalts, and is lithologically distinct from meta-greywackes of the Hayes River Group that crop out nearby. Identical gneiss interlayered with amphibolite occurs as enclaves within tonalite-granodiorite (8). The tonalitic gneiss shows no structures that pre-date those in the greenstone belt, but could represent pre-greenstone belt sialic basement rocks that have been tectonically reconstituted and structurally interleaved with cover rocks. In this respect the tonalitic gneiss-greenstone contact relationship is identical to the Archean-Proterozoic boundary relationship in coastal Labrador.[1]

Hayes River Group

Foliated medium-grained amphibolite units (3e) up to 1700 m in thickness, within the granitoid terrains, are tentatively assigned to the Hayes River Group as there is no structural evidence that they represent an older volcanic or intrusive suite. The amphibolite is most abundant in a zone flanking the Munro Lake-Murray Lake belt on the south. Primary volcanic structures are lacking, but a tectonic banding on a 1-2 cm scale is locally developed.

The Munro Lake-Murray Lake belt consists of bedded greywacke, flanked and structurally underlain by hornblende-schists, in which intensely flattened pillows can locally be distinguished. The belt is broad in the Vermilyea Lake area but relationships there are obscured by major intrusions and drift cover. The belt is structurally alternated in the Murray Lake area and pinches out to the east.

The Webber Lake belt consists of fine-grained schistose amphibolite and flattened pillow basalt. Minor quartz porphyry and felsite units, strongly cleaved and up to 15 m thick, at Webber and Sharpe Lake are believed to be of intrusive origin.

North of the Gods Narrows shear belt the Hayes River Group has an apparent thickness in the order of 18 km with no evidence of structural repetition. The lowest part-of the sequence occurs southeast of Knife Lake and consists of massive pillow basalt and metagabbro. These rocks are overlain by approximately 3 km of pillow basalt (commonly amygdaloidal and in places variolitic) alternating with units of dacite, dacitic pyrobreccias and greywacke. The dacitic units are subordinate in the lower part of this section but predominate in the upper part.

These rocks are succeeded by an acid unit up to 700 m in thickness comprising massive and flow-brecciated rhyolite with minor dacitic agglomerate; this unit underlies the northwest shore of Knife Lake. Three outcrops of sulphide iron formation are associated with the acid unit, and pyritic gossan zones are common in shore outcrops of the rhyolite. All of the gossan zones are

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[1]Sutton, J.S. (1972): The Precambrian Gneisses and Supracrustal Rocks of the Western Shore of Kaipokok Bay, Labrador, Newfoundland; Can. J. Earth Sci., 9: 1677-1692.

*Numbers in parentheses refer to rock unit numbers on 1973 Preliminary Maps.

show evidence of previous sampling and one of the sulphide iron formation outcrops has been trenched.

The overlying volcanics consist of monotonous pillowed and massive basalt with local pockets of pillow breccia. A lenticular unit of massive rhyolite, up to 250 m in thickness, occurs in this sequence north of Knife Lake, together with a 30 m thick rhyolite lens exposed on the northeast shore of Chataway Lake. Pale altered andesitic(?) pillow lava occurs on strike to the southwest of the larger unit. Thin horizons (up to 1 m) of oxide iron formation are intercalated with pale, possibly andesitic, pillow lava in the uppermost 400 m of the Hayes River Group exposed on an island 11 km northeast of Gods Narrows.

A linear zone of fine-grained amphibolitic schist, greywacke and volcanoclastic sediments in the Gods Narrows shear belt were previously correlated with the "Oxford Lake Subgroup"[2], but are here included in the Hayes River Group on the basis of structural evidence and lithological similarity to rocks in the Knife Lake sequence.

Oxford Group

The Oxford Group is represented by 1,000 m of polymictic conglomerate unconformably overlying the Hayes River Group. The unconformity is exposed on Chataway Lake where it is knife sharp, with no indication of pre-Oxford Group weathering of the palaeosurface. The conglomerate contains abundant mafic volcanic and minor acid volcanic clasts, and a variety of granitoid boulders, some of which were foliated prior to incorporation.

Intrusive igneous rocks

Minor gabbroic intrusions are ubiquitous in the Hayes River Group and are believed to be comagmatic with the volcanism as are minor rhyolite porphyry and felsite dykes. "Quartz-eye" granodiorite, which grades eastward into non-porphyritic granodiorite, and related quartz and feldspar porphyry dykes also intrude the Hayes River Group and pre-date the Oxford Group. Ultramafic bodies at Vermilyea and Webber Lakes have been outlined by airborne and ground geophysics and diamond drilling[3] but are not exposed, and their relationships remain unknown.

Large areas of the granitoid terrain are underlain by a migmatitic gneissoid tonalite complex, that contains relics of layered gneiss and amphibolite with a contorted nebulitic gneissosity. This complex passes into areas of more homogeneous tonalite and granodiorite containing enclaves of layered gneiss and amphibolite. The amphibolite associated with layered gneiss in these units is identical to the amphibolite of unit 3e and locally to 3f, and is believed to be derived from the Hayes River Group.

Homogeneous grey granodiorite (unit 8) post-dates units 6 and 7 and has locally intruded the north margin of the Munro Lake-Murray Lake belt and also the south and north flanks of the Webber Lake belt. A belt of tonalitic-granodioritic gneiss southwest of Sharpe Lake (unit 9) is believed to have been formed by tectonic flattening of a migmatitic complex equivalent to unit 6.

Porphyritic and pegmatitic leucogranite is the youngest plutonic intrusive south of the Gods Narrows shear belt and appears to post-date the regional deformation; a primary intrusive fabric is locally developed. A complex body of uncertain age and comprising many cross-cutting phases of diorite, tonalite, granodiorite and quartz monzonite, is exposed on the west shore of Gods Lake, north of the Narrows.

At least four gabbroic dykes, up to 80 m in thickness, occur in the Webber Lake-Sharpe Lake area and have locally pronounced topographic and aeromagnetic expression.[4]

Structure and metamorphism

The earliest structural event recognized is a phase of intense penetrative deformation that affected the greenstone belts and layered gneisses south of Gods Narrows. This was accompanied by metamorphic mineral growth in the upper greenschist-middle amphibolite facies. Subsequent widespread migmatization and plutonism formed the granitoid complexes and was in part

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[2] 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.

[3] "Chubb" #5, 14; Reservations 101, 102 and 103, Man. Mines Br., Assessment Files.

[4] Scoates, R.F.J. (1971): Ultramafic Rocks Project; *in:* Summary of Geological Field Work 1971; Man. Mines Br., Geol. Paper 6/71.

syntectonic with a regional deformation that gave rise to the east-southeast trend and linear form of the Munro-Murray Lake and Webber Lake greenstone belts. These belts, therefore, are second phase synclinal structures.[5]

North of the shear belt, the Hayes River Group forms a homoclinal northwest-facing sequence. In general the rocks lack a penetrative fabric, though they have been metamorphosed to the upper greenschist and lower amphibolite facies.

The shear belt passing through Gods Narrows is a zone of intense deformation and tectonic reconstitution up to 4 km wide. Stiuctural trends in the Hayes River Group to the north swing dextrally into this zone; the swing is accompanied by progressive development of a penetrative schistosity and intense flattening.[6] Tonalitic rocks to the south of the shear belt also become intensely foliated as the shear belt is approached, passing rapidly into a zone of mylonite and blastomylonite up to 200 m thick. The blastomylonite was mapped previously as felsite by Barry (1961)[7] and as acidic crystal tuff by Campbell *et al.* (1972).[8] In the Gods Narrows section blastomylonite units are tectonically intersliced with intensely schistose lithologies derived from the Hayes River Group. The shear belt appears to represent a zone of movement between two major crustal blocks, with relative upward movement of the block to the south which exposes a deeper structural level of the Archean terrain.

