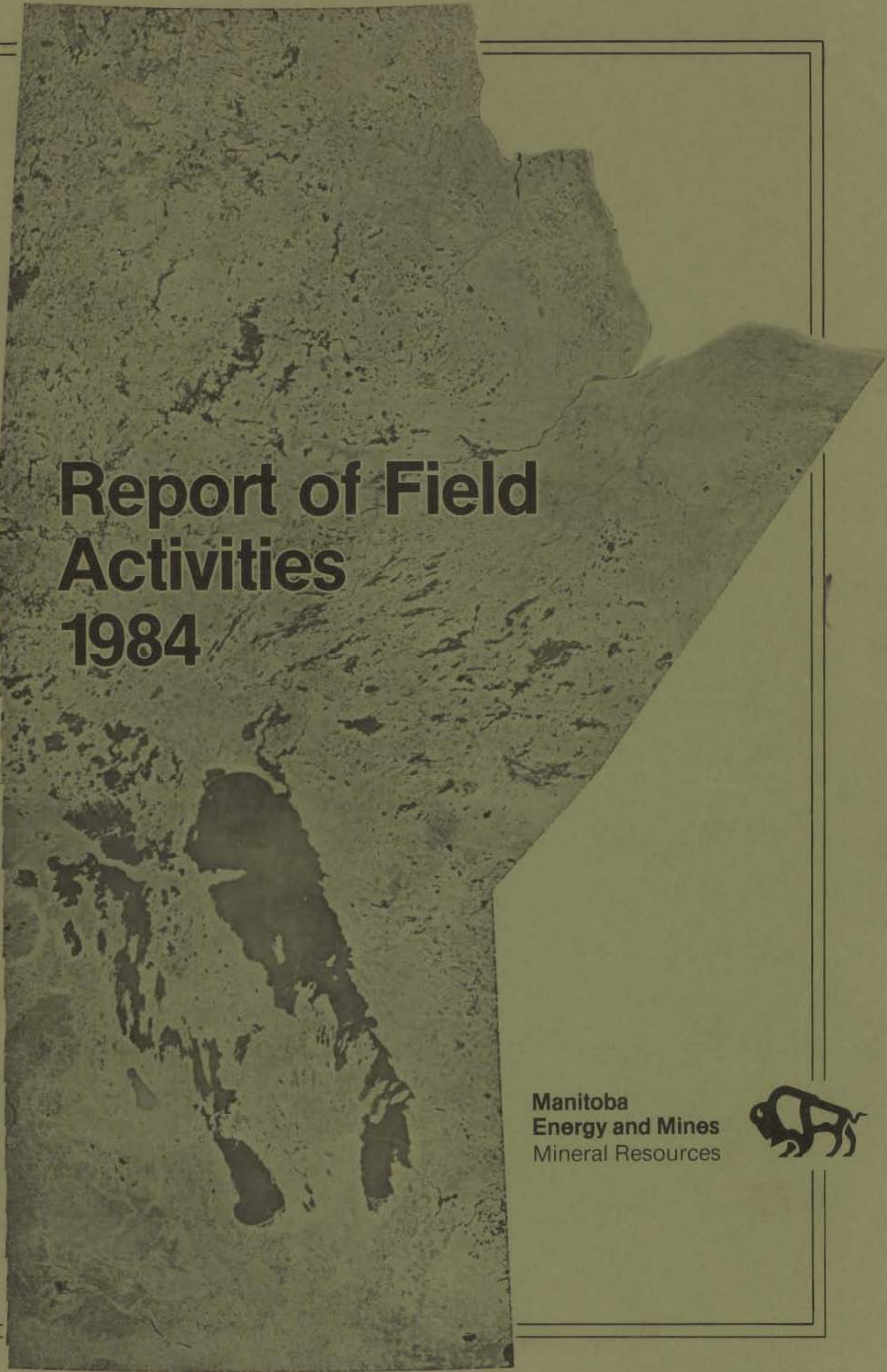
Report of Field Activities 1984



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Energy and Mines

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MINERAL RESOURCES

REPORT OF
FIELD ACTIVITIES
1984

1984

ERRATA

Several photographs have been incorrectly located during printing of this publication. All captions are correctly located in the text.

Substitutions are as follows:

Affected photograph:	Photo appears as:
Figure GS–17–2, p. 71	Figure GS–32–5, p. 123
GS–17–3, p. 71	GS–17–2, p. 71
GS–17–5, p. 72	GS–32–8, p. 124
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GS–30–2, p. 118	GS–17–5, p. 72
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AR–3–3, p. 174	AR–2–2, p. 171

e.g.: Photograph for Figure GS–17–2 appears on Page 123 as Figure GS–32–5. Read caption on Page 71 with photo on Page 123.

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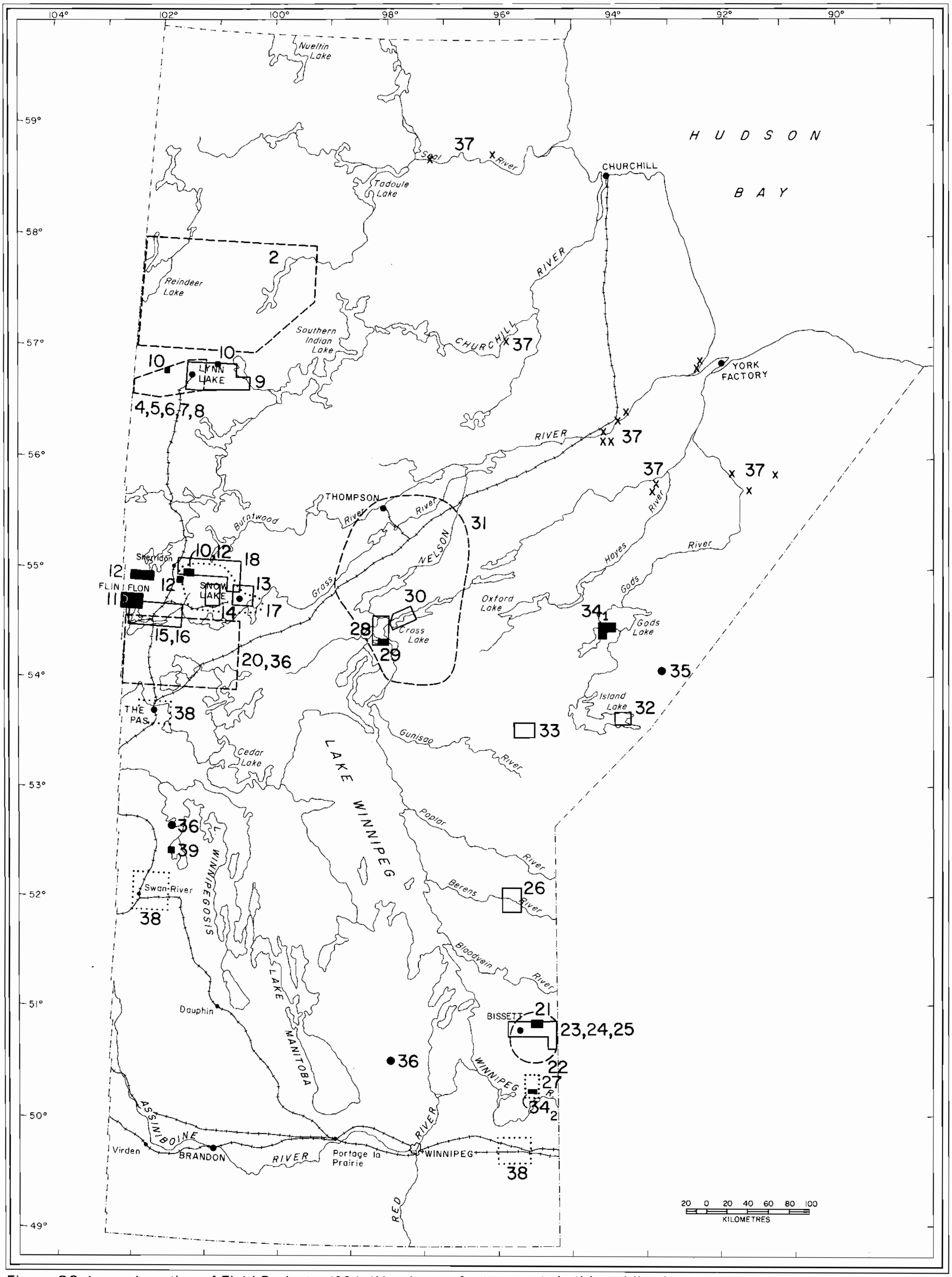


Figure GS-1: Location of Field Projects, 1984. (Numbers refer to reports in this publication.)

SUMMARY

In April of this year Manitoba was the first Province to join with the Federal Government in signing a new 5-year Agreement to assist mineral exploration and development in areas of common concern. Under the terms of the Canada-Manitoba Mineral Development Agreement (MDA), Canada and Manitoba will spend, over the next 5 years, a total of 24.7 million dollars to implement geological, geochemical and geophysical surveys, research into mining technology development, marketing and other mineral economic studies in order to improve the level and effectiveness of mineral exploration, and to investigate potential new developments that could lead to a diversification of the mineral base currently exploited in the Province.

The 1984/85 Workplan for Sector 'A' Geoscientific Activities identified a total of 46 Provincial projects, and 19 projects to be implemented by the Geological Survey of Canada (GSC). Contributions by the GSC (under a new concept of parallel delivery) are intended to complement programs mounted by their provincial counterparts and will be restricted to projects in which they (GSC) have a unique technical or technological expertise. An integral part of the programming will also include Applied Geoscience Research contributions from Universities. This year several projects were initiated with the Universities of Manitoba, Waterloo, Windsor and Kansas.

In this the first year of the agreement, heavy emphasis has been placed on assisting the search for new ore deposits in the Lynn Lake and Flin Flon regions and on raising the level of exploration elsewhere in the Province. The Provincial Geological Services Branch mounted a broad range of projects investigating the base and precious metal potential of the Lynn Lake region. Mineral deposit documentation ranged from the LAR deposit on Laurie Lake to gold occurrences on Cartwright Lake. The Agassiz metallotect was the subject of lithogeochemical, biogeochemical and basal till studies, and can now be traced from Lynn Lake to east of Barrington Lake for a total distance of 60km. Detailed work in the area of the Fox Mine has brought to light the structural controls delimiting the extent of the orebody and these together with a much enhanced stratigraphic and geochemical definition of the mine lithologies will play a key role in guiding the search for other copper-zinc deposits in the mine area. Several reports on the geology of the region are now close to completion as are 1:250 000 scale synoptic compilations which are released in preliminary form with this report. The long-outstanding need for more isotopic data is being addressed through U-Pb zircon programs initiated with the GSC and University of Kansas as well as continued Rb-Sr work by the University of Manitoba.

In the Flin Flon region geological mapping of the Kisseynew metallotect demonstrated considerable along-strike extensions to the gold-bearing formation on Nokomis Lake as well as the equivalency of this zone to that currently being investigated on Puffy Lake. Documentation of gold and base metal deposits progressed both within the greenstone terrain and on the northern flank at File Lake and led to the inference that the Kisseynew metallotect might have regional extent incorporating the rocks hosting gold mineralization at Squall Lake. Detailed 1.20 000 geological mapping will in future years be focussed on the Athapapuskow and Reed Lake regions as well as extensions into the Wabishkok region north of those sheets already mapped at Flin Flon and White Lake.

Scout drilling of magnetic anomalies south of Cranberry Lakes, extended a program initiated in 1982 south of Reed and Wekusko Lakes, and will eventually provide much needed information on the basement that will be used to compile 1:250 000 scale synoptic interpretations of the Precambrian geology lying beneath the Paleozoic cover rocks. Several of the holes drilled this year were cased to basement and used by the GSC to test borehole I.P.. gamma-ray and susceptibility probes.

Magnetic susceptibility measurements were made by the University of Manitoba on a number of diagnostic formations in the Shield immediately north of the Paleozoic limestones to provide yet another control on the assembly of information from the subsurface.

Elsewhere in the Province the Branch's J.K. Smit 300 drill was used successfully to obtain critical information on Paleozoic sequences as part of the Industrial Minerals and Stratigraphic drilling program. Additional holes drilled this year in the Paleozoic sequences provided information needed to ground-truth a seismic profile in Devonian reef structures at Dawson Bay, and for correlation of Ordovician stratigraphy in the Cormorant Lake region, as well as the Silurian near Narcisse. Stratigraphic mapping of shoreline exposures on northern Cormorant and Rocky Lakes encountered buff to red dolomites of the Stony River Formation, whereas at Yawningstone, Mitchell, Ochunipe and Goose Lakes a similar dolomite has been assigned to the lower part of the Red River Formation. Lake sediment and bottom-water samples were taken on several lakes in the region as part of a pilot study to evaluate the usefulness of this technique as an exploration tool in highly buffered alkaline waters entrapped within limestone sequences.

At Cross Lake mapping, north of last year's work, identified layered mafic-ultramafic intrusions on the N.E. arm of the lake, as well as previously unrecorded occurrences of fragmental felsic volcanic rocks. Geochemical sampling of granitic and pegmatitic bodies in the region was concluded, and detailed sampling and a magnetic survey initiated as part of an evaluation into titanium- and vanadium-bearing anorthositic gabbros south of Pipestone Lake.

Detailed mapping was initiated on Bigstone Lake where volcanic units and associated siliceous iron formation appear to have good potential for associated mineralization. On Island Lake mapping encountered extensive carbonatization near Loonfoot Island and confirmed the existence of a pronounced break between the Island Lake Group, and underlying locally gold-bearing formations of the Hayes River Group. A brief examination of rare-element-enriched pegmatites in the NW Superior Province was extended this year by the University of Manitoba to include examination of the bodies on Red Sucker Lake.

A brief reconnaissance in the Horseshoe Lake area focussed primarily on the south limb of the volcanics, and recorded siliceous and ferruginous sediments associated with pillowed flows in the vicinity of an INPUT anomaly. Little work has been done in this region and further investigations to evaluate the potential for gold associated with chemical sediments, may be warranted in the future.

Minerals investigations in SE Manitoba centered in the area east of Bissett and resulted in detailed documentation, sampling and mapping of iron formations and associated metallotects north of Wallace and Beresford Lakes. Gold occurrences elsewhere in this region were documented and sampled in detail to investigate possible extensions to known mineralized zones as well as geologically favourable units that might contain significant background gold.

Repeated attempts to locate chromite occurrences north of Maskwa Lake failed to encounter deposits of any consequence; moreover, the association of intrusive and extrusive, possibly comagmatic, anorthositic gabbros and glomeroporphyritic pillowed flows in this region differs markedly from the much more ultramafic association of the Bird River Sill itself. On the Bird River Sill the platinum metals investigation completed a slice across the lowermost megadendritic and layered section of the sill and provided additional samples that are also being subjected to major and trace element analysis by N.A.S.A. geologists as part of a co-operative program in this area.

Industrial minerals programming continued to engage in evaluation of a broad range of potentially exploitable commodities including silica sand, building stone, soapstone and chromite. Additional silica samples were collected from the Swan River Formation and the Beausejour area, and newly identified beds of glauconite in the Swan

River area mapped and evaluated for extent. A brief reconnaissance of the Flin Flon region was undertaken to investigate reported occurrences of garnet, sillimanite and other industrial minerals that might have development potential and lead to a diversification of the mineral base in this area.

Remote sensing studies conducted in collaboration with the Manitoba Remote Sensing Centre continued evaluation of satellite imagery in The Pas region as a means of identifying new deposits of sphagnum peat as well as providing a tool to conduct a dependable, systematic and inexpensive province-wide peat inventory. The Canada Centre for Remote Sensing has scheduled a low level airborne imagery program for the Lynn Lake region as a preliminary test for spectral analysis of stressed vegetation that might serve as an indicator to buried mineralization.

Field demonstrations were held once again at the outset of the mapping season in the Flin Flon, Thompson and Lynn Lake regions in order to facilitate co-ordination and co-operative programming with GSC and University personnel under the MDA, and for the benefit of company geologists in the respective mining districts.

The Exploration Services Section of the Mines Branch is actively engaged in monitoring and supervising the construction of a new core shed at The Pas. In Winnipeg existing core storage and research facilities at the University of Manitoba and 1521 Brady Road are being expanded and upgraded to house and process samples from all sectors of the mineral industry.

Gradiometer surveys mounted in the Lynn Lake area during 1982 and 1983 were extended this year by the GSC to provide complete coverage for the greenstone terrain from the Saskatchewan border to east of the Ruttan Mine and the Churchill River diversion. Regional lake sediment geochemical surveys, also contracted through the GSC, this year were extended to encompass NTS sheets 64F, 64G and 64B, thereby completing sampling at a density of 1 per 13 km^2 for the entire block including 63C, sampled in 1983. GSC activities in northern Manitoba also entailed mapping surficial deposits in the Lynn Lake area, mineral deposit studies of selected gold occurrences in the Flin Flon region, mineralogical studies of alteration zones in the southeastern Churchill Province, as well as crustal and metamorphic studies focussed in the Kisseynew region and adjacent to the Fox Mine. U-Pb isotope studies of zircons from the Lynn Lake, Flin Flon and Pikwitonei regions continued this year as did analytical work related to the evaluation of chromite in S.E. Manitoba. Several Applied Geoscience Research Agreements were established between the GSC and Universities in this Province and elsewhere in Canada.

W.D. McRitchie. Sept. 28. 1984

GS-1 CURRENT GEOLOGICAL, GEOPHYSICAL AND REGIONAL GEOCHEMICAL INVESTIGATIONS IN THE LYNN LAKE DISTRICT

by H.V. Zwanzig

Provisional compilation maps at 1:250 000 scale have been prepared for NTS areas 64B and 64C (Fig. GS-1-1). They cover the Lynn Lake and Rusty Lake greenstone belts and the adjacent parts of the Southern Indian gneiss belt and Kisseynew sedimentary gneiss belt. The geology was compiled under a single legend keyed to the 1:1 000 000 scale geological map of Manitoba. The maps provide a regional overview of the geology and serve as a base for the Regional Lake Sediment geochemical survey (see below). They are released in preliminary format and a revised version will form the first sheets of a 1:250 000 scale synoptic geological compilation map series.

An assessment of the structural and stratigraphic data collected during the re-mapping of the Lynn Lake belt is in progress. Results from rock geochemistry in the Lynn Lake belt and final maps and reports for areas at Melvin, Barrington, Eden, Kamuchawie and Russell Lakes are in the final stages of preparation.

The uranium-lead geochronology program under the Canada/Manitoba Mineral Development Agreement has provided suitable zircon separates from Wasekwan Group felsic volcanic rocks and pre-Sickle Group intrusions. The isotopic ages will be published by the Geological Survey of Canada.

As part of the Federal delivery under the Canada/Manitoba Mineral Development Agreement, gradiometer surveys were extended by the Geological Survey of Canada to cover the western segment of the Lynn Lake greenstone belt, up to the Saskatchewan border, as well as the "Ruttan block" (Figs. GS-1-2 and GS-1-3). The results of an earlier survey over Barrington Lake were released as GSC Open File OF1047 on July 25th, 1984, comprising 6 vertical gradient maps and 6 total field maps at a scale of 1.20000. Colour Applicon plots at a scale of 1.50000 were also made available, for viewing.

The results of the 1983 Regional Lake Sediment geochemical surveys conducted by the GSC, under the jointly funded Canada/Manitoba Interim Mineral Agreement, in the Granville Lake region (NTS 64C) were released as Open File OF999 on June 27th, 1984, comprising 24 geochemical maps, a sample location map and text of field observations, analytical and statistical data. In 1984, under the Canada/Manitoba Mineral Development Agreement, the surveys were extended (Fig. GS-1-1) by the Geological Survey of Canada to cover a further 40 000 km^2 in the Lynn Lake region (NTS areas 64F, G and B). A total of 2,600 sites were sampled at an average spacing of 1 per 13 km^2. Analytical work will be conducted over the winter months with release of processed data scheduled provisionally for the early summer of 1985. As in 1983, the Provincial Department of Environment, Workplace Safety and Health will analyze a portion of the water samples to assist in their evaluation of the impact of acid rain in this sector of the province.

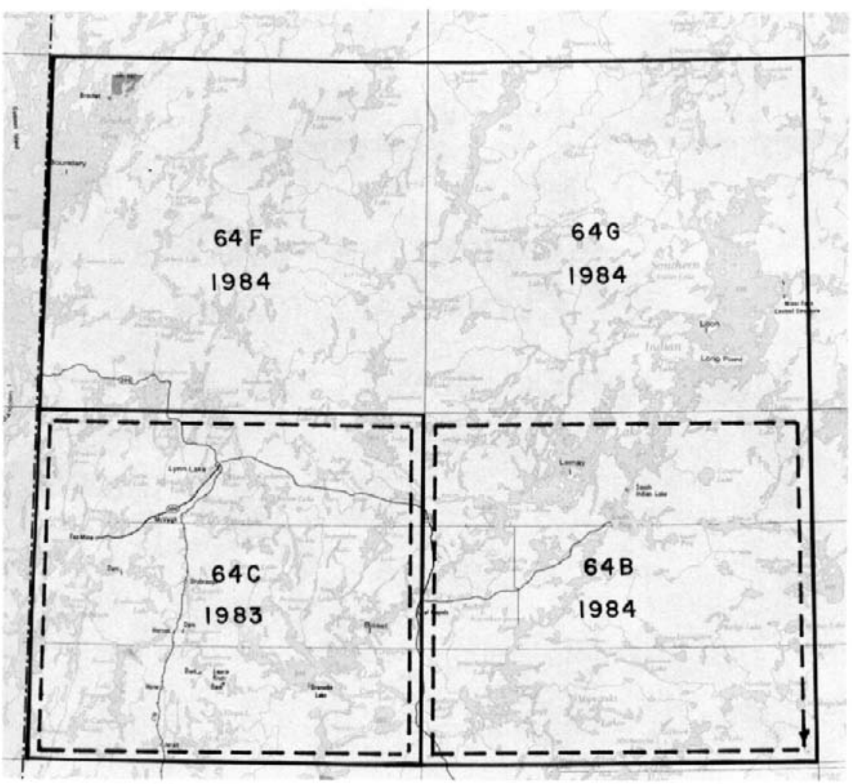


Figure GS-1-1: Location of Provisional Compilation maps (dashed line) by the Mineral Resources Division, and Regional Lake Sediment Geochemical Surveys by the Geological Survey of Canada, 1983 and 1984.

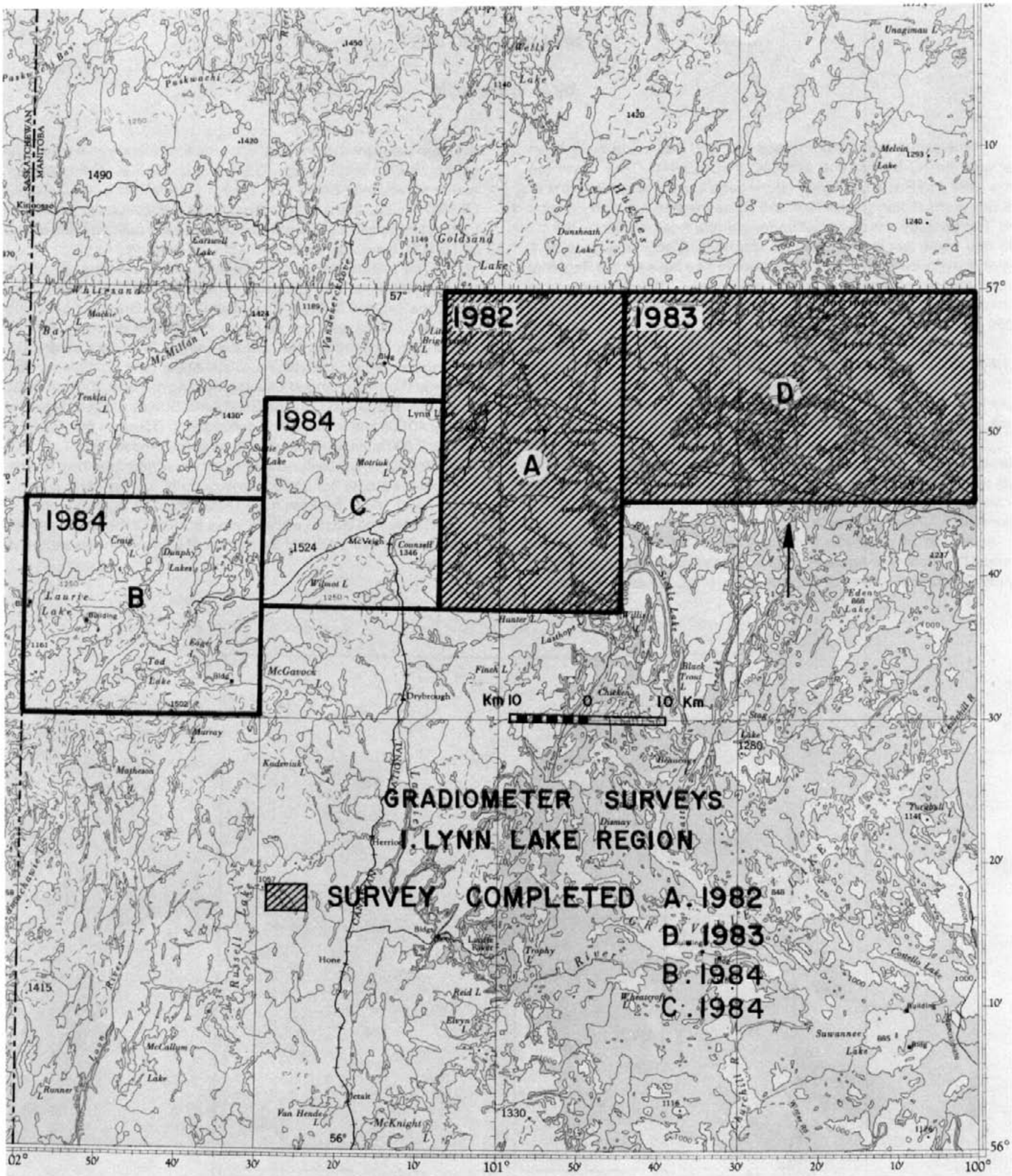


Figure GS-1-2: Gradiometer surveys in the Lynn Lake region.

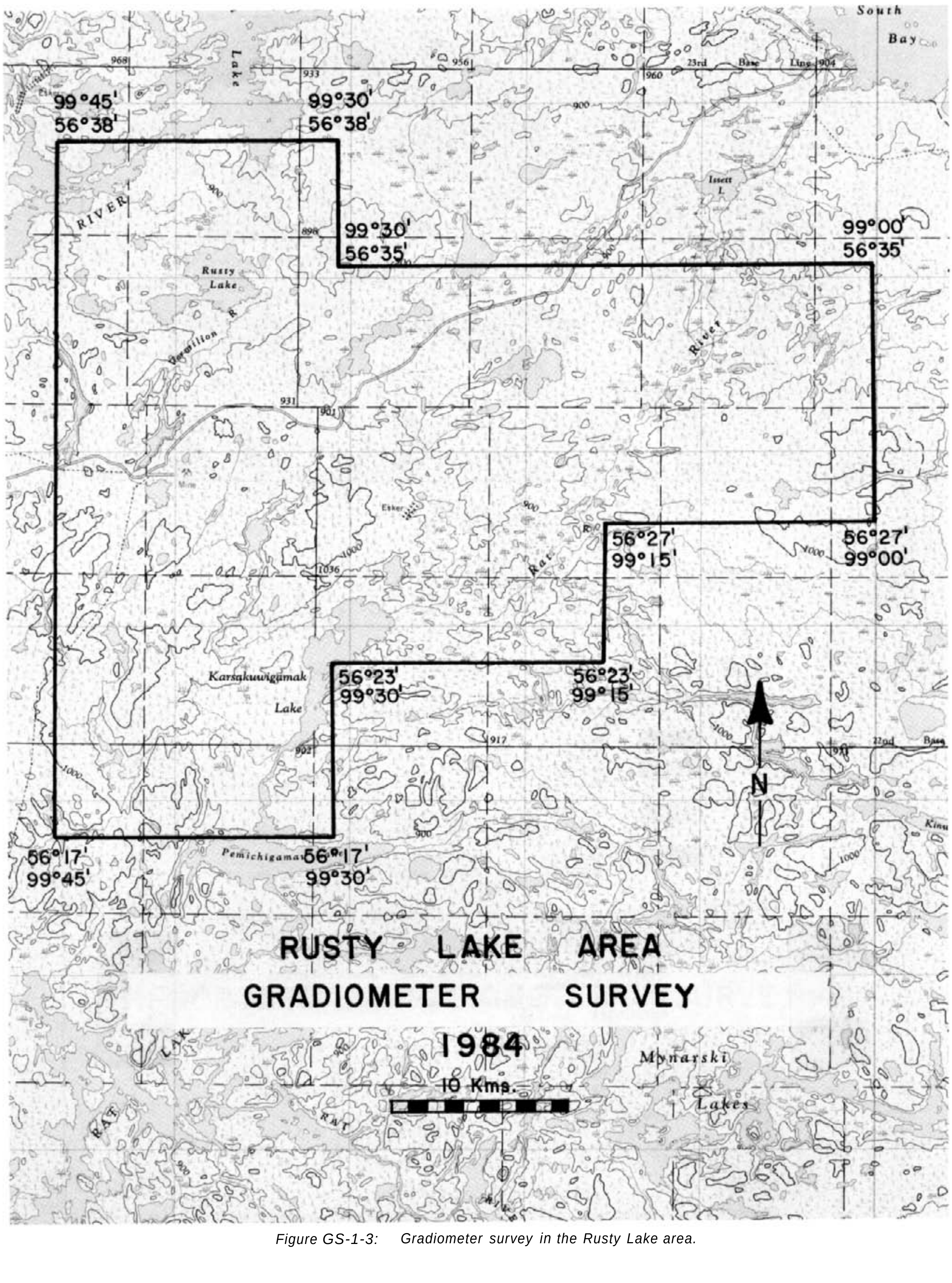
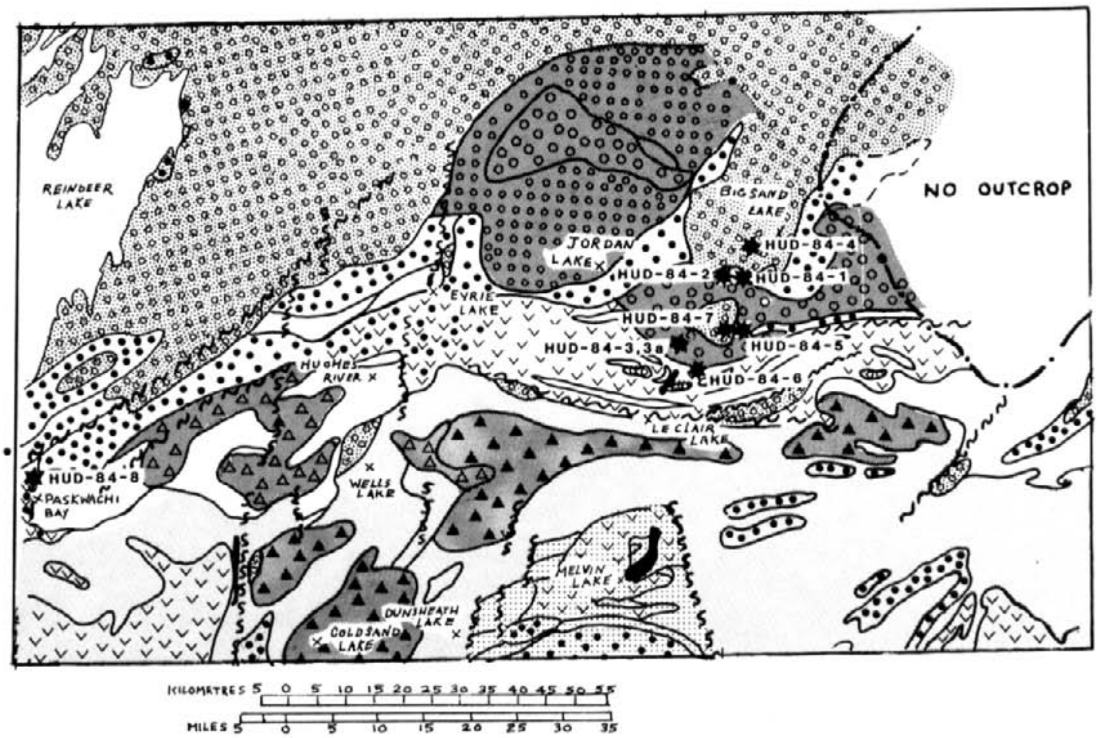


Figure GS-1-3: Gradiometer survey in the Rusty Lake area.



- Region with abundant group 3 granite (unit 16) intrusive rocks with inclusions of group 2 biotite megacrystic granite (unit 13) and group 1 dioritic gneiss and granodioritic gneiss (unit 7, 7a)

Areas of metadiabase and metadiorite (unit 15)

- Region of group 2 syn- to late-metamorphic megacrystic granites to monzonites

  - Biotite granite with pink megacrysts of potassium feldspar (unit 13)
  - Pyroxene-hornblende monzonite to monzogranite with olive, honey-brown megacrysts of potassium feldspar (unit 12)
  - Hornblende-biotite-granite to monzogranite with pinkish brown megacrysts of potassium feldspar (unit 12b)
  - Biotite $\pm$ hornblende white megacrystic granite with white megacrysts of potassium feldspar (unit 11)

- Region with areas of conglomerate and meta-arkose (units 6, 6a), locally exhibits areas of lower to middle amphibolite facies of metamorphism

- Region of varied suite of quartzofeldspathic gneisses (units 4, 3a, 3b and 2) as inclusions in a granodioritic gneiss (unit 7a) and grey quartz monzonite (unit 9)

  - Grey $\pm$ magnetite-biotite quartz monzonite (unit 9) (group 1 intrusive rock)
  - Meta-diorite and granodioritic gneiss (units 7a, 7a) (group 1 intrusive rocks)

- Region of $\pm$ graphite $\pm$ garnet $\pm$ sillimanite-biotite feldspar-quartz gneiss with intrusions of biotite $\pm$ hornblende tonalite (unit 8), both rocks contain 40 to 80 per cent white leucogranite (unit 14)

U-Pb (zircon) sample locations

Figure GS-2-1: Lithologic zonation of the Brochet (NTS 64F) and Big Sand Lake (NTS 64G west half) map areas with U-Pb (zircon) sample locations (after Schledewitz, 1983).

GS-2 GEOCHRONOLOGY OF THE BROCHET-BIG SAND PROJECT (U-Pb, ZIRCON)

by D.C.P. Schledewitz

INTRODUCTION

During a brief field season sampling was carried out for U-Pb zircon isotopic studies in the Brochet-Big Sand project area. The samples will be analyzed as part of "Geochronology of Early Proterozoic Orogenic Belts, Southern Churchill Province, Canadian Shield", a program being conducted by W.R. Van Schmus and M.E. Bickford, Department of Geology, University of Kansas, and supported by the U.S. National Science Foundation. The program is designed to date major igneous events in the Hudsonian Orogenic terrains of Saskatchewan and parts of Manitoba. Most of the sampling will becarried out in Saskatchewan in collaboration with J. Lewry. Department of Geology, University of Regina (Bickford et al., 1983). The Saskatchewan and Manitoba Departments of Energy and Mines provide logistical support in Saskatchewan and Manitoba, respectively. The data will assist in the tectonic modelling of the southern Churchill Province and establish the geologic relationships between the Hudsonian Orogen and the Wopmay Orogen in the Northwest Territories (Hoffman et al., 1982; Bowring and Van Schmus, 1982; Hildebrand et al., 1983) and the Penokean Orogen to the south (Van Schrnus, 1980).

Radiometric ages currently available from the Hudsonian Orogen in Manitoba are predominantly Rb-Sr whole rock data (Clark, 1980 and 1981). The more precise zircon ages to be obtained from this project, combined with those of a U-Pb zircon geochronology project (Joint Federal-Provincial) initiated in 1982 in the Lynn Lake greenstone belt (Syme, 1983) south of the Brochet-Big Sand project area, will establish a temporal framework for the igneous and metamorphic events of these two regions. The more precise zircon data should also improve the interpretation of the existing Rb-Sr data base.

ROCK UNITS SAMPLED IN THE BROCHET-BIG SAND PROJECT AREA

During 1984 most samples were collected in the Big Sand Lake-Jordan Lake region within and immediately south of a monzonite, monzogranite, units 12, 12b Intrusive complex (Katamiwi Intrusive Complex, Fig. GS-2-1). One sample site was at Paskwachi Bay on Reindeer Lake near the Saskatchewan-Manitoba border (Fig. GS-2-1). The rock type sampled at this site is a meta-quartz diorite (Unit 15). The rock samples appear to represent three phases of igneous activity:

i) a pre-metamorphic diorite, tonalite and quartz monzonite complex (units 7 and 9);
ii) a syn- to late-metamorphic intrusive complex (units 12, 12b);
iii) a post-metamorphic suite of diorite stocks and dykes (unit 15) and a younger suite of granites (unit 16).

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GS-3 RUBIDIUM-STRONTIUM AGE INVESTIGATIONS IN THE CHURCHILL AND SUPERIOR STRUCTURAL PROVINCES, NORTHERN MANITOBA

by G.S. Clark[1]

INTRODUCTION

This report summarizes the most recent Rb-Sr studies completed as part of research agreements with the Manitoba Department of Energy and Mines. A major program for Rb-Sr isotopic age studies of selected lithological units from the major tectonic domains in the Churchill province was initiated in 1979. The results of this study are summarized by Clark (1981).

Subsequently, additional work was planned largely to complement the results from earlier studies as field mapping progressed in the Churchill province. These results will be reported here along with results from the Molson Lake-Kalliecahoolie Lake area in the northwestern Gods Lake region of the Northern Superior province.

Finally, a brief outline of work recently initiated in the Churchill and Superior provinces will be presented.

REPORTING OF ISOTOPIC DATA

Isotopic measurements were made on whole-rock samples using a triple filament source assembly in a single focussing mass spectrometer having a 25 cm radius of curvature and a 90 degree deflection. The measurements were taken with a Cary model 401 vibrating reed electrometer and recorded with a HP model 5326 DVM. The data were processed with a HP model 85 on-line computer which also partially controls the mass spectrometer. Rb and Sr concentrations are presently being determined by mass spectrometry and $^{87}Sr/^{86}Sr$ ratios measured on both ^{84}Sr-spiked and unspiked samples. During the course of this study, we obtained an average $^{87}Sr/^{86}Sr$ value of 0.7082 ± 0.0002 (1 sigma) for the E and A $SrCO_3$ standard.

The ages and initial ratios are calculated using the York I method from the Regross programme of Brooks et al (1972). Errors on the ages and initial ratios are given at the 1 sigma level and blanket errors for the $^{87}Rb/^{86}Sr$ and $^{87}Sr/^{86}Sr$ ratios of 1.5% and 0.06% (1 sigma) respectively were used. The ^{87}Rb decay constant of 1.42×10^{-11} yr^{-1} was used to calculate ages.

ISOTOPIC AGES - CHURCHILL PROVINCE

BROCHET/BIG SAND LAKE REGION

Isotopic measurements on two units from the western area of the Southern Indian domain have been completed. This domain is comprised of paragneisses and migmatites and granodiorite to tonalite of possible anatectic origin (Schledewitz, 1981).

A suite of eight samples of greywacke-derived paragneisses were analyzed and yielded an isochron of 1910 ± 50 Ma and an initial $^{87}Sr/^{86}Sr$ ratio of 0.7015 ± 0.0008. The mean square of weighted deviates (MSWD) for this unit is 2.3, indicating that the eight data points generate an isochron . The MSWD is a theoretical index used to test the scatter of data points about the regressed line. In general, a MSWD of about 3 or less, for this lab, means that the data points generate an isochron. If it is greater than 3, the data points scatter about the fitted line beyond the limits of the assigned experimental errors, and hence generate an "errorchron". In the latter case, the ages and initial ratios may not be valid within the error limits quoted.

The samples of paragneiss analyzed are rather uniform in terms of the Rb/Sr ratio and have a maximum value of about 0.65. The age is interpreted as the time of formation of the gneisses and this, combined with the initial ratio, suggests an age of sedimentary deposition considerably older than that for the paragneisses in the Kisseynew metasedimentary gneiss belt to the south.

Paragneiss from the same domain, but farther east at Missi Falls, gave an errorchron age of 1975 with an initial ratio of 0.705 (Clark, 1981), showing that the information from Rb-Sr isotopic systematics for paragneiss over the extent of this tectonic domain is consistent.

A suite of samples was collected from an intrusive unit varying in composition from quartz to tonalite. This unit intrudes the paragneisses discussed above and samples were collected over the same area (covering a distance of about 100 km) between Paskwachi Bay on the west. east to Le Clair Lake (Schledewitz and Cameron, 1982). These rocks have undergone deformation and metamorphism and represent an early phase of intrusive activity. The regression of ten of eleven samples analyzed gives an isochron age of 1845 ± 65 Ma with an initial ratio of 0.7025 ± 0.0003. The MSWD is 1.5. Inclusion of the other sample results in an age of about 1878 ± 87 Ma with a MSWD of 2.6. These tonalitic rocks have a low range in Rb/Sr ratios, with a maximum of about 0.2, reflecting a depletion in Rb for these rocks with concentrations ranging from 25 to 100 ppm.

LYNN LAKE DOMAIN

Additional samples from a tonalite-granodiorite unit within the Lynn Lake greenstone belt have been analyzed. This is a pre-Sickle intrusion believed to be equivalent in age to a tonalitic unit sampled at Hughes and Sickle Lakes which yielded an isochron age of 1940 ± 40 Ma (Clark, 1980). In the present study, an age of 1845 ± 100 Ma was obtained, along with an initial ratio of 0.7019 ± 0.0005 (MSWD = 2.1). This age is based on six additional samples. The 1 sigma errors on these ages precludes resolving the problem of whether or not the two bodies were intruded at different times as suggested by the reported ages.

A composite isochron of the two units based on fourteen samples gives an age of 1855 ± 85 Ma (MSWD = 1.9) and an initial $^{87}Sr/^{86}Sr$ ratio of 0.7025 ± 0.0003. These ages agree within the statistical uncertainties quoted. The 1855 Ma age is interpreted as the minimum age of intrusion related to the early plutonism in the area.

It is interesting to compare these ages with those obtained from three granitoid gneiss units from the vicinity of Snow Lake, in the Flin Flon domain (Bell et al., 1975). The three Rb-Sr isochron ages range from 1750 to 1810 Ma (with similarly low initial ratios). The results of the present study suggests that plutonism was earlier in the Lynn Lake domain by as much as 100 Ma, notwithstanding the possible disturbance of the Rb-Sr isotopic systematics in the granitoids by later metamorphism.

SUPERIOR PROVINCE

MOLSON LAKE-KALLIECAHOOLIE LAKE AREA

Isotopic work has been completed on two igneous units from this area in the northwestern Superior province and the results are currently being prepared for publication (with W. Weber). The two units comprise an older hornblende-biotite monzonite to quartz diorite

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underlying most of the area and a granite-alaskite suite, representing the youngest phase of Archean plutonism in the area. The occurrence of the granite bodies as small, discrete intrusions, as well as their wide distribution throughout the area, suggested to Weber and Schledewitz (1979) that they may have been derived by mobilization of older crustal rocks. The late granites are also of economic importance because of their anomalous uranium contents (Weber et al., 1982).

The hornblende-biotite monzonite gave an (errorchron) age of 2690 ± 105 Ma and an initial ratio of 0.7008 ± 0.0008. The MSWD is 6, indicating scatter of the data points beyond our quoted analytical errors. The result is interpreted as a minimum age of these older granitic rocks, and the scatter is attributed to later metamorphism.

Although the granitic samples analyzed were collected from widely scattered localities throughout the area, the eight data points generated a good isochron age of 2495 ± 30 Ma with an initial ratio of 0.7053 ± 0.0023 (MSWD = 1,2). The initial ratio for the late granite is higher than expected for a mantle-derived magma and supports the conclusion of Weber and Schledewitz (1979) that the magma was derived by mobilization of older crustal material. The isotopic results strongly suggest that the late granite bodies, as now exposed, originated from a single magma pool, rather than resulting from localized partial melting of older crust. In other words, the $^{87}Sr/^{86}Sr$ ratio was established prior to emplacement of the late granites.

The isotopic results for the late granites and the older granitic unit (which is a juvenile addition to the crust) are consistent with a derivation of the late granites from partial melting of the older granitoids (assuming about a 200-250 Ma difference in their ages).

CURRENT INVESTIGATIONS

Churchill Province

Work is now in progress on three additional units within the Churchill structural province. Rubidium-strontium whole-rock isochrons will be determined for the following:

1. Coarse grained granite phase from the vicinity of Big Sand Lake.
2. Seriate granite - lower Churchill River area.
3. Coarse grained granite from the vicinity of Goldsand Lake.

The granites of (1) and (2) above have been recognized as distinct phases within the Chipewyan batholith. Previously, samples collected on a regional scale, and representing different phases of this batholith, gave an age of 1800 ± 50 Ma (Clark. 1981). The two granite phases in this study are believed to be late granites within the batholith and an attempt will be made to see if the Rb-Sr method can resolve different times of crystallization. The sample from Big Sand Lake are from the southwestern Chipewyan batholith in Manitoba whereas the seriate granite is from the southeastern part.

The granite from Goldsand Lake is a coarse grained, biotite-rich granite which intrudes the paragneisses of the Reindeer-Southern Indian domain. Field evidence suggests it is younger than the tonalitic unit discussed earlier in this report, based on its deformational history. The isotopic information from this unit will assist in determining the range of igneous activity in this tectonic domain.

SUPERIOR PROVINCE

The following two units from the Cross Lake area have been sampled for Rb-Sr isotopic work:

1. Muscovite-biotite granite.
2. Pelitic metasedimentary rocks.

The granite occurs near the north shore of Cross Lake. It is porphyritic and intrudes the pelitic metasedimentary rocks. None of the rare-element pegmatites appear to be associated with this body (Lenton and Anderson, 1983), but it is probably the same age as other late granites which are pegmatitic. The age of this granite should indicate the time of the last granitic igneous activity in this region of the Superior province and closely approximate the time of formation of the rare-element pegmatites in the Cross Lake region.

The pelitic metasedimentary unit under investigation has been also sampled at Cross Lake and extending into Pipestone Lake. This unit occurs near the top of the sedimentary sequence and is intruded by the late granites and pegmatites. The information from this unit may indicate the time of the last major metamorphism in the region and furnish information on the provenance of the sediments and put limits on the age of deposition.

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GS-4 MINERAL DEPOSIT DOCUMENTATION IN THE LYNN LAKE AREA

by K.J. Ferreira[1] and D.A. Baldwin

INTRODUCTION

Mineral occurrences in the Lynn Lake greenstone belt near Wilmot Lake, Eldon Lake, Pool Lake, Flag Lake, Motriuk Lake, Pole Lake, Ralph Lake and Minto Lake (Fig. GS-4-1, Table GS-4-1) were examined and where warranted mapped in detail and sampled for assaying. In addition, diamond drill cores from the Irene (Gale et al., 1980), HAT, FL/DH and PHY occurrences (Koo, 1976) (Fig. GS-4-1, Table GS-4-1) were examined in order to determine the stratigraphy and type of mineralization. This report presents general features of these occurrences; detailed reports are available upon request. Several of the mineral occurrences on geological maps GP-1980-1-1, GP-1980-1-3 and GP-1980-1-4 (Gilbert et al., 1980) and briefly described by Milligan (1960) were searched for but not found. One of the authors (D.A. Baldwin) managed the Laurie Lake, Tod Lake, Lynn Lake, Cartwright Lake and Lar Deposit field programs.

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MINERAL DEPOSITS

STRATABOUND SULPHIDES IN FELSIC SEDIMENTS

(1) Wilmot Lake. Stratabound py-po-cp-mt in fine grained sediments occur at two stratigraphic intervals. Both are hosted by quartz-rich, chloritic, garnetiferous and laminated to thin bedded siltstones. Mafic tuffs underlie both of the sulphide-bearing zones. The remainder of the stratigraphic section includes mafic heterolithic breccias, rhyolite tuff, and biotite- and hornblende-greywackes.

The areas of mineralization are identifiable by the rusty appearance of the siltstone in outcrop; however, sulphide minerals were not identified in outcrop. Drill core from the vicinity contains bedded solid sulphides, presumably from these zones. These intersections are very fine grained, laminated, solid sulphide consisting of pyrite, pyrrhotite, chalcopyrite and magnetite.

(6) Eldon Lake. Stratabound py-po in fine grained felsic sediments occurs both at (6) and 30 m north of (4) (Fig. GS-4-1). The sediments are laminated to thin bedded siltstones that contain alternating felsic and garnetiferous maflc beds; graded beds within this unit

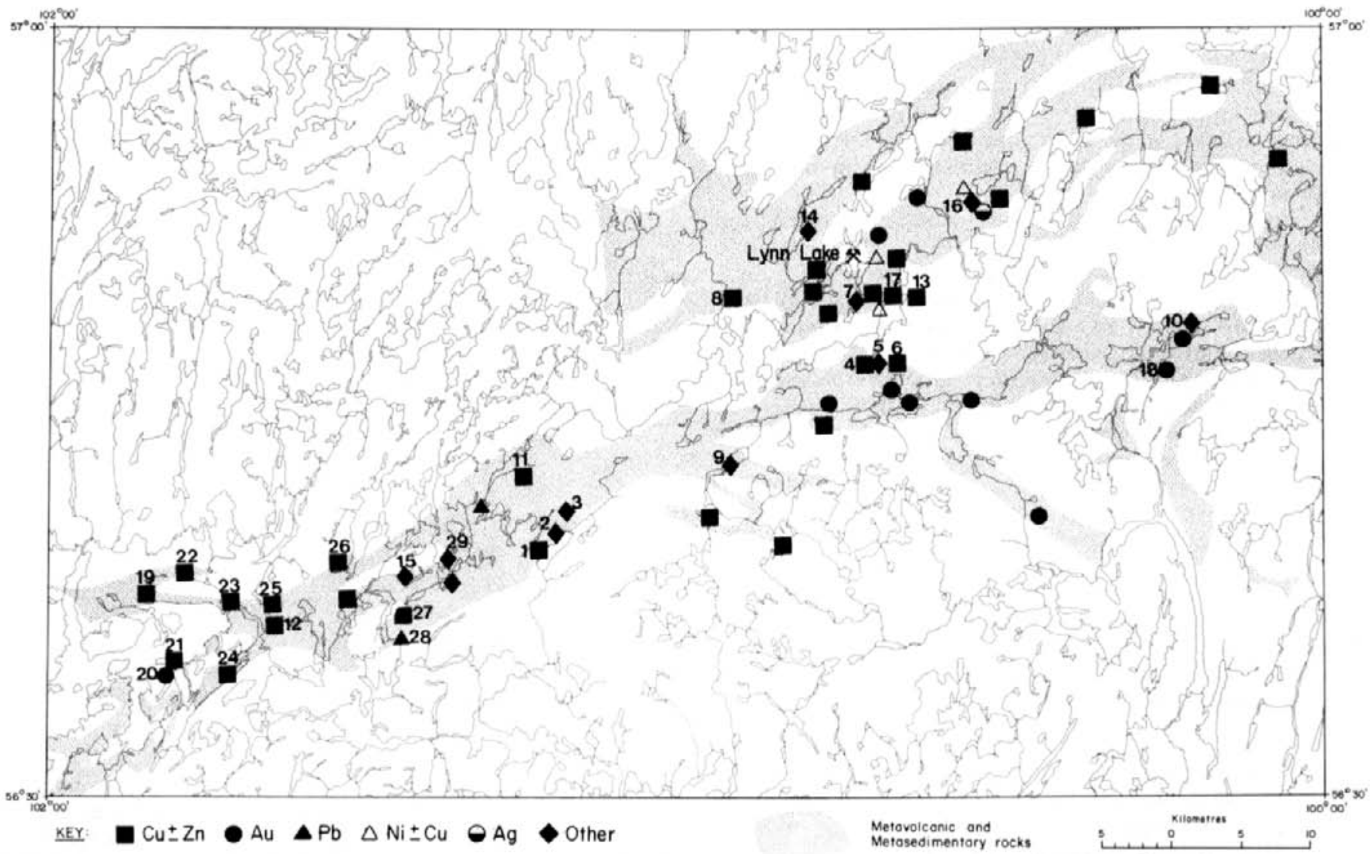

Figure GS-4-1: Mineral deposits and occurrences, and metavolcanic and metasedimentary rocks of the Wasekwan Group in the Lynn Lake area. Localities examined during the 1984 field season are: 1. Wilmot Lake; 2. Wilmot Lake; 3. Weldon Lake; 4. Eldon Lake; 5. Eldon Lake; 6. Eldon Lake; 7. Flag Lake; 8. Motriuk Lake; 9. Pool Lake; 10. Pole Lake; 11. Irene Lake (Sir); 12 Hatchet Lake (Hat); 13. FL-DH; 14. Ralph Lake; 15. Phy; 16. Minton Lake; 17. Gods Lake; 18. Cartwright Lake; 19. Lar; 20. Caimito; 21. South Laurie; 22. Gran; 23. Rye; 24. Tod; 25. New Fon; 26. North Fon; 27. Bog; 28. Gal; 29. East Dunphy Lake.

TABLE GS-4-1 LIST OF AREAS INVESTIGATED WITH SUMMARY DATA

No.[1]	Location	Sulphide Mineralogy[2]	Host Rock	Habit of Sulphide Mineralogy	Nature of Mineralization	Type of Occurrence	Thickness	Remarks
1	Wilmot Lake	py, cp, mt	siltstone	disseminated (1-2%); solid, bedded in drill core; rusty weathering	stratabound sulphides in felsic fine-grained sediments	outcrop, drill core	1.5, 2.5 m	two stratigraphic intervals
2	Wilmot Lake	asp	siltstone	disseminated (1-2%); rusty weathering mapping	quartz veins in siltstone	outcrop, trench	5 m	
3	Weldon Lake	mt	amphibolite iron formation	streaks, bands (5-40%)	iron formation	outcrop	16 m	not a bedded sedimentary iron formation
4	Eldon Lake	py, po, cp, sp	siliceous argillite, chert	solid, rusty weathering	stratabound sulphides	outcrop, drill core	10 m	
5	Eldon Lake	asp, py	felsic greywacke	disseminated (1%); rusty weathering	disseminated sulphides at	outcrop	6 m	intrusive contact
6	Eldon Lake	py, po	felsic siltstone	disseminated (1-3%); rusty weathering	stratabound po-py in felsic fine grained quartz-rich sediments	outcrop	12 m	
7	Flag Lake	py, po	mafic greywacke	massive, disseminated; rusty weathering	alteration along fracture	outcrop	—	part of the alteration zone to the Nicoba deposit
8	Motriuk Lake	py, asp	felsic sediments	disseminated (1-3%); rusty weathering	stratabound py-asp in felsic quartz-rich fine grained sediments	outcrop, ddh	12 m	
9	Pool Lake	py, po, asp, py	felsic tuff; lapilli-tuff	disseminated (5-10%)	stratabound cp-py-po in fragmentals	outcrop, trench		lensoid
10	Pole Lake	py, po, (cp)	hornblende diorite	disseminated (3%)	disseminated py in intrusive	outcrop	—	outcrop limited to one roadcut
11	Irene Lake	po, mt, cp,	felsic tuff; gr-an-chl assemb.	massive and disseminated (16-30%)	sulphides in felsic sediments	ddh	16 m	only 1 ddh examined; Sir #1
12	Hatchet Lake	py, po	felsic-intermediate siltstone	fine grained disseminated in beds; sulphide blebs	stratabound py-po in felsic sediments	ddh	13 m, 6 m	only 1 ddh examined; HAT occurrence, 3 stratigraphic intervals
13	FL-DH Eldon Lake	po, py, cp,	quartz diorite	solid, stringers	solid and stringer sulphides in quartz diorite	ddh	12 m	only 1 ddh examined
14	Ralph Lake	py, po	felsic siltstone	disseminated (10-15%); rusty weathering	stratabound sulphide in felsic sediments	outcrop	7-12 m	
15	PHY	Data not compiled						
16	Minton Lake	py	greywacke and felsic lapilli-tuff	disseminated; rusty weathering	alteration along a cross-cutting vein system	outcrop		

[1] Refer to Figure Gs-4-1.
[2] Magnetite is also included here.

Abbreviations: an — anthophyllite, asp — arsenopyrite, chl — chlorite, cp — chalcopyrite, gr — garnet, mt — magnetite, po — pyrrhotite, py — pyrite, sphalerite indicate that the stratigraphy 'youngs' to the north. The proportion of felsic beds increases 'up-section'. This felsic siltstone is part of a sequence that is underlain by siliceous argillite and chert in association with a solid sulphide zone, and in turn by a coarse sand-sized greywacke with possible amalgamated bedding at (4). However, at (6), exposure is limited to a small part of the siltstone unit; lack of exposure precludes more detailed mapping or sampling. One to three per cent very fine grained disseminated pyrite and rarer pyrrhotite occur within the upper portion of the siltstone unit.

(8) Motriuk Lake. Stratabound py-asp occurs throughout felsic sandstones exposed near the top of a 700 m thick stratigraphic sequence. The felsic sandstones are underlain by thin mafic flows, tuffs, breccias, and sediments with lesser rhyolite tuffs, crystal tuff, and flows. A chlorite-carbonate-magnetite schist and mafic intrusive rocks also occur within the underlying rocks. Amphibolite, hornblendite, and hornblende diorite occur stratigraphically above the mineralized zone.

The sandstone is thin bedded (1 to 2 cm), fine sand-sized, quartzose and biotitic; mafic beds are garnetiferous. Bedding decreases in thickness and the proportion of mafic layers increases to the south. Graded bedding indicates the sequence 'tops' north.

Fine grained disseminated pyrite and arsenopyrite (1 to 3%) occur throughout a 12 m section of the sandstone. Mineralized layers alternate with non-mineralized layers at intervals of 1 to 3 m. The mineralized layers have a rusty weathered surface and boundaries between the mineralized and non-mineralized layers are sharp and conformable with bedding.

(4) Eldon Lake. Stratabound Zn-Cu-bearing sulphides occur within a lensoid unit of siliceous argillite and chert. The siliceous argillite and chert occur as rare pieces of rubble in outcrop, but in one drill core they have a collective thickness of 25 m, including a 5 m thick solid sulphide zone 3 m from the top of the unit. Overall the unit is very fine grained and appears to be massive; however, there is a marginal increase in grain size above the solid sulphides. A laminated to thinly bedded felsic siltstone (6) overlies the siliceous argillite. Medium grained greywacke with amalgamated bedding underlies the unit.

The chert directly overlying the greywacke contains disseminated pyrrhotite, pyrite, chalcopyrite and sphalerite that increases to 10 per cent by volume upwards. The 5 m thick massive sulphide zone occurs in both drill core and on the outcrop surface. It comprises pyrite, pyrrhotite, sphalerite and rare chalcopyrite with less than 10 per cent chert. Hydrozincite is prominent on the outcrop surface.

(14) Ralph Lake. Stratabound disseminated sulphides occur in fine grained felsic siltstone (tuff) that forms part of a 60 to 65 m thick felsic unit comprising siltstone, crystal tuff and lapilli-tuff. The southeastern part of the felsic unit is stratigraphically underlain by a 240 m thick upward- coarsening bedded unit of heterolithic fragmental volcaniclastic metasedimentary rock with a mafic to intermediate composition matrix. The abundance of felsic fragments increases upwards; however, the abundance of mafic fragments decreases. The fragmental unit thins and fines to the northeast. The felsic unit and the heterolithic fragmental unit are interpreted to be redeposited pyroclastic rocks.

The mineralization comprises a 72 to12 m thick zone of 10 to 15 per cent po, py with minor cp and sp in bedded felsic siltstone and lapilli-tuff. The sulphide grains are disseminated in the siltstone and the matrix of the lapilli-tuff. The mineralized zone occurs near the exposed 'top' of the felsic unit.

(12) Hatchet Lake (HAT). Py-po mineralization occurs at three intervals within a succession of felsic sediments. The sediments are laminated, fine sand-sized, and quartzose with minor chlorite and rare biotite; minor mafic layers consisting of chlorite and lesser biotite are also present. Thin (less than 1 cm) carbonate veinlets parallel to bedding constitute about 1% of the unit. Other units are fine grained, laminated, and silt- to fine sand-sized; increases in the amount of biotite and carbonate distinguish various subdivisions within the sedimentary succession.

Mineralization occurs in three intervals: (1) approximately 1 per cent pyrite and pyrrhotite accompanied by 1 to 3% garnets; (2) trace amounts of pyrite and pyrrhotite in a slightly more mafic section containing fine grained hornblende; and (3) 5 to 10% pyrite and pyrrhotite concentrated mainly in garnetiferous, chloritic mafic beds interbedded with felsic sediments.

STRATABOUND SULPHIDES IN FELSIC FRAGMENTALS

(9) Pool Lake. Stratabound py-po-asp-cp occurs in a felsic tuff and lapilli-tuff with a lens-shaped map pattern that is overlain by mafic pillowed flows and underlain by mafic pillowed flows, tuffs, breccias and gabbro. The mineralized tuff is dark green, weakly foliated, medium grained and contains quartz, chlorite and plagioclase.

Sulphide mineralization includes fine grained and well-formed crystals of pyrite and arsenopyrite, cleavable masses of pyrrhotite, and minor fine grained chalcopyrite. The sulphide minerals are disseminated throughout the rock, which is heavily rusted. Quartz, muscovite and hematite are associated with the sulphides. Spotty non-rusty areas exhibit hornblende blastesis.

(11) Irene Lake (Sir). Po-mt-cp-py occurs in felsic tuff within a succession of primarily felsic with lesser mafic sediments and tuffs. The host is fine grained, has weak foliation defined by chlorite, and consists of subequal quantities of quartz and chlorite. The units appear to be massive and non-bedded. The sequence of sediments and tuffs are all fine grained with units separated on the basis of compositional differences reflected in the relative amounts of chlorite, quartz, plagioclase, carbonate, and biotite that are present. Lapilli-tuffs of similar composition are less common. Mafic rocks total only 5 per cent of the sequence. A 3 m thick alteration assemblage of garnet-chlorite-anthophyllite with minor pyrite and pyrrhotite occurs 8 m uphole from the mineralized zone encountered in the drill core.

Mineralization comprises a zone of solid pyrrhotite and magnetite with less than 10% total chalcopyrite and pyrite; all of these minerals are mutually intergrown and there are no apparent remnants of felsic tuff or open spaces. Downhole from the solid sulphide zone a felsic tuff unit contains approximately 30% sulphides. This mineralization occurs as disseminations and also as irregular clots. Down the hole it passes into a thin bedded felsic sediment that contains 10 per cent pyrite and pyrrhotite.

SULPHIDE MINERALIZATION ASSOCIATED WITH QUARTZ VEINS IN SILTSTONE

(2) Wilmot Lake. Arsenopyrite associated with quartz veins occurs in siltstone within a succession of sedimentary rocks. The siltstone is medium grey, fine grained, laminated to thin bedded, and garnetiferous. Although mafic and felsic beds alternate, mafic layers composed of subequal amounts of hornblende and plagioclase are the predominant rock type. Individual beds have a pronounced lensoid nature and are discontinuous or slightly curving along strike. Limited exposure inhibits the placement of this unit within a stratigraphic framework. A siltstone and a hornblende greywacke occur in the vicinity of the mineralized unit. This siltstone is distinguished from the mineralized siltstone on the basis of composition, grain size and bedding. The non-mineralized siltstone is quartzose, has less plagioclase, is finer grained and contains thinner beds; its laminae do not exhibit the same discontinuous lensoid nature as the mineralized siltstone does.

Arsenopyrite occurs in several habits: acicular, well-formed crystals (up to 1 mm), fine grained masses, and fine grained surface coatings in the siltstone. Cross-cutting quartz veins appear to control the concentration of arsenopyrite as it was observed **in situ** only adjacent to, and very rarely within, the quartz veins. The outcrop displays rusty weathering near these veins and elsewhere this type of weathering is patchy. A second set of quartz veins parallel to bedding was the subject of previous trenching efforts by an unknown party;

however, no mineralization or rust staining is associated with this set of veins. The cross-cutting quartz veins may be either the source of the arsenopyrite, or the process of their emplacement may have caused mobilization and local concentration of arsenopyrite within the sediment.

MAGNETITE IN IRON FORMATION

(3) Wilmot Lake. Up to 40 per cent magnetite occurs locally in an iron formation containing foliated monomineralic streaks and bands of plagioclase, hornblende and fine grained magnetite. Beds were not observed and the original textures were poorly preserved.

Magnetite also occurs in a white, fine grained felsic rock that appears to be an intrusion. The magnetite infills a network of two sets of oblique fractures within the unit. These fractures do not extend into adjoining fine grained mafic rocks.

DISSEMINATED SULPHIDES AT AN INTRUSIVE CONTACT

(5) Eldon Lake. Arsenopyrite and pyrite occur within fine grained felsic sediments near the contact with a biotite granodiorite. The mineralized sediment is a siliceous, biotitic (up to 30%), well foliated, and very fine grained siltstone. The siliceous siltstone is underlain by a series greywackes and hornblende siltstones that are intruded by hornblende diorite. The siliceous siltstone is in contact with the biotite granodiorite in outcrop to the north of the mineral occurrence. Xenoliths of fine grained felsic sediments and mafic rocks are found near the margin of the granodiorite.

The siltstone has a rusty appearance, and contains fine grained disseminated (1 per cent) arsenopyrite and pyrite concentrations along foliation planes.

SULPHIDE MINERALIZATION WITHIN INTRUSIVE BODIES

(10) Pole Lake. Disseminated pyrite occurs in hornblende diorite in a roadcut at Pole Lake. The hornblende diorite is dark green, equigranular, non-foliated, and contains approximately 25% hornblende crystals. A large number of structural features including four directions of shear planes, four fracture orientations, and a minor fold dissect the hornblende diorite. Grain size decreases toward the centre of sheared zones, and the rock becomes very fine grained, chloritic, highly foliated, and recrystallized to the extent that it imparts a slaty cleavage to the rock. The sheared zones are approximately 1 m across and have sharp boundaries. Relict hornblende crystals occur within the less sheared portions of these zones. Some, but not all, fractures 5 mm in width (max. 2 cm), are in-filled with quartz.

Disseminated, cubic pyrite (3 per cent) occurs throughout the hornblende diorite. The grain size and locally the volume of pyrite increases in and near shear zones and fractures. In one shear zone crystals of pyrite up to 5 mm in size occur in a distinct orthorhombic shape.

(13) Eldon Lake (FL/DH deposit). Mt-po-cp-(sp?) occurs in a fine grained chloritic rock (probably a xenolith) in quartz diorite. The host is fine grained, comprising chlorite, quartz and plagioclase. It is foliated and in places chlorite bands alternate with plagioclase and chlorite bands. The quartz diorite consists of chlorite, hornblende, biotite, and plagioclase, and ranges from non-foliated and equigranular to strongly gneissic. In the immediate vicinity of the mineralized area, the quartz diorite is not foliated.

Magnetite, pyrrhotite, pyrite, chalcopyrite, and possibly sphalerite are found as solid sulphide with less than 5% of a yellow clayey material and vugs. Above the solid sulphide zone encountered in the drill core, the chloritic rock contains 3 per cent stringer and disseminated sulphides. A friable zone with sulphides, magnetite, and a yellow clayey material surrounding 3 mm angular fragments of the chloritic host occurs in the uppermost parts of the hole.

SULPHIDE MINERALIZATION IN A FRACTURE SYSTEM

(7) Flag Lake. Py-po mineralization occurring in a fracture system cross-cutting a hornblende greywacke, results in varying degrees of alteration. The greywacke is fine grained, granular and hornblendic with very fine grained angular mafic lithic clasts, and an unknown clast type that weathers in negative relief. Slightly to moderately altered greywacke exhibits replacement by pyrite and rusty weathering along fractures and bedding planes. Highly altered rocks are characterized by ovoid, medium green, fine grained structures approximately 10 x 25 mm surrounded by a matrix of purple, dark red, and rusty weathering material containing pyrite and lesser pyrrhotite (Fig. GS-4-2). Garnets up to 3 mm diameter and averaging approximately 1 mm are distributed unevenly throughout the rock. They preferentially occur in the suiphide matrix and less commonly in the less altered material.

(16) Minton Lake. Rusty weathering zones cross-cut greywacke and felsic heterolithic lapilli-tuff that are exposed in a sand pit south of Minton Lake. In the sand pit 55 m of bedded greywacke are overlain to the north by 15 to 20 m of bedded heterolithic lapilli-tuff with minor interbedded felsic tuff.

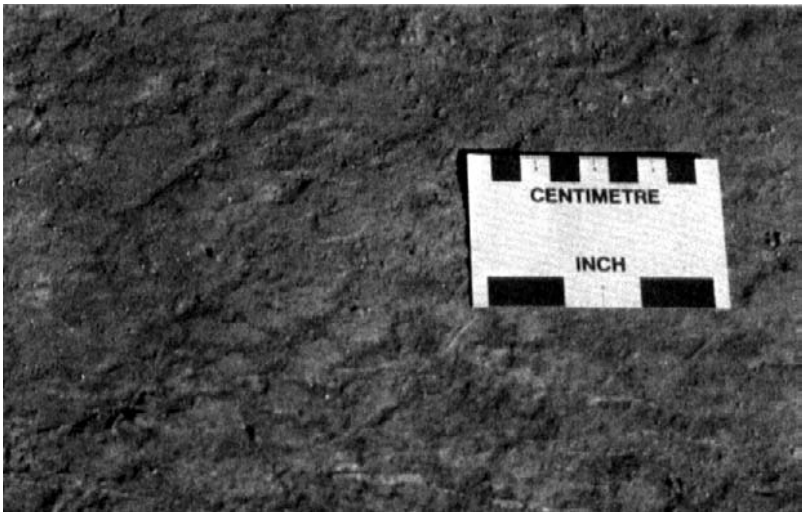

Figure GS-4-2:

Anastomosing, sulphide-bearing stringers and veinlets in altered sediments at Flag Lake (locality 7 on Fig. GS-4-1).

The rusty weathering zones are friable and comprise quartz, biotite, minor feldspar and minor fine grained sulphide. These zones are up to 1.5 m wide, anastomosing and form a network through the greywacke and felsic lapilli-tuff. The boundaries between the rusty zones and the host rock are mostly diffuse over 5 to 10 cm but locally they are sharp. The rusty zones are considered to be filled channelways through which the fluids altering the host rock migrated. Between the north end and the sand-pit and the south shore of Minton Lake there are two east-trending geophysical conductors that are parallel to subparallel to bedding in the greywacke and lapilli-tuff. The conductive zones are not exposed; however, at one locality south of Minton Lake, on or very close to the geographical position of one of the conductors, there is an outcrop of a sugary textured, layered silicic rock containing fine grained disseminated sulphide.

If the conductors reflect mineralization, then the cross-cutting rusty zones in the greywacke and felsic lapilli-tuff and this mineralization are probably genetically related.

CONCLUSIONS

Stratabound disseminated to solid sulphide mineralization in felsic fine grained sediments and volcanic fragmental rocks is a particularly prevalent style of mineralization in the Lynn Lake area. Other styles of mineralization that occur less commonly are: sulphide mineralization associated with quartz veins in siltstone; magnetite in iron formation; sulphide mineralization within intrusive bodies and at intrusive contacts, and sulphide mineralization within fracture systems.

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GS-5 MINERAL DEPOSIT STUDIES IN THE WESTERN LYNN LAKE GREENSTONE BELT

by P.W. Stewart and K. Brewer

INTRODUCTION

Field work conducted in 1984 documented sulphide mineral occurrences and alteration zones in the Laurie Lake area (NTS map 64C/12). This was part of an ongoing larger scale investigation of mineral deposits and related rocks in the Lynn Lake greenstone belt (Fedikow and Gale, 1982; Gale, 1983; Baldwin, 1983; Fedikow, 1983; other papers in this volume). Study localities included: 1) current and lapsed claim groups recorded in government files; 2) sulphide mineral occurrences, porphyroblastic schists and altered dacites reported by Zwanzig et al. (1980); and 3) previously unrecorded mineral occurrences, gossans and porphyroblastic schists. The intention of the project is to enlarge the data base on mineral occurrences in the Lynn Lake area, to identify the types and styles of mineralization and to determine the genesis of these occurrences.

Each study location was mapped in detail at scales ranging from 1:300 to 1:1200. Locations are given on Figure GS-4-1. Samples of mineralized exposures were collected for assay and for geochemical evaluation. Maps and analytical data will be added to the open file data resource base for the Lynn Lake belt. Petrographic and mineralogic examination will be conducted during the winter.

GOLD (AND GOLD POTENTIAL) OCCURRENCES

CAIMITO

The Caimito occurrence was a Au-Cu prospect on a small island in southeastern Laurie Lake. Diamond drilling was conducted on the property in 1951 by Sherritt Gordon Mines Ltd. Subsequently the Laurie River system west of McGavock Lake has been flooded (Milligan, 1960). Consequently, drill hole locations and trenches were not found, although partially deteriorated drill core was located on the island. The previously reported Au and sulphide mineralization in quartz veins (Milligan, 1960) in a plagioclase amphibolite was not found and is presumed to be presently under water. From surface observations, the plagioclase amphibolite is considered to be derived from a hornblende- and plagioclase-rich greywacke, rather than from "basic lavas" as reported by Milligan (1952).

EAST DUNPHY LAKE

A sequence of iron stained, fine grained sedimentary or volcaniclastic rocks with layers containing 1 to 10 per cent disseminated arsenopyrite and pyrite on eastern Dunphy Lake was investigated. The sulphide mineralization appears to be stratabound, with evidence of some mobilization due to tectonic movement. The predominance of the arsenopyrite mineralization, its occurrence in fine- to very fine-grained sedimentary rocks, and the close association of siliceous and highly magnetic beds with the mineralized layers suggest potential stratabound Au mineralization analogous to the Agassiz Au deposit in the north-central Lynn Lake belt (Fedikow and Gale, 1982; Fedikow, 1983). Assay samples have been collected to test this hypothesis.

BASE METAL SULPHIDE OCCURRENCES

TOD/LAURIE LAKE PENINSULA

Several locations of pyrite, pyrrhotite and chalcopyrite mineralization on the peninsula separating Tod and Laurie Lakes and on Laurie River were investigated. They are discussed together because of the similar type of mineralization and their occurrence within the same or similar lithologic sequence.

Diamond drill logs from previous claim holders indicate intersections of disseminated to NSS (near solid sulphide, terminology after Gale et al., 1980) pyrite and pyrrhotite with trace to minor chalcopyrite mineralized layers(?). This mineralization was most commonly reported to be in graphitic fine grained (slaty) sedimentary or tuffaceous rocks. Observed surface mineralization consists of 1 per cent or less disseminated pyrite and/or pyrrhotite in fine- to medium-grained basaltic flows and fine grained tuffaceous (volcaniclastic?) rocks. Fracture surfaces commonly show iron staining, and with one exception, no pervasively stained or rusty weathering rocks were observed. On east Laurie Lake, rusty weathering rocks have a strike length of 500 m and contain local concentrations of garnet and biotite. However, very little evidence of an alteration zone could be found. The rusty weathered zone is believed to be related to a major fault structure in that locality (Zwanzig et al., 1980).

No evidence of previously reported (Zwanzig et al., 1980) disseminated pyrrhotite and chalcopyrite mineralization in a conglomerate on the same peninsula could be found.

SOUTH LAURIE LAKE

A small lens of pyrite-chalcopyrite mineralization (1.1 m x 4.7 m) was examined in southeastern Laurie Lake. The host rock contains garnet and anthophyllite porphyroblasts and weathers rustily. The porphyroblasts extend slightly beyond the limit of the rusty zone and are considered to be a metamorphosed product of an alteration related to the emplacement of the sulphide mineralization. The original host rock lithology is not discernible due to this alteration and the subsequent upper amphibolite grade regional metamorphism (Gilbert et al., 1980). The mineralization is bounded on three sides by the altered rock and appears to occur in the hinge of a small fold structure. No evidence of alteration or mineralization was observed down strike from this fold hinge. The mineralized zone is bordered to the north by fine grained, laminated tuffaceous(?) rocks and deformed mafic pillowed flows. Greywacke, siltstone and calcareous sandstone occur along strike to the south of the mineralization.

RYE

Reconnaissance work was conducted over the old Rye claim group 1 km northwest of the entrance to Laurie Lake from Laurie River. Very little outcrop was found, and no evidence of mineralization or effects of alteration were detected. Two probable drill hole locations and partially deteriorated drill core were found.

PORPHYROBLASTIC SCHISTS

LAURIE LAKE AREA

An east-trending belt of metasedimentary and metavolcanic rocks occurs north of Laurie Lake and the Laurie River, and due west of the Fox Mine (Sherritt Gordon Mines Ltd.). Several localities of garnet and/or anthophyllite porphyroblastic schists have been reported in the area (Zwanzig et al., 1980; Gale, 1983). Other minerals present in the schists are quartz ± biotite ± chlorite ± cordierite ± magnetite ± kyanite Mineralogically similar rocks occur at the Fox Mine, where they are considered to represent a metamorphosed alteration zone associated with massive sulphide mineralization (Lustig, 1979).

At the Lar deposit, porphyroblastic schists are associated with. and believed to underlie a massive sulphide lens (Gale, 1983). These schists appear to overlie basaltic volcanic rocks and to be overlain by a rusty weathering quartz and sericite rock that probably represents a metamorphosed chert zone. The Lar deposit and alteration zone are discussed in more detail by Elliott (1984).

At the old Gran claim group, 4.5 km east of the Lar deposit, a zone of rusty weathering, very fine grained siliceous rock with up to 10 per cent pyrite and pyrrhotite occurs within quartz-biotite-garnet gneisses and mafic tuffaceous or volcaniclastic rocks. Several diamond drill holes (Sherritt Gordon Mines Ltd.) were located on the property. Garnet and garnet + anthophyllite porphyroblastic schists occur within a fine grained mafic sedimentary (volcanic?) rock, approximately 300 m southeast of the sulphide mineralization. Hornblende-rich mafic rock is in contact with felsic gneiss believed to be derived from a felsic intrusive body. Porphyroblastic rocks appear to be layers within a volcano-sedimentary sequence, rather than a cross-cutting vein system.

NEW FOX OCCURRENCE

A zone of garnet and anthophyllite porphyroblastic schists occurs 1.5 km south of Vaughan Lake and approximately 6 km west of the Fox Mine. This zone is roughly continuous for 1 km, with a maximum width of 50 m. Very minor disseminated pyrite, pyrrhotite and chalcopyrite are present. The porphyroblastic rocks have been subdivided into three zones:

1) Main zone - up to 40% garnet crystals (up to 2 cm in diameter) and up to 40% radiating sheaths of anthophyllite crystals forming rosettes up to 6 cm across set in a siliceous matrix (Fig. GS-5-1).
2) Anthophyllite-rich zone - adjacent to the main zone, anthophyllite occurs as radiating sheaths but with little or no garnet; with increasing distance from the main zone anthophyllite forms individual bladed crystals and the tuffaceous (volcaniclastic?) nature of the host rock becomes increasingly evident.
3) Vein zone - adjacent to the anthophyllite-rich zone, 1 cm to 20 cm wide anthopyllite (±garnet) porphyroblastic veins cross-cut fine grained mafic tuffaceous (volcaniclastic?) host rocks; anthophyllite blades transect the vein host rock contacts (Fig. GS-5-2). The veins form 50% or less of the observed outcrops.

These porphyroblastic zones are associated with basaltic pillowed flows and fine grained greywacke, and occur within mafic to intermediate tuffaceous, volcaniclastic or sedimentary rocks.

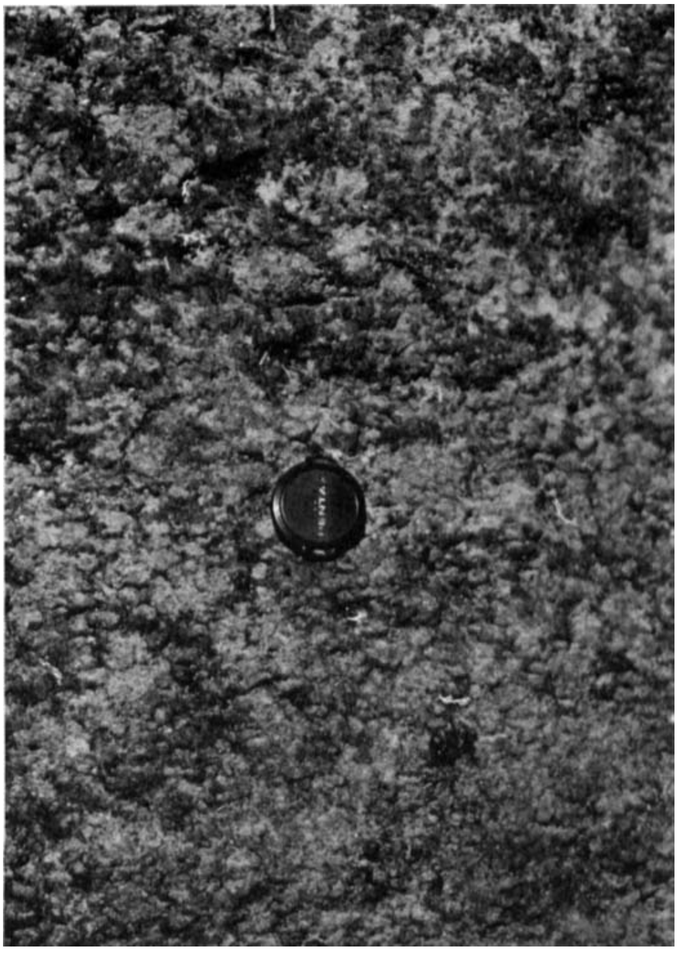

Figure GS-5-1:
Garnet and anthophyllite porphyroblastic schists ('main zone') at the new Fox occurrence.

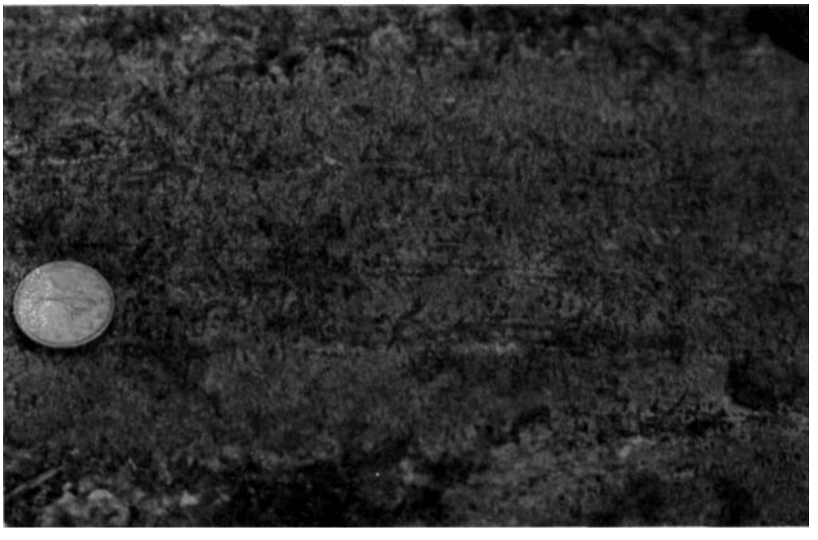

Figure GS-5-2:
'Veins' of predominantly anthophyllite porphyroblastic rock within a fine grained mafic tuffaceous or volcaniclastic rock.

SNAKE LAKE AREA

Approximately 4 km southeast of the Fox Mine in the Snake Lake area, several units of dacite contain sulphide mineralization or show evidence of alteration (Gilbert et al., 1980). At the Bag prospect on eastern Snake Lake, disseminated pyrite and chalcopyrite mineralization (less than 2 per cent) occurs in two trenches in a siliceous anthophyllite+cordierite+biotite ± garnet porphyroblastic schist. The mineralized and altered rocks are associated with a staurolite + sillimanite ± garnet porphyroblastic rock and sericitic felsic rocks. All of these units appear to be contained in a xenolith (less than 300 m x 300 m) within a large body of fine-to medium-grained gabbro. The origin of the altered rocks is presently undetermined.

In trenches at the southeastern end of Snake Lake on the Gal prospect, pyrite, pyrrhotite and rare chalcopyrite mineralization occurs as disseminations and stringers which parallel the foliation in mafic to intermediate sedimentary or tuffaceous rocks. Galena mineralization less than 5 cm wide occurs in quartz veins up to 1 m thick. These quartz veins cross-cut lithologic boundaries and the primary foliation. Rusty weathering, fine grained quartz + sericite ± garnet schist containing less than 2 per cent disseminated pyrite, chalcopyrite and arsenopyrite(?) occurs in outcrop within 300 m west of the mineralized trenches. Garnet and anthophyllite porphyroblastic schists occur within the dacitic rocks, southwest of the mineralized areas. Their relationship to the mineralization and their origin are yet to be determined.

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GS-6 A STUDY OF THE ALTERATION ZONE ASSOCIATED WITH THE LAR DEPOSIT

by S. Elliott[1]

INTRODUCTION

A preliminary investigation of the geology of the Lar massive sulphide deposit on the north side of Laurie Lake (Fig. GS-6-1) was conducted during the 1984 field season. The main purpose of this work was to define the major lithologic units and to examine an alteration zone associated with the deposit. In addition, material was collected to conduct a geochemical study of the alteration zone.

The alteration zone stratigraphically underlies a solid sulphide layer, and contains a complex assemblage of metamorphic minerals. The zone is lens-shaped, with the most intense alteration occurring in the core of the zone. An increase in alumina towards the solid sulphide layer is suggested by the occurrence of kyanite and sillimanite.

Whole-rock and petrographical analysis of approximately 60 samples will supplement the field component of the study. The analytical data and field observations will form the basis for an M.Sc. thesis to be undertaken at the University of Waterloo

GENERAL GEOLOGY

The stratigraphic sequence at the Lar deposit comprises south facing, overturned conformable felsic to mafic metavolcanic and metasedimentary rocks that form part of the Wasekwan Group in the Lynn Lake greenstone belt. Major lithologic units trend 110° to due east, and dip 40° to 70° to the north. Top criteria include: (1) graded bedding in a greywacke unit; (2) a scour channel in a mafic debris flow unit; and (3) a solid sulphide lens mineralization overlying an alteration zone that cuts across the volcanic rocks. Although major folds and faults were not delineated, analysis of foliation attitudes across the area suggests that the volcano-sedimentary sequence has been subjected to at least one major folding event other than that which overturned the deposit and its host rocks.

The rocks have undergone regional metamorphism, attaining upper amphibolite facies. Garnet porphyroblasts, typically less than 2 mm in diameter, were identified in all of the major lithologic units.

UNIT DESCRIPTIONS

AMPHIBOLITE (1)

The amphibolite is typically fine grained, black, and has an average mineralogical composition of 40% amphibole, 30% biotite, and 30% quartz. However, mineral proportions are variable and the rock becomes more siliceous toward the unit boundaries. Amphibole crystals display a parallel orientation that is more distinct in the north than in the south of the unit. Pillow-like structures suggest that the amphibolite is composed of basaltic flows.

Felsic and mafic mineral segregation commonly occurs near contacts with the overlying unit, and with felsic intrusive rocks. Quartz and amphibole segregate into separate lens-shaped structures, about 1 cm long and 2 to 5 mm wide. These are considered to be a metamorphic feature.

Epidotization is common and lends both a greenish hue and a layered appearance to the rock. These layers range from 1 to 2 m in width with a sharp contact between the epidote-rich layer and the mafic host rock.

Finely disseminated pyrite is present in amounts of less than 2 per cent. The greatest concentration occurs toward the stratigraphic top of the unit.

ALTERATION ZONE (2)

The alteration zone displays a variety of mineral assemblages. The rocks may be classified as quartz-anthophyllite-chlorite ± biotite ± cordierite ± magnetite ± kyanite ± sillimanite ± garnet porphyroblastic schists. The fine grained matrix typically comprises quartz-chlorite-biotite assemblage of variable composition; the remaining minerals occur as either fine- or coarse-grained porphyroblasts. An early generation of fine grained cordierite may be present in the matrix.

Metamorphic mineral assemblages are:

anthophyllite-garnet
cordierite-anthophyllite
cordierite-anthophyllite-garnet
cordierite-anthophyllite-sillimanite
cordierite-anthophyllite-garnet-kyanite-magnetite
cordierite-anthophyllite-sillimanite-kyanite-magnetite.

Cordierite and magnetite porphyroblasts range between 2 and 6 mm in diameter. Sillimanite and kyanite crystals are generally about 5 to 10 mm long. Anthophyllite porphyroblasts are either 5 to 6 mm long, or more typically are coarser grained, up to 2 cm long. The garnets are roughly equigranular and range in diameter from 0.5 to 4 cm. Large elongate garnets occur at the contact with the underlying unit.

The alteration zone is cross-cut by chlorite and quartz pods or veins, ranging in length from 40 to 200 cm, and thickness of 12 to 20 cm. The smaller chlorite pods typically have quartz cores. Disseminated pyrite, lesser chalcopyrite and sphalerite occur throughout the alteration zone. The complexity of the distribution of the mineral assemblages will require mapping of this alteration in greater detail.

BASALT (3)

A fine grained, dark grey unit of basaltic flows is compositionally similar to the amphibolite unit (unit 1). It is distinguished from the amphibolite unit by a slightly greater proportion of felsic minerals, by a poorly developed foliation, and by better preserved primary structures that include distinct pillows, amygdules, preservation of bedding and scouring in a volcaniclastic unit. Locally thin amygdaloidal massive flows are interbedded with fine grained tuff that forms beds less than 5 cm thick. Rusty weathering chloritic veins containing up to 3 per cent pyrite and minor chalcopyrite and sphalerite form local cross-cutting networks in the basalt unit.

SILICIC ZONE (4)

The silicic zone displays a range of compositions, from 70% quartz and 30% mafic minerals, to nearly 100% quartz. The quartz-rich variety contains sulphide in fractures that has subsequently been leached by surface weathering. Disseminated sulphides, mainly pyrite, occur in more mafic portions of this rock. The unit is poorly exposed along strike. The silicic zone is distinguished from the greywacke unit by absence of plagioclase. This rock unit probably represents a metachert in part.

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[1]University of Waterloo.

