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MANITOBA MINES BRANCH
DEPARTMENT OF MINES AND NATURAL RESOURCES

SUMMARY OF GEOLOGICAL FIELDWORK 1968

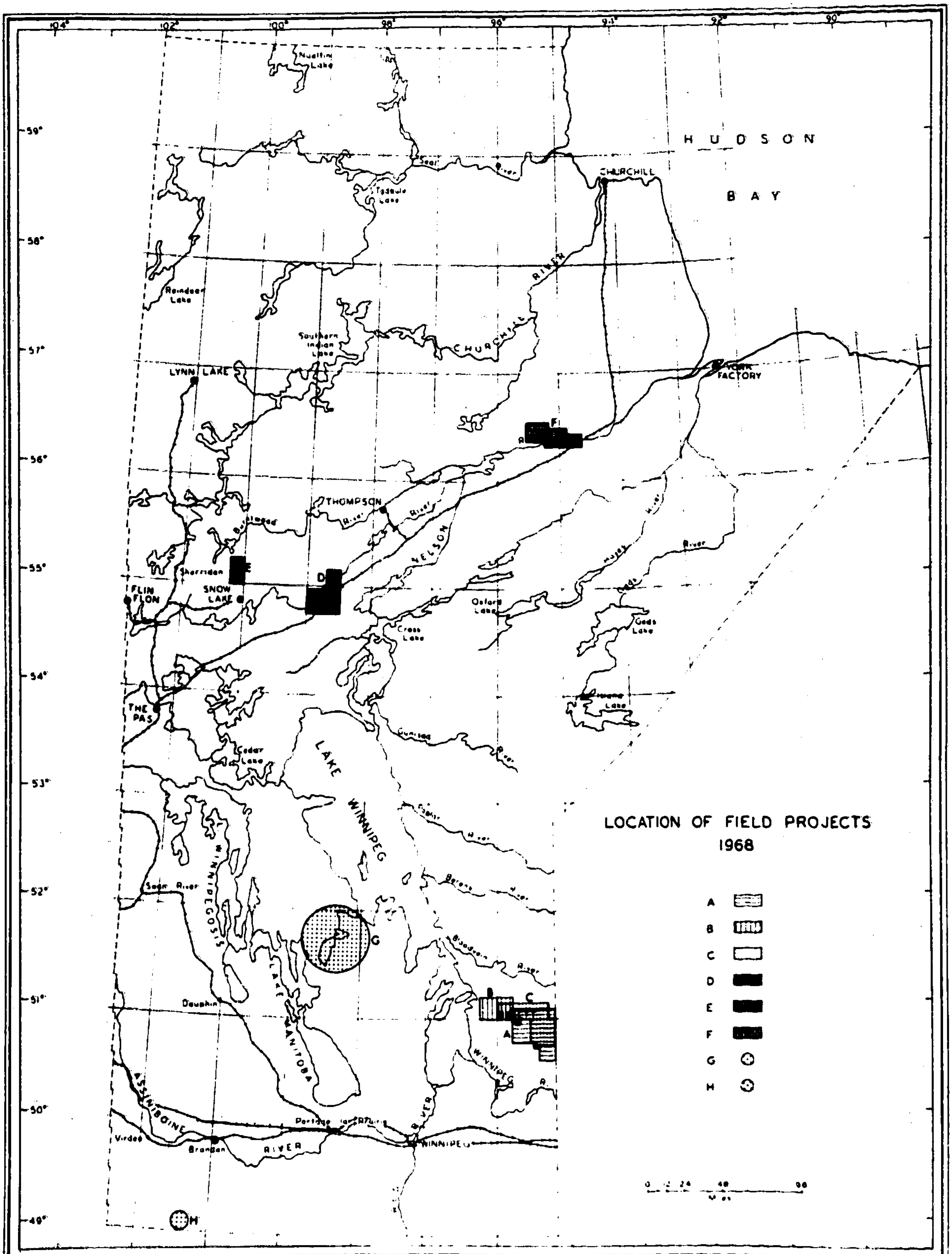
Geological Paper 3/68

Winnipeg 1968

SUMMARY OF

GEOLOGICAL FIELD WORK 1968

GEOLOGICAL PAPER 3/68



HUDSON BAY
CHURCHILL
YORK FACTORY
LYNN LAKE
THOMPSON
FLIN FLON
SNOW LAKE
THE PAS
CHURCHILL RIVER
NELSON
LAKE WINNIPEG
WINNIPEGOSIS
LAKE MANITOBA
ASSINIBOINE
RIVER
WINNIPEG
LOCATION OF FIELD PROJECTS
1968
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SUMMARY OF GEOLOGICAL FIELD WORK, 1968

by the

MANITOBA MINES BRANCH

INTRODUCTION

by

K. A. Phillips[1]

In this report a summary is given of the geological fieldwork carried out by the Manitoba Mines Branch in 1968. Most of this work was done in the Precambrian areas, both in the southeast and north-central parts of the Province.

The fieldwork for Project Pioneer, an intensive geological and geophysical study of the Rice Lake greenstone belt in southeast Manitoba, was virtually completed in 1968. The first three summaries (A, B and C) refer to the main geological field investigations. The major geophysical contribution of the University of Manitoba and the co-operation of the Geological Survey of Canada are acknowledged.

The northern Precambrian programme initiated in 1968 was the largest since 1965. Three five-man parties, led by staff geologists, were engaged in mapping at one half mile to the inch. One party (summary D) commenced field investigations along the southwest extension of the Nickel Belt, while a second (summary E) began mapping an area of some economic interest a few miles north of the Snow Lake copper-zinc mineralized zone.

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1 Assistant Director of Mines, Norquay Building, Winnipeg.

The most northerly party (summary F) was located on the Nelson River west of Manitoba Hydro's Kettle Rapids dam, now under construction. Its objective was to record geological information from the entire forebay area, prior to flooding.

Significant information about the Lake St. Martin area (summary G) has been gained from a diamond drilling programme still in progress. Interest in this area, which lies between Lake Winnipeg and Lake Manitoba, is focussed upon the anomalous occurrences of granitic and volcanic rocks in a region of Lower Palaeozoic sediments.

Updating of the stratigraphic maps (summary J) covering Palaeozoic and later formations was continued, utilizing oil-well data to supplement the very limited outcrops. New information was obtained concerning the Tertiary succession at Turtle Mountain (summary H). Attention was also given to industrial minerals (summary I) in the southern part of the Province.

(A) RICE LAKE - BERESFORD LAKE AREA

(52 L - 11 NE & NW, 13 NE, 14 (all); 52 M - 3 SE & SW, 4 SE)