The Oxford conglomerate appears to post-date initial formation of the shear belt, but was involved in a subsequent phase of rejuvenated movement, that transposed the early fabric related to the shear zone into a composite second phase penetrative schistosity.

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[5]Elbers, F.J., and Gilbert, H.P. (1972): Munro Lake Area; *in:* Summary of Geological Field Work 1972: Man. Mines Br., Geol. Paper 3/72.

[6]Ramsay, J.G., and Graham, R.H. (1970): Strain variation in shear belts; Can. J. Earth Sci., 7: 786-813.

[7]Barry, G.S. (1961): Geology of the Gods Narrows area; Man. Mines Br., Publ. 60-1.

[8]Campbell *et al.* (1972): ibid.

KNEE LAKE-GODS LAKE AREA

(53L-9, 14, 15, 16; 53K-12, 13)

by H. P. Gilbert

INTRODUCTION

Field work by the writer in 1973 comprised a study of the Gods Lake Subgroup volcanism on Southern Knee Lake, investigation of granitoid intrusive rocks in the entire project area, and a review of some previously mapped areas.

The identity of a suite of well layered mafic rocks which occurs west of Gods River and in the northeastern part of Gods Lake was revised. These rocks, which were formerly mapped as mafic greywacke, are now interpreted as highly attenuated pillowed basalt.[1]

Tonalite, granodiorite, and diorite of units 9, 10 and 12 (Manitoba Mines Branch Preliminary Maps, Series H, 1972) are now recognized as being older than the Oxford Group,[2] and not younger as formerly mapped. This revision is based mainly upon the recognition of clasts in the "Oxford Conglomerate" which closely resemble these plutonic rocks.

Gods Lake Subgroup at Southern Knee Lake: Third Cycle Pyroclastic Rocks

A mixed assemblage of acid to basic pyroclastic rocks, with interlayered flows, sills, and epiclastic rocks, outcrops along the southern shore of Southern Knee Lake. The assemblage has been interpreted as the upper unit of the Third Cycle of volcanism at Southern Knee Lake.[3] The unit has both calc-alkaline and alkaline affinities; dacite, trachyandesite, and alkaline picritic tuff have been identified by chemical analysis.

Good exposure at the lakeshore and on offshore islands permits investigation of lithological variation. A record of the matrix percentage, maximum clast size, shape of clasts, degree of sorting, and clast types (and relative abundance) was made at 101 stations in the pyroclastic rocks. A 1 m grid divided into 10 cm squares was constructed for counting either matrix or clast for a minimum of 200 points per station. The length of the maximum and minimum axes of individual clasts was measured and multiplied to a factor which could be used for comparison.

Results

1. Two principal localities, 5 km apart, were identified as volcanic centres on the basis of maximum clast size (Figure 5-2). Pyroclastic breccias in these centres contain blocks (up to 2.6 m x 0.6 m) which were probably deposited inside or at the rims of volcanic craters.
2. Distribution of maximum clast size and matrix percentage is irregular at these volcanic centres, but there is a close correlation of decreasing clast size and increasing matrix percentage with increasing distance from the volcanic sources.
3. The angularity of the breccia fragments is greatest at the volcanic centres.
4. Sorting is poor or absent in the breccias at the centres, but improves away from the volcanic sources.
5. The pyroclastic breccias are generally polymictic, with accessory fragments predominant. The matrix is commonly more mafic than the mean composition of the clasts. The breccias are therefore considered to have an "air-fall" origin. No evidence of subaqueous deposition of the breccias has been found. However, pillows in a trachyandesite flow, and the presence of greywacke interlayered with the pyroclastics indicate local subaqueous deposition.
6. Volcanogenic greywacke with slump structures, sporadic bombs, and minor intercalated pyroclastic breccias locally overlies the main pyroclastic sequence.

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[1]Gilbert, H.P. (1973): McIvor Lake; Man. Mines Br., Prelim. Map 1973H-5.

[2]Wright, J.F. (1931): Oxford House Area, Manitoba; Geol. Surv. Can., Summ. Rept., Pt. C.

[3]Gilbert, H.P., and Elbers, F.J. (1972): Parker Lake-Knee Lake-Oxford House Area; *in:* Summary of Geological Field Work 1972; Man. Mines Br., Geol. Paper 3/72.

7. Clast size decreases towards the top of the pyroclastic sequence, where chloritic tuff and lapilli tuff are intercalated with greywacke. The contact between the pyroclastics and underlying basalt coincides with a shear zone; however, the sequence from Third Cycle basalts (lower unit) of the Gods Lake Subgroup into Third Cycle pyroclastics (upper unit) appears to be conformable.
8. Two major periods of deformation can be recognized at Southern Knee Lake. The present regional distribution of lithologies is influenced by an early series of subparallel, easterly trending folds. The eastern volcanic centre (Figure 5-2) is repeated by this folding, and now outcrops in the cores of anticlines. The centre to the west also appears to be structurally repeated. Coarse pyroclastics at the volcanic centres have been less flattened than rocks outside the centres.

GRANITOID ROCKS

Introduction

At least 50 percent of the total project area is underlain by acid plutonic rocks and their metamorphic derivatives. Five ages of acid intrusive rocks are recognized. These intrusives occur within units 1, 2, 3, 5 and 7 in the following generalized legend.

POST-OXFORD GROUP INTRUSIVES

8 Massive porphyritic diabase; foliated diabase; lamprophyre

7 Massive granodiorite to granite, locally pegmatitic

6 OXFORD GROUP

PRE-OXFORD GROUP INTRUSIVES

5 Massive granodiorite to quartz monzonite; diorite; foyaite and alkalisyenite; aplite and pegmatite; quartz and/or feldspar porphyry. Rocks locally foliated

4 Gneissoid gabbro and diabase; serpentinized ultramafic rocks

3 Gneissoid granodiorite and tonalite; diorite; minor gneissoid granite

2 HAYES RIVER GROUP (Knee Lake Subgroup; Gods Lake Subgroup)

1 GNEISS COMPLEX

The oldest granitoid rocks are found in the gneiss complex (1) where an igneous origin can be recognized for many of the migmatites and gneisses.

Synvolcanic hypabyssal porphyries intrude rocks of the Gods Lake Subgroup (2).

Gneissoid sodic plutonic rocks (3) are generally easily distinguished from massive granodiorite (5), although some rocks are intermediate between the two types.

Massive granodiorite to granite (7) intrudes Oxford Group sediments, although in some cases rocks of unit 7 are indistinguishable from those of unit 5. Minor pink aplite and pegmatite dykes intrude rocks of units 1 to 7.

Gneiss Complex (1)

A variety of gneisses is found south of the Oxford Lake and Southern Knee Lake greenstone belts. Older gneisses and migmatites are intruded by younger tonalite and granodiorite which also intrude rocks of the greenstone belts and may be equivalent to unit 3. The older gneisses consist largely of granitoid intrusives with remnants of sediments and/or volcanics of pre-Hayes river Group age.

Hayes River Group-Gods Lake Subgroup (2)

Synvolcanic hypabyssal plagioclase porphyries intrude rocks of the Gods Lake Subgroup. In some cases the intrusive rocks are identical to clasts in pyroclastic breccia of the Gods Lake Subgroup. The porphyries occur mainly as minor dykes and sills, and at Wilson Lake, in an ovoid stock.[4]

[4]Elbers, F.J., and Gilbert, H.P. (1972): Munro Lake; Man. Mines Br., Prelim. Map 1972H-8.