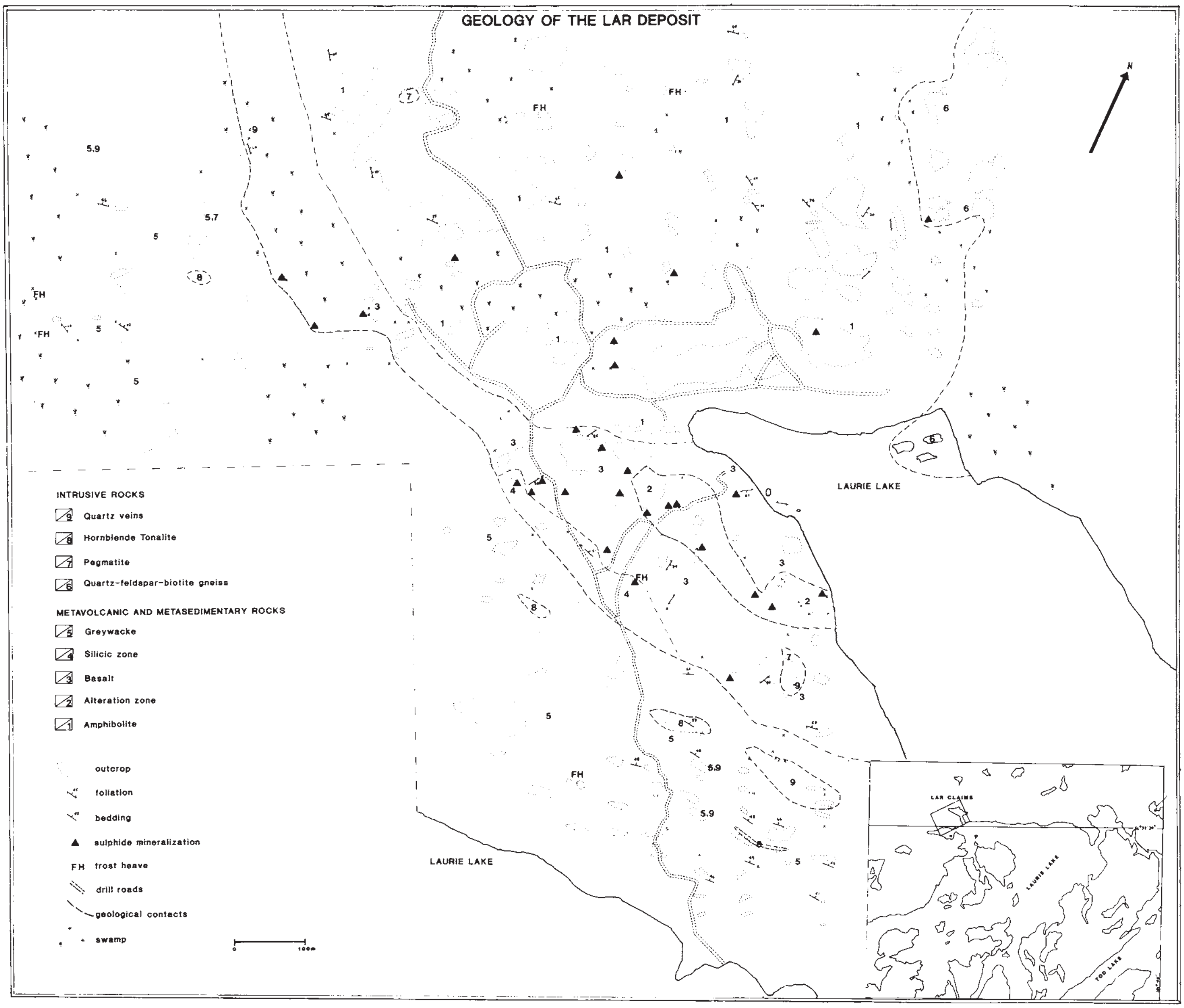

Figure GS-6-1: Geology of the Lar deposit.

GREYWACKE (5)

The greywacke is a light grey typically fine grained bedded unit that weathers off-white and contains 60% quartz, 20% feldspar, and 20% biotite. Beds are typically less than 3 to 5 cm thick, although beds up to 30 cm thick are present. These latter beds are medium grained, with a more granoblastic texture. Some beds have a more mafic composition due to a higher biotite content. Contacts between the greywacke and the silicic zone, and between the greywacke and the basalt/amphibolite unit, appear to be gradational.

INTRUSIVE ROCKS

QUARTZ-FELDSPAR-BIOTITE GNEISS (6)

The quartz-feldspar-biotite gneiss is medium- to coarse-grained, weathers off-white but is tan-coloured on a fresh surface. Generally it contains 50% quartz, 40% plagioclase, and 10% biotite. The biotite defines a distinct foliation. Alternating felsic and mafic bands 6 to 8 cm thick define the gneissosity in the rock. Mafic bands contain up to 20% biotite. Less than 1 per cent disseminated sulphides occur in proximity to the contact with amphibolite (unit 1). The gneiss is an intrusive rock that clearly pre-dates the development of regional foliation. Late mafic dykes, up to 30 cm wide, cross-cut the gneiss.

PEGMATITE (7)

An isolated, coarse grained pegmatite body, and pegmatitic veins, occur within the amphibolite unit. The intrusive body measures about 24 by 30 m and includes a major, light rose quartz vein about 5 m thick. Pegmatitic veins are more common toward the base of the amphibolite and can be traced for up to 60 m.

HORNBLENDE TONALITE (8)

The mineralogical composition of the hornblende tonalite is 40% hornblende, 30% plagioclase, 15% quartz, and 15% biotite. It has a medium- to coarse-grained equigranular texture. The absence of mineral lineation suggests that it postdated development of regional foliation.

QUARTZ VEINS (9)

Quartz veins occur throughout the area. Locally, in amphibolite they are up to 60 cm wide, whereas in greywacke they are commonly less than 1 cm wide. Quartz-carbonate veins are more typical of the basalt unit, and range in size up to 75 cm long and 10 cm wide. Quartz veins in the alteration zone are rare but measure up to 200 cm in length and up to 20 cm in thickness. Well formed tourmaline crystals up to 2.5 cm long are associated with one of these quartz veins. Quartz veins are absent in the silicic zone.

Field mapping and sampling of the alteration zone will be continued during the 1985 field season.

GS-7 THE GEOLOGY OF THE FOX MINE AREA

by Philip E. Olson[1]

INTRODUCTION

At the current rate of mining known reserves at Sherritt Gordon's Fox Mine will be exhausted by October, 1985. In June of 1984 the University of Manitoba, the Geological Services Branch of the Manitoba Department of Energy and Mines and Sherritt Gordon Mines initiated a co-operative project to document the geological setting of the Fox Mine and to assess the potential for similar type mineralization in the Fox Mine area.

The study area is approximately 3 km^2. Field work included mapping 600 outcrop locations and re-logging 10 exploration drill holes. Field work furnished 2,000 samples for geochemical analyses and 200 samples for petrographic studies.

Final results of this project will be presented in the form of an M.Sc. thesis at the University of Manitoba.

[1]Sherritt Gordon Mines Ltd.

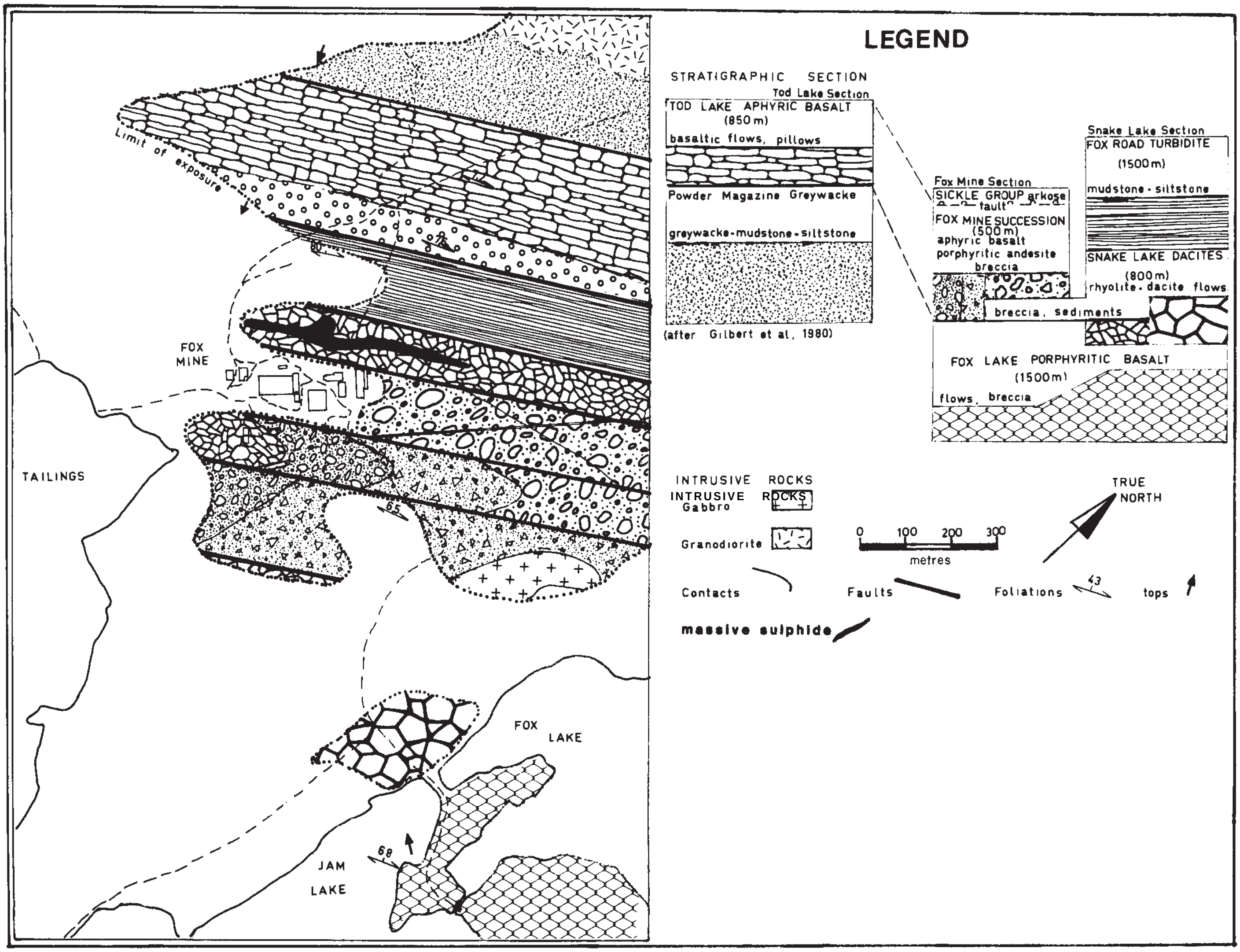

Figure GS-7-1: Generalized geological map and regional stratigraphy of the Fox Mine area. The lithologies represented by patterns on the geological map are identified by the text printed immediately above each pattern in the stratigraphic sections.

GENERAL GEOLOGY

Fox Mine is located 45 km southwest of Lynn Lake in northwestern Manitoba. It is an Apbehian age volcanogenic copper-zinc massive sulphide deposit. The orebody is contained within east-trending, north dipping volcanic, volcaniclastic and sedimentary rocks of the Wasekwan Group (Stanton, 1949). The lithologies in the map area have been metamorphosed at amphibolite facies.

Previous work includes regional surveys (Stanton, 1949; Milligan, 1960 and Zwanzig, 1977); two theses (Obinna, 1974 and Lustig, 1979) and five publications (Glass, 1972; Turek et al., 1976; Gilbert et al., 1980; Jealous et al., 1982 and Gilbert et al., 1982).

Preliminary assessment of current field mapping has revealed the Fox orebody is south-facing and the Fox Mine area comprises several post-folding fault slices that are lithologically diverse making stratigraphic correlations from one slice to another and to regional stratigraphy extremely difficult.

STRUCTURE AND STRATIGRAPHY

A pronounced set of east-trending faults has resulted in the juxtaposition of apparently random stratigraphic slices. North of the Fox Mine the faults are predominantly parallel to bedding (Fig. GS-7-1). To the south of the mine, faults cut bedding at variable angles.

The lowermost unit in the Fox Mine stratigraphic section is the Fox Lake Porphyritic Basalt (Zwanzig. 1977). It outcrops in the southeast corner of the map area and comprises massive flows, pillowed flows, flow breccias, derived volcaniclastic and associated intrusive rocks that are interpreted to be a primitive calc-alkaline shield volcano (Gilbert et al., 1982).

Overlying the Fox Lake Porphyritic Basalt are the Snake Lake Dacites (Gilbert et al., 1980) comprising felsic flows, pyroclastic deposits and associated sedimentary rocks that show compositional variability from rhyolite to dacite. Massive flows outcrop in the southeast and abut the Fox Lake Porphyritic Basalt. Pyroclastic rocks outcrop in the central part of the area and are intercalated with massive flows.

The Snake Lake Dacites are overlain by the Fox Road Turbidites (Gilbert et al., 1980). Lithologies contained within the Fox Road Turbidites include sandstones, siltstones and mudstones.

Porphyritic to aphyric, massive, pillowed and flow breccia tholeiitic basalts overlie the Fox Road Turbidites. These lithologies outcrop immediately south and east of the Fox ore body and with minor felsic sedimentary rocks have been labelled the Fox Mine Succession (Gilbert et al., 1980). The Sickle Group arkose (Gilbert et al., 1980) overlies the Fox Mine Succession, in faulted contact.

The Tod Lake Aphyric Basalt (Zwanzig, 1977) outcrops along the northern contact of the Sickle Group arkose. It is interpreted as a lateral equivalent of the Fox Mine Succession (Gilbert et al., 1980).

Outcrops north of the Tod Lake Aphyric Basalt include immature clastic sedimentary and tuffaceous rocks belonging to the Powder Magazine Greywackes (Gilbert et al., 1982), and are interpreted to be part of the Early Wasekwan Group (Gilbert et al., 1980).

GENETIC IMPLICATIONS

The massive sulphide deposit and associated alteration zone at the Fox Mine are interpreted to be volcanogenic. The distribution of alteration, metal zonation and the attitude of lithologic contacts indicate the deposit is overturned to the south. Felsic pyroclastic rocks occupy the stratigraphic footwall of the deposit and spherulitic rhyolites define the stratigraphic hangingwall. The amphibolite facies altered equivalents of these rock types are cordierite-anthophyllite-mica schists and quartz-sericite schists, respectively.

The Fox orebody occurs in a fault-bounded slice less than 150 m thick. The rocks in this fault slice are interpreted as stratigraphic equivalents of the Snake Lake Dacites. The occurrence of altered and unaltered felsic volcanic rocks with minor sulphide mineralization south of the Fox Mine orebody coupled with a reversal in topping direction is interpreted as a syncline with the closure and southern limb segmented by the east-trending regional fault system.

Ongoing investigations are focussed on defining the amount and direction of fault slice displacement. The position of the favourable stratigraphy must be established before the economic potential of the Fox Mine area can be assessed adequately.

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GS-8 AN INVESTIGATION OF GOLD MINERALIZATION AT CARTWRIGHT LAKE, MANITOBA

by David C. Peck[1]

INTRODUCTION

Detailed mapping at a scale of 1:2400 was carried out on the Bonanza claim group, located at the south end of Cartwright Lake, Manitoba (Fig. GS-8-1). The objectives of this study were:

a) to define the nature of the gold mineralization in a zone of felsic dykes;
b) to investigate gold occurrences in a granitic intrusive body outcropping on a peninsula north of the Bonanza claims; and
c) to investigate the extension of the Johnson Shear Zone south of Cartwright Lake.

Approximately 300 samples were collected during the field season. They include samples for whole-rock and trace element geochemistry, assay, petrographic analysis and a fluid inclusion study. These analytical data and the field observations will provide the data base for a study on the origin of gold mineralization at Cartwright Lake. The results of this study will be submitted for an M.Sc. thesis to the University of Windsor.

Previous mapping in the area was carried out by G.C. Milligan (1960) and E.C. Syme (map GP80-1-2 in Gilbert et al., 1980).

GENERAL GEOLOGY

The stratigraphic succession in the study area comprises a series of conformable mafic to felsic metavolcanic and metasedimentary rocks. They form part of the Wasekwan Group in the Lynn Lake greenstone belt. Major lithologic units trend 060° to due east and dip vertically to 60° north; locally, rare top criteria suggest that part of the succession 'youngs' toward the south.

Intersecting foliations identified in the metasedimentary rocks indicate that at least two folding events affected the Wasekwan rocks. Major folds and faults were not identified, but the correlation of minor folds (drag and shear folds), boudins and outcrop patterns suggest that major east-trending folds occur at Cartwright Lake.

Regional metamorphism of the Wasekwan rocks attained greenschist facies. The occurrence of chlorite and actinolite in the intrusive rocks suggests that intrusive activity predates the main regional metamorphic event.

UNIT DESCRIPTIONS

MAFIC TO SILICEOUS METASEDIMENTARY ROCKS (1)

These rocks consist of 1 to 10 cm thick siltstone layers that change from predominantly mafic to largely siliceous in composition from north to south. Mafic siltstones contain greater than 70% chlorite, actinolite and biotite, with minor plagioclase feldspar. Siliceous siltstones are composed of greater than 60% quartz + plagioclase + alkali feldspar, and less than 40% chlorite + actinolite + biotite. The sedimentary rocks are characterized by a strong magnetic signature, and contain up to 3% magnetite crystals.

Within this unit near its southern limit, a 10 m wide zone (unit 1b) consists of alternating magnetite-rich mafic layers and cherty siliceous layers. A 10 m wide zone of hornfels, identified by a lack of cleavage and a coarser grained texture, occurs in the metasedimentary rocks at their contact with the sheared syenite and granodiorite (unit 5c).

This unit is defined as a fine grained clastic sedimentary sequence that developed a phyllitic to slaty cleavage and a schistose fabric during regional metamorphism.

FELSIC METAVOLCANIC ROCKS (2)

Bedded fine grained felsic volcanic flows and breccias occur in the central part of the volcanic sequence. These rocks contain minor biotite and greater than 80% quartz and alkali feldspar. They are quartz-phyric, containing 2-3% quartz phenocrysts. The flows are massive and grey to pinkish grey. The breccias contain 20 to 50% monolithologic subangular clasts ranging in size from 1 to 50 cm, surrounded by a fine grained felsic matrix. Both fragments and matrix appear to have been derived from the underlying massive flows. Flows range in thickness from 5 to 20 m, and have irregular contacts with the breccias. Thin felsic tuff beds, 5 to 10 cm thick, containing fragments less than 1 cm in size, occur within the breccias. This unit is interpreted as a series of subaqueous rhyolitic flows accompanied by overlying flow-top breccias. The breccias probably formed by thermal shock-induced shattering of the flows in a marine environment. The thin tuff layers are interpreted to be aquagene tuff beds and their stratigraphic position relative to the massive flows and breccias are the only younging criteria observed in the study area.

During tectonism an extensive fracture system was developed by brittle deformation in the felsic flows. Abundant subparallel sets of quartz veins and irregular quartz pods were localized within these fractures.

MAFIC TO INTERMEDIATE METAVOLCANIC ROCKS (3)

Mafic tuff (unit 3a) consists of fine grained plagioclase-phyric volcanic rock fragments. The matrix contains greater than 70% chlorite + actinolite + minor biotite and hornblende, and less than 30% plagioclase feldspar. Plagioclase feldspar phenocrysts are 2 to 4 mm in diameter and comprise 10 to 15% of the rock. The abundance of phenocrysts in the unit indicates that the rocks are mafic crystal tuffs. They developed a slaty cleavage during regional metamorphism.

Basaltic flows (unit 3b) outcrop over much of the area. The rocks contain between 60 and 75% chlorite + actinolite, 25 to 40% plagioclase feldspar, and rare phenocrysts of plagioclase. 1 to 3 mm in diameter. The rocks have a fine grained to aphanitic texture. Locally they contain 1 to 3 cm diameter calcite-filled vugs that are interpreted to be amygdules. Calcite and epidote occur as secondary minerals in the matrix, and as irregular veins and pods. It appears that extensive hydrothermal alteration by calcium-rich fluids altered the rocks prior to regional metamorphism. Subunits ranging in thickness from 10 to 20 cm are distinguished on the basis of slight mineralogical and textural variations. The unit represents a series of massive and amygdaloidal basaltic to andesitic flows. These mafic flows are typically dark to olive green, soft and readily weathered, and moderately well foliated. Flow contacts are irregular.

Intermediate lithic tuff (unit 3c) occurs as a 30 m thick layer of fine grained, monolithic fragmental volcanic rock. The matrix consists of 60 to 70% quartz + plagioclase feldspar, and 30 to 40% biotite + actinolite + chlorite. Fragments compose 20 to 30% of the rock, have an intermediate composition, are subangular, and range in size from 1 to 10 cm.

[1]University of Windsor.

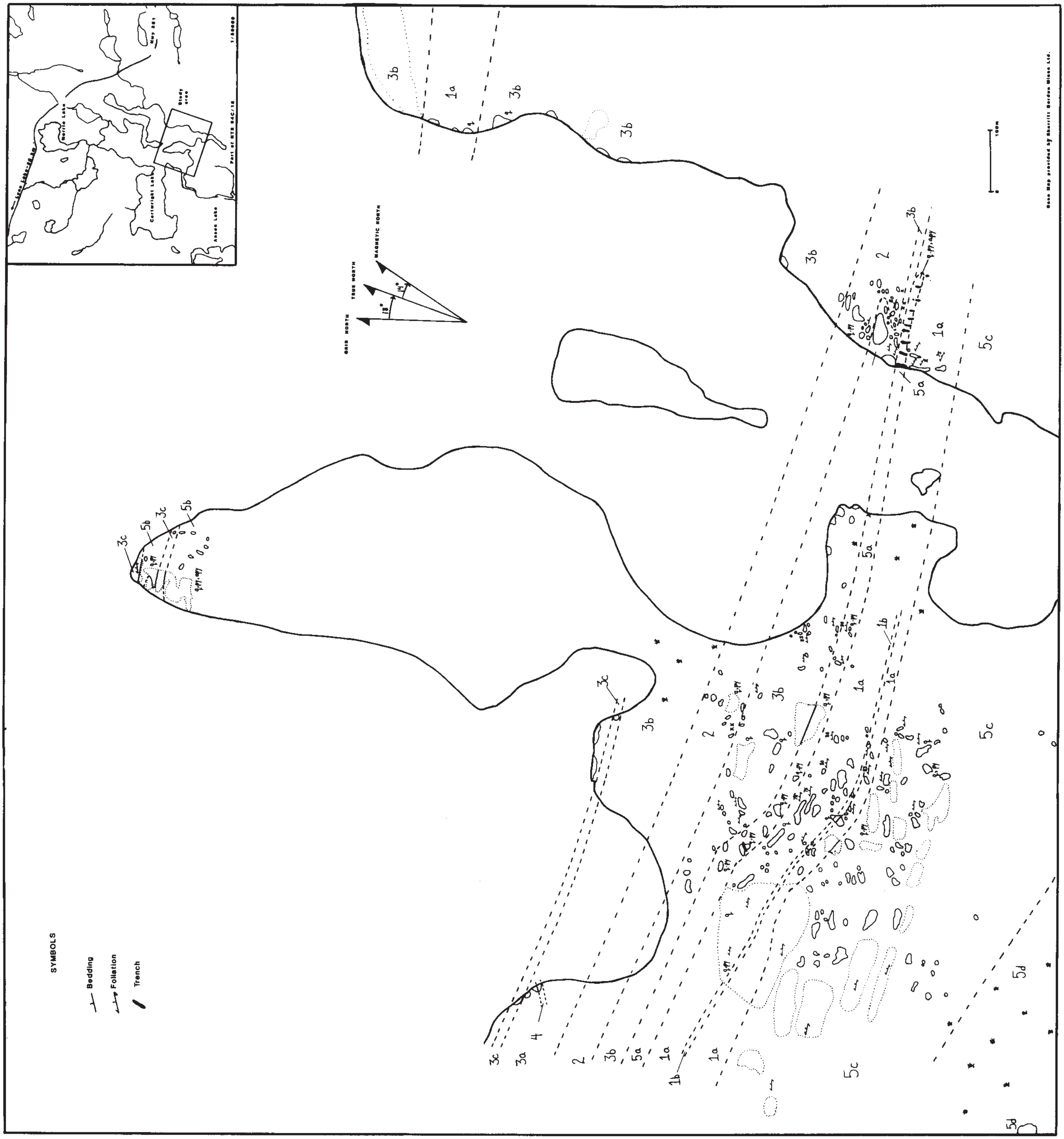

Figure GS-8-1:

Geology of southeast Cartwright Lake, Manitoba. 5a — fine grained felsic dykes; 5b — foliated porphyritic granite; 5c — sheared syenite and granodiorite; 5d — foliated diorite and quartz diorite; 4 — gabbroic dyke; 3a — mafic tuff; 3b — mafic flows; 3c — intermediate lithic tuff; 2 — massive rhyolite flows and bedded rhyolite breccia; 1a — phyllitic siltstone and mudstone; 1b — banded magnetite-rich metasediment; q — quartz veins; py/apy — pyrite/arsenopyrite in quartz veins or fractures.

MAFIC INTRUSIVE ROCKS **(4)**

An 8 m thick gabbroic dyke intrudes mafic metavolcanic rocks (unit 3b) in the western part of the map area. It contains 70% hornblende + actinolite + chlorite, and 30% plagioclase feldspar. It is medium grained and aphyric. The dyke has a fine grained margin, and grain size gradually increases away from the margin. The dyke is discordant with the trends of the volcano-sedimentary sequence.

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS (5)

Felsic dykes (unit 5a) are pink, aphanitic to fine grained and massive. They contain 50% quartz and 50% alkali feldspar; however. quartz phenocrysts are rare. The dykes have sheared margins and massive cores and are commonly pod-shaped, with lengths of 0.5 to several metres; locally they contain 0.1 to 1.0 m thick quartz pods. Quartz-filled fractures, 1 to 3 cm wide, within the dykes form an irregular pattern. Up to 20% chlorite, biotite and actinolite occur locally in the rock and probably result from the assimilation of country rock during the intrusion.

These discordant rocks intrude mafic volcanic rocks in the west and mafic sedimentary rocks in the east. The dykes are interpreted as subvolcanic intrusions of granitic composition.

Porphyritic granite (unit 5b) is composed of 30% alkali feldspar, 30% blue quartz phenocrysts, 20% plagioclase phenocrysts, and 20% chlorite + biotite. The groundmass of the rock is medium- to fine-grained. On the peninsula to the north of the Bonanza claims, the rock changes southwards, from a fine grained, schistose, alkali feldspar-rich granite, to a coarsely banded, medium grained plagioclase-rich granite. Cross-cutting sets of quartz veins, 1 to 20 cm wide, are ubiquitous in the granite. They range in orientation from 330° to 060°W. Numerous aplitic dykes, ranging in thickness from 0.5 to 2.0 m, intruded the granite prior to the emplacement of quartz veins.

Syenite and granodiorite (unit 5c) and diorite to quartz diorite (unit 5d) are phases of a single intrusive body and display gradational contacts with each other. Syenite and granodiorite contain 20 to 50% alkali feldspar, 5 to 30% plagioclase, 5 to 10% quartz, and 20 to 40% chlorite + biotite + actinolite + hornblende. The rocks grade from syenite at the contact with metasedimentary rocks (unit 1a), to granodiorite approximately 100 m south of this contact. The rocks display a strong tectonic foliation imposed by shearing. Felsic minerals are elongated into lenses within schistose bands. The sheared texture becomes indistinct approximately 200 m south of the contact with metasedimentary rocks.

Diorite to quartz diorite contains 50% plagioclase, 20% biotite + chlorite, 20% hornblende, 5% alkali feldspar and 5% quartz. The rock is medium- to coarse-grained and has a poorly developed gneissic banding at the contact with the granodioritic phase (unit 5c). The unit appears massive at a distance of 550 to 600 m south of the contact between the metasedimentary rocks (unit 1a) and the syenitic phase (unit 5c). Xenoliths of mafic sedimentary rocks similar to rocks in unit 1a occur in the diorite.

ECONOMIC GEOLOGY

Gold mineralization at Cartwright Lake is associated with quartz veins within felsic dykes (unit 5a) and porphyritic granite (unit 5b). In both, gold is probably associated with pyrite and minor arsenopyrite at the edges of the veins.

The felsic dyke zone contains two phases of quartz veining. The first consists of large (up to 1 m wide) quartz pods unrelated to fractures and barren of sulphides. The second phase consists of a network of thin (1 to 3 cm wide) impure quartz veins which were localized in fractures and contain coarse calcite and ankerite crystals, fine aggregates of tourmaline, and medium- to coarse-grained biotite and muscovite. These veins can be traced into primary pods of the first phase. They are interpreted to represent mobilization of silica from the primary pods into fractures. Pyrite and, less commonly, arsenopyrite form massive layers of fine grained subhedral crystals at the edges of second phase quartz veins.

The origin of the sulphide/gold mineralization and the crystallization of carbonate, mica and tourmaline within the quartz veins appears to be related with a leaching process. During intense fracturing of the felsic dykes, mobilized silica entered fractures and Fe, Ca, S and Au were concurrently leached from the wall rock. Favourable temperature, pressure and chemistry existing in the fractures allowed crystallization of sulphides and gangue minerals. Since the initial phase quartz pods are barren of sulphides and they provided the silica for the second phase quartz veins, it is postulated that the mineralization must have originated from the wall rock, rather than having been introduced in the quartz-vein system. The original source of the Fe, Ca and S that entered the fractures was probably from mafic volcanic and sedimentary 'rafts' that were partially assimilated by the felsic dykes. The source of the Au remains unresolved.

Previous exploration in the felsic dyke zone included diamond drilling, geophysical surveying and trenching. Continuous chip samples collected from a series of trenches in the dyke zone yielded low Au values (Baldwin, 1983).

Anomalous gold values were obtained from quartz veins in the porphyritic granite by Sherritt Gordon Mines Ltd. These occurrences are very similar to those in the felsic dyke zone. The quartz veins in the porphyritic granite probably resulted from silica injection into fractures in the granite from an external source. The gold may have been carried in with the silica; however, the habit of the sulphide mineralization is consistent with that observed in the quartz veins in the felsic dykes, and a similar metallogenetic process may be involved in both occurrences.

Other sulphide mineralization in the area includes pyritic layers within quartz veins and fractures in felsic metavolcanic rocks, and minor disseminated pyrite observed in both mafic metavolcanic rocks and mafic to siliceous metasedimentary rocks. Anomalous gold values have not been reported from these units.

THE JOHNSON SHEAR ZONE

Field observations confirm the extension of the Johnson Shear Zone through the area immediately south of Cartwright Lake. Distinct sheared textures occur in syenite and granodiorite phases (unit 5c) of a major intrusive body for a distance of approximately 200 m to the south of the intrusive contact with a metasedimentary unit (1a). The intensity of shearing decreases to the south of this contact. The absence of mylonitization of these sheared rocks indicates that cataclasis was not a dominant process during the shearing event.

It is possible that intense fracturing of felsic intrusive rocks (units 5a and 5b) and felsic metavolcanic rocks (unit 2) at Cartwright Lake is related to an episode of the major shearing event. Gold showings similar to those at Cartwright Lake occur at Foster, Franklin and Wasekwan Lakes and may be related to the tectonic event which produced the Johnson Shear Zone. If the intense fracturing and the presence of quartz veins in those localities and at Cartwright Lake can be correlated to the Johnson Shear Zone, then known gold occurrences along the shear zone may represent only a small part of a significant metallotect.

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GS-9 GEOCHEMICAL STUDIES ALONG THE AGASSIZ METALLOTECT

by M.A.F. Fedikow, B. Kramarchuk[1] and R.B. Charlesworth[1]

Vegetation and peat bog geochemical sampling, initiated in 1983, was continued this summer at two locations along the Agassiz Metallotect. The two study areas, Dot Lake and Farley Lake, are outlined in Figure GS-9-1.

BIOGEOCHEMISTRY PROGRAM

A total of 1100 black spruce (***Picea rnariana***) samples were collected from a 30 m^2 grid over a 2.4 km x 1.6 km area west of the Agassiz Au-Ag deposit. On the basis of the Questor Input Survey (1976) and subsequent regional gradiometer surveys it would appear that the Agassiz stratigraphic succession persists in a westerly direction through the study area (Fig. GS-9-1). This summer's sampling program was prompted by the results of a vegetation geochemical orientation survey (Fedikow, 1983; 1984) conducted over the Rushed occurrence, a known gold occurrence in the Dot Lake area. In this orientation study distinct multi-element geochemical halos were associated with a gold-bearing sulphide zone. The halos were defined by the chemical analysis of black spruce needles and twigs; the extent of the halos was determined to be greater than 140 m and centered on a 5 - 10 m mineralized zone. Because anomalous patterns of trace metal concentrations were observed at the limits of sampling in the orientation study at the Rushed occurrence, the orientation sampling line was extended in length for a further 50 m stratigraphically above and below the mineralization. This line extension will enable a determination of the true extent of the anomaly and an estimation of background concentrations of various trace metals in the black spruce samples.

The black spruce samples collected from the Dot Lake grid were dried and separated into needles and twigs at the field camp. The needles will be macerated in a Wiley mill prior to analysis. In addition to sample collection predominant flora in the study area were speciated (Table GS-9-1). Results of this survey will be utilized to determine whether or not vegetation geochemistry represents a viable, regional exploration tool for gold mineralization along the Agassiz Metallotect.

PEAT BOG GEOCHEMICAL PROGRAM

The permafrost peat bog geochemical program initiated in 1983 (Fedikow, 1983) was continued this summer. The sampling was conducted at Farley Lake approximately 40 km northeast of the Agassiz Au deposit but still within the area defined as the Agassiz Metallotect (Fig. GS-9-1). The Farley Lake area was selected for study in order to test the response of the trace element content of peat bog samples overlying INPUT anomalies (Questor, 1976) at a location free from any contamination resulting from past mining activity centered on the town of Lynn Lake. Peat bog studies conducted in 1983 indicated high concentrations of base metals and sporadic gold values from peat bog samples in proximity to the Agassiz deposit; however, it was not determined whether or not these values resulted from a clastic component representing airborne particulate contamination.

The Farley Lake area is characterized by oxide facies magnetite-chert iron formation centered on Gordon and Farley Lakes with mafic volcanic extrusive and tuffaceous rocks to the north and mafic and intermediate crystal and lapilli tuff to the south. Farther south, gneissic

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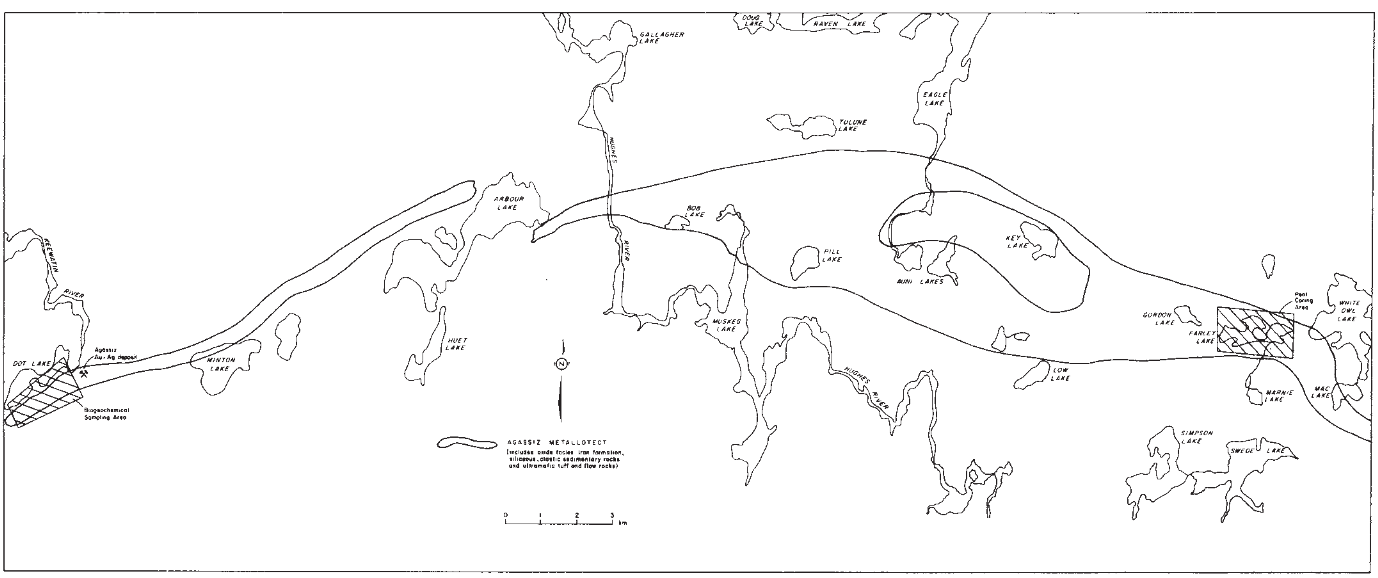

Figure GS-9-1: Location map illustrating the biogeochemical (Dot Lake) and the peat bog geochemical sampling areas (Farley Lake) in relation to the Agassiz Metallotect.

TABLE GS-9-1
SUMMARY OF MAJOR SPECIES IN BOG AND BOREAL FOREST ENVIRONMENTS, DOT LAKE BIOGEOCHEMICAL SAMPLING AREA, LYNN LAKE.

Trees	**Herbs**
Picea mariana*	Epilobium sp.*
Betula papyrifera (F)	Arctostaphylos uva-ursi (F)
Larix laricina*	Vaccinium oxycoccus (F)
Pinus divaricata (F)	Vaccinium vitis-ideaus (F)
Shrubs	Ribes sp (F)
	Lycopodium (obscurum/ annotinum) sp. (F)
Ledum groenlandicum (F)	Viola (pallens/renifolia) (F)
Vaccinium augustifolium*	Chimaphila sp (F)
Vaccinium myrtilloides*	Urtica gracilis (F)
Alnus sp.*	Aster sp.*
Rosa sp. (F)	Cornus canadensis (F)
Acer spicatim (F)	Equisetum sp. (B)
Salix sp.*	Potentilla norvegicus/sp. (B)
Lonicera sp.*	Caltha palustris (B)
Carex sp. (B)	Carex sp. (B)
Grass sp. (B)	Grass sp (B)
Corylus cornuta (B)	
Kalmia polifolia (B)	**Moss**
Betula glandifera (B)	
	Sphagnum (B)
Lichen	Mnium (B)
	Thuidium (F)
Cladonia fimbriata (F)	Polytrichum (F)
Cladonia mitis (F)	Pleurozium (F)
Cladonia rangifera*	Brachythecium (F)
Crustos green/grey*	Eurynchium (F)

Abbreviations are as follows:
F — boreal forest. B — bog. An asterisk indicates the flora occurs in both boreal forest and bog environments.

tonalite, granodiorite and related gneisses occur (Gilbert, 1980). Peat coring was undertaken primarily in areas underlain by the iron formation and mafic flow and tuff south of Farley Lake.

A total of 344 permafrost peat cores were collected from 5 grids sited over known INPUT anomalies and in a control bog where there was no input response (Fig. GS-9-2). The peat cores average less than 1 m in length; however, the majority of the cores penetrated the peat bog allowing samples of the underlying clay and till to be sampled. Measurements of pH were taken from peat core samples and from the underlying sediment as well as from any water that seeped into the bore hole. The pH of all materials exhibited a narrow range of 5-6; a few measurements of 3 - 3.5 were obtained. The peat core samples will be air dried then analyzed using selective digestion techniques and a variety of analytical methods. Black spruce samples were also collected from three of the five grids at Farley Lake in order to examine the correlation in trace metals between the two sampling media.

Analytical results and final interpretations of both the vegetation and the peat bog geochemical programs will be available in the form of a mineral deposit open file, available for viewing upon request. In addition to the peat bog and vegetation geochemical studies, a basal till sampling program was undertaken this summer in the Farley Lake area and represents part of an ongoing program of the evaluation of surficial geochemical exploration methods for the Agassiz Metallotect. The results of the program to date are described by Nielsen (1984).

ACKNOWLEDGEMENTS

I would like to acknowledge the perseverance of Bruce Kramarchuk, Doug Bell and Darrell Boguski in their efforts to core the permafrost peat bog at Farley Lake. Rob Charlesworth is thanked for his efforts in conducting the vegetation geochemical sampling program at Dot Lake as is Simon Wilkins who is also responsible for the speciation of flora at Dot Lake.

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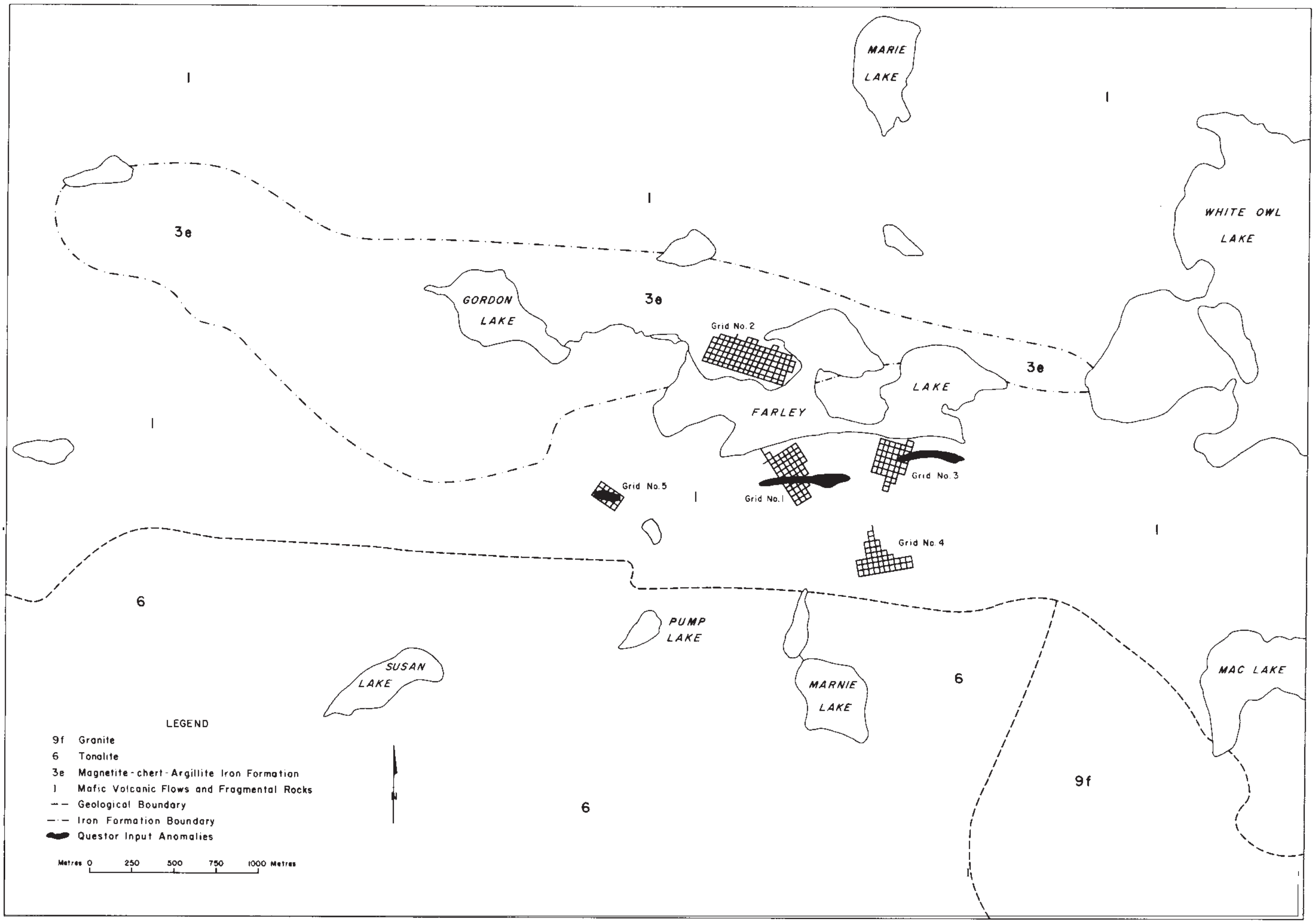

Figure GS-9-2: Location map for peat core samples, grids 1 to 5, Farley Lake area, Agassiz Metallotect. Geology modified after Gilbert (1980).

GS-10 TILL GEOCHEMICAL INVESTIGATIONS IN THE LYNN LAKE AND FLIN FLON AREAS

by Erik Nielsen and Dave Graham

Basal till sampling around known mineral occurrences, initiated two years ago (Nielsen 1982, 1983) for the purpose of mapping glacial dispersion fans, was extended this year in three areas in the Lynn Lake region, and in one area in the Flin Flon region.

In the Lynn Lake region detailed sampling was carried out at two sites along the Agassiz metallotect: (1) at Dot Lake immediately west of the Agassiz Au-Ag deposit and (2) around Farley Lake to the east of the Agassiz deposit. Sampling was also undertaken around the Lar Cu-Zn deposit on Laurie Lake, southeast of Lynn Lake.

In the Flin Flon region sampling was undertaken at the Nokomis gold deposit northeast of Flin Flon.

DOT LAKE

Fifty-two holes were hand dug in a 1 km^2 area near Dot Lake just west of the Agassiz deposit (Fig. GS-10-1) resulting in 110 till samples. Bedrock outcrops extensively in this area and till occurs only immediately south of the iron formation on the west side of Keewatin River. These samples augment the till sampling carried out previously (Nielsen, 1983) and the biogeochemical studies by Fedikow (1984).

The holes varied between 0.8 and 1.2 m in depth and the samples weighed between 8 and 10 kg. Multiple samples of till were collected from 30 holes to compare gold analysis obtained on oxidized and unoxidized till.

The till varies little throughout the area. It is pinkish grey in colour and sandy in texture having been derived from the comminution of mafic and intermediate volcanic rocks which underlie the area, and of granite and granodiorite which occur extensively to the north. The till along the southeast shore of Dot Lake overlies granodiorite and is pinker in colour and sandier in texture than samples collected throughout the rest of the region.

Typically the till in the Dot Lake-Minton Lake area consists of less than 5% clay, 25% silt, 50% sand and 20% gravel. Oxidation is generally from 20 to 40 cm deep and rarely does it extend to 60 cm (Fig. GS-10-2A).

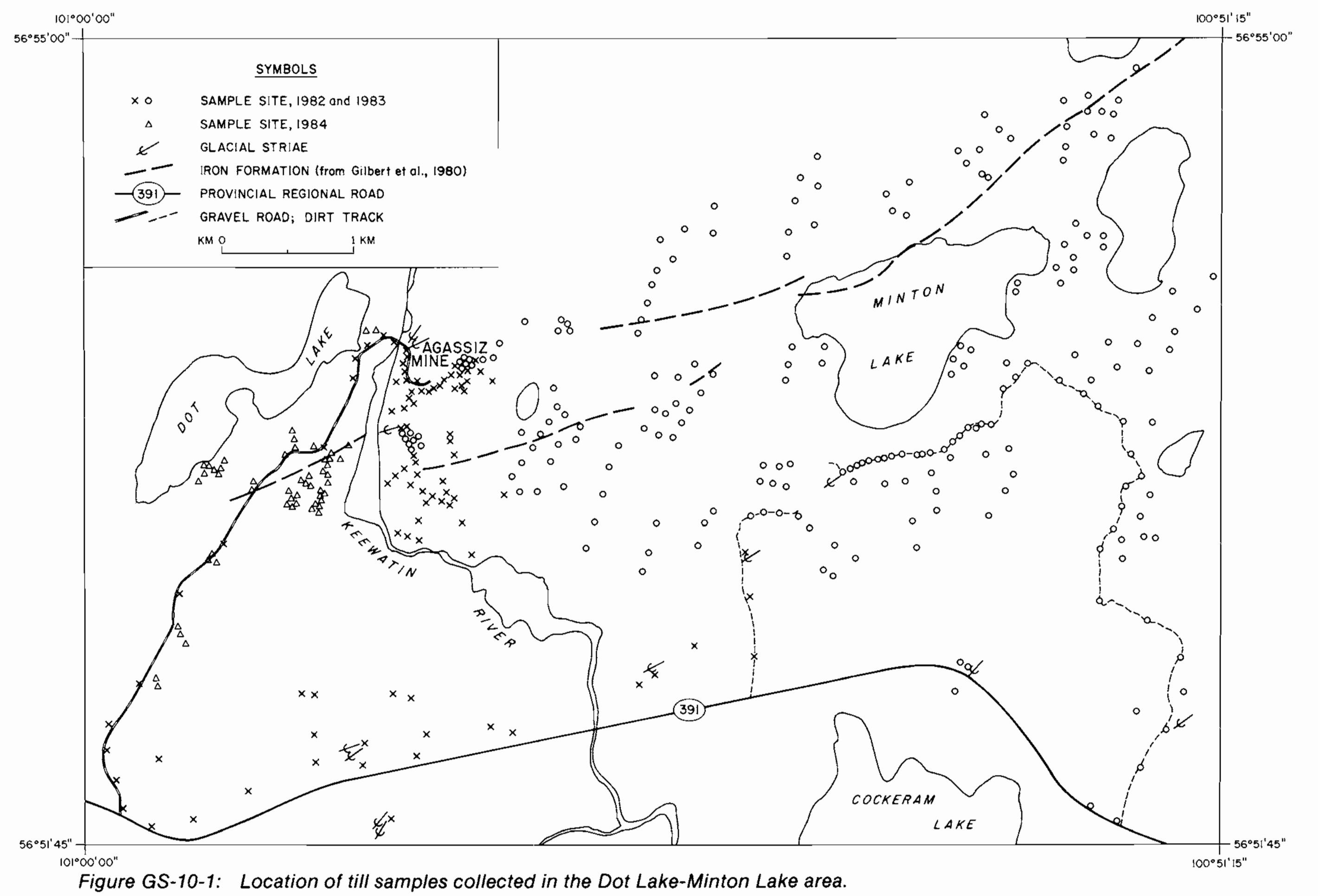

Figure GS-10-1: Location of till samples collected in the Dot Lake-Minton Lake area.

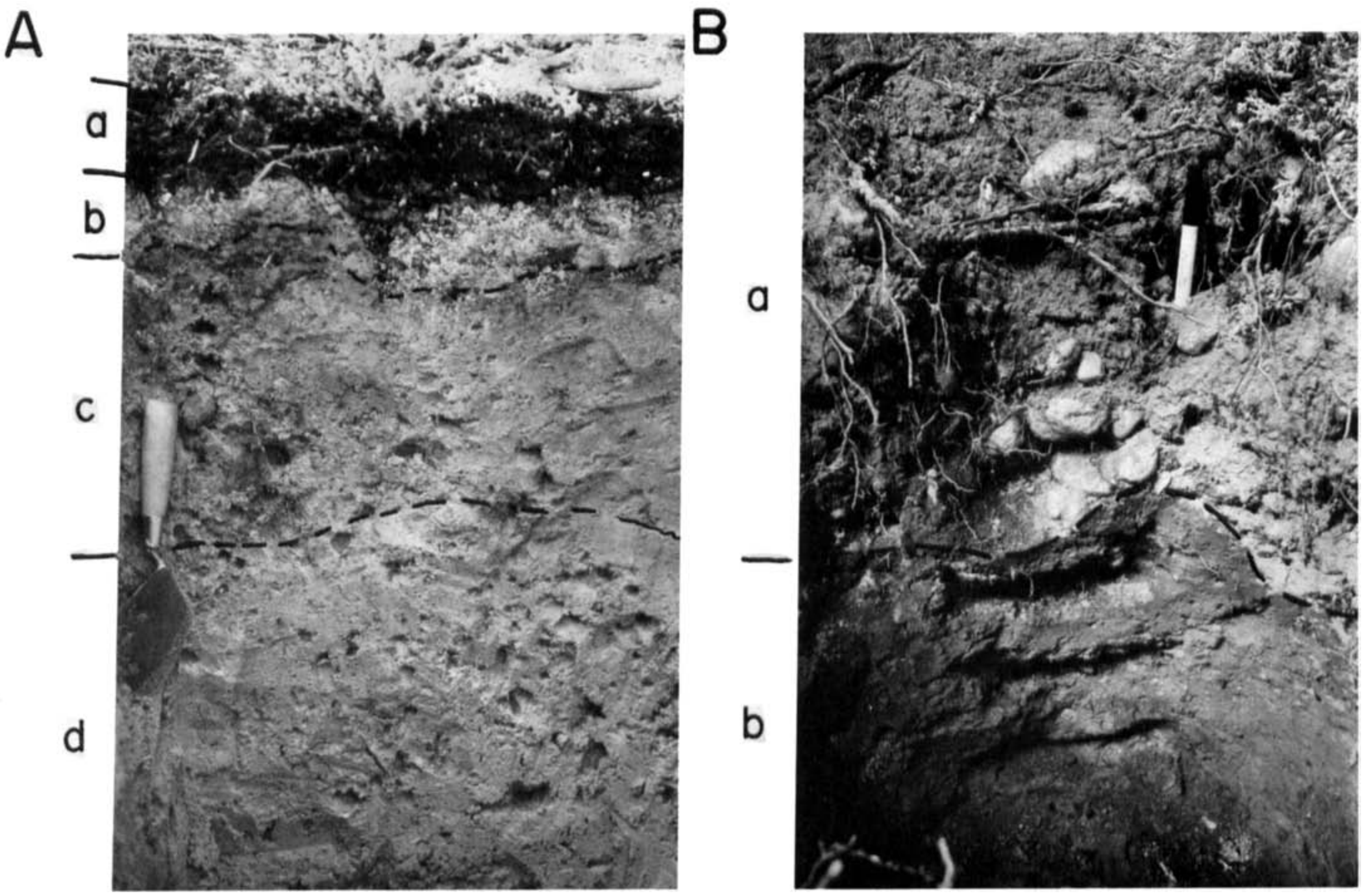

Figure GS-10-2: Typical soil development in the Dot Lake area (A) showing the humus (a) leached (b), oxidized (c) and unoxidized (d) materials and in the Laurie Lake area (B) showing the oxidized (a) and unoxidized (b) materials.

FARLEY LAKE

In the Farley Lake area (GS-10-3), 30 km east of the Agassiz deposit, 240 till samples were collected in an 18 km^2 area to test the model of glacial dispersion established previously for the Agassiz deposit and to augment the peat geochemical study carried out in this area (Fedikow, 1984).

A total of 259 holes were hand dug but 43 holes were abandoned because till was not reached. Till was sampled in the other 216 holes although variable thicknesses of Lake Agassiz sediments had to be penetrated in 102 of the holes. Bedrock or very large boulders were encountered in 27 holes and 3 holes terminated in brown regolith.

The ice flow direction in this area was towards 140° although there is evidence of an earlier ice flow toward 190° (DiLabio, pers. comm., 1984).

The till in the Farley Lake area is texturally and compositionally similar to the till in the Dot Lake-Minton Lake area.

LAURIE LAKE

The Lar deposit is a small copper-zinc deposit situated on the north side of Laurie Lake (Fig. GS-10-4). Details on the geology are described by Elliot (report GS-6, this volume).

The deposit outcrops near the crest of a hill situated on the south side of a 45 m deep valley which is drained by a small creek. To the south of the deposit the hillside slopes gently towards Laurie Lake which is approximately 500 m away. There is therefore more relief in this area than in the Dot or Farley Lake areas. The effect of the higher relief is reflected in the variation in striae directions observed along the shore and on islands in Laurie Lake where striae directions vary between 180° and 210°. The regional ice flow is, however, towards 190°.

Of the 80 hand dug holes, 24 terminated on bedrock and a total of 139 till samples were collected. The holes varied in depth between .5 and 1.3 m. A boulder lag, formed during the regression of Lake Agassiz, is widespread at the surface throughout the area although lacustrine sediments are generally absent.

The till around the Lar deposit is texturally similar to the till in the Dot Lake-Farley Lake area though it is derived from coarse- to fine-grained metasedimentary rocks of the Wasekwan Group (Gilbert et al., 1980). The oxidation of the till appears to be deeper than in the other areas and several exposures show dark reddish brown oxidation to depths of more than 80 cm (Fig. GS-10-2B). The deeper and more intense oxidation is probably due to the higher relief as well as the composition of the source rocks for the till.

The widespread shallow till, and the scarcity of lacustrine sediments make the western part of the Granville Lake sheet (64C) an ideal area for till geochemical exploration.

NOKOMIS LAKE

Basal till sampling was undertaken around the Nokomis gold

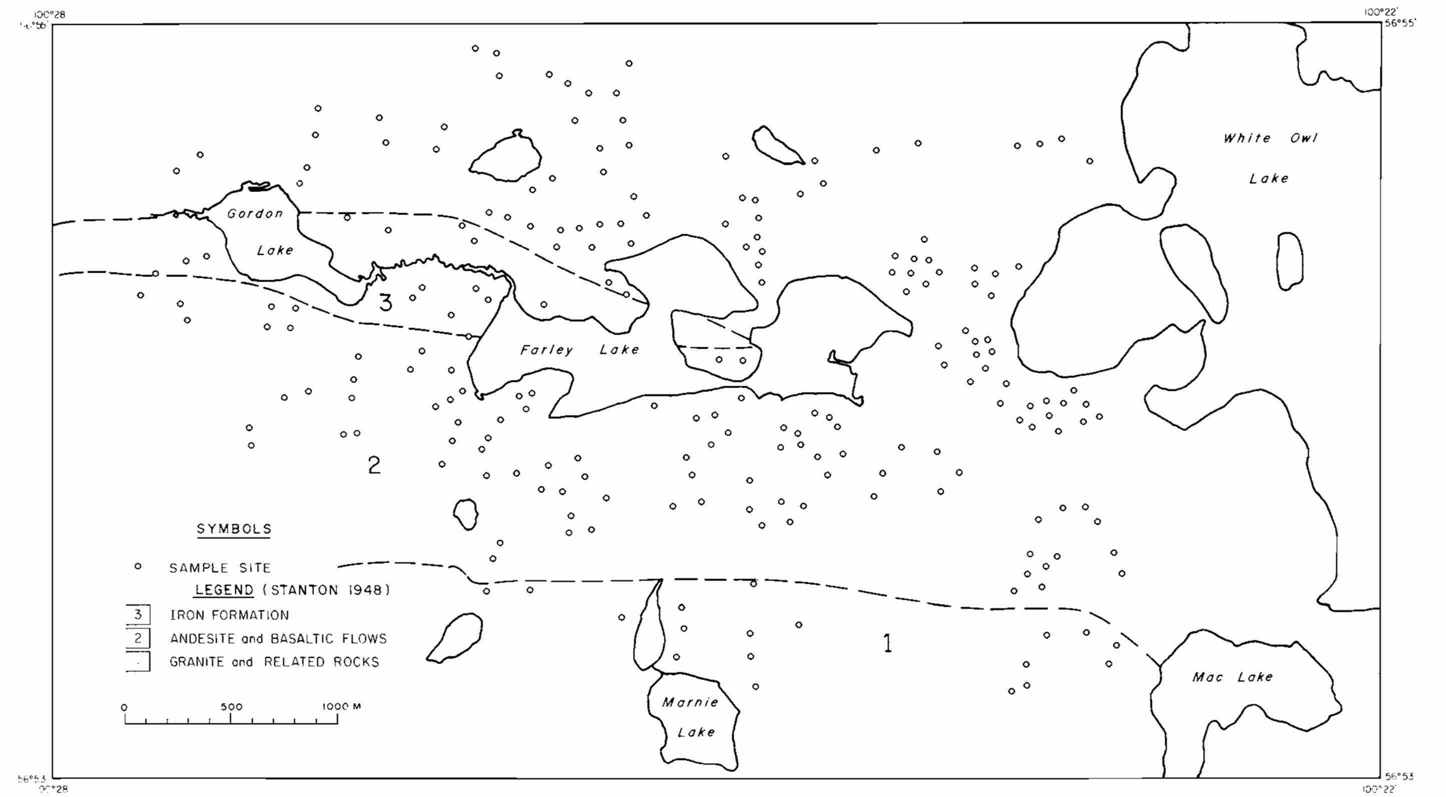

Figure GS-10-3: Location of till samples collected in the Farley Lake area.

deposit situated on the southeast side of Nokomis Lake, 70 km northeast of Flin Flon. The gold-bearing unit or 'host horizon' varies from 2-8 m wide and can be traced for more than a kilometre through the area (Fig. GS-10-5). Details of the geology are described by Zwanzig (this volume).

The 56 holes dug vary in depth from 0.5 - 1.5 m and resulted in 67 samples. As Lake Agassiz sediments are widespread in this area till was encountered in only 24 holes and in several of these holes the till showed evidence of redeposition as subaqueous debris flows.

The till is derived from quartz-plagioclase-biotite and from blende-plagioclase gneisses and is grey in colour. The colour and texture of the till is not unlike the till in the Dot Lake area.

The Nokomis Lake area is not suitable for till sampling from hand dug holes because the low lying areas are covered extensively with Lake Agassiz silt and clay deposits and the bedrock ridges are generally flanked by littoral sand.

The results of the till geochemical investigations carried out to date will be published as a Manitoba Mineral Resources Division Open File Report in the spring of 1985. Maps showing the glacial dispersion fan south of the Agassiz Mine have been included in Manitoba Mineral Resources Division Open File Report 84-1 (in prep.).

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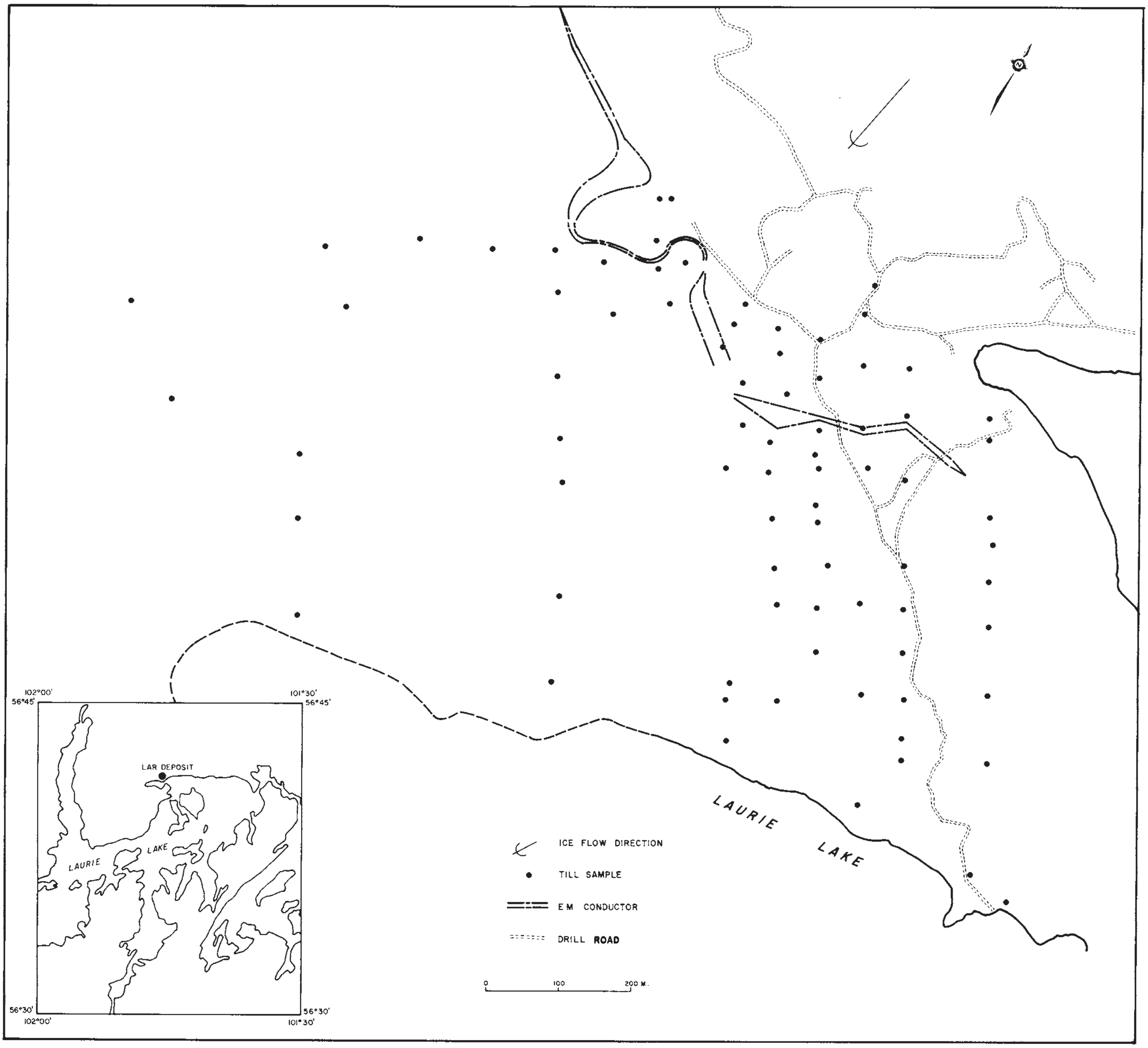


Figure GS-10-4: Location of till samples, collected around the Lar Cu-Zn deposit.

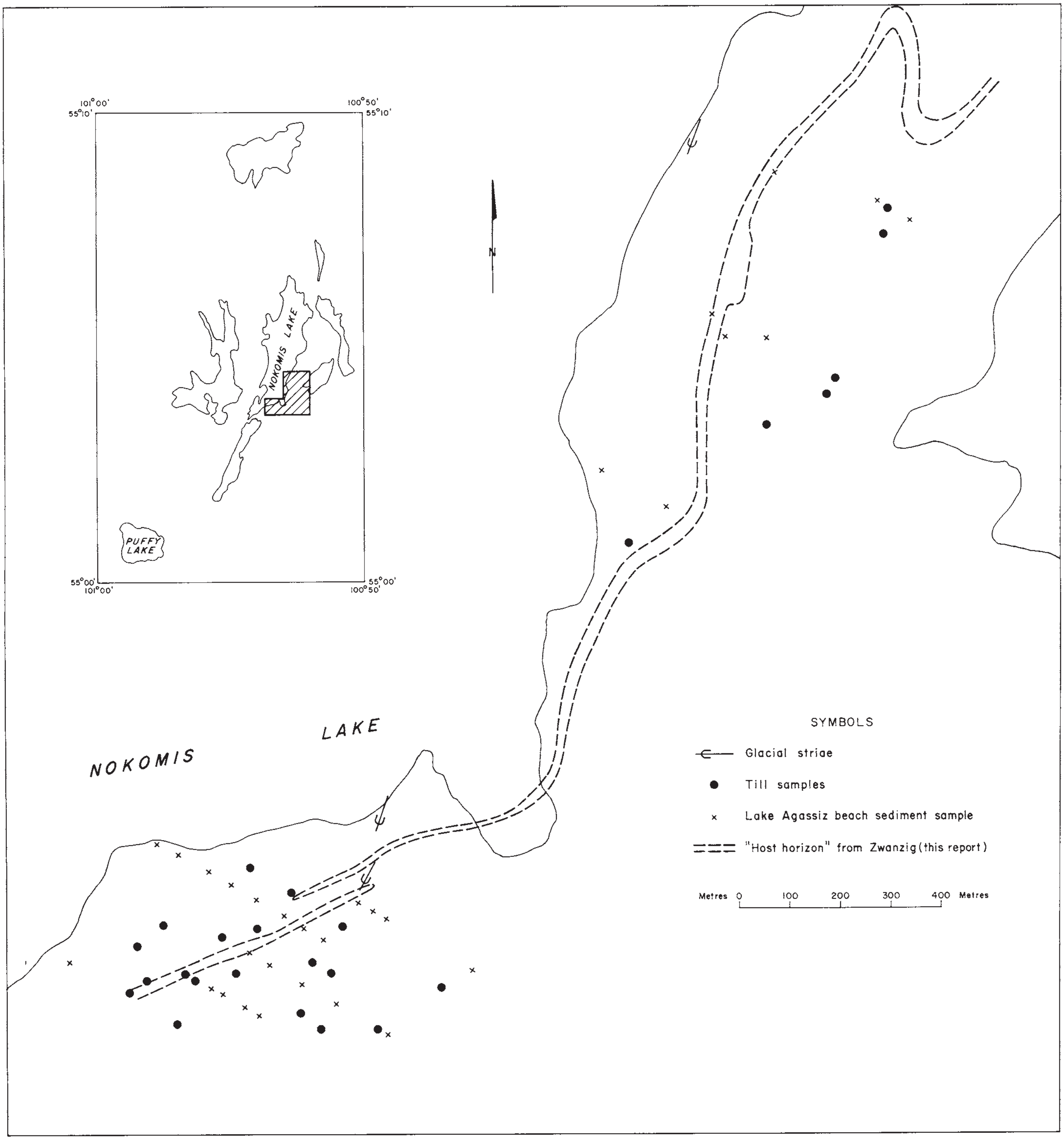


Figure GS-10-5: Location of samples collected around the Nokomis Au deposit.

GS-11 GEOLOGICAL INVESTIGATIONS IN THE FLIN FLON AREA

by A.H. Bailes and E.C. Syme

In 1984 the final stages of field mapping for the Flin Flon-White Lake Project were completed. Preparation of a report and final map is proceeding, with release of the final report scheduled for 1986. During 1984 geochemical analysis of least-altered rock types in the area reached over 200 samples, and 20 samples have been analyzed for rare earth elements.

A U-Pb zircon age-dating program, in co-operation with the Geological Survey of Canada, under the Federal-Provincial MDA, is proceeding with collection this year of samples from the Flin Flon and File Lake areas. Samples of rhyolite from the Flin Flon Mine area should date Amisk Group volcanism; a sample from the Cliff Lake Pluton may indicate whether or not this body is synvolcanic. To date this program has yielded an age on a synvolcanic rhyolite intrusion emplaced in Missi Group rocks east of Wekusko Lake (T. Gordon, pers. comm.).

Future projects planned for the Flin Flon belt include 1:20 000 scale mapping at Athapapuskow and Reed Lakes. Reconnaissance work in these areas will begin in the 1985 field season.

GS-12 KISSEYNEW PROJECT: LOBSTICK NARROWS-CLEUNION LAKE, PUFFY LAKE AND NOKOMIS LAKE AREAS

by Herman V. Zwanzig

INTRODUCTION

Mapping at 1:20 000 scale was continued in three areas at the transition between the Flin Flon-Snow Lake greenstone belt and the Kisseynew sedimentary gneiss belt. These were the Lobstick Narrows-Cleunion Lake area, the Puffy Lake area and Nokomis Lake area (Fig. GS-12-1). The survey is to provide regional stratigraphic control for gold and base metal mineralization. In this report a description of the high-grade metamorphic rock units is given and an interpretation of these units as volcanic, sedimentary or intrusive rocks is attempted. Special emphasis is given to the stratigraphic and structural relationships among the Amisk, Nokomis and Sherridon Groups and the granitoid gneisses of the Defender Lake and Hutchinson Lake domes.

The able assistance of David Seneshen in mapping and of Lloyd O'Brian, Mark Nelson and Glen Grambo in the field are gratefully acknowledged. I thank Barbara Leathers for doing much of the drafting of the accompanying Preliminary Maps 1984K-1, 2, 3.

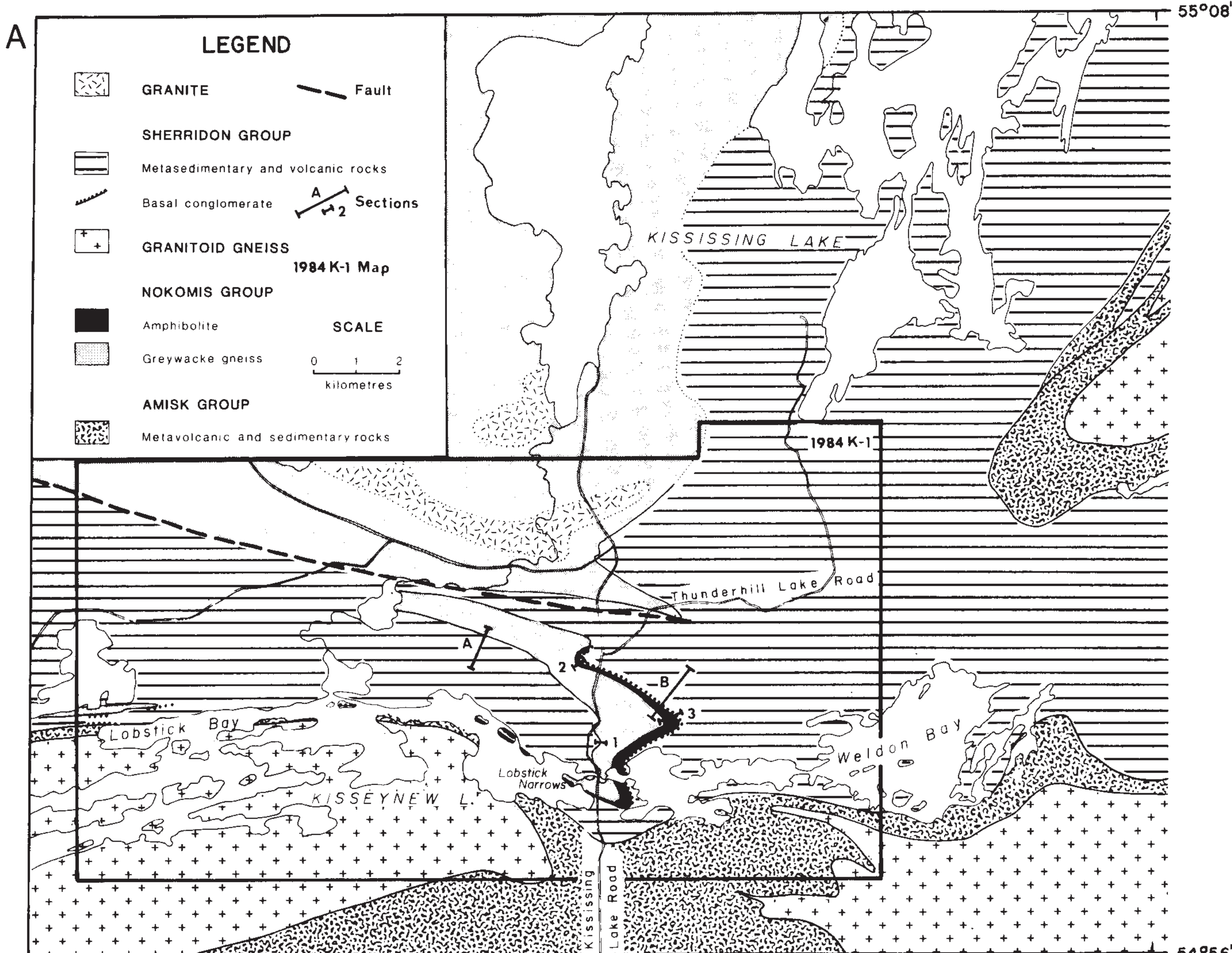


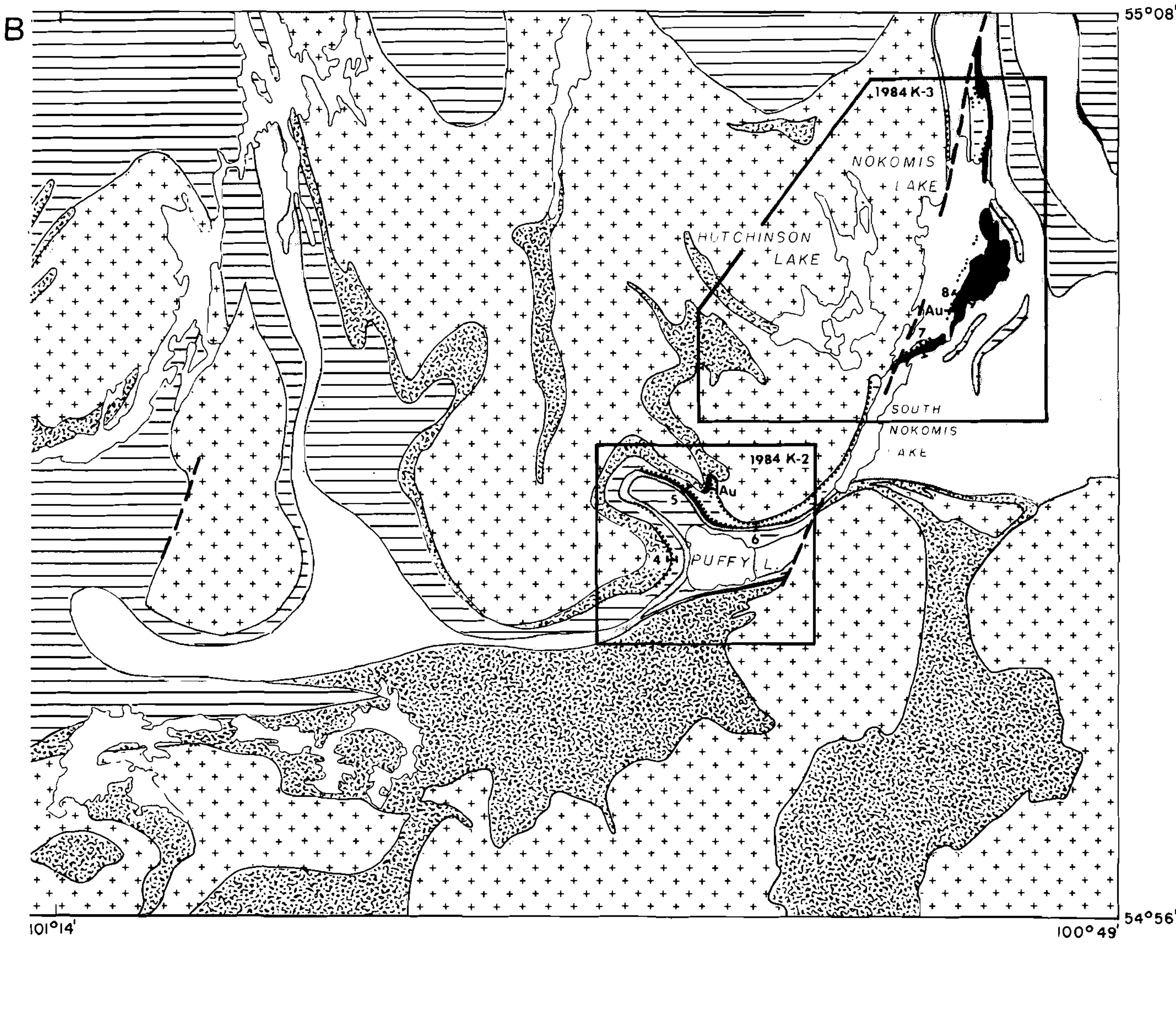
Figure GS-12-1: Location of map areas and simplified geology of the Sherridon region, compiled after Kalliokoski (1952), Robertson (1953), Manitoba Mines Branch Aeromagnetic Survey (1953), Froese and Gall (1981), Froese (written comm., 1984) and this report.

SUMMARY GEOLOGY

The map areas lie within the high-grade metamorphic terrane on the south margin of the Kisseynew sedimentary gneiss belt where primary rock types can still be recognized for most of the gneisses.

The Amisk Group extends north into the Kisseynew belt as large screens within foliated granitoid bodies and as discontinuous mantles around them. The granitoid rocks form domal structures and are probably correlative with intrusions in the greenstone belt. The Nokomis Group which comprises mainly metagreywacke gneiss is the basinal equivalent of the Amisk Group (Bailes, 1980).

The Sherridon Group overlies the Amisk and Nokomis Groups and the granitoid gneisses, and is correlated with the Missi Group. Lateral facies changes take place in the Sherridon Group from a metamorphosed, pebbly sandstone facies (Missi-type) at Lobstick Narrows to a largely felsic volcanic and volcanogenic sedimentary facies at Cleunion Lake (Fig. GS-12-1 and Preliminary Map 1984K-1). Farther north and to the east amphibole-rich gneiss derived from siltstone, calcareous mudstone and mafic tuff is abundant. A major unconformity has been documented this summer between the Sherridon Group and the granitoid gneisses. The conglomerate which marks the unconformity also extends over the Nokomis Group and over screens of Amisk Group rocks. There is an abrupt vertical change from marine deposits in the Nokomis Group to shallow-water, probably alluvial deposits in the Sherridon Group, but all units are structurally concordant (Fig. GS-12-2). The prominent amphibolite formation and gold-bearing unit stratigraphically overlying the Nokomis Group metagreywacke are also considered part of the Nokomis Group because they underlie the Sherridon basal conglomerate and because they are part of the marine succession.



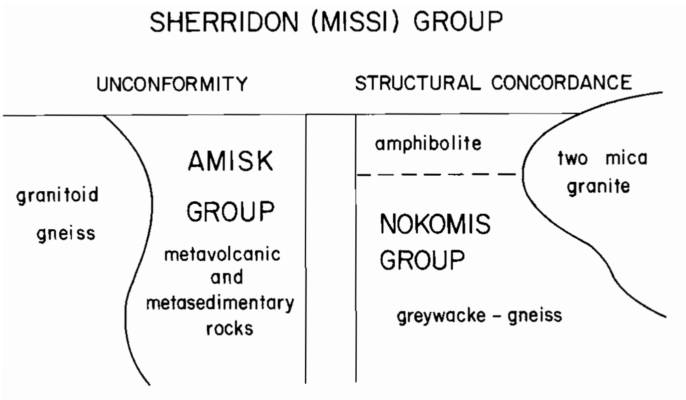


Figure GS-12-2: Stratigraphic relationships on the south flank of the Kisseynew sedimentary gneiss belt.

STRATIGRAPHY

AMISK GROUP

Amisk Group greenstones (unit 1) are preserved at Lobstick Narrows, Weldon Bay and Puffy Lake (Kalliokoski, 1952; Robertson, 1953; Froese and Gall, 1981, and this study). Narrow belts of similar lithology which lie within and around the granitoid domes are correlative. A common lithology is fine- to medium-grained amphibolite which is identified as massive and pillowed basalt, and coarser grained sills or thick flows. Minor felsic units may be sediments or tuff. Garnet- and locally quartz-bearing amphibolite of intermediate composition is weakly layered and apparently derived from volcaniclastic rocks. The Amisk Group forms screens in the granitoid rocks and mantles of some of the domes. Felsic rocks are not abundant but biotite-bearing gneiss is an important component in screens at Hutchinson Lake. In the mantle of the dome west of Puffy Lake there is a northerly change from mafic amphibolite to intermediate rocks. Near the gold deposit north of the lake there may be a further transition to lithologies more typical of the Nokomis Group amphibolites. East of the deposit, rocks identified as Amisk Group are unconformably overlain by the Sherridon Group.

NOKOMIS GROUP

The Nokomis Group comprises greywacke gneiss and migmatite, characterized by abundant biotite and 2 - 3 mm garnet porphyroblasts. An overlying succession of amphibolite with diopside, calcite or garnet-bearing varieties is also included in the Nokomis Group. This is not consistent with the original definition of the group (Robertson, 1953) but with data from the present study. A typical section is east of Nokomis Lake, about 300 m north of a fishing cabin. The top of the unit is amphibolite, generally with garnetiferous layers, which is in sharp contact with a thin felsic unit of the Sherridon Group and stratigraphically below banded conglomerate gneiss. A second important locality is 500 m northeast of Puffy Lake where the top of the metagreywacke and bottom of the Sherridon Group are exposed at a single site. A more accessible locality is in the sand pit on the west side of the Kississing Lake road, 2.8 km north of Lobstick Narrows. The base of the Nokomis Group is not known to be exposed in the Kisseynew belt.

Unit 2: Metagreywacke, migmatite

Metagreywacke is a brown to grey weathering, biotite gneiss, generally with garnet, staurolite, sillimanite or white granitoid veins. Remnants of graded bedding are preserved as changes in biotite and garnet concentration and size. Quartz- fibrolite knots are locally abundant in a member near the top of the formation at Lobstick Narrows and a highly migmatized unit (diatexite) occupies a similar position east of Nokomis Lake. The top of the metagreywacke is exposed west and northeast of Puffy Lake and comprises finely laminated gneiss with a characteristic orange, broken surface of the weathered rock. The upper contact is sharp and apparently conformable with amphibolite.

Unit 3: Amphibolite

The amphibolite formation is up to 200 m thick at Nokomis Lake, and possibly 150 m thick northeast of Lobstick Narrows. It is thinner and discontinuous elsewhere. Amphibolite is massive to weakly layered or locally strongly banded. The rock is dark grey, black or rusty weathering. The lower part of the formation is generally garnetiferous and the upper part diopside- or carbonate-bearing. However, at Nokomis Lake a more complex stratigraphy exists (Fig. GS-12-3). It contains a central sulphide-iron oxide- and gold-bearing member of quartz-plagioclase-hornblende gneiss ± garnet or calcite (Fig. GS-12-4).

The remarkable continuity of the detailed stratigraphy at Nokomis Lake and the regional distribution of diopside- and garnet-bearing members suggest a sedimentary origin for the amphibolite. Layering, defined by concentrations of carbonate, diopside, quartz, garnet, magnetite and rare sulphides, is preserved locally in the amphibolite. It is interpreted as bedding in an iron-rich metasedimentary rock or low-grade silicate-iron formation. Metabasalt may be present at Lobstick Narrows (Zwanzig, 1983) but was not identified at Puffy or Nokomis Lake. An origin as mafic tuff is also unlikely because there are no concentrations of hornblende or plagioclase as are generally preserved in metamorphosed tuff. A combination of fine grained mafic ash and chemical precipitates is a plausible precursor to the amphibolite.

The felsic to intermediate, gold-bearing member at Nokomis Lake is up to 20 m thick. It is a grey, mottled gneiss, locally with amphibole-rich stockwork. The member has remnants of an internal stratigraphy with stratabound pyrite, arsenopyrite and gold concentrations, especially in local layers of chert or siltstone. Systematic variations of iron-oxide, carbonate and sulphides among layers are consistent with a sedimentary origin. Remnants of probable fragments suggest that part of the gneiss was derived from felsic tuff.

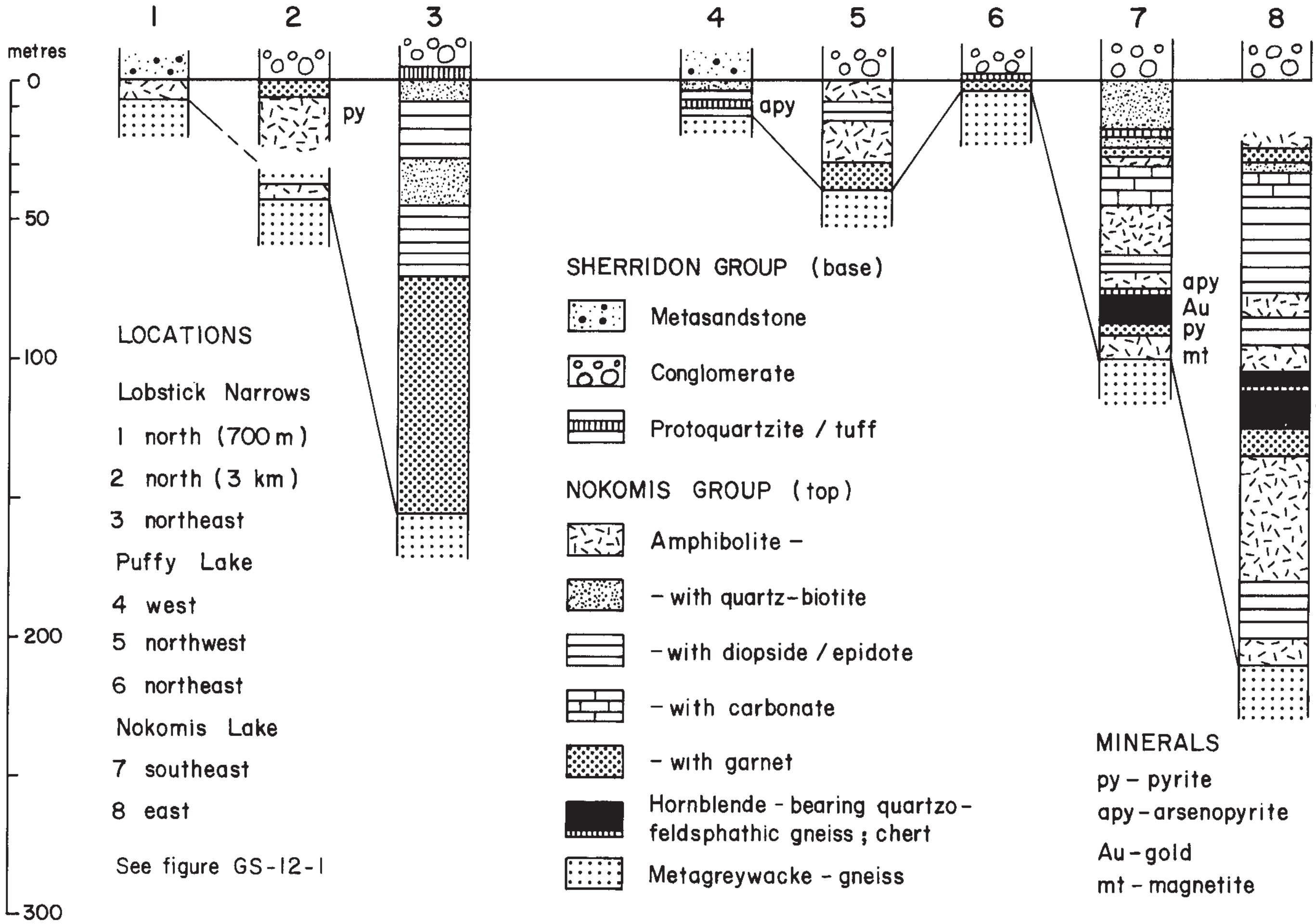
PROBABLE PRE-SHERRIDON GROUP ROCKS

Unit 4: Felsic rocks

A suite of felsic rocks of limited distribution and thickness underlies the "basal" Sherridon conglomerate. It is cut by two granite plutons of the Hutchinson Lake domal complex. Similar rocks occur within the Sherridon Group but they are younger than the domal rocks.

About 40 m of pink to buff weathering, quartz-rich metasedimentary rocks and possible metarhyolite tuff stratigraphically underlie 2 m of basal Sherridon conglomerate on the southern margin of the Hutchinson Lake domal complex. Conglomerate with felsic clasts and an impure arkosic matrix occurs at the base of an upward-fining succession. The unit is cut by a sill of domal granite. What appear to be small rafts of the unit occur in the margins of the adjacent domal granite and of the pluton east of the gold deposit (Fig. GS-12-5). Some inclusions have a fragmental texture. A similar unit, 10 m thick, comprising fine grained, pink quartz-muscovite schist, underlies the basal conglomerate and overlies Amisk Group(?) amphibolite in the mantle of the dome west of Puffy Lake. These felsic units may have formed penecontemporaneously with the potassic granites of the domal complex. That such rocks were extensively eroded is evident from the clast population in the basal Sherridon conglomerate.