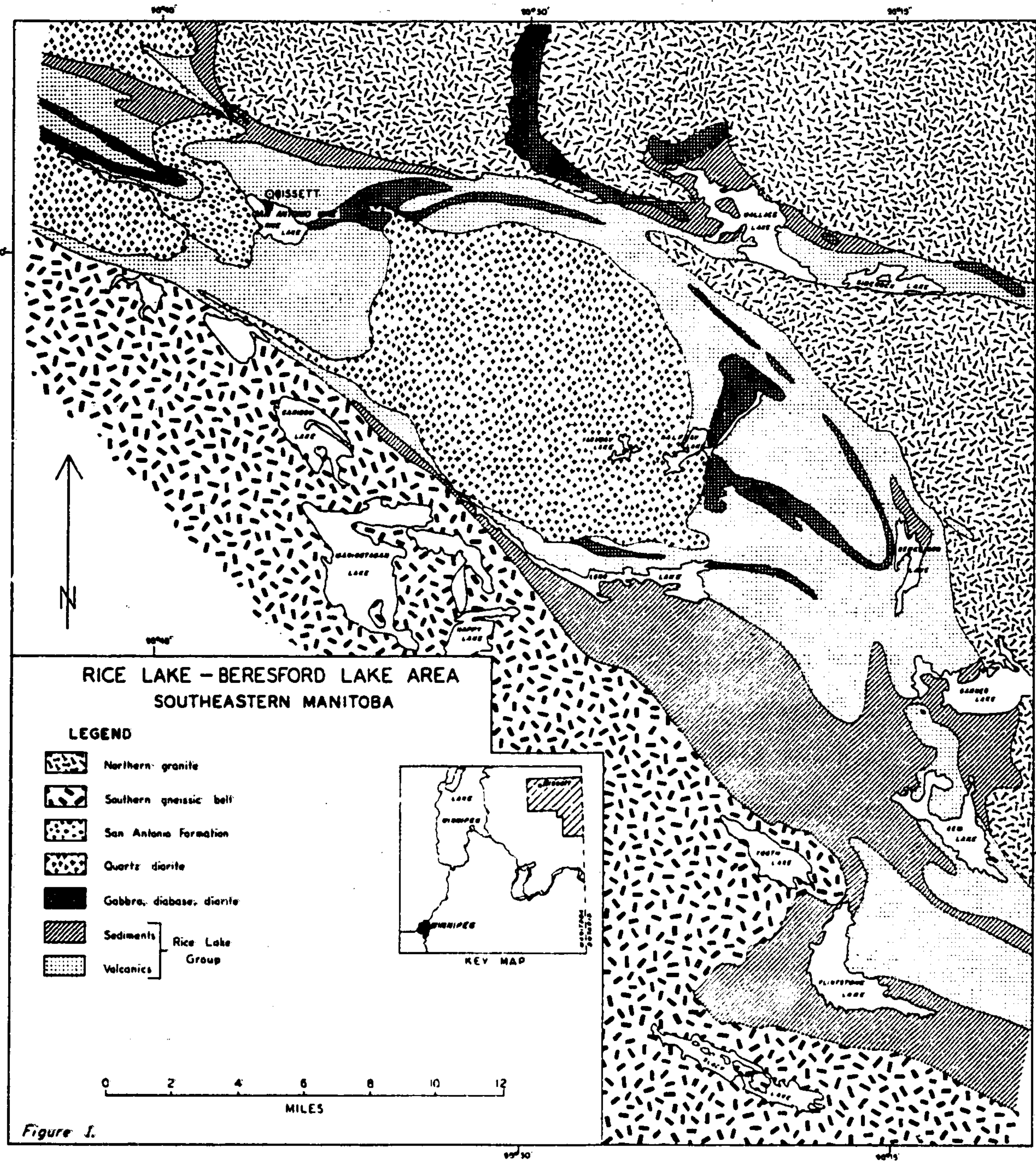
by A. Turek, W. D. McRitchie and W. Weber

Introduction

This fieldwork is part of Project Pioneer which was commenced in 1966 as a joint undertaking by the Manitoba Mines Branch (Davies 1966) and the University of Manitoba (Department of Geology). It was designed as an integrated field and laboratory study of the Rice Lake-Beresford Lake area, around Bissett, approximately 100 miles northeast of Winnipeg. The field area (fig. 1) is about 700 square miles in size. Three seasons of fieldwork have now been completed and the data collection phase of the project finished. Laboratory and office work will follow for the next two years. A total of twnety men were engaged in the field work during the past season, three staff geologists, undergraduate, and graduate students; of the latter five were mostly working on their thesis topics. Over the three years to date four Ph. D. and eight M. Sc. theses were initiated and nine of these are still in progress at the University of Manitoba.

General Geology

The Bissett Archean greenstone belt trends easterly to southeasterly and extends from the east shore of Lake Winnipeg through to Ontario. Definitive mapping in the area was done by Stockwell (1938 A, B, C, 1939), Stockwell and Lord (1939), Davies (1953) and Russell (1948, 1952). The present work fully supports the previous



BISSETT
RICE LAKE – BERESFORD LAKE AREA
SOUTHEASTERN MANITOBA
LEGEND
Northern granite
Southern gneissic belt
San Antonio Formation
Quartz diorite
Gabbro, diabase, diorite
Sediments
Volcanics
Rice Lake Group
KEY MAP
0 2 4 6 8 10 12
MILES
N

Figure 1.

lithologic mapping and there is little room for improvement in this area. However, the emphasis of the present work is in fields of earth sciences which have developed in the last ten-twenty years.

The oldest rocks in the area, the Rice Lake Group, are a succession of basic to acid volcanics with interbedded sediments. These have been intruded by basic dykes and sills which in turn were intruded by quartz diorite plutons. The San Antonio Formation, an arkosic sandstone, unconformably overlies the Rice Lake Group. To the north of the greenstone belt the potassic granite pluton, "northern granite", can be subdivided into four types. Areas of this pluton have abundant xenoliths, now mostly amphibolites but clasts of gabbros, pillow lava and a conglomerate have been noted. The largest of such xenoliths, a gabbro, is about 3000 feet in diameter located approximately ½ mile south of Wanipigow River and 1 mile west of the Manitoba-Ontario boundary. This area was burned recently and exposure is excellent. It may be that other xenoliths are of comparable magnitude but recognition of this is hindered by outcrop conditions. To the south of the greenstone belt in the "southern gneissic belt", an extension of the English River gneisses, seven granite types and three pegmatite phases are recognized here.

The terms "northern granite" and "southern gneissic belt" are being used for convenience and are not formal names.

Structure and Metamorphism

Grade of regional metamorphism in the greenstone belt is greenschist facies; the high grade gneisses to the south are tentatively assigned to the amphibolite facies. However, the grade appears to be increasing to the south away from the greenstone boundary. Only retrogressive metamorphism is noted in the "northern granite".

Mylonite is extensively developed along the northern and southern boundary of the greenstone belt and it is probable that the high grade gneisses to the south have been upthrust into their present juxtaposition adjacent to low grade volcanics and sediments of the Rice Lake Group.

Deformation in the greenstone belt is variable and has been influenced by the central quartz diorite pluton as discussed subsequently. More extensive deformation is noted in the "southern gneissic belt", where at least three phases of folding and two of cataclastic deformation associated with the development of major fractures are recognized. In the northern granite a very marked increase of the intensity of foliation is noted to the south towards the greenstone belt and also from east to west.

Economic Geology

Gold was first discovered in the area in 1911 and continuous production was maintained until June 1968 when San Antonio Gold Mines Ltd., the last producing mine, closed operations. Just under 1.5 million ounces of gold were produced in that time. Bulk of this production has come from two areas, around Rice Lake and Long, Beresford and Halfway Lakes. The central, egg-shaped quartz diorite appears to have protected these two areas as pressure shadow zones and the deformation here is less intense. There is also a greater concentration of quartz veins in these two areas than elsewhere. In an area north of

Wallace Lake mapping on a mine scale shows that gold-quartz veins tend to be localized axial planar to S folds. A detailed geological-geochemical study of the gold-quartz veins and wall rock alteration is in progress as a Ph. D. dissertation.

Other mineralization noted in the area includes uranium at Caribou and Manigotagan Lakes, fluorite and some free gold at Happy Lake, and molybdenite south of Tooth Lake. A grab sample from a sedimentary iron formation north of Wanipigow River, between Siderock and Wallace Lakes, assayed 30.2% total iron. In close association to this is a 300 foot pyrite zone. Numerous occurrences of supergene copper staining, as well as the frequent presence of accessory pyrite, chalcopyrite and pyrrhotite in intermediate to ultrabasic intrusive rocks, are suggestive of base metal potential. Particularly noteworthy is the occurrence of chalcopyrite, arsenopyrite and pyrite as epigenetic mineralization along microfractures in a granodiorite and associated feldspar porphyry dykes in the Flintstone Lake area.

Geochronology

Twenty-three Rb-Sr age determinations on the area were reported by Turek and Peterman (1968). The gold mineralization at 2720 m.y. post-dates and thus provides a minimum age for the Rice Lake group as well as the successively younger basic intrusives, quartz diorite plutons and the San Antonio Formation. A whole rock isochron age for the northern granite gives 2550 m.y. which is also taken as the age of regional metamorphism. An age of 2630 m.y. on a cross-cutting pegmatite in the "southern gneissic belt" provides a minimum age for that terrain.

Geophysics

University of Manitoba is engaged in a seismic study of the greenstone belt to provide information on the location of the Conrad and Mohorovicic discontinuities. Preliminary interpretation of results indicates a downward warp of the Conrad. Also a gravity survey by the University has essentially been completed, a total of 1100 readings over the three years.

The Geological Survey of Canada has completed an INPUT E-M survey of three selected areas involving 670 line miles as an experimental survey principally to assist in the interpretation of structural geology and hopefully to delineate rock types in areas of swamp and overburden.