Granitoid Rocks

A variety of sodic, gneissoid rocks intrude rocks of the the Gods Lake Subgroup (2), but have not been found intruding sediments of the Oxford Group. Mafic varieties are common in areas close to the contact with host amphibolites, and variations of rock type are largely the result of assimilation and igneous differentiation. However, potassium metasomatism is evident locally, notably northwest of Gods Narrows where the granodiorite has undergone shearing and locally mylonitization.

Massive granodiorite, quartz monzonite, and related rocks (5)

Granodiorite (and quartz monzonite) intrude the gneiss complex (1), the Hayes River Group (2) and gneissoid granodiorite and tonalite (3). The massive granodiorite has undergone potassium metasomatism. Microcline porphyroblasts and quartz aggregates are common. Up to three phases of porphyry dykes are associated with the granodiorite. At Northern Knee Lake pyroclastic breccia is associated with quartz porphyry related to the Semmens Lake granodiorite.[5]

Foliation is uncommon in rocks of unit 5. However, a vague flow foliation exists locally, and peripheral zones of plutons are well foliated in some cases. Some porphyry dykes are foliated where crossed by shear zones and in some cases the dykes are folded and disrupted. Basic volcanic xenoliths of the Gods Lake Subgroup bear a foliation that developed prior to the intrusion of the granodiorite.

Massive granodiorite to granite, locally pegmatitic (7)

Massive granodiorite (to granite) intrudes sediments of the Oxford Group at northern Oxford Lake,[6] and at Southern Knee Lake and Magill Lake.[7]

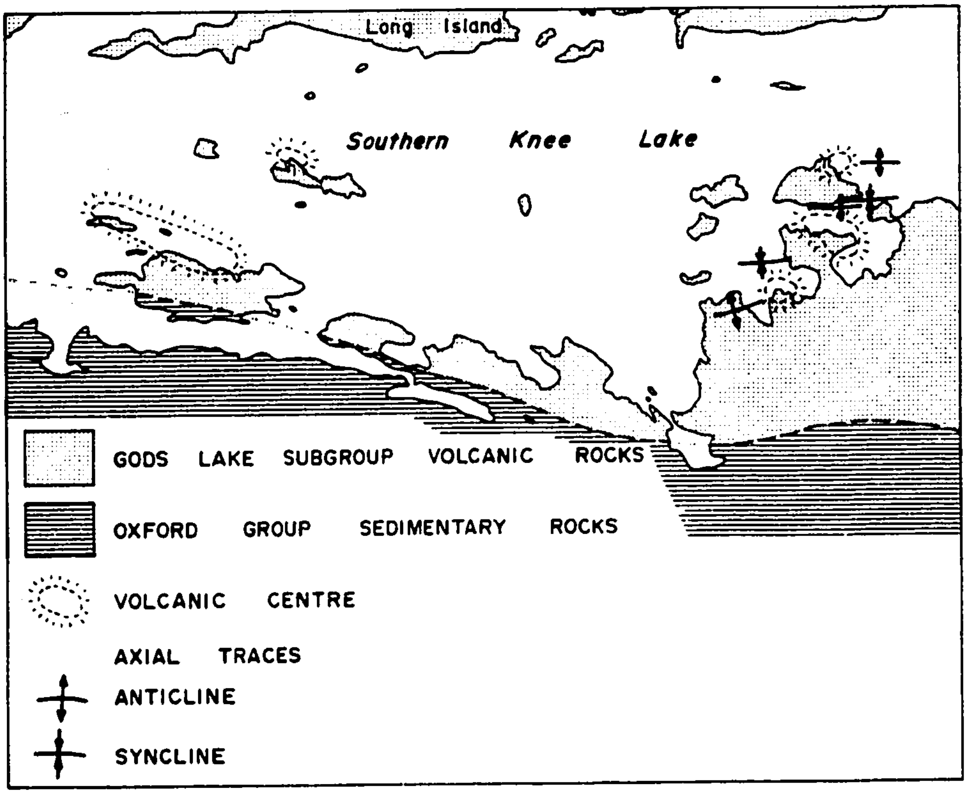

Figure 5-2: VOLCANIC CENTRES AT SOUTHERN KNEE LAKE AS DEFINED BY CLAST SIZE ANALYSIS OF PYROCLASTIC BRECCIAS

[5] Elbers, F.J., and Gilbert, H.P. (1972): Semmens Lake; Man. Mines Br., Prelim. Map 1972H-2.

[6] Hubregtse, J.J.M.W., and Gilbert, H.P. (1973): Oxford House; Man. Mines Br., Prelim. Map 1973H-4.

[7] Gilbert, H.P., and Elbers, F.J. (1972): Knee Lake; Man. Mines Br., Prelim. Map 1972H-5.

Pegmatitic granodiorite to granite at Beaver Hill Lake intrudes rocks of the Gods Lake Subgroup[8] The pluton closely resembles that at Magill Lake, but a post-Oxford Group age cannot be confirmed for the Beaver Hill body. Both plutons have related dykes which are boudinaged, folded and disrupted; two phases of intrusion are recognized, separated by the deformation.

Aplites and pegmatites of at least two ages are recognized.

1) Pre-Oxford Group, intruding rocks of units 1 to 5.
2) Post-Oxford Group, intruding rocks of unit 7. Late pegmatites intruding the gneiss complex may be related to one or both of these phases, and possibly the pervasive potassium metasomatism of unit 5.

Plutonic history

Classification of plutonic rocks by kinematic stage[9] is not well suited to a terrain of polyphase deformation such as that of the project area. The granitoid rocks investigated here are thus classified according to their relationship with the two main ages of deformation, defined as (1) Pre- and (2) Post-Oxford Group sedimentation.

Intrusive rocks of units 1 and 2 precede the deformations of the supracrustal rocks which form the basis of the present classification. They are thus excluded from the following discussion.

	Unit	Present Classification	Ages of deformation	Classification of Eskola
Partly intrusive	1	Pre-Gods Lake Subgroup		
	2	Synvolcanic		
	3	Pre- or syn-tectonic	Pre-Oxford Group	Even grained Synkinematic
	5	Post-tectonic		Commonly porphyroblastic
	7	Late-tectonic	Post-Oxford Group	Late-kinematic
Minor pegmatite and aplite		Post-tectonic		Late- or Post-kinematic

Rocks of unit 3 are typically synkinematic in their high Na content, gneissoid texture, and concordant form.

Massive, porphyroblastic granodiorite (unit 5) closely resembles intrusives which are synkinematic, according to Marmo.[10,11] However, unit 3 and unit 5 are considered to be of quite separate ages. Massive rocks of unit 5 can be seen to intrude the well foliated tonalite and granodiorite of unit 3.

Granodiorite to granite (unit 7) has the characteristics of a late-kinematic intrusive: the rocks are relatively potassium-rich, locally attaining a eutectoid granite composition; garnet and mica trails are characteristic of three of the plutons (Southern Knee Lake, Magill Lake, and Beaver Hill Lake); and the foliation is poor or absent in these rocks.

Late pegmatites and aplites are the only post-kinematic rocks that are recognized in the area. They are massive and of granitic composition.

The three-fold division of post-Gods Lake Subgroup major intrusives is comparable with other Archean sequences[12,13,14]. A genetic relation between the early and late granitoid rocks has been proposed by a number of workers, notably Glikson[14] and Marmo[15]. Such a relationship may well exist between units 3 and 5, especially since compositional differences appear to be the result of metasomatism. These relationships, and the significance of plutonism in the tectonic evolution of this area of the Superior Province will be the subject of further study.