Above the Nokomis Group a single felsic bed underlies the Sherridon basal conglomerate and similar beds are intercalated with the conglomerate. These rocks are apparently younger than unit 4 and suggest that the Sherridon unconformity and the granite plutons were formed during an extended period of felsic volcanism and sedimentation.



GS-12-3: Thickness and mineralogical variation of the Nokomis Group amphibolite between Lobstick Narrows and Nokomis Lake.

Unit 5: Granitoid gneiss

Granitoid gneiss of intrusive and supracrustal origin forms multiple domes with an unconformably overlying mantle of Sherridon Group rocks. Two studied domes contain tonalitic gneiss in the core surrounded by granodiorite gneiss and granite gneiss. On the whole, each dome increases in grain size and potassium feldspar content outward (Fig. GS-12-6).

In the vicinity of Kisseynew Lake the Defender Lake dome contains five major and several minor phases of granitoid gneiss with intercalations and inclusions of amphibolite, biotite-hornblende gneiss and biotite gneiss. The core contains fine- and medium-grained tonalitic gneiss; the main phase has 40 - 50 per cent quartz and is layered (5 - 10 mm) with a maximum grain size of 5 mm. The composition of a thick shell ranges from tonalite gneiss to granodiorite gneiss. The rock has a simple intergranular texture with quartz and feldspar grains up to 1.5 - 2 mm long and biotite aggregates 1 mm in diameter. This shell contains discontinuous belts of tonalitic core gneiss (main phase). The northern mantle of the dome contains granite to granodiorite with amoeboid potassium feldspar megacrysts up to 8 mm long. A partial mantle of banded mylonitic tonalite and an incomplete outer shell of Amisk Group rocks are overlain by the basal Sherridon metaconglomerate and quartz-rich gneiss. The contact is not exposed but can be deduced to be the Sherridon basal unconformity. In detail the core

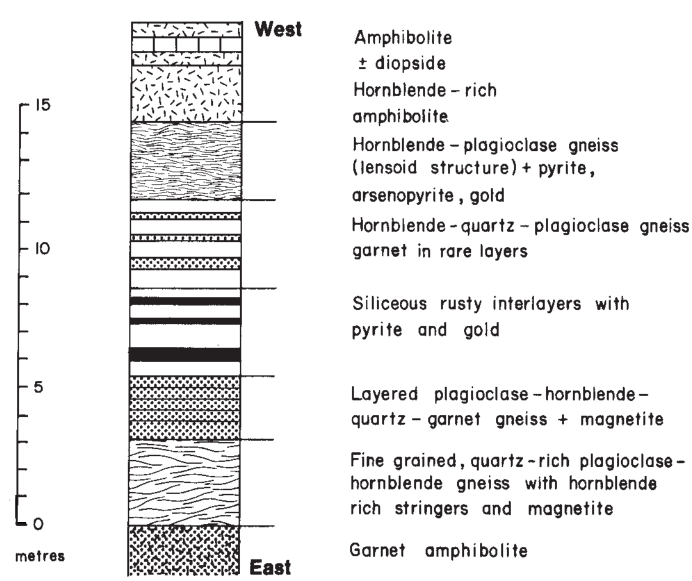


Figure GS-12-4: Generalized section (east to west) of the gold-bearing unit east of Nokomis Lake.

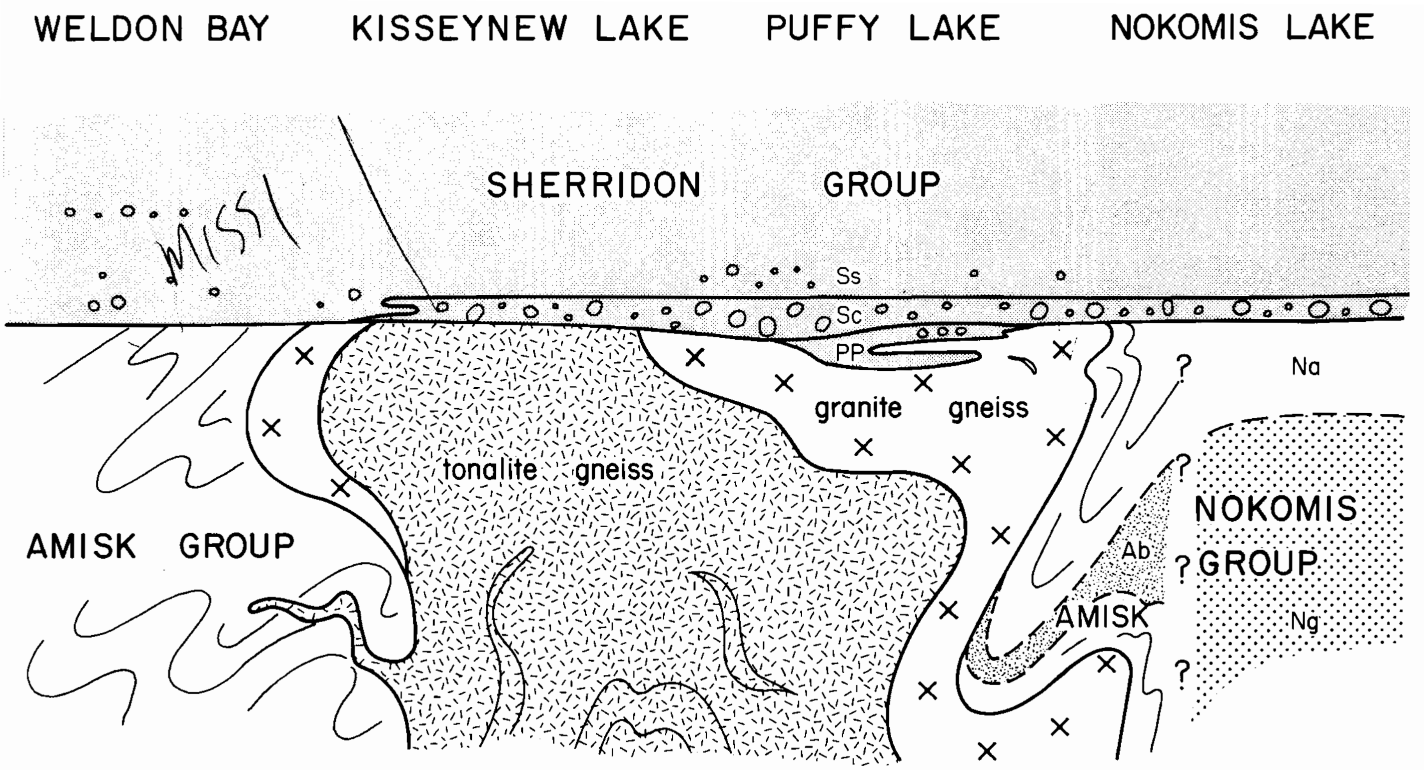


Figure GS-12-5: Cartoon section, illustrating the stratigraphic relationships at the base of the Sherridon Group: Ss — Sherridon Group fine grained metasedimentary and volcanic units; Sc — Sherridon Group metaconglomerate; PP — probable pre-Sherridon Group; Ab — Amisk Group biotite gneiss; Na — Nokomis Group amphibolite; Ng — Nokomis Group greywacke gneiss.

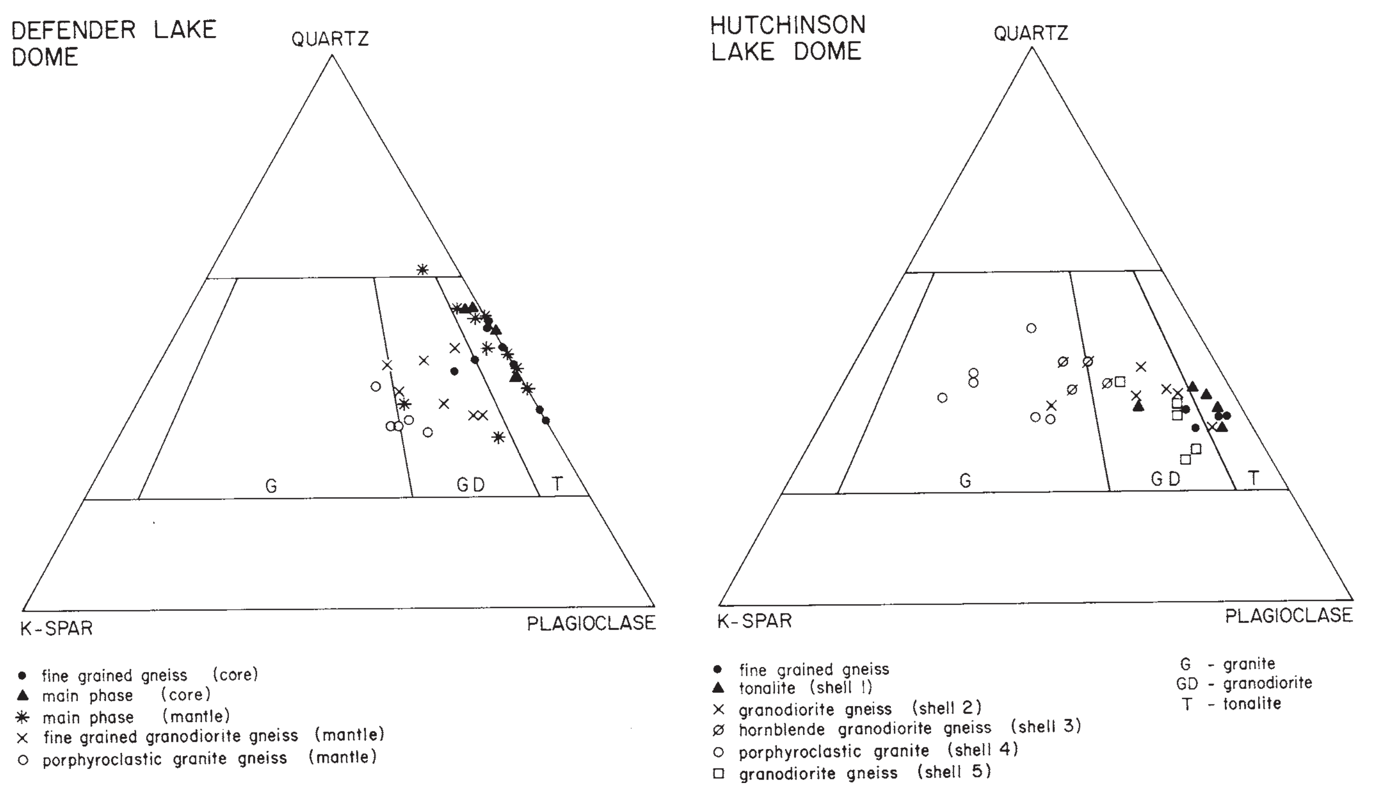


Figure GS-12-6: Ternary plots showing modal composition (quartz: K-feldspar:plagioclase) of granitoid gneiss (more than 300 points counted per sample, up to 20% counting error).

gneiss is heterogeneous and may contain a considerable volume of supracrustal rock. The high quartz content of the tonalitic gneiss distinguishes the Defender Lake dome from the Hutchinson Lake dome (Fig. GS-12-6). The possibility that the core of the Defender Lake dome was derived from the Sherridon Group has not been ruled out.

The Hutchinson Lake structure is a multiple dome that forms the southeast portion of a small granitoid massif. A northern dome is zoned from fine grained tonalite in the core to potassic granite on the margin. The east half of the body has four shells of different intrusive phases that are progressively coarser grained, more strongly foliated and more potassic outward. Each shell is also thinner and more attenuated. The core is massive and the eastern part of the outer margin is protomylonitic.

Shell (1) comprises medium grained tonalite with small interstitial grains of potassium feldspar. Shell (2) is tonalite-granodiorite and has gneissic layering. Its outer part contains several minor phases. Shell (3) is strongly foliated hornblende- biotite-rich granodiorite. Shell (4) is a coarse grained, foliated, subporphyroclastic granite that forms a half-moon-shaped subsidiary dome south of Hutchinson Lake. The southern dome contains a large area of Amisk Group rocks and extends to Puffy Lake where it comprises mainly coarse grained granite.

All rocks in the outer shell of the composite dome are unconformably overlain by the Sherridon Group basal conglomerate.

The origin of the domes is controversial. Because the shells consist of distinctive but relatively uniform phases they are interpreted to be deformed plutons. The Sherridon Group was deposited unconformably on the plutons and their Amisk Group cover. During high-grade metamorphism and doming the igneous texture was obliterated, garnet formed, and in the Defender Lake dome mobilizate was developed. Doming was likely in a solid state and produced a mylonitic foliation that extends into the Sherridon Group. The compositional, textural and structural zoning are unsolved problems and the high quartz content of the Defender Lake dome allows the possibility that its core was derived from the Sherridon Group.

SHERRIDON GROUP

The Sherridon Group comprises quartzofeldspathic gneiss and amphibolite derived from sedimentary and volcanic rocks. Grey, quartz-rich gneiss derived from arkosic sandstone and pebbly sandstone predominates at Kisseynew Lake (Froese and Gall, 1981); the sediments become finer grained in a distal facies towards the northeast (Zwanzig, 1983). At Cleunion Lake large bodies of pink gneiss are derived from felsic volcanic rocks, rhyolite conglomerate and tuffaceous sandstone (Fig. GS-12-7). Hornblendic rocks were derived from sandstone, mafic mudstone and basalt. Lithologic changes along strike interpreted as transitions between pyroclastic and sedimentary rocks are common and indicate that at Cleunion Lake much of the Sherridon Group represents a thick, largely reworked felsic volcanic pile.

At Puffy and Nokomis Lakes the base of the Sherridon Group consists of conglomerate gneiss or banded gneiss overlain by tabular units of hornblende-bearing gneiss and amphibolite. The latter were apparently derived from calcareous sandstone, mudstone and mafic tuff. The entire succession lies unconformably on granitoid domal gneiss and disconformably(?) on Nokomis Group amphibolite.

Unit 6: Conglomerate-gneiss

Sherridon Group basal conglomerate, and derived banded gneiss, have been traced from Nokomis Lake to Puffy Lake and were identified at Lobstick Narrows and in Lobstick Bay. The unit is well exposed in the sand pit north of Lobstick Narrows and near the south shore of Nokomis Lake where it overlies Nokomis Group amphibolite. Near the west shore of South Nokomis Lake, and east of the Puffy Lake gold deposit, excellent exposures of the same conglomerate unconformably overlie the Hutchinson Lake granitoid dome or its mantle of Amisk Group amphibolite. The overturned unconformity east of the gold deposit oversteps an intrusive contact between granite and amphibolite but the complex folding requires more work to resolve the local structural problems. Nevertheless, the unconformity is established because identical conglomerate overlies Nokomis amphibolite, felsic rocks, mafic to intermediate garnetiferous amphibolite of the Amisk Group and five different plutons in the granitoid domes over a distance of 50 km.

The basal conglomerate has a dark green amphibolite matrix. It contains fine grained, angular to rounded, buff, pink and pale grey metarhyolite and metasandstone clasts, mafic and calc-silicate pebbles and rounded quartz pebbles. Cobbles are up to 30 cm long where they are least deformed. At South Nokomis Lake dimension ratios of the clasts are ca. 1:4:16. Farther north the unit is a banded black, pink and grey gneiss in which most clasts have been reduced to a thickness of 2 or 3 mm. The unit is generally 10 m thick (at least 40 m prior to deformation). North of Lobstick Narrows it comprises the lower 18 m of unit 5 of Zwanzig (1983).

At that locality, and wherever the basal conglomerate overlies granitoid gneiss, it grades upward into a conglomerate unit which has an impure sandstone matrix and is generally interbedded with hornblende-bearing grey, pink and pale green metasandstone or hornblende-bearing gneiss. In some places this unit grades upward into quartz-rich pebble conglomerate or protoquartzite which is overlain in turn by hornblendic metasandstone.

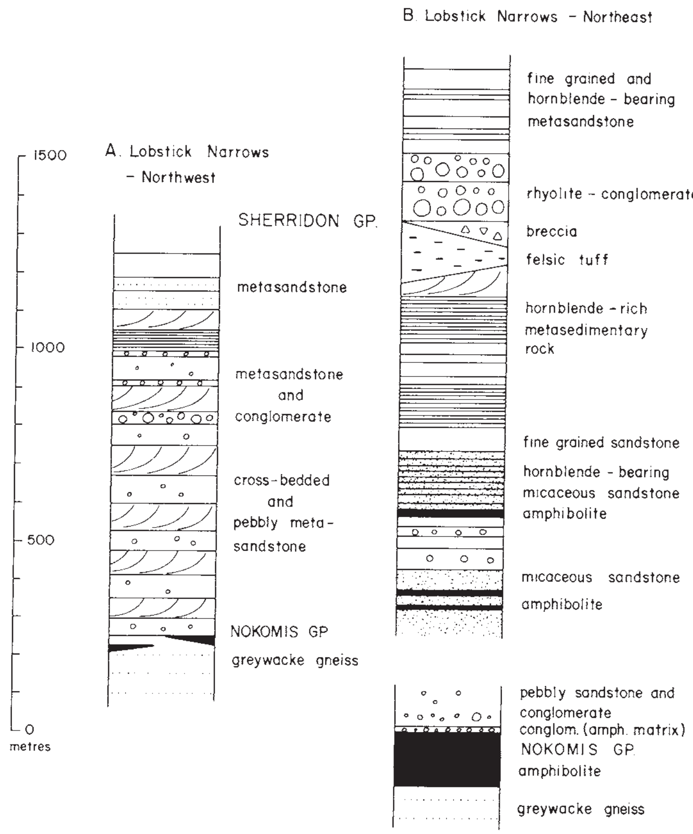


Figure GS-12-7: *Stratigraphic cross-sections of the Sherridon Group. Location shown in Figure* GS-12-1.

Where the Sherridon Group overlies the Nokomis Group in the east, the basal amphibolite-matrix conglomerate is present but the upper conglomerate and pebbly sandstone are absent. At these localities the basal conglomerate is overlain by hornblende-bearing metasandstone, locally with an intervening felsic unit. There is generally a bed of felsic tuff or sandstone at the base of the amphibolite-matrix conglomerate and similar beds are locally interlayered with the conglomerate. The disappearance of the upper conglomerate is interpreted as a basinward-fining at the margin of the Flin Flon-Snow Lake greenstone belt.

Clasts of the underlying granite have not been found above the unconformity. However, the pale pink clasts which are diagnostic of the basal conglomerate are similar to part of unit 4 which also underlies the conglomerate and which has been intruded by the granite.

Unit 7: Quartz-rich gneiss, metasandstone, pebbly sandstone

Grey meta-sandstone which makes up much of the Sherridon Group adjacent to Kisseynew Lake (Zwanzig, 1983, p. 20) is restricted to the lower part of the group farther north and is generally absent in the eastern map areas. The belt of pebbly sandstone-derived gneiss along the north-trending stretch of the Thunderhill Lake road, probably stratigraphically underlies the metavolcanic rocks in that area. The unit contains layers with quartz-sillimanite knots, scattered quartz and rhyolite pebbles and rare crossbedding.

Unit 8: Hornblende-bearing quartzofeldspathic gneiss. vari-coloured metasandstone;
Unit 9: Fine grained quartz-hornblende-biotite gneiss; siltstone-mudstone

From Lobstick Narrows northeast across the Thunderhill Lake road the dominant grey, quartz-rich gneiss (unit 7) derived from coarse- to medium-grained sandstone changes to fine grained, pink, grey and pale green weathering gneiss (unit 8). The rock generally contains hornblende and/or epidote but some layers are muscovite-bearing. The unit was apparently derived from a rhythmic succession of fine grained sandstone and argillaceous siltstone with carbonate-bearing beds (Zwanzig, 1983, p. 21). Northwest of Cleunion Lake lies fine grained grey hornblende-biotite gneiss with conspicuous green calc-silicate interlayers (unit 9). Transitions between the rock types may be regional facies changes.

West of the Thunderhill Lake road unit 9 is a weakly layered, dark grey, brown or green, fine grained metasedimentary rock or amphibolite, possibly derived from marlstone. Minor units of hornblende- or epidote-rich metaconglomerate are present throughout the area. Rhyolite clasts can be recognized in some of these units. Moreover, the pink muscovite-bearing beds in unit 8 are similar to pink gneiss derived from felsic volcanic rocks (unit 10). The mafic sedimentary rocks are locally interlayered with mafic tuff. These data indicate that the Sherridon Group sediments in the Cleunion Lake area and probably elsewhere had an important component of felsic and mafic volcanic material.

At Puffy and Nokomis Lakes unit 8, 9 is a compositionally graded formation that contains thin-layered hornblendic, quartz-rich gneiss at the base, and amphibolite at the top. The basal unit (8) has layers (1 - 20 cm) that alternate in colour between pink, green and grey. Internally laminated layers are common but northwest of Nokomis Lake the layering is a diffuse gneissosity. Unit 8 is interlayered with conglomerate at the base or rests on conglomerate. At the top it becomes fine grained and hornblende- and biotite-rich (unit 9). This rock is faintly layered (3 - 30 cm) or laminated. It weathers greenish grey with a brown cast. Fine grained amphibolite occurs at the top of and locally within unit 8.

Where the Sherridon Group overlies granitoid gneiss the quartz-rich, hornblendic gneiss is thicker than where the Sherridon Group overlies the Nokomis Group and the mafic part of the section is thicker. Facies changes among these units are consistent with a basinward fining of the Sherridon Group.

Unit 10: Amphibolite, meta-basalt, mafic-intermediate tuff

Thick units of mafic volcanic rocks are restricted to an area northeast of Lobstick Narrows (Zwanzig, 1983, p. 20). However, thin, laterally continuous units of tuff have been identified as far east as Puffy Lake and may occur as amphibolite at Nokomis Lake. Tuff is generally plagioclase-phyric. Some layers contain hornblende grains, probably as pseudomorphs after pyroxene. One layer contains small quartzofeldspathic fragments. Medium grained amphibolite contains 1 cm long amygdales indicating that the amphibolite was a basaltic flow. Fine grained greenish grey amphibolite was probably a mafic sedimentary rock.

Unit 11: Pink gneiss, felsic tuff and volcaniclastic rocks

Large bodies of pink felsic gneiss occur in the Lobstick Narrows-Weldon Bay and Cleunion Lake areas. They are interpreted as rhyolite and felsic tuff. Thin units of felsic tuff or reworked tuff extend east to Puffy Lake. The body at Lobstick Narrows is over 15 km long and 400 m thick. It lies near the base of the Sherridon Group and comprises uniform pink gneiss with relicts of small quartz and feldspar phenocrysts, and rarely preserved fragmental texture. The bodies at Cleunion Lake are highly variable in structure. South of the lake, the gneiss is massive to faintly layered and contains up to 15 per cent feldspar eyes and rare quartz eyes. Some of the rock contains thin quartz lenses that may be attenuated metamorphic relicts of silicified pumice fragments but generally primary structures are lacking. The south end, and the margins of the largest body of pink gneiss consists of felsic breccia and rhyolite-rich conglomerate, interbedded with metasandstone.

The distribution of felsic rocks west of Cleunion Lake is poorly defined because of complex structure and lateral stratigraphic changes. One conglomerate unit contains folded blocks up to 40 cm long. The fragments are unsorted and comprise buff, pink and grey weathering rocks, including quartz-eye rhyolite and muscovite schist. They are contained in thick beds which appear to have coarse-tail grading and may be interpreted as debris flows. However, most conglomerate units are barely recognisable, especially where hornblende blastesis has occurred or where fragments have been highly stretched.

There is a transition of rock types from rhyolite tuff to rhyolite conglomerate and to the more heterolithologic conglomerate of unit 8. Moreover, the felsic volcanic bodies are associated with the fine grained pink weathering metasandstone of unit 8. Some of the bodies overlie crossbedded metasandstone which can be correlated with the alluvial deposits of the Missi Group. Associated basalts are massive, coarsely amygdaloidal flows. These relationships are consistent with an interpretation that one or more subaerial felsic volcanic centres was surrounded by reworked pyroclastic detritus in the vicinity of Cleunion Lake.

Unit 12: Two-mica leucogranite

The belt of Nokomis Group metagreywacke north and east of the Kississing River and the belt southeast of Nokomis Lake are extensively intruded by white weathering leucogranite. The rock contains a small amount of biotite and traces of muscovite. Where rafts of metagreywacke are abundant the granite contains local garnet. The rock forms **lits** in the greywacke and large and small sill-like bodies. The periphery of the larger intrusions is generally intruded by pegmatitic dykes. The margin of the instrusion is a raft complex, followed by a sill complex of massive granite.

STRUCTURE

In the areas of study the regional structure of the south flank of the Kisseynew sedimentary gneiss belt is consistent with the structural history proposed by Bailes (1980). An interpretation of the structure at Lobstick Narrows is given by Zwanzig (1983).

Early folds had a very large amplitude and were probably recumbent. They are preserved as ribbon-like structures such as at Puffy Lake where the Nokomis Group metagreywacke forms a 50 m thick "layer" that extends around various cross-folds for many kilometres. The metagreywacke is the hinge-zone of an isoclinal anticline or possibly part of a thrust-nappe. The adjacent synclinal structure in the Sherridon Group is outlined by the basal conglomerate and overlying hornblendic, quartz-rich gneiss in the two limbs, and by mafic gneiss in the core. Such tight folds generally separate the Nokomis Group from the granitoid domes.

These early folds are refolded by northerly-trending, east dipping structures as preserved at Cleunion Lake.

Subsequent folds have east-trending axial planes, overturned to the south and include the chevron-like structures north of Lobstick Narrows (Zwanzig, 1983) and the fold extending east through the middle of Puffy Lake. The latter has refolded the earliest ribbon-like folds as well as a structure that produced the re-entrant of supracrustal rocks in the domal granite. The structure at the gold deposit is not known at present. The granitoid domes have northerly and east-trending structures at their margins that apparently developed simultaneously.

The east-trending folds are associated with a strong foliation and there are two major shear zones. The Kississing River fault zone has a prominent mylonite belt with fault breccia. Post- and pre-metamorphic pseudotachylite veins indicate a long history of rnovement. Northeast-plunging lineations and small S-shaped fold pairs indicate a north-side-up and sinistral movement. The fault zone dies out towards the east along with the local east-trending folds against northerly-trending structures.

A mylonitic belt, 300 m wide forms the south shore of Puffy Lake. It follows the contact between the main outcrop belt of Arnisk Group rocks and the folded Sherridon and Nokomis successions. Small folds again suggest a north-side-up and sinistral movement.

Younger structures are northwest-trending, large-scale kink folds in the foliation of the Hutchinson Lake dome. East of Nokomis Lake, large, box-shaped folds and associated faults show a consistent east-side-up displacement that produces considerable thickening of the Nokomis Group amphibolite and local repetitions of the gold-bearing unit.

A late fault on the west shore of Nokomis Lake has a wide zone of low-grade retrogression and contains spectacular fault breccia and zones of structureless cataclasite. Rare, curved slickensides have steeply east-plunging slickenlines. The fault dips about 70° to the east and reverse dip slip has produced a 300 m wide repetition in the moderately east- dipping strata on the north end of the lake.

ECONOMIC CONSIDERATIONS

Several marker units can serve as a guide to locating the stratigraphic position which is equivalent to that of known gold deposits. The Sherridon Group basal conglomerate which generally forms small ridges on low ground or islands near shore is easy to trace. The rock has a unique lithology comprising black mafic matrix and highly coloured felsic clasts. In areas of high strain the unit is a banded gneiss with a dark background and buff, grey and pink streaks. The gold-bearing stratum at Nokomis Lake and apparently at Puffy Lake lies in the predominantly amphibolitic section, stratigraphically below the conglomerate. The overall direction of facing is provided also by the upward transition of the overlying grey, pink and greenish gneiss to arnphibolite-rich rocks.

The position of the gold-bearing unit at Nokomis Lake is further determined by the presence of garnet in the amphibolite stratigraphically below (structurally above) the host unit and the presence of carbonate or diopside stratigraphically above it. The amphibolite is interpreted as iron-rich metasedimentary rock. Gold occurs with pyrite and arsenopyrite, stratabound in quartz-hornblende-plagioclase gneiss.

The deposits occupy a unique position on the greenstone belt-sedimentary belt transition. They are in the outer limb of a synclinal structure that contains the Sherridon Group in the core. Granitoid rocks and greenstones (Amisk Group) underlie this structure on one side and Nokomis Group metagreywacke on the other. This may have been the site of a major fault before the deposition of the Sherridon Group. Gold was apparently deposited near this break.

Traces of copper mineralization (chalcopyrite and malachite) occur within the basal Sherridon conglomerate. A small U.R.P. anomaly appears to be caused by the conglomerate at South Nokomis Lake. The underlying granite is also above background (Manitoba Mines Branch Survey, 1953).

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GS-13 MINERAL DEPOSIT STUDIES - SNOW LAKE AREA

by A. Gonzales[1] and M.A.F. Fedikow

INTRODUCTION

Mineral occurrences in the Snow Lake-Herblet Lake area were examined this summer as part of the development of a mineral deposit data base for the Snow Lake area. General documentation procedures undertaken include the production of detailed geology maps at various scales centered on trenches and/or diamond drill sites where mineralization had been previously indicated. After completion of detailed geology maps, assay samples were collected from mineralized quartz veins and wall rock in and around the trenches. A preliminary assessment of the geological depositional environment was attempted to help provide a basis for future mineral deposit studies. The basic sources of information used this summer were (1) the geology maps with mineral occurrence locations produced by Harrison (1949; Map 929A) and Russell (1954-1955; Map 55-3), (2) mineral inventory cards, and (3) cancelled assessment files.

In this report mineral occurrences are discussed under the headings of "Vein-Type" and "Stratabound" mineralization. No attempt was undertaken to examine any geological or geochemical aspects of the currently producing massive sulphide deposits in the Snow Lake area. The location of examined mineral occurrences are plotted on Figure GS-13-1 and geological data are summarized in Table GS-13-1. A total of 33 mineral occurrence geology maps were produced and 111 assay samples collected. The maps are currently available for viewing and as assays are completed the results will be combined with the geology maps to form a mineral deposit open file report available for perusal upon request.

VEIN-TYPE MINERALIZATION

I. OCCURRENCES WEST OF BIRCH LAKE (BL-11, BL-25 TO BL-31)

Mineral occurrences west of Birch Lake are primarily disseminated sulphide mineralization in association with quartz and carbonate veins and stringers in fine grained basalt and mafic intrusive rocks (Units 8 and 14d, respectively; Harrison, 1949). Characteristically, both volcanic and intrusive rocks are iron stained and also may be silicified and contain quartz-carbonate veinlets, carbonate patches and disseminated pyrite, pyrrhotite ± arsenopyrite in the vicinity of the trenches that were examined. Quartz veins exposed in the trenches are either barren of sulphide mineralization or contain very minor disseminated iron sulphide ± arsenopyrite. The highest concentration of sulphide mineralization occurs within the wall rock at or near the contact between the veins and the host rock. In this area, blocky and acicular arsenopyrite and euhedral to subhedral iron sulphides are present in amounts up to 15 per cent. This style of mineralization is observed in both basalt and mafic intrusions. Acicular arsenopyrite preferentially appears where the host rocks have been silicified.

These silicified host rocks may be silicified basalt or siliceous sedimentary rocks; stripping of selected outcrop will determine whether the rocks mapped by Russell (1954,1955) as Unit 5, are mafic volcanic or sedimentary rocks. Extensive shearing of the wall rock was not observed in the occurrences. Mineral occurrence BL-11 occurs in a slightly different geological setting than the other occurrences. At this locality, disseminated chalcopyrite and pyrite occur in sheared, siliceous sedimentary rocks (Unit 6a, Harrison, 1949) associated with a quartz vein and a thin mafic intrusion with disseminated pyrrhotite. The siliceous sedimentary rocks occur within a stratigraphy dominated primarily by massive basalt with minor garnetiferous (tuff?) sections.

Mineral occurrences west of Birch Lake appear to be related to the intrusion of the diorite/gabbro mapped as Unit 14d by Harrison (1949). Fracturing of the basalt by this intrusion produced a plumbing system for silica-rich solutions that filled the fractures and deposited iron sulphide ± arsenopyrite as reaction products between the wall rocks and the incoming solutions. The occurrence at BL-11 is an exception in that shear and/or intrusive related mobilization of sedimentary sulphide and the incorporation of this mineralization into quartz veins resulted in a somewhat different geological scenario.

II. NORTHEAST ARM, HERBLET LAKE (HL-9, 12, 13, 14)

Four occurrences of vein-type mineralization on the north shore of the Northeast Arm of Herblet Lake were examined. Occurrence HL-9 is a previously reported tungsten prospect associated with quartz veins in felsic and mafic gneiss. The mineralization is associated with garnetiferous, biotite gneiss with quartz-feldspar-biotite layers and a quartz-feldspar-biotite gneiss locally intruded by magnetite-bearing pegmatite. From an examination of the overgrown trenches the quartz veins, containing disseminated pyrrhotite, occur at or close to the contact between the above- mentioned rock units. Quartz veins parallel the fabric of the gneisses.

The Ferguson Mine (mineral occurrence HL-12) is characterized by quartz veins containing pyrite, chalcopyrite, arsenopyrite and native gold that are hosted by rusty weathered, garnetiferous mafic volcanic rocks and greywacke. The majority of the sulphide minerals occur adjacent to the wall rock/quartz vein contact.

The Cyclone occurrence (HL-13) is comprised of disseminated pyrite-pyrrhotite ± chalcopyrite-magnetite in quartz veins paralleling the fabric of the host biotite-amphibole-quartz gneiss. Other rocks in the area of the occurrence were subdivided on the relative abundance of constituent minerals. These include quartz-biotite-amphibole gneiss, biotite-amphibole-garnet-quartz gneiss, and garnet-biotite-amphibole-epidote-quartz gneiss.

Mineral occurrence HL-14 is known as the Cabin Cu6 prospect and consists of quartz veins containing pyrite, chalcopyrite and magnetite hosted by a biotite-amphibole schist. Disseminated iron sulphides and garnets occur at the quartz vein-wallrock contact.

The Northeast Arm mineral occurrences are all associated with rocks that have a strong northeast-trending fabric related to deformational events accompanying the emplacement of granitic intrusions (Unit 18; Russell, 1954,1955) immediately adjacent to these occurrences. Rusty weathering of the host units and abundant sulphide mineralization at the wallrock-vein contact is a common feature of these occurrences.

III. OTHER OCCURRENCES (TL-18, PL-20, SL-21 AND NL-33)

Three mineral occurrences were examined southeast of West Snow Lake. Quartz veins containing sphalerite, galena, pyrite and magnetite hosted by brecciated and massive basalt occur at location TL-18, west of Tern Lake. Basalt is rusty-weathered near the contact with the quartz veins. South of Tern Lake at PL-20 and northeast of Tern Lake at SL-21 disseminated arsenopyrite was observed in a medium grained mafic intrusion with minor amounts of pyrite and pyrrhotite. No quartz veins were observed at these two locations.

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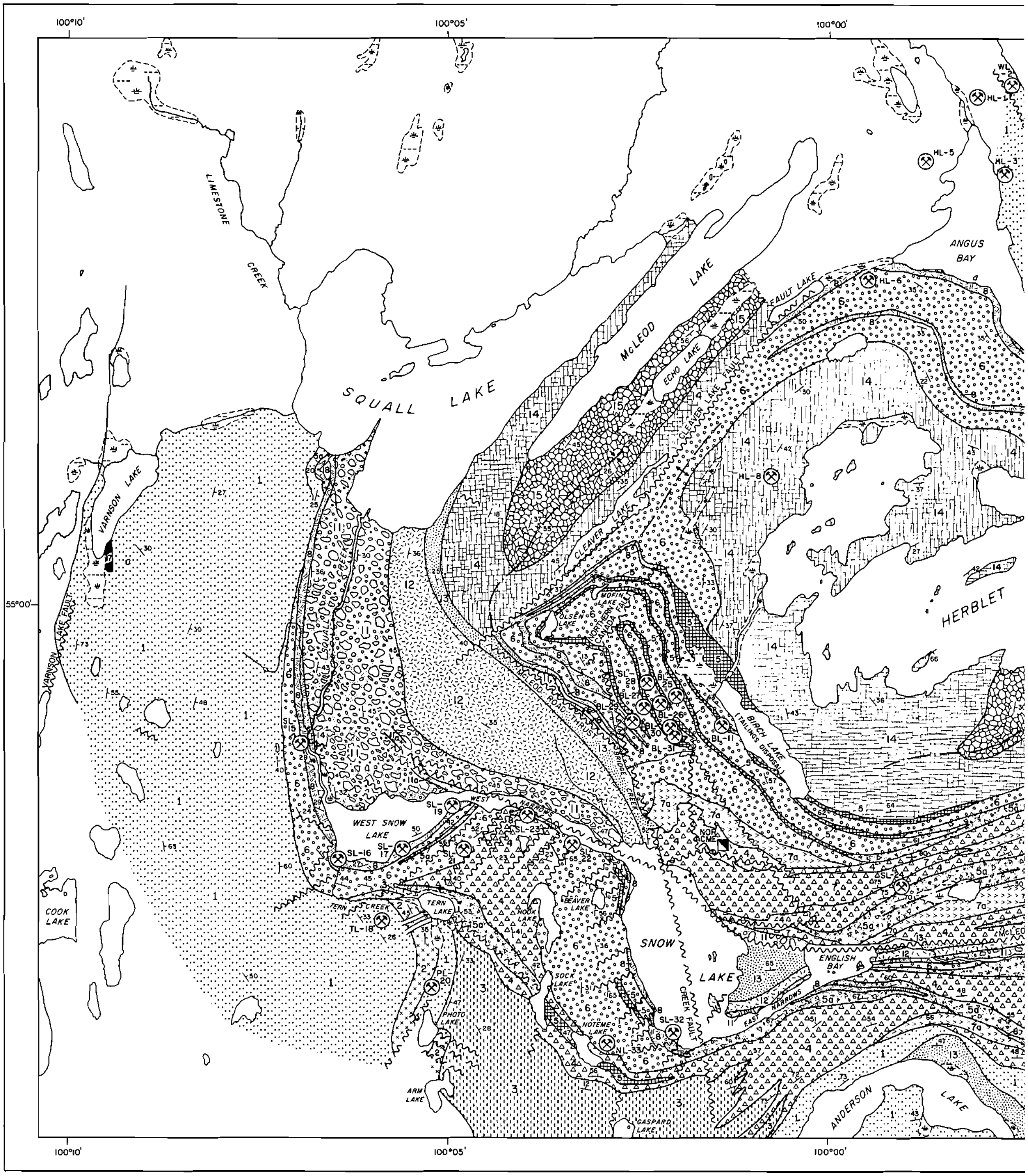


LEGEND

PRECAMBRIAN

INTRUSIVE ROCKS
(TIMES OF INTRUSION UNCERTAIN)

- 18 GRAWITE, QUART2 OIORITE
- 17 PERIDOTITE
- 16 GABBRO

YOUNGER SEDIMENTARY GROUP

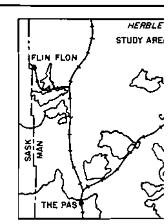
- 15 ARKOSE
- 14 CROSS-BEDDED ARKOSE
- 13 STAUROLITE-GARNET-MICA SCHIST
- 12 STAUROLITIC GREYWACKE AND STAUROLITE-GARNET-MICA SCHIST. INTERBEDDED
- 11a FERRUGINOUS, GARNETIFEROUS TUFF INTERBED IN (11)
- 11 STAUROLITIC GREYWACKE
- 10 GREIWACKE. SLATE
- 9 CONGLOMERATE, QUARTZITE, ARKOSE, INTERSTRATIFIED VOLCANIC ROCKS

INTERMEDIATE GROUP

- 8 FERRUGINOUS, CALCAREOUS, CARBONACEOUS SEDIMENTARY ROCKS
- 7a ACID VOLCANIC ROCKS, AMYGDALOIDAL; CHERTY TUFF BEDS
- 7 ACID VOLCANIC ROCKS, FRAGMENTAL
- 6 BASIC VOLCANIC ROCKS; SOME BASIC TUFF BEDS
- 5a ACID VOLCANIC ROCKS AND SILICEOUS SEDIMENTARY ROCKS, LENTICULAR AND INTERSTRATIFIED
- 5 CALCAREOUS TUFFS
- 4 PORPHYRITIC BASALT, WITH INCLUSIONS
- 3 PORPHYRITIC BASALT

BASEMENT GROUP

- 2 QUARTZ-FELDSPAR ROCKS
- 1 BASIC VOLCANIC ROCKS, SOME DIORITE SILLS AND INTERBEDDED TUFFS



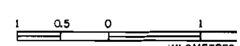


Figure GS-13-1: Geology of the Snow Lake-Herblet Lake area (after Russell, 1954; 1955) illustrating the location of examined mineral occurrences. ***COMPLETE MAP AT BACK OF THIS FILE.***

TABLE GS-13-1
SUMMARY OF GEOLOGICAL CHARACTERISTICS OF MINERAL OCCURRENCES EXAMINED IN THE SNOW LAKE-HERBLET LAKE AREA

Locality Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness	Comment/Reference
HL-1 (North Angus Bay)	graphite-pyrite	disseminated pyrite with abundant graphite	garnetiferous, ferruginous sedimentary rocks	1 m (exposed)	Russell (1954-1955) Map 55-3
WL-2 (West Side Wolverton Lake)	quartz vein	disseminated pyrite, pyrrhotite, ± sphalerite, ± chalcopyrite	rusty weathering quartz-feldspar-biotite ± magnetite gneiss	10 cm - 1 m (exposed)	Russell (1954-1955) Map 55-3
HL-3 (Northeast Angus Bay-Woods Cu8)	sulphide stratum	near solid to solid sulphides-pyrite, pyrrhotite, arsenopyrite, chalcopyrite	silicified mafic volcanogenic sedimentary rocks	2 m (exposed)	Russell (1954-1955) Map 55-3
WL-4 (West Side-Wolverton Lake)	quartz vein	disseminated pyrite, pyrrhotite, ± sphalerite, ± chalcopyrite	rusty weathering quartz-feldspar-biotite ± magnetite gneiss	0.1 - 1 m (exposed)	Russell (1954-1955) Map 55-3
HL-5 (Northwest Angus Bay)	sulphide stratum	disseminated pyrite	rusty weathered quartz-plagioclase-biotite-magnetite gneiss	5 cm	Russell (1954-1955) Map 55-3
HL-6 (West Side Angus Bay)	sulphide stratum	disseminated to near solid and solid sulphides-pyrite, pyrrhotite	fine grained cherty sedimentary rocks with 1 mm red garnets and white mica	2-3 m (diamond drill core)	Russell (1954-1955) Map 55-3
HL-7 (Whitefish Bay)	oxide facies iron formation (magnetite-chert); sulphide stratum	disseminated pyrrhotite, pyrite; chalcopyrite as mobilisate along fractures	recrystallized cherty sedimentary rocks	2 m (exposed)	Russell (1954-1955) Map 55-3
HL-8 (West Side-Herblet Lake)	quartz vein; sulphide stratum	disseminated stubby, 1-5 mm arsenopyrite with minor pyrite	arkose and mafic sedimentary rocks; silicified	3 m	Harrison (1949) Map 929A
HL-9 (Northeast Arm-Herblet Lake; W1)	quartz vein	disseminated pyrrhotite	rusty weathered and silicified quartz-feldspar-biotite ± garnet gneiss	1 m	Harrison (1949) Map 929A
HL-10 (Southeast Bay-Herblet Lake)	sulphide stratum	disseminated pyrrhotite	rusty weathered quartz-feldspar-biotite-garnet gneiss with layers of fine grained cherty sedimentary rock	20 m	Russell (1954-1955) Map 55-3
BL-11 (West Side-Birch Lake)	quartz vein	disseminated pyrrhotite, pyrite, chalcopyrite	siliceous, cherty sedimentary rocks	1 m	Harrison (1949) Map 930A
HL-12 (Ferguson Mine-Northeast Arm-Herblet Lake Moss 1)	quartz vein	disseminated pyrite, pyrrhotite, arsenopyrite, native gold, magnetite	basalt, greywacke	1 m	Wright (1931)

TABLE GS-13-1 (Continued)
SUMMARY OF GEOLOGICAL CHARACTERISTICS OF MINERAL OCCURRENCES EXAMINED IN THE SNOW LAKE-HERBLET LAKE AREA

HL-13 (Cyclone-Northeast Arm Herblet Lake)	quartz vein	disseminated pyrite, pyrrhotite	biotite-amphibole-quartz ± garnet gneiss	1 m	Wright (1931)
HL-14 (Cabin Cu6-Northeast Arm Herblet Lake)	quartz vein	disseminated pyrite and chalcopyrite	biotite-amphibole schist ± gneiss	6 cm	Bell (1978)
SL-15 (Jacknutt Mine South Squall Creek)	quartz and carbonate veins	disseminated pyrite, pyrrhotite, arsenopyrite, scheelite	silicified and carbonatized basalt	2 m	Russell (1954-1955) Map 55-3
SL-16 (Tern Creek)	sulphide stratum arsenopyrite, scheelite	disseminated arsenopyrite, pyrrhotite	rusty weathered, calcareous, siliceous sedimentary rocks	1-2 m	Russell (1954-1955) Map 55-3
SL-17 (West Snow Lake)	sulphide stratum; quartz vein	disseminated arsenopyrite and pyrite	siliceous, calcareous carbonaceous sedimentary rocks interbedded with chert	1 m	Russell (1954-1955) Map 55-3
TL-18 (East Side-Tern Lake)	quartz vein	disseminated pyrite, sphalerite, galena, magnetite	silicified and garnetiferous basalt	1-2 m	Russell (1954-1955) Map 55-3
SL-19 (West Snow Lake)	quartz vein	disseminated pyrite and pyrrhotite	fine grained, silicified and rusty weathered basalt	1 m	Russell (1954-1955) Map 55-3
PL-20 (North of Photo Lake)	quartz vein	disseminated arsenopyrite	medium grained mafic intrusion	0.5 m	Russell (1954-1955) Map 55-3
SL-21 (Between West Snow Lake and Tern Lake)	quartz vein	disseminated arsenopyrite, pyrite	medium grained mafic intrusion	0.5 m	Russell (1954-1955) Map 55-3
SL-22 (West Narrows-Snow Lake)	sulphide stratum	disseminated pyrite	fine grained basalt; medium grained mafic instrusion	1 m	Russell (1954-1955) Map 55-3
SL-23 (West Narrows-Snow Lake)	intrusion	disseminated arsenopyrite and pyrite	mafic intrusion		Russell (1954-1955) Map 55-3
SL-24 (Northeast of English Bay-Snow Lake)	intrusion/sulphide stratum	disseminated arsenopyrite, pyrite	silicified mafic intrusion; volcanic rocks(?)	0.5 m	Russell (1954-1955) Map 55-3
BL-25 (West of Birch Lake)	intrusion/sulphide stratum	disseminated pyrite	basalt, medium grained mafic intrusion		Harrison (1949) Map 930A
BL-26 (West of Birch Lake)	quartz vein	disseminated arsenopyrite	medium grained mafic intrusion, basalt	0.5 m	Harrison (1949) Map 930A
BL-27 (West of Birch Lake)	quartz vein	disseminated arsenopyrite and pyrite	basalt, medium grained mafic intrusion	0.5 m	Harrison (1949) Map 930A

TABLE GS-13-1 (Continued)
SUMMARY OF GEOLOGICAL CHARACTERISTICS OF MINERAL OCCURRENCES EXAMINED IN THE SNOW LAKE-HERBLET LAKE AREA

Locality Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness	Comment/Reference
BL-28 (West of Birch Lake)	quartz stringers and veinlets	disseminated arsenopyrite	coarse grained mafic intrusion, basalt	0.5 m	Harrison (1949) Map 930A
BL-29 (West of Birch Lake)	quartz vein	disseminated pyrrhotite and pyrite	medium grained mafic intrusions, basalt	0.5 m	Harrison (1949) Map 930A
BL-30 (West of Birch Lake)	quartz vein	basalt, arsenopyrite and pyrite	basalt, medium to coarse grained mafic intrusion	0.5 m	Harrison (1949) Map 930A
BL-31	carbonate and quartz veins	disseminated arsenopyrite	massive and pillowed basalt	10 cm	Harrison (1949) Map 930A
NL-33 (Southwest Snow Lake) (West side of Noteme Lake)	quartz and carbonate veins	disseminated pyrite, pyrrhotite, arsenopyrite	fine grained, silicified, rusty weathered basalt and medium grained mafic intrusion	10 cm	Russell (1954-1955) Map 55-3
SL-32 (Southwest Snow Lake)	quartz vein	disseminated pyrite, chalcopyrite	fine grained basalt	10 cm	Russell (1954-1955) Map 55-3

Abbreviations are as follows:
SL — Snow Lake
HL — Herblet Lake
NL — Noteme Lake
PL — Photo Lake
BL — Birch Lake
WL — Wolverton Lake
TL — Tern Lake
cm — centimetre
m — metre

At Noteme Lake, southwest of Snow Lake, rusty weathered, silicified basalt hosts arsenopyrite, pyrite and pyrrhotite-bearing quartz veins (NL-33). Once again the bulk of the sulphide mineralization occurs at the vein/wall rock contact. Disseminated sulphide mineralization occurs in a medium grained mafic intrusion at the contact between this intrusion and the basalt.

The Jacknutt Mine on Squall Creek, north of West Snow Lake (SL-15) is a tungsten occurrence associated with quartz and carbonate veins and veinlets in a gneissic hornblende-biotite-quartz ± garnet rock. The host rocks contain numerous quartz veins that contain minor amounts of sulphide minerals; blocky arsenopyrite, pyrite and pyrrhotite are present in the host rocks. Some development work has been conducted on the property; details are presented on mineral deposit card W1, NTS area 63K/16.

A boudinaged 10 cm to 2 m thick quartz vein is exposed at surface in laminated, rusty weathered, garnetiferous ± magnetite felsic sedimentary rocks close to the west shore of Wolverton Lake (WL-2 and WL-4). These prospects are noted as gold occurrences by Russell (1955,1956) and are associated with north-trending shear zones. The quartz veins at this occurrence are characterized by rusty patches and malachite staining around disseminated pyrite accompanied by biotite books. Galena has been reported from these veins.

STRATABOUND MINERALIZATION

I. ANGUS BAY - EAST SHORE

Two mineral occurrences (HL-1 and HL-3) located on the east shore of Angus Bay in Herblet Lake comprise an earthy pyrite-massive sulphide zone. The mineralization at HL-1 is exposed in a 1.5 x 1.5 m shaft of undetermined depth. Abundant graphite, pyrite and silica were observed in muck around the shaft and this assemblage characterizes a chemical sedimentary sequence hosted by a rusty weathered, garnetiferous hornblende-muscovite-biotite gneiss with abundant quartz laminae; probably representing deformed quartz veins. Occurrence HL-3 represents a massive sulphide of pyrrhotite and pyrite, with minor arsenopyrite and chalcopyrite. The host rocks for this mineralization comprise a garnetiferous hornblende-quartz gneiss that has been silicified adjacent to the mineralization. Outcrops in the immediate vicinity of the trenches are scarce; however, approximately 200 m to the east outcrops of reworked(?) magnetite-bearing mafic volcanogenic sedimentary rocks occur. Diamond drilling along this zone by Hudson Bay Exploration and Development indicate traces of sphalerite and chalcopyrite (Mineral Resources Division cancelled assessment files #90136, 90156).

II. ANGUS BAY - WEST SHORE TO WEST SNOW LAKE

A sugary textured, siliceous, sulphide-bearing rock unit (Unit 8; Russell, 1955, 1956) occurs in numerous locations throughout the Snow Lake-Herblet Lake area. This unit hosts 5-10 per cent disseminated pyrite and pyrrhotite ± arsenopyrite. Quartz veins are generally absent from the unit. On the west shore of Angus Bay this unit is interlayered with 5-10 cm thick carbonate layers and also with garnetiferous mafic reworked tuff(?) layers; the same rock unit occurs at the back of a narrow bay near the entrance to Whitefish Bay, Herblet Lake. At this location Unit 8 occurs in proximity to a magnetite-chert oxide facies iron formation associated with a disseminated sulphide-bearing sedimentary rock, garnetiferous felsic tuff and basalt. Numerous, trenched sulphide occurrences hosted by Unit 8 are located on the southwest shore of Snow Lake and on the south shore of West Snow Lake. The mineralization is consistently characterized by disseminated (5-10 per cent) iron sulphides. The interlayered carbonate in Unit 8 appears restricted to the west shore of Angus Bay. Other sulphide occurrences associated with this unit occur in the easternmost bay of Whitefish Bay and on a peninsula across from an island preceding the entrance to the westernmost bay of Southeast Bay, Herblet Lake.

The overall consistent nature of this rock unit, the style of the mineralization, and its association with other rock units comprising the local stratigraphy suggests a strict time-stratigraphic control on the deposition of Unit 8 and the observed mineralization. A preliminary interpretation indicates genesis of this rock unit and the mineralization through chemical sedimentation.

GEOCHEMICAL SURVEYS

A rock geochemical survey of the major lithologic units in the Snow Lake-Herblet Lake area was initiated this summer to determine background concentrations for a wide range of trace elements within the study area. Definition of the background levels will assist in the interpretation of rock geochemical surveys designed to locate mineral deposits and/or their associated alteration zones. Table GS-13-2 summarizes the sampling conducted this year and Figure GS-13-2 the sample locations.

ACKNOWLEDGEMENTS

Roy Eccles and Darrell Sadowski are sincerely thanked for their efforts in assisting documentation studies this summer.

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TABLE GS-13-2
SUMMARY OF OUTCROP SAMPLES COLLECTED IN THE SNOW LAKE AREA FOR THE DETERMINATION OF BACKGROUND CONCENTRATIONS OF SELECTED TRACE ELEMENTS IN MAJOR ROCK UNITS.

Map Reference	Unit No. and Description	Sample Numbers
Russell, 1954, 1955, Map 55-3	15: Arkose	BG-27, BG-28, BG-29, BG-30, BG-35, BG-38
	14: Arkose — cross-bedded	BG-10, BG-11, BG-12, BG-23, BG-24, BG-25, BG-26
	6: Basic Volcanic Rocks — Andesite/Basalt	BG-3, BG-4, BG-5, BG-6, BG-8, BG-13, BG-14
	4: Porphyritic Basalt	BG-15, BG-16, BG-39
	1: Basic Volcanic Rocks and Derived Sedimentary Rocks	BG-1, BG-2, BG-7, BG-9, BG-36, BG-37
Harrison, 1949, Map 930A	6: Basic Volcanic Rocks; Minor Tuff	BG-17, BG-18, BG-19, BG-20, BG-21, BG-22, BG-31, BG-32, BG-33, BG-34

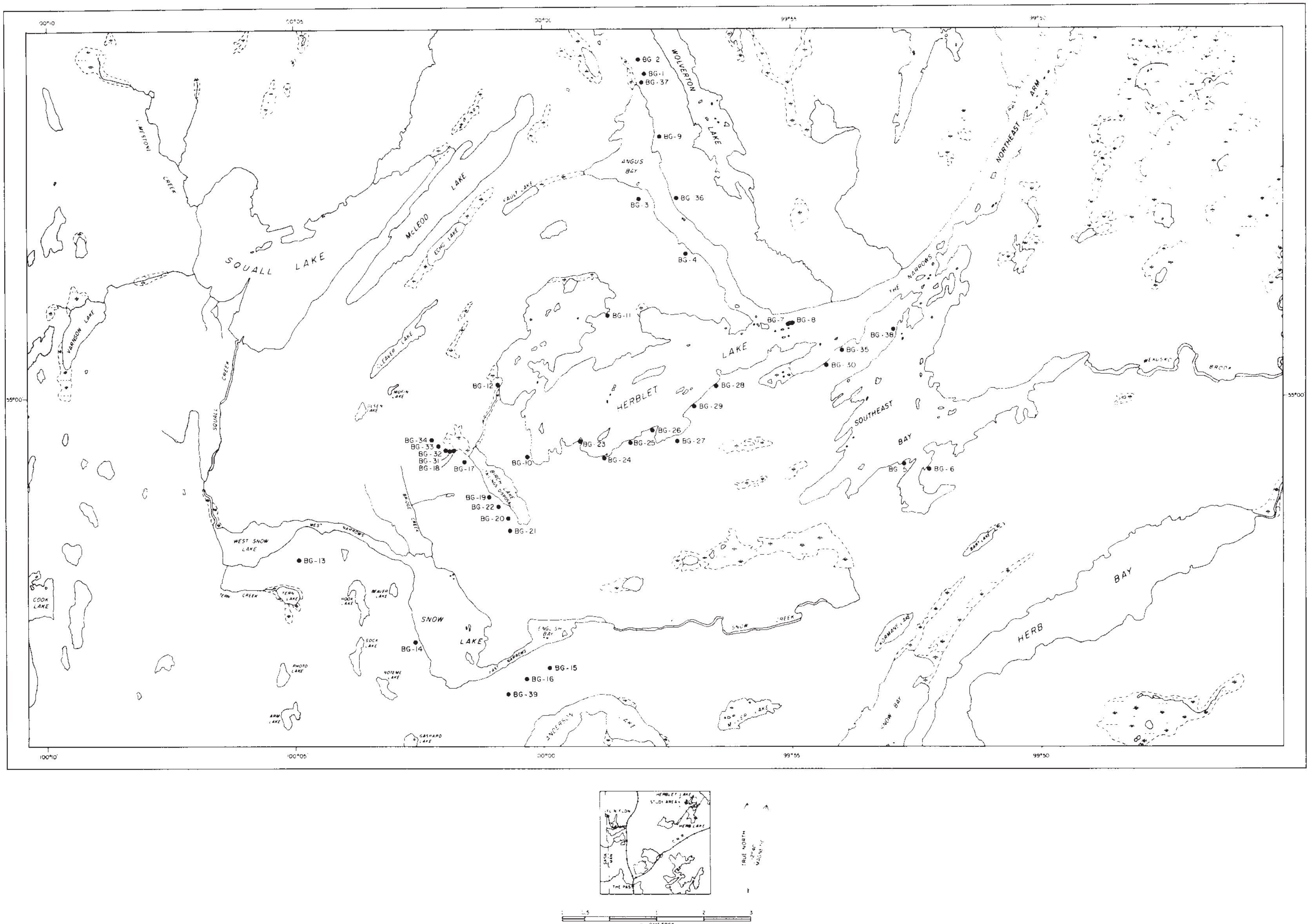

Figure GS-13-2: Location of rock samples collected from the major lithologic units in the Snow Lake-Herblet Lake area. For description of rock samples see Figure GS-13-1 and Table GS-13-2.

GS-14 MINERAL OCCURRENCE STUDIES IN THE FILE LAKE AREA OF MANITOBA

by G. Ostry

Seven weeks of the 1984 fleld season were directed towards documentation of known mineral occurrences In the File Lake area of the Flin Flon volcanic-sedimentary belt, map sheet 63K/16 (Fig. GS-14-1). Occurrences were mapped in detail, where possible, and samples taken for assay as part of the ongoing documentation of known mineral occurrences in the Province of Manitoba. This information will be included in a Mineral Deposit Open File that will be made available to the public upon request. Approximately one week was allocated to sampling the Josland Lake Gabbro (as mapped by Bailes, 1980) in an attempt to determine background gold concentrations.

Mineral occurrence locations (see Table GS-14-1) were obtained from previous geological maps (Bailes, 1980; Harrison, 1949; Stockwell, 1935). Manitoba Department of Energy and Mines Mineral Deposit Cards and non-confidential assessment work filed in Winnipeg. Fieldwork was conducted in the vicinities of File, Morton, Corley and Loonhead Lakes.

At present, the only known mineral deposit of economic significance in the File Lake area is the Dickstone Mine, a Cu-Zn massive sulphlde deposit, which operated from 1970 to 1975. The current investigation encountered a number of solid sulphide zones; however, these do not appear to contain any significant concentrations of Cu-Zn mineralization. Five groups of mineral occurrences were documented: 1) sulphide layers; 2) sulphide mobilizate adjacent to intrusions; 3) graphite-sulphide layers; 4) mineralization associated with quartz veins; and 5) mineralization associated with a high level quartz porphyry intrusion.

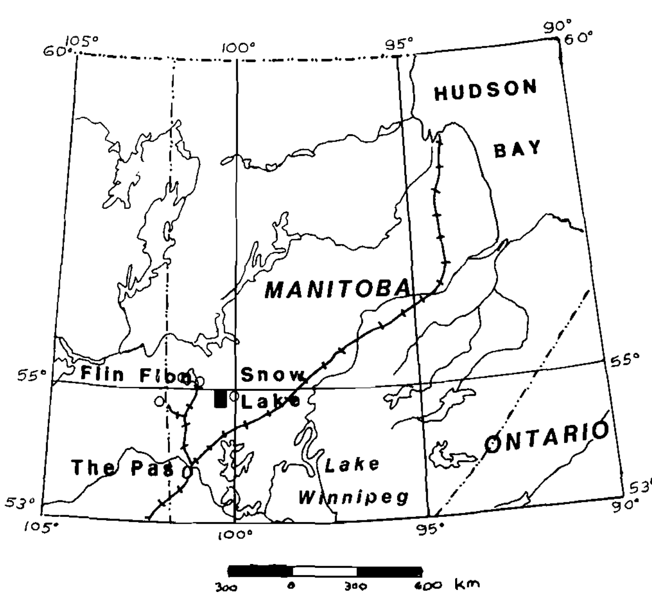

Figure GS-14-1: Location of File Lake Project area.

SULPHIDE OCCURRENCES

Solid sulphide, near solid sulphide and sulphide-rich strata (i.e. less than 50% sulphides) are characteristic components of the mafic volcanic rock sequences in the File Lake area. The sulphide occurrences and their host rocks exhibit common stratigraphic affiliations and petrological features.

Six occurrences of this type were examined:

1) Josland Lake zone;
2) Podruski Lake zone;
3) South Loonhead zone:
4) North Peloquin Lake zone;
5) North Loonhead zone; and
6) North Morton Lake zone.

Pyrrhotite is the dominant sulphide and is commonly accompanied by occasional lensoid, coarse grained metamorphic pyrite. Minor chalcopyrite, composing up to 1% of these units, occurs as distinct grains and/or as fracture-controlled mobilizate.

All the sulphide-rich units contain a very fine grained quartz-biotite-chlorite assemblage (pelite) that forms thin continuous bands (less than 1 cm) suggestive of primary layering. Sulphide unit rocks range from a sulphidic biotite-chlorite schist to a solid sulphide with variations in the relative abundances of sulphide and pelitic material.

Very fine grained felsic to intermediate (volcanogenic?) metasedimentary rocks (possible tuff), commonly containing disseminated fine grained pyrrhotite, host the sulphide-rich strata and form distinct conformable zones within the mafic metavolcanic rocks. Maximum observed thickness of a single metasedimentary bed was 1.5 m; however, pervasive oxidation has effaced all sulphide-rich rock exposure limiting data collection in most cases to examinations of rubble adjacent to trenches. The conformable zones are envisaged to be in the order of metres to possibly tens of metres in thickness. Visible alteration in and around these sulphide zones is rare except for minor local silicification and/or potassium alteration that is attributed to a late shearing event. The stratiform nature of these deposits, coupled with the lack of discernible syngenetic alteration in and around the sulphides, indicates a distal depositional environment in relation to the source of the metals.

1) JOSLAND LAKE ZONE: (JLZ)

The JLZ is exposed along the east shore of Josland Lake coincident with a north-trending 2.6 km electromagnetic conductor outlined by Hudson Bay Exploration and Development Co. Ltd. (Mineral Resources Division cancelled assessment file 90041).

One trench at the north end of Josland Lake, location JL-1, Fig. GS-14-2) and a trench and shaft at the south end of the lake, locations JL-2 and JL-3, Fig. GS-14-2, respectively, intersect solid sulphide and near solid sulphide layer(s). Interlayering of felsic to intermediate metasedimentary rocks and sulphide-rich rocks was observed in a trench at JL-2.

2) PODRUSKI LAKE ZONE (PLZ)

The PLZ lies along a 500 m electromagnetic conductor outlined with ground geophysical methods by Hudson Bay Exploration and Development Co. Ltd. (Mineral Resources Division cancelled assessment file 90045).

TABLE GS-14-1
Summary of Mineral Occurrences in the File Lake Area (63K/16)

Loc.	Type of Occurrence	Nature of Mineralization	Host Rocks	Thick-ness	Comment	Reference
FILE LAKE						
FL-1	outcrop	Diss. Po ± Cp and As; locally up to 10% where Po occurs on fracture or shear surfaces	Sheared gabbro, silicification; biotite development; Fe stain	8 m	30 m from contact with meta-greywacke	Bailes (1980)
FL-2	outcrop drill core	Graphitic Py ± Po zone	Felsic-mafic metasedimentary gneiss (tuff?); graphitic schist; Fe stain	?		Bailes (1980)
FL-3	1 trench 15 m x 6 m x 6 m outcrop	Sheared S-NS f.g. Po layer(s) with minor Py mobilizate; Cp as tensional fracture fillings	Sheared and silicified mafic meta-volcanic(?) rocks; heavy Fe staining	1 m+	Occurs in a major shear zone; in proximity to a gabbro intrusion	Wright (1930)
FL-4	1 trench	Diss., blebs, fracture fillings of Py + Po ± Cp; sulphides up to 5% of the rock	V.f.g. mafic metavolcanic (possible cataclasite); Fe stain	?	Rock is extremely hard and durable and breaks with conchoidal fracture	
FL-5	outcrop trench	Sheared graphite-Po ± Py schist; sulphides constitute up to 25% of schist; Po as diss; Py as blebs, short veins and augen	Sheared f.g. metavolcanic gneiss	?	Intensely sheared	Harrison (1949)
FL-6	1 trench outcrop	Sheared graphite-Po schist; Po diss. and as c.g. augen constituting up to 40% of schist	Sheared f.g. mafic gneiss, locally silicified and v.f.g. felsic quartz-biotite-garnet metasedimentary gneiss; heavy Fe stain	?		Harrison (1949)
	2 trenches outcrop	Sheared graphite-Po ± Py schist. Po diss.; Py as c.g. augen; sulphide 10-15% of rock		0.3 m	Intensely sheared	Bailes (1980)
CORLEY LAKE						
CL-1	1 trench (?) outcrop	Qtz vein; diss. f.g. As ± Py + Po associated with inclusions of wall-rock at vein margins	Sheared, v.f.g. mafic gneiss locally silicified, pyritized and brecciated by carbonate veining and quartz injection	0.3 m		Harrison (1949)
CL-2	outcrop	Pyritization along quartz vein margin	Gabbro; locally sheared at quartz vein margin	5.30 m		
CL-3	Series of trenches, 140 m outcrop	Irregular tourmaline-bearing quartz vein; diss. Po, Py and As, usually 1% of rock (locally up to 5%) at vein margin and up to 1.5 m away from vein	Sheared gabbro; local biotite development, silicification and carbonatization	0.1 m to 2.0 m		Stockwell (1935)

JOSLAND LAKE						
JL-1	2 trenches: 16 m x 3 m x 1 m rubble from trench	S-NS, f.g-m-g. Po, minor Py and Cp as mobilizate	Mafic metavolcanics and v.f.g. int. — felsic metasediments		No exposure in trench; intense oxidation. Mineralization and immediate host rocks seen in rubble only	Stockwell (1935)
	5 m x 2 m x 1 m	Diss. Po	Sheared and silicified mafic metavolcanics; Fe stained	2 m		Stockwell (1935)
JL-2	1 trench: 13 m x 3 m x 2 m	S-NS f.g. Po layer(s), minor Py and Cp as mobilizate; diss. Po and/or Py	V.f.g. int. — felsic metasedimentary rocks (tuffs?); heavy Fe stain	1.5 m	Only 5 m of exposure in trench	Stockwell (1935)
JL-3	1 Shaft and dump	NS Po, c.g., with minor Cp	?	?	No exposure. Samples of mineralization seen in dump	Wright (1930)
LOONHEAD LAKE						
LH-1	4 trenches: 16 m x 1 m x 0.5 m 14 m x 2 m x 2 m 18 m x 3 m x 3 m 15 m x 2 m x 2 m	S-NS c.g., Po layer(s); Py + qtz augen; minor Cp mobilizate	Banded, felsic-int. v.f.g. metasedimentary gneiss (tuffs?); heavy Fe stain			Wright (1930)
LH-2	1 trench: 5 m x 1 m x 0.5 m 1 shaft dump	S-NS c.g. Po layer(s); Py + quartz augen; minor Cp mobilizate	Felsic v.f.g. metasedimentary (tuffs?) gneiss; heavy Fe stain			Wright (1930)
LH-3	1 trench: 5 m x 2 m x 1.5 m	Diss. Po ± Py ± Cp; vuggy c.g. Py; sulphides constitute up to 20% of rock	Interbedded f.g.-v.f.g. mafic-felsic metasedimentary gneiss; Fe stained	5 m		Harrison (1949)
LH-4	2 trenches 1 shaft	F.g. quartz, biotite, magnetite ± Py + Cp infilling 0.2-2 cm cooling fractures	Altered, locally leached and/or silicified magnetite-bearing quartz porphyry; Fe stain			Harrison (1949)
LH-5	1 trench 1 shaft outcrop	Sulphide-rich mafic rock (pelite); Po + Py ± Cp as diss. and thin lamellae	F.g. mafic metavolcanic gneiss locally silicified and v.f.g. qtz-bio ± garnet metasedimentary gneiss; heavy Fe stain	1 m?		

TABLE GS-14-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES IN THE FILE LAKE AREA (63K/16)

MORTON LAKE						
ML-1	3 trenches outcrop	Graphitic pyrite unit: Py as v.f. grains and as fine 1-2 cm long, evenly distributed parallel needles imparting a lineation to the rock	V.f.g. felsic breccia (cross cut by a network of dark chloritic? alteration) and metadacite; spotty Fe staining	5 m		Bailes (1980)
ML-2	1 trench outcrop	Shear zone containing Po ± Py and Cp as diss. and short stringers in shear direction; total sulphides less than 5% of rock	Q.F.P. and gabbro contact, both intensively sheared and altered; silicification, carbonatization and Fe stain	2 m	Shearing accompanying intrusion of the Q.F.P.	Bailes (1980)
ML-3	1 trench 1 m x 2 m x 2 m	Shear zone. Mobilizate Py and Cp usually less than 10% of rock, locally up to 15%	Sheared and silicified metagreywacke; Fe stained	10 m+	ML-3 to ML-5 occur along a gabbro/metasedimentary rock contact	Stockwell (1935)
ML-4	2 possible trenches, outcrop	Shear zone; less than 1% finely diss. Po.	Sheared and silicified gabbro and metagreywacke; Fe stained	10 m+		Bailes (1980)
ML-5	outcrop	Shear zone containing thin 1 mm lamellae of Py in shear direction, less than 5% of rock	Sheared gabbro; some silicification; heavy Fe staining.	15 m		Stockwell (1935)
PODRUSKI LAKE						
PL-1	1 trench: 7 m x 2 m x 1 m	Sheared NS-S f.g. Po + Py and Cp layer(s)	Felsic— int. metasedimentary gneiss (tuff?); heavy Fe stain	?	Crenulated sulphide grains indicate shearing postdates mineralization	Bailes (1980)
PL-2	2 trenches: 5 m x 2 m x 1 m 1 m x 0.5 m x 0.5 m	Diss. Po; Py filling fractures; sulphides 1% of rock				

Abbreviations:
Py = pyrite, As = arsenopyrite, Po = pyrrhotite, Cp = chalcopyrite, mm = millimetre, cm = centimetre, m = metre; Diss = disseminated, S = solid, NS = near solid
c.g. = coarse grained; m.g. = medium grained; f.g. = fine grained; v.f.g. = very fine grained.

Note:
Trench dimensions are reported in terms of length x width x depth.

Three trenches were located but only that at locality PL-1, Fig. GS-14-2, intersects any mineralization, namely, near solid sulphide unit(s). At PL-1 a quartz-biotite-feldspar-garnet gneiss (psammite) is interlayered with the felsic metasedimentary and sulphide-rich rocks.

3) SOUTH LOONHEAD ZONE (SLZ)

A shaft and trench, location LH-5, Fig. GS-14-2, intersect sulphide-rich (less than 40% pyrrhotite) pelite. Sulphides occur as thin, contorted and discontinuous subparallel laminae. A quartz-biotite-feldspar-garnet gneiss, similar to the psammite observed in the PLZ, is associated with pelite and felsic metasedimentary rocks.

4) NORTH PELOQUIN LAKE ZONE (NPZ)

Trenching at locality LH-3, Fig. GS-14-2, has exposed a sequence of very fine grained pelitic and felsic metasedimentary rocks hosting disseminated (less than 10%) mineralization. Local sulphide concentrations of up to 20% were observed.

5) NORTH LOONHEAD ZONE (NLZ)

A trench and shaft were located within 150 m of the northeast shoreline of Loonhead Lake. The trench and shaft, location LH-2, Figure GS-14-2 are located approximately 120 m to the northwest of four parallel trenches, location LH-1, Figure GS-14-2. At both locations solid sulphide and near solid sulphide layers were intersected. The characteristic thin layers of pelite were not observed at this locality because of extensive annealing and recrystallization of the sulphide during regional metamorphism. All silicates in the sulphide unit(s) have been brecciated and locally have a 'rolled' appearance. Rock types at both localities are identical and suggests that the two sulphide occurrences are part of a single sulphide zone with a minimum strike length of 120 m.

6) NORTH MORTON LAKE ZONE (NMZ)

Two trenches were located east of Ducharme Bay and north of Morton Lake, localities FL-3 and FL-4, Figure GS-14-2. Solid and near solid sulphide was intersected in the southern trench at the north end of a 2 km north-trending electromagnetic anomaly (Bailes, 1980). Hematite veining was observed in very fine grained felsic metasedimentary rocks.

SULPHIDE OCCURRENCES ADJACENT TO INTRUSIONS

Four sulphide occurrences related to intrusion of the Josland Lake gabbro (Bailes, 1980) were examined. Localities ML-3 to ML-5 and locality FL-1, Figure GS-14-2, occur at the greywacke/gabbro contact, the former on north Morton Lake, the latter on the southern part of File Lake. At locality ML-2, Figure GS-14-2, on the east shore of Morton Lake, a medium grained quartz-feldspar porphyry intrudes the gabbro. Shearing, mobilization and the subsequent concentration of sulphides have accompanied the emplacement of these intrusions.

With the exception of locality ML-3, emplacement of the Josland Lake gabbro and the quartz-feldspar porphyry has been accompanied by the mobilization of pyrrhotite, pyrite, and/or chalcopyrite onto fracture surfaces and into the shear foliation as blebs, streaks and disseminations. These sulphide contents rarely exceed 5%.

At locality ML-3 chalcopyrite ± pyrrhotite occurs as streaks, blebs and disseminations on shear planes and as veins cross-cutting the tectonic fabric. Five metres to the south of the trench a 30 cm wide zone of sheared metagreywacke contains 15% chalcopyrite.

GRAPHITE OCCURRENCES

Sulphide-graphite layers were examined at localities FL-5 to FL-7, FL-2 and ML-1, Figure GS-14-2.

Three small trenches at the north end of Elmes Island on Morton Lake, locality ML-1, intersect a dark, very fine-grained graphitic and pyritic metasedimentary unit. Bailes (1980) has determined that submicroscopic disseminated grains of pyrite comprise up to 50% of these sediments. Acicular less than 2 cm pyrite grains, aligned in the foliation plane, are common in this unit, locally constituting up to 10% of the rock. A fine grained felsic breccia cut by an anastomosing network of dark chloritic(?) alteration with occasional grains of pyrrhotite and/or pyrite hosts the pyritic metasedimentary unit.

The felsic breccia is interlayered with a metadacite characterized by porphyroblasts of actinolite (Bailes,1980). The sulphide content in the felsic unit is up to 5%, mainly as pyrrhotite and/or pyrite disseminations and rarely as less than 1 mm streaks in the plane of foliation. A geophysical compilation by Bailes (1980) denotes a 2 km north-trending electromagnetic conductor along the east side of Elmes Island which may represent the lateral extent of the pyritic unit seen in the trenches.

A brief examination of Elmes Island, mapped as dacite flow by Bailes (1980), revealed a sequence(?) of fine grained felsic rocks that are locally brecciated, sericitized, cut by chloritic veins, silicified, and Fe stained. Alteration of this type characterizes the dacite on Elmes Island. This dacite is compositionally unique to the stratigraphy at File Lake and its stratigraphic position, between greywackes to the west and gabbro and mafic volcanic rocks to the east, is suggestive of a felsic volcanic dome (or high level intrusion?).

Trenching at localities FL-5 to FL-7 intersected a sequence of intensely sheared mafic metavolcanic (locally silicified) gneiss, felsic metasedimentary (quartz-biotite-garnet) gneiss and sulphidic graphite schists. This sequence outcrops along north-trending ridges for approximately 1 km from the north end of Ducharme Bay on File Lake.

Pyrrhotite and minor pyrite were the only sulphides observed. The graphite unit(s) contain up to 25% sulphide as disseminations, blebs, thin cross-cutting veins and as coarse, recrystallized aggregations associated with quartz augen. The host rocks commonly contain up to 5% disseminated sulphides.

Geological compilations by Bailes (1980) and Hosain (1978) indicate the presence of an electromagnetic conductor coincident with the graphite unit(s). Both conductor and graphite unit(s) terminate approximately 1 km north of Ducharme Bay notwithstanding the continuation of the fault (Bailes, 1980).

A short traverse east of Ellice Bay on File Lake, including locality FL-2, and an examination of dumped drill core nearby indicate the presence of graphitic sulphide unit(s) within a zone of interlayered mafic to felsic rnetasedimentary (tuffaceous?) gneisses with layering less than 5 cm in thickness. This zone occurs near the stratigraphic top of a sequence of mafic metavolcanic gneiss and appears to be in the order of a few tens of metres in thickness.

The geophysical compilation by Bailes (1980) indicates the presence of a long electromagnetic conductor conformable with the regional stratigraphy and coincident with the interlayered mafic-felsic metasedimentary (tuff?) zone. Pyrite and pyrrhotite were the only sulphides observed in outcrop and drill core.

QUARTZ VEIN OCCURRENCE

Three quartz vein occurrences lie within 2 km of the southwest end of Corley Lake, locations CL-1, CL-2 and CL-3, Figure GS-14-2.

At locality CL-3 a series of trenches extends southeast from the shoreline of a small unnamed lake, for a distance of 140 m. The trenching follows a series of 0.1 - 2 m wide lenses of tourmaline-bearing white saccharoidal quartz within the porphyritic leucogabbro phase (Bailes, 1980) of the Josland Lake Gabbro. Locally, the margins of the vein are well mineralized with pyrite, pyrrhotite, chalcopyrite and arsenopyrite in association with incorporated pieces of wall rock. Away from the vein margins the quartz is unmineralized and

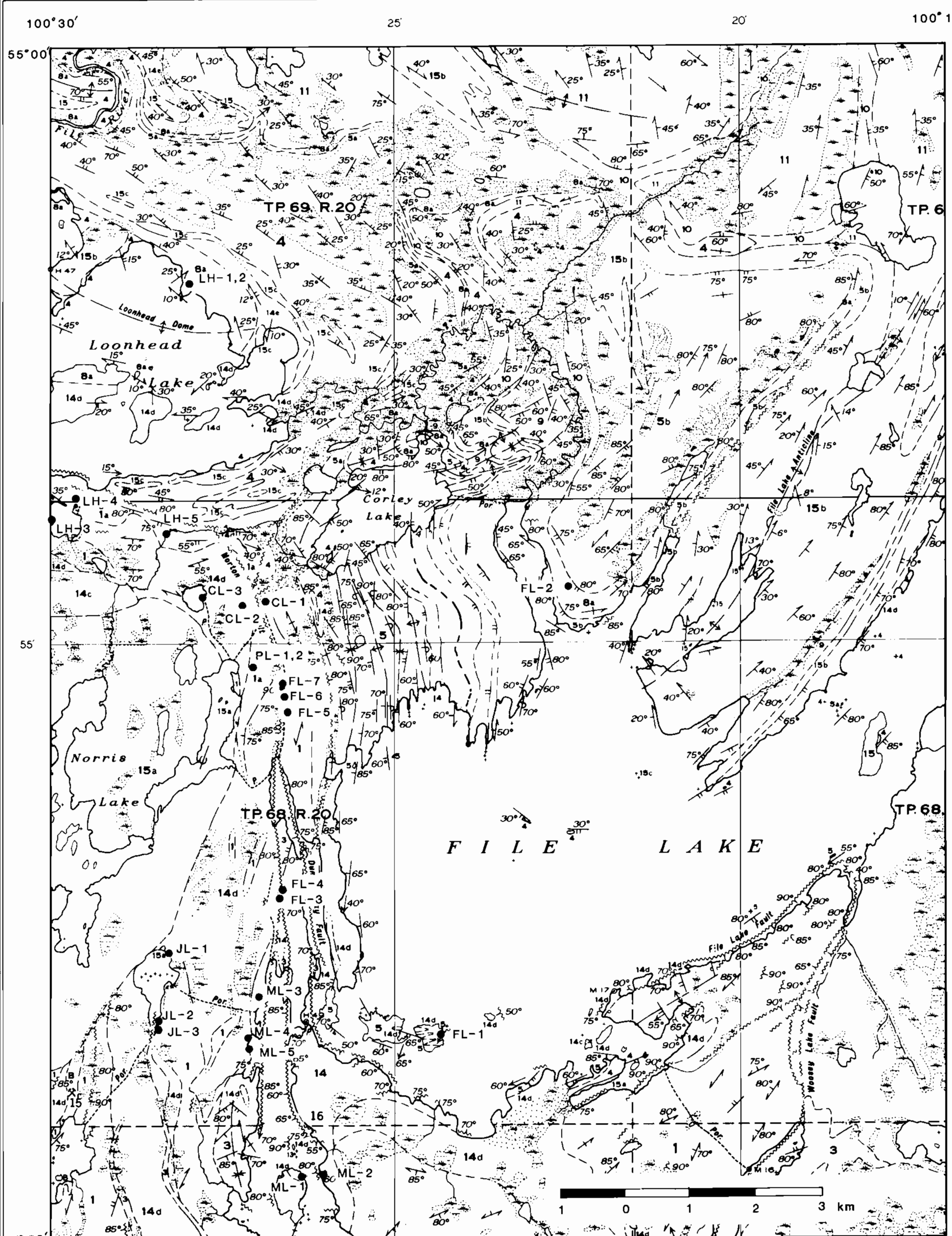

Figure GS-14-2: Mineral occurrences in the File Lake area (Part of 63/K16). Geology base after Harrison (1949).

undisturbed.

The gabbroic wall rock is sheared and altered, locally exhibiting silicification and sericitization, biotite development, quartz ± carbonate injection and patchy pyrrhotite, pyrite and/or arsenopyrite mineralization. Shearing, alteration and mineralization were not observed 1.5 m away from the quartz lenses. Native gold has been reported from this occurrence (Stockwell, 1935).

A northwest-trending 0.3 m wide tourmaline-bearing quartz vein bisects a small 'island', 4 m in diameter, at the southern edge of a swamp at locality CL-1. Only the vein margins are mineralized with arsenopyrite ± pyrite and pyrrhotite occurring as fine grains associated with inclusions of the wall rock. The wall rock is intensely sheared and altered. Pervasive silicification, carbonatization and pyritization were observed over the extent of the outcrop. Locality CL-1 occurs in an area of mafic metavolcanic gneiss. Gold has been reported from this area (Harrison, 1949).

At locality CL-2 a 5 to 30 cm wide quartz vein occurs in the granophyre zone (Bailes, 1980) of the Josland Lake Gabbro. The quartz vein is exposed for 27 m along a ridge with localized shearing at its margins. The vein and wall rock are weakly mineralized with occasional grains of pyrite.

QUARTZ PORPHYRY OCCURRENCE

A fine grained, white magnetite-bearing quartz porphyry, interpreted as a post-gabbro intrusion (Bailes, 1980), outcrops along the west shore of Peloquin Lake at location LH-4, Figure GS-14-2. Most of the exposure is leached and crosscut by fine grained 0.1 to 2 cm thick quartz-biotite-magnetite ± pyrite ± chalcopyrite veins filling tensional cooling fractures. A second set of thin, less than 1 mm parallel veins of similar composition has locally displaced the incipient vein set up to 2 cm. Two trenches are located in the area of most intense leaching and veining. The vein material is mineralogically similar to the intrusion and suggests that alteration, filling of the cooling fractures, leaching and concentration of sulphides occurred shortly after emplacement of the porphyry and before it had completely cooled.

GEOCHEMICAL SAMPLING

A limited bedrock geochemical sampling of the layered Josland Lake Gabbro was undertaken to determine its background gold concentrations. A number of previously reported gold-bearing quartz veins occupying shear zones in the gabbro were examined this summer. The sampling program will attempt to determine if any genetic link exists between the gabbro and the gold occurrences.

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GS-15 MINERAL DEPOSIT INVESTIGATIONS IN THE FLIN FLON AREA

by D. Parberry and G.H. Gale

Mineral deposit investigations in the Flin Flon area were designed to provide a documentation of known mineral occurrences that had not been investigated in previous years (Gale et al., 1980; Gale, 1981). Many of the mineral occurrences are known simply as mineral or metal locations on geological maps or trench locations in open assessment file data submitted to the Mineral Resources Division. A re-examination of these mineral localities was considered a necessary first step in identifying areas and occurrences for detailed investigations by the mineral deposit geologists under the Mineral Development Agreement. Consequently, considerable effort was expended in simply locating sites of mineralization, providing detailed maps of prospecting activities and collecting mineralized material for assay. Locations of the occurrences are shown in Figure GS-15-1.

A brief summary of data collected for individual occurrences located is presented in Table GS-15-1. Previously reported occurrences that were searched for but not located are listed in Table GS-15-II. Preliminary occurrence descriptions, with accurate locations, are available from the second author. Preliminary deposit maps with genetic classification for NTS areas 63K/11 to 63K/14 at a scale of 1:50 000 will be available for inspection at the Mineral Resources Division in the near future.

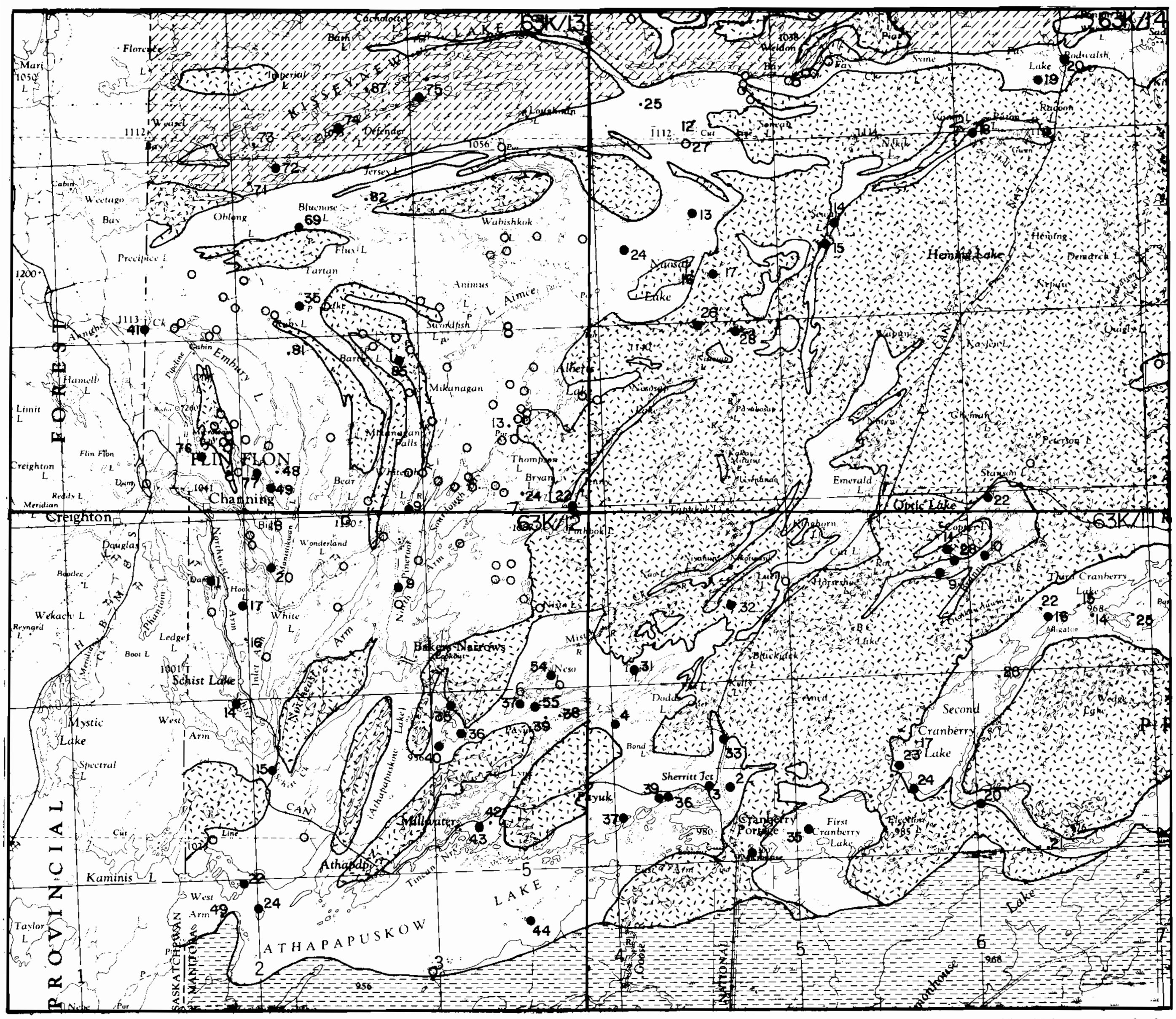

Figure GS-15-1: Location of mineral occurrences in the Flin Flon area. Solid circle = examined in 1984; Dot = not located in 1984; open circle = examined in previous years. Numbers refer to those in Tables GS-15-I and GS-15-II.

QUARTZ-CARBONATE SHEAR ZONES

TARTAN LAKE: Gold mineralization was discovered in the Tartan Lake area in the early 1930's. Recent exploration by Granges has not only confirmed the earlier discoveries but also resulted in the discovery of new gold-bearing mineralized zones. The old prospects were examined and sampled previously by Gale (1981). This year's activity consisted of a one-day examination and sampling of old workings at the east end of Ruby Lake that were not located in 1981.

