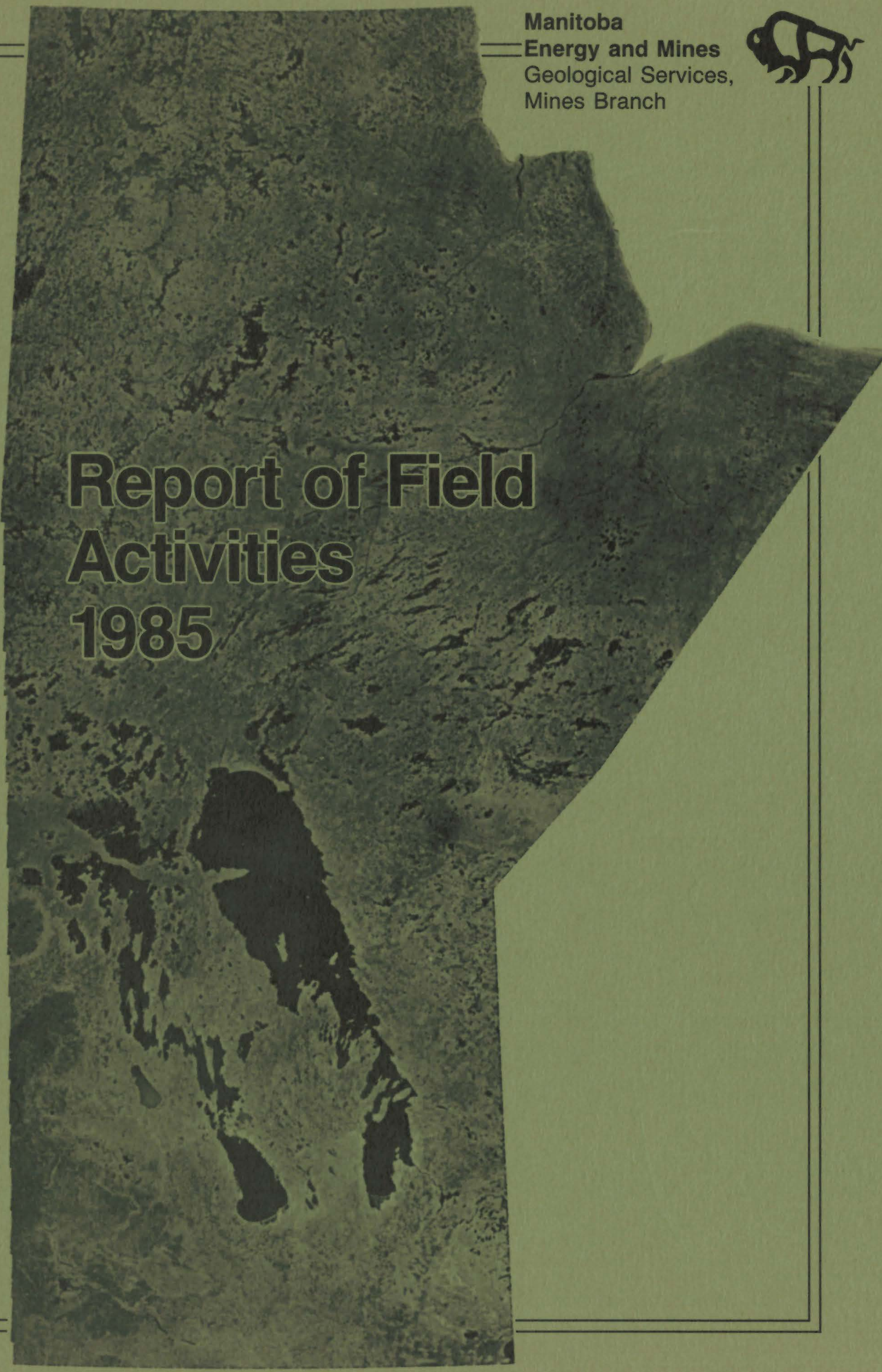
Manitoba
Energy and Mines
Geological Services,
Mines Branch



Report of Field Activities 1985

MINERAL RESOURCES STAFF

555 - 330 Graham Avenue, Winnipeg, Manitoba. R3C 4E3

Area Code: 204

PETROLEUM

Director	H. Clare Moster	945-6573
Special Projects	A. Galarnyk	945-6315
Secretary	L. Kabaluk	945-6577

Administration

Petroleum Administrator	B. Thiessen	945-6571
Crown Royalties	O. Carrothers	945-6575
Crown Leases/Accounts	C. Herman	945-6576
Production Reports	S. Besth	945-3905
Production Records/Info	P. Seymour	945-6578

Geology Section

Senior Petroleum Geologist	Vacant	
Petroleum Geologist	C. Martiniuk	945-6570
Maps and Publications	D. Surzyshyn	945-8102
Secretary	D. Hewko	945-6314

Engineering and Inspection Section

Chief Petroleum Engineer	L.R. Dubreuil	945-6574
Reservoir Engineer	M. Arbez	945-6327
Secretary	D. Hewko	945-6314

Virden Office, Box 1359,
Virden, Manitoba. R0M 2C0

District Petroleum Engineer	G.E. Johnson	748-1557
Petroleum Inspector	B. Dunning	748-1557

Waskada Office, Box 222,
Waskada, Manitoba. R0M 2E0

Petroleum Inspector	K. Lowden	673-2472
Petroleum Inspector	vacant	

MINES BRANCH

Director	W.A. Bardswich	945-6505
Secretary	L. McElhoes	945-6503

Aggregate Resources

Section Head	R.V. Young	945-6507
Geologists	H. Groom	945-6546
	C. Jones	945-6510
	G. Matile	945-6530
	P. Berk	945-6508

Exploration Services

Section Head	D. Fogwill	945-6536
Mineral Information Geologist	J.D. Bamburak	945-6534
Assessment Geologist	B. Esposito	945-6535
Geophysicist	I. T. Hosain	945-6540
Assessment Clerk	P. Carroll	945-6537
Publications	A. Harasym	945-6541
Drill Core Geologist	J.K. Filo	945-8633
Special Projects Geologist	P.J. Doyle	945-8204
Mineral Inventory Geologist	D.J. Richardson	945-6541
Compilation Geologist	P. Leskiw	945-3319
Claims Inspector	D. Meek	945-8633

Mining Recording

Chief Mining Recorder	B. Sias	945-6528
Secretary	S. Marchinko	945-6532
Administrative Officer-Mining	C.B. Lewis	945-6527
Mining Recording Clerks	L. Kerr	945-4762
	K. Pestun	945-4762
Administrative Officer-Quarrying	S. Shetty	945-6526
Mining Recording Clerks	J. Spotar	945-6531
	B. Derksen	945-6531
Revenue Clerks	L. Trann	945-6529
	B. Garai	945-4762
Cartographer	M. Fedak	945-6525

The Pas Office, Provincial Building, 3rd and Ross Avenue
P.O.Box 2550, The Pas, Manitoba. R9A 1M4

Mining Recorder	F.H. Heidman	623-6411
Mining Claims Inspector	B. Jahn	623-6411
Mining Recording Clerks	M. Goretski	623-6411
	A. Wiwcharuk	623-6411
	K. Ducharme	623-6411

Mining Engineering and Inspection

Chief Mining Engineer	A.E. Ball	945-6519
Secretary	M. Giancola	945-6522
Senior Mining Engineer	A.H. Duffield	945-6521
Project Manager	D. Cook	945-0491
Resource/Rehabilitation Planner	B.D. Bailey	945-6516
Rehabilitation Technician	C. Purdy	945-6520
Quarry Inspector, S.W. and Interlake	L. Bilton	945-6512
Quarry Inspector, East	G. Hamilton	945-6513

Dauphin Office, Provincial Building, 27 Second Avenue S.W.
Dauphin, Manitoba. R7N 3E5 638-9111

Quarry Inspector	J. Adams	638-9111

MINERAL POLICY

Director	S. Singh (Dr.)	945-6586
Secretary	C. MacKinnon	945-6580
Economic Research Analysts	L. Skinner	945-6585
	R. Payne	945-5869
	A. Gamvrelis	945-6519

GEOLOGICAL SERVICES

Director	W.D. McRitchie (Dr.)	945-6559
Secretary	L.Chudy	945-6567
	D. Kircz	945-6567
Administrative Officer	J. Athayde	945-6558
Store-keeper	N. Brandson	945-8832
	G. Tate	945-8832

Geological Survey

Senior Precambrian Geologist	W. Weber (Dr.)	945-6549
	A.H. Bailes (Dr.)	945-6555
	H.D.M. Cameron	945-6544
	M.T. Corkery	945-6554
	H.P. Gilbert	945-6547
	P.G. Lenton	945-6553
	J.J. Macek (Dr.)	945-6548
	C.R. McGregor	945-6543
	D.C.P. Schledewitz	945-6566
	E. Syme	945-6556
	H.V. Zwanzig (Dr.)	945-6552
Phanerozoic Stratigrapher	H.R. McCabe (Dr.)	945-6545
Quaternary Geologist	E. Nielsen (Dr.)	945-6506
Geological Compiler (Atlas)	J.S.D. Parker	945-7255
Rock Preparation Laboratory	D.J. Berk	945-6550
	G.L. Benger	945-6550
	D. Binne	945-6550
	R. Unruh	945-6550
	V. Varga	945-6550
	N.D. Young	945-6550

Mineral Investigations

Senior Mineral Deposit Geologist	G.H. Gale (Dr.)	945-6561
	D.A. Baldwin	945-6551
	M.A.F. Fedikow (Dr.)	945-6562
	P. Theyer (Dr.)	945-6565
	G. Ostry	945-4677
	P. Stewart	945-6560
	D. Parbery	945-4208
Industrial Minerals	D.M. Watson	945-6564
	W.R. Gunter	945-6584
	P.H. Yamada	945-4208

Editorial and Cartographic Services

Geological Editor	B.B. Bannatyne	945-6563
Chief Draftsman	R.J. Sales	945-6588
	D.F. Bagwell	945-6591
	N.P.C. Barton	945-6591
	M. Carvalho	945-6590
	L. Franceschet	945-6589
	D.L. McShane	945-6592
	C. Sandy	945-6593
	M. Simmons	945-6589
	E. Stockwell	945-6592
	M.W. Timcoe	945-6590
	E.J. Truman	945-6592

Analytical and Geochemical Laboratory
W.M. Ward Tehnical Services Laboratory
745 Logan Avenue, Winnipeg, Manitoba. R3E 1M8

Chief Chemist	J. Gregorchuk	945-3786
	R.S. Kitlar	945-2590
	W. Lipinsky	945-2590
	R.M. Nembhard	945-4788
	D.M. Snuggs	945-2610
	M.L.J. Wietzel	945-2590
	D. DeLuca	945-2590
Crushing Room		945-4787
Core Shed, University of Manitoba, Winnipeg		269-5688
Rock Storage Facility, Perimeter Hwy. and Brady Road		261-1405
Warehouse, 1680 Church Avenue, Winnipeg		945-8832

THE OIL AND NATURAL GAS CONSERVATION BOARD

Chairman	C.S. Kang	945-3130
Deputy Chairman	W. McDonald	945-2694
Member	J.F. Redgwell	945-2839

THE MINING BOARD

Chairman	C.S. Kang	945-3130
Deputy Chairman	S. Singh	945-6586
Member	David W. Crandall	945-6613

Manitoba
Energy and Mines

Manitoba
Energy and Mines

GEOLOGICAL SERVICES,
MINES BRANCH

REPORT OF FIELD ACTIVITIES 1985

1985

TABLE OF CONTENTS

* Contribution to programming under the Canada-Manitoba Mineral Development Agreement (MDA), a sub-agreement to the Economic and Regional Development Agreement (ERDA).

** Funding in part through the MDA.

GEOLOGICAL SERVICES

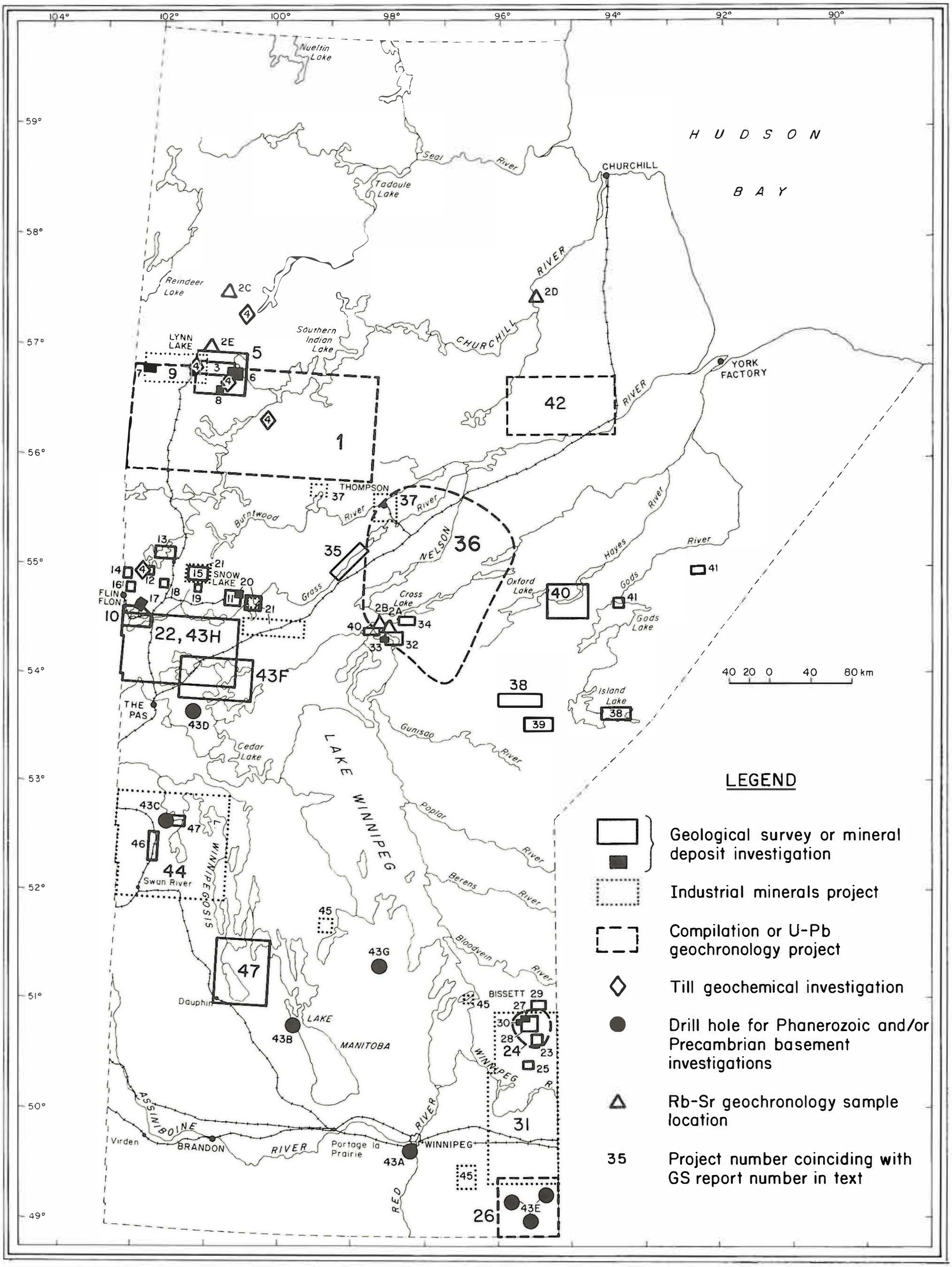


FIGURE CAPTIONS

Figure GS-1: *Location of Field Projects, 1985. (Numbers*

SUMMARY AND INTRODUCTORY REVIEW

During 1985 governmental geoscientific activities in Manitoba were again facilitated, coordinated and funded under the Canada-Manitoba Mineral Development Agreement (1984-89) a sub-agreement under the Economic and Regional Development Agreement (ERDA). Under the terms of the Agreement Canada and Manitoba will spend a total of $24.7 million dollars to implement geological, geophysical and geochemical surveys, research into mining technology development, marketing and other mineral economic studies in order to improve the level of 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 1985/86 Workplan for Sector 'A' Geoscientific Activities identified 60 Provincial and 20 Federal projects including contributions to be contracted through universities in Manitoba and elsewhere in Canada. Copies of the Workplan were forwarded to the newly constituted Mineral Exploration Liaison Committee in March, 1985 to solicit feedback that might be incorporated into this year's field program. At the outset of field activities a 5-day demonstration and field tour was given for the benefit of industry, Federal government and other Provincial geologists working along the Kisseynew metallotect north of Flin Flon. Subsequent tours of shorter duration were led by Provincial geologists in the Cross Lake area, in the Pikwitonei region and at Snow Lake.

A progress report covering all aspects of MDA geoscientific programming during fiscal 1984-85 was released in September, 1985 as yet another means of providing full visibility to these governmental surveys and investigations. In subsequent years it is intended that similar progress reports will be released in late Spring prior to the onset of the field season.

LYNN LAKE

As in previous years, heavy emphasis was 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. A substantial data base has been generated in the Lynn Lake region over the past 10 years and an intensive effort is now underway to analyze and process the data for publication. Open File reports on basal till investigations and biogeochemical surveys over the Agassiz metallotect were released in the fall of 1985 as was a detailed report on the geochemistry of the volcanic rocks in the Lynn Lake greenstone belt.

Geophysical data stemming from GSC-sponsored gradiometer surveys of the Ruttan district and Fox Mine area are currently being processed and will be released as 1:20 000 scale contour maps and 1:50 000 scale colour applicon plots in the Spring of 1986.

Work is continuing on the 1:250 000 scale synoptic geological compilations for the Granville and Uhlman Lakes sheets (NTS 64C and B) as well as a report on the Brochet and Big Sand Lake area (NTS 64F and G) immediately north of Lynn Lake. Reports and maps are also under development for the Barrington, MacMillan, Kamuchawie and Eden Lakes areas as well as a detailed investigation of metavolcanic rocks of the Ruttan district.

Uranium/lead isotope studies conducted by the Federal and Provincial surveys in this part of the Churchill Province have been extended through cooperative work with the University of Kansas (supported by the National Sciences Foundation). Work by the GSC and the Provincial Survey identified two distinct ages of volcanism. This is of significance to the ongoing tectonic and stratigraphic analysis of the area and will be a key element in unravelling the region's metallogeny.

New rubidium/strontium results from the Chipewyan batholith and Goldsand Lake region confirm observations that the paragneisses and associated intrusions of the Southern Indian Lake domain predate emplacement of the intrusive phases of the Chipewyan batholith.

Mineral deposit documentation was undertaken in the area between Lynn Lake and Barrington Lake. Detailed mapping and geochemical studies of the 'Lar' massive sulphide deposit and Cartwright Lake gold occurrence were completed.

Investigations along the Agassiz metallotect included geological mapping of known occurrences, lithogeochemical sampling of Agassiz-type rocks, and a regional basal till study. These studies confirm the presence of Agassiz-type rocks in the Nickel Lake area and re-affirm the 60 km strike length of rock units with a potential to contain gold deposits.

Metamorphosed alteration zones in the Laurie Lake area were mapped and sampled as potential sources of abrasive and refactory minerals.

Case studies of glacial dispersion haloes were undertaken near Ruttan, Dot Lake and Le Clair Lake.

FLIN FLON

A geological reconnaissance of the Athapapuskow Lake area confirmed the desirability for 1:20 000 scale geological mapping and geochemical work to upgrade the existing mapping to permit a stratigraphic analysis of the stratabound mineral occurrences. Initial findings suggest that major faults disrupt the Amisk Group successions, juxtapose blocks of widely differing metamorphic grade and in some cases appear to be the loci of gold mineralization. A zone characterized by low metamorphic grade (prehnite-pumpellyite) was traced from the Schist Creek/West Arm area to Hook Lake.

A reconnaissance of the Snow Lake region confirmed the need for 1:20 000 scale mapping of a burnt-over area between Chisel and Morgan Lakes. The area contains seven significant volcanogenic massive sulphide deposits and detailed maps are required to define the extent and degree of hydrothermal alteration zones as well as the stratigraphy of the volcanic rocks.

North of Flin Flon on the south flank of the Kisseynew belt, a new 1:20 000 mapping program has been initiated to resolve the stratigraphy of the paragneissic sequences and provide additional information on the nature and whereabouts of the Kisseynew metallotect.

Shallow dipping paragneissic sequences and amphibolites were traced westwards along Kisseynew Lake into equivalent formations documented in Saskatchewan. Amphibolites encountered at several levels in the sequence commonly contain sulphide mineralization. A domal gneissic complex south of Weasel Bay possesses a unique granulitic aspect that is typical of the Archean Pikwitonei region rather than the Hudsonian assemblages of the Churchill Province. Uranophane-bearing pegmatites were also encountered near the Saskatchewan border.

Detailed geological mapping was initiated in the Big Island area on Kississing Lake, and earlier work near Lobstick Narrows was also continued. Both projects are encountering a much greater diversity of rock types and structure than was previously anticipated, factors which will inevitably impact on the conduct of future surveys in this region.

South of Flin Flon an additional 16 holes were drilled through the limestone as part of the Province's contribution to sub-Paleozoic investigations in the Project Cormorant area. The GSC has initiated a compilation of all information from the southern half of NTS area 63K including complete re-logging of all available exploration drill core, and provincial "scout" drill core, and correlation with gradiometer, total field and VLF data, etc.

Documentation of mineral occurrences in the Flin Flon region proceeded in the Snow Lake and North Star Lake areas. In-depth studies of alteration zone geochemistry were initiated in the Snow Lake area to establish parameters for base metal exploration. At Flin Flon selected mineral occurrences such as the Vamp deposit, the Tartan Lake gold deposit, the Centennial Mine and the Baker-Patton copper-zinc deposit, were mapped thematically to resolve metallogenic problems identified during work in 1984.

Detailed 1:5000 mapping and investigations of gold occurrences in the Kisseynew metallotect re-affirmed the stratigraphic nature and regional extent of gold-bearing strata within parts of the Kisseynew terrain.

Known occurrences of garnet, staurolite, kyanite and sillimanite in the Star and Snow Lake areas were mapped in detail, and sampled as potential sources of abrasives and refractory materials.

SOUTHEAST MANITOBA

In the Rice Lake greenstone belt 1:10 000 scale mapping in the Stormy Lake area added a new unique stratigraphic marker at the boundary between felsic volcanic rocks, and metasediments containing gold and stibnite mineralization. Favourable hosts for gold mineralization are carbonated and silicified shear zones in gabbroic rocks. A U/Pb zircon geochronological program conducted through the University of Windsor, Ontario, has yielded results suggesting the felsic volcanic and intrusive rocks are comagmatic and relatively young for northwest Superior Province greenstone belts.

In the Cat Creek area, much improved access along timber-cutting roads facilitated detailed geological mapping and the discovery of several layered magnetite- and olivine-bearing pyroxenite sills within the volcanic sequences.

Several 'scout' drill holes in the Whitemouth area permitted sampling of magnetic anomalies in the Precambrian basement beneath thick Quaternary cover.

Mineral investigations in southeast Manitoba resulted in detailed mapping of iron formations in the Wallace Lake area to assess their potential as hosts to gold mineralization. Mineral occurrences in the area east of the San Antonio Mine were documented and sampled to establish the geological setting of gold and base metal mineralization.

A dimension stone survey initiated in the region south of the Winnipeg River provided background data for the preparation of a promotional brochure on building stone potential in this part of the Province.

THOMPSON

In the Cross and Pipestone Lakes area mapping confirmed the presence of subaerial-fluvial metasediments overlying an older volcanic sequence. Geophysical surveys, detailed mapping and sampling of an elongate gabbro-anorthosite complex traced magnetite-bearing layers to the east channel of the Nelson River, thereby extending the vanadium and titanium potential significantly. Analyses to date indicate high niobium contents associated with the higher vanadium values.

Uranium/lead isotope investigations in the northwest Superior Province yielded a precise age for the end of the Hudsonian overprint in the Thompson belt, and confirmed an early Proterozoic age for granitoid plutons in this belt and their derivation from Archean precursors. Preliminary ages from the Pikwitonei domain confirm the relatively young age of the granulite metamorphism.

Mapping at Phillips Lake confirmed that leucogneiss is retrogressed from felsic granulites and that granulitic domains survived the otherwise intense Proterozoic deformational and metamorphic overprint.

To the northeast and north of the Nelson River a regional compilation project completed documentation of bedrock occurrences in the sparsely exposed northern half of NTS area 54D. Proterozoic sequences equivalent to those occurring on Assean Lake and near Rock Lake were documented north of a prominent cataclastic zone marking the boundary between the Churchill and Superior Provinces.

Industrial mineral investigations in the Thompson area delineated sources for carving, building and ornamental stones.

GODS-ISLAND LAKES

Regional greenstone mapping in the Island Lake area was completed with mapping at Stevenson, Knight and Wass Lakes. Stratigraphically, Knight Lake is a continuation of the Bigstone Lake succession. Felsic volcanic rocks mapped near the major northwest-trending fault zone are now viewed as silicified mafic flows. Assay data from Bigstone Lake yield significant zinc and precious metal values.