[8]Elbers, F.J., and Marten, B.(1973): "Kanuchuan Rapids"; Man. Mines Br., Prelim. Map 1973H-12.
[9]Eskola, P. (1932): On the origin of granitic magmas; Mineral. Petrog. Mitt., 42: 455-481.
[10]Marmo, V. (1956): On the porphyroblastic granite of Sierra Leone; Acta Geographica 15, No. 4: 1-25.
[11]Marmo, V. (1971): Granite petrology and the granite problem; Developments in Petrology, v. 2, 244 p.
[12]Woyski, M.S. (1949): Intrusives of Central Minnesota; Geol. Soc. Am. Bull. 60: 999-1016.
[13]Viljoen, M.J., and Viljoen, R.P. (1969): A proposed new classification of the granitic rocks of the Barberton Region; Geol. Soc. S. Africa., Spec. Publ. No. 2: 153-188.
[14]Glikson, A.Y. (1972): Early Precambrian evidence of a primitive ocean crust and island nuclei of sodic granite; Geol. Soc. Am. Bull. 83: 3323-3344.
[15]Marmo, V. (1971): ibid.

MINERALIZATION

by F. J. Elbers

A. Knife Lake

An area mapped by B. Marten (this report) in the western part of Knife Lake contains abundant acid volcanic rocks, sulphide facies iron formation and graphite horizons, several sulphide showings and "dalmatianite-type" alteration (as observed at the northwestern tip of the long narrow peninsula in the western part of Knife Lake). A previous airborne geophysical survey[1] indicated at least two pronounced conductive zones: one between the long narrow peninsula and the islands to the east, and a large continuous zone underlying the northeast-trending bays in western Knife Lake, and extending in an open arc-like fashion towards the rapids in Knife River. In both zones sulphide facies iron formation and graphite layers have been found, and rusty gossan zones are semi-continuous along the eastern shorelines which border these zones. Pyrite is the dominant constituent of these showings and occurs as massive mineralization, locally in rhyolite breccia, and as disseminated crystals in vitreous rhyolite. Only traces of chalcopyrite have been found during careful investigations of the showings. Most gossan zones show signs of previous sampling and one sulphide iron formation has been trenched. The dalmatianite-type alteration consists of dark grey to black chlorite occurring in an anastomosing fashion in slightly altered dacite, and directly underlies the westernmost conductive zone.

B. Gold mineralizations in Gods Lake and Knee Lake

A brief visit was paid to the abandoned Jowsey Island and Elk Island gold mines in Gods Lake, and the Knee Lake and Johnston Knee Lake gold mines in northern Knee Lake. All these mines operated in the mid-thirties.

Both the Knee Lake and Gods Lake mines occur in the vicinity of porphyritic granodiorite intrusions with off-shoot dykes of quartz-feldspar porphyry. The emplacement of the gold mineralization was in all cases structurally controlled, and penetrated sheared and brecciated rock or followed contacts.

The mineralized zone on Jowsey Island occurs in a central, fractured zone within a porphyritic rhyolite or rhyolitic porphyry. The rock is light grey, aphanitic and shows quartz eyes where it is not fractured. Grey to black quartz veins have cemented together the fractured rock and contain pyrite, chalcopyrite, arsenopyrite, galena, sphalerite, and gold.

The Elk Island mine occurs in a thin (30 cm to 5.5 m) tuff layer which occurs between pillowed basalt and a gabbro sill. As the same tuff layer is found on the other side of the sill, the gabbro has apparently intruded the tuff layer. The tuff layer to the north of the gabbro has been heavily sheared and cemented together by grey quartz, containing pyrrhotite, pyrite, chalcopyrite, sphalerite and gold mineralization.

The two gold mines on Knee Lake also occur in sheared tuffs and porphyries which are mineralized with pyrite, pyrrhotite, minor chalcopyrite, sphalerite, galena and gold. Barry (1964)[2] estimated that some 10,000 tons of broken ore is stockpiled in two dumps. The tenor of this ore is unknown; he reports that a 1-pound sulphide-rich grab sample from the dump assayed 6.42 ounces of gold per ton.

C. Western Oxford Lake

A group of acid intrusive and extrusive rocks has been mapped by J.J.M.W. Hubregtse (this report) in the western part of Oxford Lake. Extensive drilling by Croinor Pershing Mines in the early sixties outlined a small copper deposit of 350,000 tons, grading better than 2.5 per cent copper, at the southwestern tip of Hyers Island[3]. The mineralization consists of chalcopyrite-pyrite veins in altered (sericitized and chloritized) wall rock.

Quartz-carbonate veins are abundant in the area. They crosscut the rocks at random and have

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[1]Manitoba Mines Branch assessment files (open file): Exploration Reservation 94; Amax Exploration, Inc.

[2]Barry, G.S. (1964): Geology of the Parker Lake area; Manitoba Mines Branch, Publ. 62-1.

[3]Northern Miner, July 16, 1964.

a brown limonitic coating. The dominant carbonate is reported to be ankerite. Quartz has filled cracks in the veins in a net-like fashion. Fragments of these veins occur in pyroclastic deposits which themselves are cut by these veins, indicating that the veining was contemporaneous with the volcanism, possibly representing channelways to fumaroles. Stibnite occurs within such a carbonate vein at the northeastern tip of Hyers Island.

The mineralization in western Oxford Lake appears to be of a hydrothermal type. The quartz-ankerite veins and the stibnite indicate an epithermal regime; the chalcopyrite-pyrite mineralization is probably also related to the hydrothermal activity but the mineralogy of the veins indicates a higher temperature (mesothermal) regime. Sulphide showings are abundant in this area, which also seems to be favourable for concentrations of gold and silver.

(6) BIRD RIVER AREA

(52L-5, 6)

by D. L. Trueman

Examination of rocks occurring within the syncline paralleling the Bird River[1] indicates the presence of extensive felsic metavolcanic and derived rocks although the limits of their distribution is not known. The rock types include quartz porphyry (rhyolite), ignimbrite deposits, felsic flow breccias, welded tuff, lapilli tuff, and felsic volcanic wackes.

In the Lac du Bonnet-Bird River area these rocks have been mapped as rhyolite and dacite[2] (Davies, 1952), and in the Bird Lake area as greywacke and silicified zones[3] (Davies, 1955). This suggests that felsic rocks similar to those noted above may occur in the Shatford Lake area[2] and west of Ryerson Lake (Davies, 1957).

Felsic volcanic rocks represent important exploration targets for Cu-Zn sulphide deposits. These rocks are therefore of considerable economic interest.

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[1]Trueman, D.L. (1972): Geological compilation map of the Bird River area; Man. Mines Br., Prelim. Map 1972F-1.

[2]Davies, J.F. (1952): Geology of the Oiseau (Bird) River area; Man. Mines Br., Publ. 51-3.

[3]Davies, J.F. (1955): Geology and Mineral Deposits of the Bird Lake area; Man. Mines Br., Publ. 54-1.

[4]Davies, J.F. (1957): Geology of the Winnipeg River area; Man. Mines Br., Publ. 56-1.

(7) PEGMATITE PROJECT

by B. B. Bannatyne

During 1973, the examination of the major pegmatites with rare element minerals was completed. Pegmatites were examined in the Cat Lake-Donner Lake area, in the Bird River, Rush Lake, Lac du Bois, and southern Whiteshell areas[1], and in north-central Manitoba (Figure 7-1). The major pegmatites of the north-central area are described briefly below. Other dykes, reported in the literature, are included in Figure 7-1.