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Stockwell, C. H. 1938A:	Rice Lake-Gold Lake Area Southeastern Manitoba; Geol. Surv. Can. Memoir 210.
Stockwell, C. H. 1938B:	Gem Lake Map 811A 1/63,360; Can. Dept. of Mines and Nat. Res.
Stockwell, C. H. 1938C:	Beresford Lake Map 809A 1/63,360; Can. Dept. of Mines and Nat. Res.
Stockwell, C. H., and Lord, C. S. 1939:	Halfway Lake-Beresford Lake Area, Manitoba; Geol. Surv. Can. Memoir 219.
Turek, A., and Peterman, Z. E. 1968:	Preliminary Rb-Sr Geochronology of the Rice Lake-Beresford Lake Area, Southeatern Manitoba; Can. J. E. Sc. 5, 6. (Geol. Paper 2/68, Manitoba Mines Branch)

(B) WANIPIGOW LAKE AREA

(52 M - 4W; 62 P - 1E)

by N. Church and F. Franchi

The Wanipigow Area (fig. 2) is located about ten miles west of Bissett, Manitoba. Geological investigation during the summer of 1968 included parts of Twps. 24 and 25, and Rgs. 10, 11, and 12, covering a total area of about 100 square miles.

Briefly, the geology of the Wanipigow area is as follows: bedded Archean rocks, mixed lavas and sediments, form a two-mile-wide southeasterly-trending belt striking parallel to the long axis of Wanipigow Lake. The same rocks underlie much of Wanipigow Lake and the area immediately to the southwest. The belt is bounded on the northeast and southwest by zones of apparently uplifted plutonic rocks. A complex of tonalite and diorite stocks lies to the northeast of the volcanic-sedimentary beds, and a granite batholith lies to the southwest. Locally, small gabbro and dacite stocks and sills intrude the volcanic rocks. Also, the tonalite-diorite complex is cut by numerous diabase dikes and a few large dike-like serpentinite bodies.

Some of the important revisions and additions to previous mapping by Russell (1949) and Davies (1949 and 1950) are as follows:

1. Recognition of the south granite batholith and petrographic distinction of this unit from the tonalite - diorite complex to the north.
2. Location of several new serpentinite bodies: (a) immediately

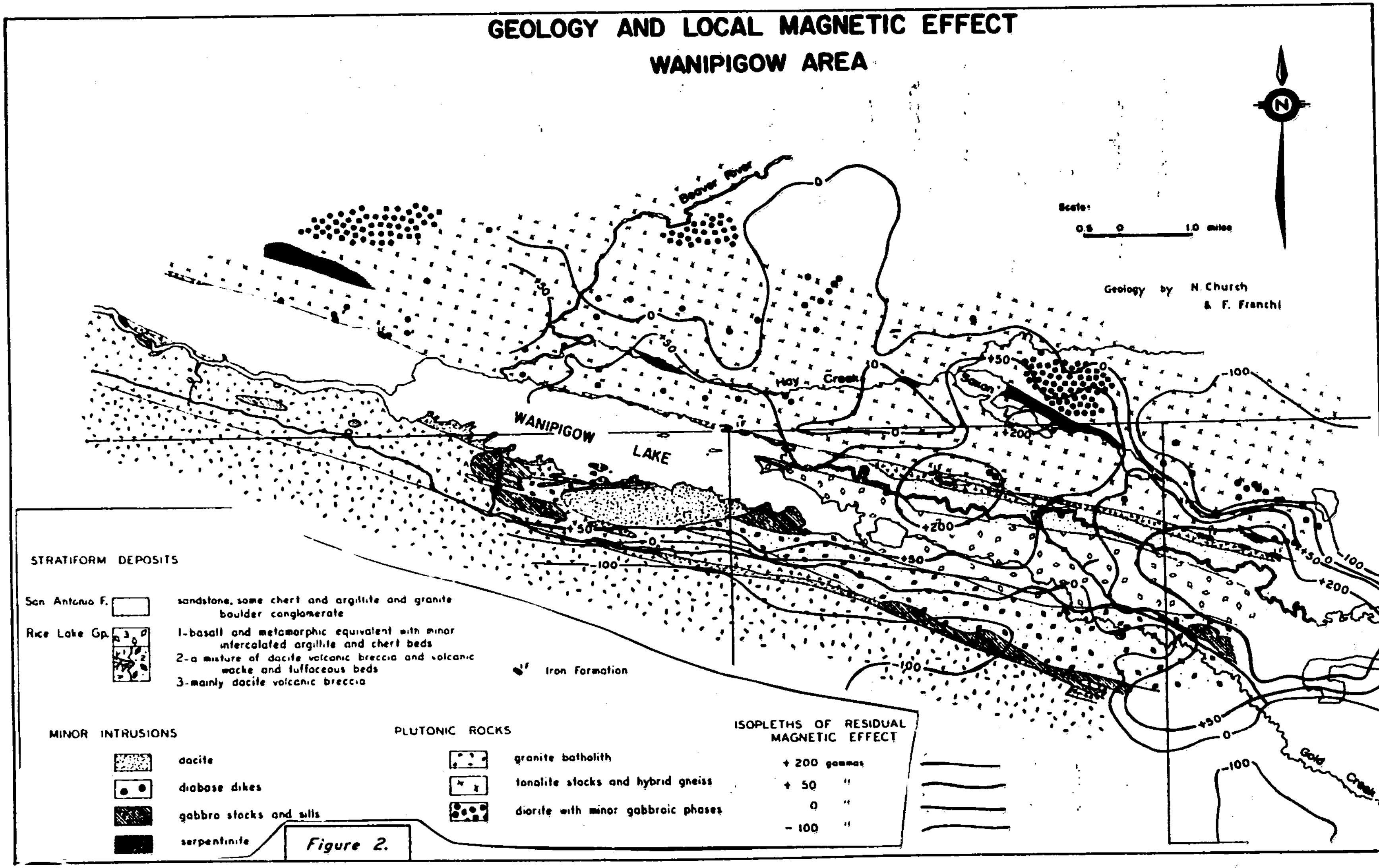
GEOLOGY AND LOCAL MAGNETIC EFFECT
WANIPIGOW AREA
N
Scale:
0.5 0 1.0 miles
Geology by N. Church
& F. Franchi
Beaver River
Hay Creek
WANIPIGOW
LAKE
Gold Creek
+50
0
+200
-100
STRATIFORM DEPOSITS
San Antonio F.
sandstone, some chert and argillite and granite boulder conglomerate
Rice Lake Gp.
1-basalt and metamorphic equivalent with minor intercalated argillite and chert beds
2-a mixture of dacite volcanic breccia and volcanic wacke and tuffaceous beds
3-mainly dacite volcanic breccia
Iron Formation
MINOR INTRUSIONS
dacite
diabase dikes
gabbro stocks and sills
serpentinite
PLUTONIC ROCKS
granite batholith
tonalite stocks and hybrid gneiss
diorite with minor gabbroic phases
ISOPLETHS OF RESIDUAL MAGNETIC EFFECT
+ 200 gammas
+ 50 "
0 "
- 100 "

Figure 2.

west of the Russell exposure about two miles northwest of Wanipigow Lake, (b) three new bodies west of Saxon Lake along Hay Creek and one body about a mile northwest of Saxon Lake, (c) similar discoveries east of Saxon Lake about one and a half miles, at the east end of Woods Lake and about three miles southeast of Saxon Lake near Mud Lake, (d) a poorly exposed serpentinite near the head waters of Hay Creek about one and a half miles north of Beaver Lake at the east margin of the map area.

3. Indentification and delineation of a new dacite intrusive body on the southwest shore of Wanipigow Lake.

4. Subdivision of the volcanic rocks of the Rice Lake Group into three important lithological units, (i) basaltic lava with minor chert and argillite beds and metamorphic equivalent, (ii) a mixture of dacite volcanic breccia, tuffs, and volcanic wacke, (iii) mainly dacite volcanic breccia.

5. Recognition of the main sedimentary unit as stratigraphic equivalent of the San Antonio Formation.

The magnetic character of rocks underlying the Wanipigow area varies markedly as might be expected because of their wide range in iron composition. Iron formation and basic igneous rocks such as serpentinite, gabbro, diabase, and metabasalt are responsible for many magnetic anomalies detected by aeromagnetic survey and on the ground. Cherty and fine grained argillaceous sediments associated with metabasalts are commonly magnetic but the sandy and coarse clastic sediments generally have weak magnetic susceptibility like granite, tonalite and dacite.