North of Loonfoot Island (Island Lake) a large slightly differentiated gabbro intrudes the youngest Hayes River Group. South of Savage Island abundant iron formation was mapped. Along the southern contact of the greenstone belt hornblendite and serpentinite related to olivine gabbro norite may be metallogenically significant.

Rare element pegmatite studies were completed on Cross Lake. On Magill Lake a lithium-enriched halo associated with granite is dispersed to the west and northwest. Two dykes with spodumene and one beryl-bearing dyke were discovered.

MANITOBA GENERAL

A regional industrial mineral resource program was initiated this year in the Swan River area (NTS 63C). Other industrial mineral activities in the southern part of the Province continued evaluation of commodities such as silica sand, bentonite, kaolin, glauconite, gypsum and cement rock.

A basal till sampling profile was conducted along the Pelican Rapids Road as part of the ongoing search for lead-zinc mineralization in the Paleozoic. The study was augmented by geochemical analysis of five Paleozoic drill cores in the west-central part of the Province.

Stratigraphic drilling in the Project Cormorant area confirmed the uniformity of the Precambrian erosion surface and overlying Phanerozoic strata. Structural trends on the Precambrian surface change gradually from 090° (in the east) to 070° (in the west). This northeast-trending synclinal flexture is coincident with the Churchill-Superior boundary.

Stratigraphic mapping and geochemical lake sediment sampling of the Moose Lake-Cormorant Lake area were completed.

Drilling in southeast Manitoba confirmed the eastward extension of large Mesozoic channel deposits within the Precambrian. Drilling at Dawson Bay confirmed the superficial local structural relief resulting from draping over the buried Winnipegosis reefs. Comparison of drill data with seismic profiles permits an evaluation of the complex velocity anomalies affecting seismic interpretation of the reef complexes.

EXPLORATION SERVICES

The Exploration Services Section of the Mines Branch has continued to spearhead core retrieval activities and the upgrading of core storage facilities in the Province. Plans for construction of a new core shed at Thompson have been suspended in favour of consolidating and upgrading facilities in Winnipeg. During 1985 a total of 13 418 m of core were retrieved in the Flin Flon (6108) and Lynn Lake (7310) districts; existing holdings at The Pas and Winnipeg were classified and organized into readily retrievable configurations; total holdings at The Pas and Winnipeg were reduced by 11 851 m as part of the ongoing consolidation and screening program.

The accelerated level of operations funded through the MDA permitted reactivation of the Province's Mineral Inventory Project (dormant since 1979) as well as the development of a comprehensive bibliography on literature pertaining to Manitoba's geology and mineral resources.

REMOTE SENSING

The Province's continuing evaluation of remote sensing, as a tool for mounting a Province-wide inventory of peat resources, this year completed pilot studies in southeast Manitoba. The joint peat study (Departments of Energy and Mines and of Natural Resources, and the Botany Department, University of Manitoba) continued classification of peatlands in the Lac du Bonnet-Sprague area. Peatland classification maps, data on bog thickness and a preliminary assessment of bog potential will be released as a report in the Spring of 1986.

Stressed vegetation studies, resulting from metal concentrations in bedrock, have been initiated in cooperation with the Ontario Centre for Remote Sensing and the Department of Earth Sciences, University of Manitoba. Test sites at Flin Flon and Lynn Lake are scheduled for coverage in September, 1985 with data and image analysis proceeding thereafter.

GEOLOGICAL SURVEY OF CANADA

Programs delivered by the Geological Survey of Canada included U/Pb isotope investigations, and detailed studies of alteration zones and assemblages in the Flin Flon and Lynn Lake area (Linda-Nicoba deposits). Structural studies were initiated at the Pipe Pit and in southeast Manitoba, both in an attempt to define parameters controlling mineralization in these areas. Detailed property-scale mapping of chromitite seams and ultramafic phases was initiated in the Bird River Complex. Applied Geoscience Research projects conducted by the GSC and Department of Earth Sciences, University of Manitoba, continued work on the mafic and ultramafic intrusions of the Flin Flon belt as well as detailed mapping and petrological studies of the Falcon Lake Stock.

Metamorphic studies southwest of the Fox Mine on Laurie Lake are being conducted in cooperation with Queen's University.

Precious metal oriented investigations were continued in the Flin Flon belt as part of a broader metallogenic evaluation of mineralization in this region.

Gradiometer surveys, contracted to Kenting, were conducted in the Namew and Nokomis Lake regions and over the northern one-third of the Moose Lake area.

Regional lake sediment surveys covered most of the well exposed Kisseynew terrain in NTS areas 63N and 63-O/W 1/2 as well as in Flin Flon greenstone belt in NTS area 63K/N 1/2 and 63J/NW 1/4.

Sampling and mapping of surficial deposits was completed for the northern half of the Uhlman Lake (64B) and Big Sand Lake areas. Airphoto interpretation of surficial deposits was extended into NTS areas 53E, L and K with output intended at a scale of 1:250 000.

W.D. McRitchie
October 2, 1985.

GS-1 LYNN LAKE REGIONAL COMPILATION AND GEOCHRONOLOGY

by H.V. Zwanzig, J.S.D. Parker, D.C.P. Schledewitz and W.R. Van Schmus[1]

Compilation work on NTS sheets 64B (Uhlman Lake) and 64C (Granville Lake) of the 1:250000 scale Precambrian map series was completed this summer and an additional 19 samples were collected for U-Pb zircon dating of felsic igneous rocks within those areas. Preliminary U-Pb zircon ages from the 1984 sampling program are presented for the Big Sand Lake area.

COMPILATION

The compilation maps provide a simple lithologic subdivision similar to the preliminary compilation maps (1984 C-1 and 1984 C-2) but also separate each area into geological domains similar to the lithostructural domains of McRitchie (1977) and Sibbald et al. (1976). The domains are defined by the distribution of principal lithologies and isotopic ages of supracrustal rocks or by the distribution of regionally extensive intrusive suites and their ages. Some domain boundaries are considered preliminary and may be adjusted during the course of the U-Pb zircon dating programs outlined below. The following domains are included in 64B and 64C (Fig. GS-1-1):

1) the southern margin of the Southern Indian domain
2) the Lynn Lake domain
3) the western part of the Leaf Rapids domain and
4) the northern margin of the Kisseynew domain.

The **Southern Indian domain**[2] is the gneissic belt bounded in the north by the Chipewyan granite and in the south by the Lynn Lake domain.

The **Lynn Lake domain** is the greenstone-granite belt defined by the distribution of Wasekwan Group metavolcanic and sedimentary rocks yielding a U-Pb zircon age of 1910 +15/-10 Ma and by the distribution of 1876 +6/-4 Ma tonalite (Baldwin et al., 1985).

The **Leaf Rapids domain** includes the Rusty Lake greenstone belt with rhyolite yielding a U-Pb age of 1878 ± 2 Ma (Baldwin et al., 1985) and large areas of relatively young intrusive rocks (Lenton and Corkery, 1981) which have been sampled for dating.

The **Kisseynew domain** is the sedimentary gneiss belt south of the Lynn Lake and Leaf Rapids domains. Short descriptions of the domains will be included in the marginal notes on the compilation maps.

U-Pb ZIRCON DATING PROGRAMS

Nineteen new samples were collected for U-Pb zircon dating in joint programs with T.M. Gordon and others of the Geological Survey of Canada under the Canada/Manitoba Mineral Development Agreement for the Lynn Lake and Kisseynew domains, and with W.R. Van Schmus of the University of Kansas and supported by the U.S. National Science Foundation for the granitoid rocks of the Leaf Rapids and Southern Indian domains (Table GS-1-1, Fig. GS-1-2)

Four of eight samples collected during the 1984 field season, (Schledewitz, 1984), in the area of Big Sand Lake (Fig. GS-1-2), have been analyzed at the University of Kansas and have yielded concordia intercept ages (Table GS-1-2). Analysis of the remaining four samples is in progress. The resultant ages are consistent with a time of crystallization of the igneous rocks at approximately 1860 Ma. These plutonic rocks appear to be coeval with a suite of plutonic rocks within the La Ronge domain in Saskatchewan (Van Schmus and Bickford, 1984).

[1] Department of Geology, University of Kansas
Lawrence, Kansas 66045

[2] Reindeer Lake-Southern Indian lake metasedimentary gneiss belt of McRitchie (1977).

TABLE GS-1-1
U-Pb ZIRCON SAMPING, 1985

LEAF RAPIDS DOMAIN-SOUTHERN INDIAN DOMAIN

1.	Livingston granodiorite, main phase	— Roe Lake
2.	Livingston granodiorite, main phase	— Barnes Lake
3.	Ridge tonalite, main phase	— Ridge Lake
4.	Ridge tonalite, main phase	— NW of Ridge Lake
5.	Baldock batholith, main megacrystic phase	— Gauer River
6.	Baldock batholith, seriate phase	— N of Baldock Lake
7.	Outlaw Bay intrusive complex, granodiorite	— Eden Lake
8.	Outlaw Bay intrusive complex, tonalite	— Eden Lake
9.	Eden intrusive complex, monzonite	— Eden Lake
10.	Eden intrusive complex, granite	— PR 391
11.	Eden intrusive complex, megacrystic granite	— PR 391

LEAF RAPIDS DOMAIN-LYNN LAKE DOMAIN BOUNDARY

12.	Quartz-feldspar porphyry (rhyolite)	— Beaucage Lake
13.	Quartz-feldspar porphyry (rhyolite)	— Beaucage Lake
14.	Black Trout Diorite, quartz diorite	— Beaucage Lake
15.	Post-Sickle Group granite	— Beaucage Lake

LYNN LAKE DOMAIN

16.	Snake Lake dacite (Wasekwan Group)	— S of Fox Mine
17.	Snake Lake tonalite	— S of Fox Mine

KISSEYNEW DOMAIN

18.	Felsic gneiss (tuff)	— Laurie Lake
19.	Post-Sickle Group tonalite	— Laurie Lake

TABLE GS-1-2
SUMMARY OF CONCORDIA INTERCEPT AGES, BIG SAND LAKE AREA (CHIPEWYAN DOMAIN)

Location (Fig. GS-1-2)	Sample No.	Rock Type	Age (Ma) ± 2 σ	Lower Intercept
A	HUD84-1	xenolith of diorite rock in dark "monzogranite" and porphyritic granite	1860 ± 17	1030
B	HUD84-4	porphyritic granite	1864 ± 15	670
C	HUD84-5	dark "monzogranite" (incomplete, consistent with 1860 Ma.)		
D	HUD84-7	porphyritic granite with rapakivi phases	1854 ± 12	450

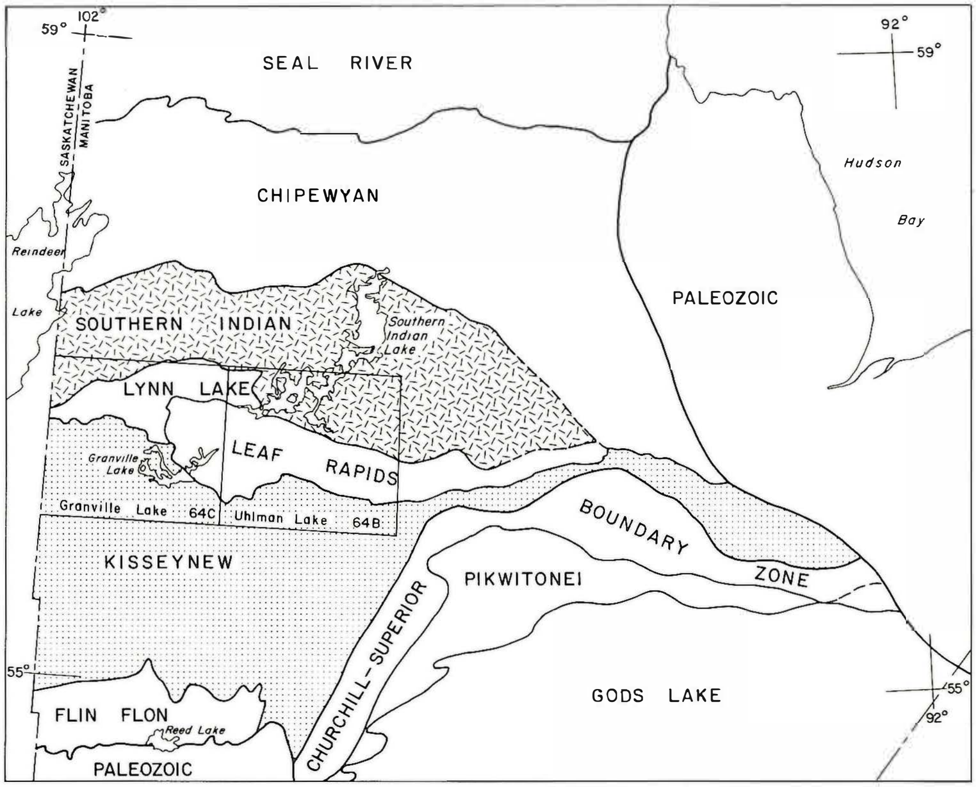


Figure GS-1-1: *Geological domains, Churchill Structural Province, and adjacent Superior Province, also showing location of compilation maps (64B and 64C).*

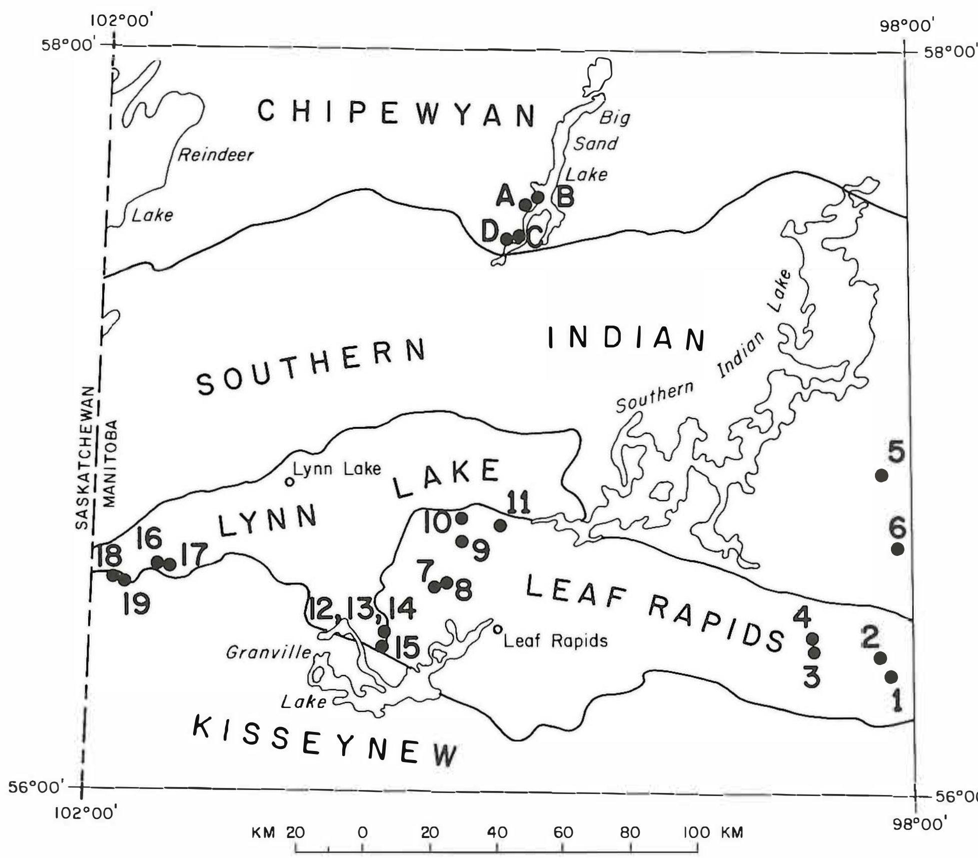


Figure GS-1-2: *Location map of U-Pb zircon dates (A-D) and new sample localities (1-19), also showing geological domains.*

REFERENCES

Baldwin, D.A., Syme, E.C., Zwanzig, H.V., Gordon, T.M., Hunt, P.A. and Stevens, R.D.
1985: U/Pb Zircon ages from the Lynn Lake and Rusty Lake metavolcanic belts, Manitoba: two ages of Proterozoic magmatism (Abstract); Geological Association of Canada, Annual Meeting, Program with Abstracts, v. 9.

Lenton, P.G. and Corkery, M.T.
1981: Lower Churchill River Project (Interim Report); Manitoba Department of Energy and Mines, Open File Report OF81-3.

McRitchie, W.D.
1977: Reindeer lake-Southern Indian Lake (regional correlation program); in Manitoba Mineral Resources Division, Report of Field Activities, 1977, p. 13-18.

Schledewitz, D.C.P.
1984: Geochronology of the Brochet-Big Sand Lake Project (U-Pb, zircon); **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 9.

Sibbald, T.I.I., Munday, R.J.C. and Lewry, J.F.
1976: The geological setting of uranium mineralization in northern Saskatchewan; **in** Uranium in Saskatchewan, Saskatchewan Geological Society, Special Publication 3, p. 51-98.

Van Schmus, W.R. and Bickford, M.E.
1984: Preliminary U-Pb age data for the Trans-Hudson Orogen in northern Saskatchewan; **in** Summary of investigations 1984, Saskatchewan Geological Survey, p. 81-85.

GS-2 RUBIDIUM-STRONTIUM GEOCHRONOLOGY IN THE SUPERIOR AND CHURCHILL PROVINCES, NORTHERN MANITOBA

by G. S. Clark[1]

This is a progress report on Rb-Sr isotope studies of two selected rock units from the Cross Lake area in the Superior Province, two units from the Chipewyan batholith, and one from the Goldsand Lake area (Southern Indian domain) in the Churchill Province. Preliminary results are reported for the following units:

(a) Cross Lake metasedimentary rocks
(b) North Plug granite, Cross Lake
(c) Coarse grained biotite granite, Big Sand Lake
(d) Seriate granite, Chipewyan batholith
(e) Megacrystic biotite granodiorite, Goldsand Lake

A six-point "isochron" has been completed for four of these units, a, b, d, and e, while four samples have been completed for c. Laboratory work is continuing on all of these units. Ages are based on the ^{87}Rb decay constant of 1.42×10^{-11} yr^{-1}. Analytical and data treatment methods are the same as those reported by Clark (1984).

SUPERIOR PROVINCE

CROSS LAKE METASEDIMENTARY ROCKS

This represents the first attempt to obtain a Rb-Sr isochron age for metasedimentary rocks in the Gods Lake (Sachigo) subprovince. Five of the analyzed samples are meta-argillites from the highest unit in the Late Metasedimentary sequence, and one sample is a finely laminated lithic siltstone tectonically interlayered with Early Supracrustal rocks (Corkery, 1983). The six samples give a preliminary age of 2535 Ma (MSWD = 8.8). The initial $^{87}Sr/^{86}Sr$ ratio (i) of 0.7015 is consistent with a provenance of tonalites and/or mafic-intermediate volcanics (low Rb/Sr). Most samples have Rb/Sr ratios of less than 0.5. This age could represent the time of the last major Archean metamorphism in the area, coincident with the emplacement of late granites and pegmatitic granites, or it could be a minimum age for lithification of the late sedimentary sequence. The Rb-Sr system could have been disturbed by later (post-Archean) thermal events responsible for resetting many K-Ar mica ages to 1700-1800 Ma in the Gods Lake subprovince (Ermanovics and Wanless, 1983).

NORTH PLUG GRANITE

The rock is a two-mica granite with a well defined schistosity (Anderson, 1984). The work completed to date is not sufficient to define an isochron age. The six analyzed samples have a narrow range in Rb/Sr ratios (0.18 to 0.32), resulting in a considerable extrapolation of the regressed line to the $^{87}Sr/^{86}Sr$ ordinate. The points are also somewhat scattered, possibly due to late shearing. The best estimate of the age with the present data is probably obtained by forcing the regressed line through an i of 0.701, which yields an age of 2520 Ma. This could be a metamorphic age, and a minimum age of intrusion of the late leucogranites and pegmatitic granites common to this area (Clark and Meintzer, in progress).

The North Plug granite has been considered as part of the late intrusive phases which include the late leucogranites and pegmatitic granites. However, the low Rb/Sr ratios for this unit, combined with high Sr concentrations (600-800 ppm), seem to preclude a genetic relationship between the North Plug granite and the more highly evolved leucogranites.

[1]Department of Earth Sciences, University of Manitoba.

CHURCHILL PROVINCE

BIOTITE GRANITE, CHIPEWYAN BATHOLITH

The rock is a coarse grained biotite granite, one of several phases of the Chipewyan batholith. The area sampled lies about 30 km east of Reindeer Lake and 10 km north of the southern contact with paragneiss of the Southern Indian domain (Schledewitz, 1983). This unit, and the seriate granite discussed below, are considered late intrusive phases within the batholith. Clark (1981) reported an 1800 Ma Rb-Sr age for the Chipewyan batholith based on samples collected on a regional scale, and an 1815 Ma age from a hypersthene-bearing phase, the Katimiwi monzocharnockite from the Big Sand Lake area. Unlike these other two phases, the biotite granite has a very narrow range in Rb/Sr ratios (about 0.2-0.4). This results in a long extrapolation on the isochron plot. The data points also show geological scatter. Assuming an i of 0.7025, preliminary data give a comparable age to the other two phases.

SERIATE GRANITE, CHIPEWYAN BATHOLITH

This unit occurs along the lower Churchill River in the southeastern part of the Chipewyan batholith. Six points give an excellent isochron (MSWD = 0.6) and an age of 1815 Ma. Hence, all Rb-Sr whole rock ages obtained to date fall in the range 1800 to 1815 Ma, making it impossible to resolve any differences in age that might exist for intrusive phases within the batholith.

MEGACRYSTIC BIOTITE GRANODIORITE, SOUTHERN INDIAN DOMAIN

This coarse grained biotite-rich granodiorite occurs in the vicinity of Goldsand Lake about 30 km north of Lynn Lake and forms a pluton intruded into paragneisses. Clark (1984) reported a Rb-Sr age of 1878 Ma for more highly deformed tonalitic rocks of an apparently older plutonic phase. Preliminary data, based on a six-point regression, give an excellent isochron and an age of 1880 Ma for the granodiorite, which suggests that it is similar in age to the tonalitic rocks.

Based on Rb-Sr systematics, it seems that the paragneisses and intruded plutons in the southern Indian domain predate the emplacement of intrusive phases of the Chipewyan batholith studied to date in Manitoba.

REFERENCES

Anderson, A.J.
1984: Geochemistry, mineralogy and petrology of the Cross Lake pegmatite field, Manitoba; M. Sc. thesis, University of Manitoba.

Clark, G.S.
1981: Rubidium-strontium geochronology in the Churchill structual province, northern Manitoba; Manitoba Mineral Resources Division, Report of Field Activities, 1981, p. 97-98.

1984: Rubidium-strontium age investigations in the Churchill and Superior structural provinces, northern Manitoba; Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 10-11.

Corkery, M.T.
1983: Cross Lake supracrustal investigations; Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 32-45.

Ermanovics, I.F. and Wanless, R.K.
1983: Isotopic age studies and tectonic interpretation of Superior province in Manitoba; Geological Survey of Canada, Paper 82-12, 22 p.

Schledewitz, D.C.P.
1983: Brochet/Big Sand project; Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 5-10.

GS-3 TILL SAMPLING ALONG THE AGASSIZ METALLOTECT

by E. Nielsen, M.A.F. Fedikow and G.G. Conley

Till geochemical studies were initially undertaken around the Agassiz Au-Ag deposit northeast of Lynn Lake to test the feasibility of using till as a medium for low cost geochemical prospecting in areas of little or no outcrop (Nielsen, 1982). In subsequent years the area of detailed till sampling was increased to include Minton Lake (Nielsen, 1983) and Farley Lake (Nielsen and Graham, 1984, 1985).

This year, detailed till sampling was undertaken between Minton and Farley Lakes, and at Nickel Lake, located southwest of Barrington Lake (Fig. GS-3-1) for the purpose of testing the model of glacial dispersion established at Agassiz and Farley Lake, and to define possible exploration targets along the Agassiz Metallotect. Sampling between Minton and Farley Lakes was done with helicopter support and fly-in camps were established at Eagle Lake and Nickel Lake.

The Agassiz Metallotect is a sequence of characteristic rock units that host the Agassiz mineralization. Geophysical investigations indicate a more or less continuous linear zone of coincident magnetic and electromagnetic anomalies that impart a characteristic gradiometric signature to the Agassiz Metallotect (Fedikow, 1984). Till sampling was centered on both Unit 7 of Milligan (1960), a tuff, agglomerate, volcanic breccia group of the Wasekwan Series, and Unit 9j of Gilbert et al. (1980), an iron formation consisting of well bedded magnetiferous chert, siltstone and greywacke. The strike of these units is approximately east-west, perpendicular to the regional ice flow direction. Conventional exploration of this metallotect has been restricted by the lack of outcrop (Fedikow, 1984).