Gold mineralization in the Tartan Lake area occurs in quartz-carbonate shear zones in close proximity to the large gabbroic intrusion. Visible gold occurs in quartz- and carbonate-filled veinlets and lenses in sheared mafic rocks of probable volcanic association. Although minor carbonate disseminations are present locally at the margins of the gabbroic rocks, it is not clear what, if any, role the gabbroic rocks had in the mineralizing process.

TWIN LAKES: A quartz-carbonate zone at least 30 m in thickness, occurs at locality 4 (63K/11) near the south end of Twin Lakes. It occupies a shear zone that can be traced along the eastern margin of Twin Lakes and southwards along a major depression (Fig. GS-15-2). Gold mineralization has been found in the main quartz-carbonate zone and in sulphide-bearing quartz and carbonate veins in the immediate vicinity of the shear zone (A.L. Parres and P. Bachnik, pers. comm., 1984).

NESO LAKE: Gold mineralization was discovered in quartz veins in carbonatized and schistose volcanic zones in the Neso Lake area before 1920. New highway exposures of carbonatized silicic volcanic rock with local concentrations of arsenopyrite extend the zone of altered rocks southwest of Neso Lake. Other exposures on Lake Athapapuskow (Fig. GS-15-2) indicate a probable strike length of at least 8 km for the carbonatized and sheared rocks.

QUARTZ VEINS

Gold-bearing quartz veins that are simple fracture fillings are common in the Flin Flon area (Table GS-15-I). The quartz veins occur in a variety of rock types but generally are not accompanied by extensive alteration. Minor shearing of wall rocks within a few centimetres of the quartz veins is usually present; however, this shearing postdates the formation of the quartz veins and is probably a local geological feature unrelated to the mineralizing activity.

OTHER MINERAL OCCURRENCES

Disseminated to solid sulphide mineralizations are present in a number of the mineral occurrences investigated. These deposits include sulphide strata, shear zones and lenses of mobilizate along the margins of intrusive rocks.

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1951: Cranberry Portage (63K/11. west half); one inch = one mile, Geological Map 26-1957, Geological Survey of Canada, Ottawa.

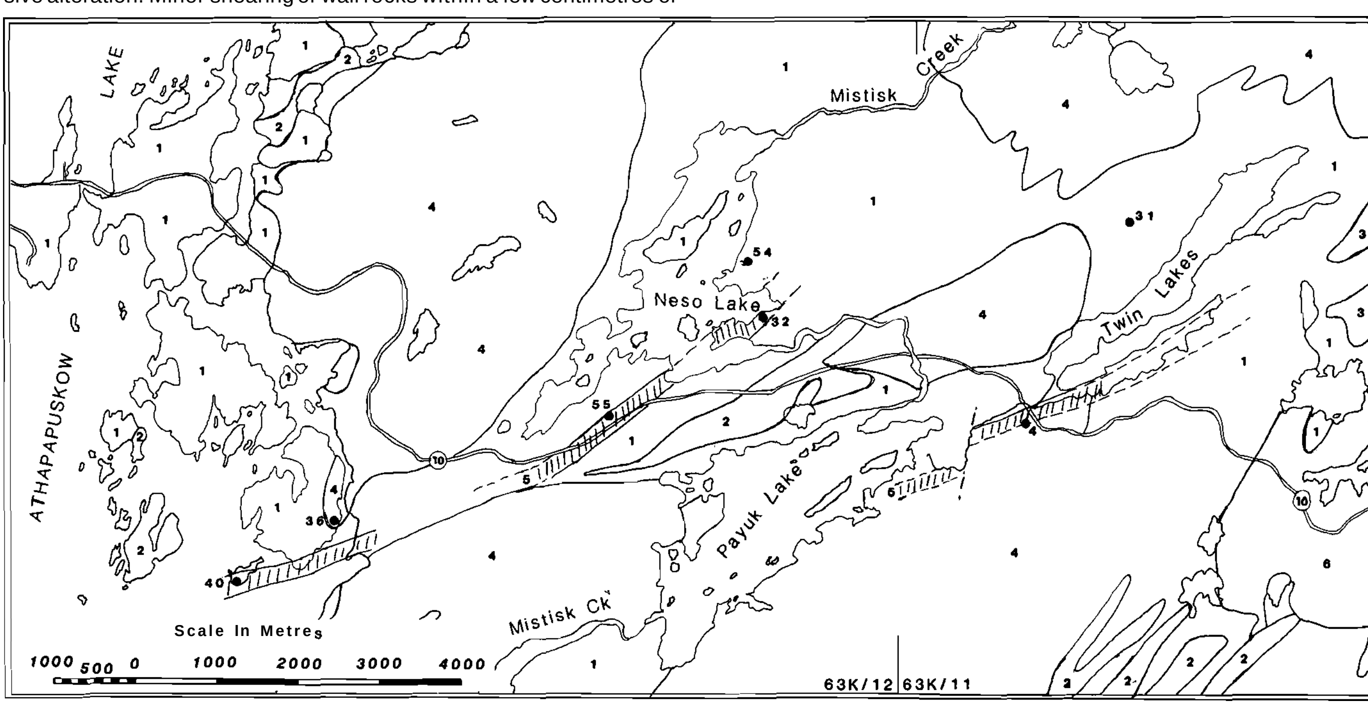

Figure GS-15-2: Location of quartz-vein bearing carbonatized and sheared rocks in the Neso Lake-Twin Lakes area. 1. mafic and felsic volcanic rocks; 2. gabbro and diorite; 3. quartz diorite; 4. granite and granodiorite; 5. quartz-carbonate zone. Solid circle indicates mineral occurrence. Geology modified after Podolsky (1951) and Buckham (1940).

TABLE GS-15-1
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE FLIN FLON AREA

PART A: AREA 63K/11

Site No.	Type of Occurrence	Nature of Mineralization	Thickness	Host Rocks
1	Shaft	Gold-bearing shear zone	?	sheared and altered granitic rocks
4	Outcrop + 15 trenches	Carbonatized zone with quartz veins	30 m	rnafic and felsic volcanic rocks
9	Trench (3 x 2 x 1 rn)	Diss. and solid po and py stratum with rnobilizate sulphide	1 rn	rnafic volcanic-sedimentary rocks
10	Outcrop	trace pyrite		altered rnafic volcanic rocks; depression in area where sulphide stratum was reported
11	Gurney Mine — old dump, shaft, trenches	pyrite, carbonate, chlorite, quartz and epidote veins; trace arsenopyrite, cp		altered rnafic and felsic volcanic rocks
16	Trench (2.5 x 1 x 1 rn) 3 ddh	Py and cp, in veinlets (14 boxes of core)	15 cm	chloritic rnafic volcanic rocks
20	Pit	Filled		no outcrop
23	Outcrop (no trench found)	Intensely silicified rnafic volcanic rock	17 rn	fine grained chloritic rnafic to interrnidiate rocks
24	Trench (2 x 2.5 x less than 5 rn)	Filled	?	chloritic schist
28	Outcrop	Solid sulphide (po and py) stratum	30 rn	rnafic volcano-sedimentary rocks
31	Trench (3 x 0.5 x 0.5 rn)	py veins at contact	1-30 cm	rnafic volcanic rocks and medium grained diorite
33	Trench (3 x 2 x 0.75 rn)	Veinlets of pyrite in silicified zone		fine-medium grained diorite
	Outcrop	Two zones of near solid pyrite; minor silicification of dioritic rock	1 m and 5	fine grained with granodioritic and aplitic dykes
35	Trench (4.5 x 2.5 x 3 rn)	Py with some cp along contacts of quartz vein	8 rn quartz vein with carbonate	fine grained chlorite schist
36	5 trenches A (4.5 x 2.5 x 3 rn)	Quartz-carbonate vein with tourmaline. 0.3 thick silicified zone parallels the vein. 5% cp in silicified rock	1 rn	fine grained chloritic intermediate volcanic rock
	B (4 x 3 x 2 m)	0.7 rn quartz vein with minor carbonate		fine grained intermediate rnafic rock
	C (5 x 2 x 4 m)	Several less than 6 cm quartz veins with py and rnt stains. Silicified host rock	6 cm veins of quartz	chlorite schist
	D (70 x 1 x ? m)	Quartz vein with silicified rnafic intermediate rock; cp and py present in 2 cm lenses		chloritic fine grained rnafic to intermediate volcanic rock
	E (3 x 1.5 x 1 m)	Quartz vein; rusty weathering	1 rn	fine grained rnafic volcanic rock
37	A Trench + shaft (50 x 2 x 1.5 rn)	Quartz vein with 5% py + cp, epidote veins with cp. 1% rnolybdenite	less than 1 rn	chloritic intermediate to rnafic volcanic rocks and amygdaloidal intermediate volcanic rocks
	B Trench (10 x 1.5 x 0.5 rn)	Less than 2% py in a siliceous rock		very fine grained chloritic schistose rnafic volcanic rock
39	12 Trenches (1 x 1.5 x 1.5 rn) rnax.	Less than 1% po and cp in chloritic rnafic rock. 10-50 cm thick quartz vein and 5 cm thick cp and py lenses. Minor carbonate and trace galena	0.5 rn quartz vein	light green chloritic rnafic to intermediate schistose volcanic rock

TABLE GS-15-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE FLIN FLON AREA

PART B: AREA 63K/12

Site No.	Type of Occurrence	Nature of Mineralization	Thickness	Host Rocks
1	Quarry	Silica-carbonate rock, near Schist L. mine	100 m +	rnafic volcaniclastic rocks
9	Trenches (24 x 2.3 x 3 m	5% py in 1 cm thick veinlets in sheared sericite schist		sericite schist and quartz porphyry
14	Outcrop	2% py in fine grained siliceous rocks Carbonate-sericite schists with rusty weathered zones		felsic to intermediate rock and (quartz)-sericite-carbonate schist
15	Trench (10 x 10 x 3 m)	10% py in fractures and in 2 cm blebs in an aphanitic rnafic rock; minor silicification	2 m	aphanitic rnafic-intermediate volcanic rock; chloritic
17	A Trench (9 x 7 m)	25% py and minor cp in veins (1-5cm) thick with quartz at contact between felsic and rnafic volcanic rocks	3 m	mafic-intermediate volcanic rock overlain by very fine grained felsic volcanic rock
	B Trench (10 x 6 m)	Py and cp, disseminated in mafic volcanic rocks	2 m	felsic volcanic rocks overlying porphyritic rnafic volcanic rocks
	C Trench (3.5 x 1.8 m)	Py and cp veins in chloritic mafic rock	3 m	felsic and rnafic volcanic rocks
20	Trench (2 x 2 x 1 rn)	2% diss. and stringers py and cp in fractures in a silicified intermediate rock		silicified/siliceous intermediate volcanic rock
22	Trench (2.7 x 2 x 2.6 m)	less than 10% diss. py in siliceous volcanic rock		siliceous volcanic rocks and quartz porphyry
24	Trench (2.6 x 1.8 x 1 m) Trench (2.5 x 3 m) Trench (3.5 x 3 x 1 m) Trench (3.5 x 2.5 x 2 m)	serpentinite (fibrous) in vein soapstone, serpentinite and carbonate serpentinite, soapstone serpentinite, soapstone	less than 1 m 1 m 1 m	pyroxenite fine- to medium-grained ultrarnafic rock serpentinized pyroxenite fine- to coarse-grained pyroxenite
35	A Trench (5 x 2.2 x 2 m)	quartz vein cuts and silicifies intermediate volcanic rock; less than 1% py and cp in silicified rock; carbonate veinlets in quartz vein	0.3 m	intermediate volcanic rock
	B Trench (4 x 1 x 1 m)	rubble filled		
36	Trench (12 x 2.2 x 1 m)	30-35% very fine grained pyrite; interlayered solid sulphide and 'cherty' rock in 1 cm layers; 10% py cubes; aphanitic silicic rock	8 m	sericite schist and very fine grained chloritic, siliceous rocks
	B Trench (20 x 10 x 5 m)	Quartz-carbonate veins with 20-25% galena in 5 cm thick veins		silicified granitic rock
37	Trench (13 x 6 x 1 m) Trench (6 x 3 x 1 m)	1-2% disseminated pyrite in greenstone disseminated pyrite		very fine grained foliated mafic volcanic rock very fine grained foliated mafic volcanic rock
40S	Outcrop (Island)	2-3% pyrite in intermediate volcanic rocks		felsic-intermediate volcanic rocks, with sericite and carbonate alteration
40N	Trench (20 x 2.3 x 2.5 m)	Less than 5% py and cp with malachite staining; sericite-quartz-carbonate alteration; sulphide veinlets are 1.5 cm thick; rocks are sheared	less than 3 m	sericitic quartz schist
43	Trenches (2 x 3 x 3 m) Trenches (2 x 1.5 x 3 m)	Quartz rubble indicates possible vein; trace py		fine grained aphanitic, grey-green intermediate volcanic rock

TABLE GS-15-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE FLIN FLON AREA

PART B: AREA 63K/12

Site No.	Type of Occurrence	Nature of Mineralization	Thickness	Host Rocks
44	Outcrop (Island)	Trace pyrite in volcanic rocks		mafic crystal tuffs and aphanitic mafic volcanic rocks with 2 m felsic "pods"
54	12 trenches	Quartz veins in carbonate-bearing shear zone	2 m	felsic volcanic rocks
55	Road cut	Quartz vein with 10-30% arsenopyrite in carbonatized zone	25 cm	silicic volcanic rocks

PART C: AREA 63K/13

Site No.	Type of Occurrence	Nature of Mineralization	Thickness	Host Rocks
9	Trench (3.5 x 2.5 x 4 m)	Sheared volcanic rocks with less than 3% py	3 m	aphanitic, chloritic, intermediate volcanic rocks and quartz-rich tuff
22	Trench (1 x 1 m)	Disseminated pyrite		biotite-quartz gneiss
35	5 trenches (10 x 4 x 2 m) maximum	Gold-bearing quartz-carbonate veins	up to 30 cm	schistose mafic volcanic rocks
41	Trench (4.5 x 2 m)	1% pyrite in schistose and weathered rocks		schistose, quartz-rich metasedimentary rock
49	Outcrop (Island)	Silicified volcanic rock with 2% disseminated py		fragmental volcanic rocks; silicified pillowed and pillow breccia flow rocks
69	Trench (3.5 x 21 x 0.5 m)	2% py in a layered rock. Mafic and felsic layers		quartz-rich and hornblende-rich layers of schistose rocks
72	Trench (4.5 x 3 x 1.8 m)	5% disseminated sulphides and 0.5 cm blebs in a bt + ch bearing schist; quartz vein with 1% py and graphite	1 m 0.5 m	biotite- and chlorite-rich schists and garnet-biotite gneisses
74	A Adit (1.7 x 2 x 7.8 m)	Quartz vein concordant with gneisses; py present in fractures; solid po in rubble		quartz-biotite gneiss and quartzofeldspathic gneiss
	B Trench (5 x 2.5 x 2.2 m)	Near solid po with minor cp; quartz blebs and blocky "chert" in sulphide	1 m	silicic rock unit and biotite-rich layer overlying a sericite schist
75	Trench (4.5 x 2 x 2.5 m)	pyrite-bearing quartz vein in micaceous gneisses with 1% py; 2-3% po and cp disseminated in qz-bt gneiss	0.3 m	quartz-biotite gneiss and quartz-garnet-biotite gneisses
76	A Trench (2 x 1.5 x 1 m)	20-40% disseminated cp in a siliceous cherty rock	1 m	fine grained intermediate volcanic rocks
	B Trench (2 x 1 x 1 m)	10-20% disseminated cp in a siliceous volcanic rock		siliceous volcanic rock with blue quartz eyes
	C Trench (1.5 x 0.5 x 0.75 m)	10-15% disseminated py and cp		intermediate volcanic rock
77	Outcrop	Trace sulphides		porphyritic volcanic rocks; fragmental volcanic rock, pillowed mafic to intermediate flow rock
85	Trench (2.5 x 1.6 x 1.6 m)	Near solid sulphide vein with py, cp and po in a very fine grained gabbroic-dioritic rock; 10% py in the mafic wall rocks	0.5 m	fine grained chloritic mafic volcanic rock

TABLE GS-15-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE FLIN FLON AREA

PART D: AREA 63K/14

Site No.	Type of Occurrence	Nature of Mineralization	Thickness	Host Rocks
13	Trench ? (2 x 1 x ?)	filled in	?	mafic volcanic and intrusive rocks
14	Trenches (18 x 3 x 1 m) Trenches (5 x 1.5 x 1 m) Trenches (4 x 1.5 x 1 m)	Near solid po with cp in felsic volcanic rocks	less than 1 m observed)	felsic rocks; possibly altered granodioritic intrusive rocks
15	Trench (17 x 3 x 2 m)	Near solid po in a silicic rock	12 m	silicic rocks, probably altered granodiorite and fine grained diorite
16	Trench (5 x 1 x 1 m)	filled		no outcrop
17	A Trench (4 x 1.5 x 1 m)	1-2 mm thick py and cp stringers		fine grained mafic volcanic rock
	B Trench (10 x 1.7 x 1 m)	2% py; minor graphite and po in fine grained silicic rock	less than 0.5 m(?)	very fine grained intermediate to mafic volcanic rock
18	8 trenches (4 x 2 x 1 m) max.	solid py and po	?	basaltic pillow lava
19	5 trenches, 1 shaft	solid po and py stratum	?	mafic volcanic rocks
20	3 trenches (15 x 1.0 x 1.0 m) max.	diss. py, trace arsenopyrite	?	fine- to medium- grained felsic intrusion
22	14 trenches	quartz vein with trace py	3 m	mafic volcanic rocks and gabbro
24	Trench (3 x 2 x 0.5 m)	near solid py and po stratum	30 cm	mafic volcanic rocks
28	Trench (5 x 2-3 m)	5-10% py in a dark coloured silicic rock		diorite and granodiorite dykes
26	Outcrop	50% garnet (2-5 mm diameter)	10 m	coarse grained garnet-chlorite-quartz rock; probably related to granitic intrusions

py = pyrite; po = pyrrhotite; cp = chalcopyrite; ml = malachite; ddh = diamond drill hole

TABLE GS-15-II
KNOWN MINERAL OCCURRENCES IN THE FLIN FLON AREA NOT LOCATED

Site	NTS Area 63K/11	Site	NTS Area 63K/13
5	abundant outcrop	13	Trench not located; mineralized outcrops
14	Trench not located	24	No exposures in vicinity
15	ditto	48	ditto
17	Trench not located	71	No trench found
18	No exposure	73	ditto
19	No exposure in swamp area	81	No trench or mineralized zone in area of extensive outcrop
22	Trench not located	82	No exposure in vicinity
25	Trench not located	87	No exposures in vicinity
26	Trench not located		
	NTS Area 63K/12		**NTS Area 63K/14**
16	Trenches not located	12	No outcrop in area
23	Trench not located	25	No exposures found in area
33	Trench not located		
34	No mineralized zone located		
38	No mineralized zone located		
39	ditto		
42	Now a CN aggregate quarry		
49	No volcanic rocks exposed		

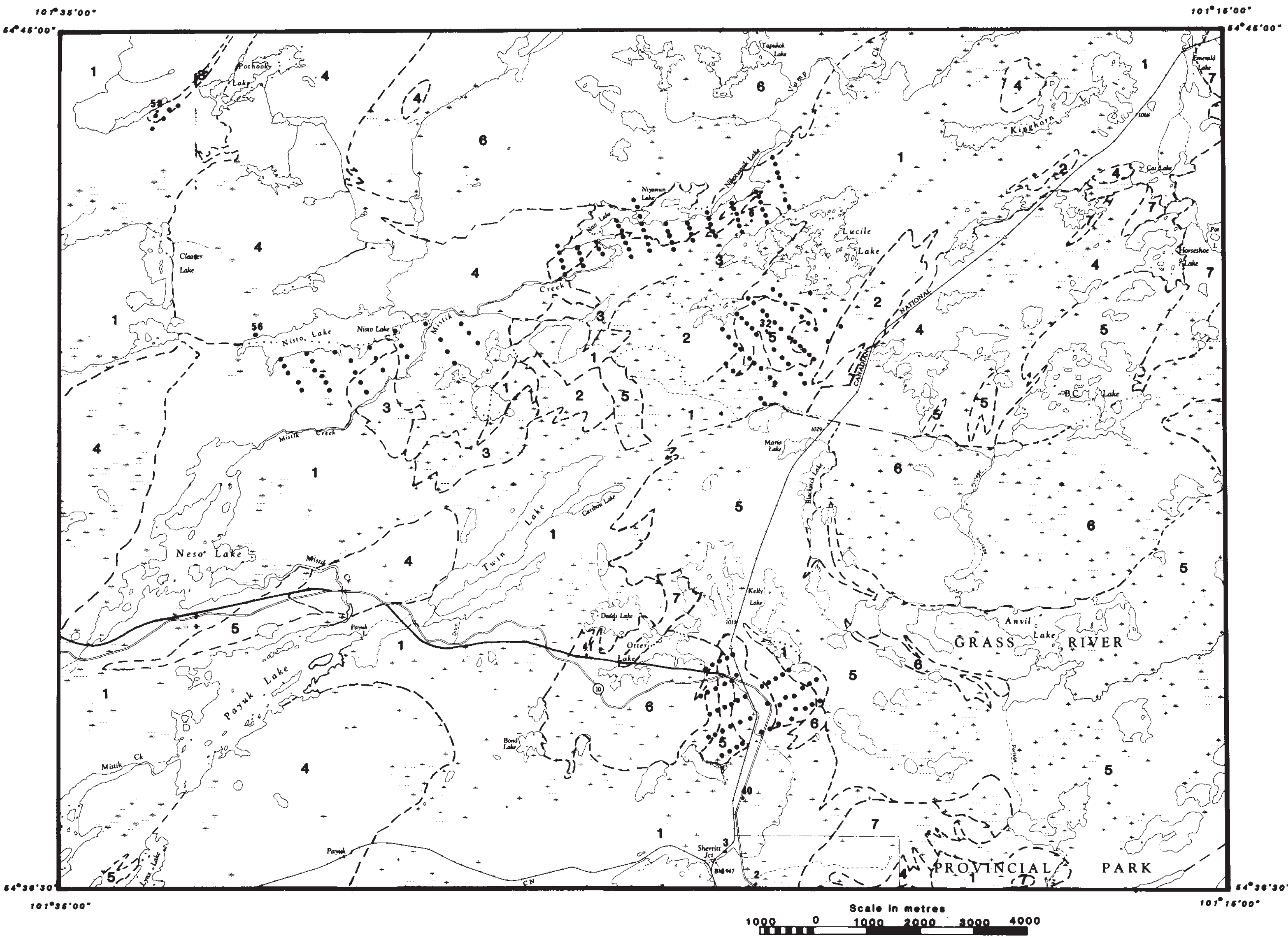

Figure GS-16-1: Location of samples collected for geochemical analyses. Numbered locations refer to mineral occurrences described in Table GS-16-1. 1. Felsic and mafic volcanic rocks. 2. Spessartite dykes. 3. Quartz-eye granites and quartz porphyry. 4. Hornblende-biotite granodiorite and diorite. 5. Hornblende-biotite-quartz diorite and biotite granodiorite. 6. Biotite granites. 7. Syenodiorite and syenite. 8. Quartz-feldspar porphyry. Geology after Podolsky (1951).

GS-16 GEOCHEMISTRY OF FELSIC INTRUSIVE AND EXTRUSIVE ROCKS IN THE NISTO LAKE-LUCILLE LAKE AREAS, FLIN FLON, MANITOBA

by R. Wadien[1] and G.H. Gale

Disseminated copper and/or molybdenum mineralization have been noted at several localities in intrusive rocks of the Flin Flon area (Baldwin, 1980). In addition, a number of occurrences of disseminated and vein type copper mineralization were discovered in volcanic rocks in the Nisto Lake area by Philip and Steven Bachnik (pers. comm., 1981). This project was designed to examine known occurrences and sample selected areas of felsic extrusive rocks in the Nisto Lake-Lucille Lake-Cranberry Portage area. All new road exposures between Cranberry Portage and Bakers Narrows were examined for mineralization and evidence of associated alteration. Mineral occurrences are listed in Table GS-16-1.

Sampling was conducted along selected grid lines spaced at approximately 400 m intervals with sample sites 150 m apart along the lines. Where intrusive rocks were sampled, the sampling was extended into the surrounding country rocks. Each sample consisted of 1-2 kg of clean unweathered rock chips collected from 3 to 5 different places on the outcrop. Areas sampled are shown on Figure GS-16-1.

Veins and disseminations of pyrite and/or chalcopyrite occur at several localities in new roadcuts along the highway between Cranberry Portage and Bakers Narrows. The mineralization occurs in association with quartz and/or epidote veins and lenses, in small shear zones and in volcanic country rocks adjacent to their contacts with intrusive rocks. Individual mineralized sections are generally several tens of centimetres thick; however, one pyritic zone (63K/11, No. 40) attains a thickness of 7 m. Trace amounts of malachite and molybdenite were observed at two localities.

A 30 cm thick quartz-magnetite-chlorite vein with minor malachite and 2-3% pyrite at locality 56 occurs within a well layered felsic tuffaceous rock. This vein is situated approximately 7 m south of a large felsic intrusion. Volcanic inclusions within the intrusion decrease in abundance northwards.

A vein of solid sulphide mineralization, exposed in trenches southwest of Lucille Lake (locality 32), has a thickness of approximately 1 m. The vein cuts through a medium grained dioritic rock that contains abundant xenoliths of fine grained mafic volcanic and coarse grained dioritic rocks. Chalcopyrite and pyrite are the dominant minerals. Grab samples from this occurrence assayed up to 26% Cu (P. Bachnik, pers. comm., 1984). Disseminated pyrite and chalcopyrite occur locally in the dioritic rocks adjacent to the sulphide vein.

Recent prospecting by P. Bachnik has uncovered a zone of sulphide mineralization (locality 58) along the northwest margin of a quartz-feldspar porphyritic intrusion with bluish quartz phenocrysts up to 1 cm in diameter. The mineralized section consists of 1-3 mm thick quartz-sulphide veinlets with 4-5% pyrite and 1% chalcopyrite. Some gold has been obtained from this occurrence (P. Bachnik, pers. comm., 1984).

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1951: Cranberry Portage (west half); Geological Survey of Canada, Map 26-1957.

[1]University of Manitoba

TABLE GS-16-1
SUMMARY OF MINERAL OCCURRENCES IN THE NISTO LAKE-LUCILLE LAKE AREA

Site	Type	Nature of Mineralization	Thickness	Host Rocks
2	roadcut	py and cp veins	5-20 cm	fine grained mafic volcanic rocks
3	trench (1 x 1 x 0.5 m)	py and cp veins	1-10 cm	mafic volcanic rocks
6	shaft 2 x 3 x 20 m adit (10 x 1.5 x 1.5 m)	py and cp vein	1-5 cm	felsic volcanic rocks
32	trench (10 x 2 x 1 m)	py and cp vein	1 m	medium- to coarse-grained diorite
40	roadcut	diss. to 25% py as lenses and veins; epidote and quartz	7 m	mafic volcanic xenolith in granite
41	roadcut	molybdenite flakes in quartz vein	1 cm	granodiorite
56	outcrop	mt-ch-qz vein; trace cp and py	30 cm	layered mafic tuff
58	trench (3 x 1 x 1 m)	py, cp, qz veinlets	2 cm	quartz-feldspar porphyry

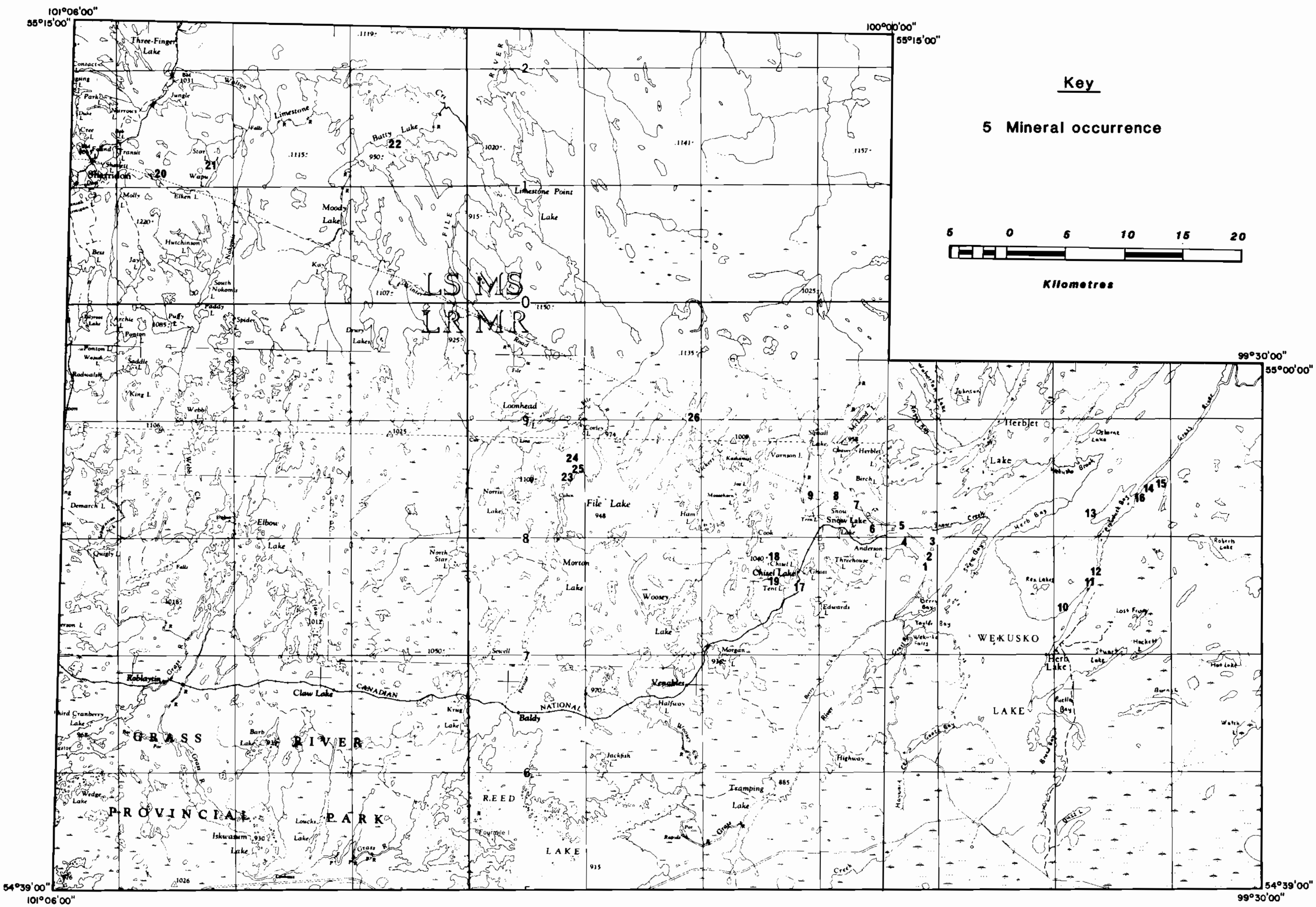

Figure GS-17-1: Location map of the Flin Flon-Snow Lake district showing examined garnet and staurolite occurrences.

GS-17 INDUSTRIAL MINERALS RECONNAISSANCE IN THE FLIN FLON-SNOW LAKE DISTRICT

by P.H. Yamada

In 1984 a one month study was initiated to document occurrences of abrasive materials, primarily garnet and staurolite. The Flin Flon-Snow Lake area was chosen as the initial study area as garnet- and staurolite-bearing rocks are abundant (Bailes and McRitchie, 1978; Froese and Moore, 1980; Gordon and Gall. 1982).

The main objectives of the programme were to provide: (1) accurate locations of garnet and staurolite occurrences; (2) the volume per cent of garnet and staurolite in each occurrence; and (3) selected specific occurrences for further detailed examination.

The locations of examined mineral occurrences are shown on Figure GS-17-1 and observational data are summarized in Table GS-17-1.

Garnet and staurolite occur in schists and gneisses derived from sandstone, shales and felsic volcanic rocks (Froese and Moore, 1980. and others). Garnet morphology varies from aggregates of subhedral grains (Fig. GS-17-2) to well developed crystals reaching 10 mm in size (Fig. GS-17-3). Staurolite occurs most commonly as subtabular porphyroblasts (Fig. GS-17-4) but also as euhedral crystals (Fig. GS-17-5).

During the winter months geochemical and petrographic analyses will be carried out on those samples containing the highest concentrations of garnet and staurolite. The results of these analyses will assist in selecting occurrences that warrant more detailed examination. An investigation of the Lynn Lake and/or Cross Lake areas will be initiated in 1985.

TABLE GS-17-1
SUMMARY OF DATA FOR MINERAL OCCURRENCES IN THE FLIN FLON-SNOW LAKE AREA

Location Number	Location Description	Mineral*	Mineral Abundance**	Mineral Shape	Average Crystal Size	Host Rock	Reference
1	West side of Provincial Highway 392 at Anderson Creek	G	4	anhedral to subhedral	1 - 5 mm	Quartz, biotite, garnet, gneiss	Sabina, 1972
2	600 m south of Junction Provincial Highway 392 and 393. East side of Highway 392	St	17	euhedral	1 x 3 cm	Altered metarhyolite	Syme et al., 1982
3	Stall Lake Mine, Provincial Highway 393 (GAC-MAC, 1982, Trip 6, Snow Lake, stop 1)	G	6	subhedral	1 - 5 rnm	Quartz-phyric meta-rhyolite	Syme et al., 1982
4	500 m east of Anderson Lake Mine headframe, south side of tracks	K	3	euhedral (blades)	1 x 10 mm	Chlorite, kyanite schist	Syme, et al., 1982
5	West side of Provincial Highway 392 at Snow Creek	St	13	euhedral	0.2 x 0.5 cm	Muscovite, biotite, staurolite, garnet schist	Sabina, 1972
6	In Park 600 m south of Health Centre in the town of Snow Lake	St G	10 1	euhedral	0.5 x 1 cm 1 mm	Quartz, biotite, staurolite garnet schist	
7	North shore of Snow Lake at entrance to Snow Lake Narrows	St G	9 2	euhedral euhedral	0.8 x 1.2 cm 1 - 5 mm	Fine grained, quartz, staurolite, garnet schist	Froese and Moore, 1980
8	Middle of Snow Lake Narrows, north shore	St G	30 10	euhedral euhedral	0.4 x 0.6 cm 0.5 - 5 mm	Schist	Froese and Moore, 1980
9	North shore of West Snow Lake	St	8	euhedral	0.2 x 0.7 cm	Fine grained, quartz, biotite, staurolite, garnet schist	Froese and Moore, 1980
10	Northwest shore of strait leading to Crowduck Bay	St	17	euhedral	0.5 x 1.5 cm	Fine grained, chlorite, biotite, staurolite schist	Gordon and Gall, 1982
11	Island in middle of strait to Crowduck Bay just before narrows	St	17	anhedral with garnet inclusions	l x l cm	Fine grained, quartz, biotite, staurolite, garnet schist	Gordon, 1981

TABLE GS-17-I (Continued)
SUMMARY OF DATA FOR MINERAL OCCURRENCES IN THE FLIN FLON-SNOW LAKE AREA

Location Number	Location Description	Mineral*	Mineral Abundance**	Mineral Shape	Average Crystal Size	Host Rock	Reference
12	Island mound 50 m southeast of small island in centre of strait to Crowduck Bay	St G	15 1	euhedral (twinning) euhedral	0.5 x 1.2 cm 0.5 - 2 mm	Quartz, biotite, staurolite, garnet schist	Gordon, 1981
13	West shore of southwest bay of Crowduck Bay	St	9	euhedral	0.5 x 0.5 cm	Quartz, biotite, staurolite, garnet schist	Gordon, 1981 Gordon and Gall, 1982
14	Northeast of Crowduck Bay, south side of Grass River	G	5	subhedral to anhedral	1 - 3 mm	Quartz, feldspar, biotite, sillimanite gneiss	Gordon and Gall, 1982
15	700 m from Grass River along bearing of 106°	G St	5 3	anhedral subhedral	3 - 6 mm 0.7 x 1 cm	Quartz-biotite garnet schist	Gordon and Gall, 1982
16	Small island mound at mouth of Grass River, northeast of Crowduck Bay	St G	9 7	subhedral anhedral	0.5 x 1 cm 5 - 10 mm	Quartz, biotite, staurolite, garnet schist	Gordon, 1981
17	Southwest of Chisel Lake headframe, 1100 m down road (GAC-MAC, 1982, Trip 6, Snow Lake, stop 5)	G	6	anhedral	9 - 10 mm	Quartz, biotite, garnet schist	Syme et al., 1981
18	2000 m west of Chisel Lake and north of Horseshoe Lake	G St	10 7	euhedral subhedral	1 - 10 mm 1 x 1 cm	Quartz, biotite, garnet, staurolite schist	Williams, 1966 Froese and Moore, 1980
19	West shore of drained Tent Lake. and southeast of Horseshoe Lake	G St	15 5	subhedral subhedral	1 - 5 mm 0.5 x 1 cm	Quartz, biotite, chlorite, garnet, staurolite schist	Williams, 1966 Froese and Moore, 1980
20	Small lake east of Sherridon, west of Star Lake and on Powerline	G	11	anhedral	15 mm	Quartz, biotite, anthophyllite gneiss	Robertson. 1953
21	Southwest shore of Star Lake	G	19	anhedral	10 - 30 mm	Quartz, biotite, anthophyllite gneiss	Robertson, 1953
22	North shore of Batty Lake, central portion	G	3	subhedral	1.5 mm	Quartz, biotite, garnet schist	Robertson, 1953
23	Northwest corner of File Lake, west side of small peninsula	St	9	euhedral	0.5 x 1 cm	Quartz, biotite, staurolite, garnet schist	Bailes, 1980
24	Between Corley Lake and File Lake on Corley Lake Member	G St	8 3	euhedral subhedral	5 - 10 mm 0.5 x 1 mm	Metamudstone	Bailes, 1980
25	Southern portion of Corley Lake Member between Corley Lake and File Lake	G St	9 3	subhedral subhedral	5 - 10 mm 0.2 x 1.1 cm	Metamudstone	Bailes, 1980
26	Northeast arm of File Lake, on small extension of bay. northwest shore	G	3	subhedral	1 mm	Quartz, biotite schist	Bailes, 1980

* Mineral symbols: G =garnet, St = staurolite, K = kyanite
Mineral abundance is based on point counting data obtained in the field and calculated as $\frac{\text{area covered by minerals within square}}{\text{area of given square}} \times 100$

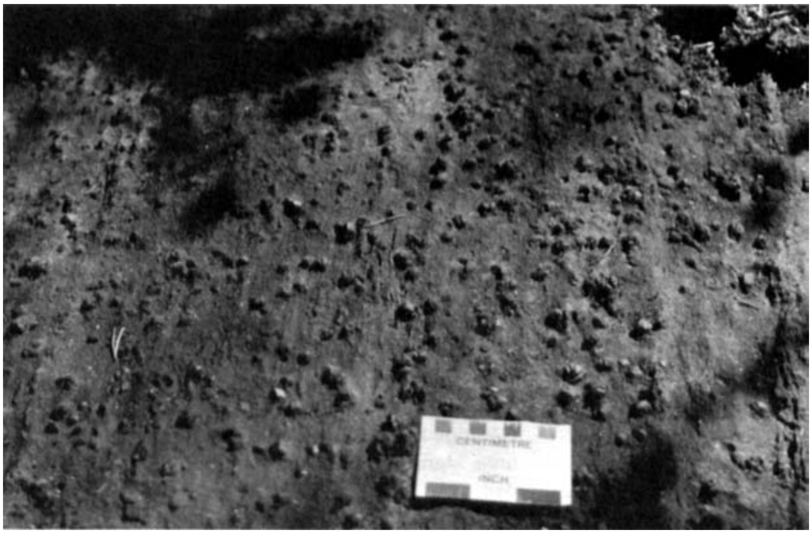

Figure GS-17-2:
Schist containing 16 per cent pink subhedral garnets (location 19).

Figure GS-17-3:
Metamudstone containing 10 per cent deep red euhedral garnets (location 25).

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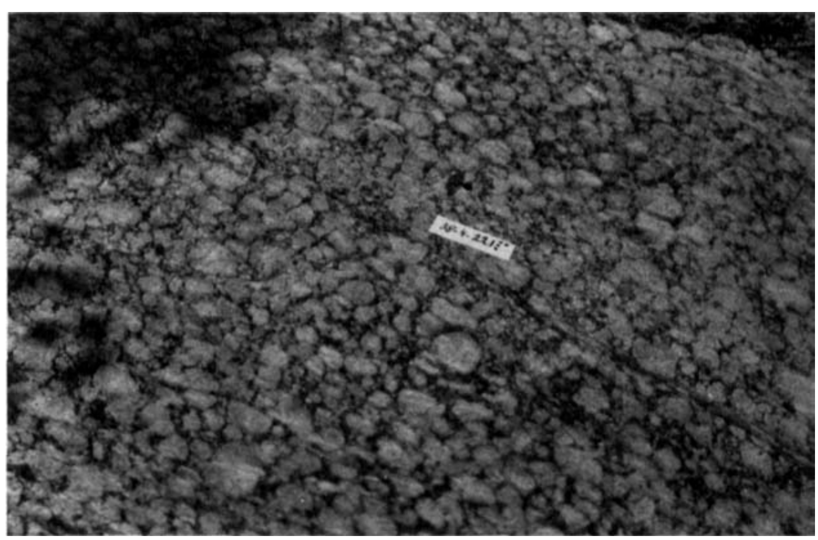
Figure GS-17-4:
Schist with 15 per cent, sub-tabular staurolite porphyroblasts (north shore of location 11).

Figure GS-17-5:
Schist containing 9 per cent black euhedral staurolites (location 13).



GS-18 STRATABOUND GOLD MINERALIZATION IN THE KISSEYNEW GNEISS TERRAIN

by G.H. Gale and G. Ostry

The southern flank of the Kisseynew gneiss terrain (Fig. GS-18-1) contains a suite of paragneisses that have been subjected to several phases of folding, including large-scale recumbent folds and thrust sheets (Tuckwell, 1979). Metamorphic conditions have attained at least garnet-amphibolite grade throughout the area. Sillimanite is common locally, e.g., at the Sherridon Mine.

In addition to the Sherridon copper-zinc massive sulphide deposit and several smaller low grade massive sulphide deposits in the vicinity (Gale et al., 1980), several gold occurrences have been known in the area since approximately 1960. Gold prospects were noted on the Batty Lake map sheet by Robertson (1950), and a gold occurrence on Kipahigan (Barrier) Lake by Pollock (1964). Diamond drilling by A.L. Parres and Riocanex (formerly Rio Tinto Canadian Exploration Ltd.) established the presence of significant gold at Nokomis Lake by 1961. Hudson Bay Exploration and Development Co. Ltd. intersected gold mineralization at Puffy Lake in 1960; later exploration by Maverick Mountain Mines and Granges Exploration led to discovery of the Puffy Lake deposit in 1979. Dome Exploration and Pioneer Metals are the current holders of the Nokomis and Puffy Lake properties, respectively.

One of the authors (G.H.G.) has indicated on several occasions that the known gold mineralization occupies a stratigraphic position that approximates that of the known massive sulphide occurrences (Gale et al., 1980), i.e., a thin unit of volcanogenic and sedimentary rocks that occur between the dominantly greywacke Nokomis Group and the dominantly quartzofeldspathic rocks of the Sherridon Group. Zwanzig (1983) has placed this sequence of rocks at the base of the Sherridon Group.

NOKOMIS DEPOSIT

At the Nokomis deposit a series of trenches (Fig. GS-18-2, 3) have been cut along a ridge that consists of a layer of quartz gneiss between two layers of amphibolite. The structurally overlying amphibolite is a garnet-bearing hornblende-rich amphibolite whereas the structurally underlying amphibolite locally contains actinolite and resembles the calcareous amphibolite observed in the Batty Lake and Kississing Lake areas (Robertson, 1950; Gale, 1981).

The quartz gneiss is a composite rock consisting of hornblende-rich and hornblende-poor layers. This unit occurs as lenses and layers several cm to several tens of cm thick and several cm to several metres in length. Accessory minerals visible with a hand lens include magnetite and garnet restricted to certain layers or lenses. Pyrite is commonly found in narrow, rusty weathering cross-cutting veinlets. Extensive lichen cover precluded a detailed breakdown of this rock unit.

The quartz gneiss consists predominantly of quartz with locally abundant garnet, calcareous and sulphide-rich zones. Portions of this rock are nearly pure silica. The rock has a definite layered appearance and locally resembles a metamorphosed chert deposit.

Pyrite and pyrrhotite are the most common sulphide minerals and occur mainly as disseminations throughout the quartz gneiss in a layer 1-2 m thick. Locally, iron sulphides occur as wisps and veinlets in the hornblende-bearing quartz gneiss. Arsenopyrite is locally common, both as disseminations and in veinlets of mobilizate over several cm in thickness. Chalcopyrite, sphalerite and galena are present as minor constituents (less than 2% by volume).

A cross-section of the Nokomis Lake deposit in outcrop is given in Fig. GS-18-4. Comparison with the Riocanex drill hole information (Mineral Resources non-confidential assessment file no. 90658) confirms the stratabound nature of the mineralized zone. Examination of the Riocanex drill core on site, established that the 'garnet-biotite gneiss' (cf Fig. GS-18-4) is typical of the biotite-rich garnetiferous metasedimentary rocks common to the Nokomis Group in this area. Consequently, the Nokomis Lake gold deposit is envisaged as occurring between structurally underlying younger quartzofeldspathic and quartzitic rocks of the Sherridon Group and structurally overlying older Nokomis Group rocks (Zwanzig, 1983, 1984).

The magnetite-bearing quartz-rich gneiss which outcrops in the Nokomis Deposit area was traced for over a kilometre along strike. Locally it contains minor sulphide mineralization. Zwanzig (1984) indicates that the quartz-rich gneiss hosting the gold mineralization can be traced for a distance of several kilometres. A 30 cm thick sulphide-bearing metasedimentary layer, adjacent a garnet amphibolite layer, exposed on the powerline approximately 3 km north of the gold deposit, is considered to be the along strike extension of the gold-bearing sulphide layer.

Drill holes put down by A.L. Parres (pers. comm. 1984) intersected significant gold mineralization, i.e., up to 0.4 oz/tonne and indicate that the stratigraphic unit can be extended to the south at least several hundred metres.

PUFFY LAKE DEPOSIT

Several drill holes put down by Hudson Bay Exploration and Development Co. Ltd. intersected minor gold-bearing sulphides (galena, arsenopyrite, pyrrhotite, chalcopyrite) in a dark coloured quartz-rich gneiss. By 1982 it was concluded, on the basis of geophysical and regional geological maps, that the Puffy Lake and Nokomis Lake occurrences were probably of exhalative origin and situated at approximately the same stratigraphic position (Gale, 1982).

Subsequent detailed mapping at Nokomis Lake by Zwanzig (1984) has now confirmed the similarity of stratigraphic successions at both Nokomis and Puffy Lakes.

EVANS LAKE (KAY LAKE)

A brief examination of the mineralization and geology at Evans Lake indicates that the mineralized zone is similar to that examined at Nokomis Lake. Gold occurs with minor sulphides (pyrrhotite, chalcopyrite, arsenopyrite) (Robertson, 1950) in quartz-rich gneiss (locally meta-chert?) sandwiched between a garnetiferous amphibolite and a thinly layered amphibolite. The structurally lowermost thinly layered amphibolite is underlain by a reddish weathering quartzofeldspathic metasedimentary (arkosic) rock similar to rocks of the Sherridon Group. Although the presumably overlying greywackes of the Nokomis Group were not observed at this locality, a major synformal structure (as shown by Robertson, 1950) is consistent with known outcrop distribution (Fig. GS-18-5). This interpretation would place the Nokomis Lake and Evans Lake gold occurrences at approximately the same stratigraphic position and on opposite limbs of a major synclinal structure. Detailed mapping of this property is planned for 1985.

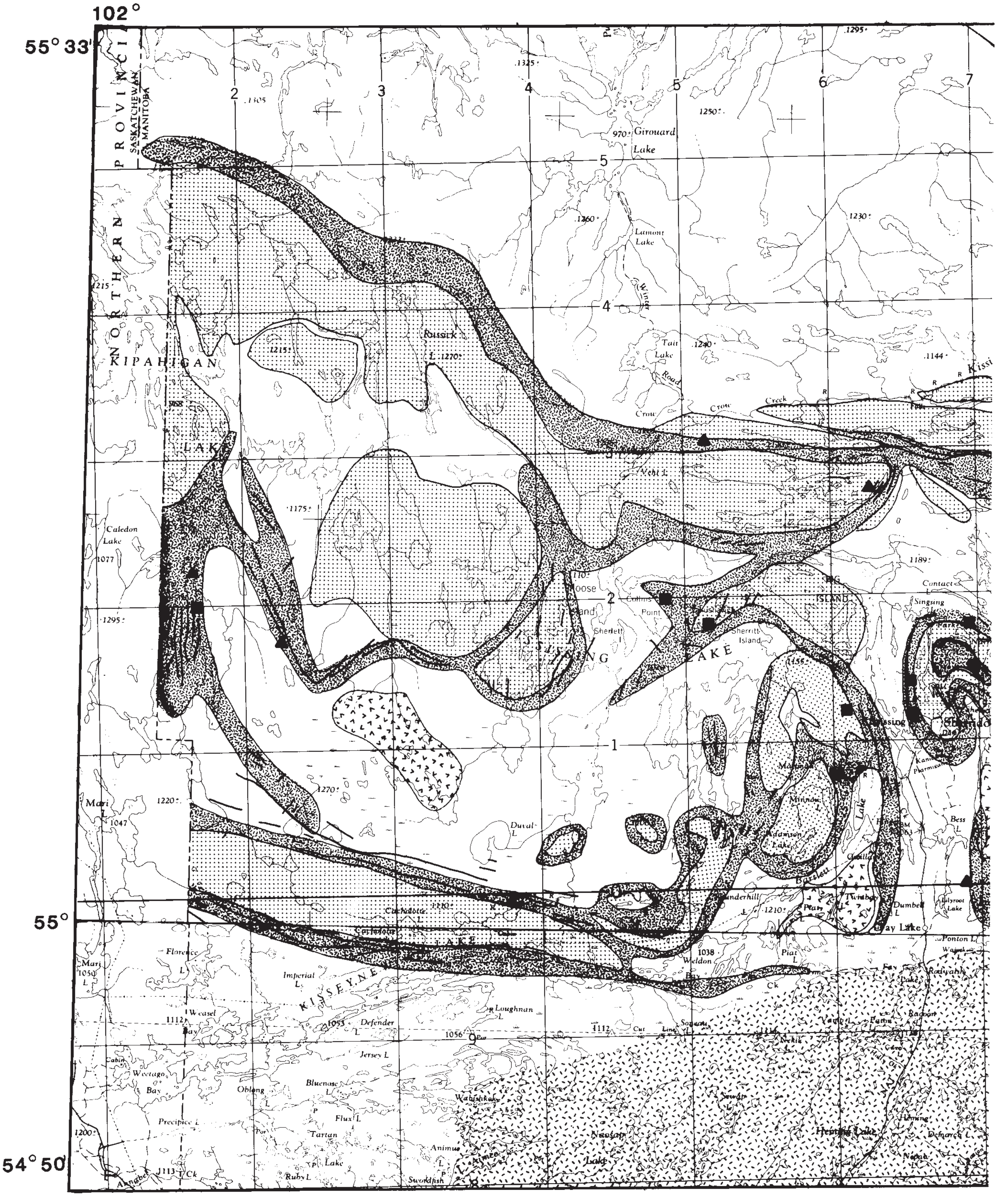
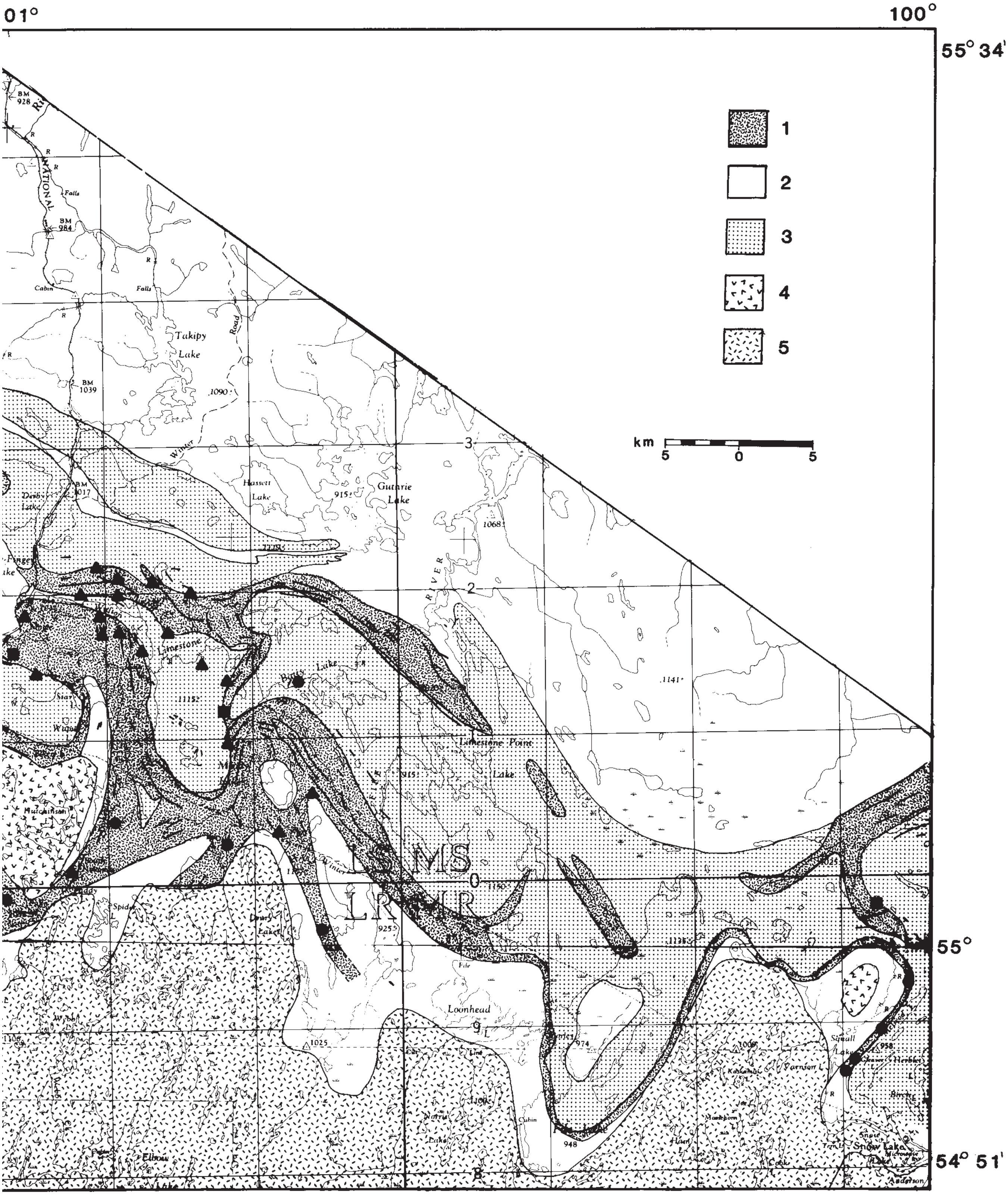


Figure GS-18-1: Geologic sketch map of the southern flank of the Kisseynew gneiss terrain illustrating the approximate distribution of major lithologic units, electromagnetic conductors (from non-confidential assessment files), base and precious metal occurrences and the 'Kisseynew metallotect'. Legend: 1. 'Kisseynew metallotect'; 2. Metagreywacke and granitoid gneiss; 3. Meta-arkose; 4. Felsic intrusions; 5. Metavolcanic, metasedimentary and intrusive rocks of the



Flin Flon greenstone belt. Electromagnetic conductors are indicated by solid discontinuous lines. Gold occurrences are indicated by a circle; Solid sulphides with copper and zinc rnineralizationare indicated by a square; Trace copper and/or zinc and/or lead rnineralization is indicated by a triangle.

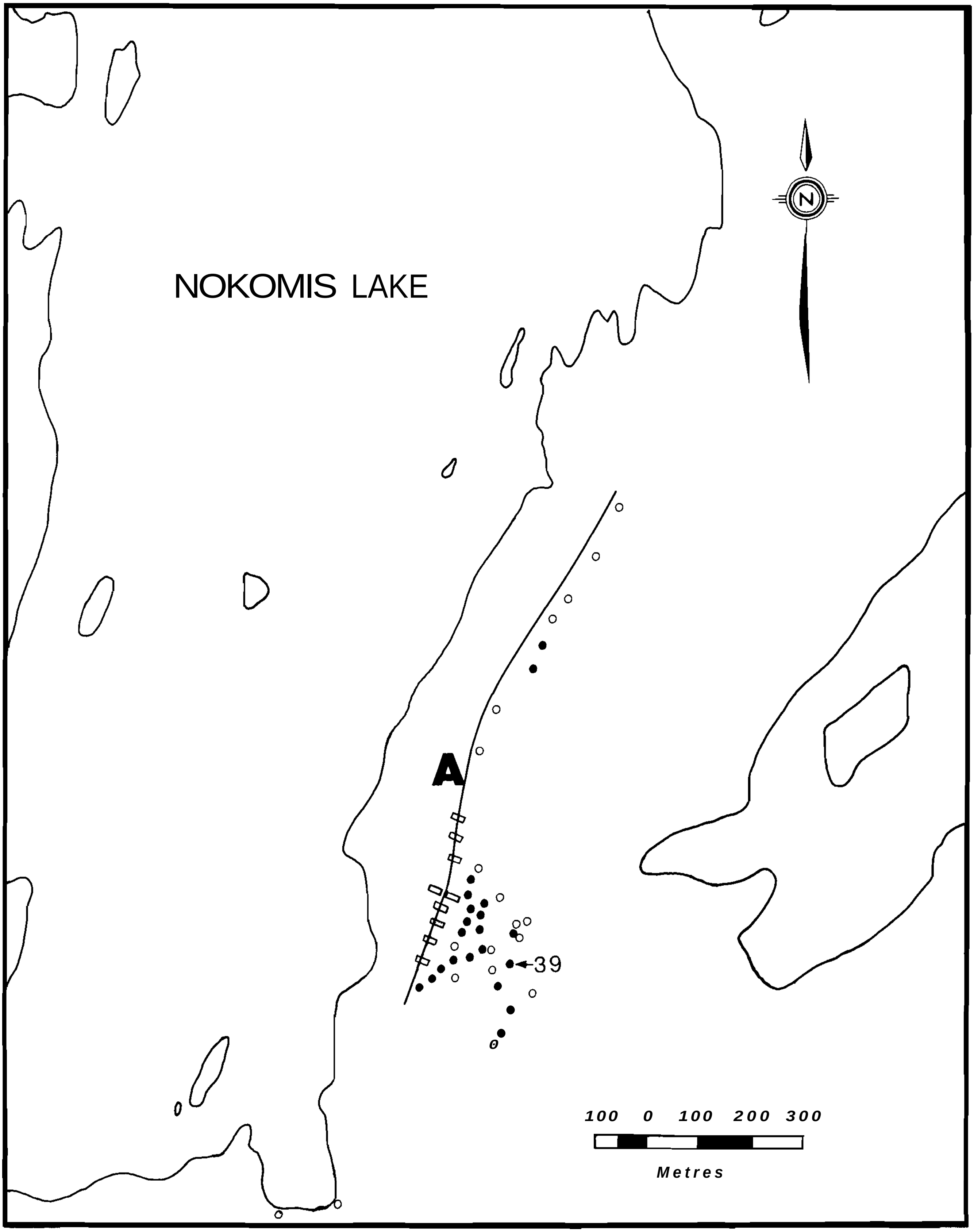


Figure GS-18-2: Location of quartz-rich gneiss and minor sulphide mineralization (A) at the Nokomis Lake gold deposit. Solid circles represent diamond drill holes with drill core intersections assaying 0.1 oz/ton Au or greater. Rectangles represent trenches (cf. Fig. GS-18-3).

WOOD LAKE

Robertson (1950) indicates that gold occurs in association with chalcopyrite, arsenopyrite and galena immediately to the west of Wood Lake. The old workings were again searched for but not located (cf. Gale, 1981). A conglomeratic unit similar to that structurally overlying the Puffy Lake deposit was observed in the vicinity of the prospect location shown by Robertson. Further work is needed in this area to establish if this 'occurrence' is located at the same stratigraphic position as the Evans, Nokomis and Puffy Lake occurrences.

SQUALL LAKE OCCURRENCES

Five gold occurrences are shown along the margins of a 'biotite diorite' (unit 14e; Harrison, 1949) in the Squall Lake-McLeod Lake area. A reconnaissance of several of these occurrences revealed:

a) the gold mineralization is associated with disseminated sulphides;
b) the 'biotite diorite' is a well layered mafic metasedimentary and/or metavolcanic rock and is not an intrusive rock unit; and
c) the gold occurrences are all located in the same portion, i.e., near the easternmost margin of the metasedimentary mafic rock unit.

Although a direct stratigraphic correlation of the gold occurrences cannot be established at this time, the following observations warrant this consideration:

a) stratabound gold mineralization occurs in association with a layered mafic metasedimentary/metavolcanic rock unit;
b) the gold-bearing mafic rocks are structurally overlain by quartzofeldspathic metasedimentary rocks (unit 9 of Harrison. 1949);
c) the mafic rocks are underlain by psammo-pelitic rocks (unit 5, Harrison, 1949) that are probably less metamorphosed equivalents of the psammo-pelitic rocks in the Nokomis group;
d) unit 4 of Harrison (1949) which outcrops on the north shore of Squall Lake and structurally underlies the psammo-pelitic rocks (unit 5) is identical to psammitic rocks of the Nokomis Group. A schematic cross-section through the Squall Lake area is given in Figure GS-18-6.

REGIONAL INTERPRETATION

Massive sulphide deposits of the Sherridon region appear to be hosted by a thin unit of highly variable volcanic and sedimentary rocks located between thick sequences of dominantly metagreywacke, known as the Nokomis Group, and dominantly quartzofeldspathic rocks referred to as the Sherridon Group (Gale, 1981). Since the known gold occurrences in this area are located within this sequence of volcanic and sedimentary rocks, the unit is tentatively designated the 'Kisseynew metallotect'. An initial definition of this metallotect (Fig. GS-18-1), has been compiled using: a) available geological maps (1" = 1 mile and 1.50 000 scales) to determine the approximate boundary between the greywacke and quartzo-feldspathic sequences; and b) available geophysical data from the Mineral Resources Division assessment files to establish sulphide and graphite conductors that occur predominantly near or within the greywacke-arkose contact zone. It is envisaged that this contact zone represents a sediment starved interval in the development of the basin, a brief period of mafic volcanism and increased fumarolic activity as witnessed by the abundant sulphide-rich and graphite-rich sedimentary rock layers.

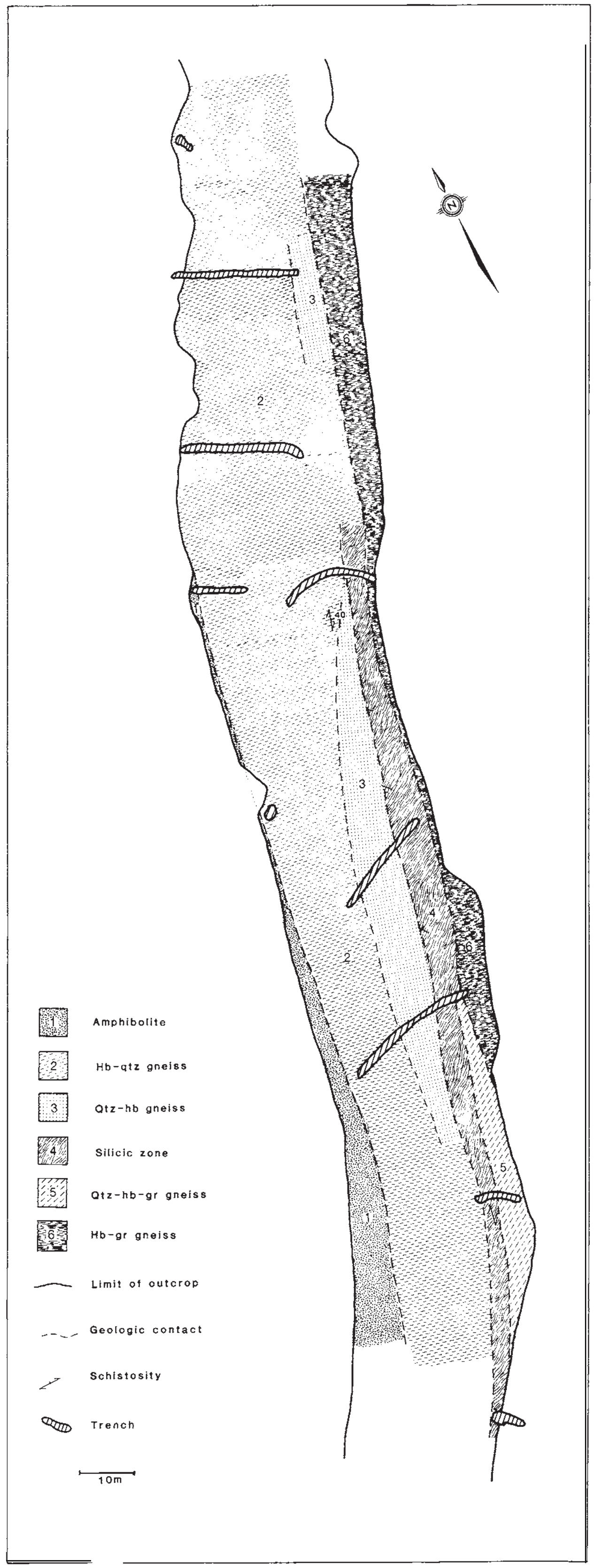


Figure GS-18-3: Sketch map of the geology and trench locations at the Nokomis Lake gold deposit.

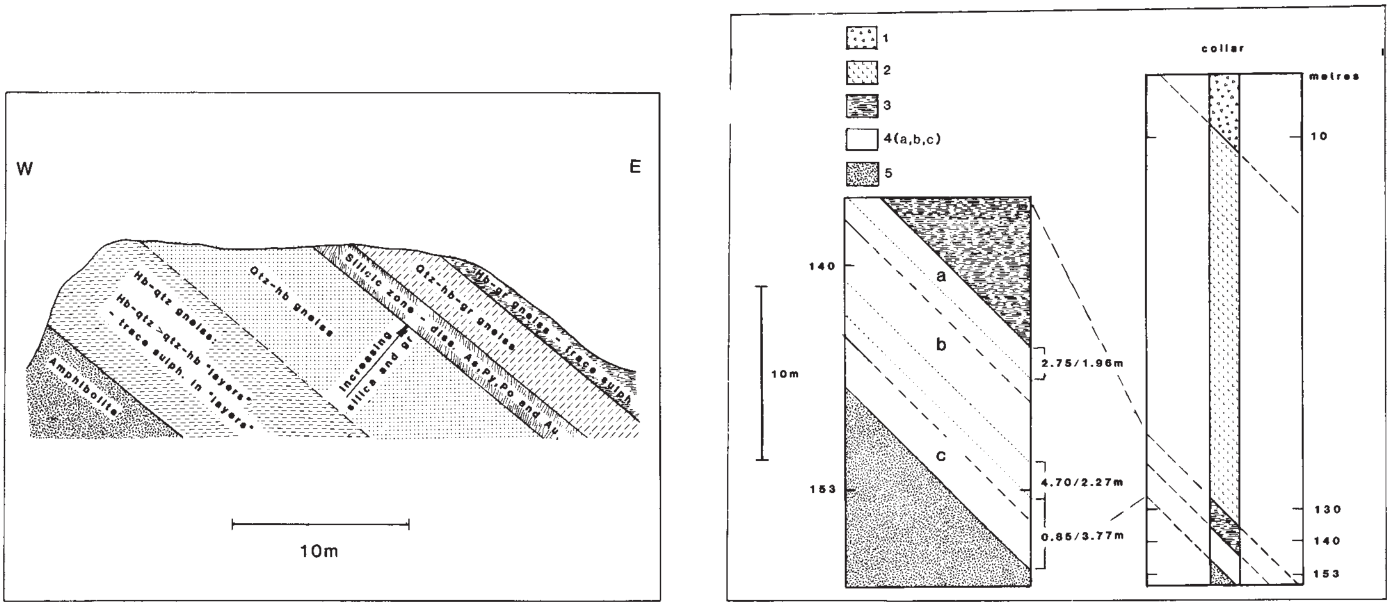


Figure GS-18-4: Comparison of east-west schematic sections from outcrop (left) and D.D.H. no. 39 (cf. Fig. GS-18-2) illustrating the stratigraphic position of gold mineralization at the Nokomis Lake deposit. Legend: 1. Hornblende-biotite gneiss; 2. Garnetiferous quartz-feldspar-biotite gneiss; 3. Garnetiferous hornblende gneiss; 4. Mineralized zone: a. Grey to dark banded siliceous gneiss; b. Grey and green banded siliceous gneiss; c. Granitized gneiss; 5. Hornblende gneiss. Gold intersections in the D.D.H. are expressed in grams/tonne/metre. All drill hole information from Mineral Resources Division open assessment file 90658.

Assay data were not required for filing of assessment work in Manitoba until recently. Consequently, most of the assessment data in the Division's files does not contain gold assays. Since galena, arsenopyrite, chalcopyrite and minor amounts of pyrrhotite and pyrite are associated with known gold occurrences in the 'Kisseynew metallotect', indications of these minerals from drill log data in the assessment files and from other sources are superimposed on the metallotect shown in Figure GS-18-1 in an attempt to give an idea of potential for gold in the Kisseynew gneiss terrain.

It is anticipated that the regional mapping program initiated by the Geological Services Branch (Zwanzig, 1983, 1984) and detailed property mapping by the authors and others will result in a better definition of the 'Kisseynew metallotect'. The ideas presented here have been put forward, in an attempt to delineate 'favourable' areas that the prospector and explorationist might investigate further. A definitive statement on the origin and location of gold mineralization in the Kisseynew metallotect must await completion of documentation and detailed mapping scheduled over the next few years.

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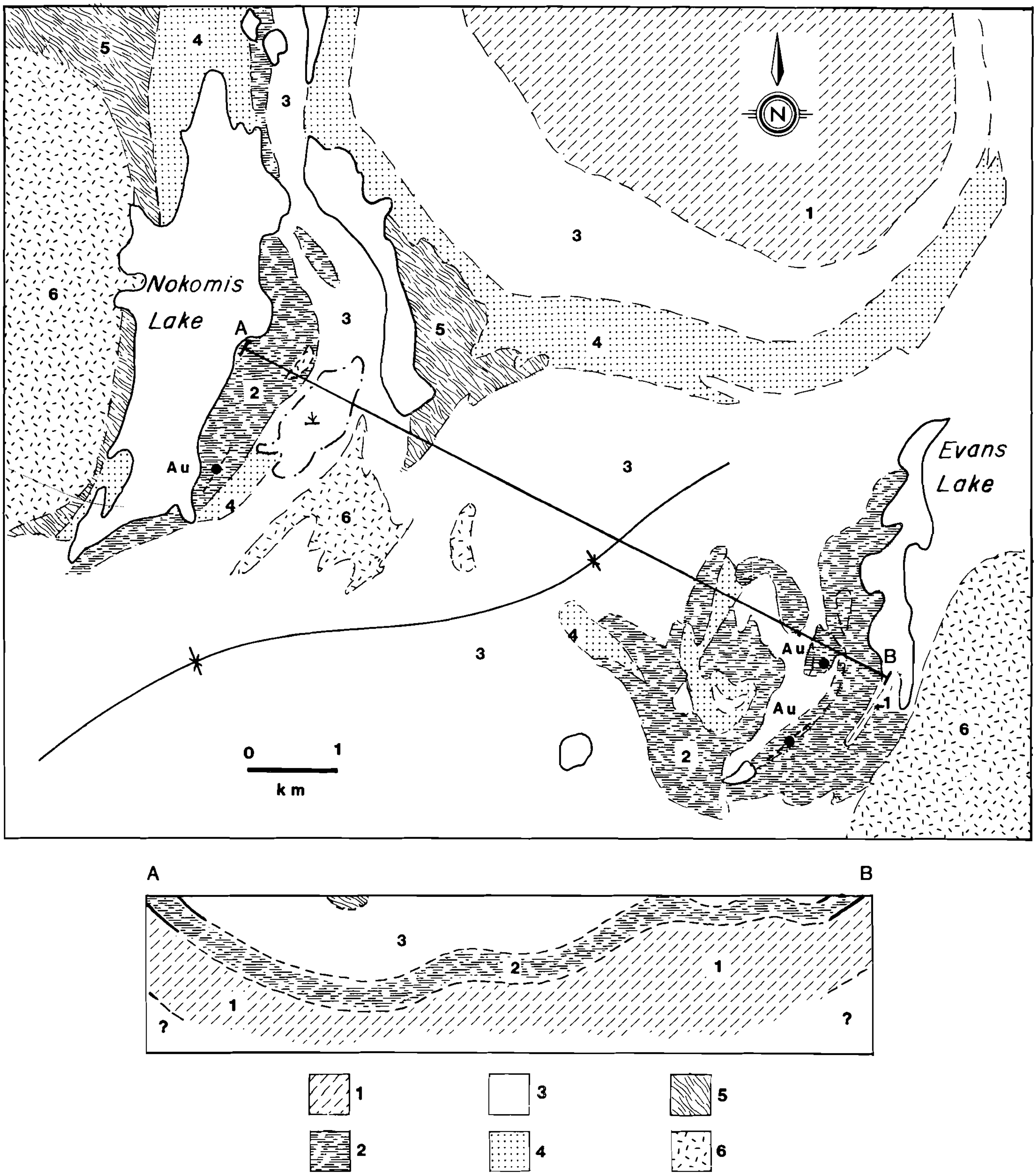

Figure GS-18-5: Geological map of the Nokomis and Evans (Kay) Lakes area (modified after Robertson, 1950) indicating distribution of major lithologic units with schematic cross-section illustrating a major synformal structure. Legend: 1. Quartzofeldspathic metasedimentary rocks (Sherridon Group?); 2. Amphibolites and quartz-rich gneiss containing zones of sulphide and gold mineralization; 3. Metagreywacke of the Nokomis Group; **4.** 'Granitized' units 2 and 3, undifferentiated; 5. Granitoid oligoclase-quartz gneiss; 6. Late granitic intrusive rocks.

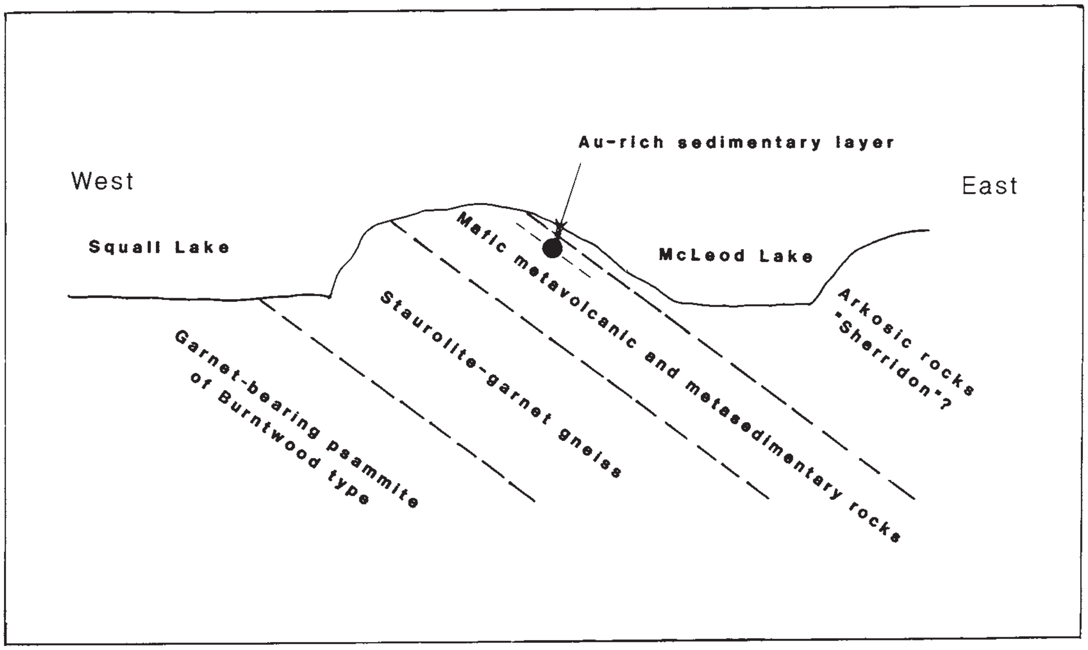

Figure GS-18-6: *Schematic section illustrating the stratigraphic position of gold mineralization at the Squall Lake deposits.*

GS-19 MAGNETIC SUSCEPTIBILITIES OF PRECAMBRIAN ROCK UNITS IN THE FLIN FLON-SNOW LAKE REGION

by D. Hall[1] and T. Millar[1]

Susceptibility measurements on outcrops in the area (Fig. GS-19-1) and on core samples from the area were made with a Scintrex SM-5 **in situ** susceptibility meter during the period June 20 to July 20, 1984. The purpose of the measurements was to aid in the interpretation of vertical gradient airborne magnetometer surveys being carried out by the Manitoba Department of Energy and Mines, and the Geological Survey of Canada.

Each outcrop was sampled at an average of 25 points in a one-metre grid, and 240 outcrops were sampled. These were reached by road, rail and boat.

Cores in the core library at Grace Lake, The Pas, were sampled at 1 m intervals for 108 drillholes in the study area, giving a total of approximately 6,500 measurements. Statistical analysis of the data is in progress.

[1]University of Manitoba, Winnipeg

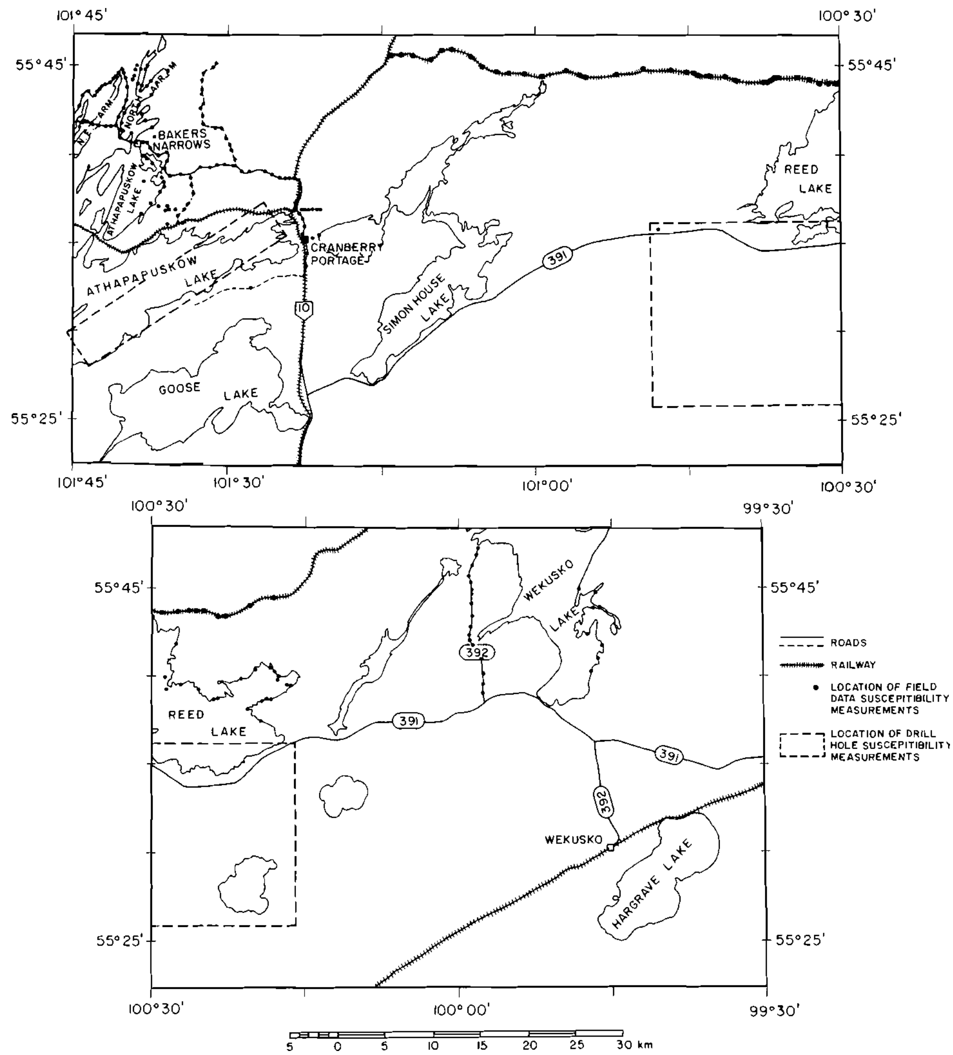

Figure GS-19-1: Preliminary map of surface outcrops sampled in the study area. Two of the principal areas covered by drillholes sampled are shown. There are four other such areas not shown on this preliminary map.

GS-20 PROJECT CORMORANT - SUBPALEOZOIC INVESTIGATIONS

SOUTH OF FLIN FLON AND SNOW LAKE

by W.D. McRitchie and I. Hosain

Between 1980 and 1983 the Geological Survey of Canada undertook airborne vertical gradient (gradiorneter) and total field magnetometer surveys over the Project Cormorant area (Fig. GS-20-1) as part of co-operative programming with the Provincial Geological Services Branch, conducted under the Federal/Provincial Northlands and Interim Mineral Agreements (McRitchie and Hosain, 1981, 1982, 1983). Contour maps at a scale of 1:20 000 were released jointly as GSC Open Files 756, 876, 877 and 937 and later as 1:50 000 scale experimental colour total field and gradiometer maps, the most recent of which were made available in the Spring of 1984:

	Total Field	Gradiometer
63J/5 - N 1/2	C20349G	C40090G
63J/12 - full sheet	C20350G	C40091G
63K/5 - NE 1/4	C20346G	C40087G
63K/6 - N 1/2	C20342G	C40083G
63K/7 - N 1/2	C20340G	C40081G
63K/8 - N 1/2	C20351G	C40092G
63K/9 - full sheet	C20352G	C40093G
63K/10 - full sheet	C20341G	C40082G
63K/11 - full sheet	C20343G	C40084G
63K/12 - E 1/2	C20347G	C40088G
63K/13- E 1/2	C20348G	C40089G
63K/14 - full sheet	C20344G	C40085G
63N/3 - E 1/2	C20345G	C40086G

"Scout" drilling was initiated by the Province in 1983 to test basement magnetic anomalies of unknown parentage in the area south of Athapapuskow, Reed and Wekusko Lakes. The program was extended this year, to the west, with the drilling of an additional 11 holes (Table GS-20-1; see also Report GS-36, McCabe; this volume). Numerous other potential drill sites are currently under consideration by the Provincial Geological Services Branch and Geological Survey of Canada, the ultimate objective being the creation and assembly of data that can be used to compile 1:250 000 scale synoptic geological interpretations for the Precambrian basement in NTS areas 63J and 63K. Another key component of the program will be to explore the potential of the region as an Exploration Technology Development Test Site, and in this context several of this year's drill holes were used by the Geological Survey of Canada to test various borehole geophysical methods. The results of these investigations will be released in a series of open file reports by both organizations. A preliminary interpretation of the airborne magnetic surveys using all the data available for the region has recently been completed by the Provincial Exploration Services Section (Hosain, 1984).

TABLE GS-20-1
PROJECT CORMORANT DRILLING PROGRAM 1984
PRECAMBRIAN DRILL INTERSECTIONS
— SUMMARY DESCRIPTION

M-5-84 (Location 22)	Medium grained, equigranular, homogeneous, unfoliated biotite granite with minor opaques, trace apatite, sphene and secondary chlorite and epidote. Sporadic microcline megacrysts.
M-6-84 (Location 4)	Medium- to fine-grained weakly layered hybridized hornblende- and biotite-bearing diorite and other supracrustals. Hornblende, biotite and plagioclase all highly sieved and recrystallized into granoblastic mosaic. Layering defined by variations in hb, biotite and common opaques with associated apatite aggregates. Microcline restricted to isolated clots. Calc-silicate-rich layers and later cross-cutting pink pegmatite.
M-7-84 (Location 10)	Pronounced textural variation in layered heterogeneneous, igneous textured ultramafic with carbonate/quartz veinlets in upper 3-4 m. Patchy coarse grained sulphides from 24.05 to 24.58. Finer grained disseminated sulphides throughout with concentrations in coarser grained gabbroic zone near base of hole. Cumulitic opx, cpx and hb with oikocrystic phlogopite and pale green amphibole and serpentine. Pseudomorphous aggregates of opx and opaques may be after primary olivine cumulus phase. Accessory apatite and carbonate.
M-8-84 (Location 31)	Hornblende- and biotite-bearing fine grained microgranite with strongly kaolinized upper zone from 18.12 - 20.60 and slightly less altered zone from 20.45 to 23.30. Blue quartz eyes prevalent throughout lower section to base of hole where sand was encountered.
M-9-84 (Location 26)	Migmatitic hornblende- and biotite-bearing mesocratic gneiss with grey and white tonalitic **lits** and pink, younger, cross-cutting granitic phases. Thin dp- and hb-bearing pegmatitic **lits** at about 27 m. Strong magnetic response throughout.
M-10-84 (Location 30)	Equigranular coarse to medium grained unfoliated hornblende-, biotite- and epidote-bearing plagiogranite with sporadic fine grained hornblende-rich xenoliths and pronounced bleached zone from 23.55 to 23.80. Abundant myrmekite and generally strained and undulose texture. Epidote alteration of the larger plagioclase crystals.
M-11-84 (Location 29)	Homogeneous equigranular coarse- to medium-grained hornblende- and biotite-bearing plagiogranite with scattered epidote, altered sphene and accessory apatite; containing finer grained hb-, bo- and ep-rich rafts and sporadic poikiloblastic microline. Minor thin plagioclase- and quartz-bearing veinlets.

M-12-84 (Location 27)	5 cm weathered and bleached zone in coarse to medium grained inequigranular hornblende-, biotite-, epidote- and sphene-bearing pink and grey plagiogranite with antiperthitic plagioclase and sporadic poikiloblastic microclines containing seed laths of partially albitized plagioclase. Sphene overgrowths on sphene; accessory apatite, secondary carbonate, and common pink veinlets of aplite and pegmatite.
M-13-84 (Location 13)	Hornblende and plagioclase amphibolite-, dioritic-magnetite-bearing gneiss with accessory biotite, quartz, opaques and apatite. Upper 6 m highly altered with possible kaolinite-carbonate-quartz and spotted biotite remnants.
M-14-84 (Location 24)	Heterogeneous medium- to coarse-grained foliated granitoid gneiss cut by later pink granite and pegmatite veins. Highly weathered and variegated zone from 27.35 to 30.26 with thin white and purple clay intervals may be surficial boulder or debris deposit.
M-15-84 (Location 32)	Graphitic and quartz-chlorite schists and metasediments with quartz veins and pyrite stringer mineralization. Minor biotite-bearing quartz-chlorite schists near base of hole. Incipient strain slip axial cleavage sporadic. Core axis near-parallel to layering.

Abbreviations:
bo = biotite; cpx = clinopyroxene; dp = diopside; ep = epidote, hb = hornblende; opx = orthopyroxene

For complete drill logs refer to Report *GS-36,* this volume

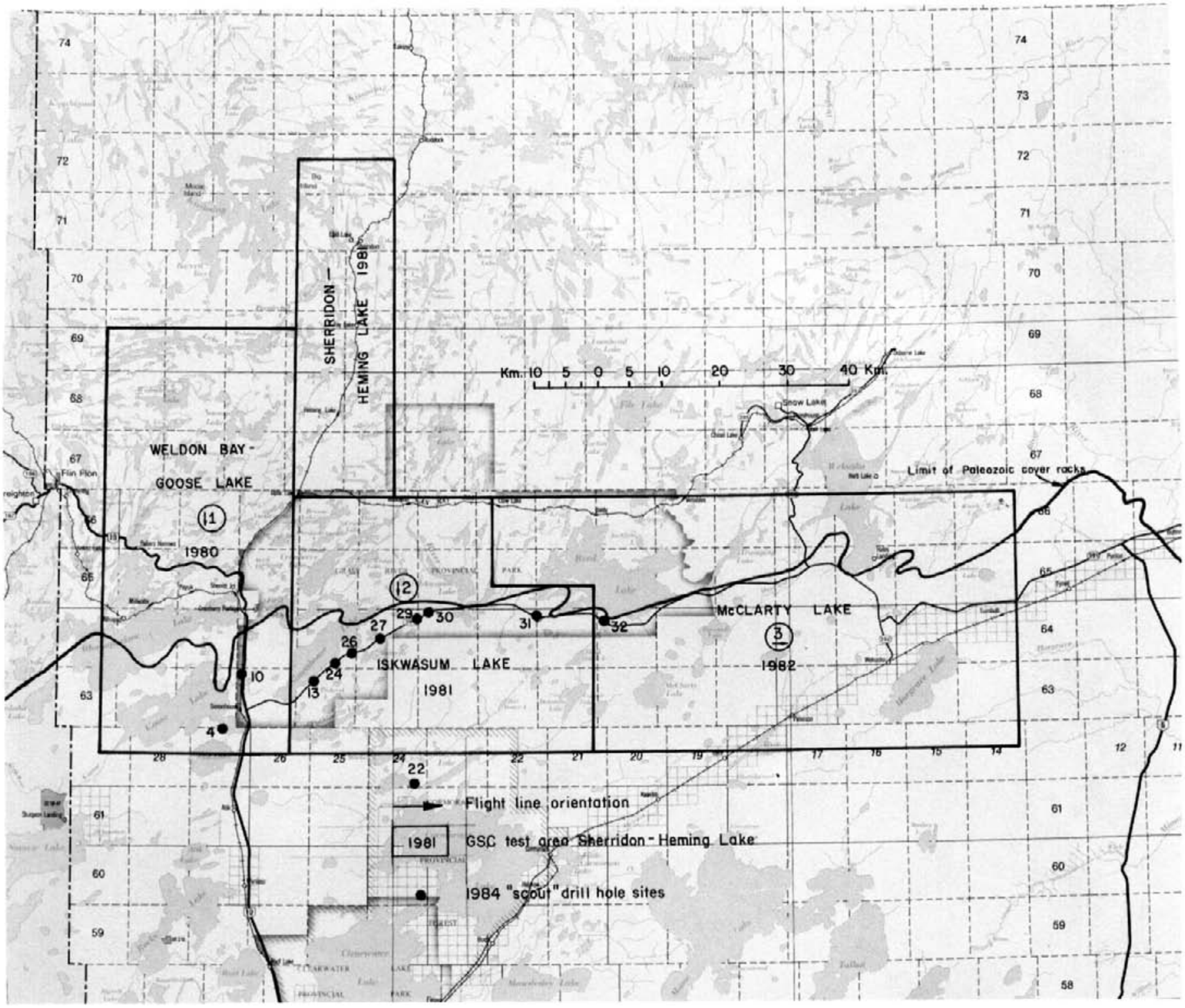

Figure GS-20-1: Gradiometer surveys in the Project Cormorant area and locations of "scout" drilling 1984 (see also Report GS-36, this volume, by McCabe).