Analysis of air-photo linear data shows the relative development and importance of fracture systems in the rocks underlying the Wanipigow area. The following statistics are obtained from measurement of more than 3,500 linears covering the entire area:

Tonalite-Diorite Complex

Mean Linear Azimuth	Relative Angular Scatter	Frequency Percent
040	very broad	7.0
090	sharp	10.0
145	broad	5.0

(Generally a high scatter background is observed)

Volcanic-Sedimentary Belt

Mean Linear Azimuth	Relative Angular Scatter	Frequency Percent
015	broad	2.5
055	broad	5.0
100	sharp	20.0
130	broad	5.0
155	very broad	2.5

South Granite

Mean Linear Azimuth	Relative Angular Scatter	Frequency Percent
050	broad	5.0
095	very sharp	33.5
145	sharp	6.5
160	broad	4.5

(Generally a very low background is observed)

Field examination shows that the strong easterly-trending linear, about 095 degrees, is coincident with the main lithological strike in the Wanipigow area and is parallel to an important steeply dipping shear direction. Evidence suggests that most recent movement along this shear is right-handed (dextral) and almost horizontal (strike slip). If this interpretation is correct then the linears striking roughly 130 to 160 degrees are probably coincident with a conjugate set of left-handed (sinistral) shears.

The northerly linear, about 015 degrees, and northeasterly linears, between 040 and 050, are roughly parallel to the two most recent Pleistocene glacial advances through the area. Also, it is noted that commonly diabase dikes are found striking about 045 degrees suggesting possible structural control for linears oriented in this direction.

In conclusion, recent revision of the geological interpretation should attract new prospecting interest in the Wanipigow area. It is advised that serpentinite, diorite, metabasalt, chert-argillite units, indicated on the accompanying map, be examined in detail for possible mineralization.

<u>References Cited:</u>

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1949: Manitoba Mines Branch Pub. 48-2

Davies, J. F.
1950: Manitoba Mines Branch Pub. 49-3

Russell, G. A.
1949: Manitoba Mines Branch Pub. 48-3

(C) MAFIC AND ULTRAMAFIC ROCKS OF THE BISSETT AREA

(52 L - 14 (all); 52 M - 3SW, 4 SE & SW)

by R. F. J. Scoates

A study of mafic and ultramafic intrusive rocks has been conducted in the Project Pioneer area during the past two field seasons. Six weeks of the 1968 field season were spent in examining exposures of the mafic-ultramafic suite within the area. All of the units described can be found on G.S.C. Maps 809A, 810A and 811A (Stockwell, 1945).

Gabbro

Three main field classifications of gabbro are made: ophitic gabbro, spotted gabbro and orbicular gabbro.

(1) Ophitic gabbro

Two large masses of ophitic gabbro occur, one east of Bissett and south of the Bissett-Wallace Lake road and the other north and west of Halfway Lake. These masses are largely homogeneous although local variations occur. The rock is medium grained, has a sub-ophitic to ophitic texture and is greenish black in colour. The ophitic nature of the rock is enhanced on the weathered surface. The rock is generally massive and non-foliated.

The rock consists of lath plagioclase and hornblende with lesser amounts of clinopyroxene, chlorite, quartz and magnetite. Sparsely disseminated pyrite and pyrrhotite occur.

Attempts to map compositional variations within this gabbro unit met with little success. Texture and mineralogical composition do not show regular variations, except that the central portion of each of the bodies displays the coarsest grain size.

(2) Spotted gabbro

Spotted gabbro sills are intrusive into the volcanic and associated sedimentary series. Most sills are continuous over ½ to 1 km and then pinch out. One outstanding exception is a southwesterly striking sill mapped by Stockwell and Lord (1939) for 15 kms and traced by the writer for another 11 kms. Some sills have sheared contacts while others are unsheared and display fine grained margins against the host rocks.

The mafic minerals, hornblende and rare remnant pyroxene, occur as randomly distributed crystals and/or aggregates of crystals in a medium to fine grained matrix. This imparts a distinctive knobby appearance on weathered surface. The density of crystals varies widely in a short distance on individual outcrops and attempts to map the distribution of crystals on a broad scale (e.g. from contact to contact across individual dykes) proved fruitless.

Some gabbro bodies, notably those intrusive into the basalt series, are transitional between the spotted and ophitic varieties. They are generally finer grained and possess only sub-ophitic texture.

(3) Orbicular gabbro

Orbicular gabbro is sporadically developed over a wide area and is essentially a sub-variety of the gabbros described above. In the western part of the area it occurs where gabbro is in contact with the acid volcanic series north of Gold Creek and the diabase mass south of the Bissett-Wallace Lake road.

Orbicules or clots of creamy white to greenish white altered feldspar, are found in the gabbro and form a narrow zone adjacent to the contacts described above. This zone ranges in width from 1 to 10 metres. Individual orbicules are equidimensional to eliptical and average 2 cms in diameter. They appear to be entirely free of inclusions and are homogeneous.

Orbicular gabbro is also found in some of the spotted gabbro sills, notably those in contact with acid volcanics. The most outstanding development of this type occurs between the Long Lake road and the northwest end of Moore Lake.

Ultramafic rocks

Three types of ultramafic rocks are found in the area:
(1) a discontinuous series of highly serpentinized ultramafic lenses,
(2) a continuous straight-walled dyke of hornblende peridotite and
(3) a stratiform complex composed of alternating layers of serpentinized peridotite and pyroxenite that occupies most of Garner Lake.

(1) The serpentinite bodies of the first type form a discontinuous series of lenses which occur along a well defined topographic linear. The known exposures extend from east of Woods Lake westward to the Wanipigow Indian Reserve. These rocks are characterized by being completely serpentinized and moderately to strongly foliated and by lacking relict primary textures. Two isolated exposures of serpentinite have been recorded during the study; one on the north shore of Wallace Lake and the other approximately ½ mile east of Beresford Lake.

(2) A continuous dyke of coarse grained hornblende peridotite, mapped by Stockwell and Lord (1939) as hornblendite, outcrops from Dove Lake eastward to a point ½ mile north of Stormy Lake, a distance of approximately 3.5 km. The dyke, which is intrusive into a fault

zone, ranges in width from 30 to 60 meters. The form of this dyke is displayed on G.S.C. Map 536A (Stockwell and Lord, 1939). The rock consists of strongly pleochroic brown hornblende and biotite and ovoid serpentine after olivine with lesser amounts of chlorite and magnetite. Fine grained pyrrhotite is a rare constituent. The rock is generally massive with foliation developed locally at the contacts.

(3) The Garner Lake stratiform body consists of alternate layers of serpentinized peridotite and pyroxenite. The layers strike easterly and appear to have a shallow dip to the north. The peridotite outcrops, which weather a characteristic brownish buff colour, contain veinlets of crossfibre asbestos (½ to 1 cm). The rock consists of clinopyroxene, poikilitically enclosing ovoid areas of serpentine; magnetite is a common constitutent. The pyroxenite is medium grained, consists of an accumulation of clinopyroxene and weathers dark grey to greyish black. Partially serpentinized interstitial olivine is common as well as secondary magnetite.

<u>References Cited:</u>

Stockwell, C. H. 1938: Rice Lake - Gold Lake Area, Southeastern Manitoba; Geol. Surv. Can. Memoir 210.

Stockwell, C. H., and Lord, C. S. 1939: Halfway Lake - Beresford Lake Area, Manitoba; Geol. Surv. Can. Memoir 219.

(D) PAKWA LAKE AND PISTOL LAKE (east half) AREAS
(63 J - 15 (all), 63 O - 2E)

by D. A. Cranstone

In 1968 the writer commenced mapping an area of approximately 500 square miles, around the village of Wabowden. The Pakwa Lake area is bounded by longitudes 98°30' and 99°00'W and latitudes 54°45' and 55°00'N; the Pistol Lake (east half) area by longitudes 98°30' and 98°45'W and latitudes 55°00' and 55°15'N. Approximately 350 square miles were mapped during the summer of 1968.

Areas of little or no outcrop were traversed by helicopter, flying 700 feet above the ground, at intervals of 2000 feet. This resulted in a saving of time, money and effort in comparison to conventional pace and compass traversing. It is considered that a higher proportion of the few outcrops exposed in such areas can be located by helicopter than by pace and compass traversing.