SURFICIAL GEOLOGY

Elevations range from a height of 350 m a.s.l. north of Arbour Lake to 335 m at Key Lake. Nickel Lake is at an elevation of 290 m. The regional slope is to the east. There is little bedrock exposed except in the area north of Arbour Lake and northwest of Key Lake.

The bedrock is mantled by a till sheet of variable thickness, ranging from zero over the bedrock highs to more than several metres in the lee of bedrock outcrops. The till sheet is overlain by brownish-grey glaciolacustrine silt and clay that is thickest under the bogs which cover the low lying areas. In many of the topographically high areas the till sheet is capped by littoral sand or gravelly sand deposits. Black spruce bog and fen cover most of the area. The bogs are shallow and are found overlying Lake Agassiz clay deposits between the high areas.

TILL SAMPLING

A sample spacing of approximately 100 m was used. Holes ranged in depth from 90 to 120 cm and samples weighed between 8 and 10 kg. Multiple samples at vertical intervals of 10 cm were taken from every tenth hole. A total of 560 holes were hand dug in the 115 km^2 area (Fig. GS-3-2 and GS-3-3). The average depth of oxidation is approximately 40 cm. In 332 holes, variable thicknesses of littoral sand were penetrated before the till could be sampled. Lake Agassiz clay was encountered in 35 holes. Bedrock or very large boulders were encountered in 120 holes and another 20 holes ended in permafrost.

In 43 holes the till was observed to be normally graded. Normal grading of till was considered to be indicative of subaqueous debris flow deposition (Nielsen, 1983).

At Nickel Lake an additional 50 holes were dug (Fig. GS-3-4). Littoral sediments were penetrated in 11 holes and Lake Agassiz clay was encountered in 10 holes. Normal grading of the till was observed in only 2 holes. The till sheet is thinner at this location as bedrock (or very large boulders) was encountered in 34 holes.

The till sheet appears to be homogeneous throughout the area and has a sandy-silty texture.

GEOCHEMISTRY

The less than 2 micron sized-fraction will be analyzed for Cu, Pb, Zn, Ni, Co, Cr, Fe, Mn and As. Additional selected samples will undergo heavy mineral separation and gold analysis.

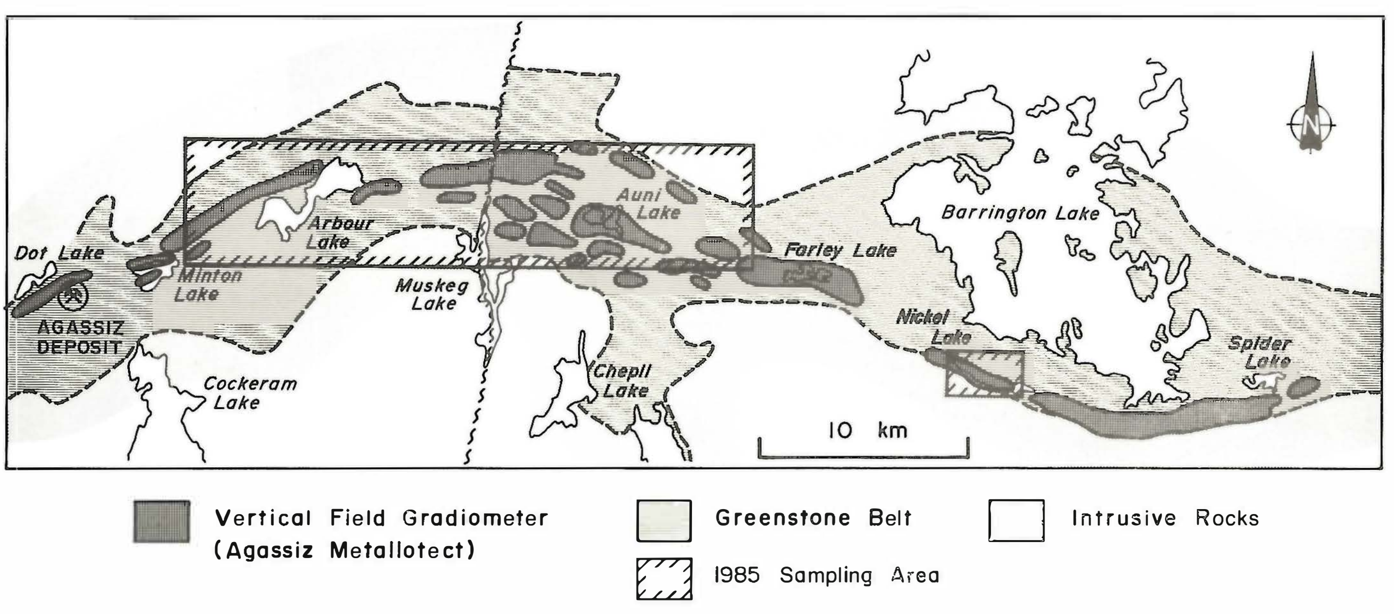


Figure GS-3-1: Location of the till sampling areas along the Agassiz Metallotect.

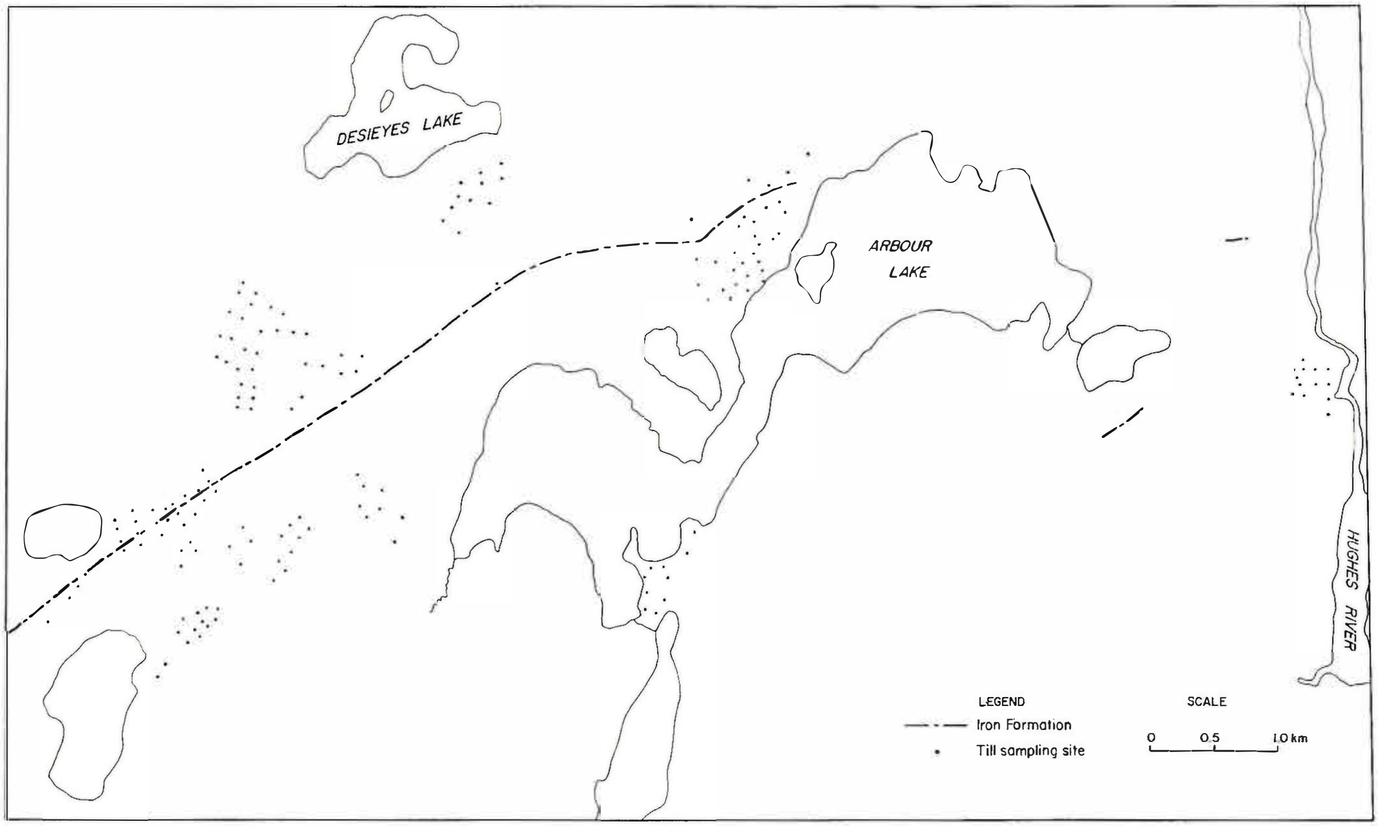


Figure GS-3-2: *Location of till sampling sites in the Arbour Lake area.*

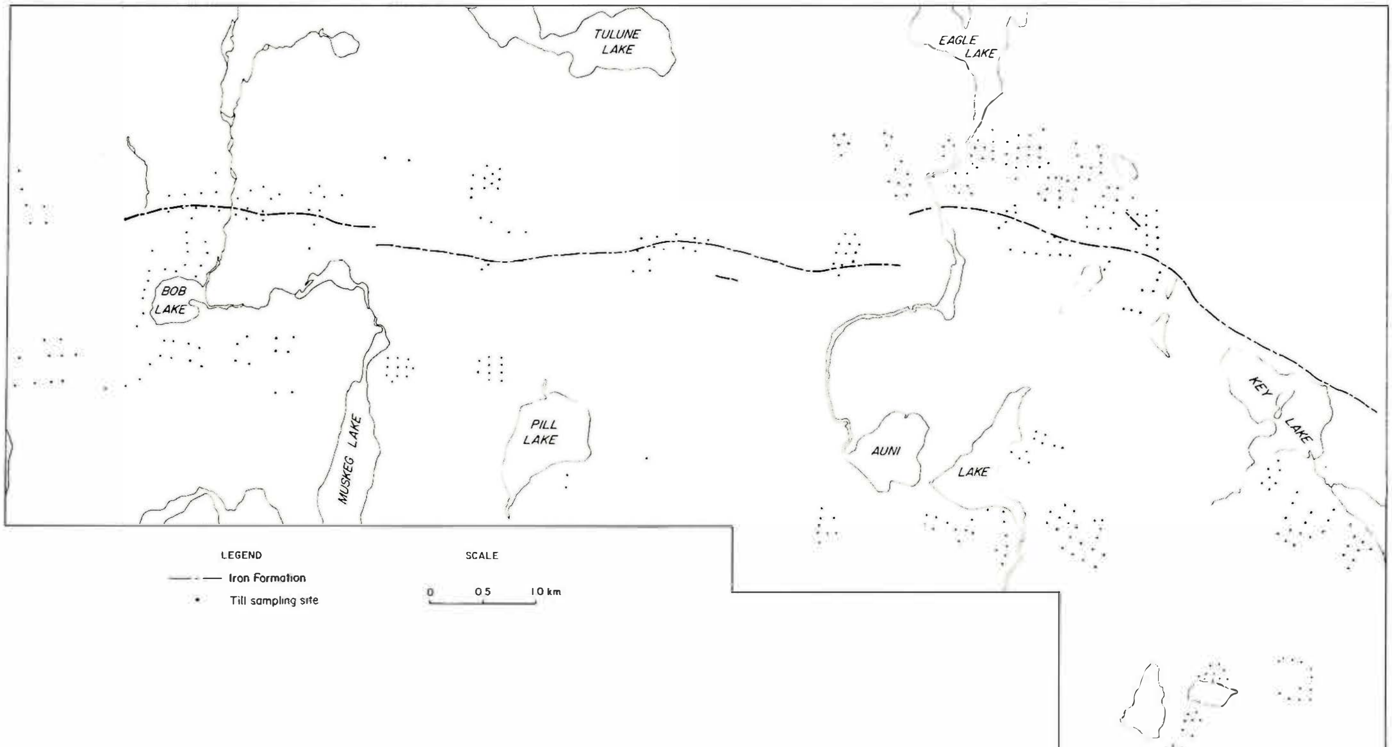


Figure GS-3-3: *Location of till sampling sites in the Auni Lake area.*

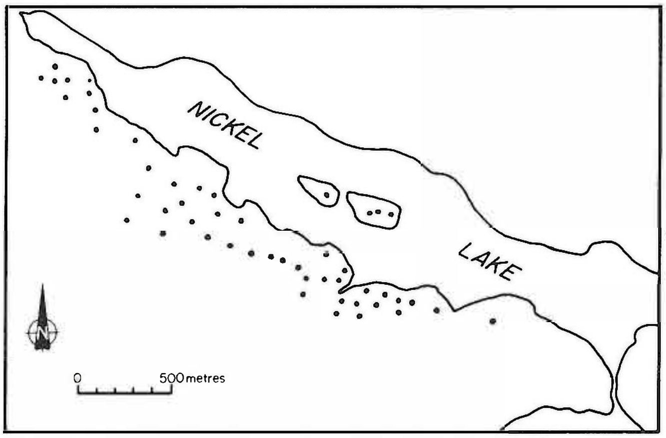


Figure GS-3-4: *Location of till sampling sites in the Nickel Lake area.*

REFERENCES

Fedikow, M.A.F.
1984: Preliminary results of biogeochemical studies in the Lynn Lake area; Manitoba Mineral Resources Division, Open File Report OF84-1; 104 p.

Gilbert, H.P., Syme, E.C. and Zwanzig, H.V.
1980: Geology of the metavolcanic and volcaniclastic metasedimentary Rocks in the Lynn Lake area; Manitoba Mineral Resources Division, Geological Paper GP80-1, 118 p.

Milligan, G.C.
1960: Geology of the Lynn Lake district; Manitoba Mines Branch, Publication 57-1, 317 p.

Nielsen, E.
1982: Overburden sampling in the Lynn Lake area; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1982, p. 81-83.
1983: Overburden sampling in the Lynn Lake area; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 98-100.

Nielsen, E., and Graham, D.C.
1984: Till geochemical investigations in the Lynn Lake and Flon Flon Areas; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 32-36.
1985: Preliminary results of till petrographical and till geochemical studies at Farley Lake; Manitoba Mineral Resources Division, Open File Report OF85-3, 62 p.

GS-4 TILL GEOCHEMICAL INVESTIGATIONS IN NORTHWESTERN MANITOBA

by Erik Nielsen

Mapping of glacial dispersion fans initiated in 1982 (Nielsen, 1982, 1983, and Nielsen and Graham, 1984, 1985) was continued this year in the Lynn Lake, Leaf Rapids and Flin Flon areas (Fig. GS-4-1).

LYNN LAKE

DOT LAKE

Initial sampling in this area in 1984 indicated a well developed dispersion fan west of the Agassiz deposit between Dot Lake and Keewatin River. The fan was defined by anomalous values of gold in the heavy mineral fraction and arsenic in the clay-sized fraction. In addition to the dispersion fan anomalous values of gold of 8340, 50 and 180 ppb in the heavy mineral fraction were found in samples 84-48, 84-49 and 84-51, respectively, collected approximately 1.5 km south of the Dot Lake mineralization. Sample 84-48 contained 10 grains of visible gold in the heavy mineral fraction. Additional detailed sampling at approximately 100 m intervals was completed in the Dot Lake area to determine the extent of the geochemical anomalies outlined in this area in 1984 (Fig. GS-4-2).

One hundred and thirty holes were hand dug resulting in 130 bulk till samples. The till and the ice flow direction across this area have been described previously (Nielsen and Graham, 1984).

GOLD LAKE

Basal till sampling in this area was undertaken:

(1) because of the known high mineral potential of the Johnson Shear and the relatively little outcrop exposed in this area
(2) as an orientation survey with relatively easy access and good till exposure for the till sampling crew and
(3) to study the glacial dispersal of erratics in an area of highly varied though easily distinguishable bedrock lithologies (Milligan, 1960, Gilbert et al., 1980).

Fifty till samples were collected on and adjacent to the Johnson Shear Zone (Fig. GS-4-3). The ice flow across this area was toward 170°. The light grey sandy till is thickest and more widespread on the lee side of bedrock hills. Sandy littoral sediments deposited in glacial Lake Agassiz are common; till samples are difficult to get from hand dug holes except in the borrow pits along the highway which offer good exposure.

LE CLAIR LAKE

The bedrock in this area consists of biotite-feldspar-quartz gneiss, gneissic quartz monzonite and tonalite (Schledewitz, 1983). The biotite-feldspar-quartz gneiss is cut by a shear zone with associated disseminated pyrite mineralization (Schledewitz, 1983). Schledewitz (pers. comm.) found trace amounts of gold and silver associated with the mineralization along the fault; this study was initiated to determine the nature and extent of glacial dispersion along a small portion of the shear zone.

Glacial striae trending 150° were observed at only one site. The orientation of the striae is parallel to the main esker in the area and southeasterly ice flow is considered to have deposited the till. The till sheet is extensive and generally thin in the area adjacent to the shear zone.

Thirty six till samples were collected down-ice from the shear zone on the north side of Le Clair Lake (Fig. GS-4-4). Bedrock was reached in 10 holes whereas the other 26 holes terminated in till.

LEAF RAPIDS

RUTTAN

Previous till studies in the Lynn Lake and Flin Flon areas (Nielsen, 1982, 1983, Nielsen and Graham, 1984, 1985) have all been in areas which were under the influence of the Keewatin ice domain during the last glaciation. The area to the east of the Leaf Rapids interlobate moraine (Nielsen and Graham, 1985) was affected by ice flow from the Hudsonian sector of the ice sheet.

The till sampling program 2 km northeast of the Ruttan Mine (Fig. GS-4-5) is the first till geochemical investigation in the area affected by ice from the Hudsonian sector of the Laurentide Ice Sheet. The bedrock

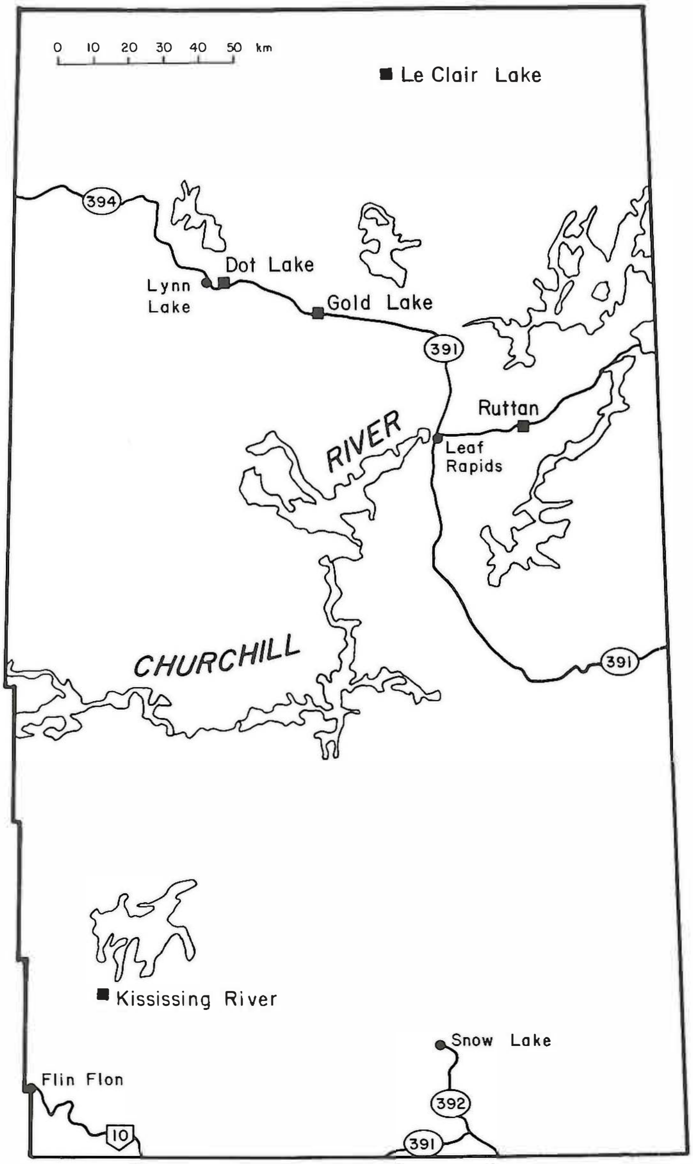


Figure GS-4-1: Location of till sampling areas.

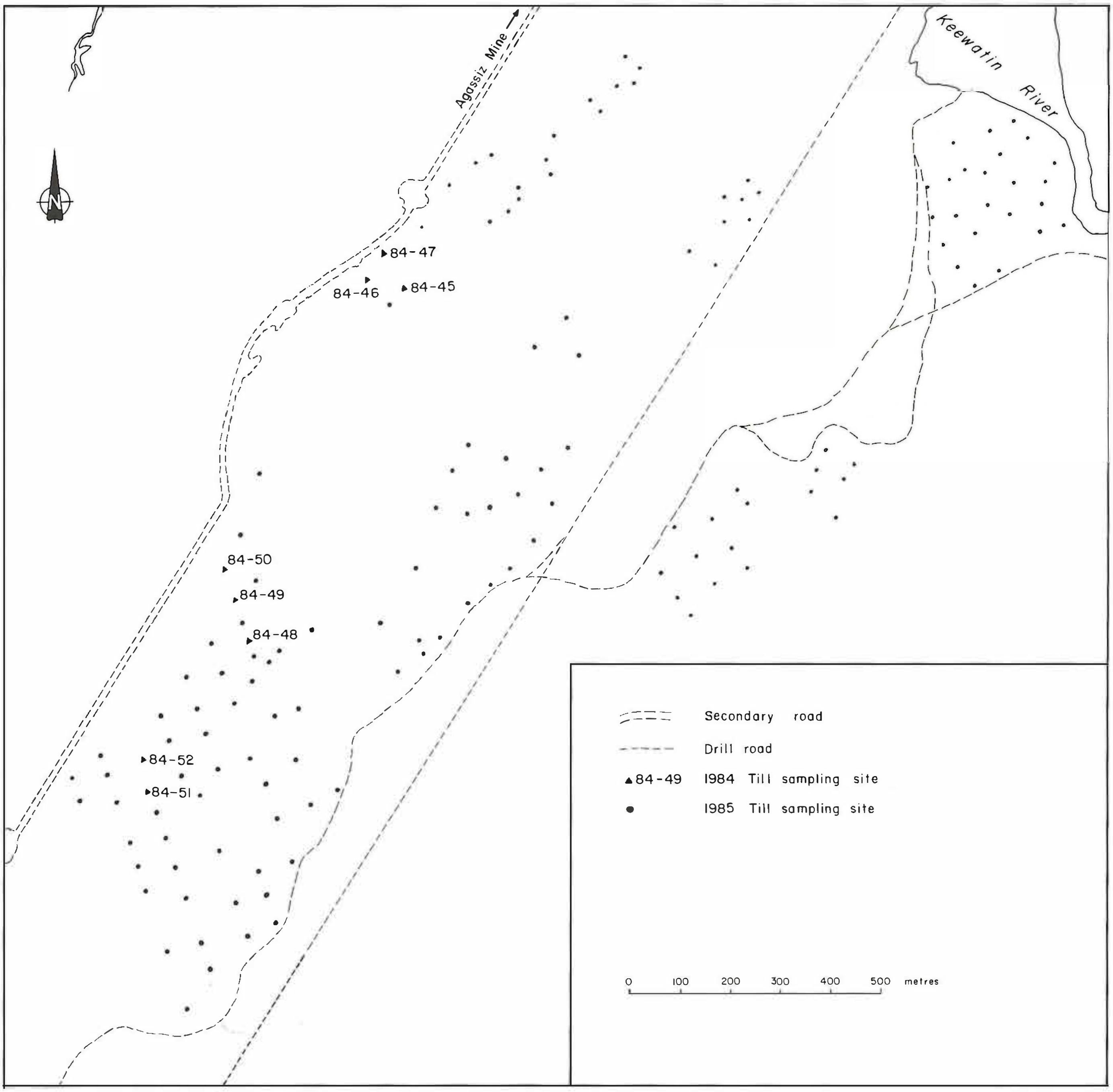


Figure GS-4-2: Location of till sampling sites in the Dot Lake Area.