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GS-21 WALLACE LAKE PROJECT

by D. Gaboury[1] and W. Weber

Mapping on a scale of 1:20 000 was carried out between Wallace Lake and the abandoned Jeep gold mine north of Highway 304.

The objectives were to document whether the supracrustal rocks of the Conley gold showing and "Limestone Hill" strike into the Jeep gold mine area, as tentatively proposed by Theyer (1983, Fig. GS-17-3) and whether the area between the Jeep mine and Wallace Lake contains supracrustal rocks with potential for gold mineralization.

The results of mapping indicate[2] that the Jeep gabbro (as compiled by Weber, 1971, from Stockwell, 1945) is an inhomogeneous gabbroic body with abundant leucogabbroic to dioritic zones and layers, minor anorthosite layers and widespread fine grained plagiophyric and hornblende (after pyroxene)-phyric phases, similar to dykes occurring in the Rice Lake area.

Locally, e.g., near the Johnston gold showing, the gabbroic rocks are strongly layered due to variations in the ratio of plagioclase to mafics and/or variations in ductile shearing.

The tonalitic rocks immediately north of the gabbro and the granodiorite south of the gabbro contain evidence of variable ductile strain and recovery rates leading to protomylonite, ultramylonites and augen gneiss (Wise et al., 1984). Mylonites generally cross-cut earlier sheared rocks in a northwesterly direction (see Map 1984R-1). North of the gabbro, quartz-phyric gneisses are either porphyroblastic gneisses or deformed "quartz-eye granites" as known from the Gold Lake area (Weber, 1971). The gabbro is intruded along its southern contact by granodiorite. However, shearing locally obliterates the original relationship. The northern contact is generally more sheared, including the adjacent gabbroic and granitoid rocks, thus precluding the establishment of original relationships. The Johnston gold showing is situated at this sheared contact. North of the gabbro near the Johnston showing, sheared tonalite contains mafic inclusions which could represent mafic dykes or earlier mafic supracrustal rocks. Migmatized metasediments as mentioned by Johnston (1960) and Theyer (1983) were not encountered. There are no mineral assemblages or anatectic mobilizates which would indicate that temperature conditions of metamorphism were high enough to produce migmatization. The simple intrusive relationships indicate a high level, relatively cold environment during intrusion of the granitoid rocks.

Metasedimentary rocks of interlayered oxide-silicate (± minor sulphide) facies iron formation, garnetiferous greywacke and arkosic wacke, occur 1 km inland from the west shore of Wallace Lake within tonalitic rocks. These metasediments are similar to those exposed along the north shore of Wallace Lake (see Gaba and Theyer, GS-25, this volume).

Results of the limited mapping did not indicate that supracrustal rocks of the Conley showing and "Limestone Hill" continue towards the Jeep mine, although isolated, possible rnetasedimentary inclusions were encountered in the gabbro.

[1]University of Manitoba.

[2]Because of premature termination of the project, the survey is less detailed than originally planned.

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GS-22 U-Pb ZIRCON GEOCHRONOLOGY PROJECT,

RICE LAKE GREENSTONE BELT

by A. Turek[1] and W. Weber

The objective of the 2-year project funded through an Applied Geoscience Agreement under the Canada-Manitoba MDA is to determine the temporal evolution of the Rice Lake greenstone belt to aid in establishing stratigraphic and/or intrusive/hydrothermal parameters for the control of gold mineralization and thus to assist mineral exploration in the region.

This summer A. Turek and 2 students collected samples from 12 volcanic and intrusive units. The geological data base for collection and interpretation of units is from Weber (1971a, b) and Stockwell (1938).

The samples are now being processed at the University of Windsor for preparation of zircon concentrates. Next year, A. Turek and a co-worker will conduct isotopic analyses of the zircons at the geochronology laboratory of the University of Kansas.

Present geochronological data from the Rice Lake area consist of Rb-Sr whole rock and mineral ages (Turek, 1971; Turek and Peterman, 1968, 1971), and K-Ar mica ages (see Turek, 1971). No U-Pb zircon ages had been undertaken prior to this study.

Fifty kilometres west, in the Black Island area, the following U-Pb zircon ages have been determined and interpreted by Ermanovics and Wanless (1983) in the western extension of the Rice Lake greenstone belt:

2999 ± 10 Ma - meta-tonalite, basement to the greenstones
2900 ± 10 Ma - quartzofeldspathic gneiss (meta-dacite?)
2732 ± 10 Ma - rhyodacite breccia, stratigraphically below Hole River metasediments which are correlative with San Antonio Formation
2715 ± 10 Ma - granodiorite gneiss, intrudes (?) volcanic rocks
2690 ± 10 Ma - paragneiss and orthogneiss, English River gneiss belt, metamorphic age(?)

[1]Department of Geology, University of Windsor, Windsor, Ontario

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GS-23 MINERAL DEPOSIT INVESTIGATIONS IN THE RICE LAKE GREENSTONE BELT

by P. Theyer

Geological studies of the Rice Lake greenstone belt concentrated on:

investigations of exposures of the San Antonio Mine (SAM) unit east of Rice Lake; rock sampling and geological observations in the Jeep-Johnson area; and the Beresford Creek-Moore Creek area

SAM UNIT

Outcrops of the SAM unit (Fig. GS-23-1) (Theyer, 1983) were mapped in detail and a continuous sample was cut through the unit with rock saws. A thorough examination of textural and compositional characteristics will be undertaken as a follow-up to studies of the SAM unit in the San Antonio Mine (Theyer, 1983). An approximately 215 m profile across the thickness of the SAM unit (Fig. GS-23-2) indicates a highly sheared rock sequence of variable composition. Several rock types were delineated, although positive identification of some delineated lithologies was hampered by shearing.

The southern boundary of the SAM unit consists of buff to grey quartz-sericite schists that are equated with the "footwall schists" of the SAM unit in the San Antonio Mine (Theyer, 1983). These schists are in sheared contact with a sequence of felsic volcanogenic sedimentary rocks, mafic to intermediate volcanic rocks and a unit of amygdaloidal intermediate volcanic flows. The quartz-sericite schists are in contact on their northern boundary with an approximately 90 m thick unit of intermediate to felsic tuff and volcanogenic sedimentary rocks. They are characterized in part by a buff mottled appearance ("pinhead variety" of the SAM unit; Theyer. 1983). Pyrite, ankerite and iron oxide contents increase north of the 90 m mark (Fig. GS-23-2). Iron enrichment culminates in an approximately 1 m thick magnetite chert iron formation at the 95 m station. This iron formation grades into a gritty ferruginous sedimentary rock over a distance of approximately 2 m. Sporadic outcrops north of the 100 m station are of gritty, slightly mottled volcanogenic sedimentary rocks. A distinctive dark to light green homogeneous mafic volcanic flow that contains 5 per cent magnetite occurs at the 200 m station (a hydro pole foundation) and on several escarpments immediately to the north. Several kilometres to

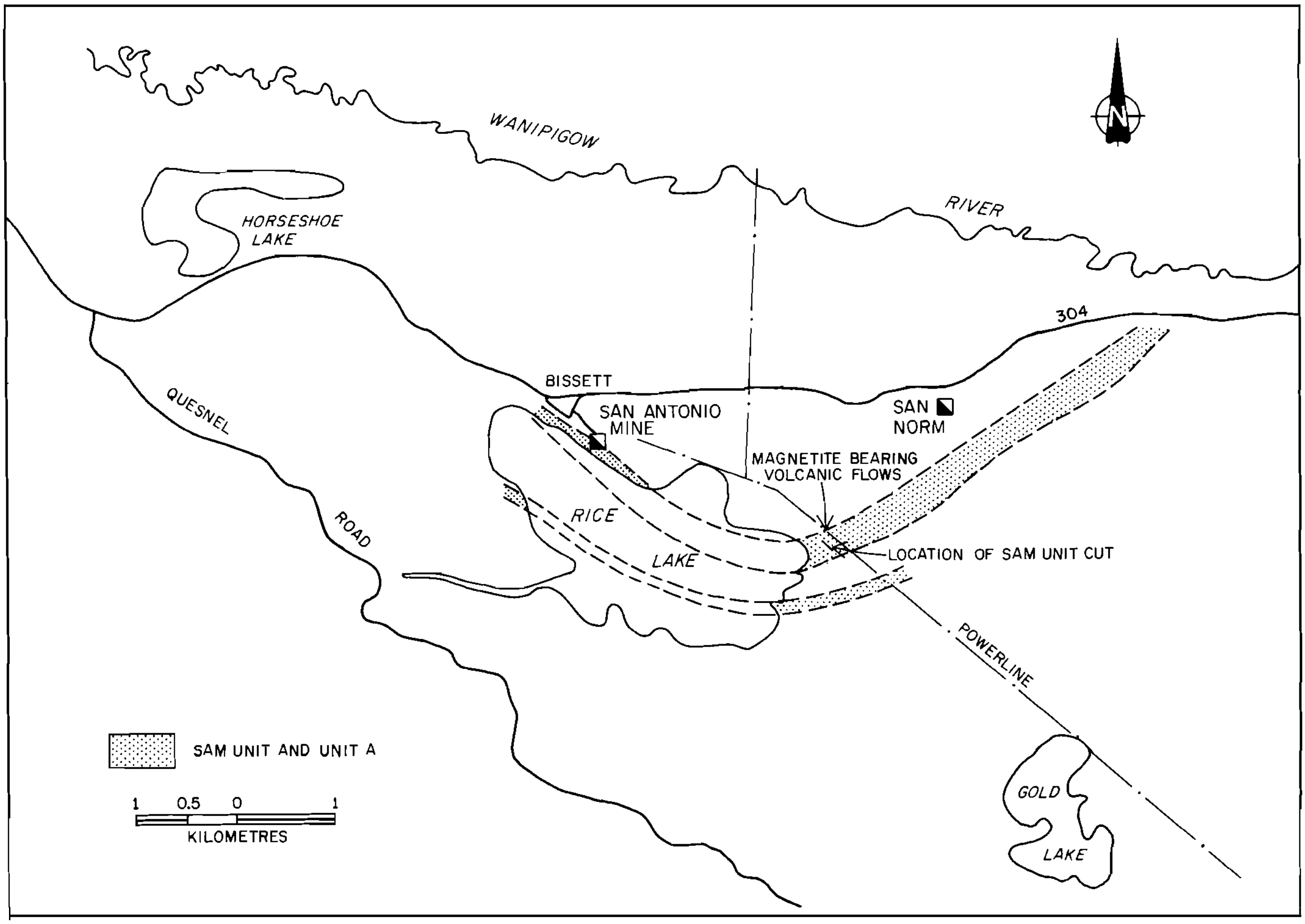

Figure GS-23-1: Geological sketch map showing the location of the rock cut across a part of the SAM unit and the location of the geological profile on Figure GS-23-2.

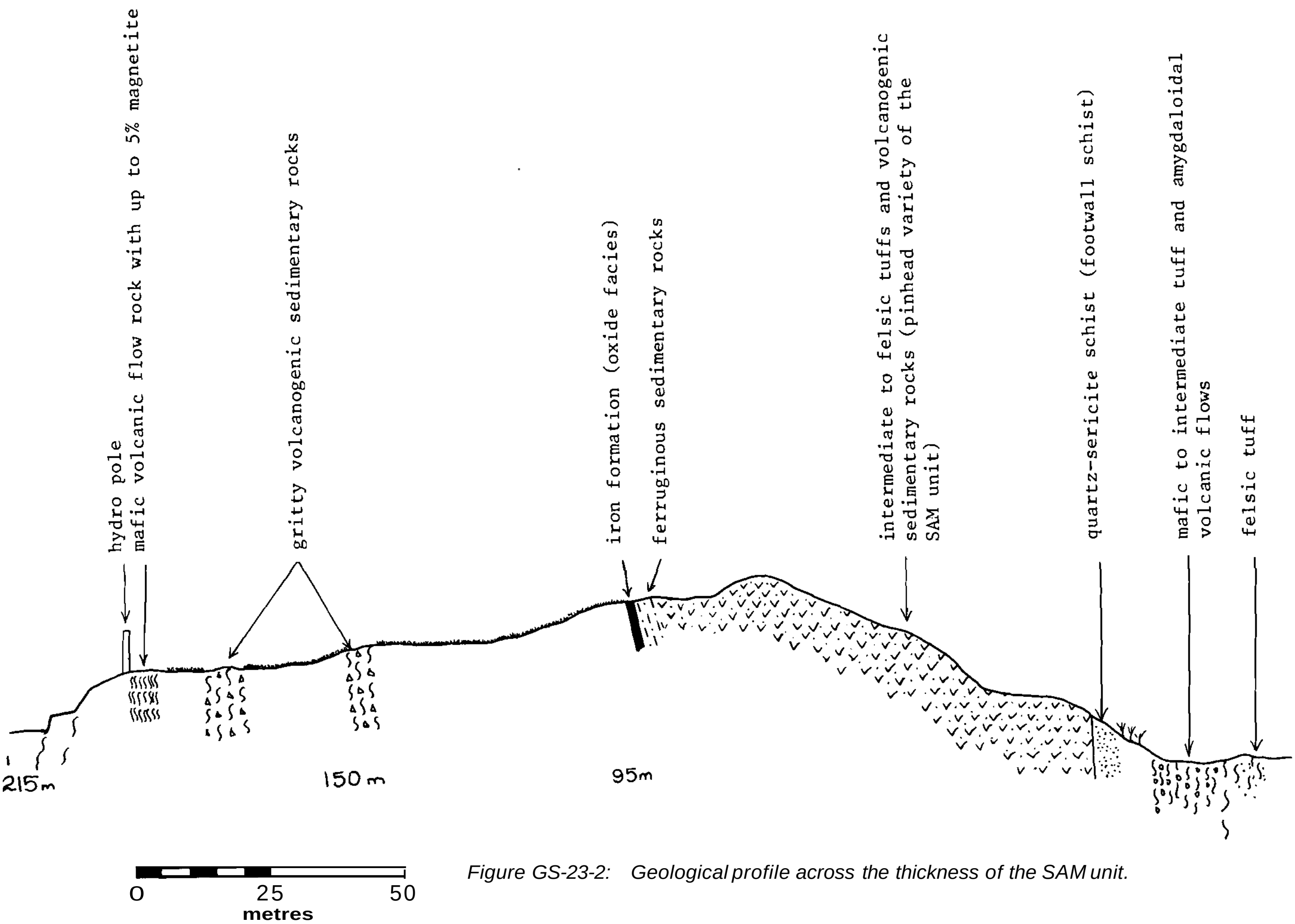

Figure GS-23-2: Geological profile across the thickness of the SAM unit.

the east of this profile at the San Norm gold occurrence (Fig. GS-23-1) this readily identifiable magnetite-bearing mafic flow and pillowed basalts were identified as part of the SAM unit. The rock units described above, with exception of the magnetite-chert iron formation, were recognized as part of the SAM unit in the underground workings of the San Antonio Mine during the 1983 field season.

JEEP-JOHNSON AREA

Preliminary observations in 1983 indicated that gold in detrital source rocks may have been mobilized during metamorphism to form the Jeep, the Johnson and possibly other, as yet unrecognized, gold occurrences (Theyer, 1983). The Jeep-Johnson area was systematically sampled for a rock geochemical survey (Fig. GS-23-3).

Traverses across the rock sequence in the Jeep area, the Johnson area, the area west of Limestone Hills and near Wallace Lake. revealed that a remarkable continuity exists in both distribution and composition of lithologies. A composite profile (Fig. GS-23-4) indicates from south to north a suite of shear-folded rhyolitic tuffs that are in contact with felsic volcanogenic detrital rocks with metre-thick rhyolitic flows and tuff layers with up to 5 per cent magnetite. In addition they contain metre-thick layers of mafic volcanogenic sedimentary rocks and minor magnetite-chert iron formation. They are also characterized by centimetre-thick epidotized feldspar-enriched layers that are interpreted to be the result of a late metasomatic event.

A gradational increase in the degree of metamorphism to the north is evidenced by feldspar and quartz blastesis that results in a quartz-feldspar augen gneiss. This gneiss with intercalated chert and rhyolitic layers crops out approximately 250 m north of the provincial highway in the Johnson showing area. Rocks north of a 30 m wide east-trending swampy topographic depression are quite different in composition from the augen-gneiss. They consist of grey-green paraconglomerate with randomly oriented pebbles, cobbles and breccia fragments that include mafic to intermediate volcanic and intrusive rocks supported by a matrix of gritty feldspathic and chloritized hornblende material. Metre-thick layers of greywacke and fine grained grey sedimentary rocks are intercalated with the conglomerates.

A few hundred metres north of the Johnson showing highly metamorphosed felsic grits are remarkably similar to felsic grits south of the showing. The geological sketch map (Fig. GS-23-3) shows the

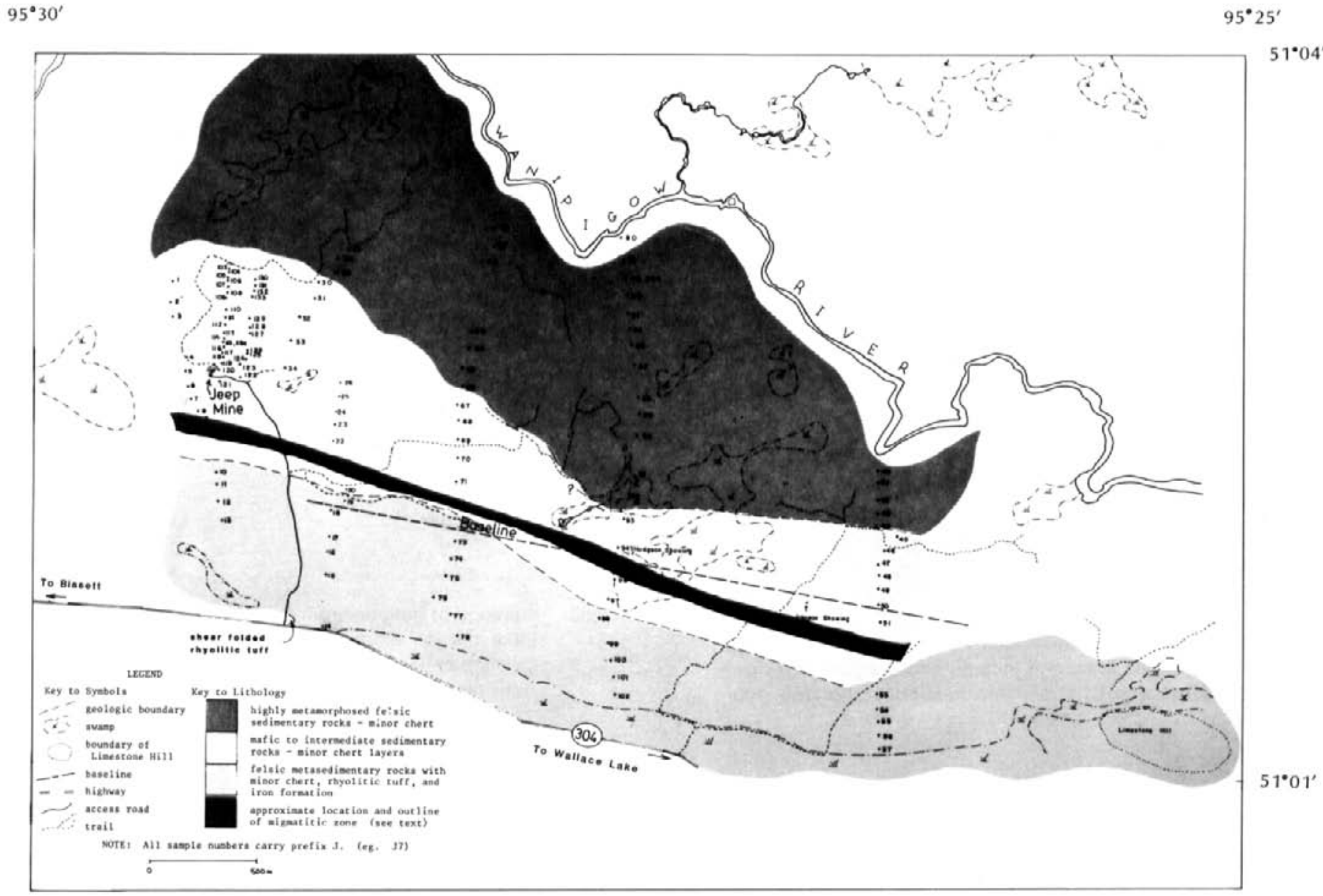

Figure GS-23-3: Geological sketch map of the Jeep-Johnson area showing rock sample locations, rock units and the migmatite zone.

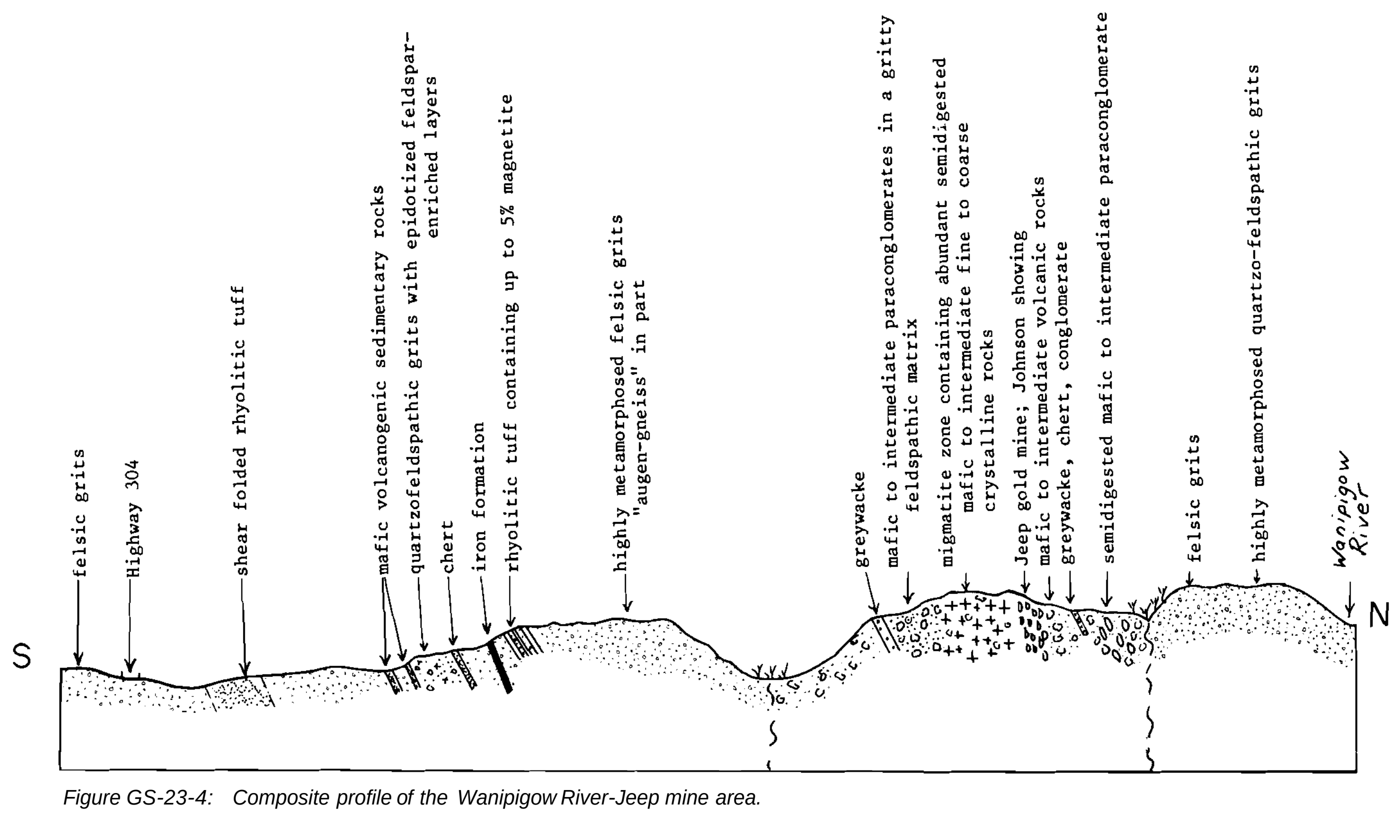

Figure GS-23-4: Composite profile of the Wanipigow River-Jeep mine area.

relationship between these units. It is proposed that the central, predominantly mafic detrital unit is fault-bounded on its northern and southern boundaries and is either a horst or a graben.

A migmatite zone (Fig. GS-23-3) in which mobilization and injection of feldspar and quartz is evident also contains abundant semi-digested relicts ("ghosts") of mafic to intermediate fine to coarse crystalline rocks. This eastward-striking zone of very high grade metamorphic rocks occurs 35-40 m south of the Jeep and the Johnson gold occurrences.

The Johnson gold occurrence (Fig. GS-23-3) comprises an array of quartz veins containing disseminated pyrite, pyrrhotite and rare visible gold in feldspathic grits with minor layers of quartz pebbles, pelites and fine- to coarse-grained intermediate volcanogenic sedimentary rocks.

BERESFORD CREEK-MOORE CREEK AREA

The Beresford Creek-Moore Creek area (Fig. GS-23-5) is underlain by northeast-striking arkose, minor quartzite, mafic volcanogenic sediments and minor interbedded argillite. Chert beds are evident in the eastern portion of this rock sequence. Rocks adjoining these sediments to the east consist predominantly of massive, pillowed and gabbroic textured basaltic flows and include a magnetite-chert iron formation ranging from 2 cm to 50 m in thickness but of short (50-100 m) length. This iron formation contains magnetite and greenalite intercalated with arkose and chert layers.

Intense sericitization, epidotization and disseminated sulphides (pyrite, bornite, sphalerite and malachite) appear to be closely associated with shear zones A, B and C (Fig. GS-23-5).

The field observations will be complemented by rock geochemistry since this area is thought to be the extension of the Wallace Lake-Siderock Lake rock suite.

The author acknowledges the contribution of a detailed geological base map of the area by Vic Colcleugh. This map facilitated subsequent reinterpretation of the geology as well as systematic sampling. Mapping and sampling of the Beresford-Moore Creek area was carried out by B. Mattison whose contribution is also gratefully acknowledged.

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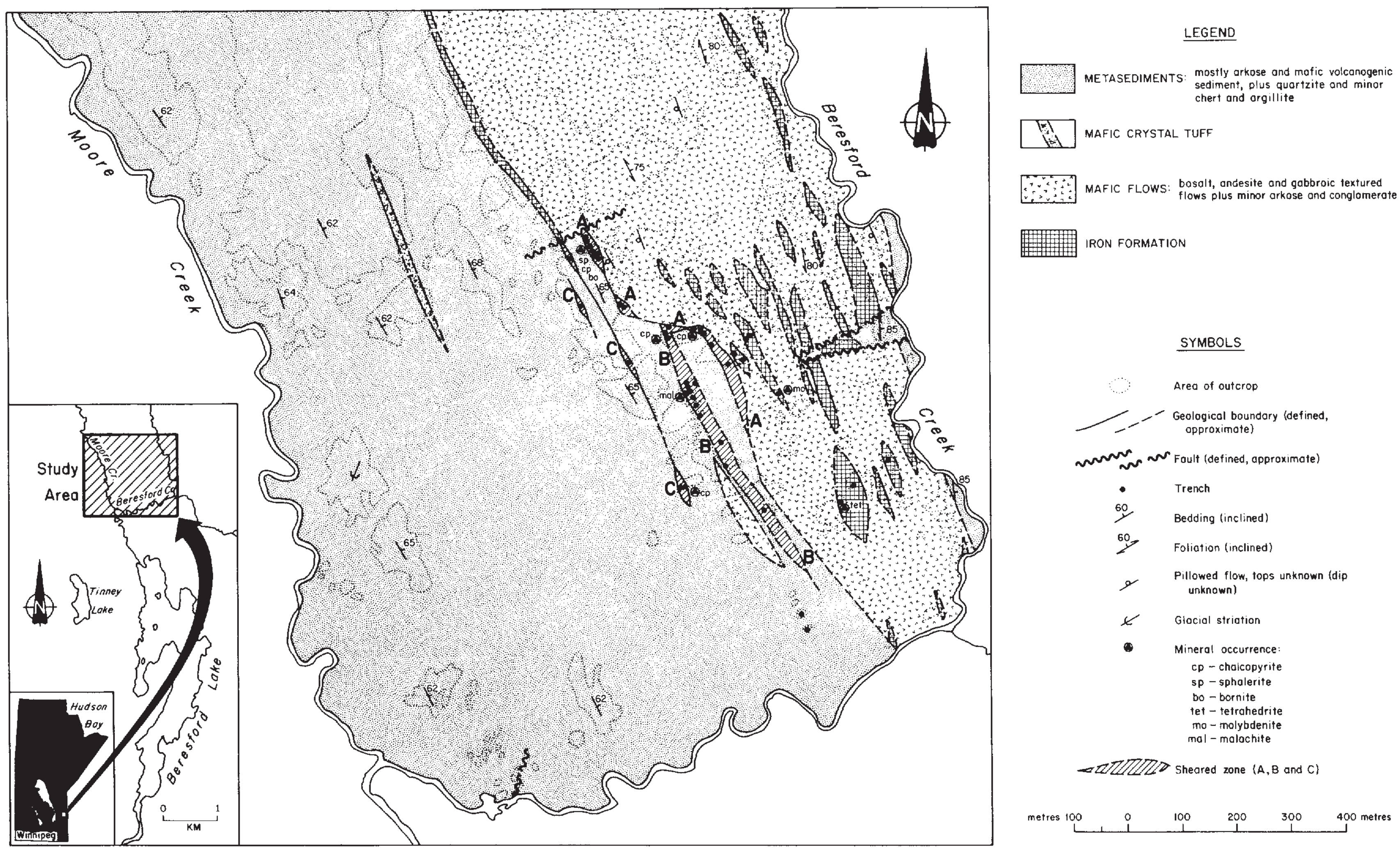

Figure GS-23-5: Geological map of the Beresford-Moore Creek area.

GS-24 MINERAL DEPOSIT DOCUMENTATION IN THE BISSETT AREA

by R.H. Schmidtke

INTRODUCTION

The documentation and inventory of mineral occurrences in the Rice Lake greenstone belt are some of the objectives of the Mineral Investigations Section. In 1984 this work concentrated on an investigation of mineral occurrences in the vicinity of Rice Lake. Information on the occurrences studied is available upon request.

Information on each mineral occurrence includes at least:

1) an accurate location on an aerial photograph at a scale of 1:16 370;
2) a detailed map that includes evidence of exploration activity such as trenches, shafts, rock dumps, and drill holes; and
3) a suite of representative rock samples collected for chemical and petrographical investigations.

Selected mineral occurrences were mapped and sampled in more detail. The location of each occurrence investigated is shown on Figure GS-24-1. The descriptive data are summarized in Table GS-24-1. Many of these occurrences were located by reference to geological maps by Stockwell (1938). The remaining occurrences were found from information available in open assessment files and/or from directions provided by local prospectors.

MINERAL OCCURRENCES

Mineral occurrences in the Rice Lake area are generally hosted by quartz veins, lenses and stringers that are associated with shear zones. Gold assay values have been documented for only a few of these occurrences.

Quartz occurrences in shear zones usually contain minor amounts of pyrite. Chalcopyrite and/or malachite occur at several localities. Carbonatization is erratic in both the quartz veins and the sheared wall rocks.

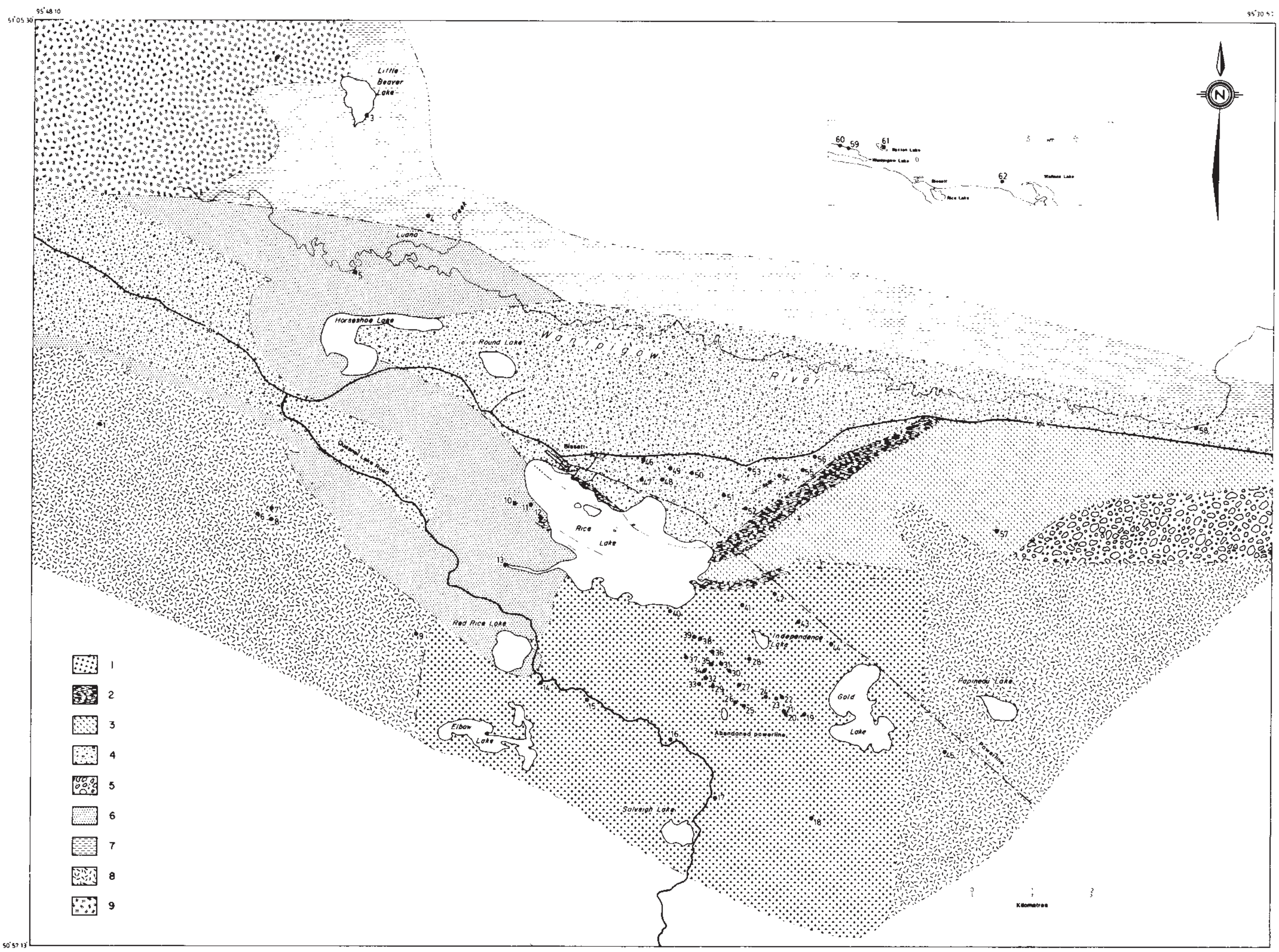

Figure GS-24-1: Location of mineral occurrences with respect to general geology in the Rice Lake Area. Legend: 1. Massive, porphyritic and fragmental felsic volcanic rocks; 2. SAM unit; 3. Intermediate to mafic volcanic rocks, gabbro; 4. Tuff breccia, crystal tuff and felsic sediments; 5. Volcanic breccia; 6. San Antonio Formation, mainly feldspathic quartzite; 7. Banded tuff, greywacke, chert and iron formation; 8. Quartz diorite; 9. Granodiorite.

TABLE GS-24-1
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE BISSETT AREA

Location Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness, Length of Exposure	Reference*
1	1 trench: 30 m x 2 m x 1 m	F.g. and c.g. eu. py, carbonate in quartz vein; malachite	Sheared grey granite	0.3 m, 130 m	
2 (Pound-maker)	2 shafts, rock dump and diamond drill core	Diss. py, bands of po and carbonate in quartz vein; malachite; mariposite?	Sheared granodiorite	6 m	Stockwell (1938) Map 810A
3	1 trench: 6 m x 2 m x 2 m	Diss. py in quartz vein; 1 cm band of sp and diss. cp in wall rock	Sheared porphyritic, tuffaceous intermediate volcanic rock	1 m	
4	1 trench 29 m x 1 m x 1 m	Diss. py, cp and visible gold in quartz lenses and stringers; fuchsite; diss. py in host rock	Layered felsic and intermediate tuff	1 m	
5	3 trenches	Eu. py in quartz vein; diss. py in sheared wall rock	Sheared feldspathic quartzite	1 m	
6	Shallow trenches	Minor diss, py in quartz	Monzonite	0.5 m	
7	1 shaft 2 trenches: 5 m x 2 m x 1 m 1 m x 1 m x 0.5 m	Diss. py and 1.5 cm bands of py in quartz vein	Sheared granodiorite with minor iron staining	1 m	
8 (Apex)	1 shaft (covered) 2 trenches 3 m x 1 m x 1 m 3 m x 1 m x 1 m	Diss. py and 1 cm of py in quartz bands	Sheared granodiorite with minor iron staining	1 m	
9 (Gilbert Vein)	6 trenches	Py and minor cp in rose quartz vein; diss. py, carbonate in wall rock	Raft of sheared mafic rock in quartz-feldspar porphyry	1 m	Stockwell (1938) Map 810A
10	Outcrop stripping, shallow trenching	Trace py in veins and stringers of quartz	Feldspathic quartzite, minor iron staining	2 m	Stockwell (1938) Map 458A sheet 1 loc. 48
11	1 trench: 8 m x 1 m x 2 m	Diss. py	Feldspathic quartzite, iron staining		
12	1 trench	Trace py	Feldspathic quartzite, iron staining		
13	4 trenches: 4 m x 1 m x 1.5 m 3 m x 2 m x 2 m 4 m x 3 m x 1.5 m 2 m x 1 m x 1 m	Diss. py in quartz stringers	Feldspathic quartzite, iron staining		Stockwell (1938) Map 458A sheet 1 loc. 47
14	1 trench: 10 m x 3 m x 1 m diamond drill holes	F.g. and c.g. eu. py, and minor cp in quartz vein; malachite and azurite	Sheared felsic breccia	15 m	
15 (Yankee Girl)	Trench along outcrop edge	Minor carbonate in quartz vein	Conglomerate	18 m	
16 (Sosueme)	1 adit 12 trenches	F.g. and c.g. eu py in quartz vein and host rock; malachite and azurite	Sheared felsic fragmental; conglomerate; quartz porphyry	6 m, 60 m	

TABLE GS-24-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE BISSETT AREA

Location Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness, Length of Exposure	Reference*
17 (Pilot)	2 shafts, rock dump 30 trenches	F.g. and c.g. subh. py in quartz vein, minor carbonate; malachite	Sheared, laminated, porphyritic and fragmental felsic volcanic rock; quartz porphyry, iron stained in part	1 m, 600 m	
18 (Bengie)	2 shafts, rock dump and diamond drill core	F.g. and c.g. subh. py in quartz dump	Porphyritic felsic fragmental rock	1 m	
19 (Chicamon Vein)	1 shaft, rock dump 10 trenches	Diss. py on shear planes. c.g. subh. to eu. py in quartz veins and brecciated rock zones; minor carbonate	Porphyritic, massive and fragmental felsic volcanic rock	2 m, 55 m	Stockwell (1938) Map 460A sheet 3 loc. 24
20 (Fox Vein)	3 trenches: 2 m x 2 m x 2 m 2 m x 2 m x 1 m 2 m x 2 m x 1 m	Py and carbonate in quartz vein; malachite	Sheared felsic fragmental rock	2 m	Stockwell (1938) Map 460A sheet 3 loc. 25
21	3 trenches	Py in brecciated zone	Porphyritic felsic volcanic rock	15 m	
22	9 trenches	Diss. py and carbonate in quartz veins and brecciated zones	Porphyritic and fragmental felsic volcanic rock	6 m, 90 m	Stockwell (1938) Map 460A sheet 3 loc. 26
23	5 trenches	Diss. py and carbonate in quartz lenses and stringers	Sheared porphyritic and fragmental felsic volcanic rock	0.5 m	Stockwell (1939) Map 460A sheet 3 loc. 27
24	12 trenches	Diss. py, carbonate in quartz lenses; diss. py in sheared wall rock	Sheared porphyritic and aphanitic felsic volcanic rock	0.3 m, 100 m	Stockwell (1938) Map 460A loc. 29
25	2 trenches	Trace py in quartz vein	Sheared porphyritic and tuffaceous felsic volcanic rock	1.5 m	Stockwell (1938) Map 460A sheet 3 loc. 31
26	10 trenches	Minor quartz and carbonate stringers	Sheared felsic volcanic rock; quartz-feldspar porphyry		Stockwell (1938) Map 460A sheet 3 loc. 34
27 (Ranger)	1 shaft, rock dump 24 trenches	Diss. py and carbonate in quartz veins and on shear planes; malachite	Porphyritic felsic to intermediate volcanic rock	1.5 m, 220 m	Stockwell (1938) Map 460A sheet 3 loc. 32
28	2 trenches	Diss. py and carbonate on shear planes and in quartz stringers	Porphyritic felsic volcanic rock	1 m	Stockwell (1938) Map 460A sheet 3 loc. 35
29	1 trench 2 m x 2 m x 1 m	Diss. py	Quartz-feldspar porphyry	4 m	

TABLE GS-24-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE BISSETT AREA

Location Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness, Length of Exposure	Reference*
30	4 trenches 3 m x 3 m x 1 m 3 m x 3 m x 1 m 2 m x 1 m x 0.5 m 4 m x 3 m x 1 m	Diss. py and minor carbonate in quartz lenses and stringers; sericitization	Sheared quartz-eye rhyolite; quartz-feldspar porphyry	0.4 m, 30 m	Stockwell (1938) Map 460A sheet 3 loc. 37
31 (Golden Rod Vein)	31 trenches	Diss. py in quartz lenses, stringers and on shear planes	Sheared felsic fragmental and tuffaceous rock	1 m, 350 m	Stockwell (1938) Map 450A sheet 3 loc. 38
32	2 trenches: 5 m x 1 m x 1 m 7 m x 2 m x 1 m	Diss. py and cp in quartz lenses and stringers	Sheared felsic fragmental rock	1 m	Stockwell (1938) Map 450A loc. 41
33	1 trench: 13 m x 2 m x 1.5 m	Carbonate in quartz stringers; sericitization	Sheared felsic fragmental rock	7 m	Stockwell (1938) Map 460A sheet 3 loc. 43
34	3 trenches 4 m x 2 m x 1 m 6 m x 2 m x 1 m 3 m x 2 m x 1 m	Diss. py and carbonate in quartz veins and stringers	Sheared felsic fragmental rock	2 m, 70 m	Stockwell (1938) Map 460A sheet 3 loc. 42
35	7 trenches	Carbonate in quartz veins and stringers; sericitization	Sheared felsic fragmental rock	2 m, 60 m	Stockwell (1938) Map 460A sheet 3 loc. 40
36	8 trenches	Diss. py in quartz lenses and stringers	Sheared felsic fragmental and tuffaceous rock	1 m	Stockwell (1938) Map 460A sheet 3 loc. 39
37	5 trenches	Quartz vein; stained in part	Extremely sheared felsic volcanic rock		Stockwell (1938) Map 459A sheet 2 loc. 45, 46
38	6 trenches	Minor carbonate in quartz lenses	Sheared felsic fragmental rock	1 m	Stockwell (1938) Map 460A sheet 3 loc. **44**
39	1 trench: 3 m x 2 m x 1 m	Brecciated zone, iron stained in part; trace py on shear planes	Sheared felsic tuff	0.1 m	
40	1 trench: 7 m x 3 m x 2 m	Carbonate on shear planes	Sheared felsic volcanic rock	3 m	
41	1 trench	Diss. py and carbonate	Sheared conglomerate	1 m	
42 (Independ-ence)	1 shaft, rock 27 trenches and diamond drill core	Diss. py in quartz lenses, stringers and brecciated zones	Porphyritic felsic volcanic rock	1.5 m, 230 m	Stockwell (1938) Map 460A sheet 3 loc. 36

TABLE GS-24-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE BISSETT AREA

Location Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness, Length of Exposure	Reference*
43	4 trenches: 3 m x 2 m x 1 m 2 m x 2 m x 1 m 1 m x 1 m x 1 m 3 m x 1 m x 1 m	Diss. py and carbonate in quartz vein	Felsic volcanic rock	0.3 m	Stockwell (1938) Map 460A sheet 3 loc. 28
44	4 trenches	Trace py and carbonate on shear planes and in brecciated zones; minor quartz stringers	Porphyritic felsic volcanic rock	1.5 m, 30 m	Stockwell (1938) Map 460A sheet 3 loc. 23
45 (September Morn)	3 trenches: 17 m x 2 m x 2 m 8 m x 5 m x 2 m 4 m x 2 m x 0.5 m	Diss. py in quartz lenses; malachite	Granodiorite, minor iron-staining	1 m, 30 m	Stockwell (1938) Map 461A sheet 4 loc. 21, 22
46 (Gold Cup)	1 shaft, rock dump	Trace py and carbonate in quartz vein	Felsic to intermediate tuff; minor iron-staining	1 m	Stockwell (1938) Map 464A sheet 7 loc. 11
47 (Big Four)	1 shaft, rock	Trace py in quartz dump	Felsic to intermediate crystal tuff	?	Stockwell (1938) Map 464A sheet 7 loc. 12
48 (Gold Standard)	2 shafts, rock dump, 1 trench: 13 m x 2 m x 2 m	Trace py in quartz vein	Sheared felsic to intermediate crystal tuff	1 m	Stockwell (1938) Map 464A sheet 7 loc. 13
49 (Gold Field)	1 shaft, rock dump	Trace py and carbonate in quartz dump	Felsic to intermediate crystal tuff	?	Stockwell (1938) Map 464A sheet 7 loc. 14, 15
50	3 trenches	Trace py and carbonate in quartz vein	Sheared felsic to intermediate tuff	0.5 m	Stockwell (1938) Map 464A sheet 7 loc. 16
51 (Emperor)	1 shaft, rock dump	Carbonate in quartz vein	Felsic to intermediate crystal tuff	?	Stockwell (1938) Map 464A sheet 7 loc. 18
52	2 trenches	Minor carbonate in quartz vein	Sheared conglomerate	0.4 m	Stockwell (1938) Map 463A sheet 6 loc. 18
53	1 trench: 4 m x 5 m x 1 m	Carbonate in quartz vein	Felsic to intermediate tuff	4 m	
54	1 trench: 7 m x 3 m x 2 m	Diss. py in quartz vein and wall rock; sericitization	Sheared felsic volcanic rock; brecciated in part	0.8 m	Stockwell (1938) Map 463A sheet 6 loc. 19

TABLE GS-24-1 (Continued)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE BISSETT AREA

Location Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness, Length of Exposure	Reference*
55	1 trench: 1 m x 1 m x 1 m	Trace py in quartz vein	Sheared mafic volcanic rock (pillowed?); epidote	0.2 m	Stockwell (1938) Map 463A sheet 6 loc. 20
56 (San Norm)	1 shaft, rock dump	Diss. py in rock dump	Sheared gritty sediment	?	
57 (F-Group)	22 trenches 27 diamond drill holes	Py and minor cp in alteration zone (silicified, pyritized)	Mafic volcanic rock	?	Open Assessment File #91130
58	2 trenches: 10 m x 1m x 0.5 m 1 m x 1 m x 0.5 m	Diss. py in quartz stringers	Felsic sediments	0.5 m	
59 (Grand Central)	1 shaft, rock dump	Carbonate in quartz vein	Sheared granodiorite	0.4 m	
60	1 trench lakeshore	Chert layer 20-30 cm with diss. py; magnetite	Chert, iron formation	4 m	
61 (Clinton)	1 adit 7 trenches	Carbonate in quartz vein; serpentinized and sericitized wall rock	Ultramafic rocks; granodiorite	2 m	Open Assessment File # 92422
62	3 trenches: 25 m x 1 m x 1 m 6 m x 1 m x 1 m 6 m x 1 m x 1 m	Diss. py in quartz vein; malachite	Silty sediments		

*References are to identify the source of the mineral occurrence location. The source locality number is included in this listing to enable cross-referencing of mineral occurrence.

Abbreviations: py = pyrite, po = pyrrhotite, cp = chalcopyrite, sp = sphalerite: diss. = disseminated, eu. = euhedral, subh. = subhedral; f.g. = fine grained, c.g. = coarse grained; loc. = location.

INDEPENDENCE LAKE AREA

This area is underlain by felsic to intermediate porphyritic, fragmental and tuffaceous volcanic rocks (Weber, 1971; Map 71-1/4). The occurrence explored by the Ranger Shaft typifies the mineral occurrences of this area. A shear zone in aphanitic and porphyritic felsic volcanic rocks contains quartz veins and stringers over 200 m of exposed strike length in a north-northwest direction. Minor pyrite and malachite are erratically distributed throughout the quartz veins and on shear planes in the wall rock. Gold assay values were reported to average 0.40 ounces/ton in a zone extending approximately 30 m southeastwards from the shaft. Low gold values, however, were obtained from the drill core intersecting quartz veins in the vicinity of the shaft (Stockwell, 1938).

RICE LAKE AREA (WEST)

Several mineral occurrences are contained in the San Antonio Formation. Exploration of this formation appears to have been concentrated on quartz veins and iron-stained areas.

Occurrences examined west of the San Antonio Formation are hosted by intrusive rocks (Fig. GS-24-1). Sulphide veins (approx. 1.5 cm thick) in quartz veins of the Apex Shaft (Loc.8) are quite typical of the area.

RICE LAKE AREA (EAST)

Several shafts east of Bissett are located in a dacitic to rhyodacitic crystal tuff (Weber, 1971; Map 71-1/4). Quartz veins, lenses and sheared wallrock contain trace to disseminated pyrite and minor carbonate. Reportedly 10,000 tonnes of gold ore have been mined in this area (Stockwell, 1938). Several mineral occurrences east of the Emperor Shaft (Loc. 51) are hosted by conglomeratic, felsic detrital and mafic volcanic rocks (Fig. GS-24-1).

F-GROUP

The F-group claim is located approximately 6.5 km east of Bissett (Loc. 57). An investigation of this property showed evidence of exploration in intermediate to mafic volcanic rocks. The volcanic rocks have been silicified and pyritized in the trenched area. Altered volcanic rocks were also observed approximately 0.5 km east of the trenches.

Gold values were obtained from blue quartz veins and a mineralized sheared mafic volcanic rock. Grab samples of quartz veins from

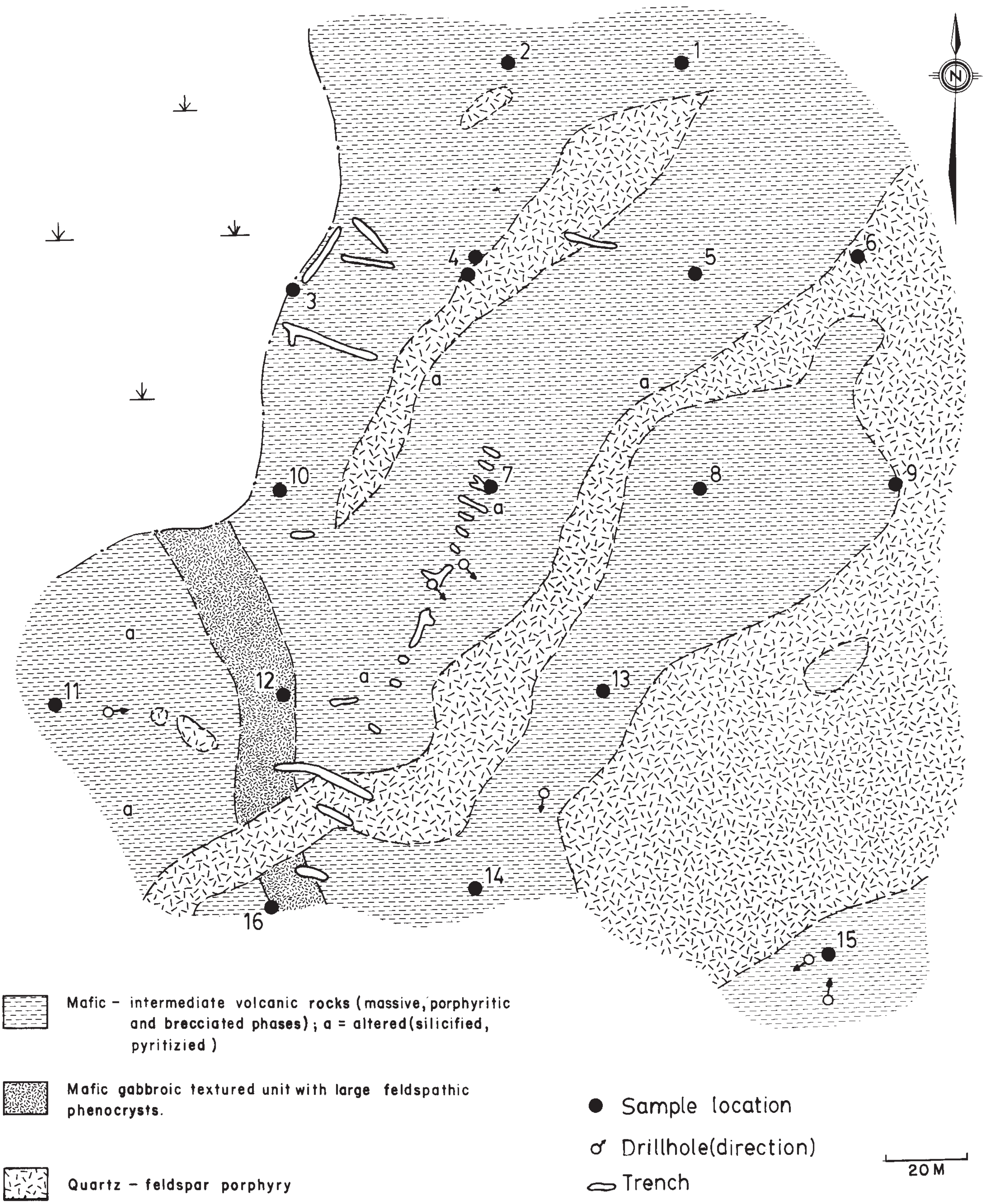

Figure GS-24-2: Geological sketch map of F-Group (Loc. 57). Trench locations after Gold Pan Mines, 1945 (Open Assessment File #91130).

the trenches were reported to assay 0.16 to 1.56 oz/ton of gold. Drill core from this property is reported to contain erratically distributed gold with assays ranging from trace to 434.7 oz/ton (Open Assessment File #91130).

A geological sketch map (1:100 scale) was prepared as a base for detailed rock sampling at 25 m intervals in the volcanic rocks (see Fig. GS-24-2).

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GS-25 THE GATLAN GOLD OCCURRENCE, WALLACE LAKE

by R.G. Gaba[1] and P. Theyer

The Gatlan gold occurrence, northern Wallace Lake (Preliminary map 1984), was mapped at a scale of 1:200. This work, complemented by petrographical and geochemical studies, is part of an investigation of gold mineralization that appears to be associated with oxide iron formation within cherty and garnetiferous sedimentary rocks. This study will contribute to a better understanding of several other gold occurrences in iron formation and cherty rocks that are present in the Wallace Lake area (Theyer, 1983).

The Gatlan gold occurrence was discovered in 1932. The property was explored by trenching, diamond drilling and two shallow shafts. It has been described in several different accounts as:

1) "a series of discontinuous quartz veins identified over 271 m and mineralized with arsenopyrite, pyrite and chalcopyrite occurring in a northwest-striking topographic depression interpreted to be the result of faulting" (Bull, 1934);
2) a mineralized vein in quartzite and garnetiferous rocks intruded by a diorite sill. A grab sample assayed 2.7 oz/ton gold (Russell, 1948);
3) a mineral occurrence in altered greywacke that was intruded by irregular dykes of metagabbro. A grab sample from the Gatlan shaft containing massive arsenopyrite assayed 1.52 oz/ton gold (Drilling report for San Antonio Mine, 1950).

The Gatlan gold occurrence consists of three shear zones transecting the main "Gatlan Shaft" that is mineralized with solid arsenopyrite. No other mineralized zones were detected in the vicinity of the pits and shafts; however, their presence cannot be discounted because a thorough search of the exploration pits and trenches is hindered by extensive development muck.

This occurrence is in a complex of detrital and chemical sedimentary rocks that interdigitate with massive and pillowed mafic volcanic flows. The stratigraphic column (Fig. GS-25-1) shows the mineralization to be stratigraphically underlain by thick and thinly bedded fine- to medium-grained felsic grit. These grits contain zones with oligomictic para-conglomerate interlayered with pillowed mafic volcanic flows. This extensive rock sequence corresponds to a "para-gabbro-sediment" rock sequence (McRitchie, 1971a, 1971b). These rocks are overlain by well layered quartz-rich sandstone, greywacke and siltstone beds that are interlayered with polymictic pebble and cobble para-conglomerate. Graded beds, crossbedding and dropstone uniformly indicate that tops are to the south. A stratigraphically higher rock sequence consists of massive, volcanogenic(?) grit, garnetiferous pelitic sediments, chert and thin intermittent bands of magnetite-chert-iron formation. This rock sequence is in turn overlain by felsic grit and volcanogenic quartz-feldspar-phyric sedimentary rocks that are interbedded with minor garnetiferous sediment layers. The stratigraphic column (Fig. GS-25-1) indicates a gradational change from a depositional environment characterized initially by many episodes of mafic volcanism, followed by coarse detrital sedimentation, to a depositional environment dominated by the deposition of fine grained detrital and chemical sediments (including iron formation).

Representative samples were taken from each of the rock units. Detailed samples of the garnetiferous sediments containing the oxide iron formation were collected at five locations. The sample locations are shown on the preliminary map 1984 R-2.

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[1]University of Western Ontario.

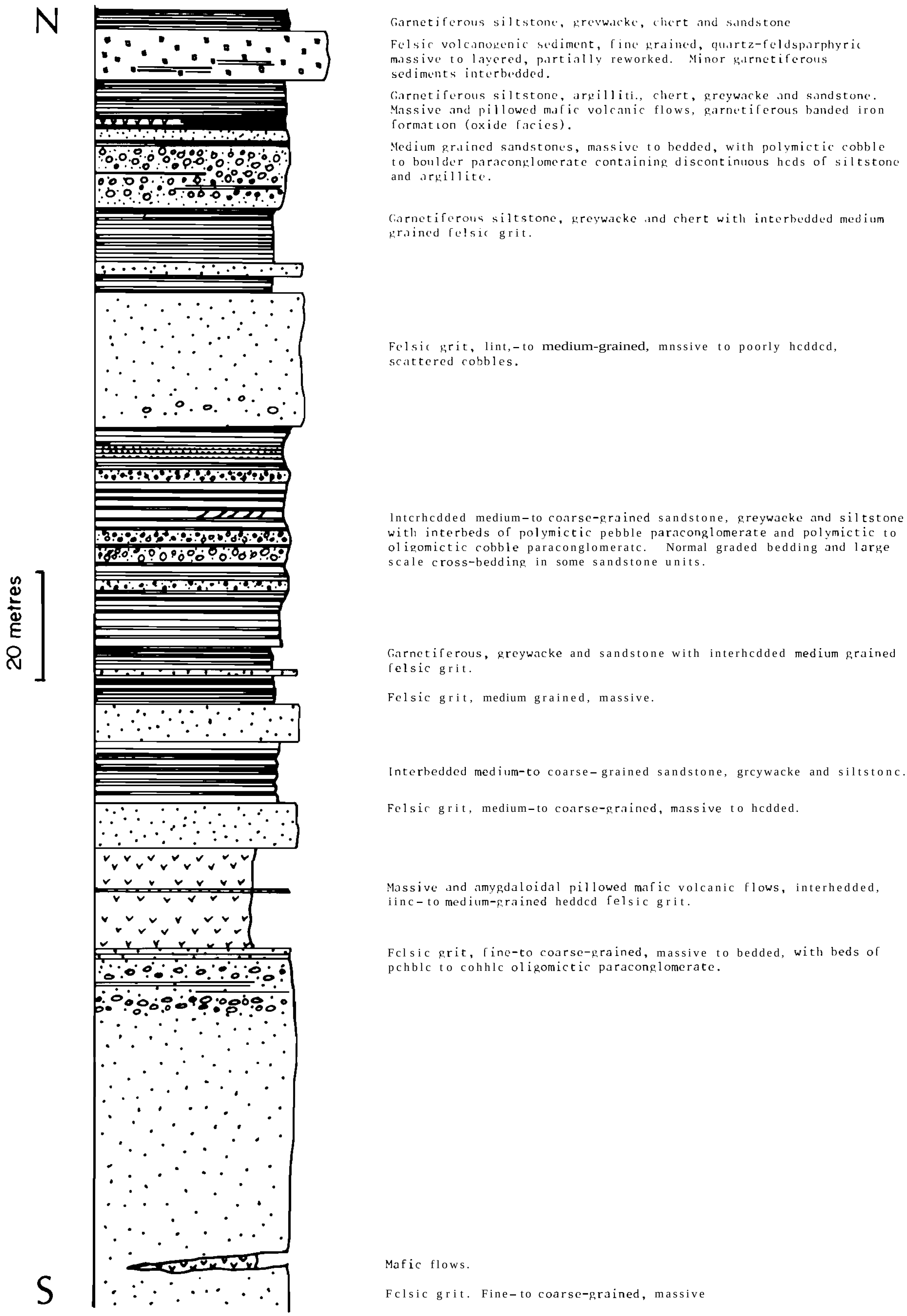

Figure GS-25-1: Stratigraphic column of the Gatlan area.

GS-26 EVALUATION OF MINERAL POTENTIAL: HORSESHOE LAKE AREA, SOUTHEAST MANITOBA

by D.A. Baldwin, M.A.F. Fedikow,

P. Theyer and G. Ostry

INTRODUCTION

A three-day reconnaissance was conducted to identify rock types and investigate mineralization in the Horseshoe Lake area. The area is underlain by felsic volcanic rocks that outcrop in a horseshoe-shape fold with the two limbs joining at Horseshoe Lake (Johnson, 1936; Ermanovics, 1970; Fig. GS-26-1). Outcrop is abundant, forming about 40% of the shoreline at Horseshoe Lake and 30% at Night Owl Lake, decreasing to 10 to 30% inland. Locally, there is 60% outcrop on the north limit of the belt. Lichen cover is extensive on all outcroppings

During this investigation exposures along the shoreline of Horseshoe Lake were examined. Three traverses were made into the south limb and the surface geology at one drill-reported mineral occurrence was examined.

GEOLOGY

The most common rock type observed at Horseshoe Lake is a massive, crystal-rich, granular textured, felsic volcanogenic sediment that appears to be redeposited felsic pyroclastic rocks. This rock occupies the central part of Horseshoe Lake where it has an apparent thickness of 3 km and is continuous from one side of the lake to the other. About 45 to 60% of this rock unit, (also present on the shoreline and northeast of Night Owl Lake), consists of crystals set in a fine grained homogeneous matrix. Plagioclase crystals make up 90% of the crystal content. They are euhedral to rounded, tabular to equant, are commonly broken and range in size from 0.5 to 3 mm and rarely 5 to 7 mm in length. Quartz crystals are equant, euhedral to rounded, 1 mm across and rarely up to 3 mm in diameter. Elliptical biotite clots, 2 to 3 mm long make up less than 5% of the rock and may represent metamorphosed rock fragments. Although variations in crystal content and grain size on a single outcrop can be identified, bedding planes were observed at only one shoreline locality at Night Owl Lake. There, graded bedding (Fig. GS-26-2), crossbedding (Fig. GS-26-3) and scour structures indicate a local north facing for the sequence.

The northern part of Horseshoe Lake is underlain by felsic flows that have a minimum aggregate thickness of 0.75 km. The flows are distinguished by randomly oriented, euhedral, tabular, plagioclase crystals that are 0.25 to 1 cm long and make up 20 to 35% of the rock. Quartz crystals that make up 2 to 5% of the rock are equant, euhedral, 1 to 3 mm in diameter and commonly are blue on both weathered and fresh surfaces. The groundmass is dark grey, very fine grained and rarely contains biotite grains. The rock breaks with conchoidal fracture. Except for flow breccia that is present in one outcrop on the northeast shoreline of Horseshoe Lake, only massive facies were observed in the flows.

The southern shoreline of Horseshoe Lake is underlain by bedded felsic lapilli-tuff and tuff. Beds of lapilli-tuff range from 0.20 to 1 m in thickness; however, beds of tuff are up to 10 cm thick. The lapilli-tuff is monolithic and comprises plagioclase- and quartz-phyric angular to subrounded felsic volcanic fragments ranging from 0.2 to 1.5 cm in diameter supported in a finegrained plagioclase- and quartz-phyric matrix. Rock fragments form 20 to 40% of the lapilli-tuff. Crystals in the matrix and fragments display the same shape and size. Tuff beds are generally similar to the matrix of the lapilli-tuff; however, some do not contain any crystals. Beds of lapilli-tuff commonly alternate with beds of tuff, but sequences consisting of 2 to 5 successive beds of either lapilli-tuff or tuff are present.

An andesite flow separates the lapilli-tuff and tuff units from the thick unit of volcanogenic sedimentary rock that occupies the central part of Horseshoe Lake. The contact between the andesite flow and the felsic lapilli-tuff is a 20 cm wide rubble zone characterized by glacially rounded pebbles of granitic and volcanic rock, mixed with sand and silt. This zone is planar and suggests that the contact between these rock units is conformable and planar. Adjacent to this contact the andesite displays a breccia facies. The breccia fragments are subrounded and form 50% of the breccia zone. Massive andesite and breccia fragments consist of 15 to 20% euhedral, tabular, 2 mm long plagioclase crystals. 10% equant 1 to 1.5 mm mafic crystals and rare equant 1 mm quartz crystals. Mafic crystals appear to be amphibole pseudomorphs after orthopyroxene. Groundmass between the breccia fragments contains less than 10% crystals and locally up to 30% 0.5 to 1 cm diameter red garnet porphyroblasts.

The shoreline in the northwest part of Night Owl Lake and the area about 1 km inland from the shoreline are underlain by a plagioclase-quartz porphyry that is probably a subvolcanic intrusion. Plagioclase crystals are euhedral, tabular, 1.5 to 2 mm long, rarely attain a length of 7 mm and make up about 25% of the rock. Quartz crystals are euhedral and equant, 1 to 2 mm across and make up about 5% of the porphyry. The crystals are set in a felsic, fine grained, homogeneous groundmass. Although slight variations in crystal content are present, the rock, in general, maintains a homogeneous, massive appearance.

Mafic volcanic rocks interpreted to be pillowed flows were examined at one locality on the south limb.

MINERALIZATION

Pyrite was observed locally in all of the volcanic rocks. It occurs as single 0.5 to 1 mm grains and is present in minute quantities. All of the rocks examined contain epidote ± minor chlorite in quartz-filled fractures.

The geology in the vicinity of an airborne input conductor (Fig. GS-26-1; Questor, 1968, Mineral Resources Division non-confidential assessment file #91748) was reconnoitered to evaluate the nature of the geological environment and, if possible, the style of mineralization responsible for the input anomaly. Bedded siliceous, garnetiferous and rusty weathered sedimentary rocks associated with pillowed mafic flows occur in the vicinity of the anomaly. Layering in the rusty weathered sedimentary rocks is defined by contorted iron sulphide laminae and bands of more than 90% garnet. Diamond drilling of follow-up ground electromagnetic surveys in the area (non-confidential assessment file #92091) indicates solid sulphide to near solid sulphide (pyrrhotite and pyrite) in siliceous sedimentary rocks. Of particular interest are two intersections of O.10 oz/ton Au over 1.5 m (5 ft.) in a fine grained siliceous host rock containing 25% pyrrhotite and pyrite. The geological environment appears to be one in which iron sulphides and gold were deposited as chemical sediments in a dominantly clastic depositional environment. The fine grained, siliceous sedimentary rocks may also be interpreted, in part, as being chemically derived. The geology and the stratigraphically controlled mineralization in this area require further detailed studies.

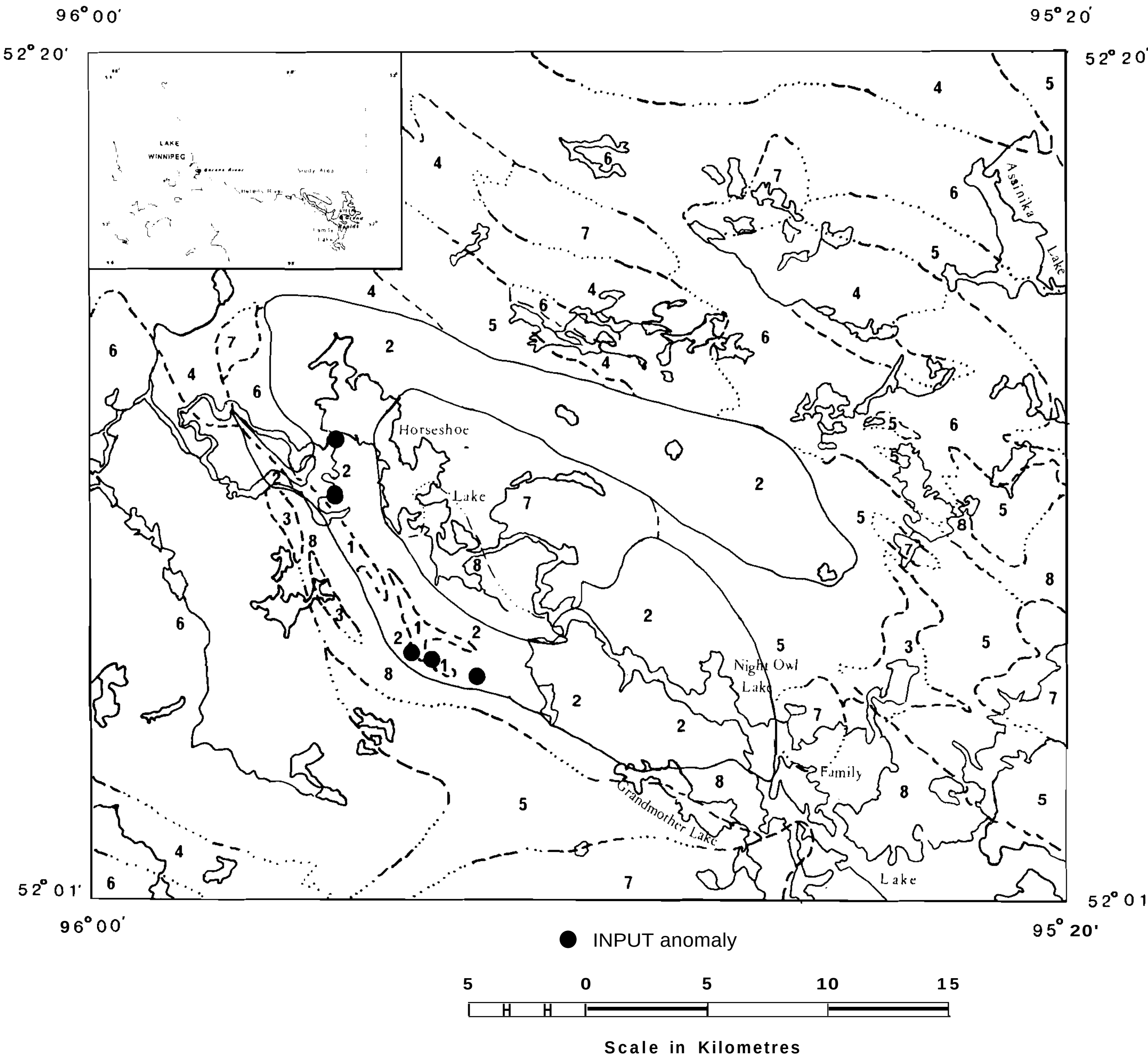

Figure GS-26-1: General geology of the Horseshoe Lake area (after Ermanovics, 1970) and the location of the INPUT anomaly. 1 — metasedimentary rocks, 2 — metavolcanic rocks (reworked pyroclastic rocks and massive flows), 3 — layered amphibolite and grey gneiss, ***4*** *— granodiorite gneiss, 5 — quartz monzonite and granodiorite gneiss, 6 — granodionte, quartz monzonitic granodiorite, 7 — quartz monzonite, 8 — migmatite.*

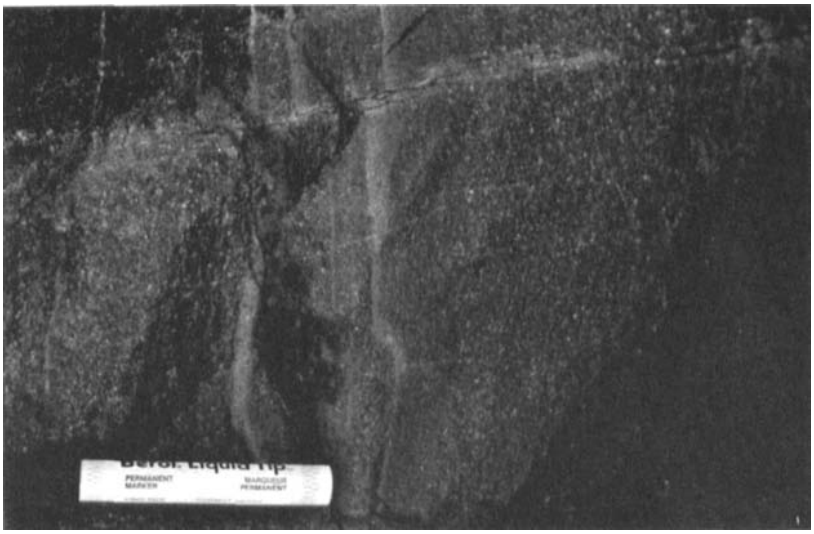

Figure GS-26-2:
Graded bedding in felsic volcanogenic metasedimentary rocks at Night Owl Lake.

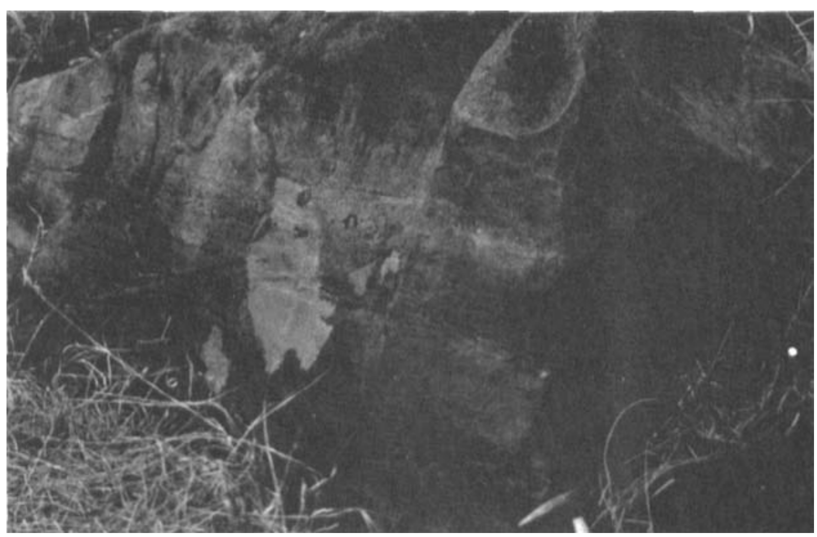

Figure GS-26-3:
Crossbedding in felsic volcanogenic metasedimentary rocks at Night Owl Lake.

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GS-27 BIRD RIVER CHROMITE PROJECT

D.M. Watson

The evaluation of chromite reserves for the Bird River Sill is complicated by an absence of outcrop and public geological information on the various properties. In some instances drill core has been lost and trenches have been in-filled with debris.

Properties along the northern portion of the sill were examined in 1984 (Fig. GS-27-1). This area was previously mapped by Trueman and Macek (1971). Since their work, new roads and several fires have increased access and the amount of outcrop. Although no new exposures of chromite were discovered during this study, it is now possible to predict the distribution of chromite in the sill.

Although chromite is found in many phases of the sill, concentrations of chromite with an economic potential have only been outlined in a few areas (Fig. GS-27-1). On the basis of this study, it is considered unlikely that additional mineable concentrations will be discovered.

The following genetic model is proposed to account for both the distribution of chromite and the various gabbroic rocks found in the sill:

1) Initial intrusion of magma into a chamber. The chamber sides were of unknown but positive slope. Accumulations of crystals took place initially both in the lower portion of the chamber and, to a lesser extent, along the sides.
2) Chromite began to appear as crystallization proceeded. The layers of chromite and olivine cumulate were much thicker in the lower

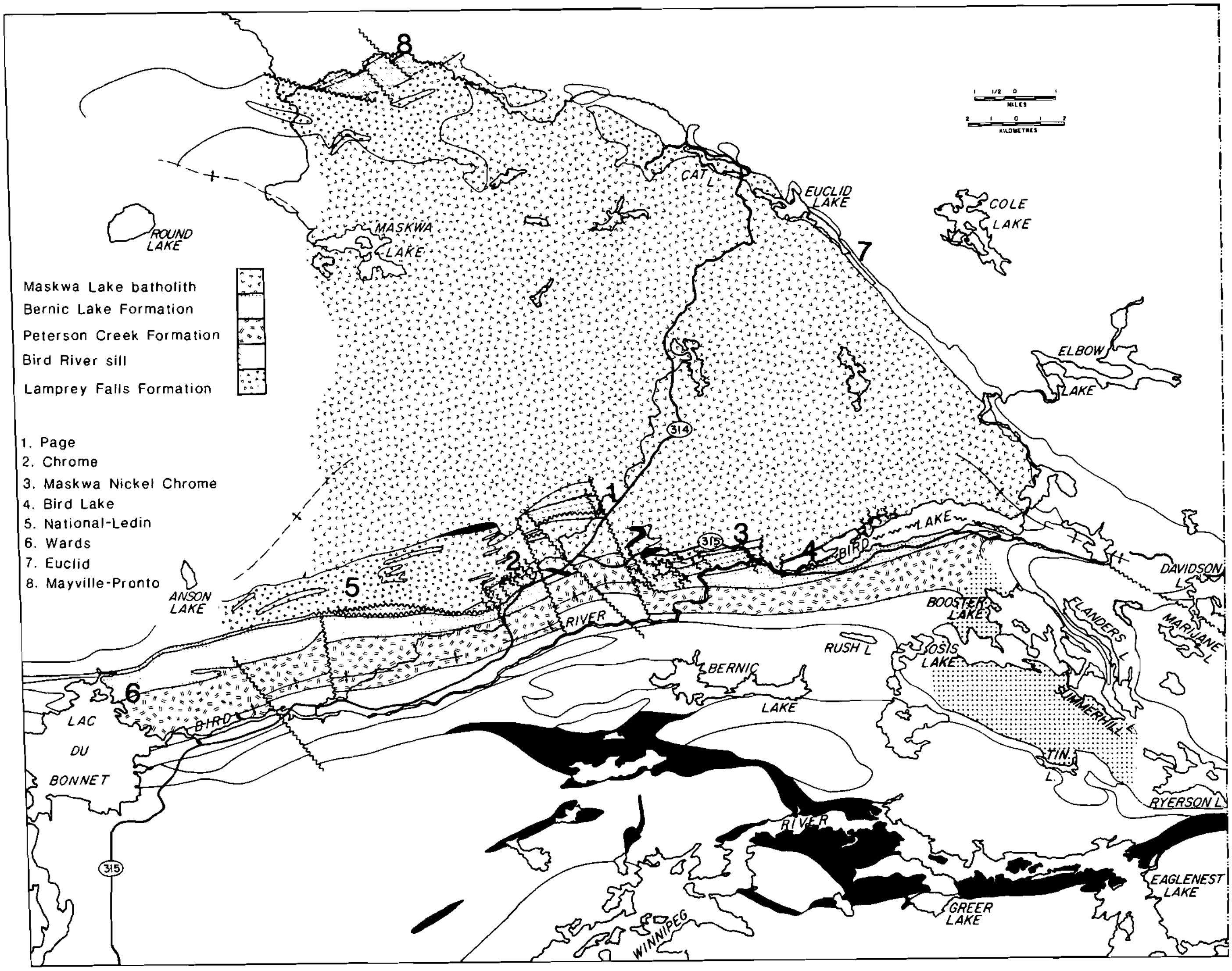

Figure GS-27-1: General geology and property locations – Bird River Sill.

portion of the chamber than along the sides. Due to a slight slope at the bottom of the chamber, partially consolidated layers of chromite and cumulus olivine probably slid downwards into the crystal mush in the lower levels of the chamber; this would account for the presence of disrupted chromite layers found in the lower portion of the sill. At the time the upper chromite layers crystallized, the lower chamber was probably filled to such an extent that there was little slope remaining on the cumulate layers and therefore no tendency for the layers to break up and move. Thick layers were also formed along the upper slopes, but these did not move as far and were trapped in the crystallizing gabbros.

3) As plagioclase became an important phase, some of the larger crystals of feldspar remained floating in the liquid and eventually rose to the top of the chamber. Some of these formed coarse grained gabbro masses that sank into the liquid and were enveloped to form blocks of coarse gabbro in a finer grained gabbro.

4) During the later stages of crystallization, the magma reached the surface since massive anorthosite grades into pillowed flows of similar composition. Near the contact coarse megacrystic feldspars in a massive gabbro are also present in basaltic flows near their contact. These were the last of the large crystals in the chamber and were carried out in the flows. Cobbles of granite and various gneisses are included in the fine grained flows about 500 m from the contact with the massive gabbro.

The chromite distribution in the Bird River Sill can be explained in terms of the model presented above as follows:

1) Chromite occurs as near solid and disseminated chromite in deposits of the "Chrome and Page" type (Scoates, 1983). These deposits represent the lower portion of the intrusion, where a relatively thick sequence of chromite and ultramafic layers accumulated and remained relatively undisturbed. Gaps in the occurrence of this type of mineralization can be attributed to later events - faulting, folding, erosion, etc.

2) sporadic small pods and lenses representing portions of layers that originally formed higher up in the magma chamber can be found in the west and northern portions of the sill.

On the basis of the model presented for the sill and the relative positions of the different chromite-bearing units within the sill, there is little possibility of additional economic reserves being found.

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GS-28 CROSS LAKE SUPRACRUSTAL INVESTIGATION

by M.T. Corkery and P.G. Lenton

Geological mapping in the Cross Lake area extended coverage from the 1983 mapping (Corkery and Lenton, 1983) north through the supracrustal belt into the plutonic rocks on the north shore of the lake (Fig. GS-28-1). Work at Pipestone Lake centered on the layered anorthosite-gabbro complex, with detailed work on titanium-vanadium-bearing magnetite layers (Cameron, GS-29, this volume, Preliminary map 1984, N-2).

Further fieldwork in 1985 should complete the mapping, with the objective of correlating stratigraphy between the northern and southern segments of the belt.

Within the map area the major lithologic units previously reported (Corkery, 1983) were traced, with minor variations and the introduction of some new subunits into the 1984 map area.

Two new units, a felsic volcanic sequence (unit 7b, c, d) and an intrusive quartz-porphyry (unit 7a) occur in the northeast corner of the area (Preliminary map 1984 N-3). Unit 7b, c, d is interpreted as a sequence of porphyritic felsic pyroclastic rocks (Fig. GS-28-2) inter-layered with volcanogenic rnetasediments with a preponderance of felsic volcanic clasts. These rocks are spatially closely associated with the quartz-feldspar porphyry (unit 7a) and thus they are probably genetically related. Mapping in 1985 will define the extent of these units and determine whether they are part of the **early supracrustal rocks** or the **late metasedimentary rocks**.

The unconformable relationship of **late metasedimentary rocks** to **early supracrustal rocks** and a tonalite pluton (unit 4) is exposed in a series of outcrops north of the community of Cross Lake (Preliminary map 1984 N-3). This unconformity, first reported by Rousell (1965), consists of basal conglomerate (unit 5b) overlying tonalite (unit 4). At a location 600 m northeast the tonalite intrudes pillowed and massive basalt flows (unit 1). This indicates a period of plutonic activity, uplift and erosion separates **early supracrustal rocks** from **late metasedimentary rocks**.

The unconformity was incorrectly interpreted by Rousell (1965) who regarded the tonalite as basement to the Cross Lake greenstone belt. This interpretation was expanded upon by Bell (1971, 1978) who assigned a pre-Keewatin age to the tonalite. The present work (Corkery, 1983) demonstrates that this unconformity separates the **early supracrustal rocks** and **late metasedimentary rocks**. No unconformable relationship between the mafic volcanic dominated **early supracrustal rocks** and basement has been documented.

In several locations **early supracrustal rocks** are interlayered with **late metasedimentary rocks** without an obvious unconformable relationship. This interlayering occurs in linear to arcuate tectonic zones, from 50 m to 100 m thick, between major block boundaries. Both ductile and brittle deformation features are abundant. One to seven metre thick shear zones occur at irregular spacing, becoming more abundant as the block boundary is approached. The rock between the shears ranges from slightly deformed to layers completely transposed into the shear direction in the boundary zone. This relationship is well exposed in an outcrop 800 m northeast of the unconformity north of the town of Cross Lake (Preliminary map 1984 N-3). Here primary bedding in well preserved pillowed basalts trending 005° is truncated by a 4.5 m thick shear zone at 226°/76°. The relationship of shearing and layering of the metabasalt (unit 1) and metasediments (units 5b and 6b, c) is shown in Figure GS-28-3.

A preliminary summary of geological events in the central Cross Lake area is as follows (from oldest to youngest):

1) Development of **early supracrustal rocks**.
2) Intrusion of major anorthositic-gabbro bodies.
3) Intrusion of tonalite (unit 4); probably concomitant with the development of early folding of the supracrustal rocks.
4) Uplift and erosion of **early supracrustal rock**-tonalite terrain.
5) Deposition of the **late metasedimentary rocks**.
6) Intrusion of small gabbro-diorite dykes and plugs.
7) Intrusion of the major granitoid batholiths with concomitant folding and activation of major linear shear zones.
8) Peak of thermal metamorphism.
9) Intrusion of late granitoid plugs and pegmatites, largely controlled by the major linear shear zones.
10) Periodic reactivation of the shear zones and minor folding.
11) Intrusion of the Molson dyke swarm in the major shear zones.
12) Late faulting manifested by fault breccia, pseudotachylite and erratic foliation developed in some Molson dykes.

Field work on granite and rare element pegmatites in the Cross Lake area was completed. Extensive sampling of granitic and supracrustal rocks for geochemical and isotope analysis and detailed structural analysis of the pegmatites were the principal objectives of this program. The results of this work will be reported as part of the Northern Superior Pegmatite program.

An M.Sc. thesis by Alan J. Anderson under the direction of Dr. Peter Cerny has been completed at the University of Manitoba. This completes the geochemical and petrological studies of the rare element pegmatites, on Cross Lake.

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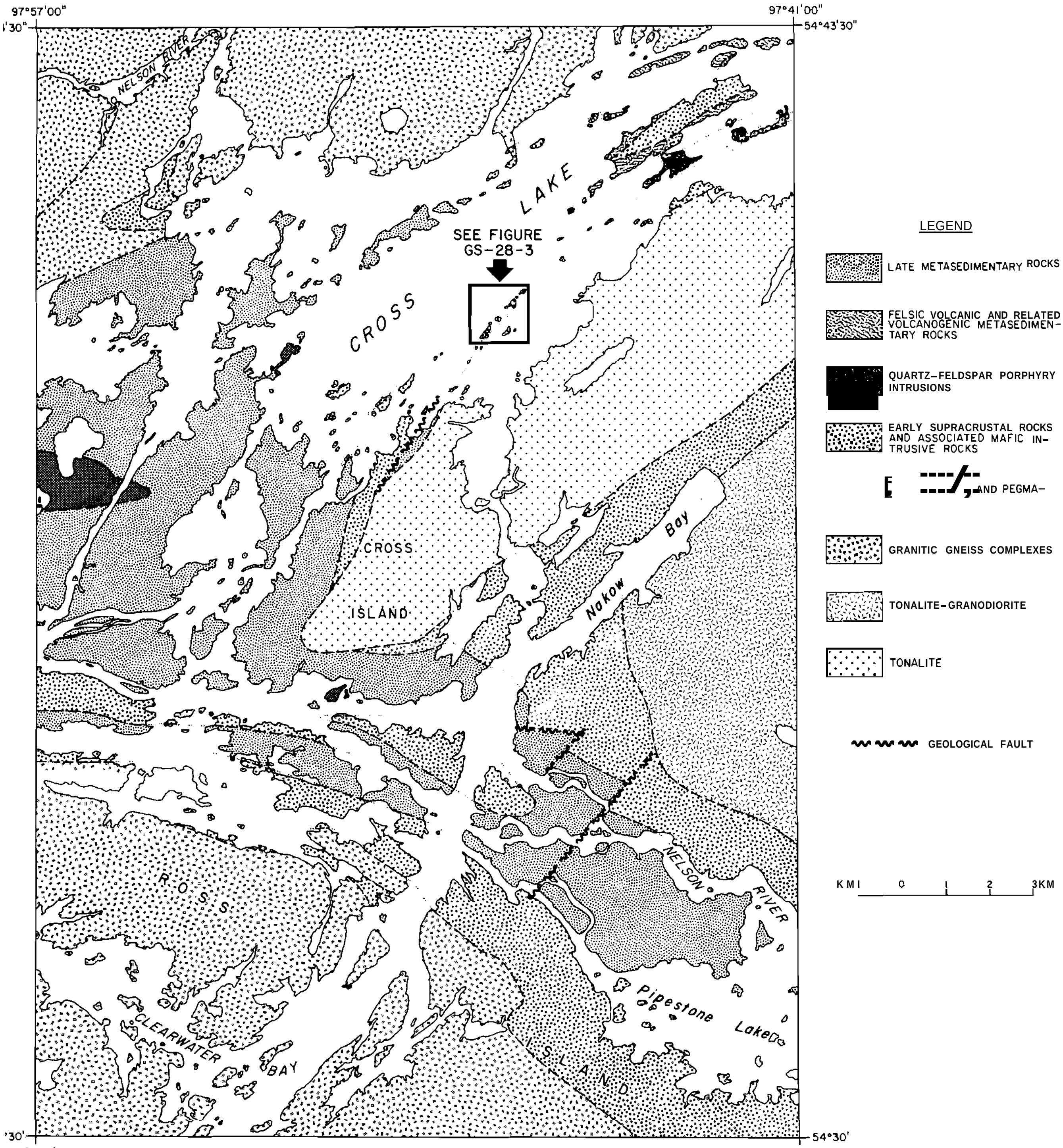

Figure GS-28-1: Simplified geological map of the central and southeast Cross Lake area.