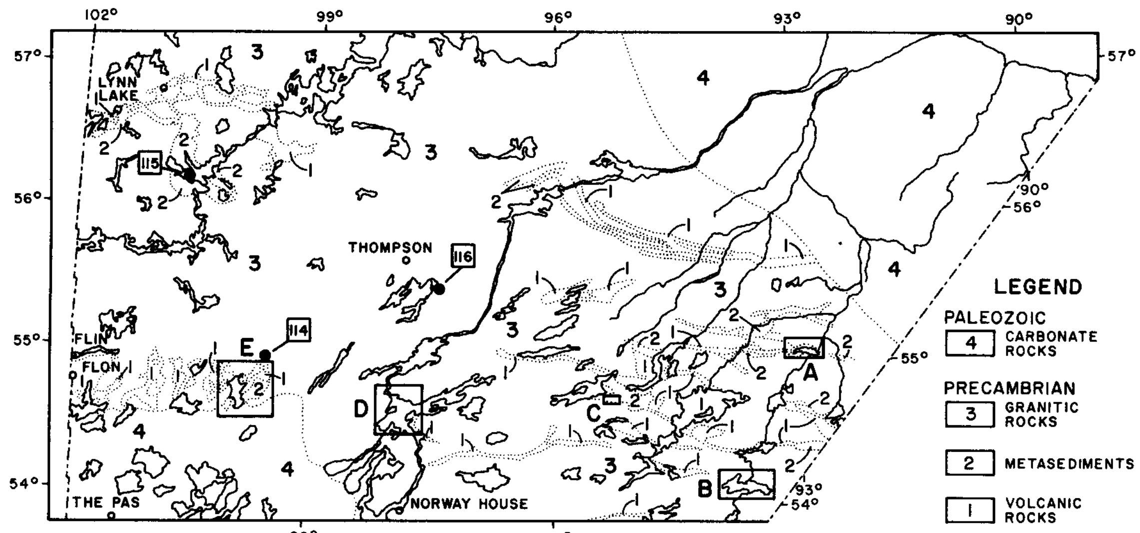

Figure 7-1
INDEX MAP, PEGMATITES IN NORTH-CENTRAL MANITOBA.

RARE ELEMENT MINERALS IN PEGMATITES

<u>Red Cross Lake</u>:	Figure 7-2, A
94	Lepidolite, Rb, Cs
95	Spodumene, beryl, Rb, Cs
<u>Red Sucker Lake</u>:	Figure 7-2, B
96	Cassiterite
<u>Lake "J"</u>:	Figure 7-3, C
97	Spodumene
<u>Cross Lake</u>:	Figure 7-3, D
98	Spodumene, beryl
99	Spodumene
100, 101, 102, 103, 104, 105, 106	Beryl

<u>Herb Lake</u>:	Figure 7-4, E
107, 108, 112	Spodumene, beryl
109, 110, 111	Spodumene
113	Beryl
<u>Missipisew River</u>:	Figure 7-1
114	Beryl and spodumene reported
<u>Watt Lake Area</u>:	Figure 7-1
115	Beryl
<u>Cuthbert Lake</u>:	Figure 7-1
116	Tantalite

[1]For location of pegmatites in southeastern Manitoba, see Bannatyne, B. B. (1972): Pegmatite Project; *in:* Summary of Geological Field Work 1972; Man. Mines Br., Geol. Paper 3/72.

1) Red Cross Lake (Figure 7-2, A; map reference[2])

A series of parallel dykes, ranging from 15 cm to 3.5 m in width, cut metavolcanics near the northeast end of Red Cross Lake (location 94). The dykes have been sheared such that they now consist of alternating narrow bands of purple rubidium-rich lepidolite, and white, fine-grained quartzo-feldspathic aggregates. Any original pegmatitic texture has been destroyed. Analyses reported by Jambor and Potter (1967)[3] indicate a high content of rubidium, cesium, and lithium.

2) Red Sucker Lake (Figure 7-2, B; map reference[4])

Small black cassiterite grains occur in a white albitic aplite dyke (96), which is exposed for 6 m along the lake shore. The cassiterite grains occur mainly in clusters near the vertical contact of the aplite with metavolcanics. A trenched pegmatite containing lithium minerals, referred to in an unpublished report in the Manitoba Mines Branch files, could not be located by the writer.

3) Lake 'J', southwest of Knee Lake (Figure 7-3, C; map reference[5])

Clusters of greenish spodumene, in well formed stubby crystals, are concentrated toward the north side of an easterly-striking vertical pegmatite that cuts metasediments (97). The good crystal form of the spodumene suggests it formed through primary crystallization. The dyke is variable in width, up to a maximum of 2 m. Quartz is only a relatively minor constituent of the dyke.

4) Cross Lake (Figure 7-3, D; map reference[6])

Two parallel dykes, 2 m and 3.5 m wide (99 and 98, respectively), are separated by 10 m of metasediments. The dykes strike 075. Trenching has exposed light greenish white spodumene, in excellent crystal form, with interstitial massive quartz. Coarse books of greenish muscovite, coarse perthite, blue apatite, black tourmaline, and fine grained cleavelandite are also present. The adjacent wall rock is highly tourmalinized. Minor beryl is present in the southern dyke (98). Roussell[7] reported seven other pegmatites containing various amounts of beryl (100 to 106).

5) Herb Lake (Figure 7-4, E; map reference[8])

Three major lithium-bearing pegmatites (108, 111, 112) and several smaller dykes (107, 109, 110, 113) are present in the area around and north of The Narrows of Crowduck Bay.

Three parallel pegmatites (107, 108, 109) on the Sherritt Gordon property, outcrop within 1/2-mile wide area. The pegmatites are 3 m to 7 m wide and strike 115. The major dyke is the central one (108), which was drilled in the 1930s. Pale greenish white spodumene crystals, up to 45 cm in length, occur across 6 m of the 7 m width of the dyke. The dyke contains patches of aplite, in shades of pink, grey and white. Tourmaline, apatite, red oxide stain and minor triphylite and beryl were noted. Limited drilling to shallow depth has outlined 225,000 tons grading 1.2 per cent Li_2O.

On the Violet Group, drilled by Combined Developments Limited in 1955-56, vertical white feldspathic pegmatites (110, 111), cut greywacke and conglomerate. The major dyke (111), containing 5.8 million tons grading 1.2 per cent Li_2O, has concentrations of thin-bladed apple-green spodumene crystals, intergrown with quartz. Almost all the spodumene crystals have a horizontal orientation, and are perpendicular to the contacts. Red oxide staining, associated with the spodumene, is common. Late fractures in the central part of the dyke are parallel to the walls, and filled with either feldspar or mica. A second 3 m wide pegmatite (110), containing clusters of coarse spodumene, outcrops 600 m south-southwest of the main dyke.

Green Bay Mining and Exploration Limited in 1955-1956 drilled the main surface dyke (112) on their property and outlined 2 million tons averaging 1.4 per cent Li_2O. This dyke is vertical, strikes 345, and is exposed in 16 cross-trenches, one of which is 23 m long and entirely within pegmatite. Features of the dyke include coarse tourmaline crystals in the central part, a low content of quartz, pink microcline-perthite megacrysts, absence of aplite, minor beryl, and coarse-bladed greenish spodumene in crystals up to 30 cm long, some with a small amount of intergrown pyrite. Other, smaller, northwest-striking dykes have been reported from the area[9]. One of these, containing a few small beryl crystals, was located (113).

[2]Potter, R.R. (1962): Gods River map-area, Manitoba; Geol. Surv. Can., Paper 62-8.

[3]Jambor, J.L., and Potter, R.R. (1967): Rubidium-bearing dykes, Gods River area, Manitoba; Geol. Surv. Can., Paper 67-15.

[4]Downie, D.L. (1936): Stull Lake sheet (west half), Manitoba and Ontario; Geol. Surv. Can., Map 452A.