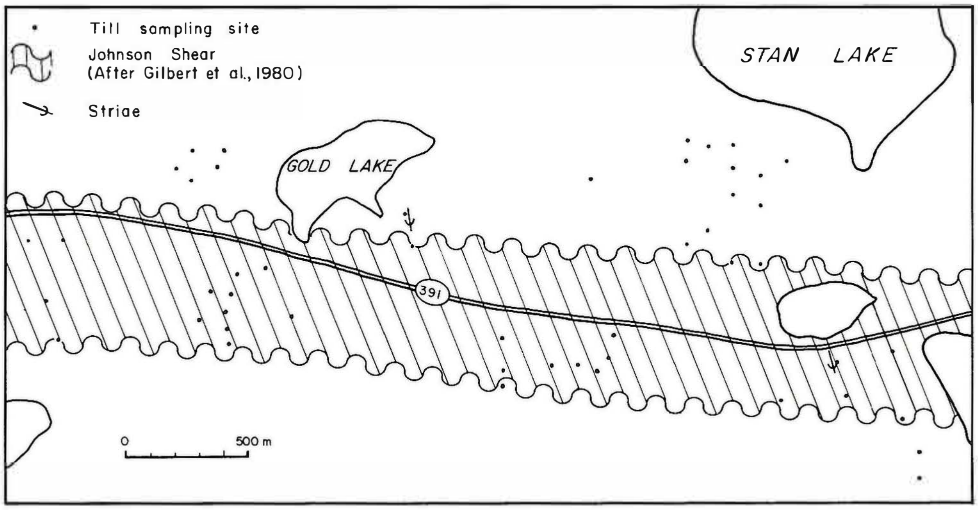
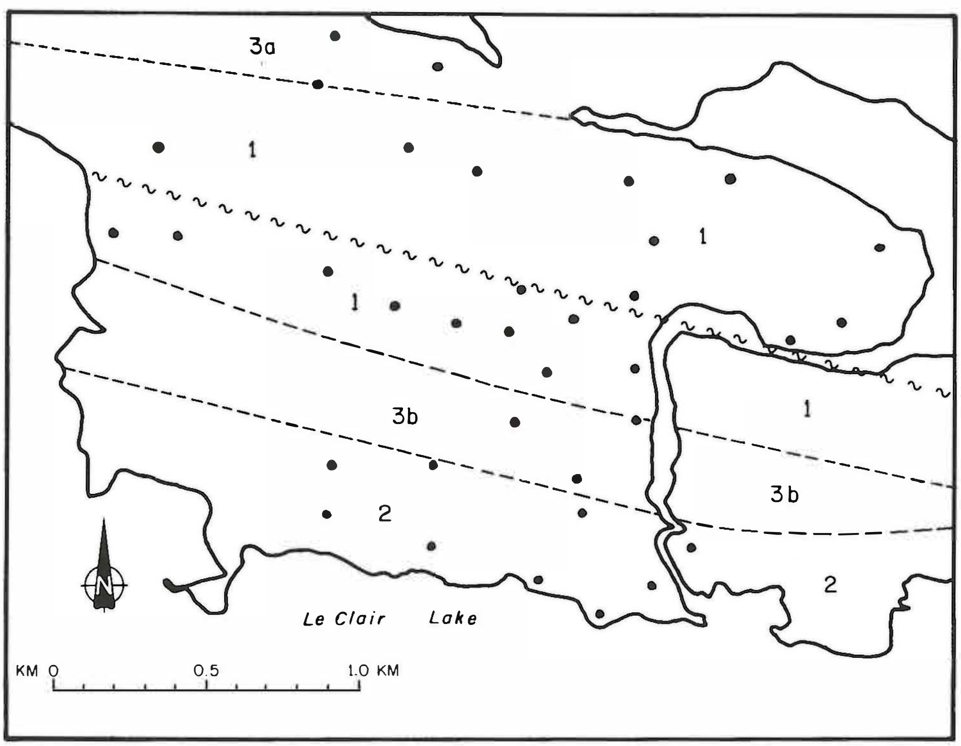


Figure GS-4-3: *Location of till sampling sites in the Gold Lake area.*



1 Biotite – feldspar – quartz gneiss
2 Tonalite
3a Gneissic monzonite and diorite
3b Hematized gneissic monzonite
• Till sampling site
Contact
Fault

Figure GS-4-4: *Location of till sampling sites in the Le Clair Lake area. The bedrock geology is from Schledewitz (1983).*

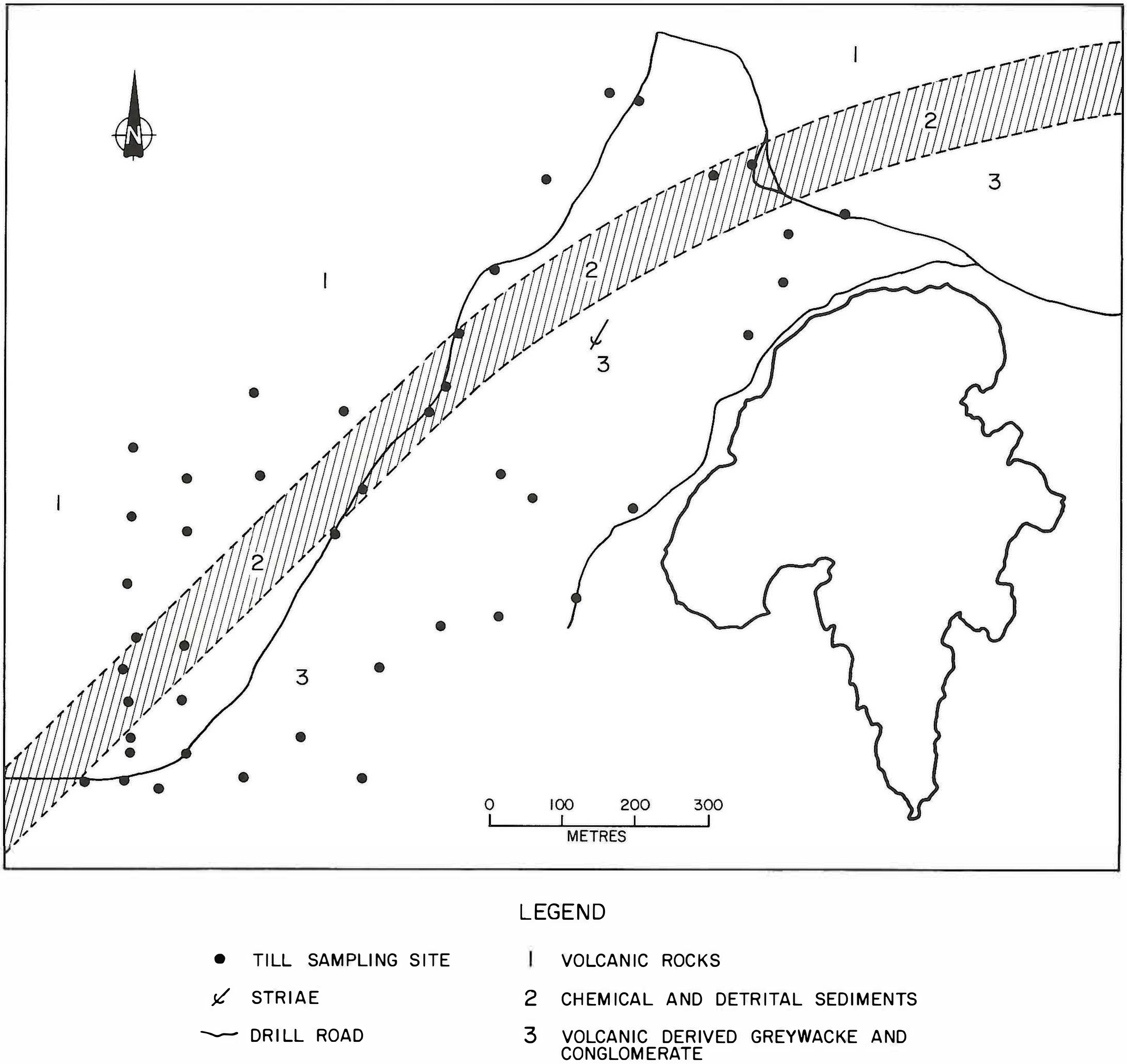


Figure GS-4-5: Location of till sampling sites in the Ruttan area. The bedrock geology is simplified from Baldwin (1982).

geology has been described by Baldwin (1982). The purpose of this sampling was to determine the style of glacial dispersal in the Hudsonian sector of the ice sheet, specifically to determine the nature of the dispersion train from known mineralization associated with the chemical and detrital sediments extending northeast from the Ruttan Mine.

The ice flow, recorded by striae at a single site within the area, was towards 210°. Striae measured along the road to South Bay 2 km to the north range between 205° and 230°. Striated and facetted outcrops show a gradual shift in the ice flow toward the southwest (Fig. GS-4-6). For this reason till geochemical anomalies may be difficult to interpret.

The area is generally not suitable for till sampling from hand dug holes because of the extensive Lake Agassiz clay deposits and the abundant bedrock outcropping in the area. Nevertheless, 44 till samples were collected from the area south of and adjacent to the "mine sequence" northeast of the Ruttan Mine.

Figure GS-4-6: Striated outcrop on the South Bay road showing the southwesterly shift in the ice flow direction.

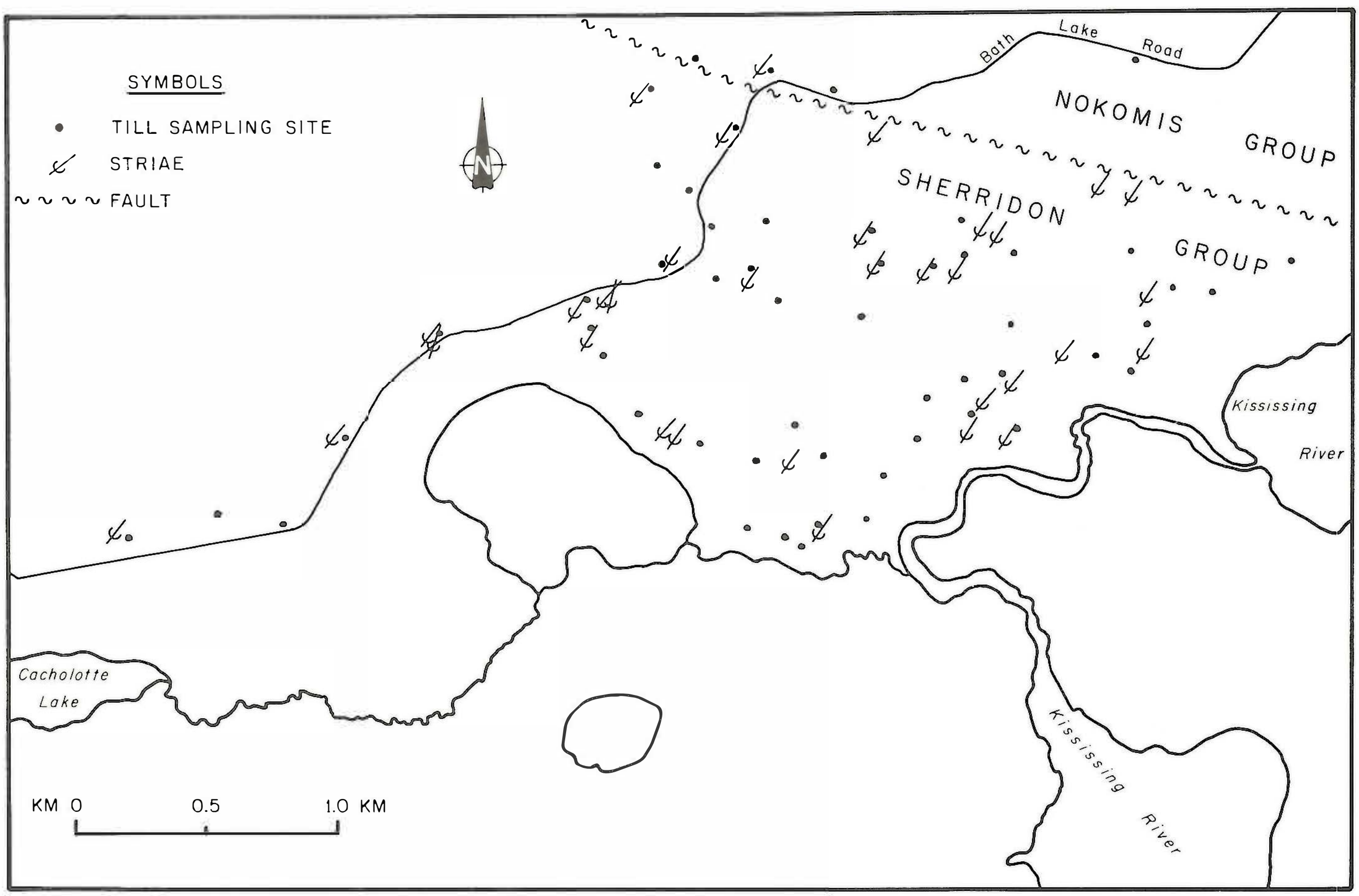


Figure GS-4-7: Location of till sampling sites in the Kississing River area. See Zwanzig (1984) for the detailed bedrock geology of this area.

FLIN FLON

KISSISSING RIVER

In 1984 till sampling was initiated along the contact between the Sherridon Group and the Nokomis Group in the Nokomis Lake area (Nielsen and Graham, 1984). This work was continued this year over the anticlinal structure situated between Kisseynew Lake and Duval Lake and west at Kississing River (Fig. GS-4-7).

The bedrock geology of this area has been described by Zwanzig (1983, 1984). Nokomis metagreywacke is faulted against Sherridon metasandstone along the north side of the anticlinal structure. Most of the till sampling was centered on this structure which is composed of interbedded metavolcanic and metasedimentary rocks, mainly arkose and conglomerate.

The ice flow as recorded by numerous striations varied between 220° and 210°. The till sheet is thin and patchy, and samples could only be collected from the lee side of bedrock knolls. Bedrock is widespread throughout and Lake Agassiz clay is extensive over the Nokomis Group along the Bath Lake Road (Fig. GS-4-7).

Fifty-four till samples were collected from this area from hand dug pits.

GEOCHEMICAL ANALYSIS

The less than 2 micron size-fraction of the 314 samples collected will be analyzed for Cu, Pb, Zn, Ni, Co, Cr, Fe, Mn, and As. Depending on the results of these analyses a selected number of samples will undergo heavy mineral separation and gold analysis.

REFERENCES

Baldwin, D.A.

1982: Mineral deposits in the Ruttan Lake, Karsakuwigamak Lake, Muskayk Lake areas, Manitoba; Manitoba Mineral Resources Division, Open File Report OF81-4, 59 p.

Gilbert H.P., Syme, E.C. and Zwanzig, H.V.

1980: Geology of the metavolcanic and volcaniclastic metasedimentary rocks in the Lynn Lake area; Manitoba Mineral Resources Division, Geological Paper GP80-1, 118 p.

Milligan, G.C.

1960: Geology of the Lynn Lake district; Manitoba Mines Branch, Publication 57-1, 317 p.

Nielsen, E.

1982: Overburden sampling in the Lynn Lake area; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1982, p. 81-83.

1983: Overburden sampling in the Lynn Lake area; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 98-100.

Nielsen, E., and Graham, D.C.

1984: Till geochemical investigations in the Lynn Lake and Flin Flon areas; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 32-36.

1985: Preliminary results of till petrographical and till geochemical studies at Farley Lake; Manitoba Mineral Resources Division, Open File Report OF85-3, 62 p.

Schledewitz, D.C.P.

1983: Brochet-Big Sand Project; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 5-10.

Zwanzig, H.V.

1983: Kisseynew Project: Lobstick Narrows; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 15-22.

1984: Lobstick Narrows-Cleunion Lake (Part of 63K/13, 14 and 63N/3, 4) Manitoba Mineral Resources Division, Preliminary map 1984 K-1.

GS-5 MINERAL DEPOSIT STUDIES IN THE LYNN LAKE AND BARRINGTON LAKE AREAS

by D.A. Baldwin, D. Parbery, S. Boden and A. Michielsen

INTRODUCTION

Documentation of mineral deposits and occurrences in the Lynn Lake greenstone belt continued this past field season. During 1984 documentation was concentrated around and to the west of Lynn Lake (Ferreira and Baldwin, 1984; Stewart and Brewer, 1984). In 1985 activities were centered around Lynn Lake and east to Barrington Lake (Fig. GS-5-1). A total of 59 occurrences were examined and where warranted detailed geology maps or stratigraphic sections were prepared. In addition, diamond drill core from several localities characterized by little or no outcrop was examined to establish geology, type of mineralization and metal concentration.

This report provides a summary of the geologic features of the occurrences examined during the 1985 field season (Table GS-5-1). Files containing detailed maps, stratigraphic sections, assay values and written reports for occurrences examined during the 1984 and 1985 field seasons are available for examination upon request. Brief descriptions of selected occurrences are presented below to give the reader an idea of the various styles and geological settings of mineralization in the Lynn Lake greenstone belt.

We gratefully acknowledge assistance provided by the exploration staff of Sherritt Gordon Mines Ltd. in Lynn Lake. Geological data, in particular geological maps of past and present exploration properties, made available from company files, contributed to the documentation of the mineral occurrences.

SHEILA LAKE-MARGARET LAKE (11, 9)

The stratigraphic succession and sulphide mineralization exposed on the peninsula in Sheila Lake (Baldwin, 1983) is also exposed in stripped outcrop and in a trench on the southeast shore of Sheila Lake 325 m along strike from the peninsula. On the peninsula felsic heterolithic fragmental rocks directly overlie the mineralized zone. On the southeast shore of the lake 6 m of interlayered chert, 0.15-2 m thick, and argillitic rocks, 1-5 cm thick, occur between the mineralization and the felsic fragmental rocks.

The stratigraphic succession at Sheila Lake can be traced southwest to Margaret Lake. At Margaret Lake, however, a 30 m thick amphibole-garnet porphyroblastic schist occurs to the southwest, stratigraphically above the felsic fragmental rocks. The porphyroblastic schist, locally containing 60 to 70% garnet, is overlain by siliceous sedimentary rocks that contain 1 to 2% disseminated pyrite, pyrrhotite and arsenopyrite.

In the Sheila-Margaret Lakes area two stratigraphically distinct siliceous sedimentary units contain disseminated sulphide. The stratigraphic succession containing the sulphide-bearing sedimentary rocks has a known strike length of 2.8 km.

LASTHOPE LAKE (20)

At Lasthope Lake the exposure of the host rocks to the Madole vein (20) consists of a west-northwest-striking layered succession that from south to north comprises quartz-feldspar porphyry, mafic tuff, quartzite, mudstone, chlorite-feldspar-quartz gneiss, magnetite-bearing quartzite and feldspathic quartzite. Two parallel quartz veins cut the quartzite. The north vein is barren whereas the 230 m long south vein is sulphide-bearing.

Forty-one trenches were excavated along the strike of the sulphide-bearing quartz vein in 1938; thirty are now moss and sand filled. The vein, 30 cm to 120 cm wide can be divided into 2 units: a southern white, massive quartz unit and a northern grey aphanitic, siliceous unit with disseminated grains and stringers of pyrite and trace chalcopyrite.

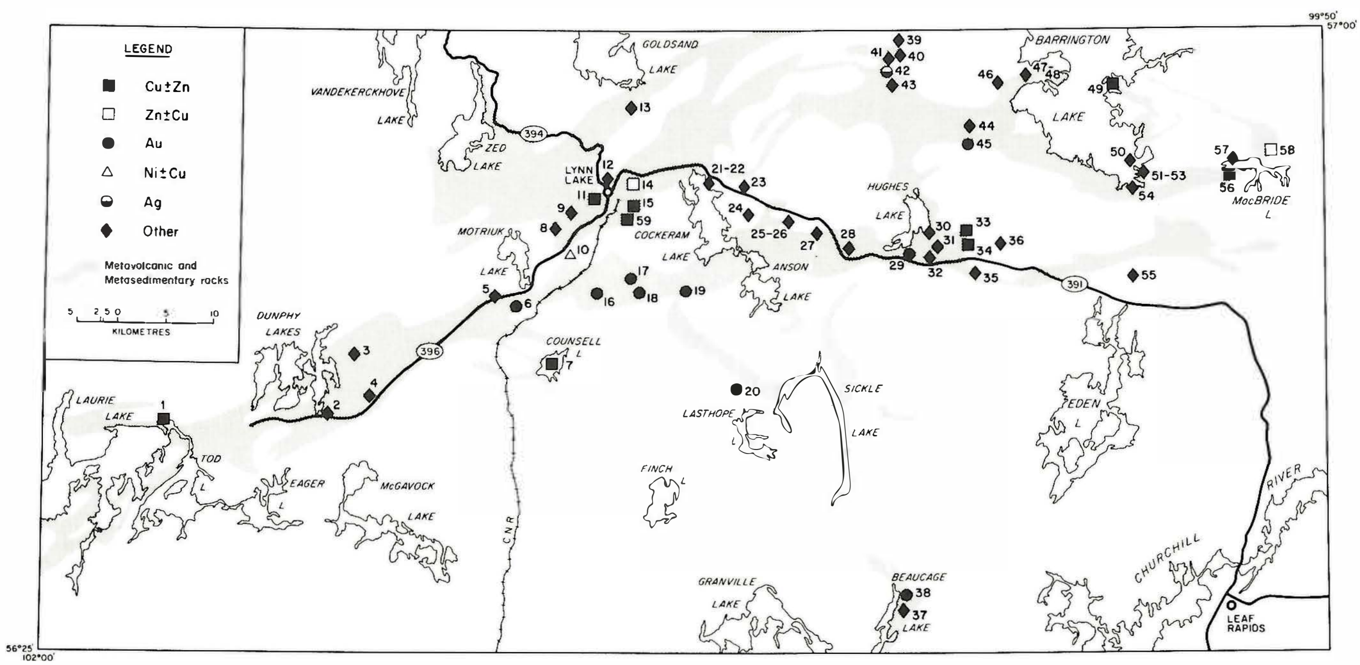


Figure GS-5-1: Mineral deposits and occurrences in the Lynn Lake greenstone belt examined during the 1985 field season. The mineralized localities are briefly described in Table GS-5-1.

The average sulphide content of the vein is 5% (up to 15% locally) and exploration in 1939 outlined 142 000 tonnes grading 7.8 g/tonne gold (Bateman, 1945).

HUGHES RIVER (33)

Mineral occurrence 33 is located 3.7 km east of Hughes Lake and 100 m southwest of the large "V" in the Hughes River. At this locality a 5.4 x 4.6 m trench exposes mineralized andesite characterized by 3-5% pyrite, chalcopyrite and pyrrhotite with a maximum of 30% disseminated sulphide minerals. Locally, up to 2% magnetite accompanies the sulphide mineralization. The host andesite is cut by a barren, 320°-trending 19 cm thick quartz vein. Outcrop within 30 m of the trench is heavily iron-stained.

FARLEY LAKE (45)

A sulphide-bearing quartz vein within medium grained gneissic granodiorite to tonalite is located 1.3 km south-southeast of Farley Lake and 123 m west-northwest of Pump Lake. The vein is 0.7 m thick, strikes 025°, has a vertical dip and outcrops irregularly for 30 m along strike. Drilling indicates the vein extends in the subsurface for 108 m to the

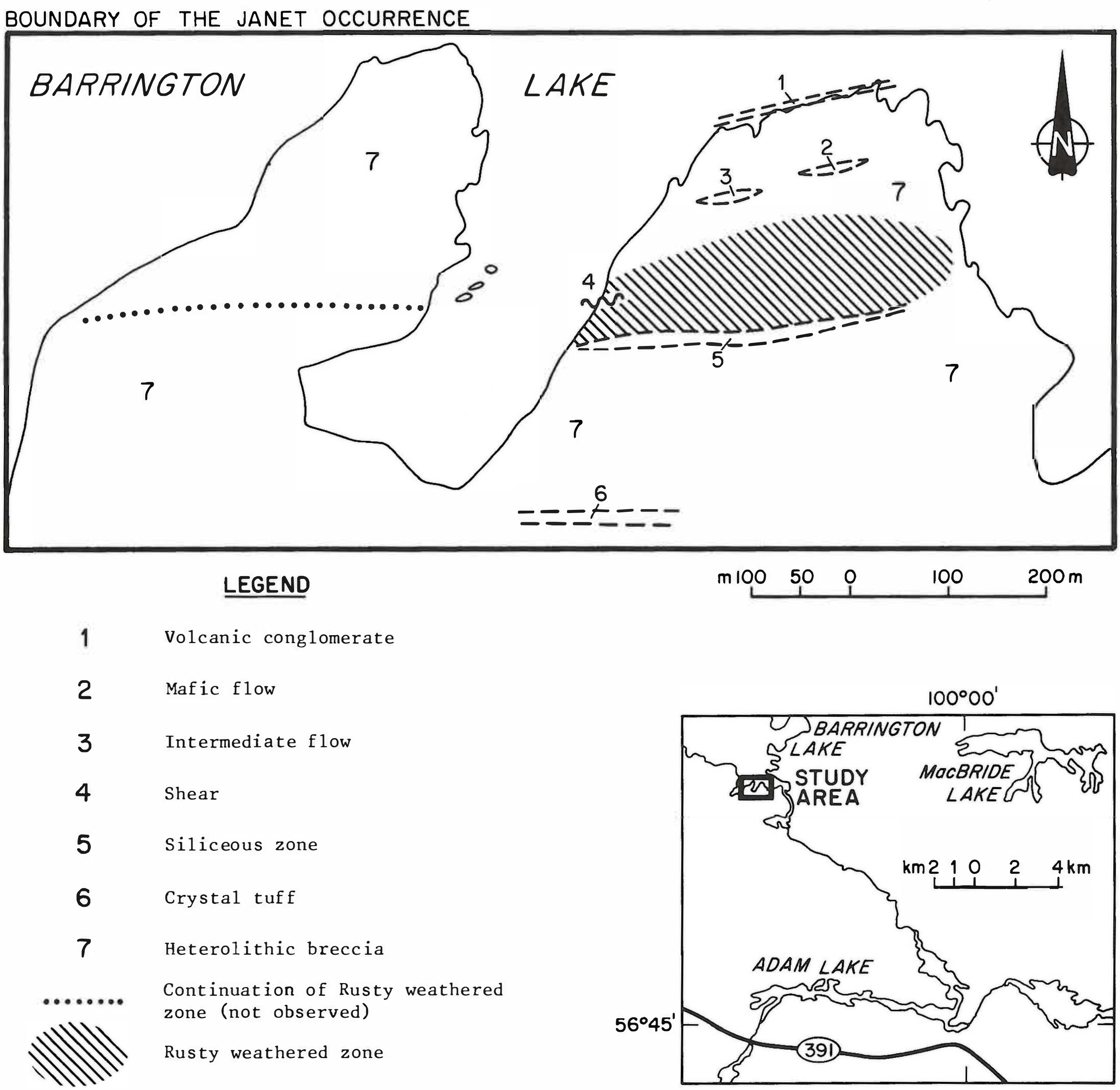


Figure GS-5-2: Simplified geology of the Janet occurrence, Barrington Lake.