Figure GS-28-2: Feldspar-quartz porphyritic fragmental rock unit 7b.

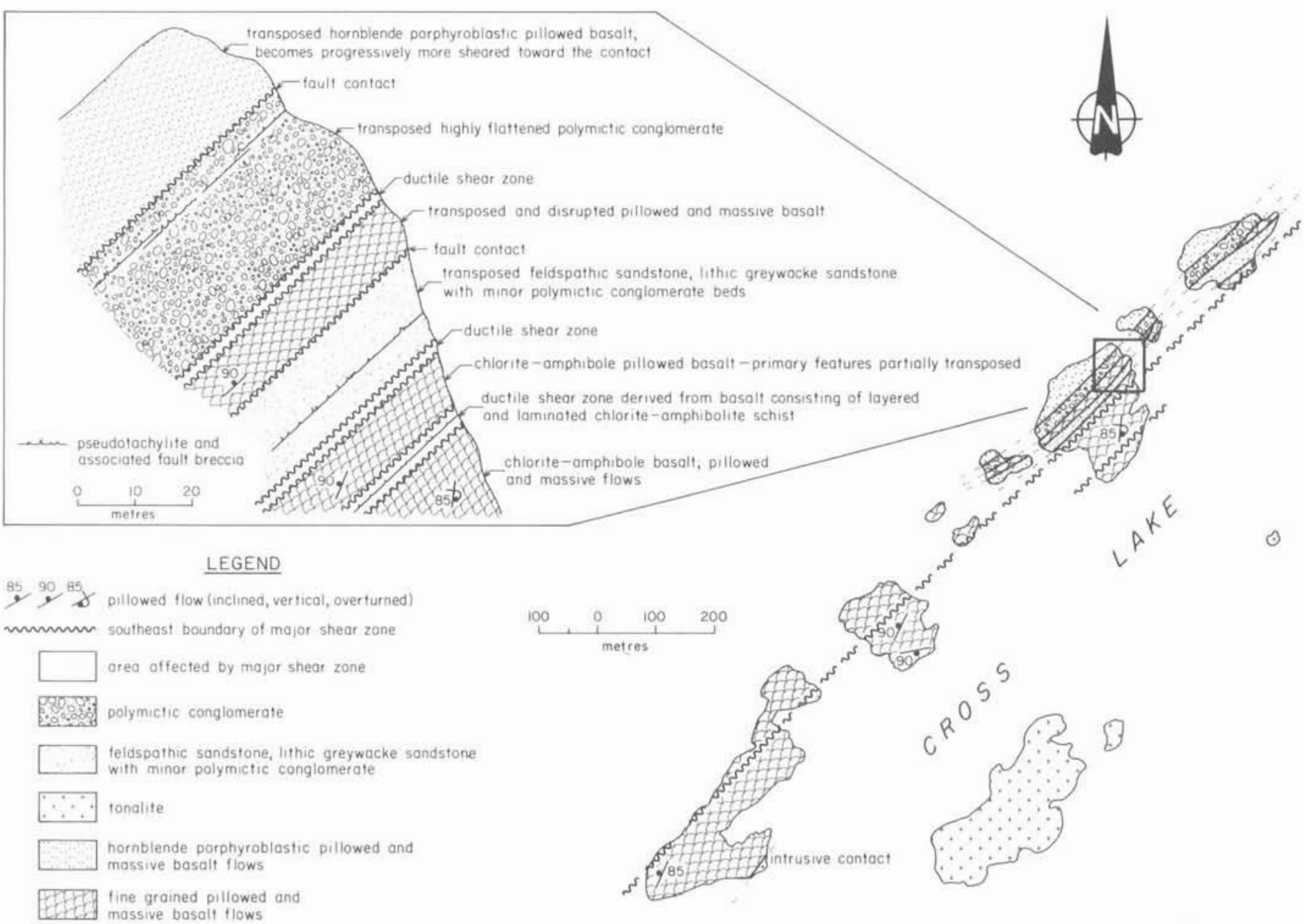

Figure GS-28-3: Geology of a block boundary zone depicting tectonic interlayering of early supracrustal rocks and late metasedimentary rocks. Location shown on Figure GS-28-1.

GS-29 PIPESTONE LAKE INTRUSIVE COMPLEX

by H.D.M. Cameron

INTRODUCTION

Geological investigation of a layered gabbro-anorthosite complex, south of Pipestone Lake, was undertaken in conjunction with the supracrustal mapping on Cross Lake (Corkery, 1983; Corkery and Lenton, GS-28, this volume). Previous work in the area by Bell (1962), Rousell (1965) and Rose (1967,1973) reported layers of massive magnetite rock and magnetite-bearing gabbro and anorthosite containing titanium and vanadium. This study is designed to re-evaluate the potential of these rocks in light of the current interest in strategic minerals.

A three-fold approach was taken in this assessment:

1) Geological mapping of the magnetite-bearing units and the rocks surrounding them.
2) Ground magnetometer survey to the west of the known showings in order to trace the extent of the magnetite layers.
3) A sampling program of magnetite-bearing rocks and related gabbros for geochemical and other laboratory analysis.

GENERAL GEOLOGY

The intrusion forms a layered complex composed predominantly of coarsely porphyritic anorthosite, with layers of massive anorthoslte and several phases of anorthositic gabbro and melagabbro as well as magnetite-bearing layers. The body intrudes the **early supracrustal rocks** (Corkery, 1983) on the north side and is intruded by the Whiskey Jack gneiss complex (Lenton and Anderson, 1983) to the south. Rafts of metavolcanic rocks and amphibolite are present near the northern margin of the gabbro and some rafts of grey metasedimentary gneiss are found in the south. Veins of younger granodiorite of the Whiskey Jack gneiss complex cut the southern flanks of the complex.

The complex extends in a broad arc from Cross Lake, in the west, to the east channel of the Nelson River at the east end of Pipestone Lake, a distance of approximately 15 km (Fig. GS-29-1). The maximum width of the body is 1500 m, tapering in the extremities.

Magnetite-bearing units occur within leucogabbro near the northern contact with the metavolcanic rocks (unit 1). They are exposed at several locations on the south shore of Pipestone Lake. Molson dykes cut the intrusive complex in several locations.

UNIT DESCRIPTIONS

PORPHYRITIC ANORTHOSITE

White weathering, coarsely porphyritic anorthosite or anorthositic gabbro is the most prominent rock in the central part of the body (Fig. GS-29-2). It is composed of large angular to rounded plagioclase phenocrysts ranging in size from 2 to 15 cm with about 5 per cent of coarse interstitial chloritized hornblende. Cores of the phenocrysts are variably altered to greenish yellow epidote and carbonate. In many locations the unit contains garnets which range in size from 2 mm to 2 cm.

Along the south shore of Pipestone Lake boudinaged layers of anorthosite form large pods, up to 20 m, in the gabbro. Away from the shore the porphyritic anorthosite is fairly continuous down to the tonalitic gneiss in the south. Variations in size and percentage of plagioclase phenocrysts define layers within the main zone of the anorthosite.

MASSIVE WHITE ANORTHOSITE

Where plagioclase phenocrysts coalesce and the mafic content decreases, massive white anorthosite layers occur. These occur also as pods and veins within both the porphyritic unit and the gabbro, although contacts with the porphyritic unit are usually gradational.

RECRYSTALLIZED ANORTHOSITE

In highly tectonized areas the anorthosite appears to be a sheared and recrystallized derivative of the porphyritic rock. It is strongly foliated with prominent chloritized hornblende clots, some of which are oikocrysts. These range from 1 mm to 3 cm wide and 1 cm to 5 cm long, occurring as either rounded to lenticular clots or thin

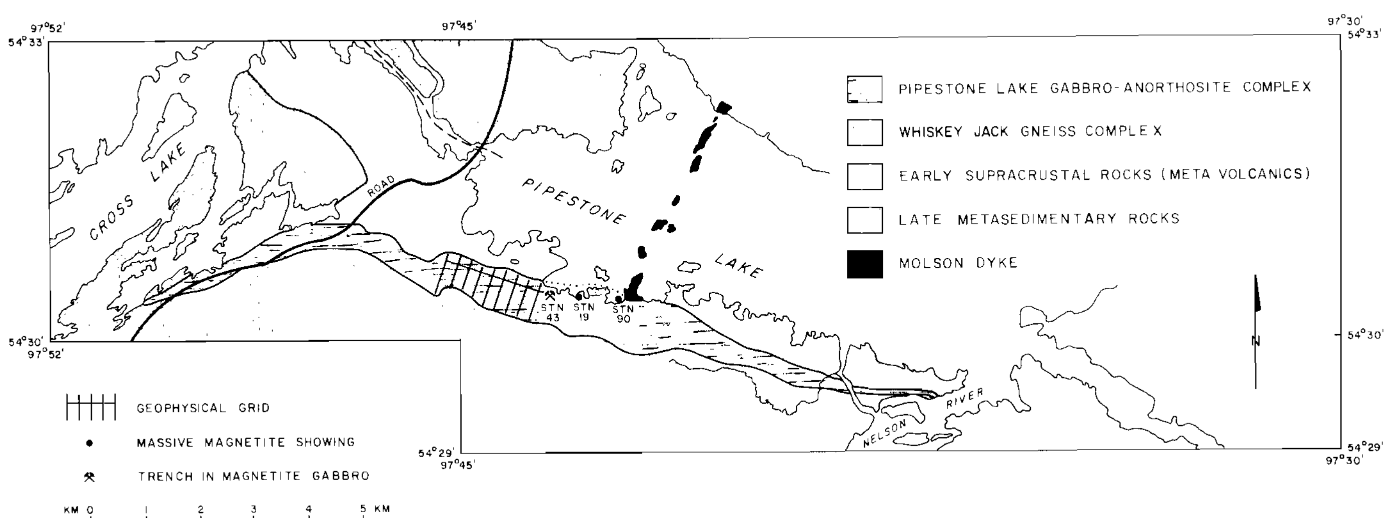

Figure GS-29-1: Location map for the Pipestone Lake area.

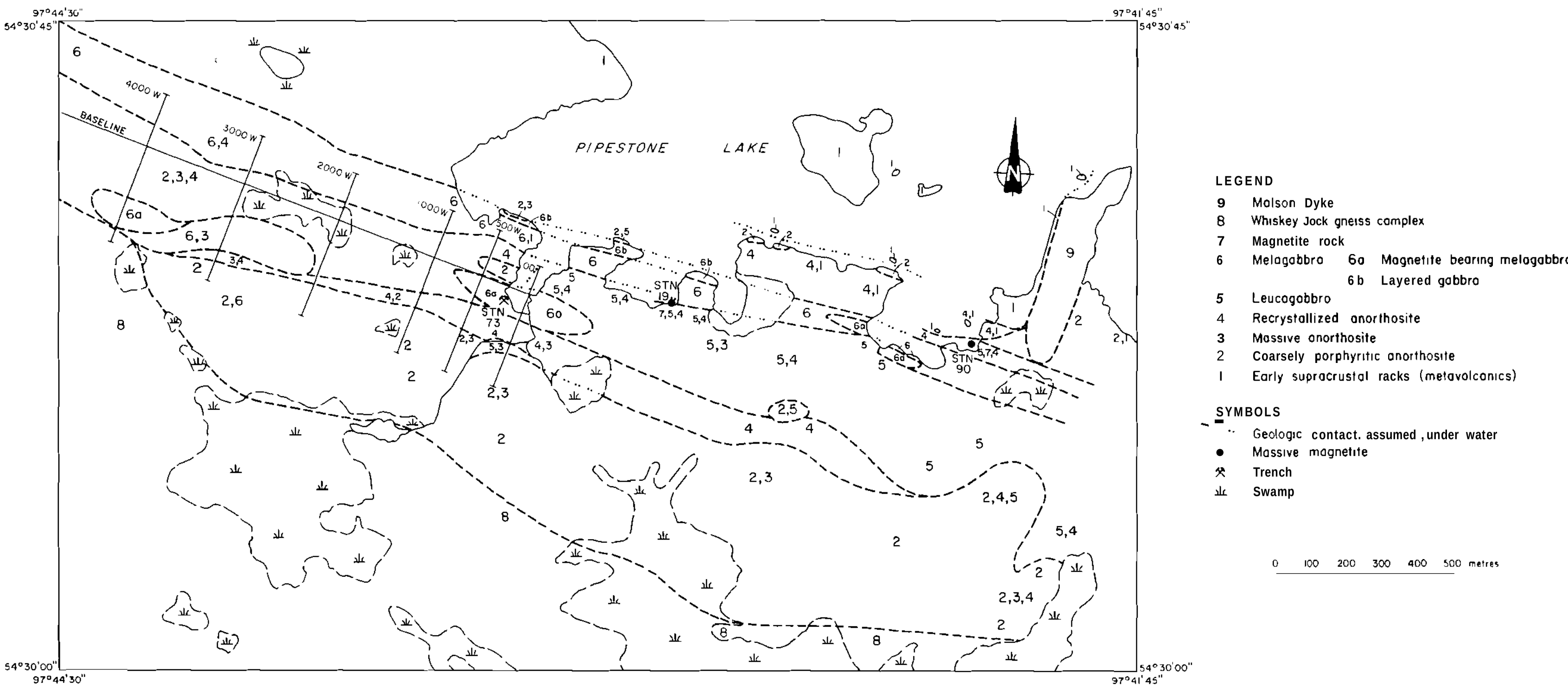

Figure GS-29-2: Geological map of the central part of the Pipestone Lake intrusive complex.

segregations. Locally the unit contains altered plagioclase phenocrysts to 3 cm, similar to those in the porphyritic anorthosite. Rafts and schlieren of supracrustal rocks are preserved and in several locations blebby magnetite layers are up to 1 cm wide and 5 to 30 cm long. Recrystallized anorthosite is found in both the porphyritic anorthosite and the leucogabbro and may represent a deformed transitional phase between the two.

LEUCOGABBRO

Leucogabbro forms white, medium- to coarse-grained layers, composed of well formed plagioclase phenocrysts up to 8 mm with interstitial hornblende. It is interlayered with both massive and recrystallized anorthosite. A mafic pegmatite phase forms pods and dykes from 50 cm to 2 m wide within this unit. In several locations leucogabbro is interlayered with massive magnetite bands. These layers contain garnet and abundant disseminated magnetite.

MELAGABBRO

Medium- to coarse-grained, dark grey to black gabbro is common along the northern margin and at the western end of the body. Plagioclase ranges in size from 1 mm to 3 mm and hornblende is 3 mm to 1 cm. Porphyritic phases with plagioclase phenocrysts from 5 mm to 1 cm and rarely to 4 cm occur.

Mafic pegmatite, anorthositic layers, quartz clots and veins and mafic rafts and schlieren occur with the unit. More mesocratic varieties contain large pods of porphyritic anorthosite and show compositional layering.

Some layers are magnetite-bearing. These contain abundant disseminated magnetite and some pyrite and chalcopyrite. The rocks are generally melanocratic and medium- to coarse-grained with interstitial magnetite up to 4 mm. Magnetite-bearing peridotite layers up to 2 m thick are associated with the gabbro.

MASSIVE MAGNETITE

Layers of massive magnetite up to 3 m thick are metallic grey to blue-black. They are interlayered with leucogabbro and recrystallized anorthosite along the shoreline of Pipestone Lake (Preliminary Map 1984N-2). The surrounding leucogabbro contains disseminated magnetite for a distance of 1 to 2 m and is garnetiferous.

Fine chloritized mafic layering and inclusions are present in some exposures. The rock has magnetite grains up to 8 mm and appears to be a cumulate.

MAGNETOMETER SURVEY

A Scintrex model MP2 proton precession magnetometer with a sensitivity of 1 gamma was used to survey the area to the west of an old trench in the magnetite-bearing melagabbro. An 8000 ft. (2440 m) baseline, bearing 289°, was cut along the strike of the units, and cross lines bearing 019° were flagged at 1000 ft. (300 m) intervals along the line (Fig. GS-29-1). The cross lines were extended up to 500 ft. (150 m) north and 1000 to 1500 ft. (300 to 450 m) south of the baseline.

Readings were taken at 50 ft. (15 m) intervals with base stations taken every 500 ft. (150 m). Diurnal fluctuations ranged from 1 to 150 gammas. Background readings in the anorthosite were in the 62,000 gamma range with peaks over the magnetite-bearing units ranging from 70,000 to over 100,000 gammas.

The results of the survey (Fig. GS-29-2, 3 and 4) indicate two major linear highs, 600 ft. (180 m) wide, straddling the baseline, with a major peak between the 5000 W and 6000 W profiles. There is a sharp 1000 ft. (300 m) left lateral offset in the peak on the 8000 W profile, probably caused by a fault.

GEOCHEMISTRY

Outcrops of magnetite-bearing units were mapped and sampled in detail at three locations (Fig. GS-29-1). Two of these (stations 19 and 90) represent layers of massive magnetite and the third (station 73), a trench in magnetite-bearing metagabbro.

Representative samples and chip samples were analyzed for titanium, vanadium, total iron, chrome and nickel.

Station 19 (Fig. GS-29-5, Table GS-29-1) is the main showing of the massive magnetite. Three bands of magnetite 1.5 m, 2 m and 3.5 m wide are exposed over a distance of 50 m, in leucogabbro and recrystallized anorthosite. Thirty-nine sites were sampled in and around the magnetite layers, including two serial sets giving a continuous section across the northern band (samples V and W, Fig. GS-29-3). Four sets of chip samples were taken across the layers (samples CHN, CH2, CS and CL).

Station 90 (Fig GS-29-6) is a small, flat exposure near the base of the large Molson dyke which crosses Pipestone Lake.

A magnetite band 1.5 m wide is exposed over a length of 7.5 m in garnetiferous leucogabbro. The magnetite layer is garnetiferous for a distance of 10 cm from the contact with the gabbro and contains several discontinuous fine grained mafic layers up to 3 cm thick. Several representative samples and a chip sample (sample 90, Table GS-29-2) were taken from the units.

Station 73 (Fig. GS-29-7) is a 15 m trench in magnetite-bearing melagabbro. Exposure is poor outside the trench with most of the outcrop being covered by heavy vegetation and rubble. Samples were taken along the trench at the intervals shown and chip samples were taken down the length of the west wall. All the samples were analyzed (Table GS-29-3)

Further examination of the intrusive complex and extension of the magnetometer survey to the east is anticipated pending the results of more comprehensive analysis of the data collected to date.

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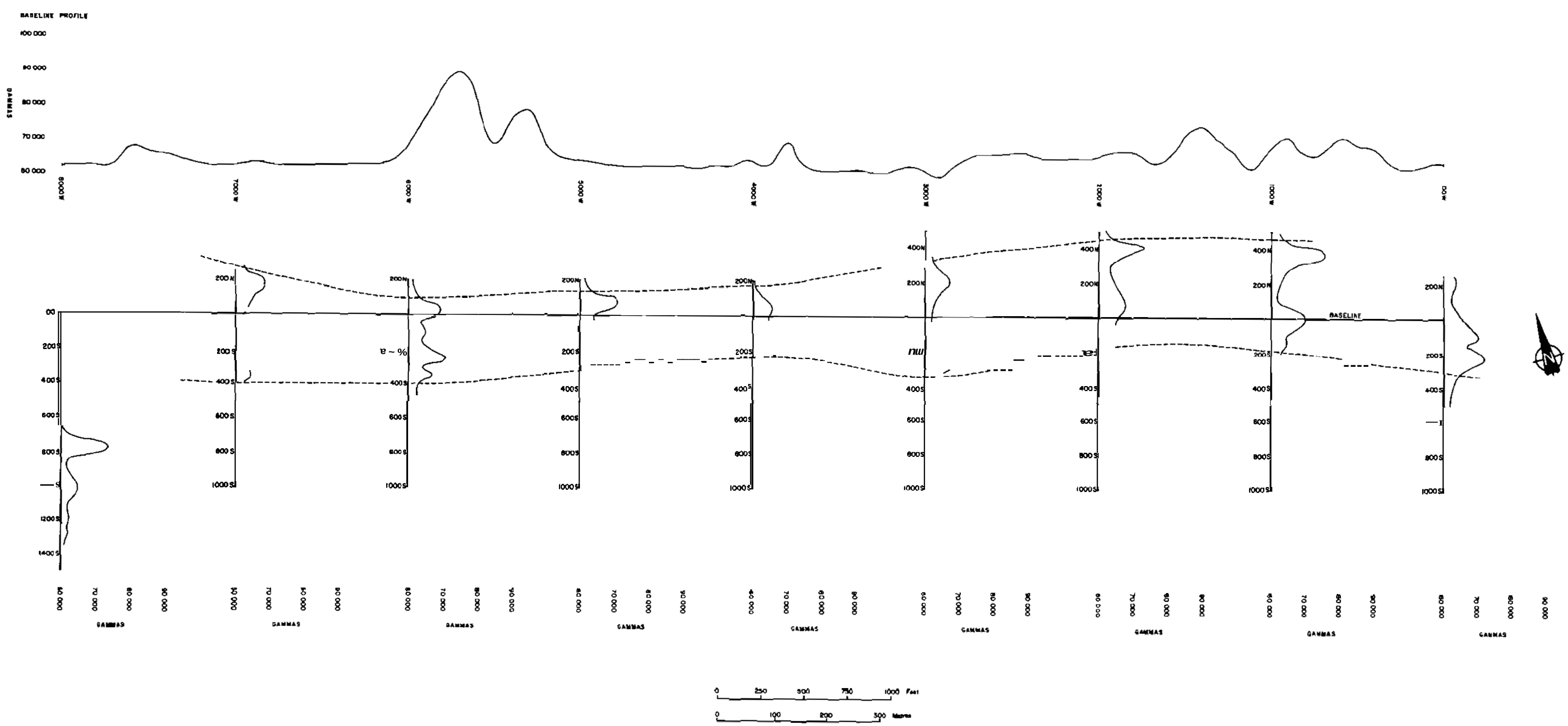

Figure GS-29-3: Magnetic profiles of the Pipestone Lake geophysical data.

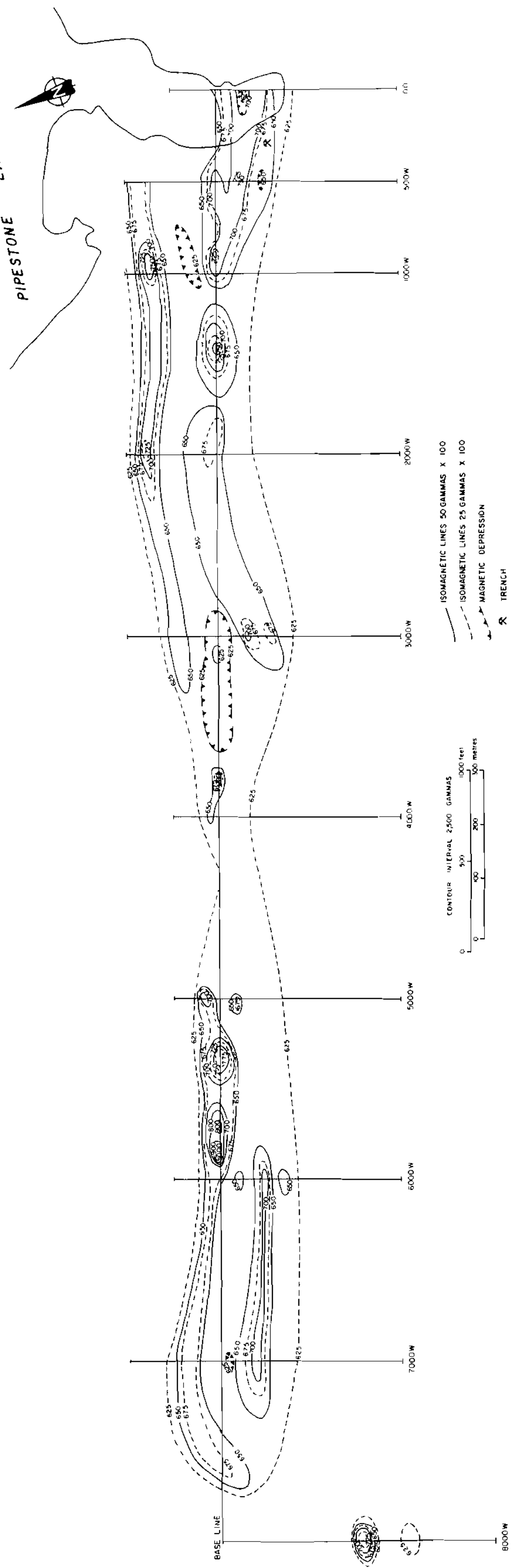

Figure GS-29-4: Isomagnetic contour map of the Pipestone Lake geophysical data

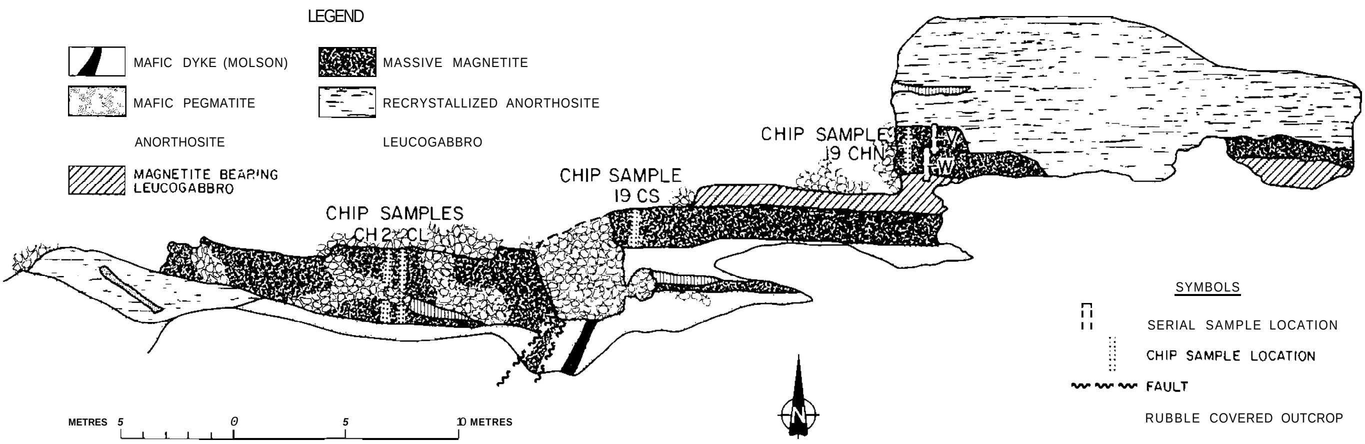

Figure GS-29-5: Geological sketch map of station 19 — massive magnetite exposure.

TABLE GS-29-1
ASSAY RESULTS FOR STATION 19, MASSIVE MAGNETITE BANDS

Sample No.	PPM V	PPM Ni	PPM Cr	Wt. % TiO_2	Wt. % ΣFeO
V-1	506	38	< 25	1.15	8.2
V-2	4983	70	< 25	17.8	64.8
V-3	4846	59	< 25	17.7	66.6
V-4	4599	82	< 25	16.1	61.8
V-5	4611	90	26	15.7	63.0
V-6	4422	84	< 25	13.8	56.7
V-7	5061	108	< 25	16.5	69.7
V-8	4962	116	< 25	15.0	64.0
V-9	5186	100	< 25	15.8	68.4
V-10	5593	123	< 25	17.2	68.4
W-1	5087	153	48	15.4	69.6
W-2	5000	118	66	16.6	67.4
W-3	4750	63	91	16.6	68.1
W-4	2009	83	25	5.5	25.8
Chip Samples:					
CH.N	4966	142	42	16.5	68.4
CH.2	4907	148	247	15.1	62.1
C.S.	5448	153	303	15.4	68.6
C.L.	4925	185	305	14.6	61.5

TABLE GS-29-2
ASSAY RESULTS FOR STATION 90, MASSIVE MAGNETITE BANDS

Chip Sample No.	PPM V	PPM Ni	PPM Cr	Wt. % TiO_2	Wt. % ΣFeO
90C	4956	176	316	13.8	61.4

TABLE GS-29-3
ASSAY RESULTS FOR STATION 73, MAGNETITE-BEARING MELAGABBRO

Sample No.	PPM V	PPM Ni	PPM Cr	Wt. % TiO_2	Wt. % ΣFeO
1.5	1259	126	34	2.6	18.4
2.1	1974	151	122	4.0	24.0
2.8	1938	169	100	3.6	23.2
3.1	2096	160	100	3.9	24.5
4.4	2195	111	128	4.1	23.2
5.1	3125	162	214	5.7	30.0
6.5	4061	239	97	7.2	42.2
7.1	4354	240	93	7.6	42.9
7.6	4086	250	102	7.4	42.3
7.9	4069	241	90	7.9	42.5
8.5	4015	225	98	7.4	41.2
9.0	3256	244	91	6.5	36.9
9.2	3700	238	117	7.5	40.2
9.5	2578	345	111	5.1	36.6
10.3	2705	219	129	5.4	34.0
11.0	3248	227	258	6.6	37.4
11.7	2402	160	206	4.8	27.4
12.2	2242	154	213	4.3	26.7
12.7	1839	96	236	4.3	23.2
13.7	2149	95	254	4.3	24.6
14.6	1514	192	253	2.8	22.2
Chip Sample					
73C	2715	174	126	5.5	30.6

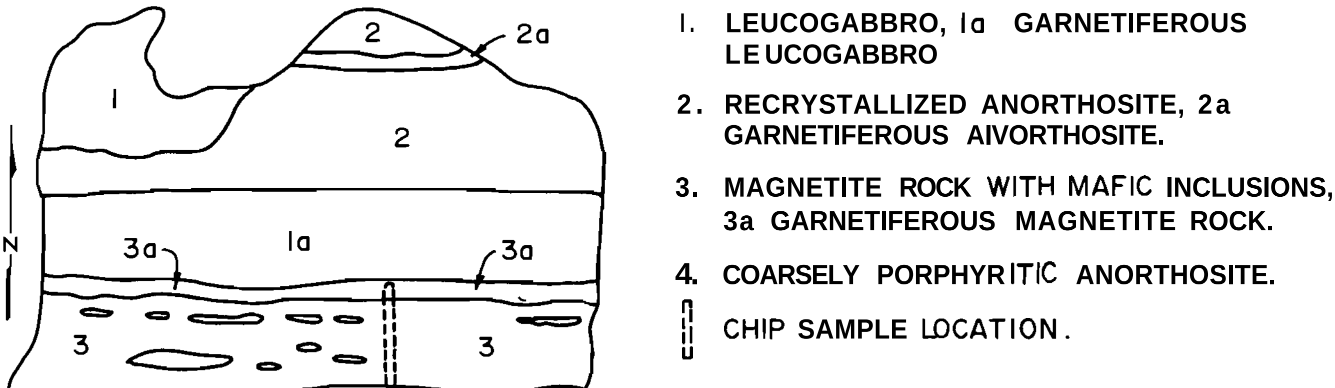

Figure GS-29-6: Geological sketch map of station 90 — massive magnetite exposure.

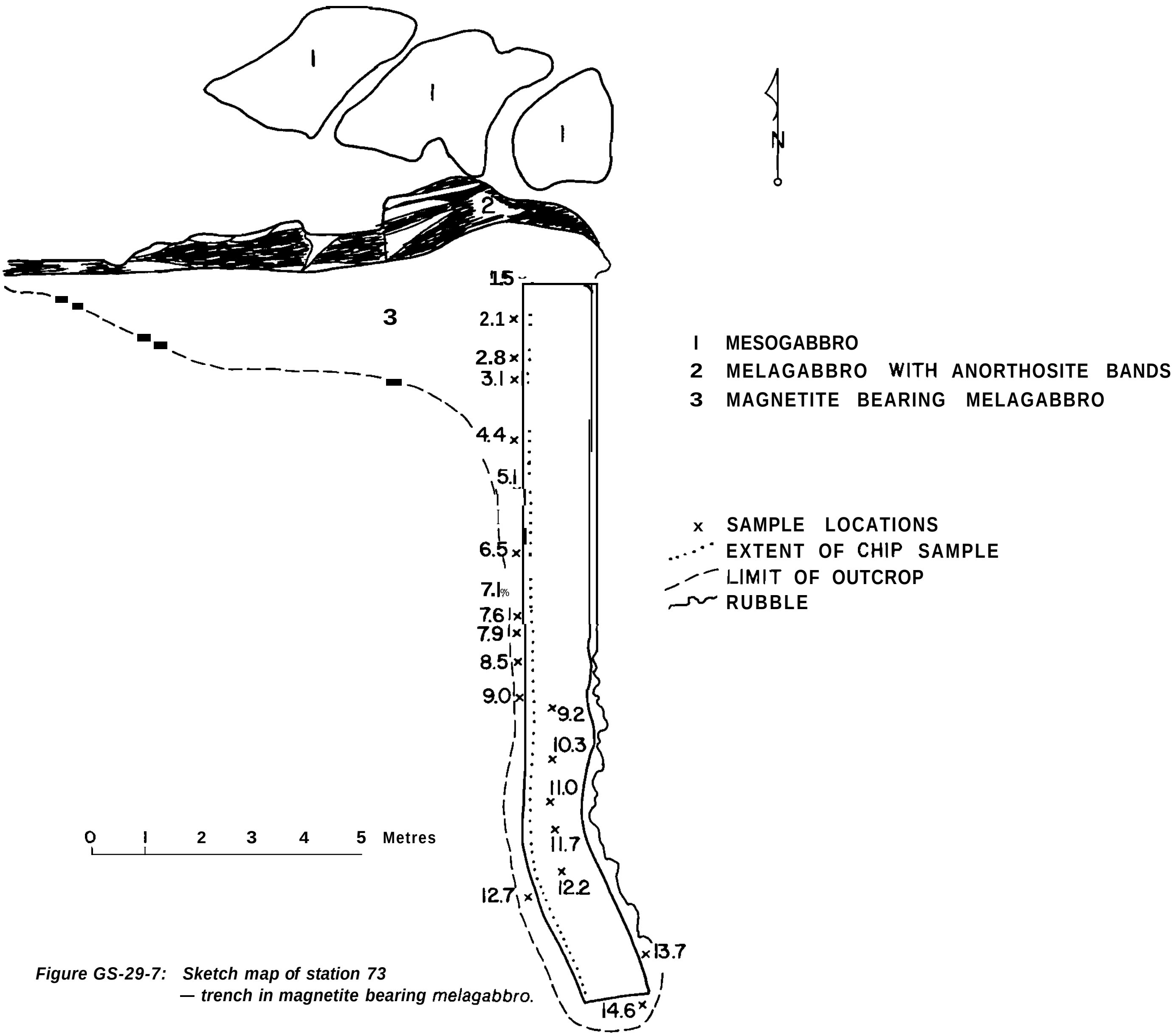

***Figure GS-29-7:** Sketch map of station 73 — trench in magnetite bearing melagabbro.*

GS-30 NORTHEASTERN CROSS LAKE PROJECT

by J.J. Macek

INTRODUCTION

Geological mapping at a scale of 1:50 000 conducted in the northeastern part of Cross Lake completed coverage between the areas mapped by Corkery and Lenton (GS-28, this volume) and Albino et al. (1983).

Emphasis of the geological investigation was placed on:

1. Regional distribution of the supracrustal rocks;
2. Lithological change of the supracrustal rocks in a southwesterly direction along the greenstone belt.
3. Relationship of geological units with those described by Corkery (1983) and Corkery and Lenton (GS-28, this volume).

GEOLOGY

The lithological units established by Albino et al. (1983) for the extreme northeastern part of Cross Lake extend into this summer's map area.

The northwestern and southeastern shorelines are underlain by a gneiss-migmatite complex similar to the one described by Albino and Macek (1983). Migmatite zones may have well defined or gradual boundaries. Evidence of a complex, multi-phase intrusive history suggest that the complex is essentially an orthogneiss.

SUPRACRUSTAL AND MAFIC-ULTRAMAFIC ROCKS

The linear belt of supracrustal and associated mafic-ultramafic rocks is exposed continuously on numerous islands in the central part of the northeast arm of Cross Lake. The best exposures occur in the western extremity of the mapped area, whereas in the northeastern part of the map area exposures are sporadic.

Exposures of layered mafic-ultramafic intrusive rocks form an extension of those described by Albino and Macek (1983). Despite intense tectonism, the layering is recognizable and defined by metapyroxenite, metagabbro and meta-leucogabbro (Fig. GS-30-1).

Zones of plagiophyric gabbros 0.5 - 5 m wide (Fig. GS-30-2) are associated with layered intrusion(s). The textural character is similar

Figure GS-30-1: Layering in metapyroxenite-metagabbro intrusion.

Figure GS-30-2:
Plagiophyric gabbro (unit 1h).

to more coarsely porphyritic anorthositic gabbros on Pipestone Lake (Cameron, this volume). Figure GS-30-3 shows grading in the population of plagioclase porphyrocrysts. In one outcrop a sharply bounded layer of plagiophyric gabbro occurs within the layered intrusion. This observation suggests a very close genetic relationship of the anorthositic and porphyritic gabbros with the mafic-ultramafic layered intrusion. Elsewhere plagiophyric zones are closely associated with pillowed flows. This association of plagiophyric gabbros and mafic igneous rocks is consistent over a distance of more than 50 km in the northeastern arm of Cross Lake. The textural similarity of the plagiophyric gabbro to those on Pipestone Lake, and the similar lithologic association of these rocks throughout the supracrustal belt, suggest that porphyritic metagabbros represent a part of a widespread mafic intrusive event. The noticeable difference between the Pipestone Lake and the northeastern arm of Cross Lake gabbros is the relative abundance and size of plagioclase porphyrocrysts.

Polymictic boulder conglomerate (Fig. GS-30-4) unconformably overlies the layered intrusion. This conglomerate contains angular to oval mafic and ultramafic clasts exclusively. The lithologic variety of these clasts represents all mafic intrusive and extrusive rocks exposed in the area (except for coarse grained leucogabbro clasts, which were not observed in outcrop). The matrix consists of mafic, fine grained lithic sand-siltstone similar to mafic, finely laminated siltstone mapped previously (Albino et al., 1983). Both mafic conglomerate and mafic siltstones are interpreted as having been derived from the same source and may represent proximal and distal facies of the same deposit, respectively.

In the western part of the area layered felsic fragmental deposits derived from bodies of quartz-feldspar and feldspar porphyries are widespread. These rocks form a wedge thinning towards the northeast. Primary textures are progressively eliminated in this direction due to deformation and recrystallization, and only light beige, faintly schlieric tectonite is recognized as remnants of the felsic volcanics.

Small outcrops of tectonized garnet-rich polymictic metaconglomerate were found in the western part of the area. These and other varieties of polymictic conglomerates described by Corkery (1983) gradually pinch out in a northeasterly direction.

MOLSON DYKES

Numerous gabbro-diabase dykes of the Molson Dyke swarm show well-exposed igneous layering (Fig. GS-30-5).

CONCLUDING REMARKS

This summer's observations, and those of last year (Albino and Macek, op. cit.), suggest the existence of an early widespread intrusive event in the form of a complex layered mafic-ultramafic intrusion (more than 75 km long) which is closely related to the mafic extrusive rocks.

Gradual appearance and increasing amount of felsic porphyries, cogenetic felsic fragmental deposits and associated polymictic conglomerates in a southwesterly direction suggest the thickening of the stratigraphic pile towards the west with the upper members preserved in the central part of Cross Lake.

The author is grateful for the assistance and excellent support of P.A. Tirschmann during the field season.

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Figure GS-30-3: Grading in plagiophyric gabbro (unit 1h).

Figure GS-30-4: Mafic polymictic boulder metaconglomerate (unit 3e).

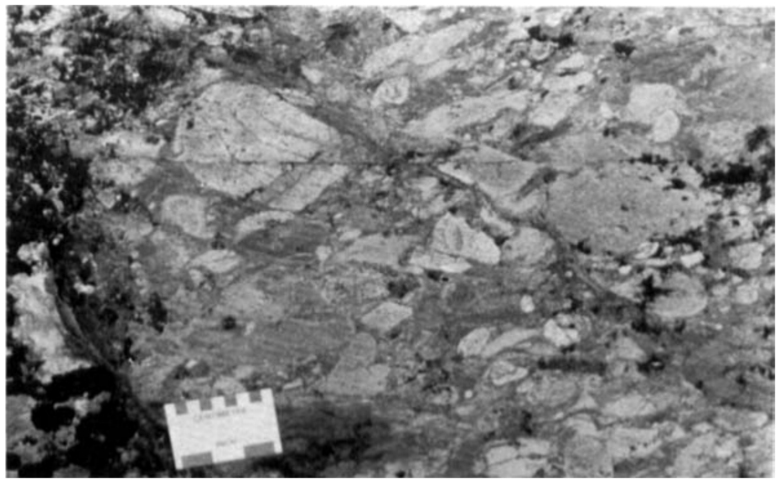

Figure GS-30-5: Igneous layering in gabbro dyke (unit 7).

GS-31 U-Pb GEOCHRONOLOGY STUDIES, THOMPSON BELT AND NORTHWESTERN SUPERIOR PROVINCE

by T. Krogh[1], L. Heaman[1], N. Machado-Fernandes[1] and W. Weber

The objective of this three-year study will be to establish a geochronological framework on the northwestern Superior Province, i.e., intrusive and metamorphic events in the volcano-plutonic domain, the Pikwitonei granulite domain, and the Thompson belt, and the age of supracrustal and ultramafic rocks in the Thompson belt.

Analyses will be funded by the Geological Survey of Canada under the Canada-Manitoba MDA. Field support and direction of the project will be provided by the Manitoba Geological Survey.

During the summer of 1984, 3 samples were collected from the Pikwitonei domain, 3 from the Cross Lake volcano-plutonic domain, 6 from the Thompson belt and 1 from the Churchill Province. Processing of the samples for zircon concentrates is in progress at the Geochronology Laboratory of the Royal Ontario Museum in Toronto.

Future work will include U-Pb zircon ages on additional units and possibly isotope analysis of monazite, sphene, rutile, and baddeleyite.

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GS-32 ISLAND LAKE PROJECT

(53E/16 SE)

by H.P. Gilbert

INTRODUCTION

The Island Lake greenstone belt in the Loonfoot Island area was mapped at a scale of 1:20 000. The work focussed on the volcano-sedimentary rocks of the Hayes River Group (Fig. GS-32-1); part of the younger sedimentary Island Lake Group was mapped by R. Pertson and B.A. Power. Further work in the area to the west is planned for next season, to provide continuity with mapping conducted between 1981 and 1983 in the west part of the greenstone belt.

		10	Diabase (aphyric and porphyritic)
		9	Plagioclase ± quartz porphyry. felsite
A	ISLAND LAKE GROUP"	8	Sedimentary rocks: polymictic pebble/ boulder conglomerate. arkosic vacke. lithic and feldspathic greyvackes: minor quartz wacke and siltstone
			UNCONFORHITY
R	INTRUSIVE ROCKS	7	Hafic inrrusive rocks: gabbro, diabase. minor leucogabbro
C		6	Ultramafic intrusive rocks: serpentinized peridotite. hornblendite
H		5	Loonfoor Island pluton: tonalite. grano-diorite (massive to gneissoid)
E			INTRUSIVE CONTACT
A	HAYES RIVER GROUP*	4	Sedimentary rocks: feldspathic greywacke. siltsrone, argillite. argillitic vacke. polymictic cobble conglomerate, carbonate. chert. iron formation (chert/hematite): related schists and shale
N		3	Felsic volcanic rocks: flows and/or sills. tuff, breccia. related sericite schist and fuchsite schist
		2	Intermediate volcanic rocks: flows. tuff. breccia
		1	Hafic volcanic rocks: flows, tuff. breccia; related gabbro. amphibolite and schist

Terms defined by Wright (1928): "Island Lake Group" was originally defined as "Island Lake series".

Figure GS-32-1: Geology of the Loonfoot Island Area.

STRUCTURE

Major folds of two ages have been identified (F_1 and F_2, pre- and post-Island Lake Group respectively - Gilbert and Weber, 1983). A major east-southeast-trending syncline (Heart Island syncline) extends through the belt just north of Heart and Bluff Islands (Fig. GS-32-2). The south limb contains a diverse volcano-sedimentary assemblage, in contrast to the north limb which consists largely of pillowed basalt. The basaltic section contains an east-trending anticlinal fold farther north, which extends into the Island Lake Group to the west, suggesting an F_2 age. Limited data indicate a syncline-anticline pair in the northern part of the basaltic section, just south of Loonfoot Island. These structures are not continuous with folds mapped in the Island Lake Group to the west. Conglomerate (8) rests unconformably on basalt (1) at the south end of Norrie Island; the conglomerate occurs in irregular zones interpreted as fissures in the basaltic substrate. These rocks occur in an east facing section infolded or faulted within the northwest facing basaltic section northwest of Loonfoot Island (Fig. GS-32-2).

Shear zones parallel to the foliation in the Hayes River Group are probably related to the major F_1 folding, which was accompanied by considerable strain in the southern part of the belt. Farther north, strain is absent in the basaltic rocks immediately south of Loonfoot Island, where the section occupies an embayment in the Loonfoot Island pluton (5). Regional foliations resulted from both F_1 and F_2 deformations. Minor F_1 folds have been observed (Fig. GS-32-3) but most minor folds and strain-slip cleavage in the Hayes River Group deform the regional foliation and are thus F_2 or younger. Late minor faulting (F_3) is discordant to the earlier structures.

STRATIGRAPHY

HAYES RIVER GROUP

Boyd Island area

Fine grained sedimentary rocks (4) and felsic volcanics (3) are predominant, with derived sericite schist and carbonatized products. Felsic porphyries of several ages and intense deformation occur in the vicinity of the abandoned Island Lake gold mine. The mineralization is located at or close to the contact between felsic rocks to the south and argillite and subordinate greywacke to the north. Carbonate units of possible sedimentary origin (up to 3 m thick) occur in the contact zone and within the sedimentary section. Gabbro (7) and minor mafic tuff (1) occur in an east-southeast-trending zone immediately south of Boyd Island. South of this zone, felsic volcanic rocks and sericite schist occur adjacent to greywacke and argillite to the south, in a mirror image of the stratigraphy at Boyd Island. The repetition of this stratigraphy may be a result of a major fold within the gabbro-tuff zone, but the structure in this area is not known. Iron formation occurs within the sedimentary section 2.5 km west of Boyd Island.

Heart Island-Bluff Island area

The south limb of the Heart Island syncline consists mainly of mafic and intermediate flows and fragmental rocks (1,2) with subordinate felsic flows and/or sills, tuff and breccia (3). The mafic rocks are strongly deformed and partly altered to chlorite-amphibole schist at Heart and Okay Islands; north of Okay Island the section is composed of moderately flattened to undeformed pillowed basalt which extends northwards for 3 km to the south shore of Loonfoot Island. The south half of Bluff Island and east end of Okay Island consist largely of intermediate volcanic breccia and tuff with fragments up to 1.5 m across. The breccias are polymictic and probably partly reworked, but the angularity of the fragments suggests reworking was limited. A cobble conglomerate unit (4) at least 80 m thick occurs close to the axial zone of the Heart Island syncline. The unit contains well rounded clasts of mafic to felsic volcanic and sedimentary rocks and quartz and is associated with chert, argillite, and feldspathic greywacke. Iron formation and felsic volcanic breccia occur within this sedimentary unit at the eastern end. Iron formation further west, at the northeast end of Heart Island, is probably part of the same unit. Minor felsic

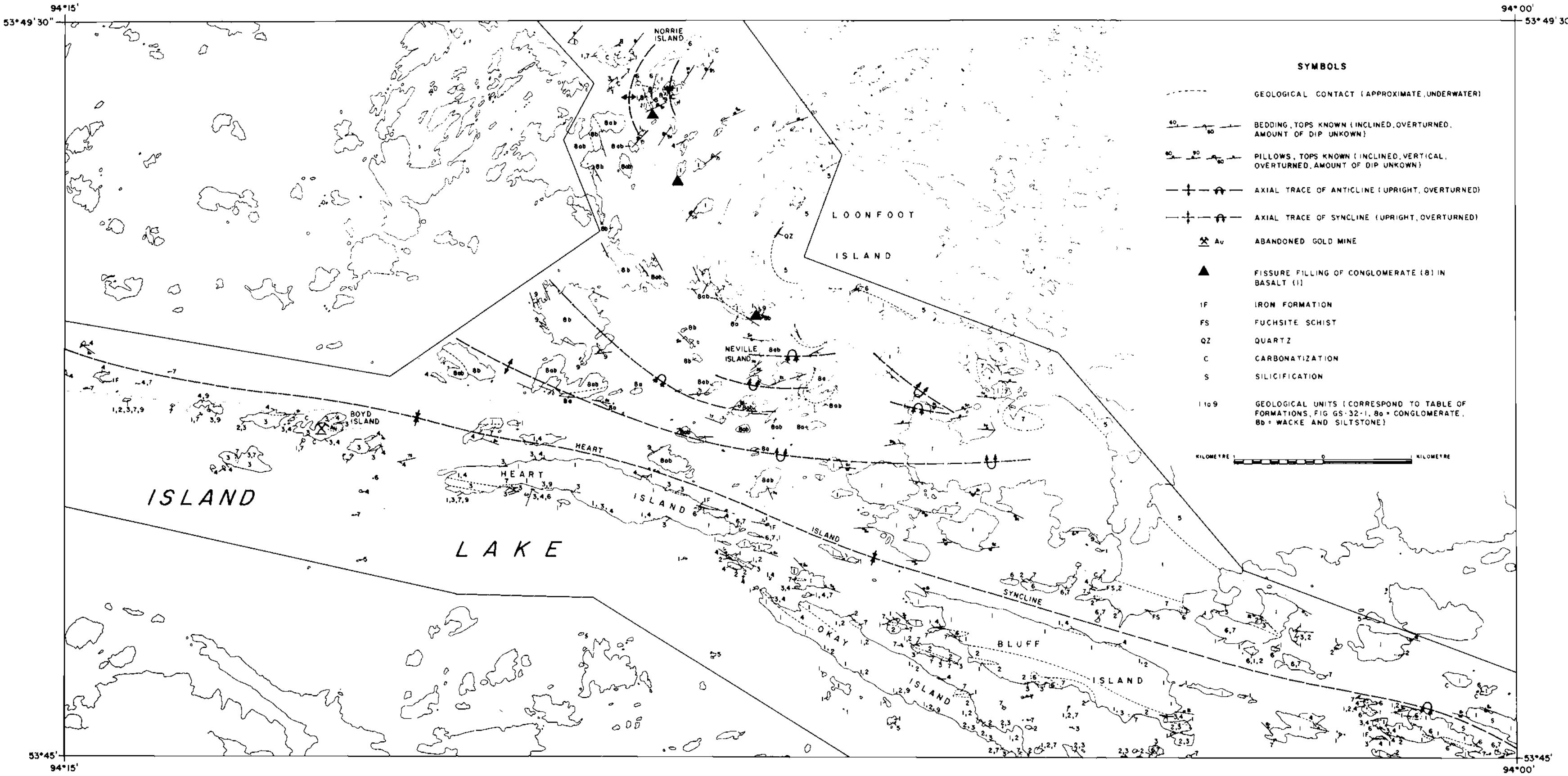

Figure GS-32-2: Geology of the Loonfoot Island area.

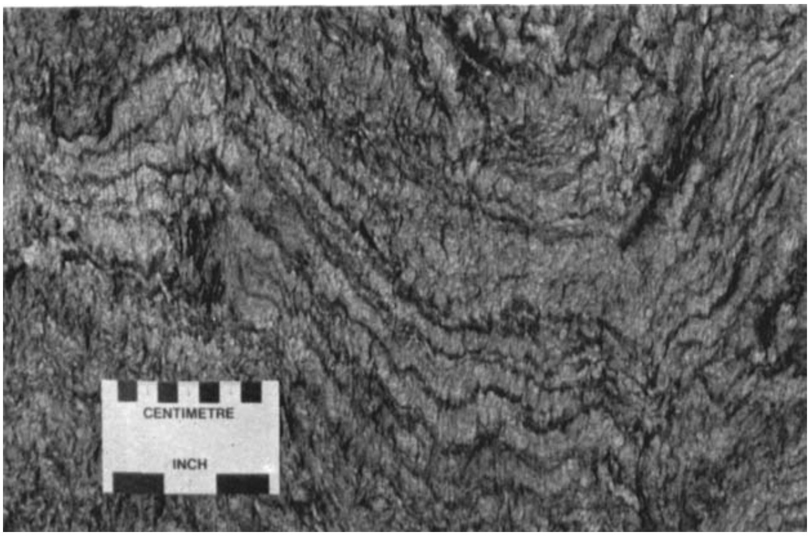

Figure GS-32-3:

Minor F, fold in quartz-sericite schist (3) close to Boyd Island.

breccia, tuff, and flow/sill units (3) occur sporadically throughout the south limb of the Heart Island syncline; these are best developed within the intermediate volcanic section in the southern Bluff Island-eastern Okay Island area. A felsic volcanic unit at least 30 m thick also occurs just north of the axial zone of the syncline between a gabbro/peridotite sill to the south and pillowed basalt to the north. Fuchsite schist (3) containing pyrite, arsenopyrite and carbonate is associated with highly vesicular andesite and tuff at the north margin of the sill just north of Bluff Island. The undeformed pillowed basalt to the north is largely aphyric, locally variolitic, plagioclase-phyric and rarely hornblende-phyric. Minor autoclastic breccia and synvolcanic gabbro sills occur in the section.

Loonfoot Island area

A basaltic section over 3 km thick, which extends northwest from the west side of Loonfoot Island, is lithologically equivalent to the section south of Loonfoot Island. The flows are increasingly deformed towards the west margin of the Loonfoot Island pluton (5), and possible hornfels suggests the pluton may postdate the mafic flows (1). Alternation of pillowed/non-pillowed units at the Loonfoot Island peninsula has been accentuated by deformation which transformed the pillowed units to laminated amphibolites more susceptible to erosion than the non-pillowed flows.

ISLAND LAKE GROUP (8)

The Island Lake Group unconformably overlies the Hayes River Group (Weber et al., 1982) and several exposures in the vicinity of Loonfoot Island confirm this relationship. At the south end of Norrie Island irregular zones of conglomerate (8) within aphyric pillowed basalt (1) are interpreted as fissure fillings (Fig. GS-32-4). Angular clasts up to 50 cm across include mafic to felsic volcanic, sedimentary, granitoid and gabbroic lithologies with minor quartz and fuchsite schist. Irregular, ovoid siliceous zones with carbonate (up to 1 m across), which are characterized by a 1-4 mm rusty-weathering ferruginous surface, are interpreted as alteration features. The conglomerate/basalt contact is also exposed at the south end of the Loonfoot Island peninsula where conglomeratic fissure fillings occur in the spheroidally weathered basaltic substrate (Fig. GS-32-5). A 10 cm

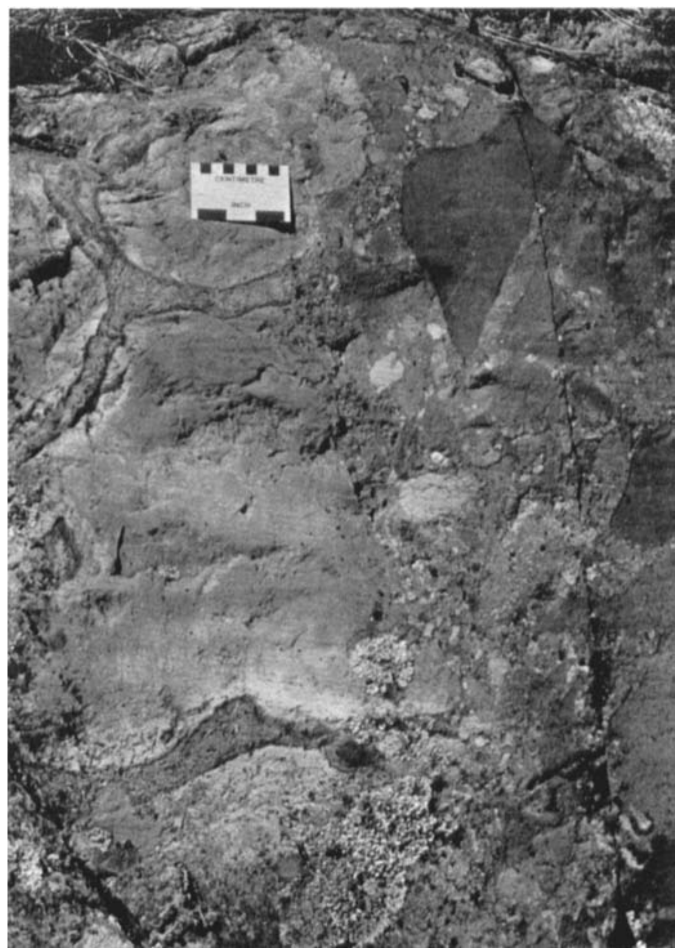

Figure GS-32-4:

Fissure filling of conglomerate (8) in pillowed basalt (1) at the south end of Norrie Island.

Figure GS-32-5:

Spheroidally weathered surface of basalt (1) with irregular zones of conglomerate (8) interpreted as fissure fillings at the south end of the Loonfoot Island peninsula.

Figure GS-32-6:

Conglomerate (8) filling a narrow crevice within basalt (1) south of Norrie Island.

wide fissure containing conglomerate (8) also occurs within massive basalt 800 m south of Norrie Island (Fig. GS-32-6). The conglomerate at Norrie Island is locally interlayered with green lithic and feldspathic greywacke, crossbedded throughout at a scale of 5-15 cm (Fig. GS-32-7). Similar green greywacke and siltstone at least 17 m thick, locally with massive magnetite laminae (up to 5 mm) overlie the conglomerate.

The lower part of the Island Lake Group is well exposed at the northwest shore of Neville Island where a 13 m basal pebble conglomerate is overlain by 30 m of coarse grained quartz-rich arkose, conglomerate and siltstone; this is overlain by at least 12 m of finely laminated siltstone and fine grained greywacke. The fine grained sedimentary rocks do not extend laterally to the northeast shore of Neville Island and either wedge out or were removed before deposition of overlying polymictic cobble/boulder conglomerate. The latter constitutes half of the Island Lake Group in the area that has been mapped. The remainder consists of medium grained arkosic wacke, lithic and feldspathic greywackes and minor quartz wacke and siltstone.

Conglomerate (8), which is similar to the Sinclair Island conglomerate farther west (Neale and Weber, 1981), contains a wide variety of subangular to well rounded cobbles and boulders as follows;

1. Tonalite/granodiorite, some with quartz phenocrysts,
2. Felsic porphyry and possible felsic volcanic rock,
3. Basalt and related silicified basalt and carbonatized basalt,
4. Greywacke, siltstone and argillite,
5. White chert and jasper,
6. Vein quartz,
7. Fuchsite schist,
8. Gabbro and hornblendite,
9. Carbonate (or possibly carbonatized volcanics),
10. Resedimented pebble conglomerate.

Tonalite and felsic porphyry clasts are generally massive but rare gneissoid types are present, especially in the area just south of Norrie Island where the granitoid clasts are most abundant. These two lithologies and basalt are the predominant clast types in the conglomerate. The conglomerate is variously matrix-supported or clast-supported, and commonly interlayered with arkosic wacke at a scale of 5 cm-2 m. Slight sorting of pebbles and cobbles is locally evident and the asso-

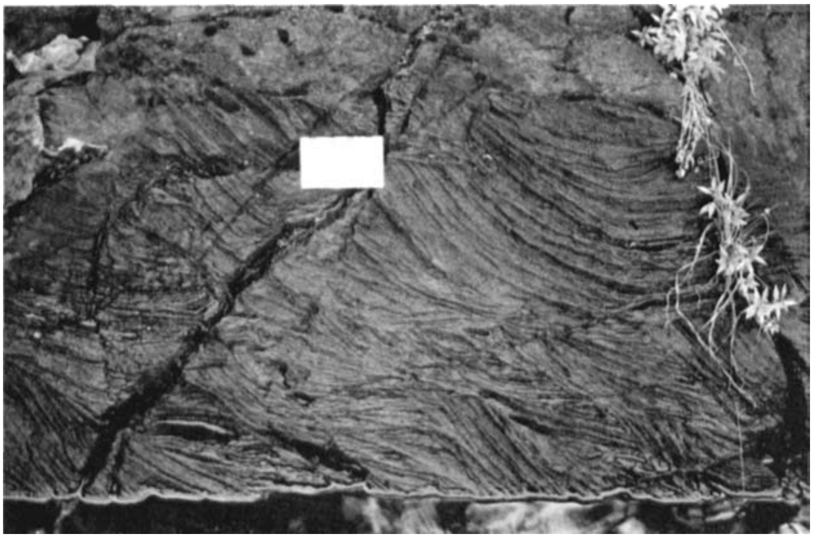

Figure GS-32-7:
Crossbedded green lithic and feldspathic greywacke (8) at Norrie Island.

Figure GS-32-8:
Channel filling of conglomerate within interlayered conglomerate/arkosic wacke (8) west of Loonfoot Island.

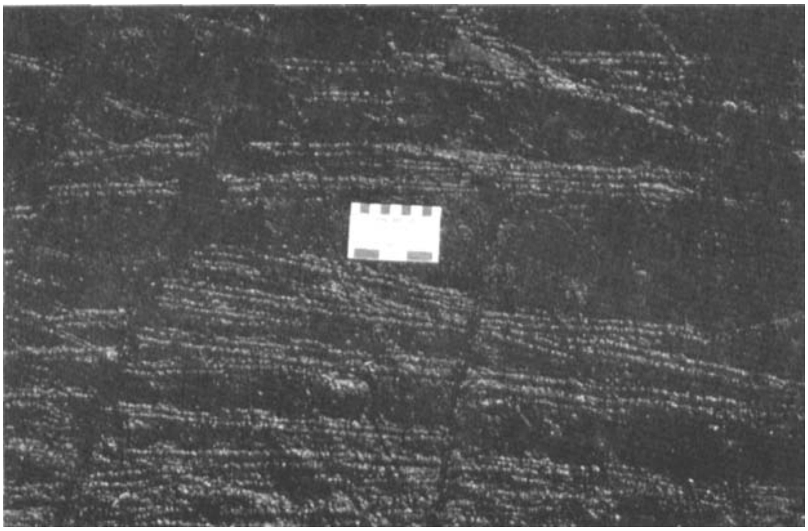

Figure GS-32-9:
Mafic or ultramafic rock (6) with irregular branching fractures at the north end of Norrie Island.

ciated arkosic wacke is crossbedded in places. Scours and channel fillings are characteristic (Fig. GS-32-8). Fine grained greywacke and siltstone locally display primary folding and siltstone rip-ups.

ULTRAMAFIC AND MAFIC ROCKS (6, 7)

Serpentinized peridotite, gabbro and related intrusive rocks occur in a zone extending across the map area which is coincident with the axial zone of the Heart Island syncline. This is part of a major zone extending for approximately 70 km through the Island Lake greenstone belt (Theyer, 1978 and 1984). The ultramafic rocks within this zone include some possible extrusive units (Theyer, op. cit.) but none were encountered in the Loonfoot Island area. Peridotite is largely confined to the eastern part of this area; minor mafic and ultramafic sills occur sporadically throughout the Hayes River Group. The northern part of Norrie Island consists of a slightly magnetiferous, pale grey, fine grained lithology of high specific gravity provisionally mapped as ultramafic; the rock displays irregular branching fractures (Fig. GS-32-9). The relative age between this unit (6) and conglomerate (8) is not clear but ultramafic intrusions have not been mapped within the Island Lake Group which is thus assumed to postdate the intrusions.

ALTERATION AND MINERALIZATION

Carbonatization is widespread in the Hayes River Group and is extensive in the vicinity of Boyd Island. Some massive carbonate units in that area have been interpreted as sedimentary, but a secondary origin has also been proposed (J. Stewart, pers. comm.). The carbonatization is locally extensive adjacent to ultramafic intrusions, and is especially pervasive west of Norrie Island where basalt and mafic intrusive rocks have been largely or entirely altered to carbonate.

Silicification of basalt is common in the south limb of the Heart Island syncline, and most conspicuous close to the axial zone at the east margin of the Loonfoot Island area where white, flinty pillowed flows are gradational with less altered, amphibolitic basalts.

Pyrite-pyrrhotite (±chalcopyrite) mineralization occurs sporadically in minor zones (0.2-1 m wide) within basalt; sulphides are locally concentrated along pillow selvages and are commonly associated with silicification and shearing. Pyrite occurs in some quartz veins, which also have a potential for gold mineralization (e.g. a 6 m thick quartz dyke between basalt and tonalite at the west margin of the Loonfoot Island pluton). Sulphides (±carbonate) are also associated with felsitic units and sericite schist (e.g. at Boyd Island). Gold mineralization at Boyd Island is apparently associated with felsic volcanic and intrusive porphyry units and has evidently been localized where these rocks are in contact with argillitic sediments. The potential for base metal and gold mineralization in ultramafic rocks (6) has been discussed by Theyer (op. cit.). Fuchsite schist is also considered a potential host for gold mineralization (e.g. north of Bluff Island).

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GS-33 BIGSTONE LAKE PROJECT

(53E/parts of 12NW and NE)

by K.L. Neale[1]

INTRODUCTION

Geological mapping at 1:20 000 was initiated in the Bigstone Lake area (Fig. GS-33-1) 60 km west of Island Lake. Previous mapping at 1:63 360 (Ermanovics et al., 1975; Herd and Ermanovics, 1976) led to a proposal that the supracrustal rocks of the Bigstone Lake greenstone belt are divisible into a lower, predominantly volcanic group correlated with the Hayes River Group at Island Lake, and an unconformable upper group with approximately equal amounts of sediments and volcanics, correlated with the Island Lake Series (Park and Ermanovics, 1978).

One of the objectives of this summer's field work was to study the stratigraphy of, and the contact between, the lower and upper successions at Bigstone Lake for ultimate comparison with possibly time-equivalent strata at Island Lake.

STRATIGRAPHY

The proposed Table of Formations (Fig. GS-33-2) is based primarily on the stratigraphic sequence from the eastern part of Bigstone Lake (AB, Fig. GS-33-1).

Supracrustal rocks of the lower group (units 1-4), exposed along the southeastern shore of the lake, comprise weakly silicified pillowed mafic flows (1b)[2] intercalated with subordinate silicified, fuchsitic intermediate volcanics (2a). Banded iron formation, containing either pyrite or magnetite (together with quartz-feldspar layers) is locally associated with the volcanics. On the eastern shore of Bigstone Lake, and along strike into Knight Lake, intermediate to felsic ash deposits (2 & 4) attain thicknesses of 5 - 10 metres. These ash flows are bordered by mafic volcanics of unit 1 and a conglomerate bearing felsic volcanic detritus (6a1), and hence are interpreted to lie near the stratigraphic top of the lower sequence.

[1]Carleton University, Ottawa.
[2]Subunits refer to Preliminary Map **1984B-1**

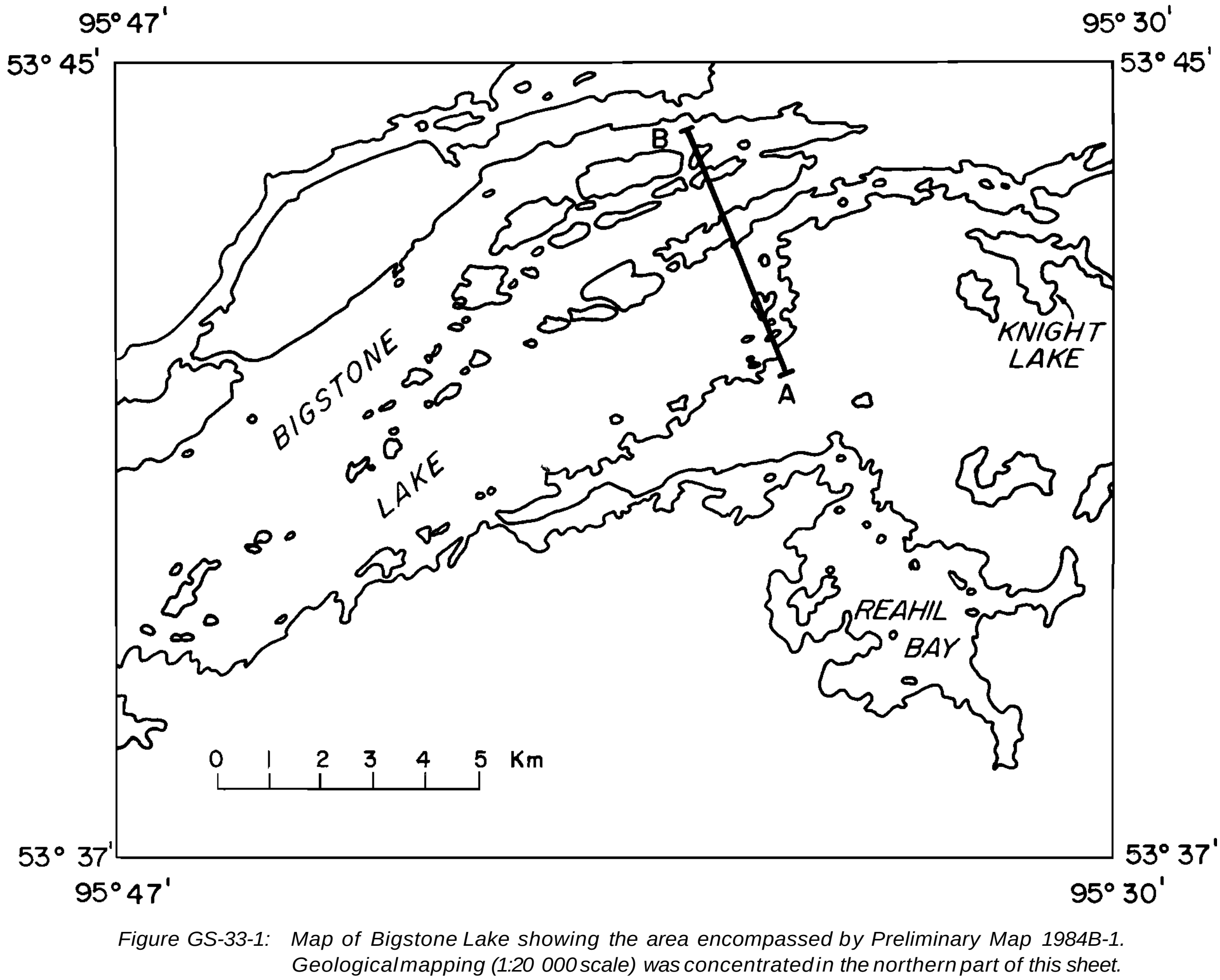

Figure GS-33-1: Map of Bigstone Lake showing the area encompassed by Preliminary Map 1984B-1. Geological mapping (1:20 000 scale) was concentrated in the northern part of this sheet. A-B: type section for Table of Formations.

Era	Rocks	Unit	Description
ARCHEAN	Late Plutonic Rocks	12	Dyke rocks
		11	Tonalite, quartz diorite
			INTRUSIVE CONTACT
	Late Supracrustal Rocks	10	Intermediate to felsic metavolcanic rocks: layered and massive ash deposits
		8 & 9	Mafic and intermediate metavolcanic rocks
		7	Plagioclase phyric intermediate ash deposits
		6	Arkosic wacke and conglomerate (derived from unit 4), wacke-siltstone couplets
			UNCONFORMITY(?)
	Early Plutonic Rocks	5	Gabbro, medium grained
			INTRUSIVE CONTACT
	Early Supracrustal Rocks	4	Intermediate to felsic metavolcanic rocks: flows, phyric ashes
		3	Siltstone-argillite couplets, laminated siltstone, iron formation
		2	Intermediate metavolcanic rocks: flows, (a)phyric ash deposits
		1	Mafic metavolcanic rocks: flows and related subvolcanic gabbro sills

Figure GS-33-2:
Table of Formations, Bigstone Lake

Conglomerate (6a1) and associated arkosic wacke (6a), mark the base of the upper succession (units 6-10). Unit 6a reflects proximal derivation from a subvolcanic source (quartz porphyry clasts occur exclusively); however, a non-conformable transition from an unaltered source rock to arkosic wacke was not observed. In the northwestern region of the lake, unit 6a grades laterally into matrix-supported and typically unstratified conglomerates (6a1 and 6a2). These coarser units, which have a minimum thickness of 25 m, are dominated by clasts of vein quartz and felsic flows (6a1, Figure GS-33-3), and mafic to intermediate volcanics (6a2).

In the southwestern sector of the lake, couplets of feldspathic wacke and siltstone dominate the sedimentary succession (6). These couplets, interpreted as classical turbidites by Park and Ermanovics (1978), deviate from the norm in that they are generally not sharp-based, basal grading is only locally developed, and siltstone, rather than argillite (Bouma division E), commonly forms the uppermost layer of the couplet. An alternative interpretation for these beds, therefore, is one of sheet flood deposition on a lower alluvial fan.

Although unequivocal facing indicators are rare in the uppermost volcanics (exposed in the central part of the lake), the apparent stratigraphic sequence consists of plagioclase-phyric intermediate ash deposits of unit 7 (15 m minimum thickness), followed by locally pillowed mafic flows and associated gabbro of unit 8 (600 m thick). Pillowed and variolitic intermediate volcanics of unit 9 (750 m thick) are generally weakly silicified, whereas widespread carbonatization typifies the massive flow rocks.

Medium grained gabbro (5) has intruded intermediate to felsic ash deposits (4) on the western shore of Knight Lake. In the narrows at the northeast end of Bigstone Lake, feldspar-quartz porphyry (11b2), interpreted as a marginal phase of tonalite unit 11b. has intruded sedimentary rocks of unit 6.

STRUCTURE

The most extensive structure at Bigstone Lake is a northeast-trending, steeply dipping syncline. In the southeastern region of the lake, sedimentary rocks of unit 6 have been tightly refolded along north-northeast-trending axes. The related linear structures plunge moderately to the west or southwest. Subsequent south-southwest-trending folds in unit 6 are of the chevron- or box-type.

Axial planar foliation associated with the major syncline is commonly overprinted by east-trending sheared zones. The shear-induced foliation is locally intersected by kink bands (Figure GS-33-4), a feature most commonly developed/preserved in the volcanic rocks of the lower and upper sequences. A non-penetrative fracture cleavage (at approximately 100°) postdates the kink bands.

MINERALIZATION

Sulphide concentrations, most prevalent in the silicified intermediate volcanics of the lower group, are typically pyrite with lesser amounts of pyrrhotite, chalcopyrite and sphalerite. Blebs and stringers of pyrite ± magnetite also occur in weakly silicified and cordierite-bearing mafic volcanics along the southeastern shore of the lake.

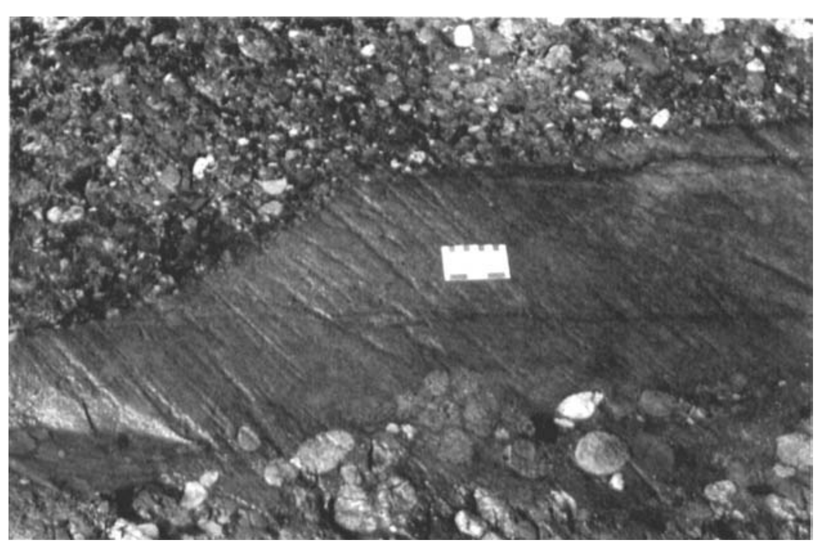

Figure GS-33-3:
Conglomerate (6a1) displaying clasts of aphyric felsic volcanic and quartz porphyry.

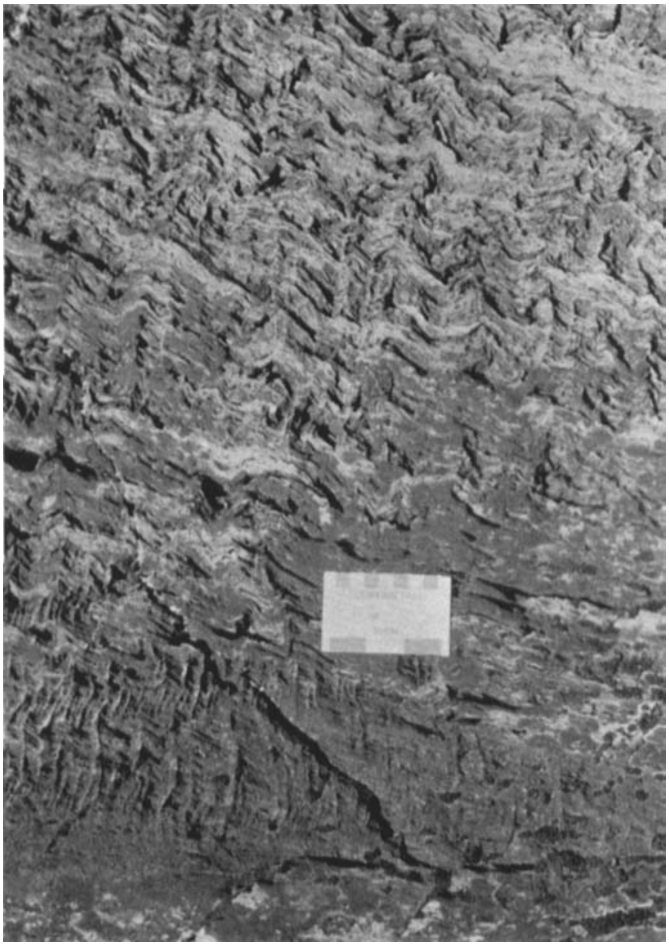

Figure GS-33-4:

Kink bands developed in mafic volcanics (8) of the younger supracrustal succession.

Gossan zones 2-10 m wide are commonly associated with both the mineralized mafic volcanics and pyrite-bearing banded iron formations of the lower sequence.

Conglomerate (6a1), which is stratigraphically above a sequence of pillowed intermediate volcanics on the northwest shore of Bigstone Lake, contains subangular clasts of iron formation (pyrite and quartz-feldspar-carbonate). Associated with these clasts is a laterally extensive sulphide-bearing zone 150 x 6 m wide, a potential area of paleo-placer (i.e., alluvial) base metal deposition. Several gossans contained within sheared or silicified zones of the upper volcanic sequence (7-10) are locally enriched with pyrite, pyrrhotite and arsenopyrite.

COMPARISON

A notable difference between the "Early Supracrustal Rocks" at Bigstone Lake and Island Lake is the lesser amount of clastic metasediments at Bigstone Lake (10-15 m thick sequences), compared to Island Lake (up to1450 m; Weber et al., 1982). The strata at Island Lake are also more diverse (e.g., siltstone, wacke-argillite couplets, conglomerate), whereas laminated feldspathic and chloritic siltstone is one of only two sedimentary rock types observed in the lower succession at Bigstone Lake.

Marginal intrusion of granodiorite to quartz diorite plutons into the lower volcanic rocks is evident at both Island Lake and Bigstone Lake. At Island Lake, the Bella Lake Pluton is transitional into an arkosic wacke-supported regolith which, together with a tonalite-bearing conglomerate, form the base of the upper sedimentary sequence. However, at Bigstone Lake, plutonic detritus is not apparent in metasediments of the younger succession. Quartz porphyry (and felsic volcanic) clasts have a widespread occurrence, which suggests that an unconformity may exist between shallow subvolcanic intrusions (related to unit 4) and sedimentary rocks of unit 6.

Conglomeratic units, which dominate the younger supracrustal sequence in the Cochrane Bay area of Island Lake, vary in thickness from 25-400 m (Neale, 1984), whereas conglomerates occur only near the base of the younger succession at Bigstone Lake and are generally not thicker than 30 m. In addition, volcanic rocks have not been observed in the sedimentary sequence at Cochrane Bay, whereas a 1400 m thick section of locally pillowed intermediate and mafic flows occurs in the upper succession at Bigstone Lake.

A viable correlation, therefore, of the lower and upper sequences at Bigstone Lake, with the Hayes River Group and Cochrane Bay group (Neale, 1984), respectively, is not apparent. Formal classification of the "Early" and "Late" supracrustal rocks (Fig. GS-33-2) will be undertaken after the next field season.

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GS-34 MINERAL DEPOSIT INVESTIGATIONS

1) GOLD OCCURRENCES IN THE GODS LAKE AREA; AND

2) PLATINUM GROUP METALS IN THE BIRD RIVER SILL

by P. Theyer

1) GODS LAKE

Elk Island and surrounding islands were investigated to determine the nature, composition and extent of the host rocks to the Gods Lake Mine, and assess if any metallogenic relationships exist between the Gods Lake gold mine deposit and other gold occurrences in its vicinity.

The Gods Lake Gold Mine produced 490812 tonnes of ore which yielded 4552 kg of gold and 805 kg of silver between 1935 and 1943. The host rock to this deposit was described by Baker (1935) as a "tuff bed occurring north of an augite diorite sill". He described the tuff bed as including:

a) slaty fine grained schist generally forming the walls of ore shoots;
b) coarse grained chlorite-hornblende schist; and
c) often multicoloured and mineralized felsic tuff.

Dix (1951) mapped the tuff bed as a very thin layer on the north shore of Elk Island. Stewart (1980) described the host rock as a tuff. A sketch map of Elk Island and its vicinity shows the location of the Gods Lake Gold Mine and other gold occurrences on Elk, Jowsey and an unnamed island west of Jowsey Island (Figure GS-34-1).

GODS LAKE GOLD MINE

The host rock to the Gods Lake Gold Mine is a fine grained volcanogenic(?) detrital and chemical sediment up to 3 m thick. Exposures west of both the No. 1 and No. 2 shafts contain a rock unit that includes argillite, finely banded greywacke, and a massive, aphanitic siliceous rock with mineralized brecciated cherty zones.

This rock unit occurs north of a 80 m to 100 m thick, mafic to intermediate coarsely crystalline and ophitic textured rock of probable igneous intrusive origin. The juxtaposition of the easily weathered mineralized tuff north of the more resistant igneous rock forms a ridge which can be traced over a distance of approximately 7 km.

SMELTER OCCURRENCE

This gold occurrence consists of quartz veins within a major east-striking fracture zone in pillowed volcanic flows. Minor pyrite mineralization was observed in several quartz veins. The rnineralization in this occurrence appears to be genetically unrelated to the gold in the Gods Lake Gold Mine.

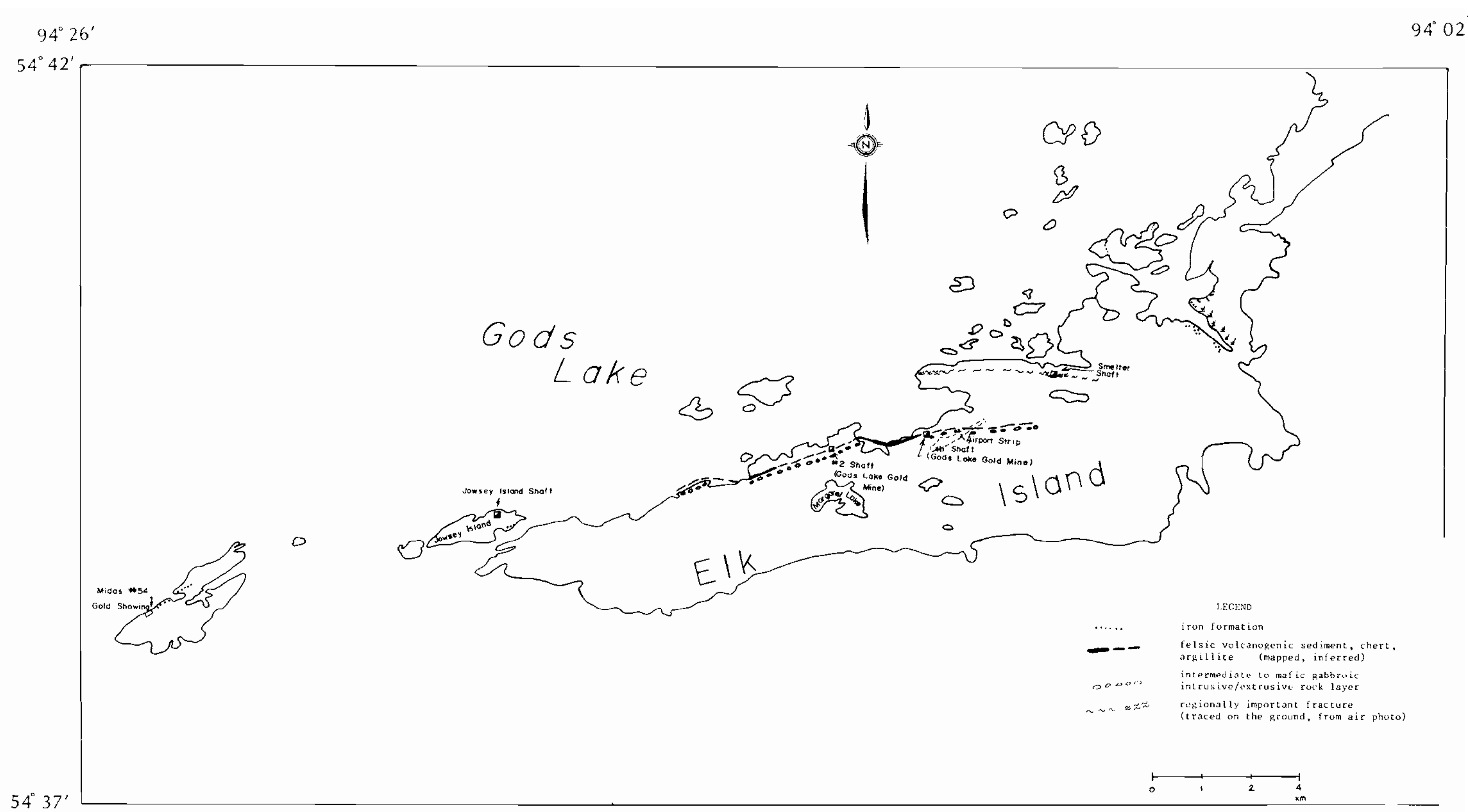

Figure GS-34-1: Geological sketch map of the Elk Island area (Gods Lake) showing the location of investigated gold occurrences and rock units.

IRON FORMATIONS ON NORTHEASTERN ELK ISLAND

Several occurrences of magnetite-chert iron formation are exposed on the lakeshore east of the Smelter occurrence. The one to two metre thick iron formations are usually hosted by unaltered, pillowed mafic flows or mafic breccia tuff. The exception is an occurrence of silica facies iron formation that grades into siliceous grits and wacke.

JOWSEY ISLAND

Gold mineralization on Jowsey Island was described as occurring with sulphides in quartz veins hosted by a fractured quartz-feldspar porphyry intruded into pillowed mafic flows (Brownell, 1932). An inspection of Jowsey Island revealed no evidence of similarities between this showing and the stratabound Gods Lake Gold Mine. A narrow oxide iron formation and chert occurrence hosted by pillowed flows is present on the south shore of Jowsey Island.

MIDAS #54

This showing consists of three trenches exposing a quartz-feldspar porphyry stock containing minor pyrite mineralization. The quartz-feldspar porphyry occurs adjacent to, and possibly replaces, a layer of silicic iron formation that is stratigraphically overlain by felsic volcanogenic sediments.

2) PLATINUM GROUP METALS IN THE BIRD RIVER SILL

A continuous sample was cut across the ultramafic portion of the Bird River Sill approximately 900 m west of the sample cut in 1983 (Theyer, 1983a) (Fig. GS-34-2). Detailed stratigraphic studies by Scoates (1983) indicated that additional, previously uncut layers of the sill were exposed in this section.

Assays of 2 m long sections from the 1984 sampling program show two zones to be enriched in Pd and Pt: 1) from 32.3 m to 52.3 m, and 2) from 93.7 m to 111.7 m.