[5]Barry, G.S. (1959): Geology of the Oxford House-Knee Lake area; Man. Mines Br., Publ. 58-3.

[6]Rousell, D.H. (1965): Geology of the Cross Lake area; Man. Mines Br., Publ. 62-4.

[7]Rousell, D.H. (1965): ibid.

[8]Frarey, M.J. (1950): Crowduck Bay, Manitoba; Geol. Surv. Can., Map 987A.

[9]Mulligan, R. (1965): Geology of Canadian Lithium Deposits; Geol. Surv. Can., Econ. Geol. Rept. 21.

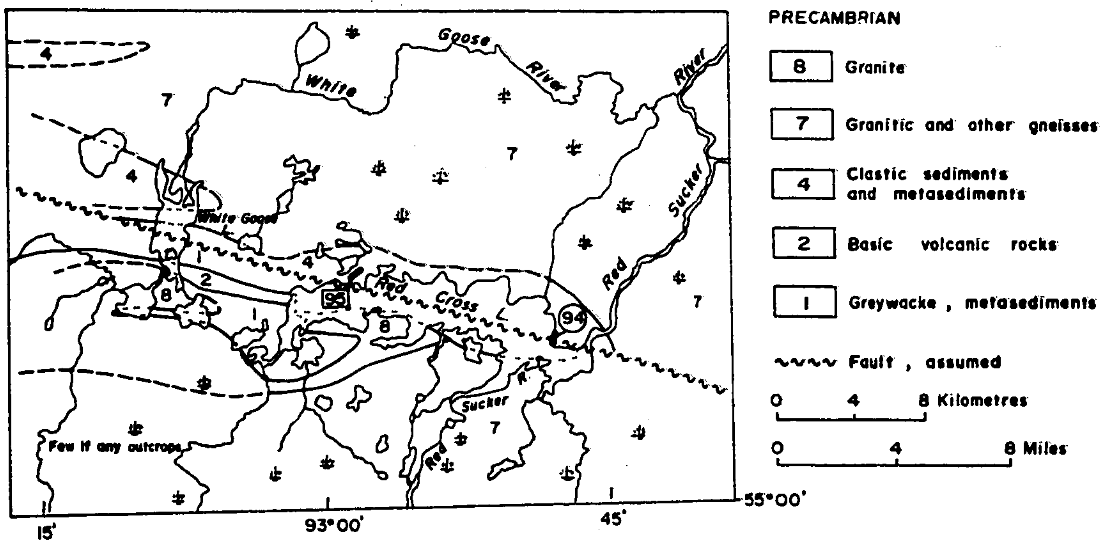

Figure 7-2,A: Red Cross Lake; geology after Potter (1962)

LEGEND FOR PEGMATITES

Pegmatite, with rare element minerals

(95) Pegmatite, examined

[105] Pegmatite, reported

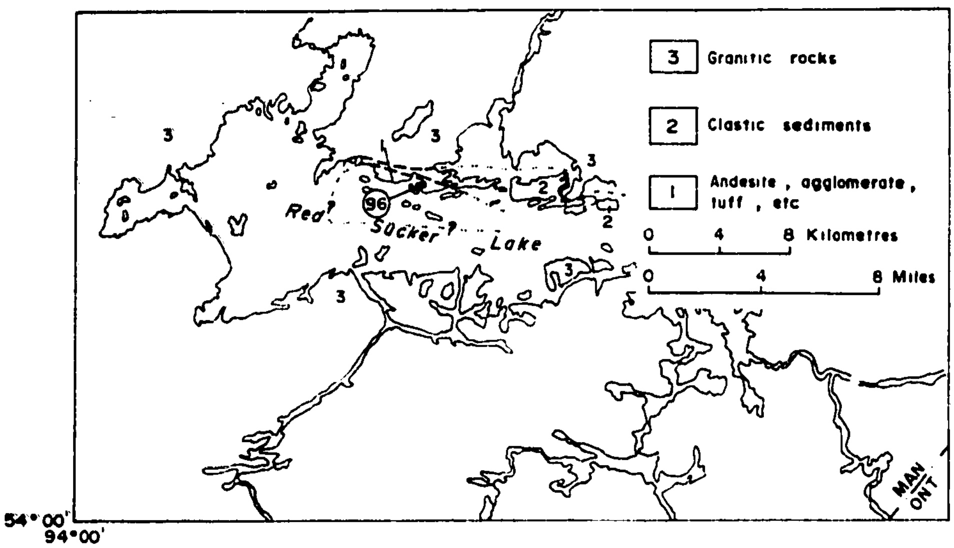

Figure 7-2,B: Red Sucker Lake; geology from Downie (1936)

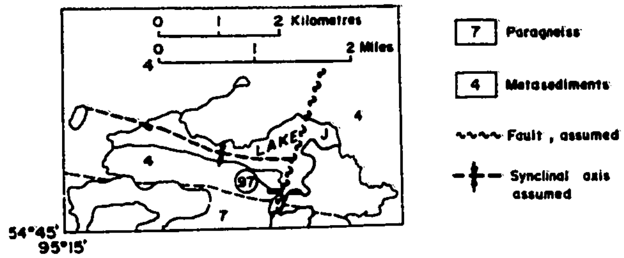

Figure 7-3,C: Lake 'J' Oxford House area ; geology from Barry (1959)

LEGEND FOR PEGMATITES

Pegmatite, with rare element minerals

(96) Pegmatite, examined

105 Pegmatite, reported

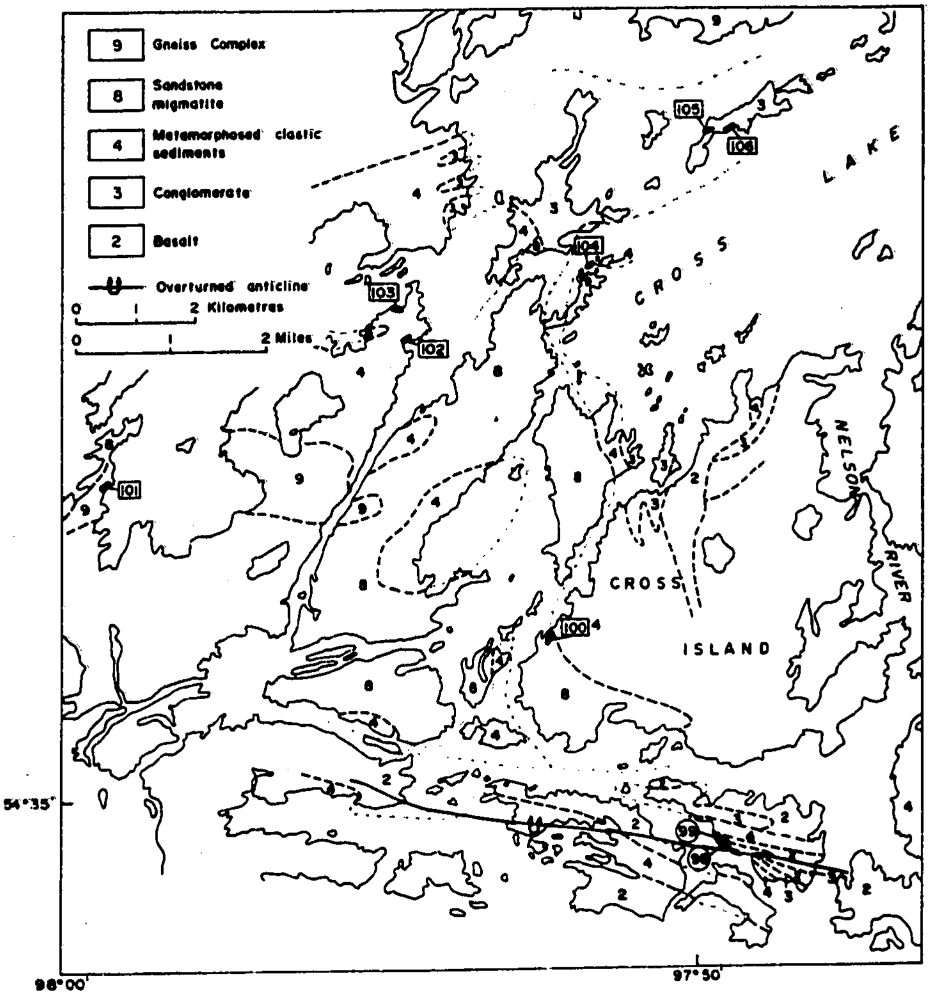

Figure 7-3,D: Cross Lake area ; geology generalized from Rousell (1965)