The area mapped can be subdivided into three distinctive sub-areas, as follows:-

1. Area south of the Setting Lake fault zone.
2. Setting Lake fault zone.
3. Area north of the Setting Lake fault zone.

South of the Setting Lake fault zone (south of Setting Lake) the rocks are granitic gneisses, granitized gneisses with interbands and remanents of plagioclase amphibolite, and intrusive (?) granitic rocks.

North of the Setting Lake fault zone the rocks are chiefly fine, granular, bedded quartzo-feldspathic metasediments, paragneisses, augen-like granitic gneisses, granites, and bedded, intermediate to mafic metasediments. These rocks are lithologically dissimilar to the gneisses south of Setting Lake and to most of the mylonitized rocks in the Setting Lake fault zone.

The Setting Lake fault zone is a steeply dipping zone of mylonites and related cataclastic rocks underlying Setting Lake and exposed on several islands in the northeastern portion of this lake. A few outcrops of mylonite and other cataclastic rocks are exposed on the east shore of Setting Lake. This more or less continuous zone of cataclastic rocks is at least 3,000 feet thick in some places, and may locally attain a thickness of 5,000 feet. The cataclastic rocks consist predominantly of mylonitized to strongly sheared sediments (mylonitized pelitic to arenaceous metasediments and strongly sheared to mylonitized conglomerate). The cataclastic zone contains at least two elongate bodies of white granite which have been mylonitized along their margins. Evidence for this major fault zone can be observed in granitic gneisses along Setting Lake, almost to the southwestern end of the lake, where the mylonite and/or fault zone must be much narrower. Smaller subsidiary zones parallel the main Setting Lake fault zone and are found north and south of Setting Lake; these zones are narrow and poorly exposed, and therefore difficult to trace.

The Setting Lake fault zone is part of a major complex cataclastic fault zone which occurs within the boundary zone between the Churchill and Superior geological provinces. This extends northeast towards Thompson as an anastomosing zone, and further northeast, at Mystery and Moak Lakes, it swings eastward along the Odei River, connecting with the major cataclastic zones recently mapped at Assean Lake and Split Lake (Cranstone 1965; Haugh and Gibbins, 1965). At Setting Lake, and elsewhere, this fault and mylonite zone contains ultramafic rocks (serpentinites, serpentinized peridotites, pyroxenites, etc.).

Ultramafic rocks and nickel-bearing sulphides have been tectonically intruded along the mylonite and fault zones, presumably originating from the mantle. However, ultramafic rocks and sulphides are not confined exclusively to the fault and mylonite zones but have also been injected into nearby country rocks (gneisses and metasediments). According to Coats (1966, 1968) the portion of this fault zone along the east side of Setting Lake contains lens-like bodies of ultramafic rock (serpentinite, serpentinized peridotite and pyroxenite) as indicated by diamond drilling. During the 1968 mapping programme other gabbroic to ultramafic (?) bodies were found exposed at various locations along the chain of islands in the northeast portion of Setting Lake. These mafic bodies are lens-shaped, are generally highly crushed or mylonitized to fine grained greenschists along their margins, and could, therefore, as a result of their cataclastic nature, be mistakenly identified as volcanic flows and pillow lavas. A few small altered ultramafic (?) bodies were noted in outcrops of granitic gneiss and mylonite along the east shore of Setting Lake. In a few outcrops, small quantities of pyrrhotite-pyrite-chalcopyrite mineralization were observed in both of the above mafic-ultramafic groups. Within the

Pakwa-Pistol Lake map area ultramafic rocks are also known to underlie portions of Clarke, Conlin, Halfway, Resting, Bowden and Bucko Lakes, with at least a few other ultramafic bodies indicated by drilling in drift covered areas.

The area has been extensively explored over a period of several years for nickel-bearing sulphide deposits, both by Falconbridge Nickel Mines Ltd., and by other companies. This work is still in progress and has resulted in the discovery of at least four such deposits. These are located at Bowden Lake, Bucko Lake, southwest of Rock Island Lake, and near the west end of Halfway Lake. None of these deposits is exposed, and all were discovered by geophysical prospecting and diamond drilling.

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Haugh, I., and Gibbins W. 1965: Split Lake: Man. Mines Br., Preliminary Map Series.

Rance, H. 1966: Superior-Churchill Structural Boundary, Wabowden, Manitoba: Ph. D. thesis, the University of Western Ontario, London, Canada.

Zurbrigg, H. 1963: Thompson Mine Geology: Can. Inst. Min. Met. Transactions, vol. 66, pp. 227-236.

(E) GUAY LAKE - WIMAPEDI LAKE AREA
(63 N - 1E; 63 O - 4W & E)

by A. H. Bailes

Location:

The three 15 minute sheets 63 N 1E (Guay Lake East), 63 O 4W (Wimapedi Lake West) and 63 O 4E (Wimapedi Lake East), bounded by latitudes 55° to 55°15' and longtitudes 99°30' to 100°15', are located north and northeast of the town of Snow Lake. Snow Lake is approximately 100 miles northeast of The Pas.

Scope of Project:

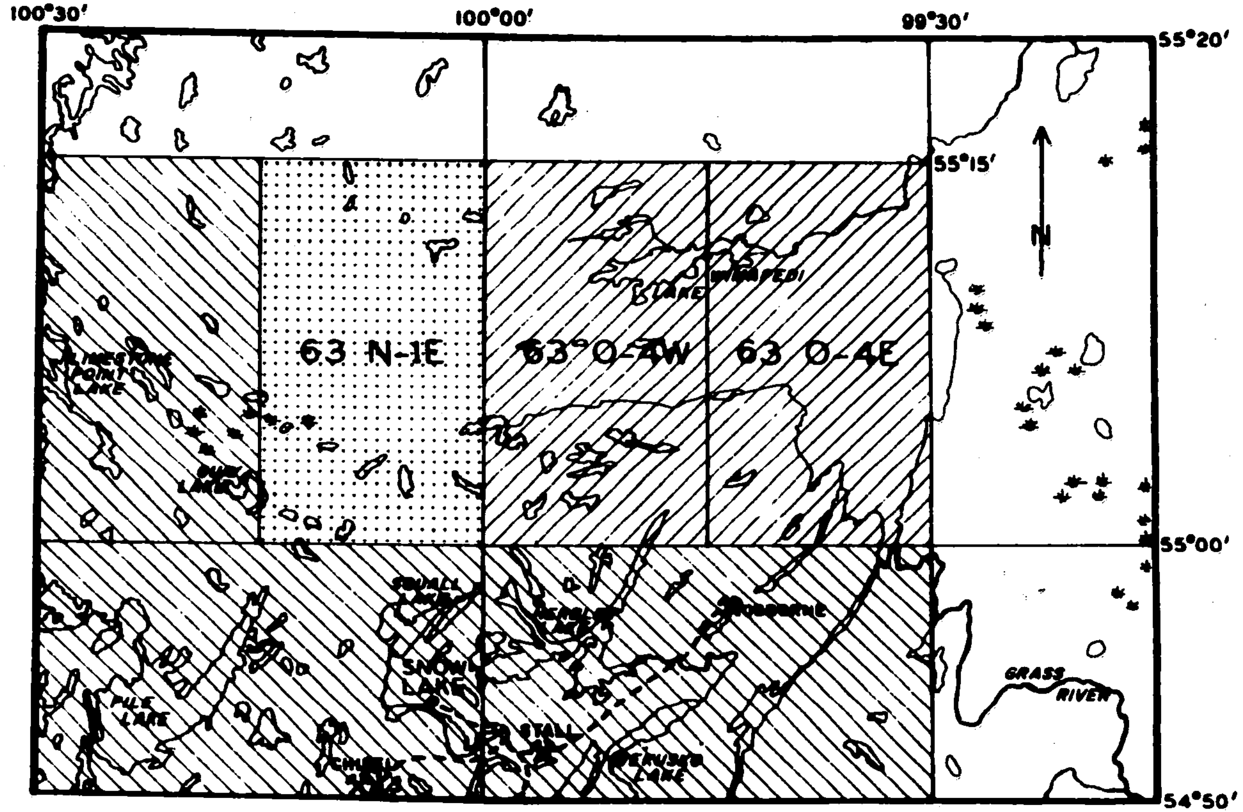
Mapping of the three fifteen minute sheets is being done on a scale of 1 inch to ½ mile, to be reduced to 1 inch to 1 mile for publication. In addition to producing a lithological map, considerable emphasis is being placed on studying the structural geology and metamorphic petrology of the area.