TABLE GS-5-1 LIST OF AREAS INVESTIGATED WITH SUMMARY DATA

No.	Location[1]	Sulphide Mineralogy	Host Rock	Habit of Sulphide Mineralogy	Nature of Mineralization	Type of Occurrence	Thickness	Remarks
1	RYE	Data not compiled.				ddh		
2	DUN	Data not compiled.				ddh		
3	Irene Lake		basalt		rusty zone	outcrop		Reported occurrence not found
4	DON	Data not compiled.				ddh		
5	North Digney	py, asp	felsic tuff, felsic breccia	disseminated (1-2%), some rusty weathering	stratabound in felsic fine grained volcanic	outcrop	300 m	Alteration to north, anthophyllite-garnet-magnetite-staurolite schist
6	Pin	py, asp, ga	K-feldspar and quartz dyke and quartz veins	massive clots and disseminated (2-5%)	clots in intrusive and quartz veins	outcrop, trench	23 m	
7	Sel, Counsel Lake	py, po Data not compiled.				ddh		
8	Frances Lake	py, po	diorite, gabbro, mafic tuff	disseminated (1-2%), lightly rust stained	stratabound in volcanic rock; sulphide in intrusive	outcrop		Diorite and gabbro intrude volcanic rocks
9	Margaret Lake	py, po asp, sp	felsic tuff and breccia	disseminated (1-5%), rusty weathering	stratabound in fine grained felsic volcanics	outcrop	3 m	Garnet-amphibole alteration
10	Fraser Group	py, po	gabbro amphibolite	disseminated (1-3%) rusty weathering	disseminated in gabbro	outcrop, ddh		Drill core data not compiled
11	Sheila Lake	py, po, asp	felsic tuff and breccia	disseminated (1-5%) rusty weathering	stratabound in fine grained felsic volcanics	outcrop, trench	5 m	
12	Eric Lake	asp, py, po, cp	basalt felsic tuff, quartz veins	disseminated 1-5%	disseminated in volcanic rocks disseminated in quartz veins	outcrop		
13	Berge Lake		diorite tuffs and fine grained sediments					Strong magnetic anomaly, no mineralization located
14	Y deposit	py, po, cp, sp	rhyolite flows and pyroclastic rocks	massive	massive lens, stratabound	trench	2 m	

15	"Z" deposit	py, po	quartz-monzonite granodiorite	disseminated (1%)	sulphides in igneous intrusive	ddh	
16	West Franklin	py, ga	mafic and felsic tuff	massive clots, disseminated (2-5%)	sulphides in quartz veins	outcrop, trench	16 m
17	McVeigh Lake	py, asp, ga	granite quartz veins	massive clots, disseminated (2-5%)	sulphides in quartz veins	trenches	
18	Foster Lake	py, asp, ga	graphitic chert and graphite - quartz schist	massive clots and disseminated (2-5%)	sulphides in quartz veins	outcrop, trench	16 m
19	CL Claim Wasekwan Lake	py, po, asp, ga, sp	quartz-feldspar dyke	massive clots and disseminated (2-5%)	sulphides in intrusive and quartz vein	trenches	6 m
20	Lasthope Lake	py, cp	quartz vein in quartzites	disseminated and stringer veinlets (5-15%)	disseminated stringer sulphides in quartz vein	outcrop, trench	0.3 - 1.2 m
21	Cockeram Lake	py	granite	disseminated (1%)	disseminated sulphide in igneous intrusive	outcrop	
22	Cockeram Lake	py, mt	granite	disseminated (1%)	disseminated sulphide in igneous intrusive	outcrop	
23	Cockeram Lake	py, mt	gabbro, granite	disseminated (1%)	disseminated sulphide in igneous intrusive	outcrop	
24	Cockeram Lake	py	greenstone	trace	disseminated sulphide in igneous intrusive	outcrop	
25	W. of Norrie lake	py	diorite	disseminated (1%)	disseminated sulphide in igneous intrusive	outcrop	
26	W. of Norrie Lake	py	diorite	disseminated (1%)	disseminated sulphide in igneous intrusive	outcrop	
27	Norrie Lake	py, mt	gabbro	disseminated (2%)	disseminated sulphide in igneous intrusive	trench, outcrop	

TABLE GS-5-1 LIST OF AREAS INVESTIGATED WITH SUMMARY DATA (Cont'd)

No.	Location[1]	Sulphide Mineralogy	Host Rock	Habit of Sulphide Mineralogy	Nature of Mineralization	Type of Occurrence	Thickness	Remarks
28	Pole Lake	py	breccia	disseminated (1-2%)	disseminated in carbonate-rich breccia	outcrop		
29	Gold Lake	py, asp; ga	fine grained felsic sediments	disseminated (1-2%)	disseminated in felsic sediment	outcrop, trench		
30	Hughes Lake	py	greenstone	disseminated (2%)	disseminated in greenstone	outcrop		
31	Hughes Lake	py, mt	gabbro	disseminated (1%)	disseminated sulphides in instrusive	outcrop		
32	Stan Lake							Mineral occurrence as reported by SGM not found
33	Hughes River	py, cp, po, mt	andesite	disseminated	disseminated sulphides in volcanic rock	outcrop, trenches		
34	Hughes River	cp	andesite	disseminated	disseminated sulphides in volcanic rock	outcrop		
35	One Island Lake	py	mafic volcanic	disseminated	disseminated sulphides in volcanic rock	outcrop		
36	Hughes River	py, cp	hornblende diorite	disseminated	disseminated sulphides in intrusive	outcrop		
37	Beaucage Lake	py	rusty, siliceous zone in amphibolite	disseminated (5%)	disseminated sulphides in rusty zone	outcrop	4.6 m	
38	Beaucage Lake	asp	silicic intrusive	disseminated (5%), rusty weathering	disseminated sulphides in intrusive	outcrop, trench	5 m	
39	Eagle Lake	py, po	granite and basalt	disseminated (5-10%)	disseminated sulphides	outcrop		
40	Eagle Lake	py, po	basalt	disseminated and patchy sulphides (2%)	disseminated sulphides in mafic volcanic	outcrop		
41	Eagle Lake	py	basalt	disseminated (1%)	disseminated sulphide in mafic volcanic	outcrop		

42	Eagle Lake	py	metasediment	disseminated (1%)	fracture filling in sediment	outcrop		
43	Eagle Lake	py	metasediment and tuff	disseminated (1%)	1'' wide shear	boulder		Possible trench nearby
44	Farley Lake	py	volcanic fragmental	disseminated (trace)	disseminated sulphide	outcrop		Possible trench
45	Farley Lake	py, cp	quartz vein	disseminated (2%)	disseminated sulphide in quartz vein in granodiorite	outcrop, trenches	0.7 m	Granodiorite is silicified, adjacent to quartz vein
46	Barrington Lake	py, po	diorite	disseminated (1%)	disseminated sulphide in intrusive	outcrop		
47	Barrington Lake	py, po	andesite	disseminated (1%)	disseminated sulphide in volcanic rock	outcrop		
48	Barrington Lake	py	intermediate intrusive	disseminated (0.5%)	disseminated sulphide in intrusive	outcrop		
49	Camp Bay	py, po	felsic meta-volcanics and sediments	disseminated (trace)	rusty weathering	outcrop	0.5 m	Rusty weathering patches are 2 x 0.5 m
50	Barrington Lake-Island	py, po	amygdaloidal basalt	disseminated (trace); thin sulphide layers	fine grained layers of sulphide and disseminated sulphide in basalt	outcrop	0.25 cm	
51	Barrington Lake	po	felsic metasediment	disseminated (10%)	disseminated sulphide in felsic bedded sediment, stratabound	outcrop, trench	8 m	Rusty weathering
52	Barrington Lake	cp, py	felsic volcanic fragment	disseminated and stringer sulphides (5%)	disseminated and stringer sulphides in a fragmental volcanic	outcrop, trenches		Groundmass is chloritic and sericitic
53	Barrington Lake	mo, cp, py	felsic dyke	disseminated (15%)	disseminated sulphides in a felsic dyke	outcrop, trenches	0.8 m	Dyke cuts a mafic heterolithic breccia
54	Barrington Lake	py, po, ± cp	heterolithic breccia	disseminated (7%)	disseminated sulphide in rusty weathered rock. Strata-bound	outcrop	100 m	Breccia is overlain by a cherty unit

TABLE GS-5-1 LIST OF AREAS INVESTIGATED WITH SUMMARY DATA (Cont'd)

No.	Location[1]	Sulphide Mineralogy	Host Rock	Habit of Sulphide Mineralogy	Nature of Mineralization	Type of Occurrence	Thickness	Remarks
55	Adam Lake	py, mt	granite and diorite	disseminated (1%)	disseminated sulphides in intrusives	outcrop		
56	MacBride Lake	py	mafic volcanics and metasediments	disseminated (trace 1%)	disseminated sulphide	outcrop		Garnet-rich zone 18 x 8 m nearby
57	MacBride Lake	py	mafic volcanic	disseminated (trace)	disseminated sulphides in mafic rock	drill core		
58	MacBride Lake	py	intermediate garnet-bearing gneisses	disseminated (2%)	disseminated sulphides in gneisses	drill core		
59	Lynn River God's Lake Deposit	po, cp, py, mt	tonalite	disseminated (1-3%); solid	Sulphide veins	drill core	2 m	Cp at margins of sulphide veins.

NOTES: ddh — diamond drill hole; py — pyrite; po — pyrrhotite; asp — arsenopyrite; ga — galena; cp — chalcopyrite; sp — sphalerite; mt — magnetite; hb — hornblende; hm — hematite.

[1]Refer to Figure GS-5-1

north of the surface showing (Stanton, 1948). The vein contains up to 2% pyrite, trace chalcopyrite and limonite/hematite as disseminated grains. The intrusive rocks are silicified adjacent to the quartz vein.

The zone of silification is 1.2 m to 7.0 m wide, has a gradational boundary with the intrusion and is buff coloured and finer grained than the unaltered intrusion. The silicified zone is cut by randomly oriented, 2-10 mm wide quartz veinlets.

Shallow trenching has been carried out along the vein. Stanton (1948) states that gold values have been reported, but did not give the values. The quartz vein, silicified zone, and the intrusive rocks were sampled.

BEAUCAGE LAKE (37, 38)

At Beaucage Lake two mineral occurrences were investigated. A 24.3 x 1.8 x 1.5 m trench (38) is located 400 m south of the mouth of Beatty Creek and 160 m east of the east shore of Beaucage Lake. The trench, situated at the southeast end of a northwest-trending outcrop, was mapped and sampled. In this outcrop, psammites, pelites, an amphibolite (possibly a dioritic intrusive) and a garnet porphyroblastic felsic rock are intruded by a 5 m wide silicic rock. The amphibolite and metasedimentary rocks contain barren, white, quartz veins up to 0.2 m thick with a sub-parallel orientation to the silicic intrusive rock. Two narrow, parallel and foliated zones in the silicic intrusive rock contain about 5% of a metallic silver mineral, probably arsenopyrite, disseminated throughout the zones. The silicic unit pinches out 12.5 m to the northwest of the trench and outcrop ends 5 m to the southeast.

Two pairs of isoclinally folded calc-silicate (amphibole-epidote) layers occur 25 m southeast of the trench. They are less than 0.3 m thick and are bounded by very fine grained, interlayered brown and grey-white mudstones, 0.2 cm-10 cm thick. Patchy anthophyllite and garnet occur in the mudstones on the northwest limb of the fold. Garnets and a streaky, white porphyroblast (possibly sillimanite) occur in the mudstones in the axial zone of the fold.

The second mineral occurrence, (38), is located 980 m south of the mouth of Beatty Creek and 470 m east of the east shore of Beaucage Lake. At this location a patchy, discontinuous 4.6 m thick rusty zone, containing up to 5% pyrite as disseminated grains and stringers, can be traced for 22 m. This rusty zone is contained within an amphibolite. The amphibolite is fine- to very fine-grained and chlorite-rich; it contains streaky, white feldspars and round to oval feldspar knots less than 2 mm in size. The amphibolite and rusty zone are intruded by a feldspar porphyry. West of the mineral occurrence garnet and magnetite-bearing psammites are in contact with the amphibolite. These metasedimentary rocks are interbedded with quartz crystal tuffs.

BARRINGTON LAKE (49-54)

Six of the sites examined in the Barrington Lake area are described below. They are the Camp Bay occurrence (49), Island occurrence (50), Barrington Peninsula pyrrhotite (51), chalcopyrite (52) and molybdenite (53) occurrences, and the Janet occurrence (54).

CAMP BAY OCCURRENCE (49)

The Camp Bay occurrence is located at the north shore of Camp Bay on the east side of Barrington Lake, 1.7 km southeast of Brooks Island. Rocks in the area comprise probable felsic to intermediate metasedimentary and volcanic rocks. The three major rock types are: I — a strongly foliated, locally biotite-rich, white-grey to buff coloured rock with pink-orange garnet porphyroblasts and garnet veins; the rock accounts for 60% of the total outcrop in the area; II — a fragmental unit, forming 30% of the outcrop, with felsic clasts averaging 5 cm x 1 cm, in a green micaceous groundmass that is foliated, crenulated and carries up to 5% garnet; III — approximately 10% of the outcrop at the Camp Bay occurrence consists of narrow (0.3 m), coarse grained to medium grained, green-brown amphibolite dykes/sills. Rock types I and II are interlayered and are both intruded by amphibolite.

Trace amounts of sulphide pyrite and pyrrhotite occur in west-striking rusty weathered patches (less than 2 x 0.5m) in rock types I and II.

ISLAND OCCURRENCE (50)

The Island occurrence is on the northwest shore of a medium sized island located 2.8 km north-northwest of the Barrington River and 2.0 km north of the Janet occurrence. This occurrence comprises trace pyrite and pyrrhotite in a grey, siliceous, fine grained rock as well as 0.25 cm thick very fine grained pyrite layers in an amygdaloidal basalt. The basalt is cut by granodioritic and diabase dykes.

BARRINGTON PENINSULA-PYRRHOTITE OCCURRENCE (51)

The Barrington Peninsula is located in the southeast corner of Barrington Lake, 1.8 km north of Barrington River. A trench, located halfway along the peninsula and 80 m south of a point on the north shore of the peninsula opposite a small island, was mapped and sampled. The trench 4 x 1.3 m is cut into the side of an intensely rusty weathered outcrop. The rusty weathered outcrops occur in a fine grained, bedded, felsic metasedimentary rock and a chlorite-rich rock. Disseminated pyrrhotite and pyrite (up to 10%) occur in the metasedimentary rock. The mineralized rocks are overlain and underlain by intermediate pillowed flows and mafic heterolithic breccia.

BARRINGTON PENINSULA-CHALCOPYRITE OCCURRENCE (52)

Mineral occurrence 52 is located on the east shore of Barrington Lake just north of the peninsula. At this locality nine small trenches occur in a felsic fragmental rock that consists of 1.5 x 4 cm felsic fragments supported in a chloritic-sericitic groundmass. Up to 5% chalcopyrite and pyrite are present in the groundmass as disseminated grains and clots, and as wispy stringers up to 3 cm in length. The mineralized rock is structurally overlain to the east by mafic heterolithic breccia.

BARRINGTON PENINSULA-MOLYBDENITE OCCURRENCE (53)

Three trenches, located 1.7 km north of Barrington River and 1.0 km northwest of Webb Lake were mapped and sampled. Two of the trenches expose a sulphide-bearing felsic dyke that has known length of 100 m and occurs in mafic heterolithic breccia. Adjacent to the dyke the mafic breccia is mottled and silicified and breccia fragments are rarely distinguished.

Locally the dyke carries up to 15% molybdenite and chalcopyrite. The sulphides are disseminated unevenly throughout the dyke. Trace molybdenite and pyrite occur within 3-15 cm wide white quartz veins developed in the heterolithic breccia.

The intrusion of the felsic dyke is a late event and appears to be unrelated to the formation of the surrounding volcanic rocks.

JANET OCCURRENCE (54)

The Janet occurrence is located on the south shore of Barrington Lake, 1.1 km east of Barrington River. Numerous intense but discontinuous rusty weathered outcrops can be traced for 500 m along a westerly strike and are developed within an approximately 100 m thick unit of recrystallized heterolithic breccia and minor intermediate flows. Individual rusty weathered outcrops are 0.3 to 2 m wide and contain up to 7% pyrite, pyrrhotite + chalcopyrite.

A thin 15 m thick cherty unit containing less than 5% disseminated pyrite and pyrrhotite is present south of the Janet occurrence. This unit is believed to overlie the volcanic unit containing the iron-stained rocks. The chert unit has been traced for 460 m along strike. Rusty weathered rocks are uncommon to the south of the cherty unit.

To the north of the mineralized area the rocks comprise intermediate volcanic fragmental rocks and minor hornblende andesites. South of the cherty unit the volcanic succession includes intermediate fragmental rocks, crystal tuffs and minor intermediate flows (Fig. GS-5-2).

GOD'S LAKE DEPOSIT (59)

Core from 13 drill holes from the God's Lake Deposit, located 4 km southeast of the town of Lynn Lake, was examined. The host rock to the sulphides, and the major rock type in this deposit, is a fine- to medium-grained, blue-grey gneissic tonalite. Granodiorite and diorite occur locally and are generally medium grained; contacts with the tonalite are gradational to sharp. The granodioritic and dioritic dykes are generally less than 0.3 m thick. One centimetre to several metre intersections of an intermediate fragmental volcanic rock occur from place to place in many of the holes and are commonly closely associated with the sulphides.

Sulphide mineralization comprises pyrrhotite + pyrite, and chalcopyrite (po:cp = 20:1) that occur as disseminated grains, stringers and veins of solid sulphide up to 2 m thick. Chalcopyrite is most commonly found at the margins of the sulphide sections where they are in contact with the tonalite. Contacts between host rock and sulphide veins are randomly oriented.

The massive sulphides were probably injected into the tonalite after mobilization from adjacent volcanic rocks. Alteration of the tonalite consists of a reduction in grain size and a green tinge in the rock, probably the result of the breakdown of plagioclase to sericite and epidote.

REFERENCES

Baldwin, D.A.
1983: Stratigraphic studies of felsic volcanic rocks associated with mineral occurrences in the Lynn Lake area, Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 88-93.

Bateman, J.D.
1945: McVeigh Lake area Manitoba; Geological Survey of Canada, Paper 45-14.

Ferreira, K.J. and Baldwin, D.A.
1984: Mineral deposit documentation in the Lynn Lake area; **in** Manitoba Energy and Mines, Mineral Resources, Report of Field Activities, 1984, p. 12-16.

Stanton, M.S.
1948: Geology of the Farley Lake area; Manitoba Mines Branch, Preliminary Report 47-5.

Stewart, P.W. and Brewer, K.
1984: Mineral deposit studies in the western Lynn Lake greenstone belt; **in** Manitoba Energy and Mines, Mineral Resources, Report of Field Activities, 1984, p. 17-19.

GS-6 GEOLOGY AND MINERAL OCCURRENCES IN THE NICKEL LAKE AREA, AGASSIZ METALLOTECT

by M.A.F. Fedikow and D.R. Eccles

INTRODUCTION

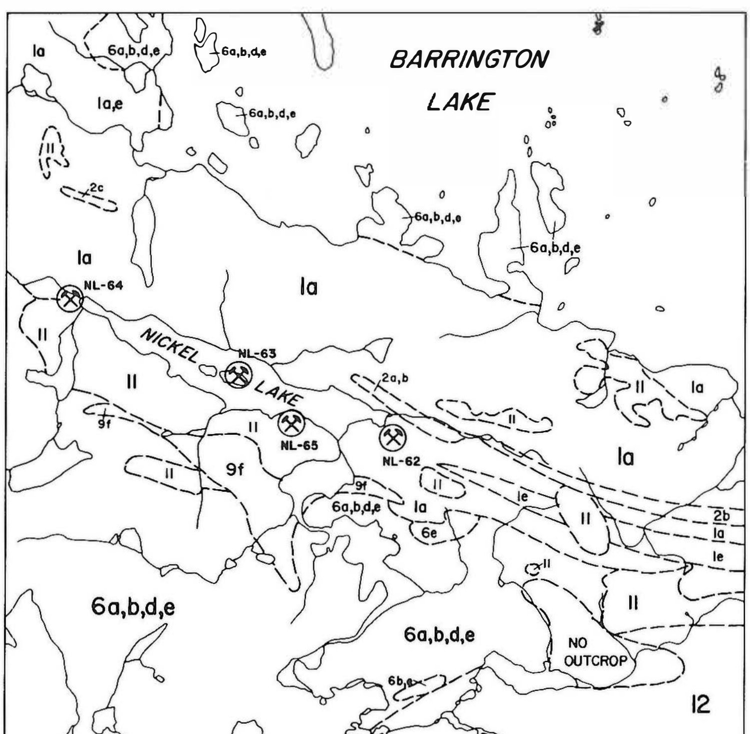
The Nickel Lake area (Fig. GS-6-1) is located approximately 42 km east of the Agassiz deposit and represents part of the eastern one-third of the Agassiz Metallotect (Fedikow, 1984). Outcrop in the area is restricted primarily to ridges owing to a cover of boulder alluvium and glaciolacustrine (Glacial Lake Agassiz) clays. The rocks in the Nickel Lake area were reconnoitred in order to:

1. relate the local geology to the airborne Input (Questor, 1976) and vertical field gradiometer anomalies that characterize the Agassiz Metallotect in this area;
2. examine the stratigraphy of the rocks in the Nickel Lake area for similarities to the host rocks of the Agassiz deposit; and
3. document mineral occurrences indicated by Milligan (1960) and Gilbert (1980) by detailed geological mapping of trenches and the collection of samples for assay and geochemical analysis.

The locations of the occurrences examined and the geology of the Nickel Lake area are presented in Figure GS-6-1. This report represents the results of ongoing studies related to the Agassiz stratabound Au-Ag deposit and the delineation of the Agassiz Metallotect. Previously published information regarding the Agassiz project can be obtained from Fedikow and Gale (1982); Fedikow (1983, 1984, 1985); and Fedikow et al. (1984).

OBSERVATIONS

The airborne Input and vertical field gradiometer anomalies on the south shore of Nickel Lake can be related, in part, to a series of interlayered mafic volcanic and rusty weathered mafic sedimentary rocks as well as to a variably textured sequence of gabbroic intrusions. The intrusions have been mapped and described by Milligan (1960). The sequence of interlayered mafic volcanic and sedimentary rocks associated with the airborne anomalies is exposed in outcrop 137 m south of the lake shore and 22 m east of a geophysical base line (Occurrence NL-65). A 12 x 6 m outcrop at this location consists predominantly of intensely altered and bleached, fine grained, jointed mafic sedimentary (volcanic?) rocks that are crosscut by white 5-10 mm carbonate veinlets. These rocks also contain 10-15 cm x 5 cm siliceous, subrounded fragments (boudined quartz veins) that are stretched and elongated with length to width ratios of 5:1. In addition to these fragments a second, smaller (0.5-2 cm) set of fragments is present in the outcrop. These fragments are rounded to subrounded, siliceous and barren of the iron oxide stain that characterizes the matrix of these mafic rocks. Scattered 1 mm grains of pyrite were observed in samples collected for assay; generally the outcrop is bleached without visible sulphide. Approximately 35 m north of this exposure along the geophysical baseline another outcrop of rusty weathered mafic volcanic breccias and sedimentary rocks occurs. The iron staining is less intense; areas of iron oxide stain are scattered through the outcrop. This outcrop com-



12	Granitoid rocks
11	Gabbro, diorite, amphibolite and related rocks
9	Massive to gneissoid tonalite to granite; pegmatite and aplite f) granite and granite gneiss, massive to porphyritic; pegmatite and alaskite
6	Gneissoid tonalite, quartz diorite, granodiorite, diorite and related gneiss a) biotite tonalite, quartz diorite b) hornblende tonalite, quartz diorite d) granodiorite e) diorite
2	Intermediate to felsic volcanic extrusive rocks a) aphyric rhyolite to dacite b) porphyritic rhyolite and dacite c) intermediate to felsic pyroclastic breccia and lapilli tuff
1	Mafic volcanic extrusive and fragmental rocks; minor related gabbro a) aphyric and porphyritic basalt, andesite, and related flow-breccia e) mafic tuff and crystal tuff

SCALE
1 0 1 2 3 4 km

Figure GS-6-1: Mineral occurrences examined in the Nickel Lake area, Lynn Lake, 1985. Geology after Gilbert (1979).

prises fine grained, mafic sedimentary rocks 1-15 cm thick interlayered with pebbly volcanic breccia units 0.5 m thick and containing three compositionally distinct fragment types. These include a 0.5-2 cm rounded siliceous type (similar to those in the more intensely altered outcrop), an elongate 0.5-4 cm clast compositionally similar to the matrix of the interlayered fine grained sedimentary rocks and a 0.2-0.5 cm elongate mafic fragment type of slightly coarser grain size than the latter. Quartz laminae, probably representing pulled-apart quartz veins, occur in a subparallel attitude to the foliation and bedding planes that strike 272° and dip 60°. Grading in these units indicates that the beds young southwards.