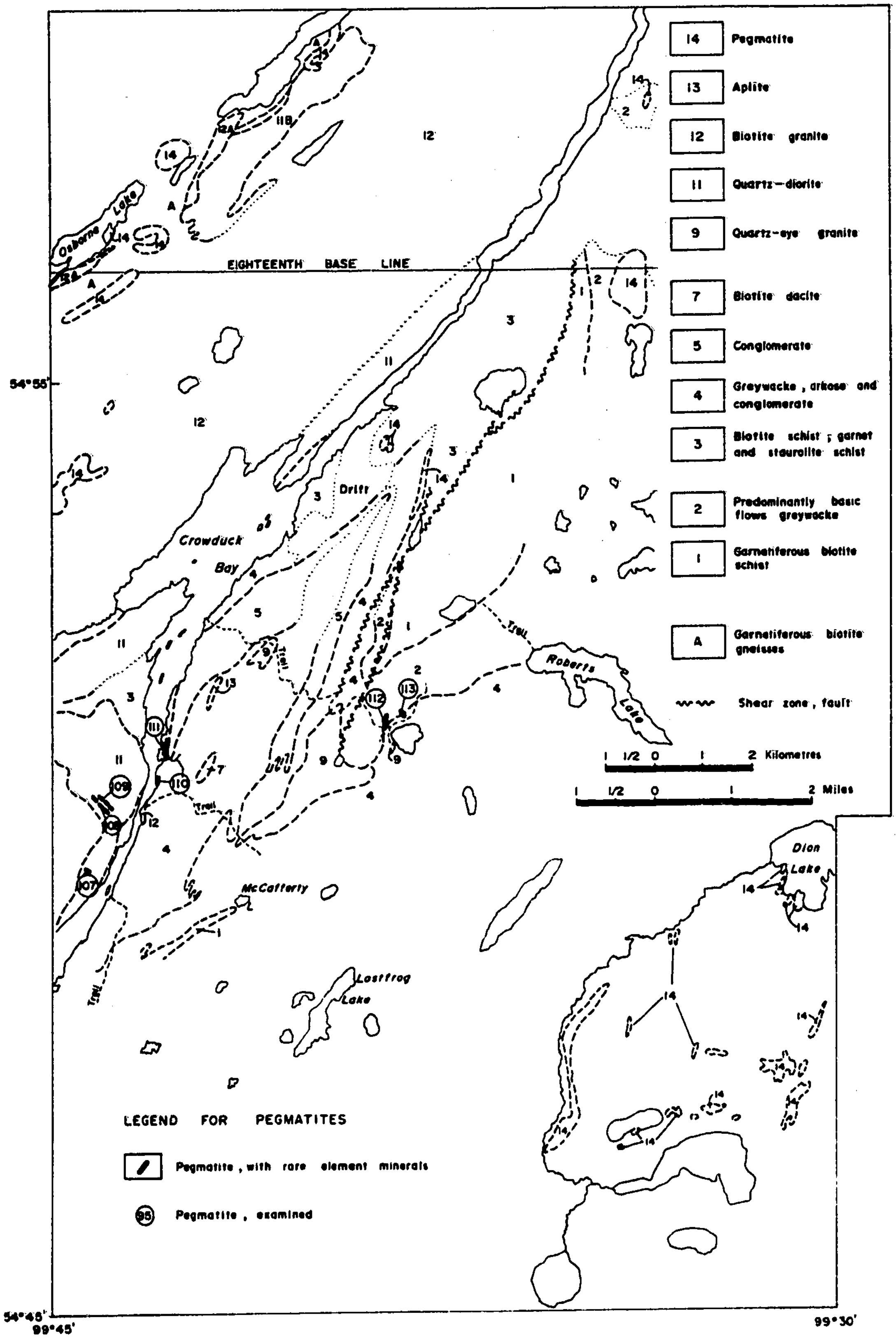

Figure 7-4,Σ: Crowduck Bay ; geology generalized from Frarey (1950)

(8) STRATIGRAPHIC MAPPING

by H. R. McCabe

Stratigraphic mapping by the writer during 1973 was a continuation of the Devonian mapping project, and was limited to checking of Devonian outcrop areas not previously examined because of difficult access. These areas included: the Pelican Bay-Cameron Bay area at the north end of Lake Winnipegosis, the Swan Lake area, the area northeast of Toutes Aides, and The Narrows area of Lake Manitoba (Figure 8-1). In addition to outcrop mapping, testing of a number of salt springs in the Pelican Bay area was carried out in conjunction with the geochemical studies by John Stephenson (this report). All Devonian data are to be incorporated into a report on the structure and stratigraphy of the Devonian outcrop belt. Information obtained this summer confirmed the previously reported complexity of Devonian structure and reef distribution (McCabe, 1972).[1]

Detailed stratigraphic mapping was carried out by P. Whiteway in the Grand Rapids area in order to define more accurately the distribution of Silurian and Ordovician strata previously noted in a reconnaissance survey by the writer in 1971 (McCabe, 1971).[2] Mapping was primarily along Highway 6 between Devils Lake (60 miles south of Grand Rapids) and Ponton (109 miles north of Grand Rapids). The erosional edge of the Silurian strata is marked by a prominent east-facing escarpment which runs roughly parallel to, and a short distance east of, Highway 6. This escarpment extends northward to a point 8 miles northeast of William Lake, where it bends sharply to the west and loses its well defined topographic expression. Traverses were made across this escarpment at selected points. Shoreline mapping was carried out on several large lakes which are now accessible from the highway, notably William Lake and Little Limestone Lake, both of which provide excellent exposure.

The results of this mapping are shown in Preliminary Map 1973M-1, and represent a significant change in configuration of the outcrop belts, as compared with previous maps. This change has resulted in a pronounced eastward shift of the Silurian outcrop belt, which emphasizes even more the prominent synclinal flexure that is evident in this area (Figure 8-1).

[1] McCabe, H.R. (1972): Stratigraphic Mapping; *in:* Summary of Geological Field Work 1972; Man. Mines Br., Geol. Paper 3/72.

[2] McCabe, H.R. (1971): Stratigraphic Mapping; *in:* Summary of Geological Field Work 1971; Man. Mines Br., Geol. Paper 6/71.