Present Status of Project:

An area of 240 square miles has been mapped. This includes the Guay Lake East (63 N 1E) sheet and a portion of the Wimapedi West (63 O 4W) sheet (fig. 3). Mapping is being done by pace and compass traverses augmented by helicopter support to reach inaccessible areas. Preliminary maps will be available as the mapping proceeds and a report covering the area as a whole will be published following completion of field mapping.

General Geology:

The project area has previously been mapped, at a scale of



GUAY LAKE — WIMAPEDI LAKE AREA

AREA MAPPED, 1968

AREA TO BE MAPPED, 1969-70

AREA PREVIOUSLY MAPPED (at 1″ = 1 mile)

0 2 4 8 16
MILES

Figure 3.

1 inch to 4 miles, by Harrison (1947, Kississing Lake sheet, 63-N), and by Quinn (1953, Nelson House sheet, 63-O). The areas to the south and west have been mapped at a scale of 1 inch to 1 mile.

In the Guay Lake East area the rocks grade from highly granitized gneisses at the northern boundary through to paragneisses, many of which could be classified as sedimentary rocks, at the southern boundary of the map sheet. A rather abrupt change in lithology, from migmatites to the north to paragneisses to the south, occurs at $55^{\circ}05'$ latitude. This 'boundary' is also marked by:

(i) a uniform magnetic low to the north ($<$ 2500 gamma) and a magnetic high (up to 3600 gamma) with considerable relief to the south; and

(ii) an abrupt change in the type and pattern of outcrops as seen on aerial photographs. The northern two thirds of the area has rolling outcrops with east-west trends, while the southern third is characterized by long outcrop ridges which almost perfectly delineate the structure of this folded sequence of gneisses.

The paragneisses are of two varieties. One is a pink to buff coloured uniform "arkosic" quartzo-feldspathic gneiss. The second is more variable, finely banded, light grey, quartz-rich gneiss, which varies from a quartzite through to a gneiss of greywacke composition. The "arkosic" gneiss contains as much as five per cent magnetite and correlates with the magnetic highs on the airborne magnetic survey maps, while the grey quartz-rich gneiss correlates with the magnetic lows. Thin units of amphibolite and hornblende plagioclase gneiss are common in the paragneisses but are not found in the northern migmatites.

The migmatites, which underlie the northern two-thirds of the map sheet, vary from almost pure gneiss to lit pat lit gneiss, highly granitized and digested gneiss, through to almost pure granite. The gneissic fraction is the equivalent of the grey coloured paragneisses already described. The major difference is the development of medium to large, pink to violet coloured garnet porphyroblasts within these migmatized gneisses. The granitic fraction of these migmatites is a white, medium to coarse grained rock composed almost entirely of quartz and white feldspar in approximately equal proportions.

These gneisses are the equivalent of those mapped by Robertson (1954) in the Batty Lake area and are the metamorphosed equivalent of the Snow Lake sediments mapped by Harrison (1947) in the Snow Lake area.

Structural Geology:

Very little can be said about the structural geology until the present data has been interpreted. Two types of minor fold have been observed in the field. One is an open set of folds with a shallow, northerly plunging fold axis. The second is a tight, isoclinal, shallow plunging set whose axial planes are approximately parallel to the gneissosity. In the southern one-third of the Guay Lake East map sheet there are many outcrops where the rocks have been complexly refolded. On a larger scale, refolding relationships can be observed on the aerial photographs; large dome and basin structures can be seen which are most likely the result of refolding. A structural interpretation of this area could prove of practical importance since many of the sulphide deposits in the Snow Lake mining district have been found to plunge parallel to fold axes (Martin, 1966).

All structures are cut by a north-south, steeply dipping fracture system. Movements on these fracture surfaces appear to have been very limited, but when discernible they are almost always left handed. Very often these fractures are filled by pegmatite dikes which have sheared margins.

Economic Geology:

Most exploration in the Guay Lake area has been restricted to the paragneisses, which are similar to the rocks found in the Sherridon and Snow Lake areas where sulphide deposits of economic importance have already been found. The only active exploration program presently being carried out in the map area (63 N 1E) is by Hudson Bay Mining and Smelting Co. in the southeast corner, near a large gneissic granite body.

The southern paragneisses would appear to be the most favourable area for exploration for commercial sulphide deposits.

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(F) KETTLE RAPIDS - MOOSE LAKE AREA

54 D - 6NE, SE & NW; 7 (all); 11 SE & SW

by I. Haugh
and S. C. Elphick

Introduction

Investigations in the Kettle Rapids - Moose Lake area were designed to recover maximum geological information, prior to flooding of much of the area on completion of the Kettle Rapids dam in 1971. Maximum reservoir elevation will be 463 feet above S. L. (Manitoba Hydro, 1967), more than adequate to cover almost all known outcrops in the area. Flooding along the Nelson River will extend as far west as a future dam site at Gull Rapids.

Previous geological mapping in the area by Quinn and Currie (1961) on a scale of 4 miles to the inch, has been completely revised by the present work.

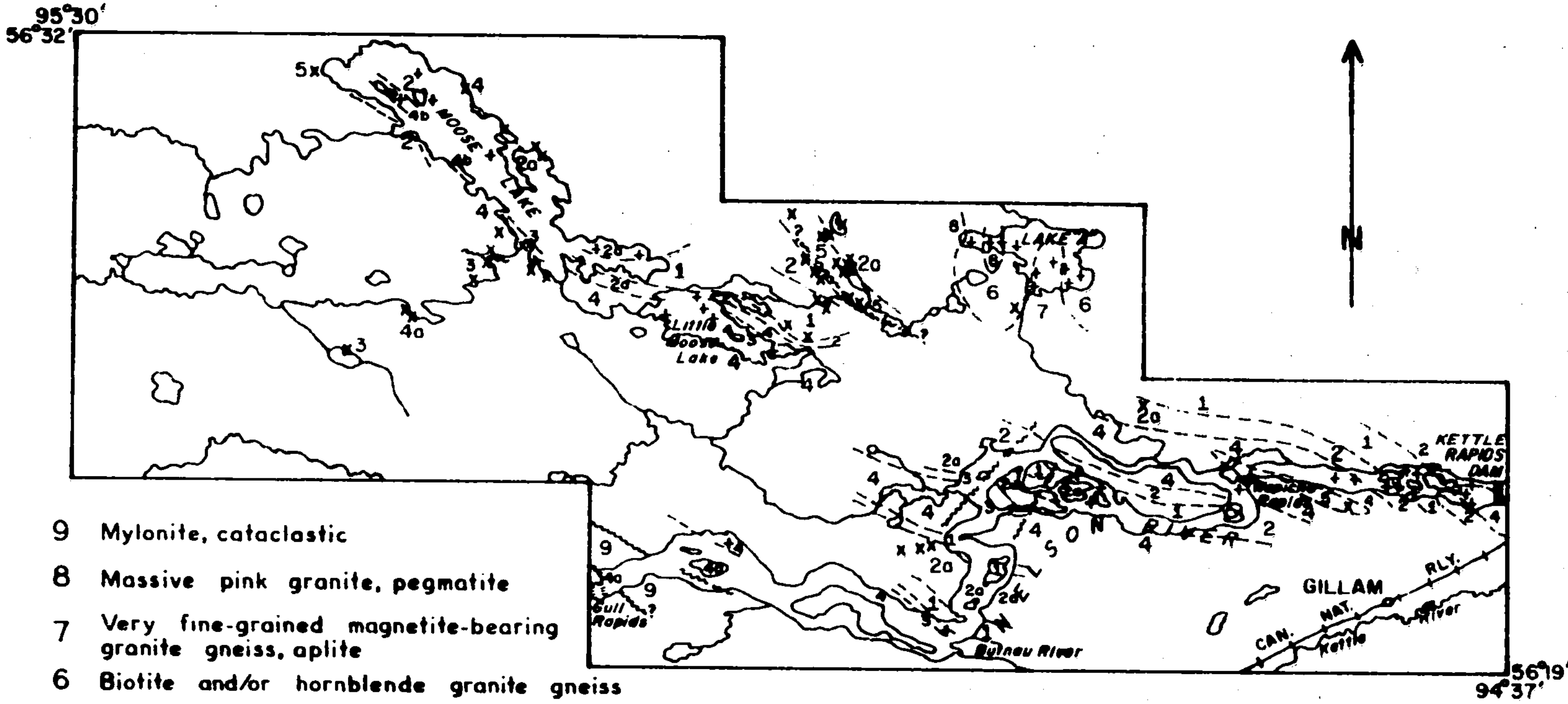
Location and estent of area

The area (fig. 4) comprises approximately 300 square miles lying within boundaries defined by latitudes 56° 19' and 56° 32', and longitudes 94° 37' and 95° 30'. The town of Gillam lies in the south-west corner of the area.