Three occurrences in the Nickel Lake area substantiate the presence of Agassiz-type stratigraphy in this portion of the Agassiz Metallotect. The first of these occurrences (NL-64) is present at the western end of Nickel Lake and has been referred to by Hosain (1981) as Cu4. This occurrence is characterized by an east-trending anomaly that has been tested by a single diamond drill hole. Diamond drill core examined from this hole indicates the geophysical response is attributable to the presence of siliceous and sericitic clastic sedimentary rocks containing 1-30 per cent pyrrhotite and pyrite. These rocks are interlayered with massive, amygdular and feldspar-phyric mafic volcanic rocks, including the Agassiz high-Mg basalt or "picrite". Siliceous pyrite-bearing units in the drill core are interpreted to be quartz veins. Two samples of the sulphide-bearing sedimentary rocks were collected for Cu, Pb, Zn, Au and Ag assay.

A second occurrence of Agassiz-type stratigraphy occurs on the easternmost of two islands in the centre of Nickel Lake (NL-63; Fig. GS-6-1). The highest topographic point on this island exposes a sequence of fine-grained rusty weathered clastic sedimentary rocks crosscut by 2-5 mm sulphidic (pyrite) carbonate veins and fracture fillings interlayered with fibrous, malachite-stained actinolite and olive-green fine grained to coarse grained chlorite layers. The amphibole-chlorite layers contain quartz and carbonate veins and disseminated pyrite and chalcopyrite. Locally, the outcrop is cleaved with quartz and carbonate stringers aligned parallel to the cleavage. Mineralogically, this rock is identical to the high-Mg basalt or "picrite" at the Agassiz deposit.

The third occurrence of Agassiz-type stratigraphy is located in a series of trenches at occurrence NL-62 just east of the east end of Nickel Lake. At this locality a sequence of interlayered "picrites" and quartz and feldspar-phyric volcanic rocks characterized by elongate (8-10 cm x 2 cm to 0.5 x 2 cm) silicified pumiceous fragments containing disseminated pyrite and chalcopyrite is exposed in 8 trenches. Most trenches are filled with overburden and overgrown. The main trench provides a 16 m section of interlayered felsic pyroclastic rocks and picrite (Table GS-6-1). Chip samples were collected over 1 m intervals through the section including three samples for silicate whole rock and geochemical trace metal analysis. Detailed sampling was undertaken in an attempt to confirm the report of 0.60 oz/ton Au (Milligan, 1960) from this area.

Geological observations and geochemical analyses confirm the presence of Agassiz-type stratigraphy at Nickel Lake thereby substantiating the proposed relationship between Agassiz-type rocks and the observed airborne geophysical signature of this rock sequence. The potential for the occurrence of Agassiz-type gold mineralization in the Nickel Lake area is therefore considered to be high. The results of assay, geochemical and silicate whole rock analyses will be available for viewing upon request.

ONGOING PROGRAMS-AGASSIZ METALLOTECT

BIOGEOCHEMISTRY

Samples of black spruce **(Picea mariana)** collected in 1984 from an area west of the Agassiz Au-Ag deposit (MacLellan Mine) and from the immediate vicinity of Farley Lake along the Agassiz Metallotect are still undergoing chemical analysis. The analysis of the black spruce needle portion of the samples is close to completion with AAS analyses for Cu, Zn, Ni, Cr, Fe, Mn and Ash (gravimetry). The data will be released as an open file report upon completion of the analyses and interpretation of the data.

TABLE GS-6-1
GEOLOGICAL SECTION THROUGH THE MAIN TRENCH OF OCCURRENCE NL-62, NICKEL LAKE

SECTION DESCRIPTION (North to South)

0-8 m	Rusty weathered, pyritic felsic pyrociastic rocks (± Cp); shears at 3 m, 4.5 m, 7 m;
8-9 m	Fibrous actinolite chlorite-rich unit (picrite) with 1 per cent disseminatd Py; cleaved; carbonate-quartz veins;
9-10.5 m	Dense, fine-grained, greenish-black basalt with disseminated Py + Cp; occasional carbonate veinlet;
10.5-14.5 m	Rusty weathered, silicified, pyritic, felsic pyroclastic rock; contact with picrite is rotten, pyritic; silicification intensifies towards picrite contact;
14.5-16 m	Foliated picrite with quartz and carbonate veins, patchy iron staining; recessive areas representing weathered carbonate stringers.

MULTISPECTRAL REMOTE SENSING PROJECT

In association with the Ontario Centre for Remote Sensing and the Canada Centre For Remote Sensing selected areas along the Agassiz Metallotect will be flown in an attempt to assess airborne spectral detection of metal-induced vegetation stress. As part of this project a VAX/Dipix Image Analysis System has been established within the Department of Earth Sciences at the University of Manitoba. The system consists of a Dipix III Image Analysis System; a VAX 11/750 with 2 disc drives and a 1600/6250 bit/inch tape drive and a Dipix interpretation package. This system will interpret remote sensing data generated from the airborne surveys conducted over the Agassiz Metallotect on the basis of integrated geological, geophysical and rock, basal till and vegetation geochemical data.

REFERENCES

Fedikow, M.A.F.

1983: Geological and geochemical studies at the Agassiz Au-Ag deposit, Lynn Lake, Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities 1983, p. 94-100.

1984: Preliminary results of biogeochemical studies in the Lynn Lake area; Manitoba Mineral Resources Division, Open File Report OF84-1, 104 p.

1985: The vegetation geochemical signature of the Agassiz stratabound Au-Ag deposit, Lynn Lake, Manitoba; Manitoba Energy and Mines Open File Report OF85-6, 94 p.

Fedikow, M.A.F. and Gale, G.H.

1982: Mineral deposit studies in the Lynn Lake area; **in** Manitoba Mineral Resources Division, Report of Field Activities 1982, p. 44-54.

Fedikow, M.A.F., Kramarchuk, B. and Charlesworth, R.B.

1984: Geochemical studies along the Agassiz Metallotect; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, p. 29-31.

Gilbert H.P.
1979: Melvin Lake Project; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1979, p. 8-12.

Hosain, I.T.
1981: Summary and evaluation of the geophysical data from the open assessment files of the Lynn Lake greenstone belt, NTS64C-9 to 16; Manitoba Mineral Resources Division, Open File Report OF81-5.

Milligan, G.C.
1960: Geology of the Lynn Lake District; Manitoba Mines Branch Publication 57-1.

GS-7 A STUDY OF THE ALTERATION ZONE ASSOCIATED WITH THE LAR DEPOSIT, LAURIE LAKE AREA

by S.R. Elliott[1] and E.C. Appleyard[1]

INTRODUCTION

The study of the alteration zone associated with the Lar deposit, a subsurface lens of massive Cu-Zn mineralization north of Laurie Lake, was continued during the 1985 field season. The surface expression of the enveloping alteration zone was remapped at a scale of 1:600 and the sampling of this zone, undertaken in 1984, was supplemented. Additionally, eight exploration diamond drill holes providing a cross-section through the sulphide mineralization and alteration zone were logged and sampled (Fig. GS-7-1). The current work has resulted in a revised sur-

[1]Dept. of Earth Sciences, University of Waterloo, Waterloo, N2L 3G1

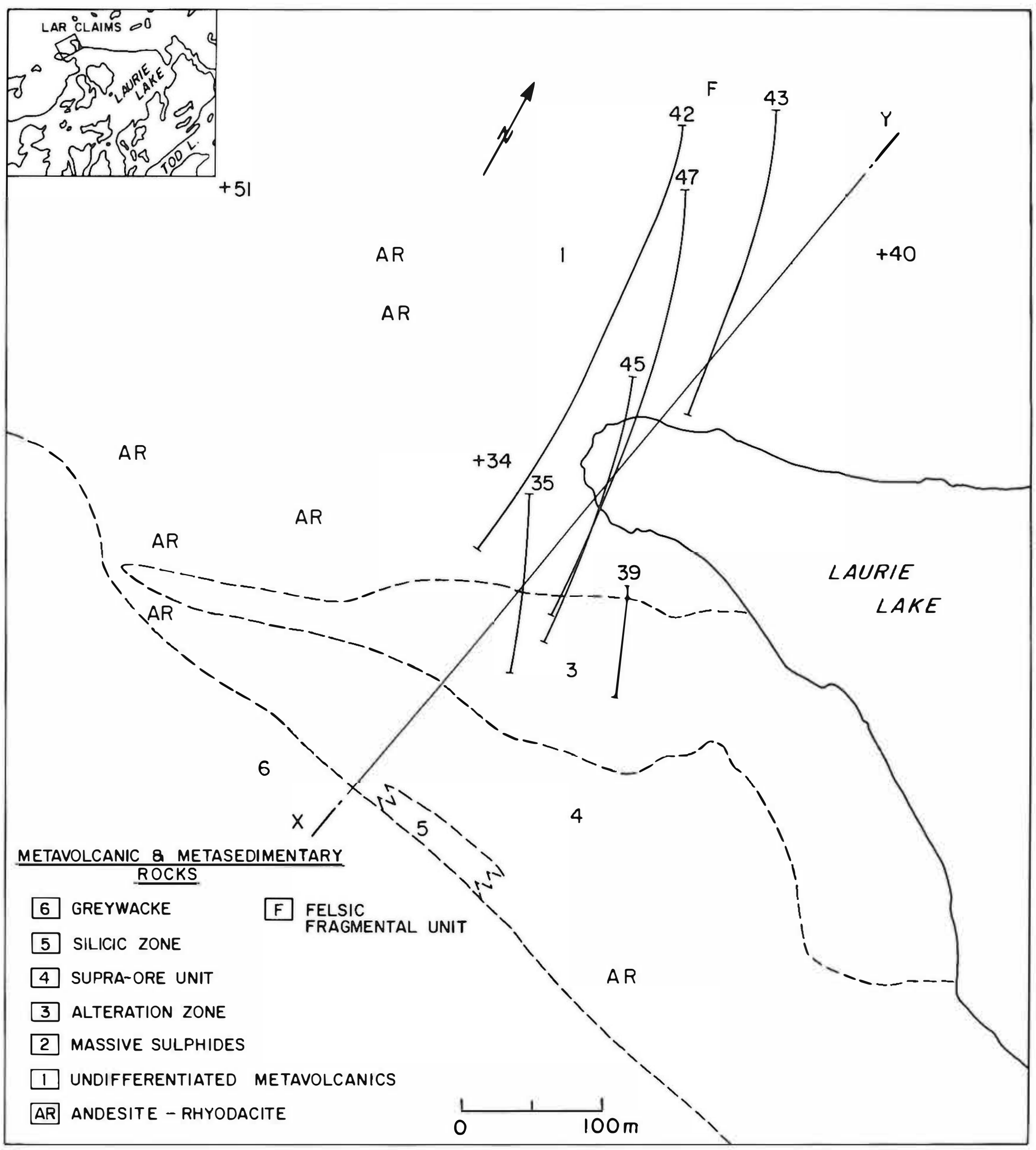


Figure GS-7-1: Revised, generalized surface geology of part of the Lar claims. Surface projections of drill holes utilized in this study are indicated; ± = collar of drill holes logged and sampled but not used in the construction of the cross-section along X-Y (Fig. GS-7-3). Locations where occurrences of andesite/rhyodacite and felsic fragmentals have been identified are marked by AR and F symbols, respectively.

face map of the alteration zone (Fig. GS-7-2) and has permitted the construction of a generalized, synoptic cross-section (Fig. GS-7-3). The previous surface map (Elliott, 1984) has been further refined through the use of thin sections and fifty-nine whole rock and trace element analyses. This report summarizes our current understanding of the deposit.

GENERAL GEOLOGY

The geological setting of the Lar deposit is a south-facing, north-dipping overturned sequence of mafic to felsic volcanic rocks belonging to the Wasekwan Group in the Lynn Lake greenstone belt. Top criteria and structural interpretation have been previously reported by Elliott (1984). The volcanic rocks appear to comprise a possibly bimodal basaltic (low potash tholeiite) and andesite/rhyodacite assemblage, the latter extensively fragmental, with minor intercalated lenses of clastic and/or pyroclastic sedimentary rocks and cherts. The volcanic sequence is overlain by a thick sequence of relatively uniform greywackes (Figs. GS-7-1, GS-7-2, GS-7-3).

The sulphide unit appears to comprise a single flattened stratiform lens, broadly conformable with and near the top of the volcanic sequence (Fig. GS-7-3) although the lack of marker units and the presence of an aureole of intensely altered host rocks precludes an adequate description of the relationship of the ore to its immediate wall-rocks.

Strongly altered host rocks form an irregular wedge- or funnel-shaped area stratigraphically underlying the sulphide zone. These altered rocks are also found, albeit more sporadically, in a heterogeneous sequence of flow rocks, fragmental rocks, cherts and clastic sedimentary rocks which overlie the sulphide lens. These rocks are herein referred to collectively as the 'Supra-ore Unit'. Examination of drill core has revealed that the volcanic rocks stratigraphically below the main alteration and sulphide zone, particularly those of fragmental character, exhibit widespread, less intense alteration effects. The main alteration zone appears to be crudely zoned and is currently divided into four subunits based on the metamorphic mineral assemblages (Fig. GS-7-2).

The dominantly volcanic sequence is capped by a sequence of highly siliceous rocks including both chert and silicified volcaniclastic rocks. These are succeeded by the greywacke unit.

The rocks of the area have been subjected to syntectonic regional metamorphism in the amphibolite facies and to a largely post-tectonic static metamorphism in the hornblende-hornfels facies, the latter possibly associated with the emplacement of a large hornblende-biotite tonalite pluton to the north of the deposit.

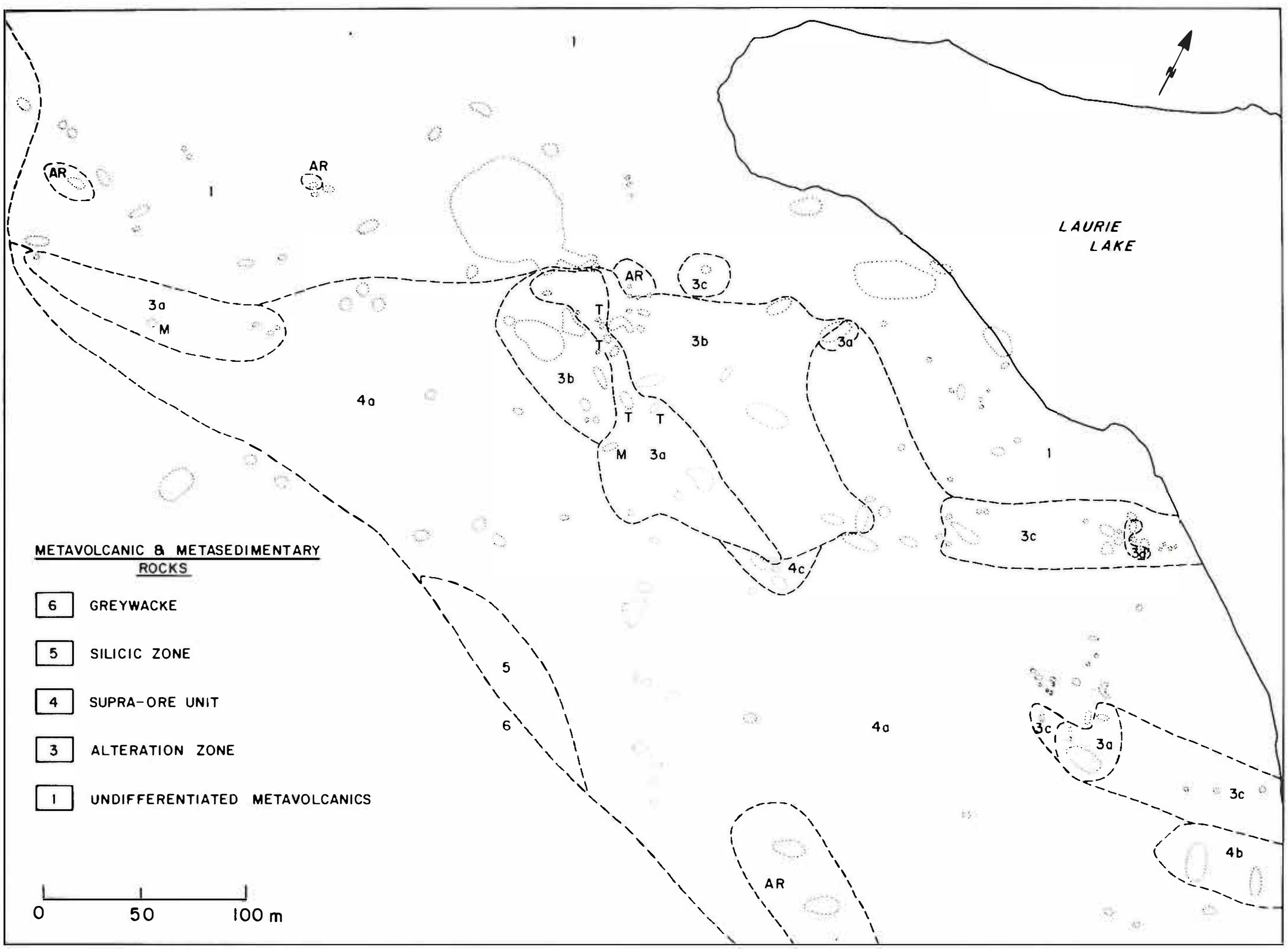


Figure GS-7-2: Detailed outcrop map of the Lar alteration zone. Subunits 3a, 3b, 3c, 3d, 4a, 4b and 4c are identified in the text. Locations where andesite/rhyodacite, tourmaline-bearing and magnetite-rich facies have been observed are indicated by the AR, T and M symbols, respectively.

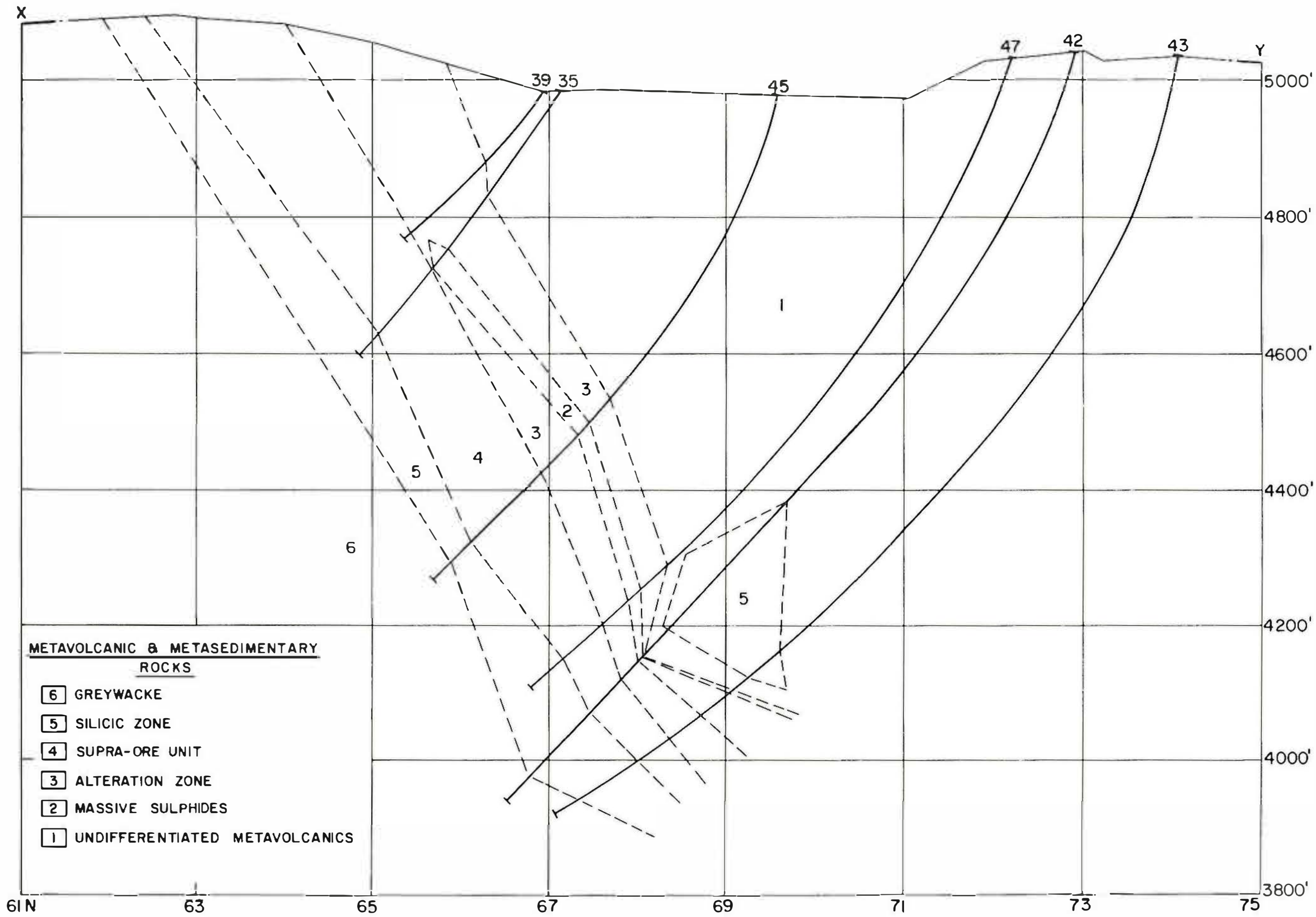


Figure GS-7-3: *Vertical cross-section through the sulphide zone and alteration along the line of section X-Y (Fig. GS-7-1). As indicated on Figure GS-7-1 the holes are not co-planar and have been projected onto this plane to give a generalized, synoptic picture of the sequence. Felsic fragmentals form a significant portion of unit 1 but generally cannot be correlated from hole to hole.*

UNIT DESCRIPTIONS

UNDIFFERENTIATED VOLCANIC ROCKS(1)

This unit includes a complex sequence of discontinuous lenses of basalt, andesite and rhyodacite which stratigraphically underlie the sulphide zone. Similar lithologies occur above the sulphide zone in the Supra-ore Unit.

Surface exposures of Unit 1 are dominated by metabasalts with limited exposures of intermediate varieties (Fig. GS-7-1). Felsic fragmental rocks, however, make up a significant part of the sequence in the subsurface. The unit as a whole, especially the more mafic varieties, is subject to widespread patchy development of epidote, chlorite and carbonate, an effect that appears to be the result of differentiation during regional metamorphism. Most basaltic units appear massive in outcrop although pillow-like structures and some fragmental varieties have been recognized. Basalts are now petrographically amphibolites and usually have a distinct foliation which increases in intensity towards the tonalite pluton to the north.

Intermediate rocks have been designated by AR symbols (for andesite/rhyodacite) on Figures GS-7-1 and GS-7-2. Identification is based on petrographic characteristics and on the element ratio Zr/Ti (Fig. GS-7-4). A generally bimodal distribution of points is observed with a preponderance of values plotting within the basalt field and a lesser concentration distributed in the andesite and rhyodacite fields.

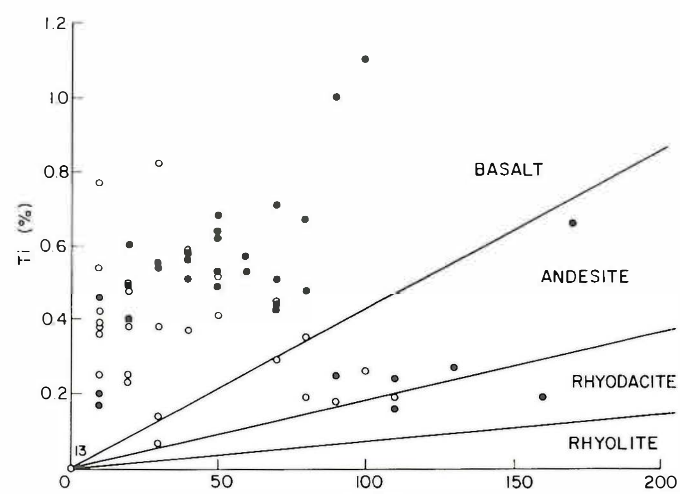


Figure GS-7-4: *Ti vs. Zr plot used to discriminate protoliths. Boundaries between fields are from Petersen (1983 and personal communication), Winchester and Floyd (1977) and Floyd and Winchester (1978). Full circles, data from this study; open circles, data provided by Sherritt Gordon Ltd.*

More mafic varieties of this group are characterized by 10-40% clinopyroxene, up to 10% hornblende, quartz, plagioclase and minor opaques and sphene. Epidote, calcite and minor sericite are commonly present. More felsic varieties have a similar mineral assemblage except that clinopyroxene is much less abundant and epidote and calcite seem to be more extensively developed.