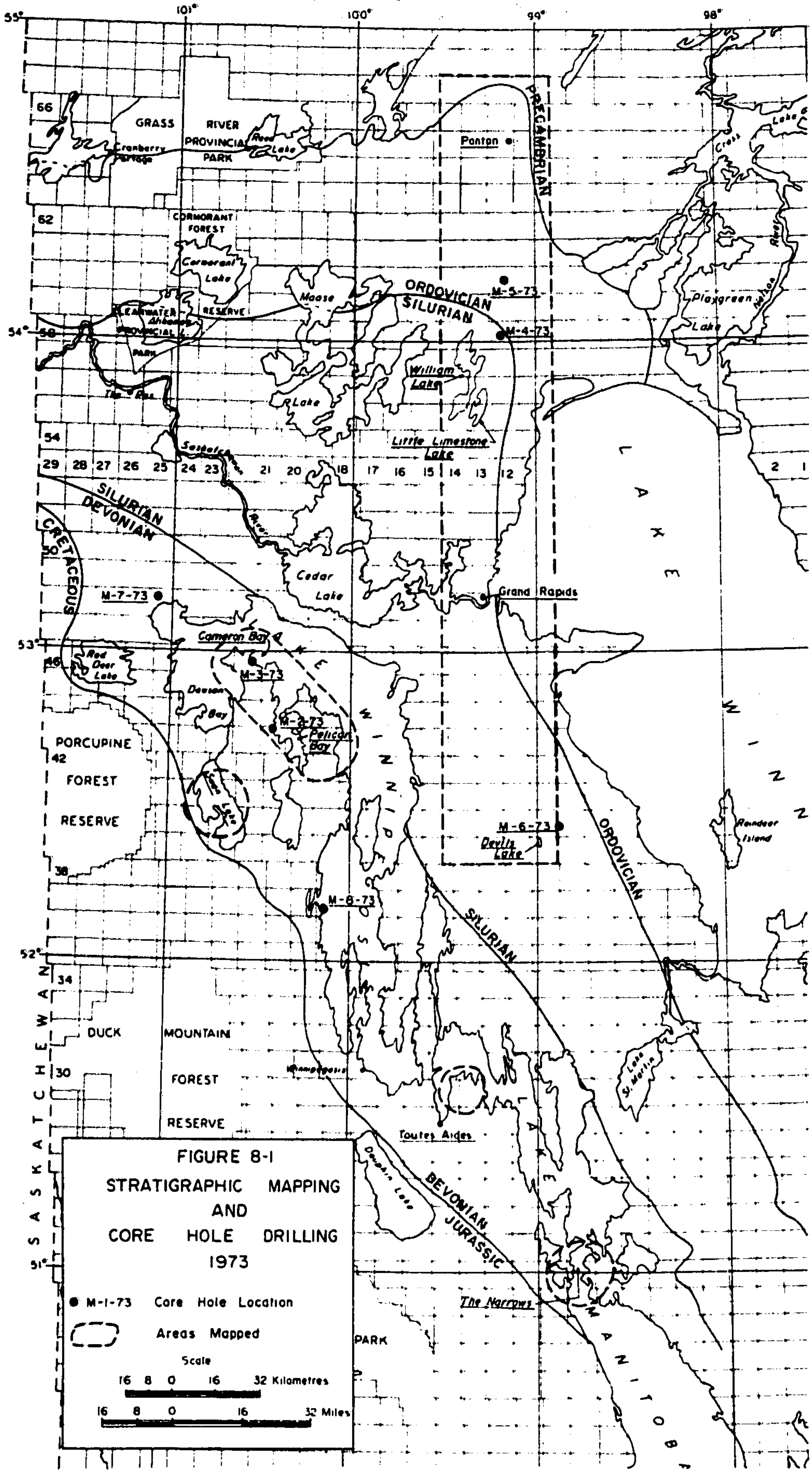

FIGURE 8-1
STRATIGRAPHIC MAPPING AND CORE HOLE DRILLING 1973

(9) STRATIGRAPHIC CORE HOLE PROGRAMME

by H. R. McCabe

Eight core holes, comprising 1,168 feet of core, were completed during the period June 4 to September 20, 1973 (Table 9-1). These holes were drilled primarily in support of the two stratigraphic mapping projects. Holes M-2-73 and M-3-73 were drilled in the remote Pelican Bay-Cameron Bay area (Figure 8-1) in order to determine the lithology of the Winnipegosis Formation and to delimit more accurately the extent of the Devonian outcrop belt. In addition, the Pelican Lake (M-2-73) hole was intended to check on the reported occurrence of sulphides (pyrite) in this area. Only traces of sulphide were encountered in both holes. Unexpectedly, the Pelican Bay hole intersected a 57+ foot section of what appears to be high-calcium limestone in the "Winnipegosis" section. This limestone may possibly be correlative with the Elm Point limestone, in which case it is the northernmost occurrence of this unit.

The Cameron Bay hole (M-3-73) was located in what was interpreted to be a structurally low, inter-reef area of presumed salt collapse. The hole intersected a relatively thin (86 ft.) Winnipegosis section, including an upper zone of 37 feet of dark, finely laminated bituminous dolomite (i.e. inter-reef lithology), underlain by 49 feet of light buff mottled granular dolomite. This is suggestive of an initial period of stable platformal deposition (correlative with the Elm Point limestone facies?), prior to more active basin differentiation and resultant development of distinctive reef and inter-reef facies, and, eventually, evaporite deposits.

Hole M-7-73 was located on a Winnipegosis reef (> 210 feet thick) which forms a prominent structural/topographic high just north of the Overflowing River. This outcrop, and a similar outcrop immediately to the north, appear to be the northernmost exposures of Devonian strata in this region. The core hole data will aid greatly in defining the distribution of the Devonian outcrop belts in this area of sparse outcrop.

Hole M-8-73, at Duck Bay on Lake Winnipegosis, intersected a sequence of dolomites of probable Winnipegosis age. The location of this outcrop indicates the presence of a thick Winnipegosis reef in an area where such reefs had not previously been reported.

Holes M-4-73, M-5-73, and M-6-73 were drilled to provide added structural and stratigraphic control for the Grand Rapids mapping project (this report). The Devils Lake hole (M-6-73) in particular will aid in defining the Ordovician and Silurian outcrop belts; previously no usable outcrop data were available for the central Interlake area, between Gypsumville and Grand Rapids.

Hole M-1-73 cored the southernmost known occurrence of the completely dolomitized facies of the Cat Head Member of the Red River Formation, and will provide additional data for determining facies changes in the Red River Formation of southern Manitoba.

TABLE 9-1. STRATIGRAPHIC CORE HOLE DATA

Hole No.	Location and Approximate Elevation	Formation	Interval	Summary lithology
M-1-73	MW22-24-4E +725'	Red River (Cat Head)	0-3	Dolomite, slightly calcareous
		(Dog Head)	3-80	Limestone, mottled, dolomitic
M-2-73	9-33-43-21W +845'	Dawson Bay	0-22	Limestone, dolomite
		(Second Red)	22-57	Shale, red
		Winnipegosis	57-78	Dolomite, minor limestone
		(Elm Point ?)	78-135	Limestone
M-3-73	9-15-46-22W +855'	Dawson Bay	0-26	Limestone, dolomite
		(Second Red)	26-55	Shale, red and grey
		Winnipegosis	55-92	Dolomite and limestone, finely laminated, partly bituminous
			92-141	Dolomite, buff, granular
		Ashern	141-182	Shale, argillaceous dolomite, red
		Interlake	182-200	Dolomite
M-4-73	NE17-58-12W +925'	Silurian (undiv.)	0-108	Dolomite, mottled
M-5-73	SW22-60-12W +750'	Red River	0-94	Dolomite, mottled
		Winnipeg	94-117	Sand, sandstone
M-6-73	SW18-40-10W +850'	Silurian/Ordovician (undiv.)	0-199	Dolomite, mottled, argillaceous
M-7-73	8-20-48-25W +890'	Winnipegosis	0-210	Dolomite
M-8-73	4-8-37-19W +840'	Winnipegosis	0-92	Dolomite