General Geology

Bedrock is obscured over most of the area by a thick mantle of mixed sand, silt, clay and till, up to 175' or more in thickness. With few exceptions, outcrops are restricted to the shores of the Nelson River and the larger lakes, so that limited continuity of rock

KETTLE RAPIDS — MOOSE LAKE AREA



9 Mylonite, cataclastic

8 Massive pink granite, pegmatite

7 Very fine-grained magnetite-bearing granite gneiss, aplite

6 Biotite and/or hornblende granite gneiss

5 Granite, pegmatite with relict layers and blocks of unit 4

4 Pelitic and semi-pelitic biotite garnet schist, migmatite; 4a fine-grained biotite schist, little or no garnet; 4b(?) kyanite schist

3 Plagioclase amphibolite

2 Grey or reddish grey quartzite; 2a granitized quartzite, granite gneiss

1 Reddish grey magnetite-bearing quartzite

~~ Fault

Figure 4

types can only be determined in three main areas i.e. along the Nelson between Kettle Rapids and the mouth of the river flowing out of Moose Lake; around Moose Lake and the smaller adjoining lake (Little Moose Lake) to the southeast; on the small unnamed lake (referred to here as lake A) ten miles northwest of Gillam.

The area constitutes part of a linear mobile belt trending west to northwest, and consisting predominantly of an original sedimentary sequence. This sequence has been repeatedly folded and faulted, subjected to upper amphibolite facies metamorphism and is extensively migmatitic. A tentative four-fold division of the sedimentary sequence has been established:

(1) reddish grey quartzite containing abundant magnetite and numerous green calcareous epidotic lenses.

(2) grey or reddish quartzite, in part magnetite-bearing and in places extremely granitized.

(3) plagioclase-amphibolite with abundant thin epidote-rich greenish yellow layers, lenses and irregular patches.

(4) interlayered pelitic and semi-pelitic biotite schist, mostly garnetiferous with locally abundant sillimanite knots, kyanite and cordierite, and containing varying amounts of ptygmatically folded lit and thicker layers of granite disrupted into boudins.

(a) No evidence exists for the order of deposits of the original sediments. Graded bedding was observed at only one locality.

(b) The exact position of the amphibolite unit (3) in the sequence is uncertain.

(c) Thinner amphibolite layers locally occur within parts of units (2) and (4).

(d) A distinctive bluish grey kyanite-sillimanite-schist occurs on the group of islands at the northern end of Moose Lake. Its relation to other units is at present unknown.

(e) The pelitic/semi-pelitic unit (4) contains varying proportions of granite lit and sills, with complete gradation into larger bodies of white or pink massive pegmatitic granite containing remnant schlieren and garnet-biotite knots, e.g. on the Nelson River east and northwest of Wapicho Rapids.

(f) The quartzites (unit 2) show varying degrees of recrystallization and conversion to a migmatitic granite gneiss.

Good correlation exists between the observed distribution of rock types and the magnetic maps of the area (sheets 2475G, 2476G, 2483G). In particular the magnetite-bearing quartzite of unit (1) exposed on the Nelson between Kettle and Wapicho Rapids, and again on the north side of Little Moose Lake, corresponds to a prominent linear high magnetic anomaly. Apart from a single break (? fault) this linear high is continuous between these two areas, probably reflecting a corresponding continuity of the quartzite unit. In contrast the pelitic unit (4) gives rise to areas of low magnetic intensity.

Along its northern margin the mobile belt appears to be flanked by an area of extreme granitic activity, reflected by a nonlinear magnetic pattern consisting of a series of diffuse, sub-elliptical low areas. In an area of intermittent outcrops two miles northeast of Little Moose Lake, a sequence of pelitic schist and quartzite contains in excess of 60% granite as anastomosing veins and larger discrete bodies. Similarly the bulk of the exposure on lake A comprises two main bodies of foliated (non-layered) biotite and/or hornblende granite gneiss flanking and probably gradational with a northerly trending body of very fine-grained, magnetite-bearing granite gneiss. Both units contain scattered inclusions of pre-existing rock types, ranging from quartzite to amphibolite in composition. The granite gneiss units, which may form small dome-shaped bodies, have not been found elsewhere in the area.

Immediately to the north of the present area, Quinn and Currie (1961) show most of the outcrops along the Limestone River as either "biotite hornblende granite gneiss" or "massive granite, granodiorite, syenite".

Two and possibly three phases of granitic activity have been recognized in the area.

1. A migmatitic phase giving rise to abundant granite lit, sills and larger discrete masses of two-feldspar pegmatitic granites in the sedimentary units.

2. Emplacement of bodies of hornblende/biotite granite gneiss and fine-grained magnetite-bearing granite gneiss on the north side of the belt.

3. Injection of discordant dykes of pink pegmatitic granite commonly trending southwest, parallel to the axial planes of late stage Z-folds throughout the area.

The relationship of phases 1 and 2 is unknown. Phase 3 is a later phase, post-dating the main folding and metamorphism of the belt.

Where granite of all three groups has assimilated pre-existing magnetite-bearing rocks, the magnetite appears to have been concentrated in the granite as large crystals and clots.

At what may be the southern margin of the mobile belt, a broad zone of southeasterly trending mylonites, approximately one half mile wide, outcrops on the north shore of the Nelson River immediately east of the foot of Gull Rapids. Cataclastic rocks also occur on the south shore at Gull Rapids but their extent and significance has not yet been fully investigated. These cataclastic rocks may constitute a major break similar to those through Assean and Split Lakes (Haugh, 1969). Magnetic trends for the region suggest that the Assean Lake fault zone may in fact swing to the southeast and eventually link up with the Gull Rapids mylonites. Quinn and Currie (1961) indicated the presence of a major fault at Gull Rapids, and noted the pronounced change in trend of the rocks south of the fault. Also noted was the absence of basic dykes north of the fault. Only one diabase dyke was encountered in the present study, on the north shore of the Nelson River at Gull Rapids, south of the main mylonite zone.

Structure

Determination of major structures in the area is severely hampered by lack of exposure, hence by the uncertainty surrounding the continuity and extent of the main rock units. In addition some transposition of original sedimentary layering has undoubtedly occurred, particularly in the more micaceous units.

Some idea of the probable sequence of events however can probably be determined from an examination of the abundant minor structures, with due consideration given to the fact that these may or may not be reflected on a macro-scale. A detailed treatment of the structure of the area must therefore await further studies but some pertinent observations based on field data alone are presented below.

1. Early tight, near isoclinal minor folding has been found throughout the area, particularly in the quartzite (unit 2) and commonly with axial plane foliation. In places these folds have been sheared parallel to their axial planes with subsequent injection of granite *lit* along the shears. By this process complete transposition of original layering and granite injection can give rise to a layered *lit par lit* gneiss whose layering is unrelated to preexisting attitude of the original unit.

2. Complex refolding of early minor folds has been observed at several localities, giving rise to an interference pattern of doubly-plunging "eyed" folds. On a large scale this type of folding appears to be present in the quartzites and pelitic schist on the group of islands immediately west of the dam site. On a minor scale refolding appears to have been accomplished by both S and Z minor folds. The status of the S minor folds is not yet fully understood.

3. Reference to the magnetic maps of the area and correlation with the known geology suggests that the entire belt may have been folded into a series of major isoclinal folds accompanied by the development of a regional axial plane schistosity. Subsequent refolding of the isoclinal folds may in places have isolated the early

fold hinges into a series of elongate domes and canoe folds.

4. Minor Z-folds are ubiquitous and reflect a late stage of deformation in the area. Axial planes, which generally trend southwest, may be sheared, and commonly have dykes of pink pegmatite injected along them. The margins of some late pegmatite dykes however, have a sinistral sense of movement along them.