The felsic rocks commonly possess a prominent fragmental structure and can be classified as tuff-breccias (Williams and McBirney, 1979). They typically consist of lapilli- and block-sized angular fragments in an ash-sized matrix. Unaltered varieties indicate that clasts and matrix have similar compositions. Most occurrences, however, have experienced substantial alteration of the matrix and clast margins with the development of abundant, relatively coarse amphibole, biotite and garnet. Fragments usually possess pronounced amphibole-rich reaction rims, 1-2 mm wide, adjacent to the altered matrix.

Previously, the extent of this unit was greatly underestimated (Elliott, 1984) due to poor surface exposure. Examination of diamond drill core indicates Unit 1 to be a major constituent of the subsurface sequence.

MASSIVE SULPHIDES (2)

This unit consists of semi-massive to massive sulphides, specifically pyrrhotite-pyrite + sphalerite + chalcopyrite + magnetite + tetrahedrite with either pyrrhotite or pyrite dominating. Sulphide mineral zonation has not been recognized within the relatively thin sulphide layer. Textural variations between fine grained and coarse grained layers are probably of metamorphic/tectonic origin.

The host rocks appear to be largely intermediate to felsic in composition (the andesite/rhyodacite association); however, extensive alteration and chemical reconstitution of the rocks cannot be ignored.

ALTERATION ZONE (3)

Remapping of the alteration zone at a scale of 1:600 has revealed spatial variations in mineral assemblages resulting in the recognition of four subunits (Fig. GS-7-2).

3a Anthophyllite-cordierite-plagioclase + quartz

This subunit is distinguished by a coarse granularity, strongly developed garbenschiefer texture and a very Mg-rich mineral assemblage. The rock contains 20-30% fascicular to radiating bundles of anthophyllite up to 2-3 cm in length, 30-50% poikiloblastic to porphyroblastic cordierite, 5-10% plagioclase, quartz, minor biotite, chlorite and fine-grained xenoblastic opaques. The chlorite occurs as a retrogressive product of biotite and anthophyllite. Cross-cutting hematite-stained veinlets are common.

Tourmaline enrichment is a common ancillary characteristic of the rocks in the core of the subunit. The tourmaline occurs in quartz-tourmaline veins and in coarse-grained ovoid tourmaline-anthophyllite-quartz pods up to 30 cm in length. Magnetite-rich facies are noted as well (Fig. GS-7-2) with xenoblastic magnetite up to 2 mm in size. One occurrence of euhedral tetrahedrite was discovered.

3b Anthopyllite-cordierite-garnet-plagioclase $\pm$ quartz $\pm$ biotite

The presence of coarse, poikiloblastic garnets is diagnostic of this subunit. A typical assemblage consists of 20-25% anthophyllite, 30-40% cordierite, 20-25% garnet, 5-10% plagioclase, 5-10% biotite, lesser quartz and variable retrogressive chlorite. Opaques comprise less than 8% of the rock. This facies displays the same textural characteristics as subunit 3a. Tourmaline, magnetite and tetrahedrite have not been observed in this rock.

3c Cummingtonite-hornblende-plagioclase $\pm$ garnet

This subunit is defined by the co-existence of cummingtonite and hornblende in varying proportions. The total amphibole content ranges from 30-50% with the hornblende: cummingtonite ratios varying from 10:1 to less than 1:10. Plagioclase content is 40-45%, along with minor microcline which appears to be absent from the cummingtonite-rich samples. Cummingtonite increases toward the core of the alteration zone. Subidioblastic, poikiloblastic garnets 1-5 mm in diameter mark a transition to subunit 3b. Hematite-stained veinlets form a network within most samples.

3d Hornblende $\pm$ biotite $\pm$ chlorite

This subunit has a limited exposure as 1-2 m patches associated with a coarse-grained cummingtonite-garnet-chlorite-plagioclase rock included in subunit 3c. It is composed of nearly 100% amphibole with very minor biotite and chlorite. On the basis of the rock composition the amphibole is classified as alumino-magnesio-hornblende, $Ca_2Mg_4AlSi_7AlO_{22}(OH)_2$. It is not clear whether this subunit is an extreme metasomatic differentiate or was formed from an exotic protolith.

SUPRA-ORE UNIT (4)

'Supra-ore Unit' is the term applied to a sequence of rocks immediately overlying the sulphide zone. It appears to comprise predominantly basaltic rock types but some indications of andesite/rhyodacite and greywacke-type sedimentary rocks were also found. The rocks generally possess a weak foliation; primary features such as pillows, amygdules and fragmental textures have been locally preserved. Thin amygdaloidal flows have been observed intercalated with fine grained basaltic tuffs. Three compositional variants have been distinguished; whether these variations represent primary compositional differences or alteration effects is unanswered.

4a Hornblende-plagioclase

This subunit appears to be relatively unaltered metabasalt and is the subunit most likely to contain primary depositional features such as pillows or amygdules.

4b Hornblende-plagioclase-biotite

This subunit is a biotite-rich variety of the Supra-ore Unit. It includes rocks of both basic and intermediate composition.

In the basaltic varieties, biotite and hornblende define a well-developed foliation. The biotite distribution is usually irregular with streaks comprising 30% biotite interspersed with biotite-sparse hornblende-plagioclase gneiss. This suggests later introduction of potash as an alteration effect. Minor quartz, sphene and calcite are usually present.

4c Hornblende-augite-quartz-plagioclase

A clinopyroxene-bearing facies is located above the top of the alteration zone. It is characterized by 30-40% hornblende, 20-30% augite, up to 20% quartz, up to 25% sericitized plagioclase plus minor opaques and sphene.

SILICIC ZONE (5)

Although this unit is not well exposed it is an important subsurface component. The Supra-ore Unit is capped by a distinctive siliceous layer that has been mapped on surface and at depth as the Silicic Zone. Additional silicic rocks were intersected beneath the alteration/sulphide zone spatially located above zones of biotite-garnet alteration in felsic fragmental rocks (Fig. GS-7-3).

The rocks of the Silicic Zone typically contain 60-80% quartz, and up to 20% plagioclase and microcline forming saccharoidal texture. A distinct foliation is defined by hornblendes (5-15%), opaques (5-8%) and by lensoid quartz and feldspar aggregates. Pyrite tends to be more prevalent than pyrrhotite. Locally opaque minerals replace and pseudomorph grains of hornblende. Sulphides also occur in minor cross-cutting quartz veins. Chlorite, hematite and sericite are minor accessories and epidote and garnet are locally abundant in patches.

GREYWACKE (6)

The greywacke was previously described by Elliott (1984). The typical composition consists of 40-50% quartz, 10-20% hornblende, 20-30% plagioclase and microcline, 0-15% biotite, 0-5% garnet and 1-2% opaques. Chlorite and carbonate are accessories and sericitization of feldspars is locally extensive. A characteristic biotite-rich, microcline-poor variety of greywacke seems to be found at the base of the sequence where it overlies the Supra-ore and Silicic Units.

DISCUSSION

The Lar volcanic pile consists of a mafic base of unknown thickness grading upward into a heterogeneous sequence of discontinuous, intercalated mafic flows and fragmental rocks, intermediate flows and felsic fragmental rocks. The presence of pillows, scour channels in some fragmental units, a few interbeds of greywacke, and chert indicate that the geological setting was a predominantly submarine eruptive centre. No evidence of a felsic plug, dome or capping sequence has been found as is the case in many volcanogenic massive sulphide occurrences. Extensive but relatively moderate alteration has been detected stratigraphically beneath the main alteration zone; however, this area does not conform to the concept of a well-defined stockwork or alteration pipe. Hydrothermal activity appears to have been prolonged at this site and in the general vicinity since it has produced silicic layers and silicified pyroclastic rocks stratigraphically underlying the main ore zone.

The main alteration zone possesses a crude zonal structure with mineral assemblages indicative of strong Mg-enrichment towards the core and a possible outer or superincumbent aureole where K and possibly Ca have been introduced. The alteration zone envelopes the sulphide horizon and forms a blunt tail beneath it indicating the sulphide lens is in situ. With the present level of surface and subsurface information it is not clear whether the sulphide lens was structurally confined to a vent, crater or depression on the volcano surface or whether the discharge site could represent the source for distal, allochthonous mineralization.

The discovery of significant thicknesses of intermediate volcanic rocks within the predominantly basaltic edifice will make the process of quantifying the alteration effects and portraying their spatial distribution more difficult than previously envisaged. Alternatively, it appears that element ratios such as Zr/Ti will adequately identify the protoliths of strongly altered rocks. Beneficial to the study is the fact that the alteration effects are much more extensive than previously recognized and possess a zonal structure implying the action of a more or less coherent hydrothermal system.

REFERENCES

Elliott, S.
1984: A study of the alteration zone associated with the Lar deposit; in Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 20-22.

Floyd, P.A. and Winchester, J.A.
1978: Identification and discrimination of altered and metamorphosed volcanic rocks using immobile elements; Chemical Geology, v. 21, p. 291-306.

Petersen, M.D.
1983: The use of the "immobile" elements Zr and Ti in lithogeochemical exploration for massive sulphide deposits in the Precambrian Pecos greenstone belt of northern New Mexico; Journal of Geochemical Exploration, v. 19, p. 615-617.

Williams, H. and McBirney, A.R.
1979: Volcanology; Freeman, Cooper and Co., San Francisco, 397 p.

Winchester, J.A., Floyd, P.A.
1977: Geochemical discrimination of different magma series and their differentiation products using immobile elements; Chemical Geology, v. 20, p. 325-343.

GS-8 GEOLOGICAL INVESTIGATIONS AT CARTWRIGHT LAKE, MANITOBA

by David C. Peck[1]

INTRODUCTION

During a three-week field season, mapping at a scale of 1:12 000 extended the coverage of the 1:2 400 map produced during the 1984 field season (Peck, 1984, p. 26) and included all of the terrain immediately surrounding Cartwright Lake. Approximately 200 samples were collected; the majority of these samples will be used for whole rock geochemical analysis. All analytical data will be presented in a forthcoming M.Sc. thesis at the University of Windsor.

GENERAL GEOLOGY

The study area (Fig. GS-8-1) is situated in the southern end of the two belts of volcanic rocks that compose the Lynn Lake greenstone belt. The supracrustal sequence at Cartwright Lake makes up part of the south limb of the McVeigh Lake anticline (Gilbert et al., 1980, map GP80-1-2). Whole-rock Rb-Sr age determinations (Clark, 1980) indicate that all rock units are Aphebian. Supracrustal rocks belong to the Wasekwan Group, and intrusive rocks are pre-Sickle in age (Gilbert et al., 1980).

Major unit descriptions were presented in the 1984 Report of Field Activities (Peck, 1984, p. 25-27). Mapping conducted during the 1985 field season revealed that a conformable mafic to felsic volcanic succession exposed at the southeast end of Cartwright Lake extends toward the northern margin of the study area (Fig. GS-8-1). The sequence appears to be continuous along strike to the western end of the lake; however, outcrop is very sparse over most of the western half of the map area. Microscopic examination of the mineralogy and fabrics of the major rock types indicates that all units were affected by two episodes of regional metamorphism. The majority of lithologic units have upper greenschist facies metamorphic mineral assemblages, although amphibolite facies assemblages are locally developed.

Initial geochemical data indicate that mafic metavolcanic rocks (unit 1) are predominantly basaltic in composition. These units are characterized by a wide variety of structures and textures. Exposures of aphyric and plagioclase-phyric flows, amygdaloidal flows, and heterolithic volcanic breccias at the north end of the study area are distinct in surface expression from mafic metavolcanic rocks outcropping to the south. The northern volcanics have a dark grey colour, and are often plagioclase-phyric. The southern mafic volcanics have a grey-green colour, are predominantly aphyric, and have more abundant carbonate and epidote. Gilbert et al. (1980) identify these northern units as the eastward continuation of the Cockeram Lake tholeiitic basalt. The volcanic rocks exposed at the southeast end of Cartwright Lake are a calc-alkaline succession thought to have been derived from a stratavolcano which developed on the Cockeram Lake basaltic platform (Gilbert et al., 1980, p. 45). Thickening of rhyolite flows (3a) and coarsening of fragment size in volcanic breccias (1f) indicate that the vent lies to the east of the study area. The coarseness of lithic fragments in the breccias suggests a proximal location of deposition.

STRUCTURAL GEOLOGY

A detailed examination of structures in metasedimentary rocks (4) and foliated quartz diorite (5b) at the south end of Cartwright Lake was completed during the recent field season. Two distinct structural trends were identified. The oldest is an east-northeasterly trending penetrative foliation (S_1). The S_1 foliation developed during the main episode of regional deformation (D_1) which affected all units in the study area. The deformation culminated with easterly-trending isoclinal folding. S_1 foliations are generally layer-parallel and have an average strike of 070, and a mean dip of 70 degrees to the north. A major anticlinal fold (F_1) was inferred on the basis of outcrop pattern, local top criteria in bedded rhyolite breccias (3a), and minor fold orientations. Provided that the interpreted age relationship between the Cockeram Lake basalt and the Cartwright Lake calc-alkaline sequence is correct, then a major synclinal fold exists to the north of the anticline.

Superimposed on the S_1 foliation is a northeasterly-trending nonpenetrative crenulation cleavage (S_2). These structures are also locally developed as minor folds and fractures related to the cleavage. Minor fold surfaces are well developed in the metasediments. Fold axes trend from 040 to 060 and plunge from 40 to 75 degrees to the northeast. Regionally, F_2 folding deforms the stratigraphy into relatively evenly spaced, northeasterly-trending open folds. All rock units in the map area show some evidence of the D_2 regional deformation. F_2 folding causes abrupt changes in orientation of the S_1 foliation which characterize the study area.

A major fault, inferred on the basis of offsets of the stratigraphy, follows the northeast arm of Cartwright Lake, and appears to terminate to the south at mid-lake. The fault has a sinistral sense of horizontal movement, and a minimum of 650 m of lateral displacement is indicated.

RE-APPRAISAL OF THE JOHNSON SHEAR ZONE

Bates and Jackson (1979, p. 575) define a shear zone as: "A tabular zone of rock that has been crushed and brecciated by many parallel fractures due to shear strain." The Johnson Shear Zone was originally described as a series of thin zones characterized by shearing, fracturing and quartz veining in Wasekwan Group rocks of Reservoir Lake, 15 km to the west of Cartwright Lake (Bateman, 1945, p. 31). This zone of fracturing and silicification was found to extend for several km along an east-west trend. Gold mineralization was first reported in sulphide-rich fractures and quartz veins within the shear zone in 1938. Numerous claims were staked along the "Johnson Shear Zone" in a period of active gold exploration in the early 1940s. Milligan (1960, p. 249) described the Johnson Shear as a zone of brecciation, fracturing and mineralization, which varied in thickness from 1 to 13 m. Although the term has been widely used over the years, and carries definite metallogenetic connotations, the structural significance of the Johnson Shear Zone has never been adequately defined.

During the 1984 field season, distinct shearing textures were observed in foliated quartz diorite (5b) and adjacent metasedimentary rocks (4b) at the southern end of Cartwright Lake. Microscopic examination of petrofabrics confirmed the existence of locally developed blastomylonitic textures in these units. It was concluded that the Johnson Shear Zone continued through the study area along the contact between these two units.

Structural studies conducted during the 1985 field season have led to a re-evaluation of this conclusion. Under the supervision of Dr. Paul Holm (University of Windsor) a closer examination of minor structures along the Johnson Shear was undertaken. New observations indicate that the intensity of deformation observed along this contact is not sufficient to warrant the usage of the term "shear zone". The textures and structures identified in the zone, including the shearing fabric, are readily explained by regional deformation (D_1), and are not indicative of a more intense deformational process. The shearing textures are thought to have developed during the D_1 event, due to differential

[1]University of Windsor

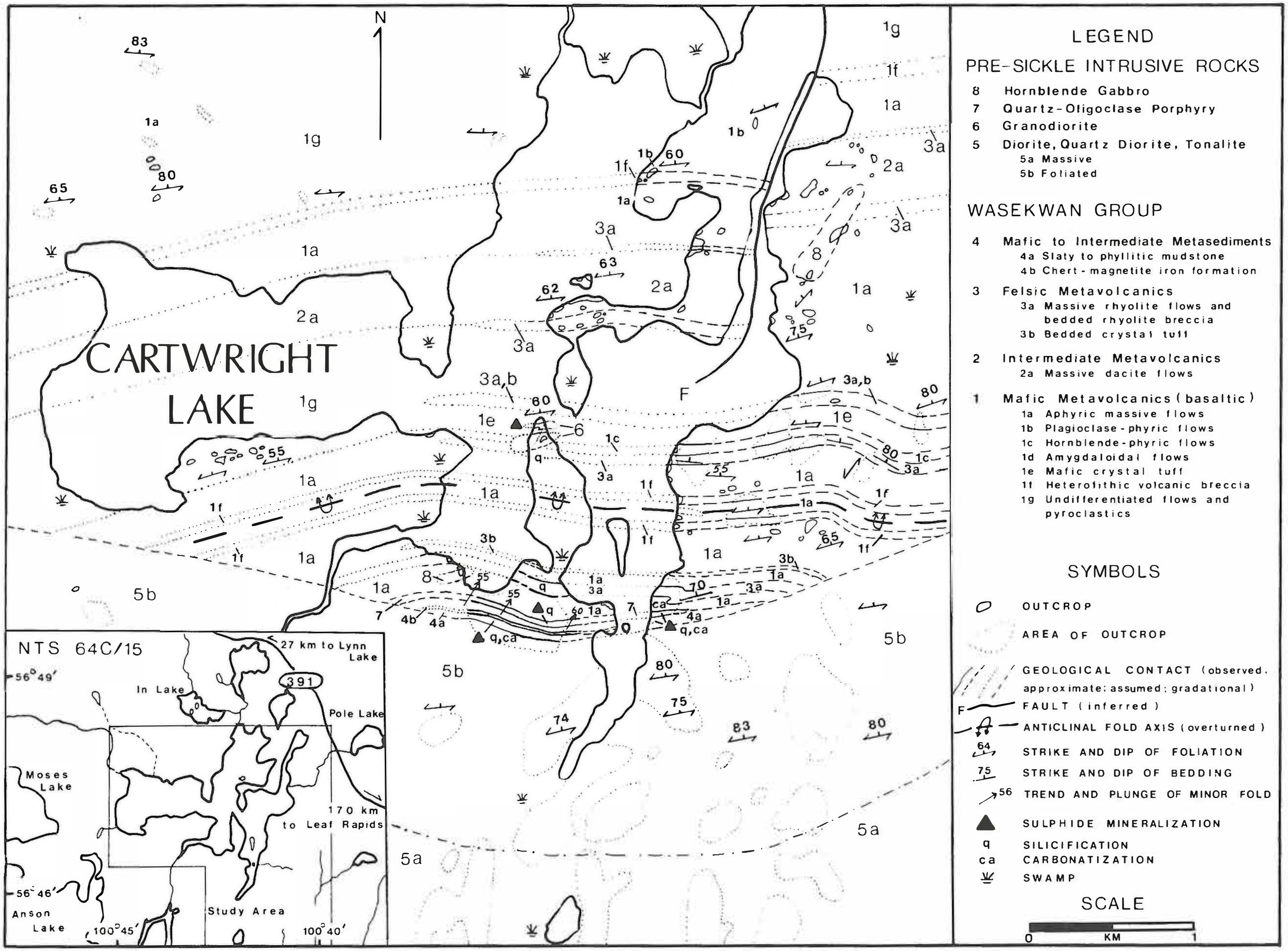


Figure GS-8-1: Geology of Cartwright Lake area.

movement along a contact between two distinct lithologies. A large ductility contact would be expected to exist between a relatively brittle and homogeneous diorite intrusive unit, and a more ductile and anisotropic mafic metasediment. During regional deformation, shear strain would be expected to occur along such a distinct contact.

Examination of the 1:50 000 geologic maps of the Lynn Lake greenstone belt (Gilbert et al., 1980) shows that the Johnson Shear Zone adheres to the intrusive contact described above over most of its defined areas of occurrence. Currently, the Shear Zone extends some 25 km west of McVeigh Lake to One Island Lake, and may extend eastward as far as Digny Lake (D. Baldwin, pers. comm.). The fact remains that no conclusive structural evidence has been presented which justifies the designation of this extensive belt as a shear zone. It is possible that shearing fabrics observed at other sites along the zone may also have been induced by differential movement at the intrusive contact during the major D_1 regional deformation. Since the "Johnson Shear Zone" remains an important prospect for gold mineralization, a re-appraisal of the usage of this term is necessary.

ECONOMIC GEOLOGY

An exploration program that included diamond drilling was initiated in 1984 by Sherritt Gordon Mines Ltd. at the Bonanza claim group located at the southeastern end of Cartwright Lake. Drilling continued into 1985, and anomalous gold values were reported in quartz-oligoclase porphyry (7) as well as in a silicified mafic volcanic flow (1a).

As part of the present study, assay results from a sampling program conducted during the 1984 field season indicate a scattered distribution of gold mineralization within the porphyry. Gold is spatially associated with sulphide-rich fractures and quartz veins, and has a strong positive correlation with Fe and S. No trace elements have been found which might be used as indicators for future exploration.

Close inspection of silicified metasediment at the south end of Cartwright Lake revealed the presence of very fine grained disseminated sulphides, which locally account for greater than 5% of the bulk mineralogy. Forty surface and core samples were collected for assaying from this unit during the 1985 field season.

It appears that sulphide and related gold mineralization was introduced into the porphyry by hydrothermal fluids enriched in Si, CO_2, S, Ca, Na, Mg, K, Fe and Pb. These fluids invaded an extensive fracture system which was already developed in the intrusive unit. Sulphide mineralization occurs in thin discontinuous fractures and quartz veins, and can account for up to 15% of the bulk mineralogy. Pyrite is the dominant sulphide mineral, but galena is locally abundant. Rare occurrences of fine grained chalcopyrite, arsenopyrite and molybdenite were observed in the porphyry. Quartz is the dominant gangue mineral, and constitutes from 0 to 100% of the hydrothermal mineral assemblage. Other common gangue minerals are ankerite, dolomite, calcite, biotite and muscovite. Dravite (Mg tourmaline) was indentified by X-ray diffraction, and occurs in many places as black, microcrystalline aggregates that partially fill fractures. Fluorite was reported from drill core examination (C. Taylor,[2] pers. comm.). No visible gold has been encountered in the porphyry, but sulphide-rich core samples with known gold values were collected for electron microprobe analysis to aid in defining the nature of the gold mineralization.

Extensive silicification, carbonatization and epidotization in unmineralized mafic volcanic flows adjacent to the porphyry indicate an extensive hydrothermal circulation system once affected these rocks. Sulphide-rich veins are commonly deformed by S_2 structures indicating that the age of mineralization is clearly pre-D_2. The most likely age of mineralization is syn-D_1. During this major deformational event, sufficient energy would have been available to initiate circulation of fluids through the rocks. The fluids may have been derived in part or completely from the magma chamber that gave rise to the pre-tectonic, pre-Sickle intrusive rocks in the study area.

This suite of intrusive rocks may be genetically related. Dykes of albitite and quartz porphyry crosscut both diorite (5) and granodiorite (6). In both cases, sulphide-bearing quartz veins transect these dykes, and the dykes are commonly boudinaged parallel to the S_1 foliation. Rare-earth element chemistry will be used to determine whether or not the diorite, granodiorite and quartz porphyry are part of a single differentiation sequence. If this is the case, then late stage siliceous fluids may have been released from the magma chamber during regional deformation, and after the last major intrusive event. It is unclear if the hornblende-gabbro dykes are coeval with the other intrusive rocks. Milligan (1960, p. 59) describes a gabbro body immediately north of the northwest corner of the study area, that predates the major diorite intrusion, but is clearly post-Wasekwan in age.

Based on field observations and geochemical data, a preliminary genetic model can be proposed for the gold occurrences at Cartwright Lake. Siliceous fluids, possibly derived from the final stages of evolution of the major intrusive event in the area, were circulated through Wasekwan Group rocks during D_1 regional deformation. The fluids may have carried primary gold, but some gold was probably leached from mafic volcanic and sedimentary rocks. In addition, CO_2, S, Ca, Na, Mg, Fe, K, plus other metals were derived from these units. These elements were carried by the fluids and were later deposited in physically favourable sites in fractured quartz-oligoclase porphyry. Sulphide mineralization in metasedimentary rocks was primarily chemically controlled, or may in fact be syn-depositional in origin. Intense silicification, carbonatization and epidotization are ubiquitous features of the hydrothermal alteration throughout the mineralized zone.