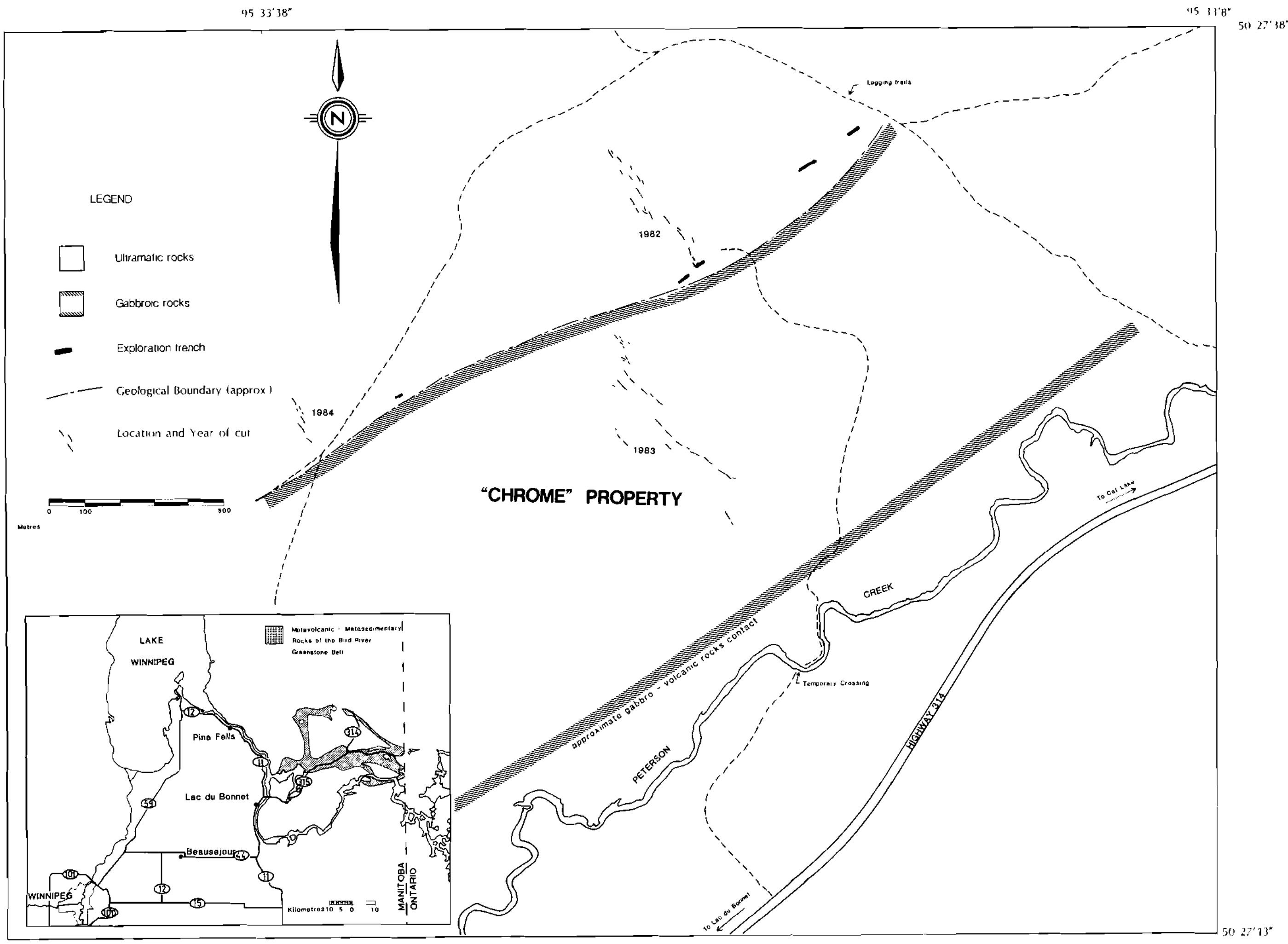

Figure GS-34-2: Geological sketch map showing the location of all rockcuts made for the Platinum Group Metals study.

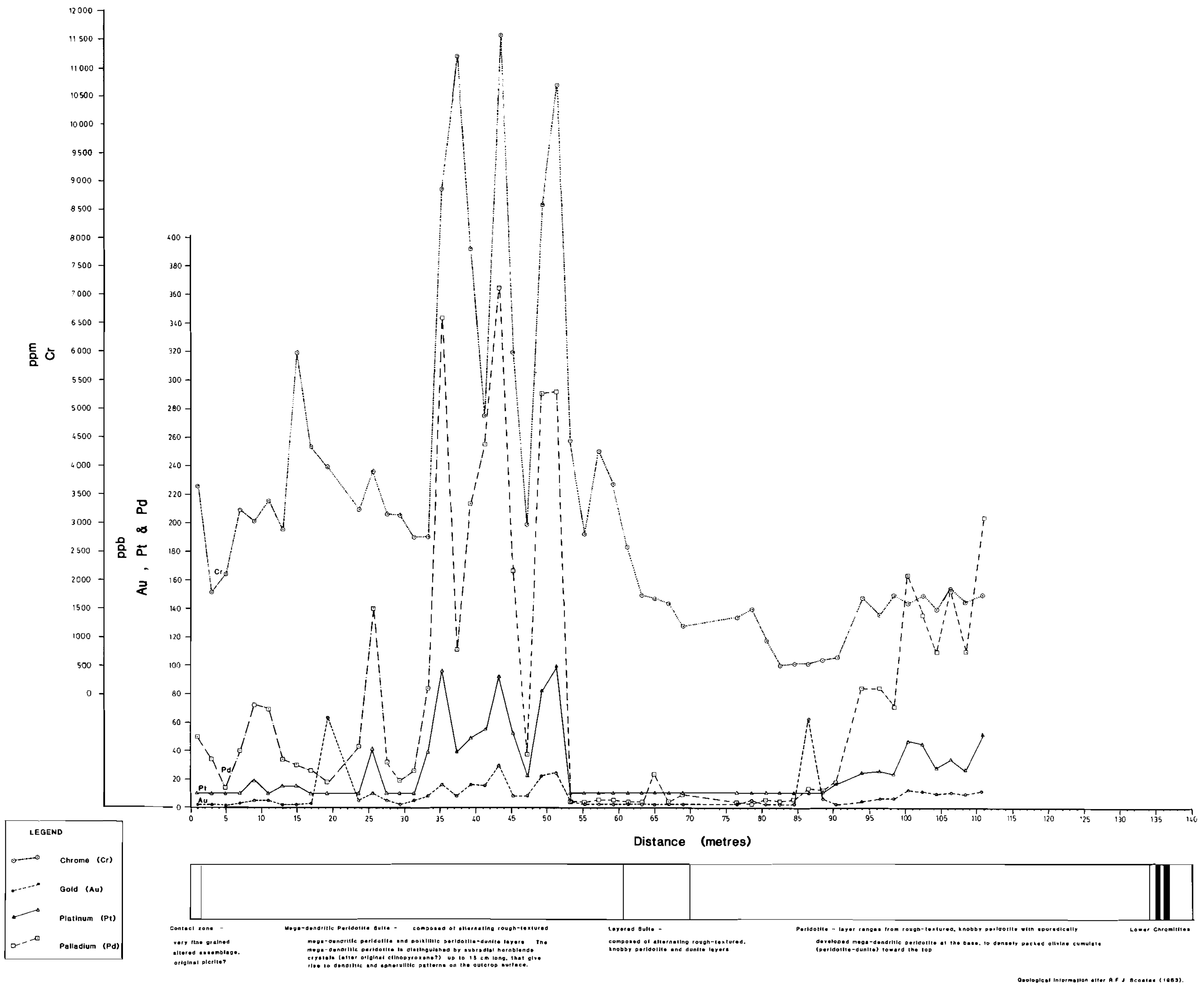

Figure GS-34-3: Geochemical profile showing the relationship between Pt, Pd, Au and Cr in a part of the Bird River Sill.

The first zone is enriched in Pd and Pt to a greater extent than the second zone and also shows a correlation between Pd and Pt contents and the Cr contents (Fig. 68-34-3).

These assays will be supplemented by detailed sampling at 50 cm lengths from the enriched zones. These samples are expected to give details of the distribution patterns for the Platinum Group Metals in parts of the Bird River Sill.

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GS-35 PEGMATITIC GRANITES AND PEGMATITES AT RED SUCKER LAKE, MANITOBA

by L. Chackowsky[1] and Cerny[1]

INTRODUCTION

An east-trending swarm of pegmatitic granites and pegmatite exposures at Red Sucker Lake was documented and sampled in detail during the 1984 field season for the purpose of studying the geochemical, mineralogical and petrological characteristics of these rock bodies (Fig. GS-35-1). About 700 mineral and 40 whole-rock samples were collected during the 6 weeks of field work. The pegmatitic granites and pegmatites were documented as to dimensions, attitude where possible, relationships to the country rocks, internal zoning and mineral assemblages.

GENERAL GEOLOGY

The pegmatitic granites and pegmatites are intruded into a 2 - 3 km wide east-trendlng belt of metavolcanic and metasedimentary rocks that extends from Red Sucker Lake to the Manitoba-Ontario border (Schledewitz and Kusmirski, 1979). The greenstone belt is one of many located in the Sachigo Subprovince of the Archean Superior Province in the Canadian Shield.

The oldest components of the belt are metavolcanic rocks and derived sediments of the Hayes River Group (Downie, 1936). These rocks occur in the southwestern part of the belt. They are overlain by metasedimentary rocks of the Oxford Group to the north and east. These are mostly garnetiferous biotite schists with subordinate arenaceous lithologies. East-trending tonalitic dykes intrude the metasediments.

The youngest rocks are the extensive granitic intrusions of batholithic proportions. They range from grey tonalites to granodiorites and pink granites. Tonalitic gneisses are also common.

Thick deposlts of glacial drift leave only extremely limited exposure; it is generally restricted to shorelines.

PEGMATITIC GRANITES

Pegmatitic granites occur throughout the area, in an east-trending belt which may partly follow an axial shear in the greenstone belt. Pegmatitic leucogranites are the most common type with lesser amounts of fine grained leucogranites and sodic aplites (for nomenclature and rock-type descriptions see Cerny et al., 1981). The pegmatitic granite intrusions are generally larger than those of the pegmatites, ranging in width from less than 1 metre to several tens of metres, and attaining up to 100 metres in length. Exposures are generally concordant to the schistosity of the country rocks. Shear banding, boudinage and ptygmatic folding occur in several outcrops.

These granites are dominantly composed of perthitic K-feldspar and graphic K-feldspar + quartz intergrowth, quartz, plagioclase and subordinate muscovite. Accessory minerals are represented by garnet, tourmaline, biotite, arsenopyrite and/or loellingite, chalcopyrite, molybdenite, and apatite. Opaque minerals, not readily identifiable in the field, are rare. Tourmaline, as the schorl species, is a widespread accessory phase usually occurring along the margins of quartz cores and surrounding blocky K-feldspars in potassic pegmatite segregations.

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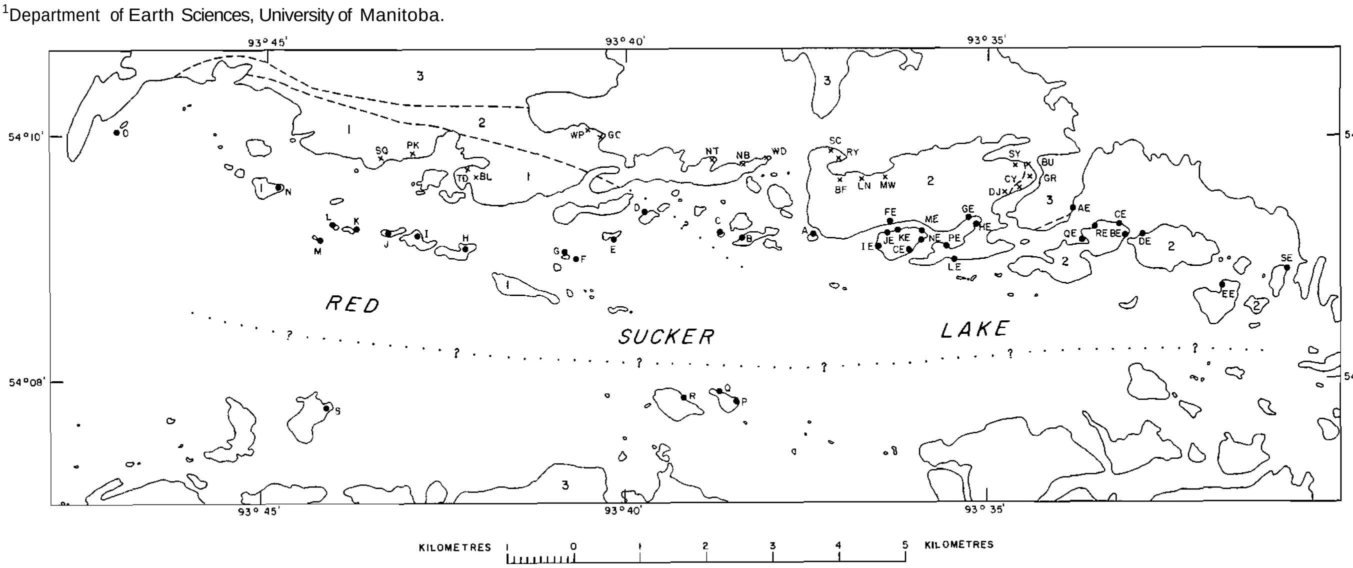

SYMBOLS :

- • PEGMATITIC GRANITES – INCLUDING PEGMATITIC LEUCOGRANITES. FINE GRAINED LEUCOGRANITES AND SODIC APLITES
- x PEGMATITES
- - - - . . . . GEOLOGICAL BOUNDARY (APPROXIMATE. ASSUMED)

LEGEND:

1 HAYES RIVER GROUP : METABASALTS AND DERIVED METASEDIMENTS

2 OXFORD GROUP : METASEDIMENTS

3 GREY TONALITES AND GRANODIORITES. PINK GRANITES

Figure GS-35-1: Location of pegmatitic granites and pegmatites, Red Sucker Lake area.

Figure GS-35-2:
Accumulation of megacrysts (graphic K-feldspar + quartz intergrowth) at location 'B'.

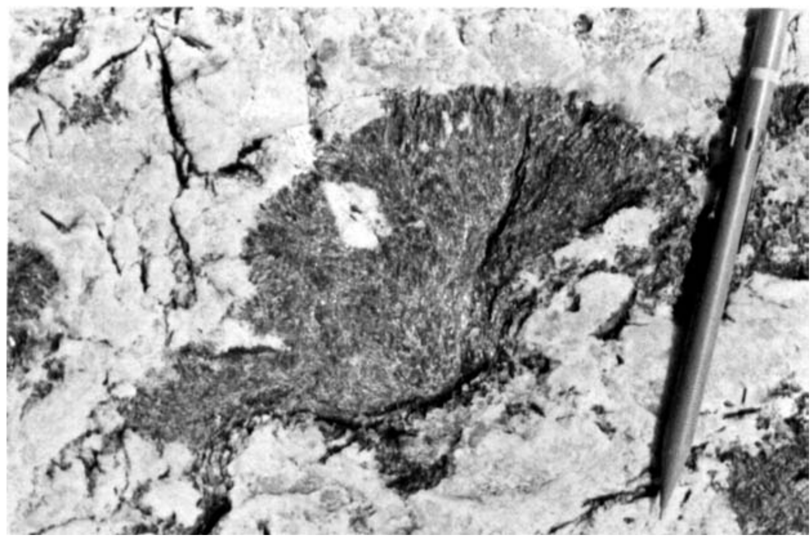

Figure GS-35-3:
Large radiating aggregate of muscovite, location 'F'.

The pegmatitic leucogranites commonly contain megacrysts of graphic K-feldspar +quartz intergrowths up to 20 cm across. They are typically imbedded in a finer grained matrix of quartz, feldspar, and muscovite, with accessory garnet, apatite and locally sulphides. These megacrysts form spectacular accumulations in several locations, as, e.g., in location 'B' (Fig. GS-35-2). Large radiating muscovite aggregates occur abundantly only in location 'F' (Fig. GS-35-3). They occur elsewhere, usually as rare, small (1 to 2 cm) poorly defined aggregates.

Sodic aplite commonly occurs as narrow layers intimately associated with the pegmatitic leucogranite. The aplite is commonly banded, with the darker bands enriched in garnet. In a few locations aplite predominates over pegmatitic leucogranite, at least within the limits of exposed outcrop.

Fine grained leucogranite is rare in the area. It occurs as small scattered exposures typically interlayered with pegmatitic leucogranites. They are composed of K-feldspar, quartz, plagioclase and subordinate muscovite with accessory biotite. One fairly large exposure occurs at location 'G'.

PEGMATITES

The pegmatites occur mostly along the northern exposure of the Oxford Group metasediments. They are generally E-W striking and subvertically dipping bodies, predominantly concordant to the schistosity of the metasediments. The pegmatite dykes are generally tens of centimetres to several metres in width, extending in some cases up to 30 metres along strike. Contacts are in many places hidden by glacial drift and/or overgrowth.

Most of the pegmatites are mineralogically and texturally simple and are nearly homogeneous. They have mineral assemblages similar to the pegmatic granites. Arsenopyrite (or loellingite) occurs in a few locations, and tourmaline is much less widespread in the pegmatites than in the pegmatitic leucogranites. As in the pegmatitic granites, opaque minerals, not readily identifiable in the field, are rare.

Three notable exceptions among the pegmatites include a Li-rich pegmatite (SQ), an albite-rich, cassiterite-bearing dyke (TD), and a beryl-bearing pegmatite (BL). The Li-rich pegmatite carries spodumene + quartz pseudomorphs after petalite, and Li-rich micas. The Sn-enriched dyke is aplitic in appearance, consisting largely of saccharoidal albite, with subordinate quartz; K-feldspar is not observable in hand specimens. Apatite and cassiterite are dispersed in the albite, and fluorite is present as late fracture fillings. The beryl-bearing pegmatite is an inconspicuous, biotite + muscovite-bearing dyke, carrying dirty yellow-green subhedral crystals of beryl; the dyke could not be located during the 1984 season but was examined in 1981.

The three above-mentioned pegmatites all occur in the metabasalts, on the western edge of the pegmatite-bearing area. These are the only tourmaline-bearing pegmatites in the area, with schorl being the predominant species but with verdelite occurring in the Li-rich pegmatite (SQ). Apart from these three exceptionally mineralized pegmatites marking the western extremity of the district, distinct mineralogical or textural trends could not be detected in the field among the accessible pegmatites.

FURTHER WORK

Laboratory investigations of the collected material have been initiated to determine whole-rock and trace-element chemistry, rock-forming mineral chemistry and structural properties, geochemistry and structural states of accessory minerals, and identification of unknown samples.

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GS-36 STRATIGRAPHIC MAPPING AND STRATIGRAPHIC AND INDUSTRIAL MINERALS CORE HOLE PROGRAM

by H.R. McCabe

INTRODUCTION

The 1984 core hole program involved four separate projects for which 15 holes were drilled (Fig. GS-36-1), totalling 739 m. One hole (68 m) was drilled for the Silurian correlation project. Two Devonian test holes (total 189 m) were drilled in the Dawson Bay area to 'ground truth' a seismic profile across a Devonian reef structure. One hole (30 m) was drilled east of Rocky Lake, near the southwest corner of NTS 63K (Cormorant sheet); this hole will provide the principal stratigraphic reference for mapping of the Phanerozoic rocks in the Cormorant sheet. The remaining 11 holes were drilled for Operation Cormorant, to obtain lithologic data of Precambrian rocks where they are overlain by a relatively thin cover of Paleozoic strata (see Hosain and McRitchie, this volume). A total of 396 m was drilled in these 11 holes, of which 162 m was Precambrian intersection. In most holes, some core was lost (a maximum of 3.1 m) at the Phanerozoic/Precambrian unconformity, but in several holes the contact was preserved.

In addition to the core hole drilling, shoreline stratigraphic mapping was carried out on a number of lakes in the southwestern part of the Cormorant map sheet, namely, Cormorant, Yawningstone, Mitchell, Ochunipe, Rocky, Egg and Goose Lakes (Fig. GS-36-3). Although a few scattered outcrops had been reported for these lakes (Stearn,1956; Baillie, 1952), much of the area had not previously been mapped. In conjunction with the shoreline mapping, lake-bottom sediment samples and lake-bottom water samples were collected for geochemical studies by the Mineral Investigations Section; a total of 37 sites were sampled (Fig. GS-36-3).

SILURIAN CORRELATION PROJECT

Previous mapping by C.W. Stearn (1956) had indicated an outcrop of Silurian, Fisher Branch Dolomite near the town of Narcisse. The Fisher Branch Dolomite is the basal unit of the Silurian and is reported to be only 4.3 m thick in this general area. The distinctive brachiopod fossil **Virgiana decussata** is, or has been, considered diagnostic in identifying this unit. Stearn indicated that the Narcisse occurrence is structurally high relative to nearby outcrops that he correlated with the Inwood Formation, the unit immediately overlying the Fisher Branch. To explain this structurally high occurrence of supposed Fisher Branch Dolomite, Stearn proposed the presence of a gentle anticline, which resulted in rather prominent flexure in the Silurian outcrop belt (Fig. GS-36-1); this flexure is shown in the Geological Map of Manitoba 79-2.

Earlier drilling by the Branch had indicated that fossiliferous beds, not definitely identifiable as **Virgiana**-bearing, also occur stratigraphically above the Fisher Branch interval, and are interbedded with Inwood-type strata. The results of hole M-1-84 show that the **Virgiana**-bearing beds near Narcisse are 11.8 m above the base of the Silurian section, and hence well above the previously indicated top of the Fisher Branch (only 4.3 m thick). The Narcisse occurrence of **Virgiana** thus represents a stratigraphically higher occurrence of this index fossil, in beds correlated elsewhere with the Inwood Formation. This also explains Stearn's report of the supposedly anomalous occurrence at Narcisse of several fossils "that otherwise occur only higher in the Interlake Group." The "Narcisse fauna" in fact represents a slightly younger fauna, in part transitional to the Inwood. The stratigraphic range of **Virgiana** thus extends slightly higher than previously indicated, and the fauna is in part a recurrent, facies-controlled variant of the Inwood fauna.

DAWSON BAY PROJECT

In 1975. a standard reflection seismic survey (C.D.P., 600%, Dinoseis source) was run by the Department of Earth Sciences of the University of Manitoba (Stephenson, 1975). One of the profiles covered the entire length of the Pelican Rapids Road, along the southwest shore of Dawson Bay (Fig. GS-36-2). Subsequent reprocessing of a portion of this profile by Ingram (1978) had the objective of providing a best possible interpretation in the area of best data acquisition. Two core holes, M-2-84 and M-3-84 were put down in an attempt to test the accuracy of the seismic profile.

The reprocessed seismic profile (Fig. GS-36-2) shows pronounced structural doming on the top of the Devonian Winnipegosis Formation. This structure is undoubtedly due to the presence of an underlying Winnipegosis reef or mound, and surface expression of the structure is evident in the pronounced doming of the suprajacent Dawson Bay strata as a result of post-Devonian salt solution and collapse (Norris et al., 1982). Figure GS-36-2 shows the results of the 1984 drilling superimposed on the seismic profile.

Prior to the 1984 drilling, the writer had questioned two principal aspects of the seismic profile. Firstly, outcrop data in the vicinity of the indicated dome, although confirming the presence of a dome, indicated that the top of the Winnipegosis should occur at a depth of less than 23 m, rather than the approximately 49 m indicated by the seismic profile. The measured depth in hole M-3-84 is only 16.2 m, confirming that the indicated depth scale for the seismic profile is in error, by a factor of about 3. A similar depth scale error is evident in hole M-2-84.

Of more importance is the question as to the relative accuracy of the seismic profiles for the top of the Interlake (base Devonian) and the top of the Precambrian. The seismic profile indicates that the near surface structure is more or less repeated by these deeper horizons, suggesting that the structure results from basement deformation. In detail, this interpretation is not possible, because the extreme complexity of the surface structure could not possibly result solely from structural deformation. However, reefal development may have been localized by some type of true basement-related structure. Although the Precambrian top is beyond the depth capability of our drilling, it was hoped that both drill holes would be able to intersect the Interlake marker. Regional data, although sparse, suggest that **no** structural relief is present on the top of the Interlake, and that the structure on the top of the Winnipegosis and higher markers is superficial, reflecting only the reef paleotopography. Unfortunately, this question cannot yet be resolved because hole M-3-84 had to be abandoned before reaching target depth, when the rods sanded in at 86.2 m. Redrilling will be attempted in 1985. The writer suspects that intra-formational velocity variations in the Devonian may be caused by isopach and lithofacies variation, and localized formational fracturing, all of which may give rise to apparent structural variation in strata that are in fact structurally uniform.

STRATIGRAPHIC MAPPING PROJECT, CORMORANT MAP SHEET (63K)

The entire shoreline was mapped for Yawningstone, Mitchell, Ochunipe, Rocky, Goose and Egg Lakes (Fig. GS-36-3). For Cormorant Lake, only the northern portion was covered. Preliminary results indicate that outcrops on northern Cormorant and Rocky Lakes are correlatable with the Stony Mountain Formation, and consist of slightly mottled, nodular, buff to reddish, hard, dense, finely crystalline dolomite. The only exceptions are 3 separate occurrences, one on the northwest shore of Cormorant Lake (M-8-84), one along a scarp a short distance west of Cormorant Lake (M-56-84), and the third on the northwest shore of Rocky Lake (M-34-84), where massive cliff-forming Stony Mountain dolomite is underlain by thin-bedded, soft, highly recessive, argillaceous and cherty dolomite believed correlative with the Upper Red River, Fort Garry Member.

All outcrops on the remaining lakes - Yawningstone, Mitchell, Ochunipe and Goose (no outcrops were located on Egg Lake) - consist of buff, mottled dolomites similar to the aforementioned Stony Mountain dolomites; however, all of these strata are correlated with the lower part of the Red River Formation (i.e. Dog Head - Cat Head - Selkirk undifferentiated). This correlation was confirmed by hole M-5-84, the most southerly of the Project Cormorant core holes, located at the southwest end of Yawningstone Lake. This hole intersected only 26 m of mottled Red River dolomite directly overlying Precambrian basement. The estimated complete, uneroded thickness of the Red River Formation in this area is approximately 50 m.

The presence of the soft recessive Fort Garry Member at the top of the Red River Formation has been a major factor in controlling the topography and geomorphology in the map area, resulting in development of a prominent scarp or shoreline cliff of resistant Stony Mountain dolomite flanked by lowlands underlain by recessive Fort Garry strata.

Detailed correlations of the strata in hole M-4-84 are uncertain, in part because of the relative uniformity of the totally dolomitized section, and in part because at least some of the marker beds used to define the stratigraphic succession are not present in the core. A 20 cm shale bed exposed in a quarry a few metres south of the drill site was not recovered in the core, and, if the writer's correlations are correct, the characteristic sandy argillaceous beds of the Williams Member, which define the top of the Stony Mountain Formation, also are either missing, unrecognizable, or have been lost during coring.

Completion of the stratigraphic mapping of the Cormorant Sheet will require additional core hole drilling, detailed comparison of outcrop samples with reference core sections, additional outcrop mapping particularly in the areas of south Cormorant and Moose Lakes, and photogeologic extrapolation of shoreline mapping.

The lake geochemistry sampling project, carried out in conjunction with the stratigraphic mapping, involved collection of lake-bottom sediment samples, at approximately 3-4 km spacing. A GSC-type weighted core tube sampler was used to obtain sediment samples, and bottom-water samples were recovered from approximately 1.5 m above lake bottom using a vacuum pump system. Eh and pH measurements were recorded in the field for all water samples.

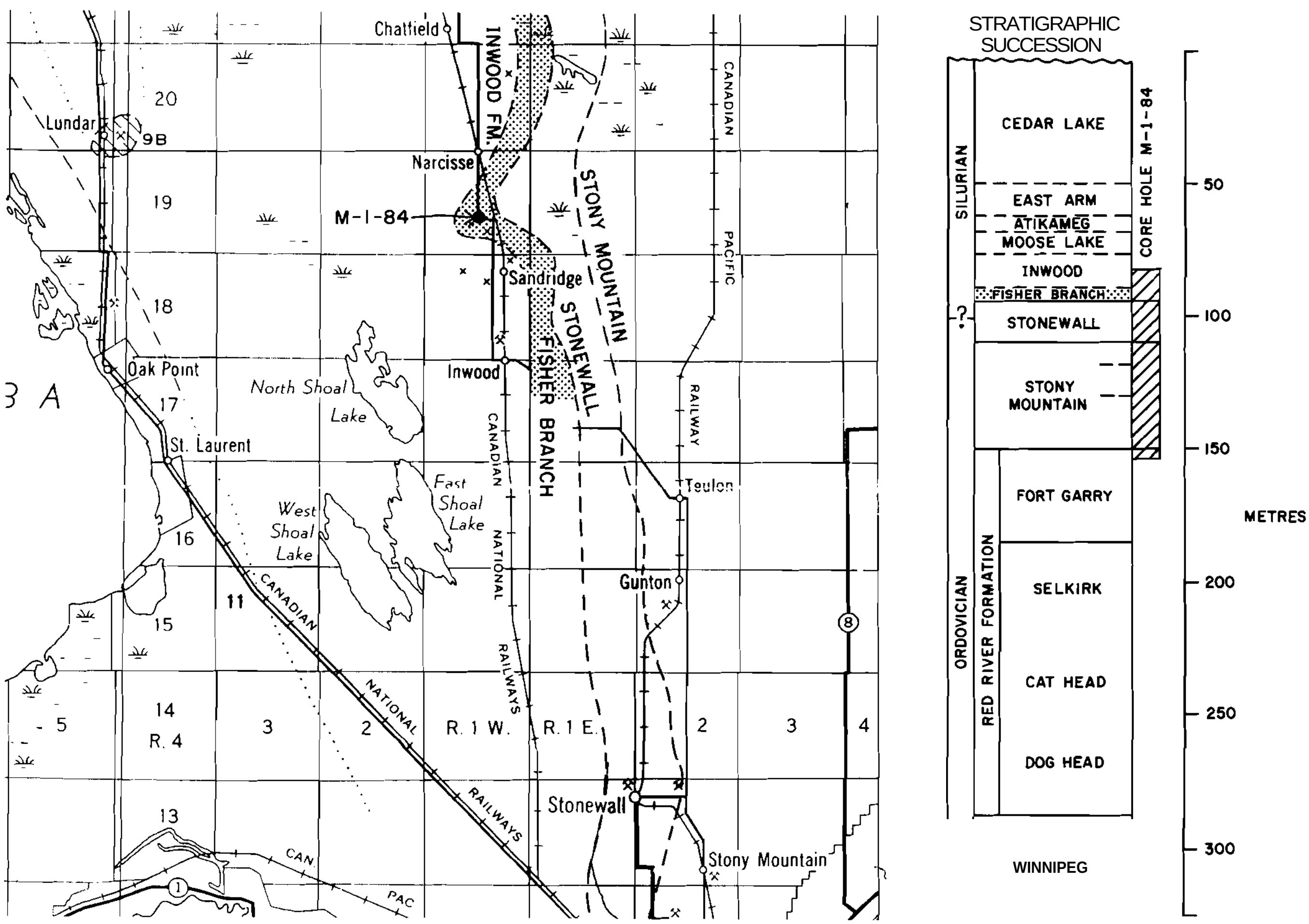

Figure GS-36-1: Narcisse area: geology (after Stearn, 1956), core hole location, and stratigraphy.

OPERATION CORMORANT

Although the principal objective of the Operation Cormorant core hole program is to obtain Precambrian lithologic data (see GS-20, this volume), drilling through the Paleozoic sedimentary cover has also provided considerable stratigraphic information (Table GS-36-1). Ten of the eleven holes drilled south of the exposed Precambrian Shield intersected Paleozoic dolomites of the Red River Formation. Only hole M-6-84 did not intersect Paleozoic strata, but drilled directly into Precambrian basement beneath 23.6 m of glacial till. This is the only such Precambrian "window" intersected to date by the departmental drilling program. The thickness of the Red River dolomites in the remaining holes ranges from 8.49 to 24.65 m, and the overburden ranges from 0.75 to 10.8 m. It is worth noting that, despite the regional structural dip to the south (Fig. GS-36-3), no general southward thickening of Phanerozoic strata occurs, because the southward topographic gradient approximately parallels the structural gradient, at about 2.4 m/km (12 ft/mile). As a result the depth to Precambrian in the most southerly of the Cormorant holes (M-5-84) is only 29 m, whereas holes drilled close to the Paleozoic edge, along Highway 391, yield thicknesses of up to 27 m.

All Paleozoic core intersections consist of a similar sequence of buff, very finely crystalline, dense to moderately granular mottled dolomite, underlain by a thin basal sandy unit. In most cores, the upper contact of this sandy unit, is fairly sharply defined, but in some holes it is gradational or interbedded, and a few scattered floating sand grains commonly occur in the basal part of the overlying dolomite unit. The uppermost part of the sandy unit consists of a sandy dolomite, grading downward to a fine grained, well rounded dolomitic sandstone. In some holes the basal few centimetres become friable due to loss of dolomite matrix (possibly due to solution). Pronounced dark purplish grey to reddish mottling is characteristic of this unit in the northern area. The rare occurrence of megafossil solution cavities, in part pyrite-infilled (cf. **Receptaculites, Maclurites**), indicates that these beds represent a sandy facies of the Red River Formation rather than a dolomitic facies of the Winnipeg Formation. Only one hole, M-13-84, included several thin interbeds of silty and argillaceous material that might be correlated lithologically with the Winnipeg Formation.

Thickness of the basal sandy unit ranges from 0.78 m to 2.0 m. If this sandy unit is a well defined stratigraphic unit, the uniformity in thickness would indicate that the Precambrian erosion surface on which these basal Paleozoic sandy strata were deposited, was indeed extremely flat and uniform. If, however, the sandy unit is only a facies of the Red River, then the thickness of the sandy unit would not directly reflect the paleotopography of the Precambrian surface. On a purely structural basis, using only the contour map of the erosion surface (Fig. GS-36-3), the erosion surface also appears to be very uniform. None of the 11 holes drilled this year departs appreciably from the regional trend outlined in the 1983 Report of Field Activities.

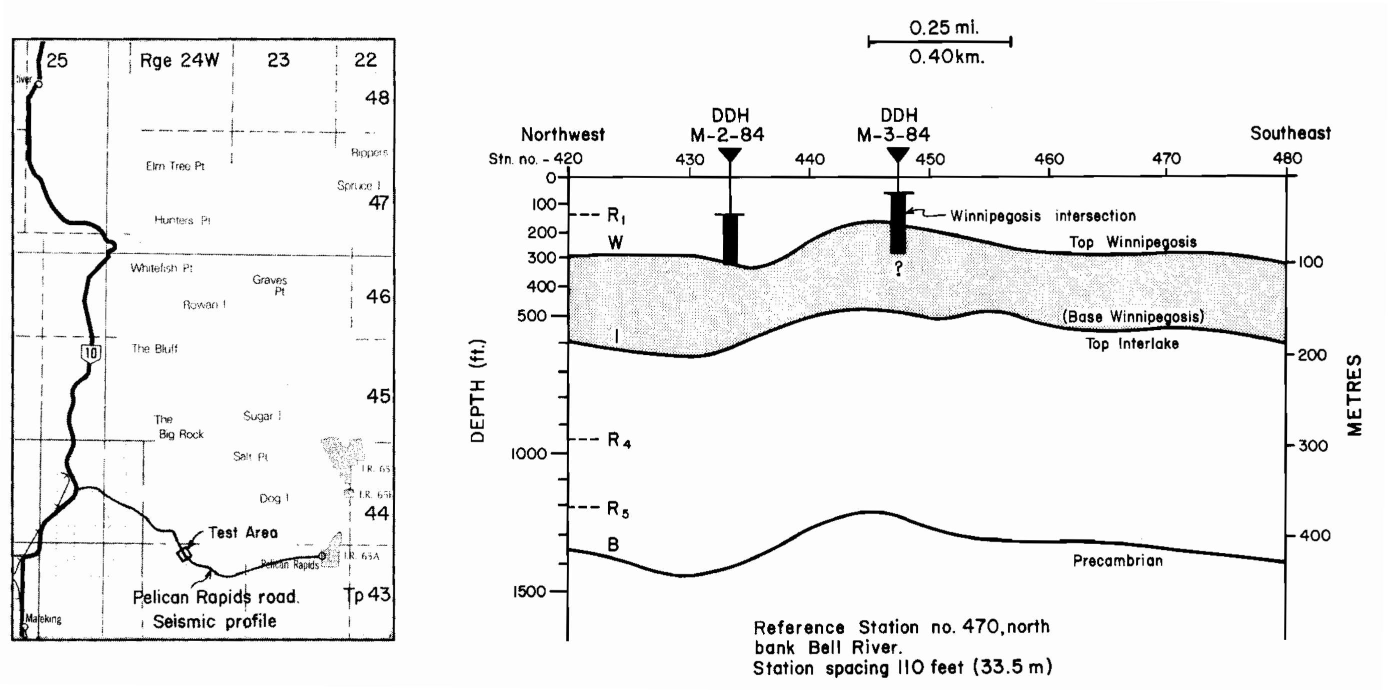

Figure GS-36-2: Reprocessed seismic profile, Bell River Dome area, after Ingram (1978), showing 1984 core hole intersection. Hole M-3-84 had to be abandoned before reaching the base of the Winnipegosis Formation, so indicated intersection (thickness) is minimum.

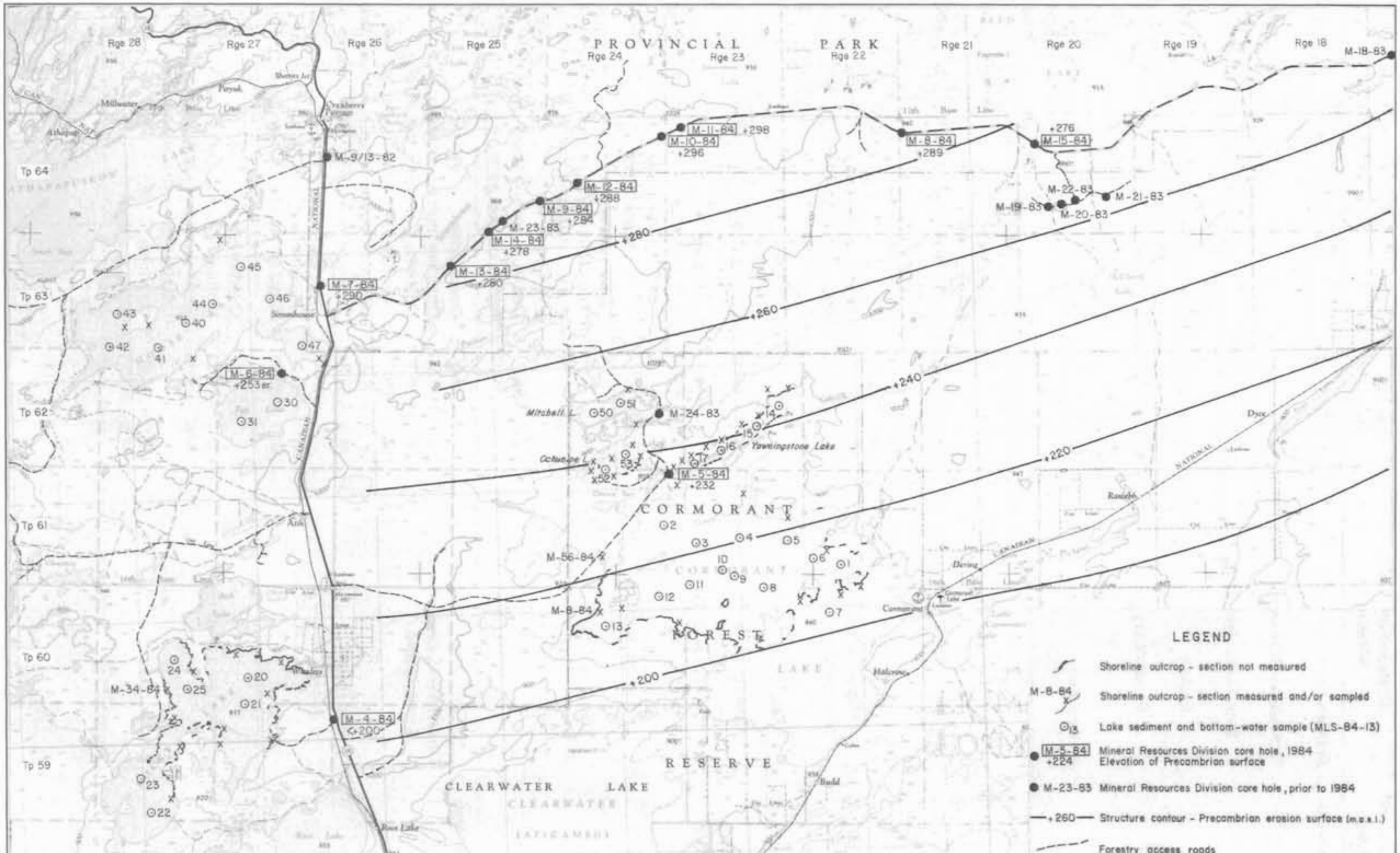

Figure GS-36-3: Stratigraphic Mapping and Core Hole Locations, Cormorant Lake Sheet (NTS 63K).

TABLE GS-36-1
SUMMARY OF CORE HOLE DATA

Hole No.	Location and Elevation	System/Formation Member	Interval Metres	Summary Lithology
M-1-84 (Narcisse)	SW4-15-19-1W + 274.6	Silurian-Interlake	0 - 11.78	Dolomite, mottled yellowish buff, finely crystalline variably fossiliferous
		Ordovician-Stonewall	11.78 - 27.6	Dolomite, buff to reddish, sublithographic to finely crystalline, medial shale
		Stony Mountain-Williams	27.6 - 29.15	Dolomite, buff to reddish, partly mottled, argillaceous and sandy
		Gunton	29.15 - 42.64	Dolomite, light buff to grey, very finely crystalline to sublithographic
		Penitentiary	42.64 - 64.82	Dolomite, argillaceous, burrow-mottled, purplish to reddish grey and light greenish grey, slightly fossiliferous, sharp contact with:
		Red River	64.82 - 68.65	Dolomite, buff, partly fine banded, chert nodules, minor argillaceous and intraformational breccia
M-2-84 Bell River salt flat Seismic station 432.5	SW16-33-43-24W + 264.3		0 - 5.3	Overburden
		Mesozoic	5.3 - 10.0	Fine grey sandstone and dark red shale, pyritic sandstone concretions
		Devonian-Dawson Bay	10.0 - 27.2	Calcareous shale, medium grey to reddish fossiliferous interbeds
			27.2 - 31.0	Limestone, brachiopod biomicrite
			31.0 - 32.15	Dolomite, calcareous, earthy
		Second Red Bed	32.15 - 42.9	Dolomitic shale, grey to reddish brown, partly fragmental
		Winnipegosis	42.9 - 44.2	Transition zone. Breccia. White limestone and grey shale
			44.2 - 98.5	(Upper and Lower Members undifferentiated) Dolomite, variable, mostly porous, massive, partly fragmental
		Ashern	98.5 - 102.5	Shale, dolomitic, medium grey to dark brownish red
M-3-84 Bell River dome Seismic station 447.5	NE9-33-43-24W + 268.2	Devonian-Dawson Bay	0 - 4.05	Limestone, buff, biomicrite
			4.05 - 7.53	Dolomite, slightly argillaceous, light buff to grey mottled, 0.04 bituminous interbed
		Second Red Bed	7.53 - 16.2	Shale, dolomitic, medium grey to dark reddish brown, partly fragmental
		Winnipegosis	16.2 - 17.2	(Upper transition zone) Limestone, white, very fine to very coarse crystalline, shaly and stylolitic partings, inclined at 30° to core
			17.2 - 86.2	Dolomite, several limestone zones upper 4.5 m, buff, mostly porous, variably fossiliferous
M-4-84 Rocky L.	SE5-31-59-26W + 290		0 - 1.0	Overburden
		Ordovician-Stonewall	1.0 - 8.5	Dolomite, buff to yellowish, partly fossiliferous
		Stony Mountain	8.5 - 12.5	Dolomite, light grey, moderately argillaceous
			12.5 - 25.0	Dolomite, buff, sublithographic, platy
			25.0 - 39.8	Dolomite, buff to reddish, nodular bedded
		Red River	38.8 - 53.2	Dolomite, partly argillaceous, partly burrowed, minor chert (Fort Garry Member?)
			53.2 - 85.0	Dolomite, buff mottled
			85.0 - 88.95	Basal sandy unit. Sandy dolomite to dolomitic sandstone
M-5-84 (Site 22)	NE35-61-24W + 261 m		0 - 2.0	Overburden
		Ordovician — Red River	2.0 - 24.83	Mottled dolomite, grey to buff
			24.83 - 26.65	Basal sandy unit. Sandy dolomite to dolomitic sandstone, fine grained, well rounded. Friable at base
		Precambrian	26.65 - 28.95	Weathered zone
			28.95 - 42.31	Bioite granite

TABLE GS-36-1 (Continued)
SUMMARY OF CORE HOLE DATA

Hole No.	Location and Elevation	System/Formation Member	Interval Metres	Summary Lithology
M-6-84	NW27-62-27W		0 - 23.6	Overburden. Boulder till
(Site 4)	+ 287	Precambrian	23.6 - 43.36	Tonalite gneiss with rafts of diorite and other supracrustals
M-7-84	C19-63-26W		0 - 2.2	Overburden
(Site 10)	+ 290	Ordovician — Red River	2.2 - 9.25	Mottled dolomite, light yellowish to greyish buff, very finely crystalline, dense to slightly granular, massive. Some burrow mottling
			9.25 - 11.1	Basal sandy unit. Sandy dolomite at top grading down to dolomitic sandstone. Fine grained at top becoming medium to coarse at base
		Precambrian	11.1 - 14.9	Weathered zone
			14.9 - 36.25	Igneous textured ultrabasic
M-8-84	SW31-64-21W		0 - 3.0	Overburden
(Site 31)	+ 305 approx.	Ordovician — Red River	3.0 - 15.8	Dolomite, mottled, minor chert, minor wispy argillaceous partings
			15.8 - 16.47	Basal sand unit. Sharp contact with sandy dolomite to dolomitic sandstone, fine grained, prominent dark grey mottling
		Precambrian	16.47 - 23.3	Weathered zone
			23.3 - 27.03	Hornblende- and biotite-bearing microgranite
M-9-84	C12-64-25W		0 - 10.8	Overburden
(Site 26)	+ 305 approx.	Ordovician — Red River	10.8 - 18.95	Mottled dolomite, light grey to buff, massive, nodular argillaceous partings towards base
			18.95 - 20.45	Basal sandy unit. Sandy dolomite to dolomitic sandstone, prominent blackish grey mottling, slightly pyritic
		Precambrian	20.45 - 28.3	Weathered zone, totally kaolinized at top, grading fairly sharply to:
			28.3 - 33.1	Migmatitic hornblende- and biotite-bearing, magnetite-rich mesocratic gneiss
M-10-84	C31-64-23W		0 - 1.3	Overburden
(Site 30)	+ 320 approx.	Ordovician — Red River	1.3 - 21.1	Mottled dolomite, partly burrowed, some floating sand grains bottom 0.5 m associated dark mottling with sulphide
			21.1 - 21.82	Basal sandy unit. Sandy dolomite to dolomitic sandstone, prominent coarse dark grey mottling
		Precambrian	21.82 - 23.55	Lost core. Recovered only .03 mixed sand, clay, quartz
			23.55 - 24.05	Weathered zone. Porous weathered granite grading down to weathered granite with kaolinized feldspar
			24.05 - 38.8	Hornblende-, biotite- and epidote-bearing plagiogranite
M-11-84	NE25-64-24W		0 - 2.0	Overburden
(Site 29)	+ 320 approx.	Ordovician — Red River	2.0 - 22.9	Mottled dolomite
			22.9 - 24.04	Basal sandy unit. Sandy dolomite to dolomitic sandstone, prominently mottled, fine grained
		Precambrian	24.04 - 24.95	Lost core — weathered zone
			24.95 - 27.1	Weathered zone; granitic, completely altered at top decreasing erratically downward, .03 m grey clay infilled at 25.5
			27.1 - 32.9	Minor visible weathering along fracture. Hornblende- and biotite-bearing plagiogranite

TABLE GS-36-1 (Continued)
SUMMARY OF CORE HOLE DATA

Hole No.	Location and Elevation	System/Formation Member	Interval Metres	Summary Lithology
M-12-84	C17-64-24W		0 - 2.5	Overburden
(Site 27)	+ 305 approx.	Ordovician — Red River	2.5 - 19.47	Mottled dolomite
			19.47 - 20.94	Basal sandy unit. Sandy dolomite to dolomitic sandstone, prominent blackish mottling, considerable pyrite. Passes sharply to:
		Precambrian	20.94 - 21.09	Weathered zone
			21.09 - 29.85	Hornblende-, biotite- and epidote-bearing plagiogranite
M-13-84	C29-63-25W		0 - 4.9	Overburden
(Site 13)	+ 303	Ordovician — Red River	4.9 - 26.13	Mottled dolomite
			26.13 - 26.44	Basal sandy unit. Sandy dolomite to dolomitic sandstone, prominent dark grey to purplish mottling, fine- to medium-grained, well rounded
			26.44 - 26.6	Sandy shale, medium olive brown, fine irregular lamination, disseminated pyrite
			26.6 - 26.8	Dolomitic sandstone, medium grained, fragments of olive brown sandy shale to 3 cm
			26.8 - 27.3	(Winnipeg Formation lithology) Shale, medium olive brown, sandy, much fine patchy and disseminated pyrite; 3 cm fragment sandy dolomite, and fine stringers dolomitic sandstone
		Precambrian	27.3 - 27.5	Lost core — probably weathered zone
			27.5 - 27.7	Weathered zone, unconsolidated sandy material **(in-situ** weathered)
			27.7 - 30.8	Variably weathered
			30.8 - 42.05	Hornblende and plagioclase amphibolite-dioritic gniess
M-14-84	SW3-64-25W		0 - 2.75	Overburden
(Site 24)	+ 305 approx.	Ordovician — Red River	2.75 - 26.6	Dolomite, mottled
			26.6 - 27.38	Basal sandy unit. Sandy dolomite to dolomitic sandstone, friable bottom 8 cm. Several fragments(?) of clean, non-sandy dolomite near base
		Precambrian	27.38 - 27.79 (?)	Lost core
			27.79 - 31.25	Weathered zone; 10 cm dark grey clay at 27.92 and 10 cm brownish red clay at 29.06 (infill)
			31.25 - 27.63	Heterogeneous granitoid gneiss cut by later pink granite and pegmatite veins — magnetite prominent
M-15-84	EC30-64-20W		0 - 0.75	Overburden
(Site 32)	+ 290 approx.	Ordovician — Red River	0.75 - 12.0	Mottled dolomite
			12.0 - 14.0?	Basal sandy unit. Sandy dolomite to dolomitic sandstone, prominent dark grey to purplish mottling (3.1 m lost core at unconformity — from 12.7 - 15.8)
		Precambrian	14.0? - 16.1	Soft unconsolidated weathered material, dark grey
			16.1 - 33.1	Graphitic and quartz-chlorite schists and metasediments with quartz veins and pyrite stringer mineralization

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GS-37 GLACIAL AND INTERGLACIAL DEPOSITS IN THE HUDSON BAY LOWLANDS: A SUMMARY OF SITES IN MANITOBA

by E. Nielsen and L.A. Dredge[1]

INTRODUCTION

Recent investigations of river sections in northeastern Manitoba have revealed a complex sequence of glacial and non-glacial deposits, which span several glaciations and interglaciations. The oldest deposits preserved in sections may belong to a Kansan glaciation; the youngest were deposited in Holocene glacial lakes and in the postglacial sea which subsequently inundated substantial parts of the Lowlands. This report provides a general inventory of interglacial sites in northern Manitoba (Fig. GS-37-1). The descriptions and discussions are restricted to those deposits associated with or predating the last glaciation, and to sites along the Churchill, Nelson, Stupart, Gods and Echoing Rivers. The report is based on work conducted in 1984, but in some places studies from previous years have also been included.

GENERAL NATURE OF THE DEPOSITS

The stratigraphic record comprises both glacial and non-glacial deposits. The observed glacial deposits consist principally of lodgement and basal melt-out facies of till, which in some places have been glaciotectonically deformed. Aquatic flow diamictons were only recognized in the deposits of Holocene age. Several tills or depositional till facies are present at each site. The individual units are defined by colour, texture, compaction, carbonate content, stoniness, clast lithology, and sedimentary or tectonic structures. Most of the tills have a clayey silt matrix. The top tills in the sequence are commonly a brownish hue, whereas those below are commonly greyish, with red stained joint surfaces. The typical matrix carbonate contents for all the silty tills range from 20 to 40 per cent (by weight).

The non-glacial deposits are of two basic types. One, and locally two relatively thin sand beds, generally less than 1 m thick, commonly separate the brown tills. These beds consist of massive, medium grained sorted sand. Lower in the sections are beds of gravel, sand and silt, clay, marl, wood and peat. The cobble gravels are possibly outwash deposits, whereas other sand and gravel sequences are of fluvial origin. The fine sand and silt beds commonly display wavy planar laminae, or ripple-drift crossbeds and were probably deposited in relatively quiet standing water. The clay deposits are both varved and massive. Marl, richly fossiliferous, was found at one site only, but fibrous, slightly compressed peat and woody peat were found at several places, generally interbedded with sands. The non-glacial sequence is 2 to 4 m thick.

The roots of a paleosol, developed in till, were identified at one location only (Sundance), although some of the colouration of the tills at other localities may also be related to soil-forming processes.

MAJOR SITES VISITED IN 1984

PORT NELSON

The 2 km long Port Nelson section (Fig. GS-37-2) is clearly exposed between Harts Creek and Port Nelson. The uppermost marine and glaciolacustrine units overlie a crumbly, very stony unoxidized brown till. The unit contains a set of arcuate sand beds (Fig. GS-37-3) which may mark former shear planes within the glacier. This till was deposited by basal melt-out of englacial debris. This upper unit is either separated from another brown till by a line of imbricated cobbles which dip towards Hudson Bay, or, in some places, grades into it. The second till is also brown and calcareous but is noticeably less stony and contains brown oxidation along joints. Some zones within the till are sub-stratified. It is underlain by a second oxidized till unit but separated from it by a 60-cm bed of gravelly sand. The till contains "clasts" of grey silt derived from underlying lacustrine deposits.

The upper till sequence grades into 1 1/2 m of stonefree colour-banded lacustrine (?) silt, which includes both massive and laminated beds. Poorly sorted, rounded, pebble gravel forms the base of the non-glacial unit.

The lowermost till is stony and very compact. The upper 40 cm of this unit are brownish grey and become distinctly redder at depth. A grey till with abundant Precambrian granitic clasts is exposed along the tidal flats.

FLAMBOROUGH

The Flamborough sections consist of a 4 km stretch of bluffs, with slumped portions, along the Nelson estuary northeast of Flamborough Head. They are stratigraphically similar to the Port Nelson section, but in some areas organic units were found particularly in slump zones. Slope failure may be related to these beds. The main section (Fig. GS-37-4) contains fossiliferous marine and lacustrine deposits underlain by loose, brown, calcareous unoxidized till with vestigal sand "shear" planes. A thick sequence of horizontally bedded grey silt containing thin sand beds conformably overlies poorly sorted sand and thin, well sorted pea gravel. This non-glacial sequence is underlain by a grey-brown till with red oxidation staining. A grey till with granitic clasts forms the tidal flat.

A second section exposes a less complete stratigraphic sequence, but contains organic sand and peat layers (Fig. GS-37-4, 5). The upper part consists mainly of silty sand and the organic stringers and pads are fibrous, thin (1-2 cm), discontinuous, and undulating. Towards the bottom of the unit they are up to 60 cm thick and consist of platy brown-black peat with some compressed twigs. The lower 50 cm of these beds consists of coarse sand and gravel, which is abruptly underlain by red-stained till.

STUPART RIVER

Three sections with glacial/non-glacial sequences lie along Stupart River near its confluence with Fox River. The highest and most extensive exposures (e.g. Fig. GS-37-6a) show multiple brown tills with intervening horizontal, structureless sand beds of controversial origin (see below). The upper till unit is looser and less oxidized than those below and contains sand shears. At Fox River the lowermost well-exposed unit is a marine or lacustrine massive, silty grey clay.

The clay layer stratigraphically correlates with a sub-till silt and clay zone at Twisty Creek (Fig. GS-37-6b). At this location the upper part of the section is tree covered, but the bottom 10 m has been eroded by a creek, exposing the non-glacial beds and their upper and lower contacts.

The upper part of the exposure is a grey-brown, oxidized, relatively stony till. The till grades downwards into a set of 20 couplets of buff silt and grey silty clay, which are interpreted as varves (Fig. GS-37-7). The couplets are of variable thickness, are draped over irregularities in the underlying bed, and have some internal erosional

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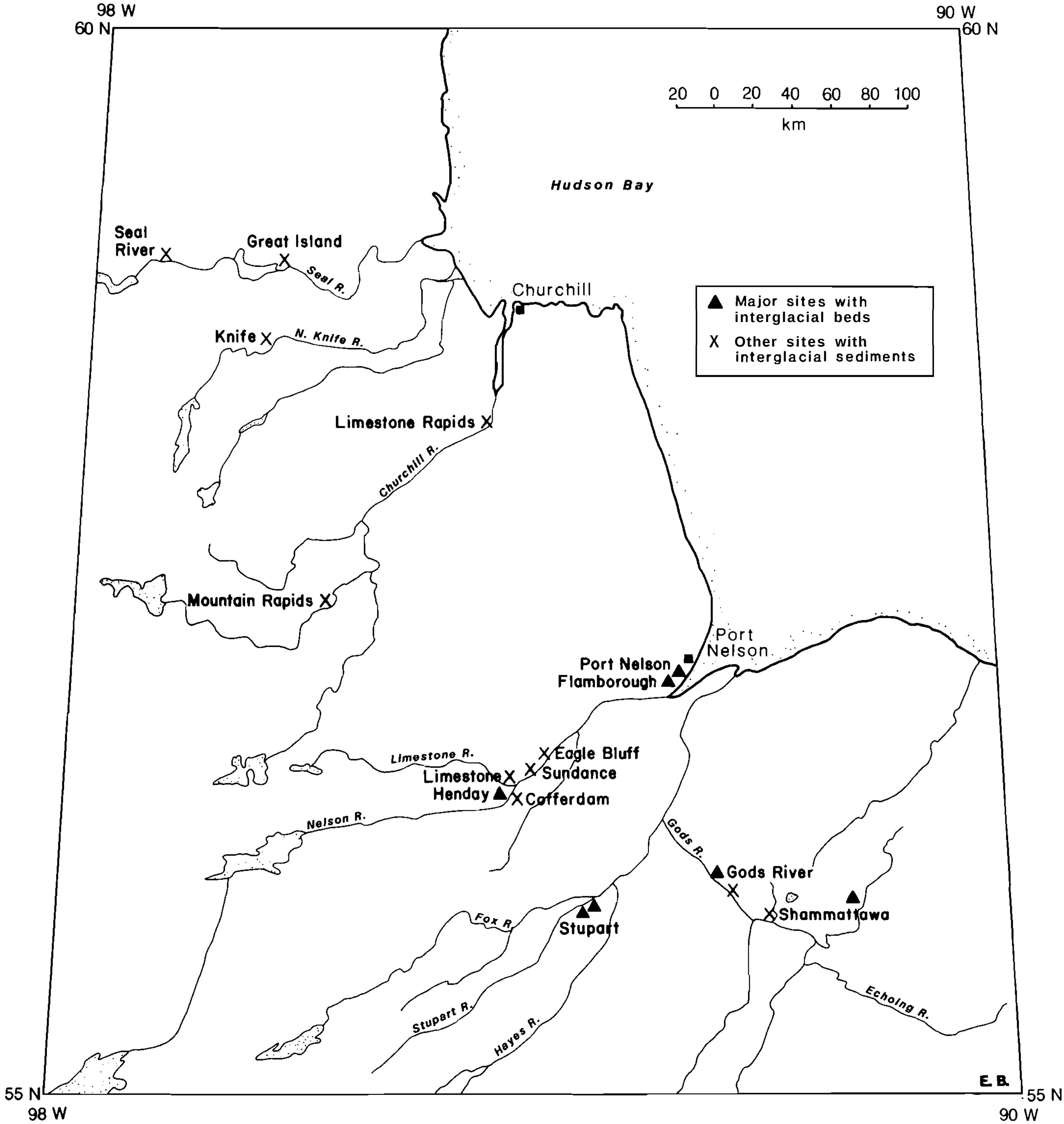

Figure GS-37-1: Interglacial sites in northern Manitoba. Triangles refer to major interglacial sites described in this report. Xs refer to sites with partial interglacial sequences.

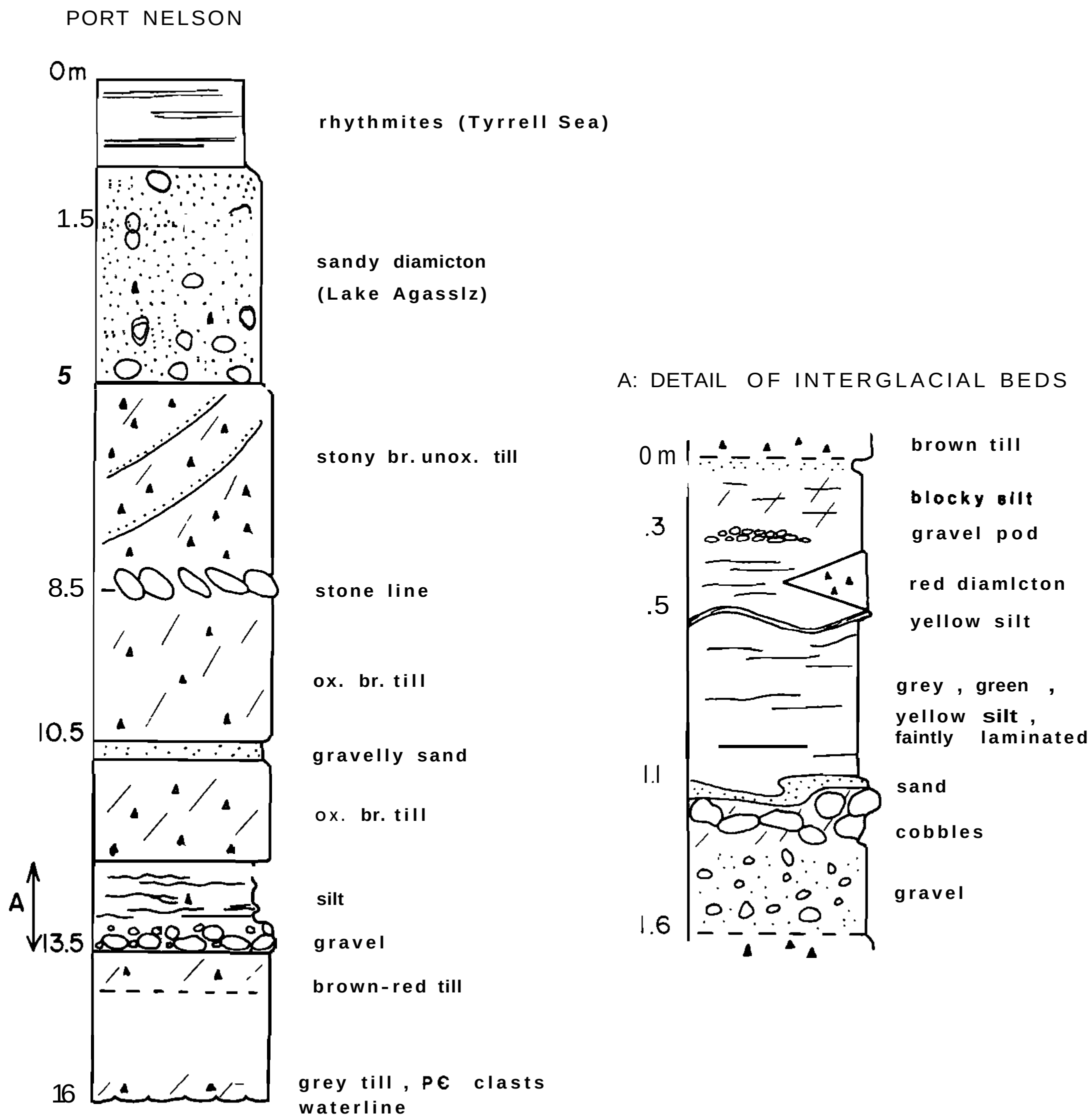

Figure GS-37-2: Port Nelson section.

contacts. The upper varves also display some deformation, produced by the glacier which over-rode them. The varves are presumed to be lacustrine; they are underlain by 2 m of steel grey, crumbly clay which may be either of lacustrine or of marine origin. The clay contains dark mottles and smells of sulphides. The clay is separated by a sharp contact from at least 5 m of blocky grey, moderately stony till which has brick red oxidation rinds around joints. The till breaks into very large blocks, in contrast to the smaller fracture habit of the overlying brown tills.

ECHOING CREEK

This 18-m section lies along a meander cut in a tributary creek flowing into Echoing River. It was first logged by B.G. Craig in 1967 during Operation Winisk. The sedimentary record (Fig. GS-37-8, 9) consists primarily of an upper till, a major multi-bed non-glacial sequence, and possibly a lower till. The top part of the upper till unit consists of a yellow-brown silty till with unoxidized joints, which is separated from its underlying grey-brown counterpart by a stone line. The oxidized till becomes stonefree near its base. At its lower contact are contorted laminae of yellow silt. The subsequent 5 m (Fig. GS-37-8) consist, from top to bottom, of grey, massive, clayey silt, brown, irregularly laminated silt, compact platy peat with wood, white marl containing lacustrine macrofossils, varved brown silt and black clay with rip-up structures, contorted sand, and blocky, black, stonefree clay. Below a depth of 40 cm the clay becomes blockier and stonier - generally more till-like, but could equally be glaciolacustrine or glaciomarine. The lowermost 4 m of the section is covered but there are some indications of a basal silty-sand unit.

GODS RIVER

The Gods River sections were the first major interglacial sections to be studied in detail in the western Hudson Bay Lowlands. Two sections were visited in 1984 to resample wood and peat beds for correlative dating and paleoecological analysis. The sites were initially described and interpreted by Netterville (1974), who proposed the name Gods River Sediments for the organic rich non-glacial beds, and the name Twin Creeks Sediments for the sand beds higher up in the sections. The tills above the interglacial beds were called the Wigwam

Figure GS-37-3:
Arcuate sand beds marking shear planes in the original ice mass, in crumbly silty till at Port Nelson.

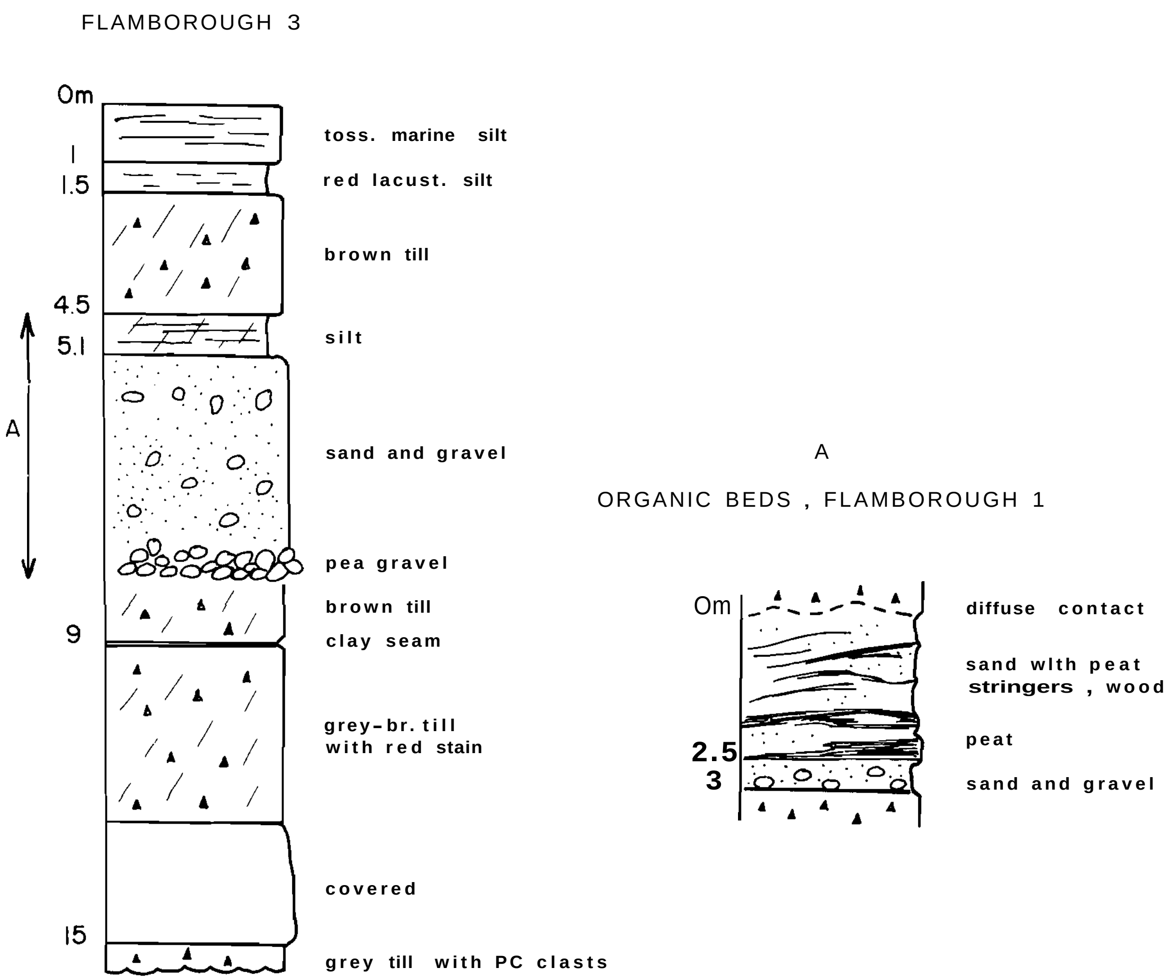

Figure GS-37-4: Sections at Flamborough Head, Nelson River.

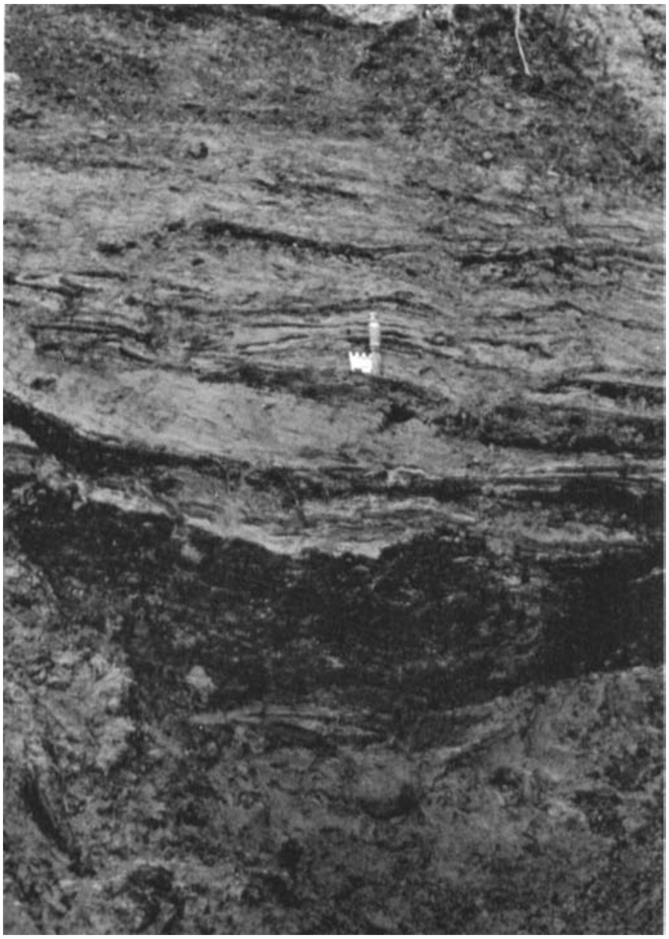

Figure GS-37-5:
Interglacial sand and peat beds at Flamborough, section 1.

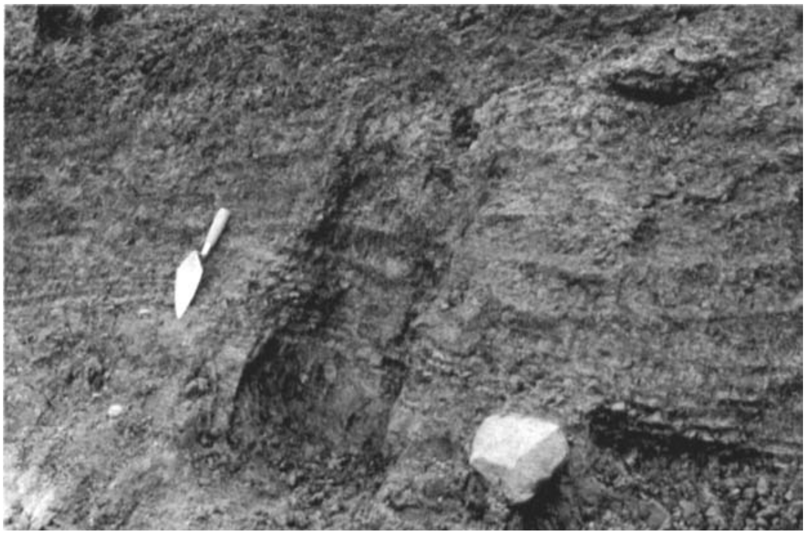

Figure GS-37-7:
Varved silt and clay, Stupart section.

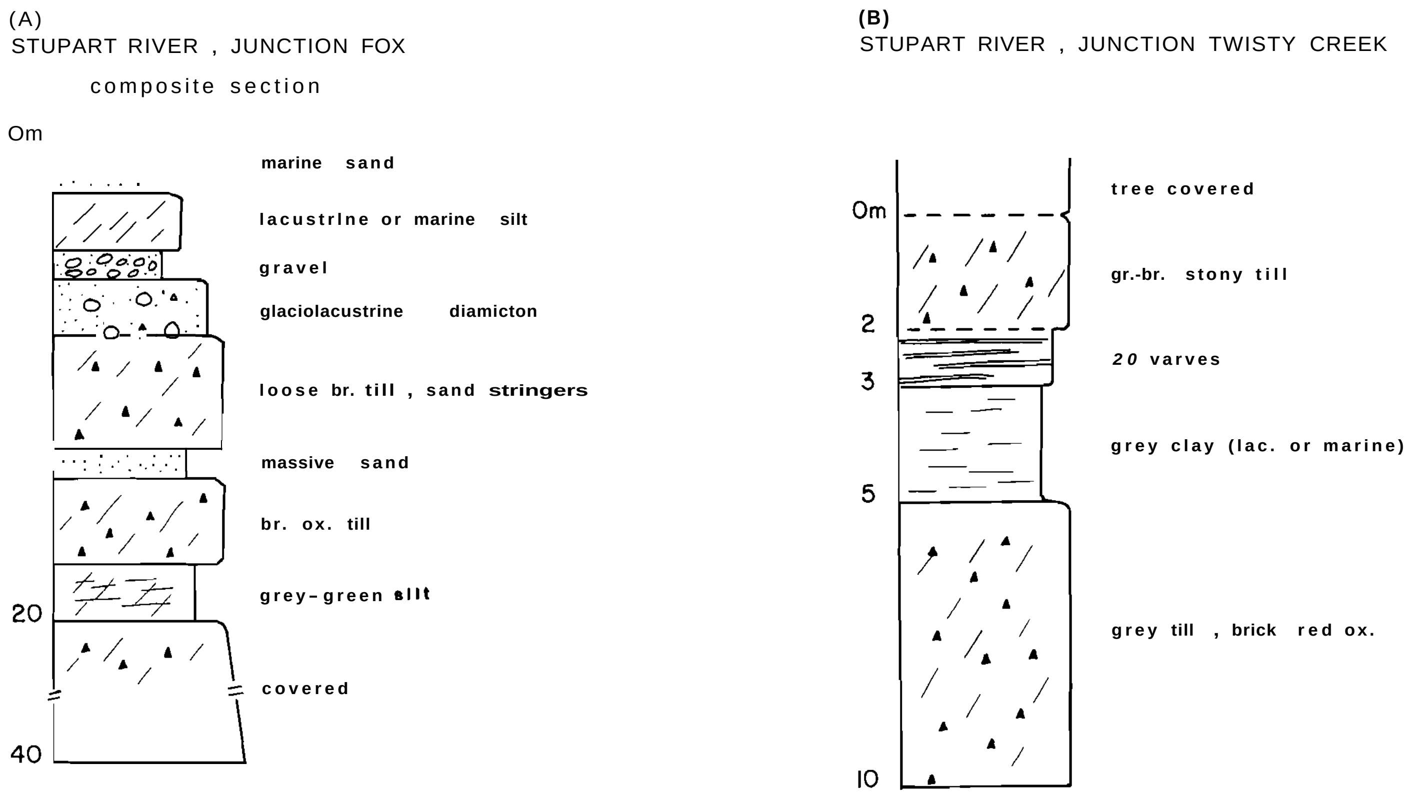

Figure GS-37-6: a) Composite section from Stupart River near its junction with Fox River and (b) the lower part of the sequence at Stupart River at its junction with Twisty Creek.

Creek Formation. The section shown on the map and schematically in Figure GS-37-10, and others along the same stretch of river show a complex sequence of multiple tills separated by sand, silt, and peat. Beneath Tyrrell Sea sediments is a set of three brownish silty tills separated by horizontal sand layers which are traceable over long distances. The upper till is crumbly and grey-brown in colour; the middle till is oxidized and irregularly jointed, and the lower till is olive grey, very compact, stony, and with wide-spaced columnar joints. The major non-glacial beds lie below these tills. The upper beds which are more than 2 m in total thickness, are of silt, sand, and organic detritus, including wood. Peaty layers are black on fresh surfaces. The woody peat is underlain by sand and gravel with less organics. The lowermost unit in the section is an olive grey till, with brick red oxidation on joint surfaces.

HENDAY

The 30-m high Henday Section (Figs. GS-37-11, 12) covers about 250 m of bluffline along the Nelson River and has been described previously by Nielsen and Dredge (1982, stop 4). The upper glacial unit is a grey-brown oxidized till. It is underlain by a non-glacial unit of blocky, weakly stratified silt, with sand laminae (Fig. GS-37-13) up to 3 m thick. One part of the bluff exposes a peat unit below the silt sequence. Pollen, and beetle assemblages from this peat have been described elsewhere (Nielsen et al., in prep.; Nielsen and Dredge, 1982).

The peat is underlain by a diamictic gravel which grades downwards into 12 m of compact grey till. At the base of one part of the bluff striae trending 140° are preserved on limestone outcrop. Mott concluded that the pollen assemblage represented climatic conditions similar to that presently experienced at Gillam, which lies within the boreal forest near the forest/tundra border. Morgan, however, suggested that the beetle population characterized cooler, tundra conditions. The two conclusions are not necessarily incompatible, since the deposits may span a range of climates. Aspartic acid ratios on wood from this site correspond to values from wood from the Missinaibi beds of the James Bay Lowlands (Nielsen et al., in prep.).

SUNDANCE

The 35-m high Sundance section (12b) has been logged previously by Nielsen and Dredge (1982, stop 1). Its essential units within the till sequence consist of an upper, oxidized greyish silty till which correlates with the lowermost till exposed at Henday, underlain by highly fractured olive grey, silty sand till. An oxidized zone separates the two tills. Microscopic examination of the oxidized zone showed that it contains pollen and charcoal, suggesting that it is the root of a paleosol. The pollen assemblage is indicative of a sub-arctic or tundra environment.

MOUNTAIN RAPIDS

Mountain Rapids lies within the Canadian Shield about 50 km west of the Paleozoic/Precambrian contact along the Churchill River. The 30 m high bluff exposes multiple till units separated by sand and gravel beds. All tills are silty and have a high carbonate matrix content (36-43%). The uppermost till is crumbly, loose and contains few stones. It truncates beds of silt and sand containing tiny peat balls and partly flattened carbonized sticks, which have been dated to greater than 32,000 (GSC-3074). The underlying three tills are olive brown stony, blocky and oxidized, although the lowest has a reddish hue.

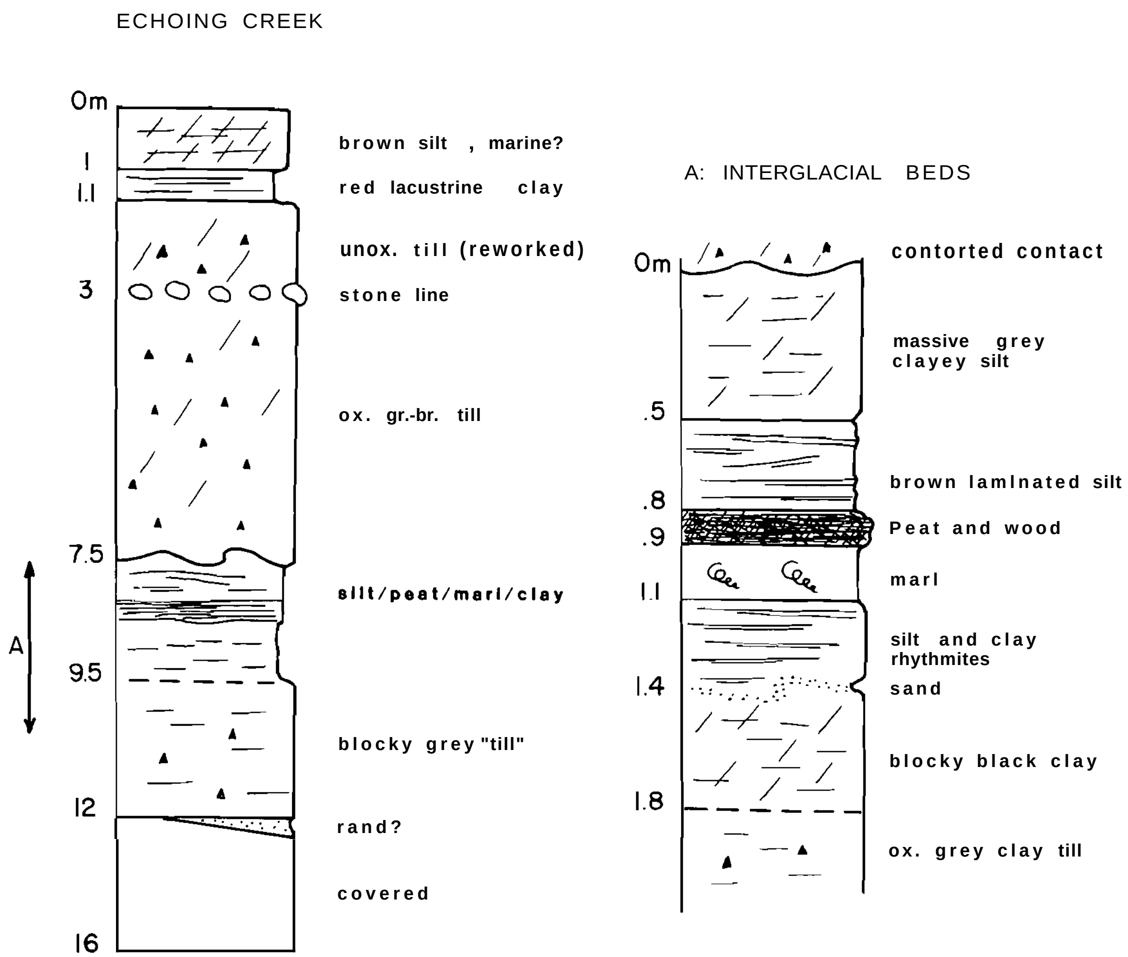

Figure GS-37-8: Echoing Creek section, and detail of interglacial beds.

These tills are separated from each other by unfossiliferous beds of sand and gravel whose upper parts are intercalated with till and have till injections within them. Crossbedding in one bed indicates current directions towards the east.

The section (Fig. GS-37-13) is difficult to interpret, in part because the section exposed in 1980 was slumped in 1984, and vice versa, and because the section lies near the zone of confluence of major Wisconsinan ice domains, so that substantial provenance changes and multiple deposits could be present within a given glacial episode. On the basis of their silty nature and high matrix carbonate content, combined with the presence of eastern indicator lithologies (greywackes and pink sandstones), the tills are considered to be of eastern provenance. However, since the upper two tills have much higher Precambrian clast contents than the lower two (50% vs 19%), they may have been emplaced by northern ice which reworked the underlying silty till, possibly during one main glacial event. The sand and gravel beds do not necessarily signify non-glacial events.

LIMESTONE RAPIDS

A 3-till sequence similar to that at Mountain Rapids was encountered at Limestone Rapids, in Paleozoic terrain farther down the Churchill River. Dredge (unpublished and Fig. GS-37-14) logged a 3-till sequence in which a thin organic-rich sand bed separated the uppermost till from those below. Nielsen and Young (1981), at a nearby section (Fig. GS-37-14), logged two tills, overlying a cobble unit, and a lower till below. Although all the tills were silty, the fabrics in the top and lowermost till indicated an ice movement from the north (155°-180°), whereas the middle till fabric suggested an easterly provenance (250°) for that unit.

OTHER SITES

Additional sites containing both glacial and non-glacial deposits in the Hudson Bay Lowlands and adjacent parts of northeastern Manitoba are shown on Figure GS-37-1. The Limestone section was previously described (Nielsen and Dredge, 1982; Nielsen et al., in prep.). The Great Island Site, which is at river level, consists only of cemented gravel and a peat layer (Taylor, 1961). The Seal River and North Knife River sections (Dredge, in press) also show incomplete sequences, as do the Cofferdam, Eagle Bluff and lower Churchill River sections, which require further analysis.

DISCUSSION

INTERGLACIAL DEPOSITS

There are two types of non-glacial deposits in the sections exposed in the Hudson Bay Lowlands. The first type consists of a 1-4m thick sequence of silt, sand, and organics; the second are structureless sand beds, generally less than 1 m thick, which are sandwiched between till units.

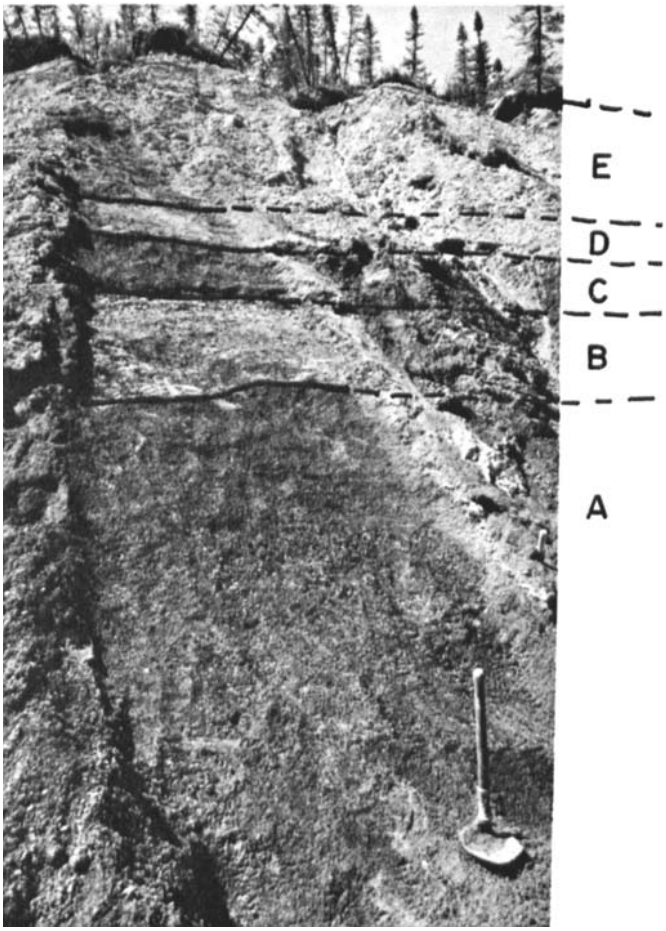

Figure GS-37-9:
Interglacial beds. Echoing Creek. Blocky grey 'till' (A) overlain by marl (B), peat (C), clay (D) and till (E).

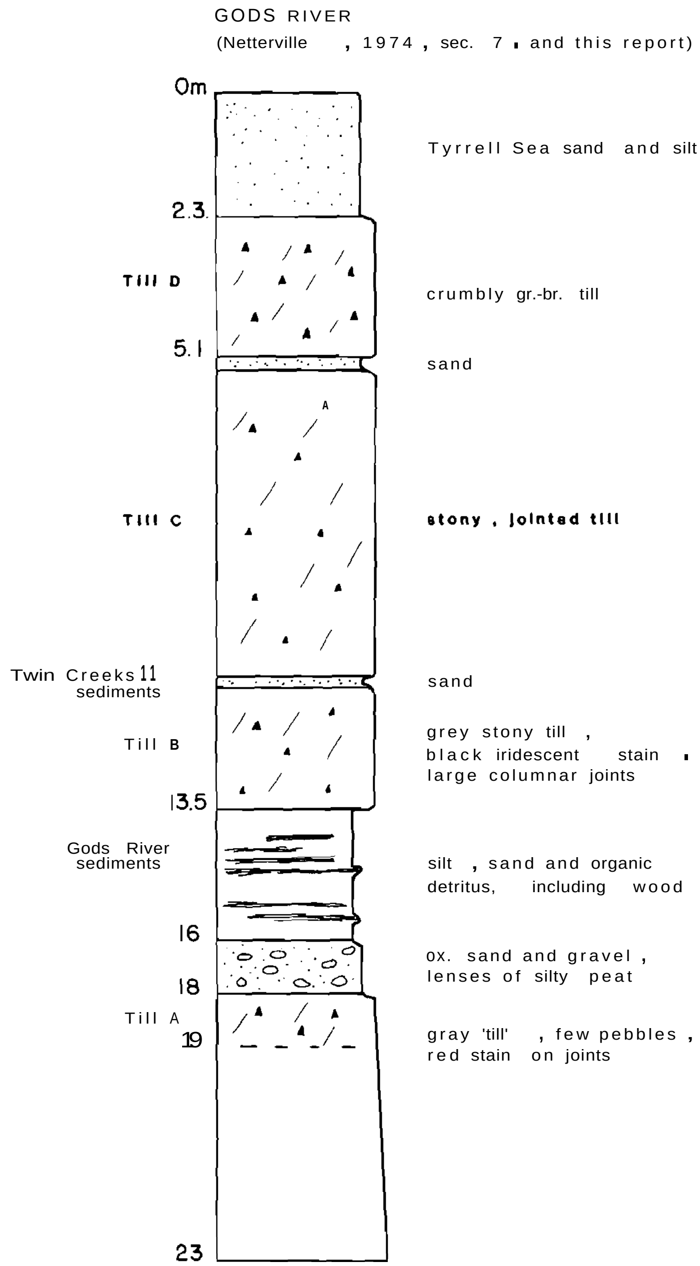

Figure GS-37-10:
Gods River section.