5. Examples of larger-scale Z-folds appear to be present:

1) at the Kettle Rapids dam site where such a fold appears to refold an early tight fold.

2) near the confluence of the river flowing out of Moose Lake and the Nelson River, where a thick body of layered amphibolite (unit 3) defines part of a large Z-fold apparently dissected along its axial plane by a southwest-trending fault. Quartzite on an island in the Nelson River at this point, has a strong southwesterly trending cataclastic foliation, itself deformed by both S and Z late-stage kinks.

6. The thin granitic lit in the pelitic unit 4 are usually highly deformed by numerous ptygmatic folds.

7. Thicker sills of granite in unit 4 are disrupted into boudins. Boudin trains are folded by later Z-folds.

8. A prominent biotite lineation is developed in the quartzite and pelitic schists. Intermittent microcrenulations of micaceous foliae in these rocks may parallel or lie oblique to the biotite lineation.

Economic Geology

No mineralization of economic significance was found during the present survey. Disseminated pyrite occurs in parts of the amphibolite units which also carry small pyrite-bearing shear zones.

Magnetite rarely exceeds 5-10%, occurring as small scattered crystals in the magnetite-bearing quartzites or associated granites in the area.

The area has seen very little exploration activity. Cancelled assessment work on file at the Mines Branch office consists of the drill log for a single hole drilled in January 1968 by Selco Exploration Co. Ltd., three miles due east of Gull Rapids. This hole encountered amphibolite, passing down into a sequence logged as quartzites, argillite, hornblende gneiss, biotite schist, granite gneiss and pegmatite, with two thin sections of hornblendite. Disseminated pyrrhotite is present in most of the metasedimentary rocks, in places forming massive bands up to a few inches thick.

A second hole drilled by Selco, outside the present area and six miles south-southeast of Gillam, also encountered disseminated pyrrhotite and pyrite in a sequence of "quartz-hornblende-biotite gneiss".

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(G) LAKE ST. MARTIN AREA

(62 O - 9, 10, 15, 16)

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

New information on the distribution of the evaporite, carbonate, volcanic, and granitic rocks in the Lake St. Martin-Gypsumville area has been obtained from a diamond drilling program sponsored by the FRED Manpower Corps. The 1968 program consisted of 17 holes, 12 of which penetrated a total of 2,500 feet of bedrock.

Previous outcrop studies indicated the presence of an inlier of amygdaloidal and vesicular, essentially unmetamorphosed volcanics, and massive to gneissic granites, in an area generally underlain by 600-800 feet of Lower Palaeozoic limestone. Potassium-argon age determinations gave the following results: andesite 250 ± 25 m.y. (Permian); vesicular lava 200 ± 25 m.y. (Permian); granite 2385 ± 100 m.y. (Precambrian-Superior). Results of drilling tend to support the indicated Permian age for the volcanics. Additional samples have been submitted for age determinations.

The following relationships are indicated by the limited data presently available:

(1) Volcanic rocks are younger than and contain abundant inclusions of the nearby Precambrian granitic rocks. In places the granitic rocks are highly altered in proximity to the volcanics.

(2) Volcanics consist not only of vesicular and amygdaloidal lavas, but also of widespread beds of coarse pyroclastic material (ignimbrite ?). These pyroclastic beds are up to 885 feet thick and extend well below the extrapolated regional Precambrian erosion surface.

(3) The volcanic rocks overlie and are presumably younger than carbonate rocks. These carbonates are strongly brecciated and sparsely fossiliferous. Although no identifiable fossils were found, these rocks are believed from general evidence to be Lower Palaeozoic in age.

(4) The volcanics are overlain unconformably by Red Beds, which are in turn overlain by Evaporites. The Red Beds and Evaporites are lithologically similar to, and probably correlated with, the Jura-Triassic Amaranth (Watrous) Formation.

(5) Structural deformation (faulting and/or folding) is evident in the periphery of the area, where Lower Palaeozoic strata have been up-lifted by at least 600 feet.

The northeast and southwest limits of the disturbed area have been partially defined by the 1968 drilling programme.

(H) TURTLE MOUNTAIN AREA

(62 F-1)

by B. B. Bannatyne

The Geological Survey of Canada carried out a study of Pleistocene stratigraphy and location of pre-glacial channels in southwestern Manitoba in 1968. Under contract with the Manitoba Mines Branch, two of their drill holes were deepened to intersect the Turtle Mountain and Boissevain Formations. The first hole, in NW15-32-1-22WPM, at an elevation of 1970 feet above sea level, intersected shale, sandstone, kaolinized sand, and thin lignite and carbonaceous shale beds between elevations 1965 and 1705 feet. The Boissevain Formation, consisting predominantly of sandstone, with minor shale and lignite, is present from 1705 to 1610 feet; it is underlain by light grey and brown shale of the Riding Mountain Formation, present from 1610 feet to the bottom of the hole, at an elevation of 1580 feet. The top and bottom elevations of the Turtle Mountain Formation are tentative.

A second hole in NW5-20-1-22WPM intersected glacial drift from an elevation of 2310 feet to 2186 feet and the Turtle Mountain Formation from 2186 feet to 1952 feet. This upper part of the formation, which extends the known thickness to 480 feet, consists of calcareous shale, siltstone, and impure sandstone.

(I) INDUSTRIAL MINERAL INVESTIGATIONS

by B. B. Bannatyne

A sample of bentonite from the Beulah area, southwest Manitoba, was found to have good swelling properties. In order to determine the extent of the deposit, several auger holes were put down along a road allowance; the mineral rights on either side are privately owned. The holes indicated the bentonite was erratic in distribution (because of disturbance by glacial action) and that other bentonite beds, with poorer swelling properties, are present. Further exploration on the privately-held ground is required to evaluate the deposit.

Enquiries were received in regard to the possible occurrence of uranium in sandstone horizons (Winnipeg Formation, Jurassic formations, Swan River Formation, Boissevain Formation) and Tertiary lignite beds of the Turtle Mountain Formation. Deposits of silica sand were investigated in the Winnipeg Formation in the area east of Winnipeg where the "Carman sandbody" outcrops under a cover of glacial drift, and in the Swan River Formation in the Pine River-Swan River area where earlier investigations have reported the occurrence of silica sand of possible glass sand quality. A sample of kaolinite reported to be from the weathered Precambrian surface exposed on the eastern part of Deer Island in Lake Winnipeg was forwarded to the Mines Branch at Ottawa for detailed tests.

The Tantalum Mining Corporation of Canada Limited mine at the west end of Bernic Lake is planning production of tantalite concentrate in early 1969. The tantalite occurs as disseminated grains in the "microcline-quartz-mica" zone in the extensive pegmatite deposit, and is essentially separate from possible economic zones of spodumene, lepidolite, and pollucite.

Western Peat Company Limited is developing a new sphagmum moss bog west of Medika in the northwest part of township 9, range 12 EPM; a processing plant will be built beside the Canadian National Railway at Elma.

Firing properties of several clay and shale samples were checked in a temperature gradient furnace; included were samples of surface clay from the Thompson area, submitted at the writer's request by The International Nickel Company of Canada Limited. A report on the firing properties and mineralogical composition of the clay and shale deposits of the province is in preparation.

(J) SOUTHWEST MANITOBA : STRATIGRAPHIC STUDIES

by H. R. McCabe

Compilation of subsurface geologic data from oil well test holes was continued, and information was issued for fifteen field wells, and forty-one wildcat wells which were released from confidential file during the year. This information is incorporated into the maps of the Stratigraphic Map Series which are periodically up-dated as the new data become available. Structure-isopach maps are now available for almost all Palaeozoic and Cretaceous Formations, and compilation of the remaining maps for the Jurassic Formations is continuing.

Cores for fifty-nine wells, and samples for forty-seven wells were added to the Mines Branch core and sample library, which now contains core for approximately 971 wells and samples for approximately 916 wells.

Work was continued on a study of isopach and structure anomalies in the Palaeozoic Formations of southwestern Manitoba. This report is a more detailed version of the paper published in the Transactions of the CIM, Vol. 70, 1967, -- "Tectonic Framework of Palaeozoic Formations in Manitoba", by H. R. McCabe.

Preliminary tests of a small, portable diamond drilling rig were made to determine if such a unit would be suitable for obtaining additional stratigraphic information for those areas of southwestern Manitoba where outcrops are inadequate for determination of a complete stratigraphic sequence. The tests were highly satisfactory.