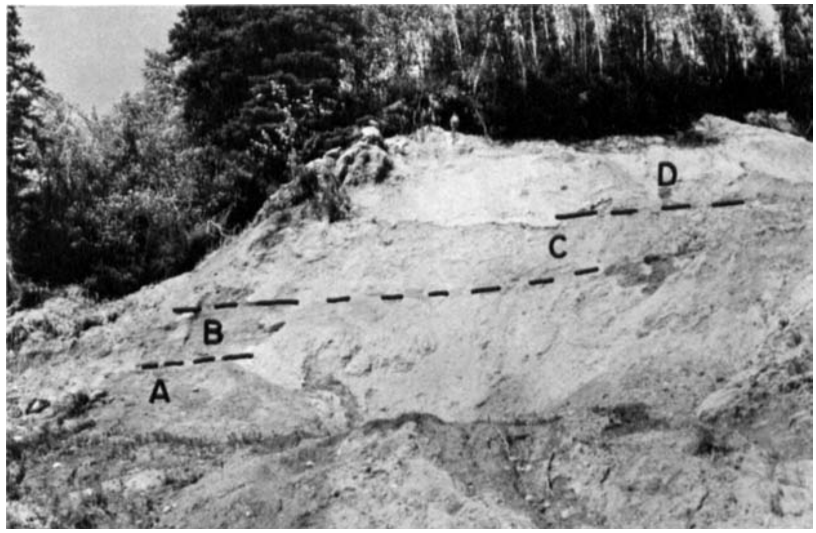

Figure GS-37-11:

The Henday section showing till (A) overlain by silt and peat (B), greyish-brown till (C) and lacustrine and marine sediment (D).

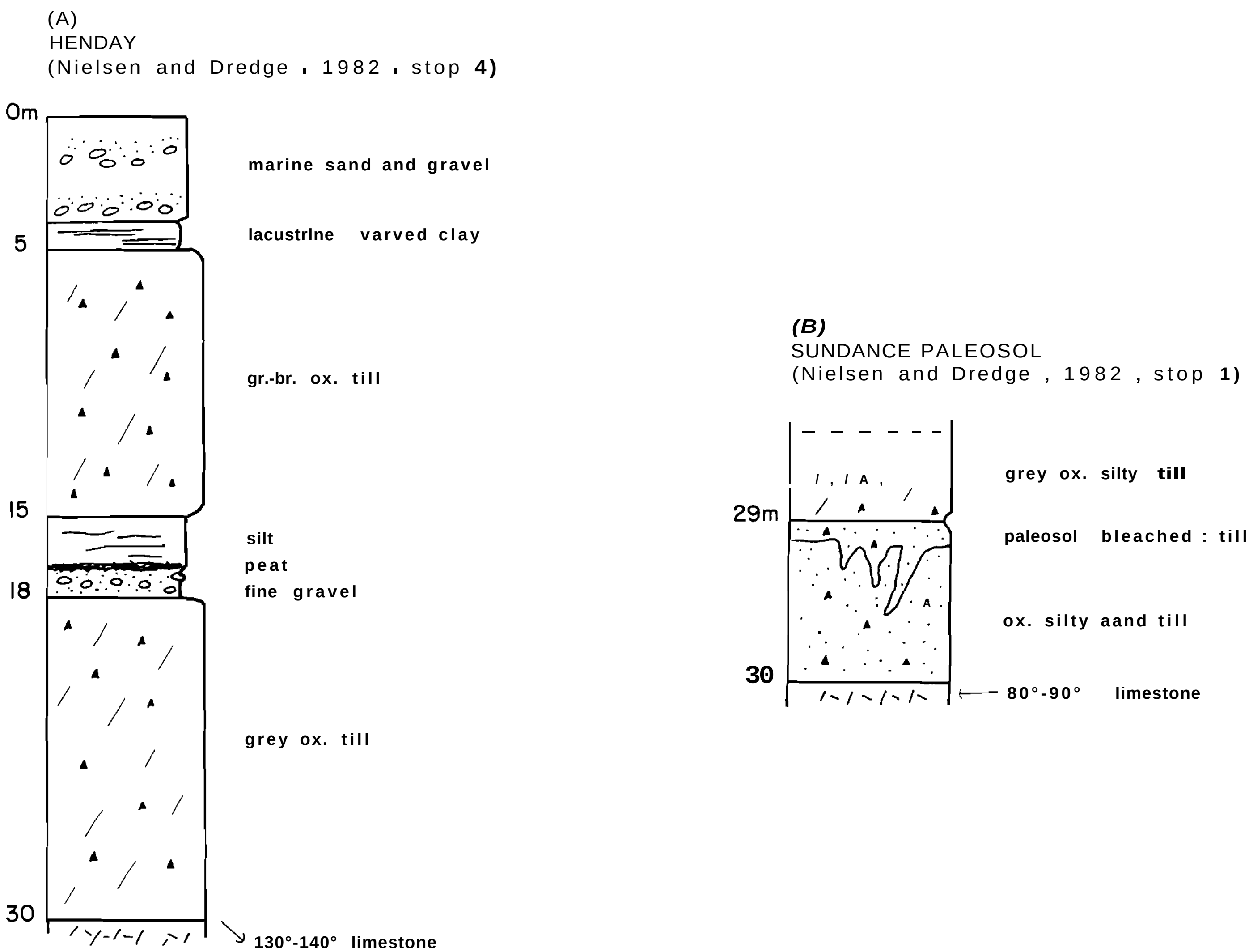

Figure GS-37-12: (a) Section near Henday switching station, on Nelson River and (b) The Sundance paleosol. The lower part of the Sundance section completes the stratigraphic sequence at Henday.

The organic beds and associated inorganic units, deposited in proglacial, lacustrine, terrestrial and possibly marine environments, are assumed to belong to the last interglaciation. This assignment is based on four aspects of their occurrence:

1. Position. They are the first (from the top) major subtill non-glacial deposits encountered in the sections and can be logically assigned to the first major interglaciation, before present, in the lowlands.
2. The pollen assemblage from peat at the Henday site reflects conditions at least as warm as present. The remaining sites are still under investigation.
3. These beds occupy a similar stratigraphic position as the Missinaibi beds in the James Bay Lowlands, which at present are assigned to the Sangamon Interglaciation.
4. Wood fragments from the Manitoba organic beds have the same aspartic acid ratios as wood from the Missinaibi interglacial unit.

Units in the Henday, Flamborough, Port Nelson, Stupart, Gods and Echoing Creek sections are assigned to this interglacial interval, the character of which is presently under paleoecological investigation.

The paleosol at Sundance has tentatively been assigned to a previous nonglacial interval (Yarmouth Interglaciation?), based on the correlation of the overlying till with the sub-Sangamon till at Henday. The pollen assemblage from the paleosol also differs from that encountered elsewhere. Lithic data indicate that the till on which the paleosol has developed has a northerly provenance, whereas all others came from the east.

ORIGIN OF STRUCTURELESS SAND BEDS

At one site at Port Nelson, at Stupart, Gods River and sections along the Churchill River there are one or two recurrent sand beds above the interglacial unit. The origin of these beds is problematic and has been the subject of much speculation about middle Wisconsinan openings in Hudson Bay (e.g. Andrews et al., 1983). We propose that these massive beds originated subglacially or englacially, and that they do not represent glacial retreats nor ice free intervals. The number of beds commonly differs from one section to the next, although a given bed may be traceable over a considerable distance. In addition, the sand beds do not occupy the same stratigraphic position and the tills overlying and underlying the sand beds are generally not correlatable. In some cases the sand beds separate englacial and basal facies of the same till sheet. In other cases they probably relate to subglacial ice streams within a single ice domain, or mark zones of weakness and convergence between confluent domains of the last glaciation (Dredge, in press). As the position of convergence of ice streams and ice masses shifted the sand units must have been entrained, smeared and homogenized by over-riding ice. The sand beds at Gods River and Stupart River, within the eastern ice domain, thus separate tills of very different provenance; those at Mountain Rapids and Limestone Rapids separate tills with more dramatic differences because they separate tills emplaced by northern and eastern ice. The sand beds at one locality need not correlate with those of another, and the deposition of the sands between any two ice lobes across a region must be somewhat diachronous.

The organics and twigs in the upper sand unit at Mountain Rapids pose a problem. However, since the peat was in the form of tiny pellets Mott (pers. comm.) has suggested that they are allochthonous material, redeposited into the sand unit from material stratigraphically lower in the section. An alternative explanation for the organic sands is that they represent the interglacial beds, and that there is an exceptionally long glacial record at the Mountain Rapids site.

GLACIAL EVENTS AND ICE FLOW DIRECTIONS

There are three major glaciations represented in the sections examined. The earliest is recorded in the till beneath the paleosol exposed at Sundance, and possibly by the river-level tidal surface at

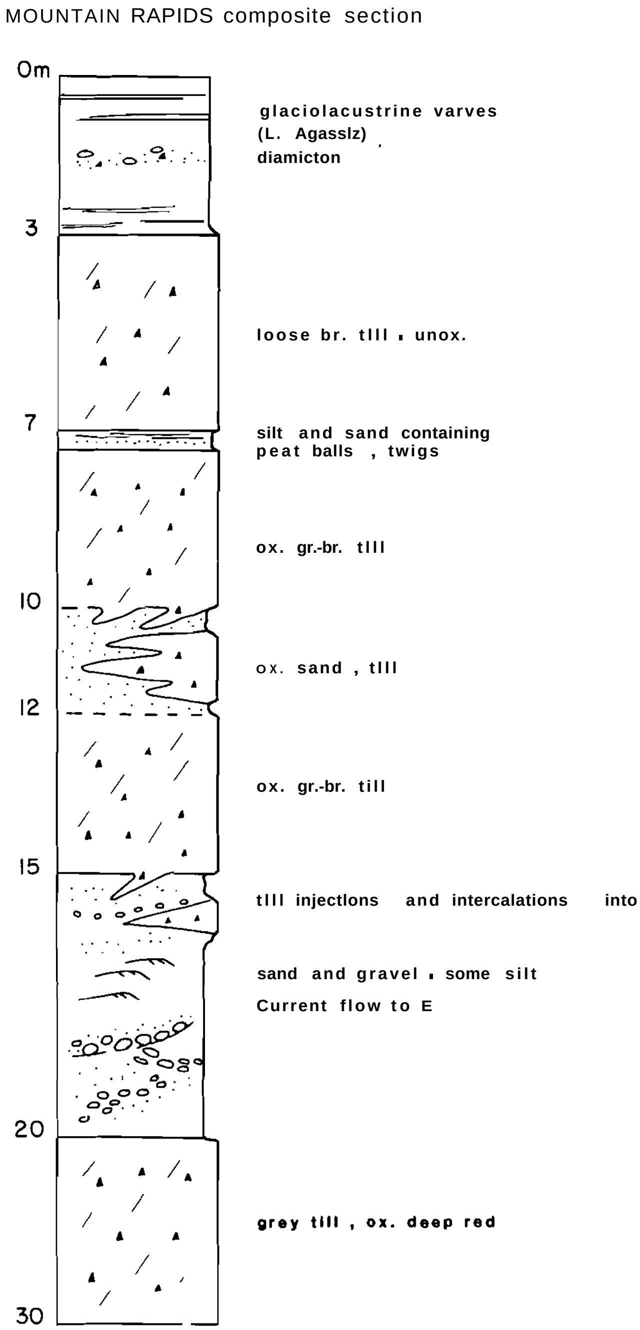

Figure GS-37-13:

Mountain Rapids, Churchill River. A composite section based on exposures logged in 1980 and 1984.

Port Nelson. The till at Sundance is sandier than others, contains more Precambrian clasts than the overlying tills, and overlies bedrock with striae indicating ice flow from the NNW. The till was emplaced by ice of northern provenance, possibly centered in west central Keewatin or Eastern Mackenzie District.

The grey and red stained till directly below the Sangamon interglacial beds at all sites is silty, calcareous, contains abundant clasts from the Hudson Platform, and was emplaced by ice from the east and northeast.

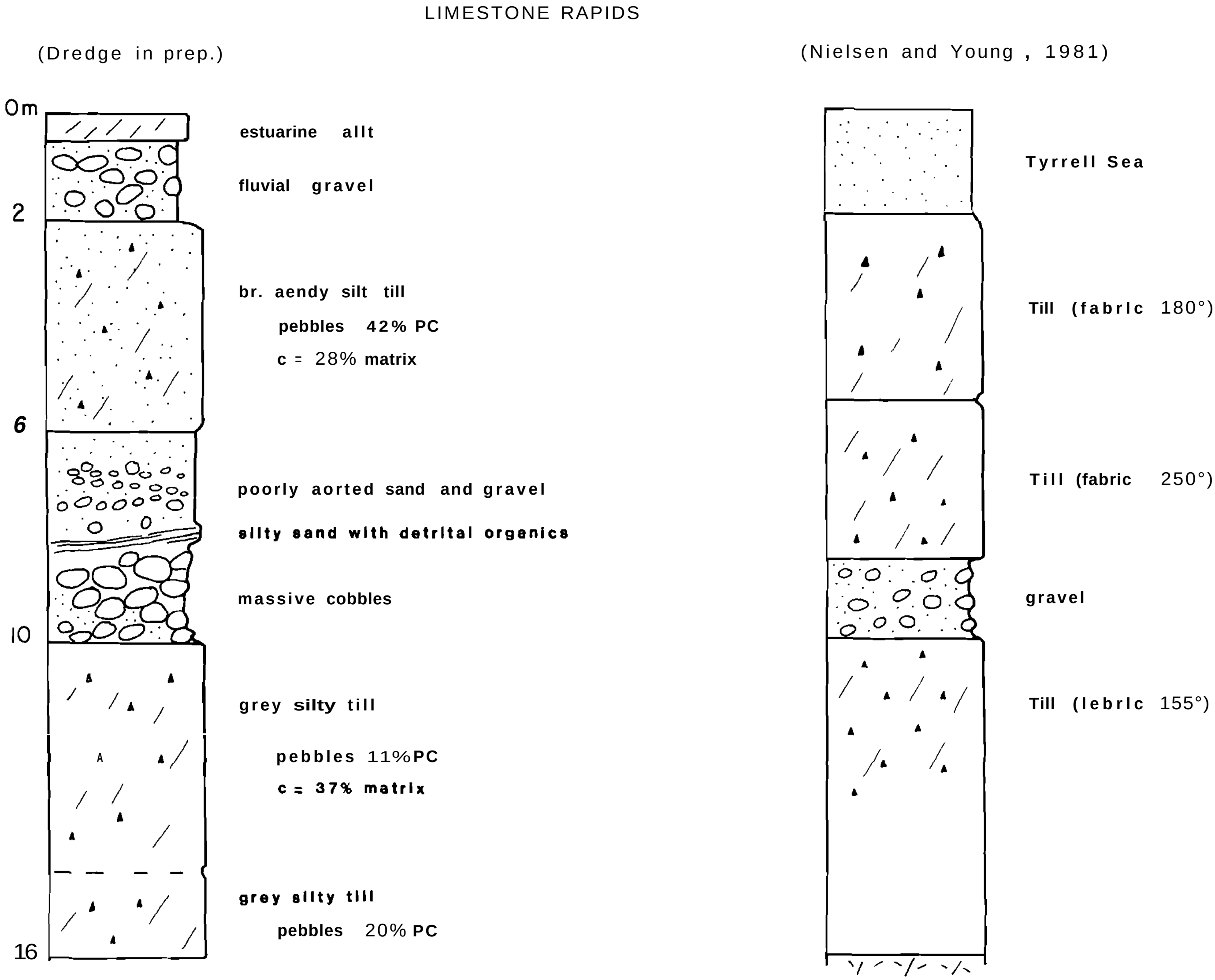

Figure GS-37-14: Sections near Limestone Rapids, Churchill River.

South of the Churchill River, all tills above the interglacial beds are brownish, have a clayey silty matrix, and contain mainly carbonate clasts. In the interpretation presented above for the intertill sand beds, all these tills belong to a continuous Wisconsinan glaciation; the variations in compaction, stoniness, fracture habits, and some of the variations in colour and structural features can be related to slight provenance shifts during the Wisconsinan glaciation, which may or may not relate to climatic conditions elsewhere. These provenance shifts are supported by fabric data from the tills (Nielsen and Dredge, 1982).

The upper part of the Wisconsinan till sheet at Mountain Rapids and Limestone Rapids was emplaced by ice from the north, although the lower part of the till sheet was emplaced by ice of eastern provenance. Fabrics from Limestone Rapids (Nielsen and Young, 1981) and clast counts from both Limestone Rapids and Mountain Rapids, which show a marked increase in Precambrian clasts (50% vs 20%), indicate that Keewatin ice overran but substantially re-incorporated the underlying tills.

SUMMARY

The "Kansan"(?) till exposed at Sundance and Port Nelson was emplaced by ice from the north. A soil-forming period followed this glaciation, during which the Sundance paleosol developed. During the Illinoian glaciation ice originated in, or extended across Hudson Bay, and reached as far west as Mountain Rapids, but possibly not as far north as Limestone Rapids, which could have been influenced by ice flowing from the north. The succeeding interglaciation left a series of glaciofluvial, alluvial, lacustrine, glaciolacustrine, marine, and terrestrial organic deposits. Ice covered the area during the entire Wisconsinan glaciation. During the early part of the Wisconsinan glaciation ice of eastern provenance covered the entire area south of Knife River, while Keewatin ice lay to the north. During the succeeding period there were a number of minor shifts in ice flow, and a major shift in the northern part of the region. In the west and north, ice flow during the late Wisconsinan was from Keewatin-Mackenzie.

Glaciofluvial sediments were deposited along zones of weakness between ice streams and ice lobes within the Wisconsinan Laurentide ice sheet. Their vestiges are the inter-till sand beds commonly observed within the Wisconsinan tills of the region.

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GS-38 INDUSTRIAL MINERAL INVESTIGATIONS, 1984

by D.M. Watson and C. Kohuska

1. SILICA AND KAOLIN

The Swan River Formation has previously been studied as a possible source of both kaolin and silica (Johnston, 1917, Watson, 1983). Because of renewed interest in both high grade silica deposits and sources of kaolin, a new sampling and testing program was undertaken during this field season.

The study area (Fig. GS-38-1) includes several portions of Township 37, Range 26, and an area north of Pine River in Township 34, Range 20. These areas were known to contain sections of Swan River sands that were readily accessible.

The Swan River Formation, occupying the Swan River Valley, is of Lower Cretaceous age in the south. The non-marine sediments in the north have been equated to the Jurassic in the south. The Swan River includes shales, unconsolidated sands and sandstones. Throughout the area, the sediments vary in age, composition and thickness. In the south, glauconite beds and the presence of marine shells indicate that the sediments are of marine origin. In the Pine River area, the occurrence of coal would indicate that the sands are non-marine.

It is this inconsistency of lithologies and sedimentary rock types that raises concern about possible problems that might be encountered in obtaining a consistent product from silica or any other mineral production from these sands.

In order to document the continuity and compositional consistency of the Swan River sands in the area, several sample locations were chosen near those previously examined. In the area north of Swan River, several holes were drilled with an Atlas Copco Minuteman drill. An additional sample was collected from the bank of the Swan River where the exposure permitted visual inspection of the section and permitted an evaluation of the scale of variations in composition. The sample from the Pine River area was collected from a hand-dug pit in the bottom of a pit that had previously been sampled for lignite. Each sample was dried, split and two portions sieved. The total weight of each sample was initially about 20 kg and the sieved portions about 500 g. The results for both portions are given in Table GS-38-1.

The sands collected from various localities during this study exhibit a great deal of consistency in grain size and impurities. Any type and degree of processing that would be applicable to the material from one locality could be equally well applied to other sample localities. In terms of mining and processing the material shows a remarkable degree of consistency.

2. GLAUCONITIC SANDS

During the spring of 1984, a sample of green sand was submitted to this department for examination. This sample was subsequently identified as a glauconitic sand containing mainly glauconite with lesser amounts of silica sand. The occurrence of this sand was examined and documented as part of field work done in the Swan River area. The beds may belong to the upper part of the Swan River Formation or part of the Ashville.

The sand is at least 5 m thick where it is exposed in a river bank. The base is hidden by slumped material. The beds seem to be of fairly uniform composition and grain size. The quality of the glauconite has yet to be determined by tests that will be carried out this winter.

3. DIMENSION STONE

During 1984, an assessment of the Province's dimension stone resources was commenced. Work on the project to date has included compilation of available information on past and present producers of stone, and a preliminary examination of those deposits that are located in the southeast portion of the Province.

Samples collected from these deposits are being prepared for petrographic examination as well as testing by the appropriate ASTM methods. Future work will include examination of rocks in the same area as existing producers as well as evaluation of stone in other areas.

4. CHROMITE IN THE BIRD RIVER SILL

Re-mapping of the Bird River Sill and evaluation of the chromite reserves continued during 1984. The results of the work by various parties are reported in GS-27, this volume.

5. ABRASIVE AND REFRACTORY MINERALS

An evaluation of the industrial mineral potential of Northern Manitoba, under the agreement, was started with a preliminary examination of selected occurrences of garnet, staurolite and kyanite in the Flin Flon-Snow Lake area. Samples collected during this season (GS-17, this volume) will be examined to determine the quality, quantity and physical properties of the various minerals. Based on the results of this preliminary look at the various minerals, a more comprehensive field program is planned for 1985.

6. PEAT MOSS

As part of an ongoing joint project with the Manitoba Remote Sensing Centre, several bogs in The Pas area were examined during this field season. The Remote Sensing Centre has been developing methods for computer analysis of satellite imagery to provide an inventory of peatlands. A ground examination of bogs this summer will provide a check on the computer-predicted bog types.

During the winter of 1984-85, application of this technique will be extended to include parts of southeastern Manitoba.

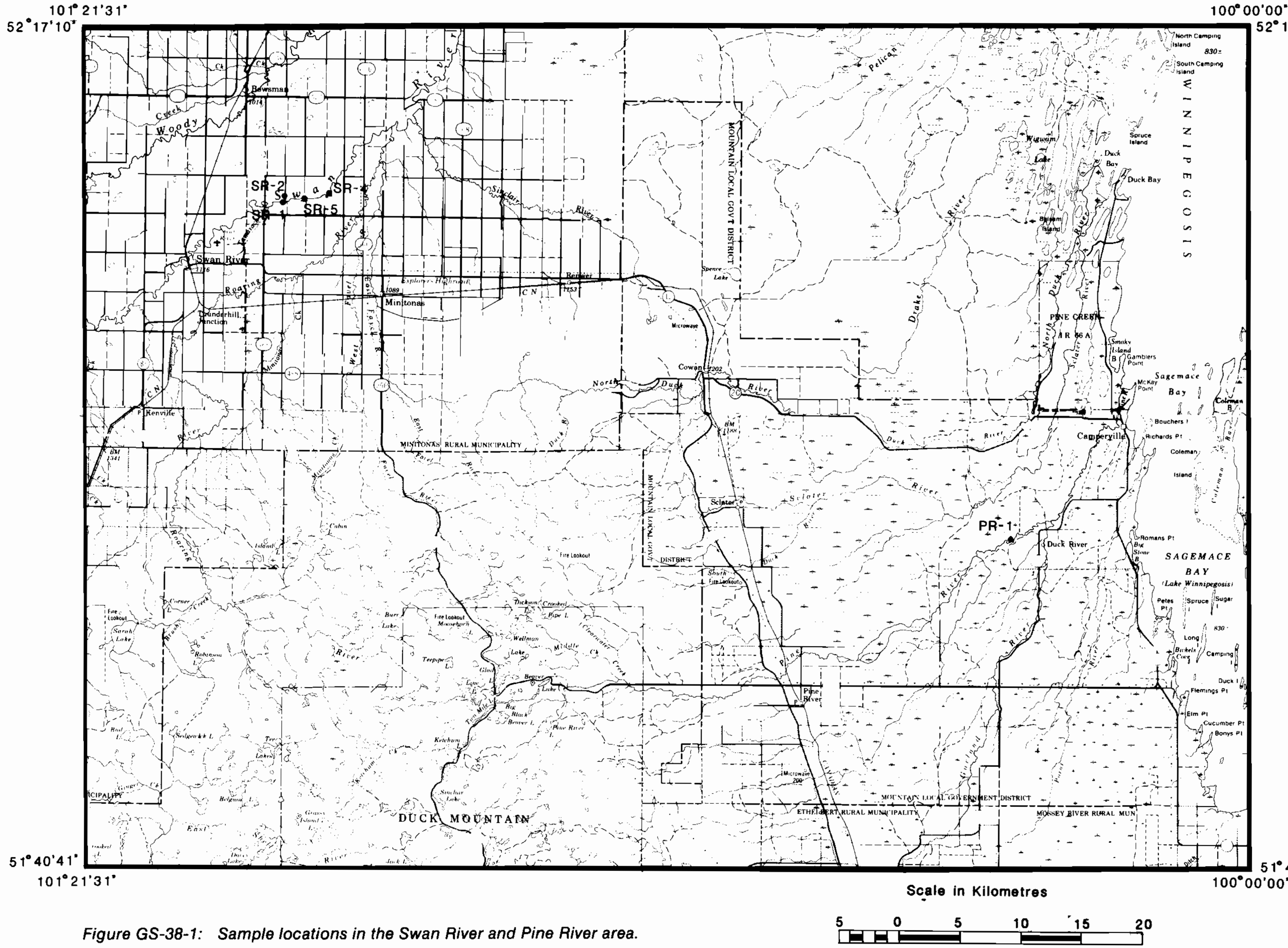

Figure GS-38-1: Sample locations in the Swan River and Pine River area.

TABLE GS-38-1
SIEVE ANALYSIS OF SWAN RIVER SANDS
% RETAINED

Sample Number	Mesh Size		+20	-20 +40	-40 +50	-50 +70	-70 +100	-100 +200	-200
SR1	0-1 m	a)	0	8.6	7.4	20.0	39.0	25.9	5.0
		b)	0	7.5	7.2	19.6	38.0	23.0	4.1
SR1	1-2 m	a)	0	4.5	6.2	26.0	41.4	19.6	2.4
		b)	0	2.6	4.5	25.6	44.5	20.8	1.9
SR1	2-3 m	a)	0	0.7	1.0	11.7	57.5	26.6	2.5
		b)	0	0.6	1.0	11.2	57.4	27.1	2.5
SR1	3-4 m	a)	0	0.5	2.2	17.9	55.1	21.5	2.2
		b)	0	0.5	2.2	21.9	53.0	19.9	2.1
SR1	4-5 m	a)	0	1.1	1.4	10.4	50.8	31.8	3.3
		b)	0	1.2	1.4	10.4	51.8	30.8	3.3
SR3	0-1 m	a)	0	6.4	6.0	23.5	40.0	20.0	4.1
		b)	0	5.5	5.7	20.8	41.8	22.0	4.2
SR3	1-2 m	a)	0	3.6	5.3	24.4	44.9	19.9	1.9
		b)	0	4.2	5.5	23.9	43.9	20.2	2.3
SR3	2-3 m	a)	1.4	1.3	3.2	36.1	41.9	15.0	1.1
		b)	0.8	0.9	2.8	18.8	56.2	19.2	1.4
SR3	3-4 m	a)	0.4	0.4	1.1	10.6	61.1	24.9	1.5
		b)	0.1	0.2	0.9	10.0	59.7	27.7	1.4
SR3	4-5 m	a)	0	2.7	6.5	21.0	44.0	22.8	3.0
		b)	0	2.5	6.2	20.7	43.0	22.6	3.0
PR1	0-.5 m	a)	2.1	0.6	0.7	5.1	31.4	48.0	12.1
		b)	2.6	0.7	0.9	5.7	32.3	45.6	12.3
PR1	.5-1 m	a)	0	0.1	0.5	21.2	45.9	25.1	5.7
		b)	0	0.1	0.4	15.3	50.4	27.8	5.9
PR1	1-1.5 m	a)	0	0.8	5.3	32.0	37.0	21.7	3.2
		b)	0	1.0	5.4	39.1	30.5	20.8	3.4

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GS-39 INVESTIGATION OF LEAD-ZINC POTENTIAL IN PALEOZOIC ROCKS OF SOUTHERN MANITOBA

by G. Gale, E. Nielsen and H.R. McCabe

This project originated from the discovery of galena pebbles in overburden in southern Manitoba. It is designed to evaluate the potential for lead-zinc mineralization in the Paleozoic rocks of southern Manitoba. Emphasis this season was placed on: (1) till sampling and analysis of the Quaternary stratigraphy in the Swan Lake area; (2) analysis of samples collected from the Porcupine Mountain-Swan Lake area in 1983; and (3) sampling of Paleozoic rocks in drill core.

TILL SAMPLING

A total of 48 till samples were collected in an approximately 40 km^2 area on the northwest side of Swan Lake as part of the continuing till geochemical study in the Paleozoic terrain of southern Manitoba (Gale et al., 1981; Nielsen, 1982; and Nielsen and Gale. 1983). Samples weighing approximately 30 kg each were collected from backhoe pits between 1 and 4 m deep.

The area sampled is located in the Westlake Plain at an elevation between 260 and 280 m (a.s.l.) and is underlain by the Devonian Souris River Formation (Fig. GS-39-1). The till is exposed at the surface in this region whereas for the south and west it is overlain by thick accumulations of alluvium. The till is fluted indicating ice flow towards the southwest.

The till is cream coloured and highly calcareous and is correlated with the Arran till described by Klassen (1978). The carbonate content of the less than 63 micron fraction is about 40 per cent. The pebble fraction consists predominantly of carbonate lithologies and Precambrian rock types constitute less than 20 per cent by weight. Some Cretaceous Swan River Formation erratics are present in the area indicating a source somewhere to the northeast, possibly between Swan Lake and Dawson Bay.

Olive coloured clay and 'buff' coloured silt overlie the till in a few places and yellow silt more than 4 m thick is present between 12 and 13 (Fig. GS-39-1). The results of the till geochemical investigations will be released as an Open File report in the Spring of 1985.

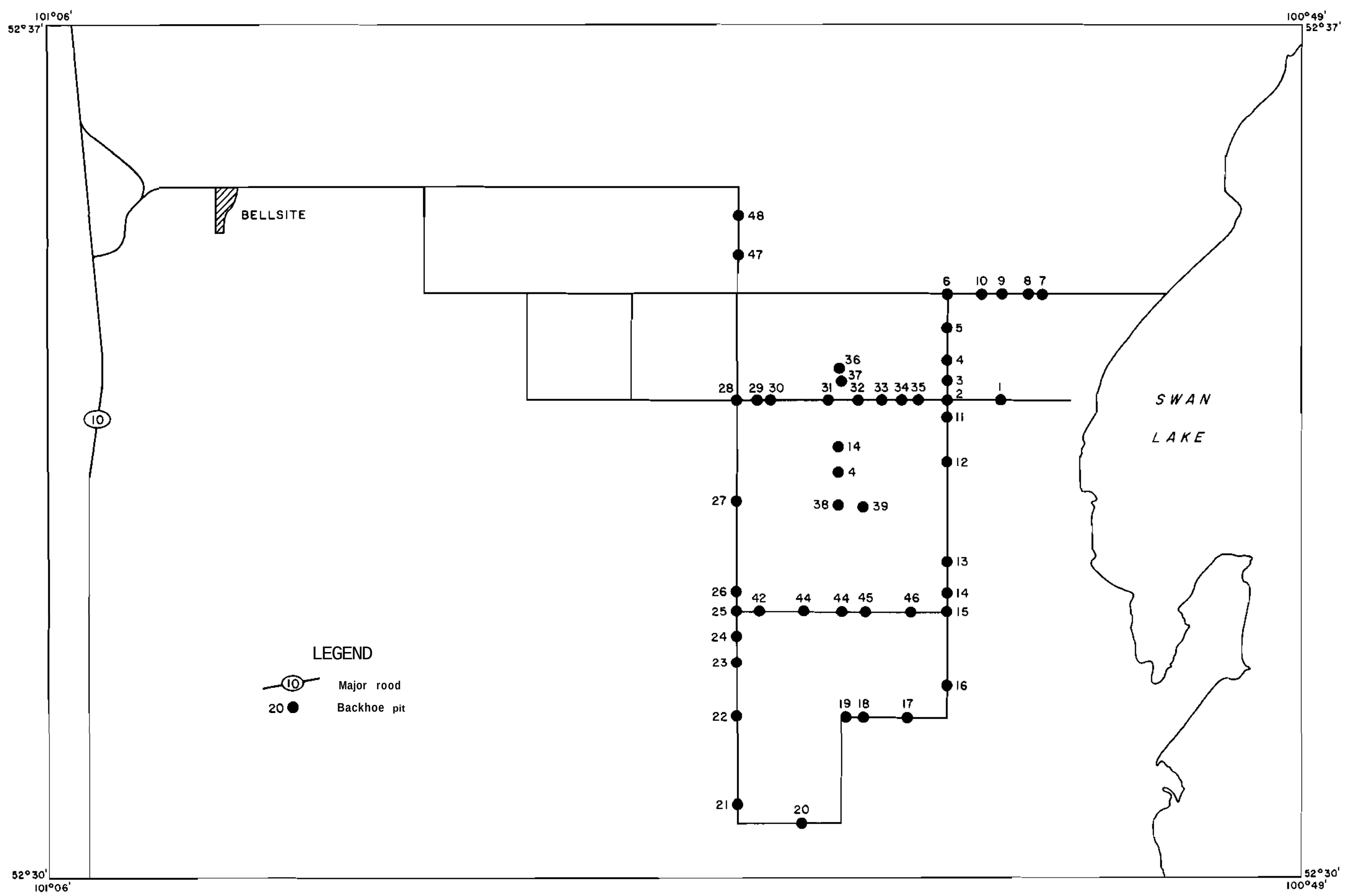

Figure GS-39-1: Location of till samples collected in the Swan Lake area.

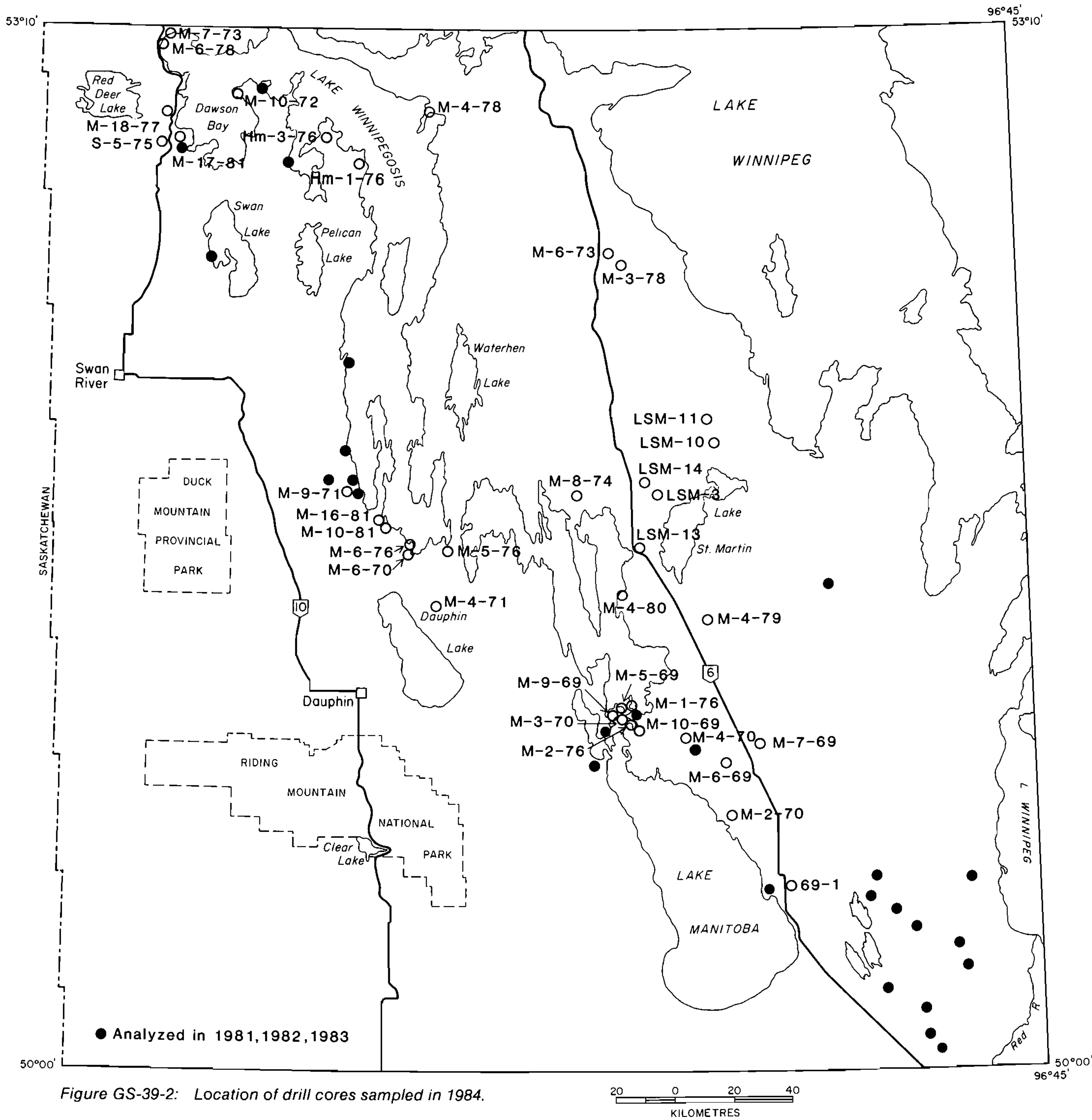

Figure GS-39-2: Location of drill cores sampled in 1984.

BEDROCK GEOCHEMISTRY

Drill cores (Fig. GS-39-2) of Paleozoic rocks were sliced and crushed to provide continuous sampling over one metre intervals. The 3200 samples of drill core will be analyzed for Cu, Pb, Zn, Ni, Co, Cd, Mn, Fe, Ba and Hg.

Several drill cores sampled in both the 1982 and 1983 projects contain trace amounts of lead and zinc in Ordovician rocks (c.f. Nielsen and Gale, 1983). Background lead values for these rocks is less than one part per million. Several sections have spurious values of more than 15 ppm Pb. One section in hole M8-81 (1983 project) has 15-45 ppm Pb with anomalously high values in Cu, Ni and Zn, Mn and Fe.

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MINES BRANCH

EXPLORATION SERVICES AND AGGREGATE RESOURCES SECTIONS

ES-1 MANITOBA'S PRECAMBRIAN DRILL CORE COLLECTION PROGRAM

by Peter J. Doyle

INTRODUCTION AND HISTORY

The Exploration Services Section of the Department of Energy and Mines has been collecting Precambrian diamond drill core for systematic storage since the early 1970s. Before 1970 the then Mines Branch had collected core as part of specific research projects. This early core was stored at the University of Manitoba.

The 1970s program was the responsibility of the Resident Geologist in The Pas. Core sheds were built in The Pas (1972), Thompson (1973) and Lynn Lake (1974). In Winnipeg part of the Geological Services Branch rock laboratory was allocated for core storage in 1980.

Between 1971 and 1977 B. Esposito (1971-74) and R. Gonzalez (1975-77) collected 72 600 metres of core. The Resident Geologist position in The Pas was discontinued in 1977. From 1978 to 1982 16 067 metres of core was periodically collected by various members of the Department (Mining Recorder, Claims Inspector, Geologists, etc.) and also delivered by private companies. During the 1970s emphasis was given to core collection; however, because of limited staff and budget, comprehensive cataloguing wasn't possible. The total amount of core collected to the end of 1982 was 88 667 metres.

In January 1983 the province's core program was reactivated with the hiring of a permanent drill core geologist. The 1983 program involved three components: accomplishments that were achieved through the Thompson Job Creation Program early in the year, the work completed by departmental staff over the summer field season and selected core retrievals completed throughout the balance of the year. A total of 24 329 metres of core was added to the provincial inventory by the end of the 1983-84 fiscal year.

1984 PROGRAM

In April 1984, the Government of Canada and the Manitoba Government finalized the Mineral Development Agreement. A portion of the funds available under the Agreement have been allocated to the province's core libraries program including construction of three new facilities in The Pas, Thompson, and Winnipeg. Construction is currently underway at The Pas with completion planned for early December.

Core racking and inventory procedures have been standardized throughout the entire system and a master inventory of all core presently in the library system is in the final stages of preparation. A master file with collar locations and drill logs as well as a series of 1:250 000 plots of our holdings will be compiled over the winter.

PRESENT HOLDINGS IN CORE LIBRARIES

The total present holdings in all four libraries is 171 094 metres of core.

(A) The Pas Shed:

This library contains 66 197 metres (217,182 feet) of core collected from the Flin Flon-Snow Lake base metal district. The present facility has an estimated capacity of 63 900 metres and is filled to capacity. Approximately 600 boxes are stacked neatly on pallets and protected from the weather. Construction of additional storage space with a capacity for a further 106 800 metres of core at the Grace Lake site is scheduled for completion in early December.

Examples of the current holdings include:
Hudson Bay Exploration; 16 projects, 231 holes (32 267 metres).
Granges Exploration; 38 projects, 307 holes (15 728 metres).
Manitoba Minerals; 11 projects, 71 holes (6 053 metres)
Espina Copper; 3 projects, 38 holes (1 609 metres)
Shell Canada; 3 projects, 15 holes (1 591 metres)
Pronto Exploration; 2 projects, 22 holes (2 061 metres)
Camflo Mines; 1 project, 35 holes (1 158 metres)
Cominco, Newmont, Inco, W. Bruce Dunlop, etc.

(B) Lynn Lake:

This facility contains 29 942 metres of core from the Lynn Lake greenstone belt, northern part of the Kisseynew basin and northern Manitoba in general. The present building's capacity was expanded this summer with the construction of an additional rack. With a current capacity of 58 960 metres this shed is half full.

Examples of the current holdings include:
Granges Exploration: 3 projects, 117 holes (9 168 metres)
Hudson Bay Exploration: 2 projects, 55 holes (4 420 metres)
SMDC: 2 projects, 44 holes (4 285 metres)
BP-Selco: 1 project, 17 holes (1 457 metres)
Falconbridge: 2 projects, 8 holes (847 metres)
Manitoba Minerals: 5 projects, 47 holes (3 743 metres)
Knobby Lake Mines, Shell Canada. Rock Ore Explorations, etc.

(C) Thompson:

This shed with a capacity of about 32 880 metres is overflowing with 47 878 metres of core. The overflow, approximately 2,500 boxes have been piled neatly and weather-covered outside in a fenced compound constructed this summer. This building houses core from the Nickel Belt and the central eastern greenstone belts. Construction of a second storage building is planned for 1985.

Examples of current holdings include:
Canamax: 11 projects, 235 holes (31 571 metres)
Cominco: 1 project, 50 holes (6 242 metres)
Falconbridge: 2 projects, 14 holes (2 573 metres)
Inco: 1 project, 3 holes (799 metres)
Manitoba Hydro, Hudson Bay Exploration, Manitoba Minerals, etc.

(D) Winnipeg:

The Winnipeg facility with a capacity of 3 511 metres is presently overflowing with a current inventory of 27 077 metres. The bulk of the core is piled outside on pallets in two fenced compounds on our site at the intersection of Brady Road and the south Perimeter Highway. Construction of additonal storage is planned for later this year.

Examples of current holdings include:
Falconbridge: 6 projects, 257 holes (18 757 metres)
Brinco: 1 project, 16 holes (829 metres)
BP-Selco: 1 project, 7 holes (878 metres)
Footloose Resources: 1 project, 3 holes (463 metres)
Newmont, Schmirf Exploration, J. Donner, S. Lesavage, etc.

Selected core retrievals are conducted by Exploration Services staff as an aid to current exploration programs at the request of the company involved and to assist ongoing research projects of the Geological Services Branch.

Figure ES-1-1:
Winter core retrieval, Kississing Lake.

Figure ES-1-2:
Core inventory: sorting and reorganization, Thompson; summer of 1984.

This year we have completed 10 recoveries resulting in the addition of 15 979 metres of core to the provincial inventory. Library use during 1984 has already equalled last years total of 32 inspections.

HOW TO USE THE CORE LIBRARIES

All four core libraries are now in excellent order for use by industry and the public. Well lit, heated inspection rooms with core splitters are provided.

None of the Department's core libraries are permanently manned therefore all enquiries and permission for access requests must be made to:

P. Doyle, Drill Core Geologist
or
B. Esposito, Assessment Geologist
Exploration Services Section
Manitoba Energy and Mines
555 - 330 Graham Avenue
Winnipeg, Manitoba R3C 4E3
Phone: (204) 945-8204/945-6535

Arrangements will then be made with appropriate local Government representatives who have keys to the northern libraries. These are:

The Pas: Mr. F.H. Heidman - Mining Recorder
Provincial Building, 3rd and Ross Avenue
The Pas, Manitoba R9A 1M4
Phone: (204) 623-6411

Lynn Lake: Conservation Officer
Manitoba Department of Natural Resources
675 Halstead Street
Lynn Lake, Manitoba R0B 0W0
Phone: (204) 356-2413

Thompson: Mr. H. Schumacher or Mr. W. Comaskey
Manitoba Department of Environment, Workplace, Safety and Health
Mines Inspection Branch
Provincial Building, 59 Elizabeth Drive
Thompson, Manitoba R8N 1X4
Phone: (204) 778-4411

Note: Do **not** contact these people direct, phone the Winnipeg office first.

Access to confidential core is only through written permission from the company which holds the ground. This written permission must be presented to the Drill Core Geologist or Assessment Geologist.

Core boxes cannot be removed from the core libraries. If sampling of core is desired, prior consideration and permission is required from Winnipeg.

Library users must be prepared to physically handle the core boxes and return them to the racks.

Local representatives will not give out door keys to core libraries. In special cases involving major inspections the Drill Core Geologist will travel to the northern facility to assist the user.

Drill logs and plans as well as other open file assessment data are available for inspection in the Winnipeg office.

DRILL CORE PROGRAM SUMMARY TABLE (in metres)

Library Location	Core Collection (Fiscal Years) 1970-82	1982-83	1983-84	1984 (to Sept.)	Present Inventory
Lynn Lake	18,058	1,917	5,858	4,109	29,942
The Pas	54,305	1,305	1,591	8,996	66,197
Thompson	6,064	38,887	354	2,573	47,878
Winnipeg	10,240	—	16,526	311	27,077
TOTALS	88,667	42,109	24.329	15,989	171,094

AR-1 AGGREGATE RESOURCE INVENTORY OF THE SOUTHERN PORTION OF THE LOCAL GOVERNMENT DISTRICT OF GRAHAMDALE

by R.V. Young

INTRODUCTION

An aggregate resource inventory was carried out in the southern portion of the L.G.D. of Grahamdale with the objective of determining location, quality and reserves of aggregate resources. This work completes an aggregate resource inventory of the Interlake south of Township 27.

The study area is located 130 km northwest of Winnipeg between latitudes 50°57' N to 51°57' N and longitudes 98°00' W to 98°18' W. It includes Townships 23 to 26 and Ranges 5 and 6 West of Principal Meridian. The area is accessible by Highway 6 and Provincial Roads 235 and 325 and the Canadian National Railway. Large areas of swamp limit access to some areas to a few secondary roads or trails. Aggregate deposits at a scale of 1:50 000 are shown on Preliminary Map 1984-SG accompanying this report.

METHODOLOGY

Airphotos at scales of 1:50 000 and 1:15 840 were used to identify potential aggregate deposits. All potential sites were visited and existing pits sampled. Samples were sieved to determine grain size, and pebble lithologies determined for the greater than 19.1 mm size fraction.

TOPOGRAPHY

The study area is at elevations between 259 - 290 m above sea level (m a.s.l.) with local drainage towards the northwest. Local relief consists of southeast trending till ridges 2-3 metres high, often with swamp deposits between the ridges. Wardlaw et al. (1969) correlated the ridges and intervening grooves to the underlying glacially abraded near-surface bedrock.

BEDROCK GEOLOGY

The study area is underlain by Paleozoic bedrock. The western portion is underlain by the Devonian Ashern Formation which consists of fine grained argillaceous dolomite and some shale. The remainder of the study area is underlain by undifferentiated dolomite of Silurian age (Norris et al., 1982). Several bedrock outcrops are located in the Mulvihill and Camper areas (Bannatyne, 1975). A description of the Devonian bedrock from a quarry 7 km west of Mulvihill is described by Norris et al. (1982, p. 155), and some physical properties and potential uses of the Silurian Cedar Lake Formation exposed in a quarry 1.6 km east of Mulvihill are presented by Jones and Bannatyne (1983, p. 160).

SAND AND GRAVEL RESOURCES

Only six sand and gravel deposits have been identified within the study area. All deposits are minor Lake Agassiz littoral deposits except deposit 5203 which is a glaciofluvial kame deposit. The littoral deposits are characterized as low quality sand and pebbly sand with depths of less than 1.0 m (Fig. AR-1-1). Two distinct strandline elevations were observed at 273 and 285 m a.s.l. These deposits show minimal surface topography with the most prominent strandline, deposit 5201, rising only 1.3 m above the surrounding terrain. Deposits 5204 and 5205 contained only 0.5 m of pebbly sand overlying till.

Glaciofluvial deposit 5203 is a kame rising 4 m above the surrounding terrain. The base of the deposit consists of fine sand overlain by massive coarse pebbly gravel and large boulders up to 1.0 m in diameter (Fig. AR-1-2). The top of the deposit at 288 m a.s.l. has been wave washed resulting in a distinct boulder lag along the surface of the deposit.

The littoral deposits are of low quality and shallow depth, and several have been mined to depletion. The only identified economical source of sand and gravel is deposit 5203, although the surface boulder lag makes mineral extraction difficult. All deposits have a high percentage of carbonate clasts ranging from 74-83 per cent.

Figure AR-1-1:
Littoral deposit 5206. The deposit consists of pebbly sand less than 1.0 m in depth.

Figure AR-1-2:

Glaciofluvial deposit 5203 showing fine sand overlain by large boulders and pebbly gravel. Survey rod is divided into 0.3 m units.

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AR-2 AGGREGATE RESOURCES IN THE R.M. OF MINIOTA

by H. Groom

INTRODUCTION

A sand and gravel inventory of the R.M. of Miniota was carried out in order to provide detailed aggregate information for resource management and land-use planning. A 1:50 000 scale map delineating the aggregate deposits is available from the Mines Branch (Preliminary Map 1984-MIN).

LOCATION AND PHYSIOGRAPHY

The R.M. of Miniota covers 840 km^2 between Twps. 13 to 15 and Rges. 25 to 27W. It lies within the Assiniboine River plain at the second prairie level.

Although the land has an overall southeast slope, within the study area elevation contours parallel the Assiniboine Valley, rising away from the river on both sides. The highest elevations are in the northeast (530 m a.s.l.); these fall to 460 m a.s.l. at the top of the river valley and rise again to the west (485 m a.s.l.).

Major drainage channels are the Assiniboine and Arrow Rivers and Birdtail, Minnewasta and Niso Creeks. The terrain is gently rolling except in the Arrow Hills area where local relief ranges from 8 to 30 m.

BEDROCK GEOLOGY

The study area is underlain by Upper Cretaceous marine shales of the Riding Mountain Formation. The lower unit, the Millwood Member, is a soft, greenish, bentonitic shale. The overlying Odanah Member is a hard, grey, siliceous shale that is well exposed in the valley walls of the Assiniboine and Arrow Rivers. The lower part of the Odanah Member is soft with thin interbeds of bentonite "somewhat resembling part of the Millwood when wet" (Bannatyne, 1970). This phase of the Odanah outcrops at several locations along the Assiniboine valley. The rock is black, very soft and clayey. Large calcite concretions (long axis up to 30 cm) are numerous and selenite crystals and bentonite are also present.

The bedrock topography map of the area (Klassen et al., 1970) shows the thalweg of several rivers that drained the region in Tertiary and early Pleistocene times. The present-day Assiniboine River occupies the valley of the ancestral Assiniboine from Miniota southwards. Birdtail Creek, the northern porion of Minnewasta Creek, and the southern portion of Arrow River, also follow ancient river courses.

QUATERNARY GEOLOGY

The surficial geology of the area has been mapped at a scale of 1:250 000 and the glacial history outlined by Klassen (1966, 1979). Figure Ar-2-1 has been modified from Klassen (1979).

Southwest of the Assiniboine River, tills of the early Wisconsinan Minnedosa, and late Wisconsinan Lennard Formations, are the predominant surficial materials. The till plain covering the northeastern portion of the municipality is composed of the Lennard Formation.

Early in deglaciation, a re-entrant developed in the ice sheet that lay in the Assiniboine Valley plain. The Arrow Hills is a kame moraine complex formed along the eastern edge of this re-entrant. The outwash lying along the northern edge of the Assiniboine River was deposited sequentially into the re-entrant as the ice front retreated northwards up the valley.

The Assiniboine River and Birdtail Creek valleys were major spillways for the meltwater accompanying deglaciation. Arrow River and Niso and Minnewasta Creeks are also meltwater channels.

AGGREGATE DEPOSITS

Aggregate deposits in the R.M. of Miniota are of three types: a kame moraine complex, outwash plains, and terrace deposits along glacial spillways and meltwater channels.

KAME MORAINE COMPLEX

The Arrow Hills moraine covers over 20 km^2 south of the town of Arrow River. The eastern edge was built along the ice front and the moraine ridges in this area often exceed 25 m in height. The material forming the ridges is extremely variable. Till is the major constituent but much of it is interbedded gravels, sands and diamicton beds. Isolated hills of shale rubble, resulting from ice-thrust, are present and much of the gravel, up to cobble size, is shale. Gravel pits are rare in this vicinity.

The western edge of the moraine is formed of southwest oriented ridges that are 10 m high and run discontinuously for over 1.5 km. Although the material is variable, ranging from sand to cobble gravel and rare diamicton beds, overall it is finer, better sorted and lower in shale than the material to the east. The ridges are predominantly formed of interbedded sand and pebble gravel and are generally coarser at the northern ends. Paleocurrent directions measured at SE24-13-26W were southwesterly (200° - 220°). This segment of the moraine has been extensively mined. Most pits are used on a temporary basis and the pit walls are slumped and often revegetated. Two pits in NW19-13-25W and SE23-13-26W were active this summer; both are over 4 m deep with sand and gravel continuing below the pit floor.

The southern edge of the moraine complex is an outwash plain. Most backhoe test sites exposed 2 to 3 m of crossbedded sand overlying till. The paleoflow in the sand is southwesterly.

OUTWASH PLAINS

An outwash plain lies along the northeastern side of the Assiniboine River for its entire length within the municipality. The width of the outwash plain ranges from 4.5 km at Miniota to 9 km at Hooper Lake. Depths range from over 9 m in the north to 5 m in the south near Miniota (Klassen, 1979). Shale content is moderate to high in all the outwash gravels.

The outwash northwest of Birdtail Creek is composed of sandy pebble to cobble gravel. The material is massive to horizontally bedded, moderately to poorly sorted and clasts are rounded to subrounded. With the exception of one small pit in SE31-15-27W, this deposit has not been mined because of its isolated location.

The eastern edge of the outwash between Birdtail and Minnewasta Creeks seems to have been deposited in a channel. At least 4 m of well sorted, sandy, fine to coarse pebble gravel overlie sand. The gravel is crossbedded and paleoflow (152° to 180°) was along the channel axis. The municipal pit (SW35-15-27W) is located in this part of the deposit.

The plain to the southwest of the channel gravels is distinctly different as it consists of medium to fine sand with local beds of pebbly sand. The sand is sometimes parallel bedded but is most often wedge

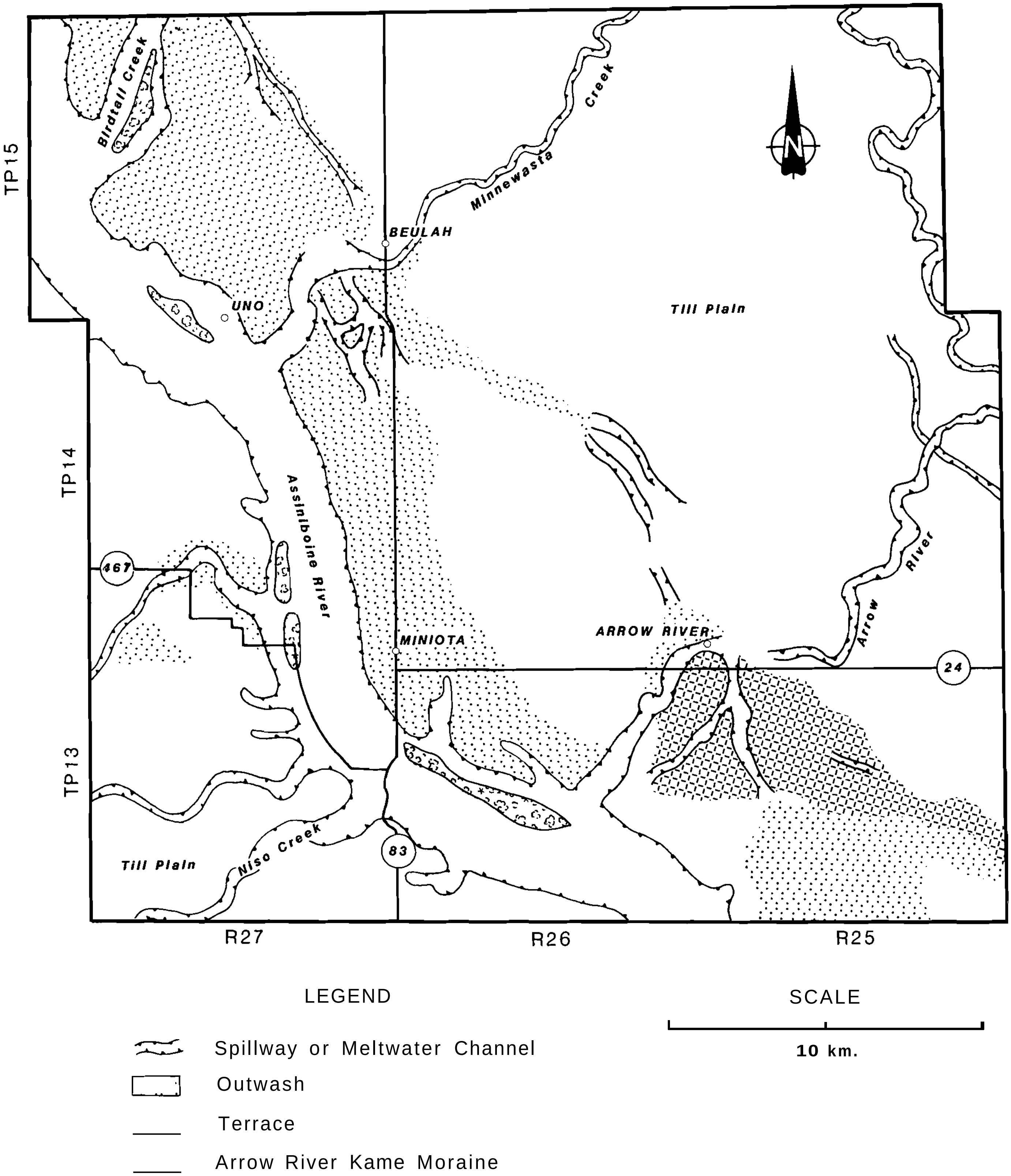

Figure AR-2-1: Surficial geology of the R.M. of Miniota; modified from Klassen (1979).

or trough crossbedded. Paleoflow was southerly between 160° and 220°. There are several esker-like ridges oriented southeastward across the plain. These are all formed of sand except for the 5 m high ridge in SW34-15-27W which is massive cobble gravel.

At the town of Beulah, a wedge of coarse gravel is 1 km wide and 2 km long. The town garbage dump (SE8-15-26W) shows 5 m of poorly sorted cobble gravel. The large pits south of town (SW8-15-26W) are revegetated and depleted. The gravel fines to the west where 2 to 3 m of pebble gravel overlies till or bedrock. To the south the plain is comprised of medium to fine sand that is massive or crossbedded; paleoflow was south to southeasterly.

The outwash south of Miniota is sand and fine pebble gravel. The material is massive to crossbedded and paleoflow was southerly. There are several gravel pits in this area but only two are still active, in NE25-13-27W and NW19-13-26W.

West of the Assiniboine River at Miniota is an outwash deposit that follows the thalweg of the ancestral Assiniboine where it diverges from the present river course. Along the channel axis, ridges of coarse gravel rise 2 to 3 m and are flanked by interbedded sand and pebble gravel. Where PR467 crosses the southern part of the deposit, three roadside pits show coarse gravel below several metres of very sandy pebble gravel. The main body of this deposit has not been mined as it is isolated by a creek valley 30 m deep.

RIVER TERRACES

The Assiniboine River Spillway is between 54 and 60 m deep along its course through the R.M. of Miniota. It is eroded into bedrock. The stratigraphy of the valley walls is generally covered by slump or alluvial fan deposits. However, in Sec. 10 and 11-13-26W there are exposures of gravel and sand buried under till.

Three terrace deposits occur along the Assiniboine within the study area. At Uno, the terrace is at 419 m a.s.l. and comprises a minimum of 3 m of well sorted, fine pebble gravel. A small pit in NW27-14-27W is used on an intermittent basis.

Near Miniota two terrace deposits occur between 381 and 388 m a.s.l. The deposit west of the river is overlain by sand of alluvial fan and slope wash origin. The exception is the northern end (NE10-14-27W) where a 5 m deep pit shows interbedded pebble gravel and sand.

The terrace southeast of Miniota is 0.5 km wide and over 3 km long. It comprises at least 6 m of gravel for most of its length and is overlain by sand and silt of slope wash origin along the valley edge. The aggregate is massive cobble gravel and crossbedded pebble gravel. An anomalously low percentage of shale, and good road access, makes this the best source of aggregate in the municipality. Several small pits have been opened in the deposit; the one in SE17-13-26W has been active recently.

The large terrace along Birdtail Creek lies between 450 and 457 m a.s.l. It is composed of coarse gravel (Fig. AR-2-2) similar to that of the outwash lying across the creek. The terrace is 8 m lower than the level of the outwash plateau and it is possible that the terrace is an erosional rather than depositional feature. Pits have not been opened in this deposit.

Arrow River and Minnewasta Creek are both meltwater channels that have small terrace deposits associated with them. The deposits along Arrow River are usually 2 to 3 m of very sandy gravel overlying till. They have been extensively mined and most are near depletion. The terraces along Minnewasta Creek comprise 2 to 4 m of poorly sorted, coarse pebble to cobble gravel. All have pits used on an intermittent basis, but none have been recently active.

CONCLUSION

Although the municipality has an abundance of aggregate, most of it is sand and the high percentage of shale in the gravel makes it of marginal quality. The river terrace southeast of Miniota is of high quality and should be protected from sterilization.

Figure AR-2-2:

Cobble gravel exposed in the Birdtail Creek terrace deposit, NW28-15-27W.

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AR-3 AGGREGATE RESOURCES OF THE RURAL MUNICIPALITY OF WALLACE

by Phyllis Berk

INTRODUCTION

During the summer of 1984, an aggregate inventory was carried out in the R.M. of Wallace. The study area lies west of Brandon between latitudes 100°52' and 101°22' and longitudes 49°48' and 50°03' and encompasses Ranges 26 to 29 W.P.M. and Townships 10 to 12. The objectives of this study were to:

1. delineate gravel-bearing deposits and determine their geological origin;
2. determine gravel quality and reserves; and
3. provide aggregate information for land use planning purposes.

BEDROCK GEOLOGY

The R.M. of Wallace is underlain by the Upper Cretaceous marine shales of the Riding Mountain Formation. The hard grey siliceous shale of the Odanah Member is most prominent. One bedrock outcrop of the Odanah shale was noted along Niso Creek in the north central portion of the municipality. The shale is jointed due to weathering and easily breaks into fragments. The Millwood Member of the Riding Mountain Formation generally underlies the Odanah Member but it reaches a topographic high in the northeast. Drift overlying bedrock is generally 40 m thick (Klassen, 1979).

QUATERNARY HISTORY

An early Wisconsin glaciation from the north deposited the compact clayey Minnedosa Till in the form of ridged ground moraine that is so evident in this area. The most recent glaciation in this area, of Late Wisconsin age, was approximately 12,000 years B.P. (Clayton and Moran, 1982), when southeasterly moving ice deposited sandy lodgement till, the Lennard Till, as a thin veneer or in patches.

As ice withdrew to the northwest, approximately 11,500 years B.P. (Clayton and Moran, 1982), it split into two lobes, the Assiniboine and the Weyburn Lobes. At this time, glacial Lake Souris and, later, glacial Lake Hind were formed east of Virden. Both these lakes drained eastward through the Pembina Trench. As ice withdrawal continued into Saskatchewan, glacial Lake Indian Head was formed. Major southeast drainage of this lake created the Pipestone Spillway which was located along the southwest margin of the northwest retreating Assiniboine Lobe. Successive drainage occurred through Gopher and Bosshill Creeks. These creeks mark consecutive ice margins as deglaciation continued. Outwash deposited along these creeks includes till, silt, and sand and gravel.

During a time of ice stagnation, small deposits of ice contact drift were deposited in the eastern portion of the municipality.

Fine sediment was eroded and transported along Bosshill and Gopher Creeks and deposited as deltaic material near Virden.

The R.M. of Wallace was totally ice-free approximately 11,000 B.P. (Clayton and Moran, 1982).

GEOMORPHOLOGY

RIDGED GROUND MORAINE

Till ridges, 2-6 m high, occur over most of the study area. These ridges are northeasterly oriented, transverse to ice flow direction and composed of compact clayey Minnedosa Till. Furrows or depressions separate the ridges creating a rolling topography.

ICE CONTACT DEPOSITS

Several small ice contact deposits are located in the area. They are generally 6-8 m high. Morphologically, they are indistinguishable from the till ridges but differ in composition and orientation. The ice contact deposits trend northwest and composition ranges from fine- to medium-grained sand with occasional pebbles to stratified pebble gravel overlain by till.

MELTWATER CHANNELS

The most distinct features in the area are the southeast-trending meltwater channels. The Pipestone channel enters the area at the southwest corner. It is a steep-sided, rectangular-shaped valley up to 40 m in depth. A small underfit stream occupies the valley. Valley sides are composed of outwash including till, sand and gravel. A deposit of coarse gravel more than 3 m deep occurs at the Wallace/Pipestone municipal boundary. The gravel in this deposit is coarse at the surface and fines downwards.

Gopher and Bosshill channels lie almost entirely within the municipality. In the northwest they are less than 2 m deep. Toward the southeast depth increases, Gopher reaching a maximum depth of 30 m northeast of Virden and Bosshill reaching a maximum depth of 10 m south of Virden. Stream flow is intermittent in these channels. Outwash deposits along the channels include silt, till, sand and gravel. Gravel was deposited as isolated or distinct pockets and tends to occur at sharp bends in the channels.

DELTAIC DEPOSITS

Deltaic sands were deposited around Virden but the deposits have no morphological surface expression. Sand is generally fine- to medium-grained with occasional pebbles and ranges from 1.5 to 2.5 m in depth. At some locations pebble seams were encountered. Clay generally underlies the sand.

AGGREGATE RESOURCES

Gravel occurs primarily as outwash deposits along meltwater channels and as minor ice contact deposits. The outwash gravel occurs as scattered isolated pockets separated by till. In general the outwash gravel is bedded with a coarse lag at the surface and fines downwards into sand. Depth of these deposits is generally less than 2.0 m with the exception of deposit 11601 on Pipestone Creek.

The ice contact deposits range from fine sand to pebble gravel. The deposits composed of sand reach thicknesses of 6 m. Gravel thicknesses are generally less than 2 m.

In the 5/8" - #4 sieve fraction there is a slightly higher percentage of carbonate clasts, roughly 55% carbonates and 45% Precambrian. In the coarse fraction, 3/4"-3", there tends to be a slightly higher percentage of Precambrian clasts, roughly 55% Precambrian and 45% carbonates. Gravel is oxidized and contains variable percentages of shale, ironstone, chert and weathered pebbles. Particle roundness ranges from subrounded to subangular with a generally rough surface texture.

Gravel quality ranges from medium low (20-40% gravel content) to medium high (60-80% gravel content).

Figure AR-3-1:
Ridged ground moraine.

Figure AR-3-2:
Coarse gravel deposit on Pipestone Creek.

Figure AR-3-3:
Depleted and revegetated pit near Elkhorn.

CONCLUSION

Gravel resources are limited primarily to outwash along meltwater channels and, to a minor extent, ice contact deposits. Many of the gravel pits are near depletion while others are completely depleted and revegetated. Some pits are being worked on a temporary basis to supply local needs.

The Department of Highways and the R.M. of Wallace are the two largest end users of gravel. Both require gravel for construction and maintenance of provincial and municipal roads, respectively, and are still extracting gravel from within the municipality to meet their needs.

The third end user of gravel is a local concrete company, Midwest Redi-crete who imports gravel from the R.M. of Pipestone.

Presently, reserves are adequate to meet local needs. But continued road maintenance and the construction of a second lane of the Trans-Canada Highway will cause a scarcity of gravel in the R.M. of Wallace.

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AR-4 AGGREGATE RESOURCES IN THE L.G.D. OF REYNOLDS

by G. Matile

INTRODUCTION

A sand and gravel inventory was carried out in the northern half of the L.G.D. of Reynolds in order to provide detailed aggregate information for land-use planning in the area. This was the first year of a two-year program which is being conducted in co-operation with the Materials and Research Branch of the Department of Highways.

The study area is a continuation of the Milner Ridge Moraine whose northern limits were mapped in detail in the summer of 1983, as part of the sand and gravel inventory of the R.M. of Lac du Bonnet. The geological setting and stratigraphy are essentially the same as described by Matile and Groom (1983) with an additional glaciofluvial unit within the upper diamicton unit (Fig. AR-4-1).

STRATIGRAPHY

The stratigraphy is outlined in Figure AR-4-1, modified from Matile and Groom (1983) with this year's findings.

The additional glaciofluvial unit comprises sand to coarse gravel and is of northwestern provenance, having an estimated pebble lithology of 70% carbonate and 30% Precambrian clasts (no analytical results are available to date).

This glaciofluvial unit is found in one deposit which extends several kilometres north and south of Ste. Rita, trending southeastward. Sediments related to this unit comprise poorly consolidated diamicton beds which are interpreted as debris flow and melt-out till facies, suggesting an association with the final retreat of the Red River Lobe in the area. The glaciofluvial unit in this deposit is not overlain by any of the younger stratigraphic units.

CHRONOLOGICAL SIGNIFICANCE

The consistency with which the upper glaciofluvial sand and gravel unit (of northeast provenance) is underlain by the silt diamicton (of northwest provenance) suggests that the Milner Ridge Moraine was formed by two separate glacial events. During the first, deposition was in an interlobate position, between the initial advance of the Red River Lobe and the retreat of the Rainy Lobe, more than 14 000 years B.P. During the second event, deposition took place at the icefront of a late advance of the Rainy Lobe, contemporaneous with the closing of the eastern outlets of Lake Agassiz, approximately 9900 years B.P.

The first event is the traditional interpretation of the formation of the Milner Ridge Moraine. Deposition of great thicknesses of sediment occurred at this time. This sediment is predominantly fine white sand. The event was terminated by the continued advance of the Red River Lobe into the United States, which deposited the Roseau Formation (upper diamicton) over much of the moraine (Teller and Fenton,1980).

The second event, although minor, is of great economic importance, as it deposited many isolated concentrations of Precambrian-rich sand and gravel on top of the pre-existing moraine.

The proposed model for deposition of these isolated areas of Precambrian-rich sand and gravel is the turbidite fan model described by Walker (1975). The inner fan (Fig. AR-4-2) is composed of coarse sand and gravel, whereas the more distal parts of the fan are predominantly sand.

Within the channelized suprafan are ridges of coarse gravel. The channels in this part of the fan provided a course for the gravity flow of coarse gravel into the distal part of the fan. Subsequent to the deposition of the fan, the regression of Lake Agassiz removed much of the fine facies, leaving the coarse gravel in the more distal areas of the fan as positive features.

Mapping to the south in the summer of 1985 may define the southern limit of the proposed late advance of the Rainy Lobe.

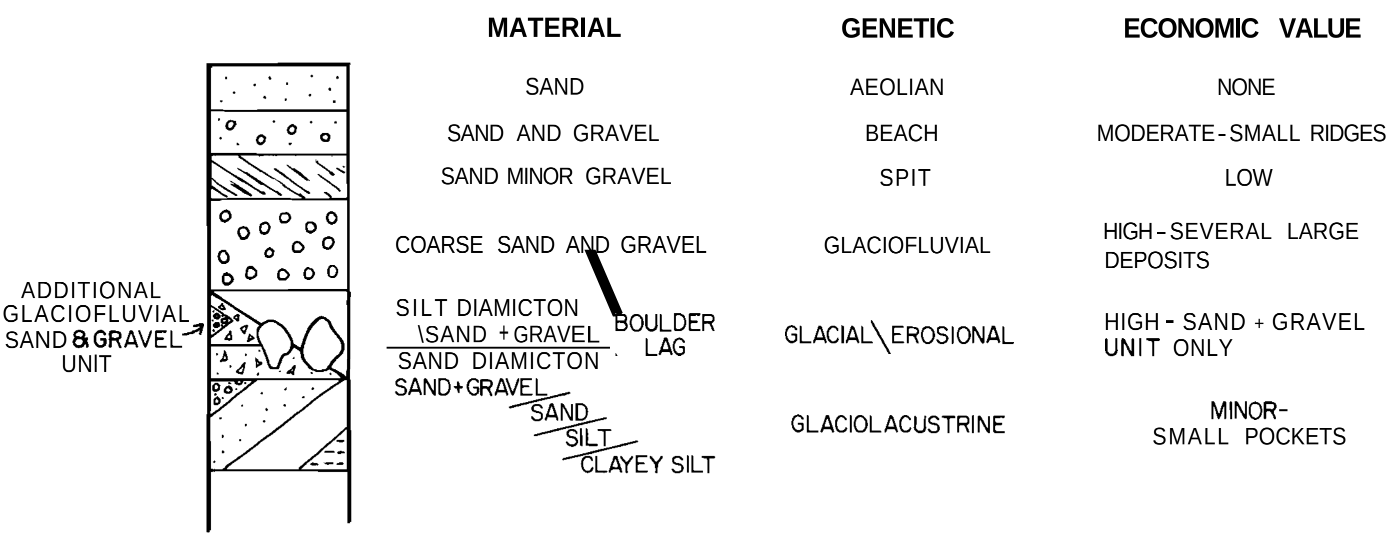

Figure AR-4-1: Generalized stratigraphy of the Milner Ridge Moraine, after Matile and Groom (1983).

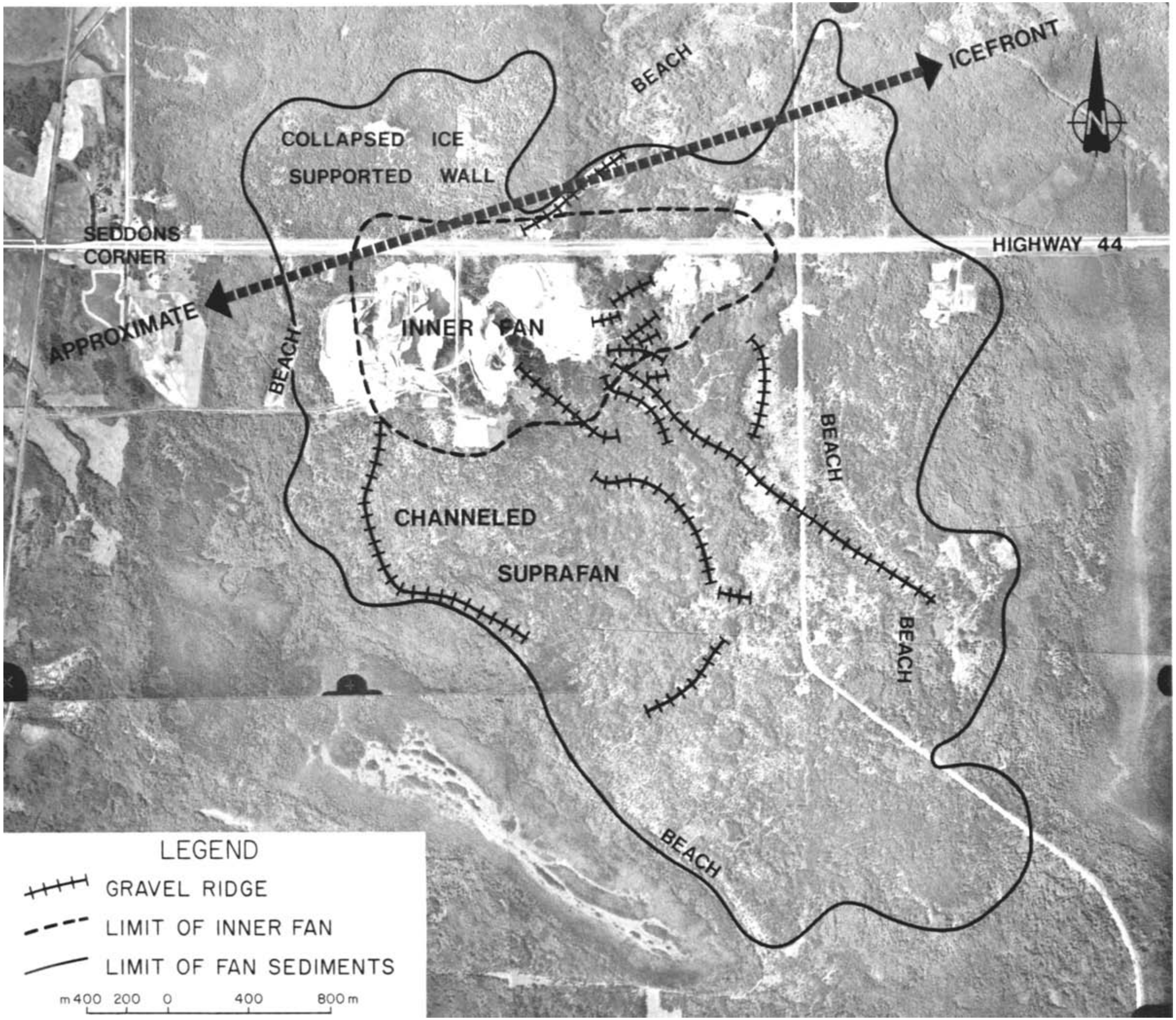

Figure AR-4-2: Seddons Corner deposit, exemplifying the Turbidite Fan Model.

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AR-5 AGGREGATE RESOURCE MANAGEMENT IN MANITOBA

by C. Jones

INTRODUCTION

Aggregate resources (sand, gravel, crushed rock) are an essential commodity required as a basic ingredient in many construction-related activities. This non-renewable resource, under present engineering technology, has no suitable substitute; it is essential for various construction end uses including road and residential construction, commercial and institutional construction and for other engineering projects (see Table AR-5-1). During 1983 an estimated 13 million tons of sand and gravel with an estimated value of nearly 28 million dollars was produced in Manitoba. The sand and gravel extraction industry, by volume produced, is the largest mineral extraction industry in the province.

The market characteristics of the construction industry dictate that aggregate extraction be located as close to the construction site as permissible. Construction economics and engineering technology dictate that the resource be readily available in large quantities of high quality (chemically and physically durable), variably graded material, and be delivered at a relatively cheap price. The delivered price of the commodity is highly sensitive to transportation costs and sterilizing the resource by surface land uses prior to depletion can add significant increased local construction costs due to the increased haulage distances required.

Since World War II a population movement from urban centres to suburban and rural areas has occurred. Many of these new rural residents are young families seeking the amenitites of country life, such as privacy, rural lifestyle and appeal of the environment. Aggregate extraction, on the other hand, has several environmental disamenities as by-products, for example, increased levels of noise, dust, and local truck traffic which agitate serious land-use conflicts when located in proximity to residential development. In time, as the land-use conflict escalates, local pressure to restrict development of the mineral resource occurs, thereby sterilizing a valuable non-renewable resource.

TABLE AR-5-1
EXAMPLES OF CONSTRUCTION ACTIVITIES DEPENDENT UPON SAND AND GRAVEL

Construction Type	End Uses
Engineering	Roads, dams, transmission lines, pipelines. oil drilling, mine development
Residential	Single, seasonal, double, row apartments
Residential (improvements)	Additions, structural changes, residential garages, swimming pools — others.
Industrial	Manufacturing, processing, transportation. communication, utilities, agricultural, forestry, mine and mill buildings.
Commercial, Building Construction	Stores, warehouses, garages, office buildings, hotels, funeral parlours, beauty salons, miscellaneous commercial signs, posters, heating and plumbing installation.
Institutional	Community, Municipal, Provincial, schools, universities, hospitals, clinics, law enforcement, public protection, government offices, national defence, gymnastics, laundromats, heating plants, retirement homes.

AGGREGATE RESOURCE MANAGEMENT PROGRAM

The aggregate resource management program has been designed to promote conservation of aggregate and quarry mineral resources as well as resolve serious land-use conflicts thereby protecting property rights. The objectives of the program are achieved through the legal instruments of land-use planning and control development. The resource information compiled by staff geologists is utilized for the preparation of background studies as a basic input for municipal basic planning statements and development plans. Resource planning recommendations, based upon Provincial Land Use Policy #13, Manitoba Regulation 217/80 of the Planning Act, are incorporated as policy in the provisions of district basic planning statements and development plans. Eventually the policies established in the planning documents are reflected in the provisions of a zoning by-law.

The aggregate resource management program is actively involved in monitoring subdivision activity and Crown surface use clearances in order to minimize conflicting land uses and conserve the resource. The Manitoba Department of Municipal Affairs solicits comments from concerned government agencies, one of which is the Manitoba Department of Energy and Mines. The subdivision application is reviewed to ensure that it conforms to the Provincial Land Use Policy #13, planning document, and provisions of The Mines Act. A comment concerning the application is sent to the Local District Planning Office, the comments are summarized, and forwarded to the Municipal Council and Local District Planning Board. A decision concerning rejection or approval is made. If the application is approved, with no outstanding concerns, a certificate of title is issued; however, if the concerns expressed by a government department have not been resolved the application is sent to the Provincial Planning Branch for their perusal.

Crown surface use clearances are also reviewed in order to ensure that Crown aggregate and quarry minerals are not sterilized and to ensure that the proposal complies with provisions of The Mines Act. Conservation objectives of the program are also ensured through regional representation on the Local Land Use Committee which reviews local land-use issues and provides detailed resource planning recommendations to Inter-departmental Planning Board.

HIGHLIGHTS OF THE YEAR

- Background studies for aggregate resource management in the R.M. of Lac du Bonnet, Winnipeg River Planning District, Boyne River Planning District (policy statement), R.M. of Tache, R.M. of Wallace (in preparation), and R.M. of Miniota (in preparation).
- Surficial geological mapping and aggregate inventories of the R.M. of Wallace, R.M. of Miniota, R.M. of Victoria, L.G.D. of Reynolds, and the south half of the L.G.D. of Grahamdale.
- Approximately 1200 subdivision applications were reviewed to ensure compliance with Provincial Land Use Policy #13, Manitoba Regulation 217/80 of the Planning Act, Development Plans, zoning by-laws and provisions of The Mines Act, of which approximately 10% required detailed investigation.

- Presentations of background studies including aggregate resource management policy to Municipal Councils and Local District Planning Boards.
- Representation on Local Land Use Committee whose responsibility is to review local land-use related issues and provide recommendations.
- Review of several development plans, basic planning statements and zoning by-laws to ensure resource planning recommendations and policy were adequately incorporated into provisions of municipal planning documents.
- Review of amendments to development plans and basic planning statements to ensure proposed changes would not sterilize the resource.
- Response to several requests for technical assistance from government agencies, industry, and public.

LIST OF PRELIMINARY MAPS

LIST OF GEOLOGICAL STAFF AND AREAS OF CURRENT INVOLVEMENT

GEOLOGICAL SERVICES BRANCH

Position	Personnel	Area of Current Involvement
Director	Dr. W.D. McRitchie	Manitoba
Geological Survey:		
Senior Precambrian Geologist	Dr. W. Weber	Manitoba
Precambrian Geologists	Dr. A.H. Bailes	Flin Flon Belt
	H.D.M. Cameron	Cross Lake and Lynn Lake regions
	M.T. Corkery	Cross Lake-Northern Superior Province. Nelson and Churchill River Corridors
	H.P. Gilbert	Island Lake and Barrington Lake
	P.G. Lenton	Cross Lake-Churchill Province - granite and pegmatite-related projects
	Dr. J.J. Macek	Walker Lake-NE Cross Lake; Maskwa River
	E.C. Syme	Flin Flon and Lynn Lake Belts
	Dr. H.V. Zwanzig	Churchill Province/ Kisseynew project
Mineralogist	C.R. McGregor	
Geological Compiler (Atlas)	S. Parker	
Phanerozoic Geologist	Dr. H.R. McCabe	Southwest Manitoba and Interlake
Quaternary Geologist	Dr. E. Nielsen	Lynn Lake region, Interlake and southern Manitoba - Basal Till Studies
Mineral Investigations:		
Senior Mineral Deposit Geologist	Dr. G.H. Gale	Manitoba, specifically Flin Flon and Snow Lake
Mineral Deposit Geologists	D.A. Baldwin	Lynn Lake-Ruttan region
	Dr. P. Theyer	Island-Gods Lake, Bissett and Bird River Sill
	Dr. M.A.F. Fedikow	Geochemistry and Gold in Lynn Lake and Flin Flon/ Snow Lake

	G. Ostry	File Lake-Sherridon area
	R. Schmidtke	Mineral Deposit Geological Assistant
	P. Stewart	Mineral Deposit Geological Assistant
Industrial Minerals Geologists	R. Gunter	Northern Manitoba
	D.M. Watson	Southern Manitoba
	P. Yamada	Industrial Minerals Geological Assistant
Editorial & Cartographic Services:		
Geological Editor	B.B. Bannatyne	

MINES BRANCH

Position	**Personnel**	**Area of Current Involvement**
Director	W.A. Bardswich	Manitoba
Aggregate Resources:		
Section Head	R.V. Young	Aggregate inventory L.G.D. of Grahamdale
Quaternary Geologist	G. Matile	Aggregate inventory L.G.D. of Reynolds
	H. Groom	Aggregate inventory R.M. of Miniota
	P. Berk	Aggregate inventory R.M. of Wallace
Resource Management Geologist	C. Jones	Aggregate resource management
Exploration Services:		
Section Head	W.D. Fogwill	Monitors/promotes exploration in Manitoba
Assessment Geologist	B. Esposito	Examination, storage/retrieval, assessment reports
Assessment Clerk	P.L. Carroll	Assists public use of Assessment Collection
Drill Core Geologist	P.J. Doyle	Collects/stores exploration drill core
Staff Geophysicist	I.T. Hosain	Regional compilation of assessment data
Information Geologist	J.D. Bamburak	Mineral deposit data, publications, information
Publications Clerk	D.W. Meek	Publication sales
Bibliographic Compiler	P. Leskiw	Compiles indices to geoscience data on Manitoba

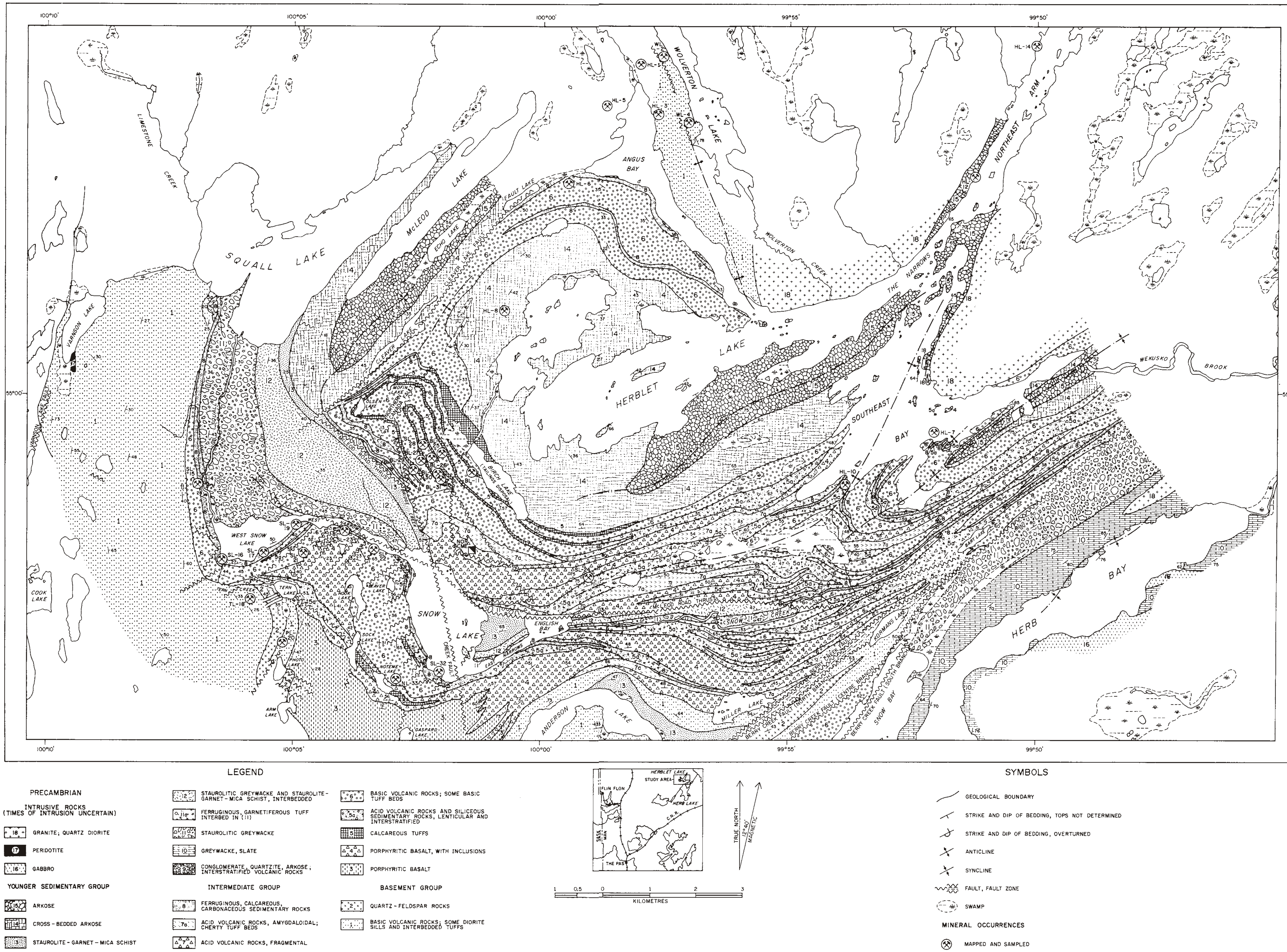

Figure GS-13-1: Geology of the Snow Lake-Herblet Lake area (after Russell, 1954; 1955) illustrating the location of examined mineral occurrences.