SUMMARY

Field work at Cartwright Lake was completed in 1985. Consideration of all field observations and analytical data leads to the following interpretation of the geologic evolution of the study area (events are listed from oldest to youngest):

1) Formation of the Cockeram Lake tholeiitic basalt.
2) Development of the Cartwright Lake calc-alkaline succession on the western flank of the tholeiitic shield.
3) Intrusion of gabbro, diorite, granodiorite and quartz oligoclase-porphyry into supracrustal rocks.
4) Major D_1 regional deformation, trending east-northeasterly. Rocks attained upper greenschist facies of regional metamorphism during F_1 isoclinal folding. D_1 activated a hydrothermal circulation system which led to sulphide and gold mineralization in intensely fractured felsic intrusives, and possibly in chemically favourable mafic sediments and volcanics.
5) D_2 regional deformation trending easterly. Possibly local increase in metamorphic grade to lower amphibolite facies. Gentle open folding and development of non-penetrative S_2 structures.

REFERENCES

Bateman, J.D.
1945: McVeigh Lake area, Manitoba; Geological Survey of Canada, Paper 45-14.

Bates, R.L. and Jackson, J.A.
1979: Glossary of Geology (2nd edition); American Geological Institute, Falls Church, Va., 751 p.

Clark, G.
1980: Rubidium-strontium geochronology in the Lynn Lake greenstone belt, northwestern Manitoba; Manitoba Mineral Resources Division, Geological Paper GP80-2.

[2]Sherritt Gordon Mines Ltd.

Gilbert, H.P., Syme, E.C. and Zwanzig, H.V.
1980: Geology of the metavolcanic and volcaniclastic metasedimentary rocks in the Lynn Lake area; Manitoba Mineral Resources Division, Geological Paper GP80-1.

Milligan, G.C.
1960: Geology of the Lynn Lake district; Manitoba Mines Branch, Publication 57-1, 317 p.

Peck, D.C.
1984: An investigation of gold mineralization at Cartwright Lake, Manitoba; Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 25-27.

GS-9 EVALUATION OF INDUSTRIAL MINERAL OCCURRENCES IN THE LYNN LAKE AREA

by W.R. Gunter and P.H. Yamada

A reconnaissance program was conducted to identify deposits of industrial minerals in the Lynn Lake volcanic belt. The investigation concentrated on an evaluation of cross-cutting metamorphosed alteration zones associated with massive sulphide deposits. The locations of the occurrences investigated are shown in Figure GS-9-1. Mineral volumes were determined by counting the number of grains of a particular size range in a 15 x 15 cm square (Table GS-9-1). The cumulative area of all the various crystal sizes is expressed as a percentage of the total area.

The Lynn Lake area encompasses a volcanic belt similar in many respects to the Flin Flon-Snow Lake volcanic belt. Metamorphosed alteration zones associated with massive sulphide deposits are potential sources of industrial minerals for abrasive and refractory use. A period of regional retrograde metamorphism has resulted in a change in mineralogy in the affected metamorphosed alteration zones. Four deposits in the Fox Mine area — the New Fox, the Gran, the Lar and the Bag — appear not to have undergone retrogressive metamorphism.

THE NEW FOX

The New Fox was originally mapped by P. Stewart (written comm. 1985) who outlined the alteration zones. A detailed study was undertaken to establish the industrial mineral potential of the garnet-bearing rock. The mineralogy of the three spatially separated zones which make up the New Fox are similar; this suggests that the zones are part of one alteration system.

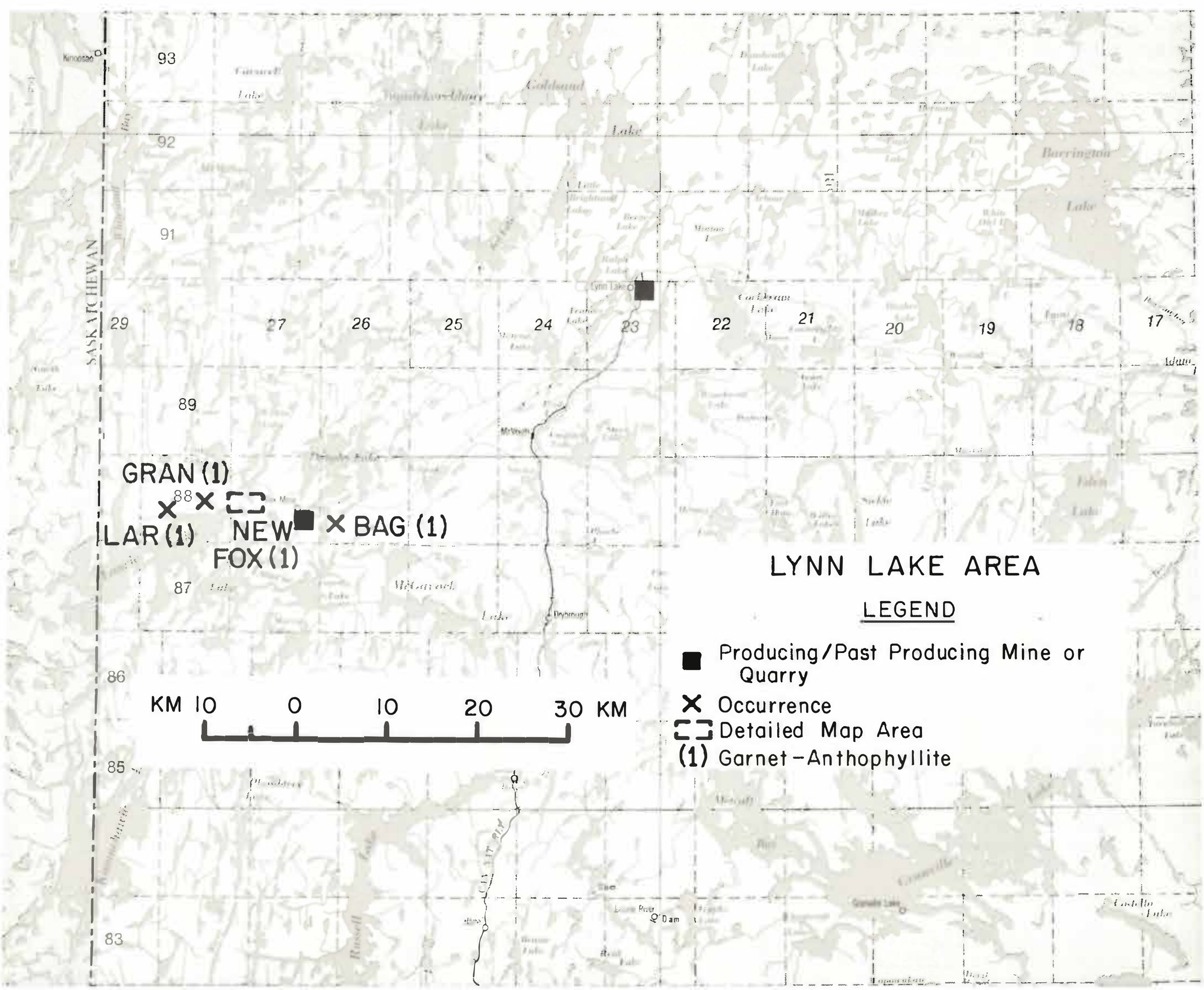


Figure GS-9-1: Location of industrial mineral occurrences in the Lynn Lake area.

Almandine, cordierite, and anthophyllite with minor magnetite, biotite, quartz and feldspar have been identified. The most common mineral assemblages are: garnet-anthophyllite-cordierite; cordierite-anthophyllite; garnet-anthophyllite; and, anthophyllite. Garnet-cordierite was not encountered.

The west zone contains the most abundant garnet; however, almost all rocks are garnet-bearing, with several units containing more than 40% garnet. The garnet content decreases systematically eastward (Fig. GS-9-2). In the central zone the garnet is an abundant, though not dominant, mineral in a matrix of anthophyllite and cordierite. In the eastern zone garnet forms thin bands within an anthophyllite-cordierite assemblage.

THE LAR

The Lar deposit has a large alteration zone (Elliot, 1984) with lenses of moderately garnet-rich anthophyllite-garnet schist. These lenses are interlayered with greenish to green-grey amphibole-cordierite assemblages. Locally the amphibole-cordierite rock contains abundant tourmaline knots, indicating that the parent of the amphibole-cordierite rock contained appreciable boron.

The Lar Zone was the only property examined where the garnets were significantly elongated. A unit which ranged in thickness from 10 to 50+ metres on the west and north side of the alteration zone contains flattened and elongated garnets and 1 mm to 5 mm thick rod-like aggregates of snowball-type garnets. The zone of elongated garnet borders a unit of mafic fragmental rocks and the garnet deformation decreases almost immediately away from the contact. The thickness of the elongated garnet zone increases to the northeast where the strike of the surrounding units changes from N-S to NE-SW.

TABLE GS-9-1
MINERAL ABUNDANCE FOR INDUSTRIAL MINERAL OCCURRENCES IN THE LYNN LAKE AREA

LOCATION	MINERAL	PERCENTAGE		
		LOW	HIGH	AVERAGE*
Gran occurrence	garnet	1	12	6
New Fox occurrence				
West Zone	garnet	6	19	11
Central Zone	garnet	4	8	7
East Zone	garnet	3	12	8
Lar occurrence	garnet	4	38	17
Bag occurrence	garnet	1	8	2
	staurolite	4	24	11
	sillimanite	4	5	4

*Average represents Arithmetic mean

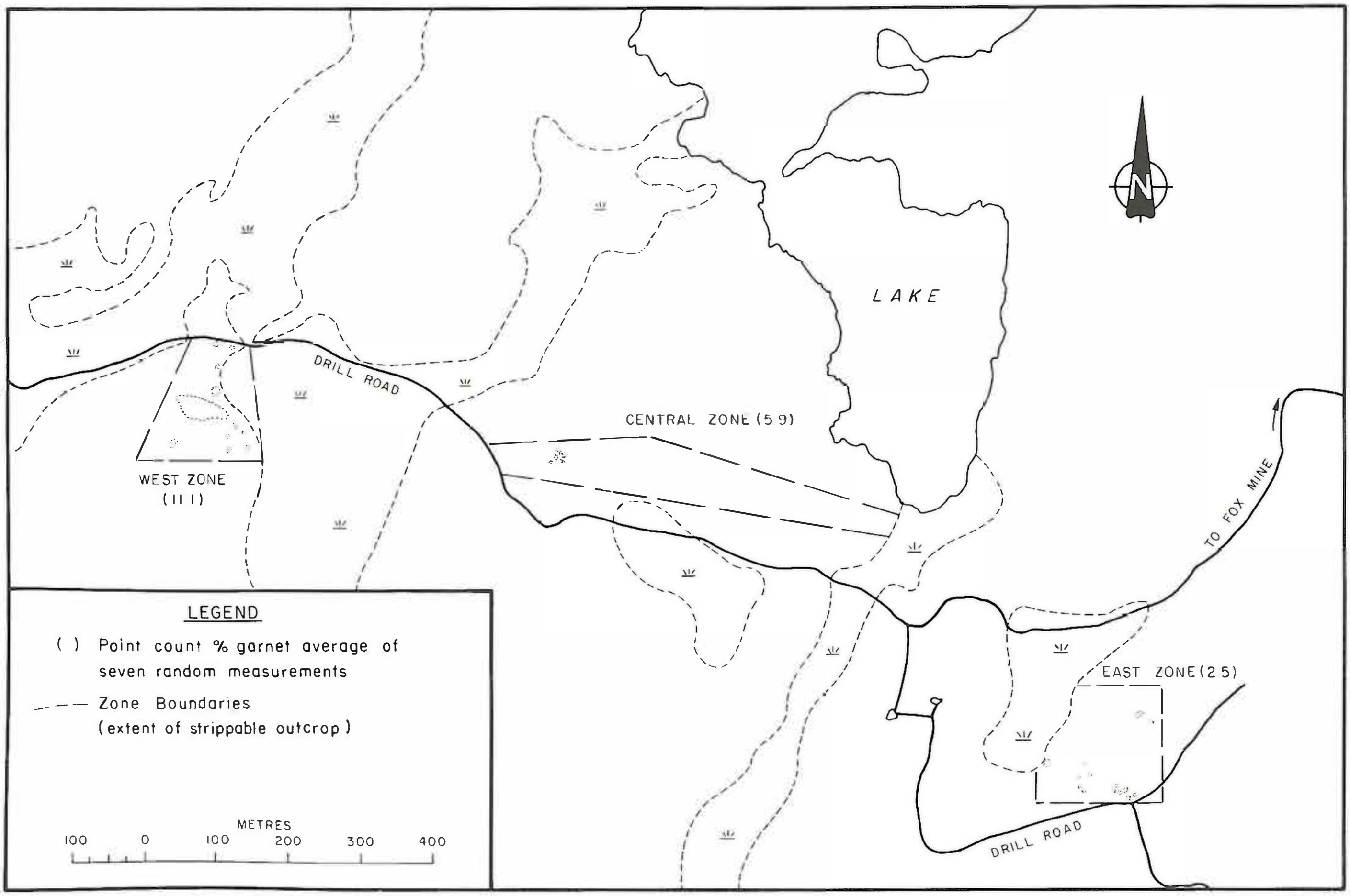


Figure GS-9-2: Garnet occurrences, New Fox Zone, Lynn Lake area.

THE GRAN

The Gran Zone is a relatively small, poorly exposed garnet-anthophyllite unit about midway between the Lar and the New Fox. The zone has two areas of outcrops separated by approximately 500 m of cover. The mineralogy of the unit is similar to the New Fox and the Lar but the garnets are subhedral crystals rather than the snowball type.

THE BAG

The Bag Zone occurs within the Snake Lake Dacites on the east side of the Snake Lake. The host rock is a garnet-staurolite, or sillimanite-bearing felsic gneiss. The Bag Zone consists of three 4 to 5 metre wide bands of an anthophyllite-cordierite rock with only minor garnets. The surrounding rock contains a significant percentage of sillimanite as quartz-sillimanite knots.

REFERENCES

Elliot, S.R.
1984: A study of the alteration zone associated with the Lar Deposit; Manitoba Mineral Resources Division, Report of Field Activities, p. 20-22.

Gilbert, H.P., Syme, E.C. and Zwanzig, H.V.
1980: Geology of the metavolcanic and volcaniclastic metasedimentary rocks in the Lynn Lake area. Manitoba Mineral Resources Division, Geological Paper GP80-1.

Milligan, G.C.
1960: Geology of the Lynn Lake district; Manitoba Mines Branch Publication 57-1.

GS-10 ATHAPAPUSKOW LAKE PROJECT

by Eric C. Syme

INTRODUCTION

A new 1:20 000 mapping project is scheduled to begin in 1986 in the Athapapuskow Lake region of the Flin Flon metavolcanic belt. The map area is bordered on the north by the Flin Flon-White Lake project (Bailes and Syme, in prep.) and extends south to the margin of Paleozoic cover (Fig. GS-10-1). The proposed mapping is part of a long term program to upgrade the quality of the geological data base, required to support effective mineral exploration in the belt. At present the only published maps in the area are those of Tanton (1941) and Buckham (1944) at a scale of 1:63 000, and a small area covered by Heywood (1966) at a scale of 1:12 000. Specific objectives of the Athapapuskow Lake project will include:

(1) definition of Amisk Group volcanic stratigraphy, and its relationship to the stratigraphy now established in the Flin Flon area (Bailes and Syme, in prep.);
(2) stratigraphic and structural setting of mineral occurrences (e.g. West Arm Cu-Zn sulphide deposit (Fig. GS-10-1); mineral occurrences shown by Parbery and Gale, 1984);
(3) definition and extension of the fault-bounded blocks which dominate the structure in the Flin Flon-White Lake area (Bailes and Syme, 1983);
(4) geochemistry of igneous units.

One month of fieldwork was conducted this summer to determine the suitability of the area for detailed 1:20 000 geological mapping. Outcrop is generally sufficient, but clean, lichen-free exposures are confined to the Schist Lake area. Major volcanic and intrusive units depicted on the older maps were investigated in a reconnaissance fashion to determine the variety in rock types and stratigraphic facing. Major faults were mapped, and the extent of a very low grade (prehnite-pumpellyite) metamorphic domain was established. As part of an ongoing U-Pb zircon geochronology program, samples were obtained from 2 felsic units and a gabbroic pegmatite, all of which are in the Flin Flon-White Lake project area.

STRUCTURAL SETTING

Previous mapping in the adjoining Flin Flon-White Lake area has demonstrated the importance of fault-bounded blocks in this part of the Flin Flon metavolcanic belt (e.g. Bailes and Syme, 1983). Fault blocks are typically characterized by differing volcanic stratigraphy, internal structural character and contained intrusive suites. Most of the blocks in the Flin Flon-White Lake area have a lateral extent of several kilometres, and thus are only partially contained in that map area. This project will provide more information on the nature of block boundaries, the relationships between blocks, and the geometry of fault blocks. Some of the major structures encountered or extrapolated during this reconnaissance work are described below.

INLET ARM FAULT

The continuation of this major, north-trending fault was mapped to the area of low outcrop density south of Schist Creek (Fig. GS-10-1); it now has a known lateral extent of 20 km.

On Schist Lake the Inlet Arm fault separates prehnite-pumpellyite grade rocks (on the west) from greenschist grade rocks (on the east), indicating that the fault has a considerable displacement and is younger than the regional metamorphism. Significant differences are shown in the style of deformation associated with the fault. On the very low grade side, rocks within about 150 m of the fault contain discrete narrow quartz-carbonate-filled breaks and subordinate wider shear zones oriented generally parallel to the Inlet Arm fault. Commonly, however, the rocks are unfoliated and primary structures are well preserved. In contrast, on the greenschist grade side a wide (up to 900 m) zone of much more intense deformation is associated with the fault: the rocks have undergone moderate to very strong ductile deformation and attenuation of primary structures, local injection of pegmatitic **lits**, and subsequent development of southerly-plunging upright folds with axial plane cleavage oriented parallel to the fault. Rocks within the zone of deformation are mainly epidotized basaltic andesite pillowed flows; epidosite domains in the flows have been drawn out into augen or planar structures (Fig. GS-10-2). The resulting banded epidosites have virtually all primary flow structures completely obliterated.

Deformation in the Northeast Arm of Schist Lake is further complicated in that the Inlet Arm fault deformation truncates structures associated with the Northeast Arm syncline and Northeast Arm fault (Bailes and Syme, 1980). Folds associated with the Northeast Arm syncline appear to be upright, northeast-plunging structures with northeast-trending axial planes. These rocks have been intruded by a diverse suite of felsic, mafic and ultramafic intrusions which are pre- to post-folding in age.

ROSS LAKE FAULT

The southern extension of the Ross Lake fault is marked by a major escarpment in the Northwest Arm of Schist Lake, and by the juxtaposition of Missi Group conglomerate and Amisk Group rocks at the south end of Schist Lake. Unlike the Inlet Arm Fault, the Ross Lake fault is not marked by a significant zone of deformation or schistosity.

PINEROOT RIVER AND CENTENNIAL FAULTS

A system of closely spaced faults which extend along the Pineroot River to Whitefish Lake and Mikanagan Lake (Bailes and Syme, 1980) opens up on Athapapuskow Lake to enclose a folded succession of Missi Group conglomerate and sandstone (Fig. GS-10-1). The Missi Group on Athapapuskow Lake appears to have been metamorphosed to prehnite-pumpellyite grade, but this has yet to be verified by thin section examination.

NORTH ARM FAULT

A major fault that trends through the North Arm of Athapapuskow Lake separates the southeast-facing Bakers Narrows Block from the west-facing Sourdough Bay Block (Bailes and Syme, 1980). The southern extension of this fault extends through the northern part of Athapapuskow Lake (Fig. GS-10-1) and separates greenschist grade rocks (in the east) from very low grade rocks (in the west). The very low grade rocks comprise at least three separate, magnetiferous diorite and quartz diorite sills intruded into a northwest-facing fine grained clastic sedimentary sequence of greywacke, siltstone, black mudstone and siliceous grey argillite. The sediments occur as thin screens between sills.

MISTIK CREEK FAULT

A tectonic break at least 50 m wide, exposed on the south shore of Neso Lake, corresponds with a southwest-trending topographic lineament which extends east, out of the map area, and west into Athapapuskow Lake (Fig. GS-10-1). The exposed portion of the zone comprises strongly flattened pillowed basalt flows and diorite sills, intruded on the south by a buff to pink granitoid dyke at least 20 m wide.

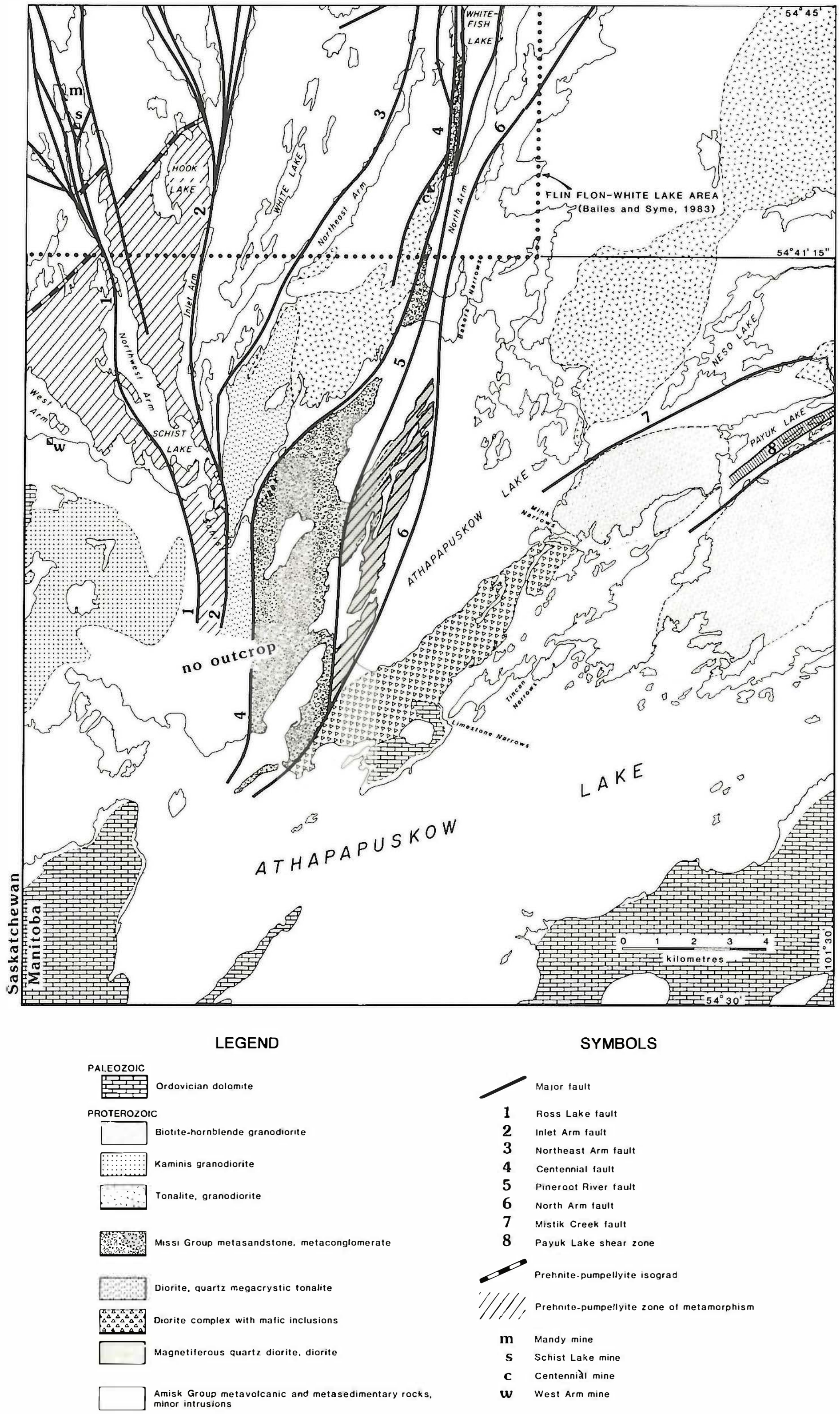


Figure GS-10-1: *Athapapuskow Lake project area (south of 54° 41' 15") with geology modified from Tanton (1941) and Buckham (1944). Some of the major faults juxtapose blocks with contrasting rock types and metamorphic grade (e.g., Inlet Arm fault and North Arm fault), others appear to host vein-type Au occurrences (e.g., Mistik Creek fault).*

Figure GS-10-2: *Banded epidosite derived from pillowed basaltic andesite; within the zone of intense deformation associated with the Inlet Arm fault.*

The mafic flows display an alternation of high strain and lower strain schist zones; the intensity of overall deformation increases toward the granitoid contact. The granitoid rock is foliated, locally intensely brecciated, and contains a quartz stockwork. Open spaces between angular granitoid tectonic fragments are filled with quartz, carbonate and chlorite. The quartz stockwork has been extensively sampled, presumably for Au. Other gold occurrences in the Neso Lake-eastern Athapapuskow Lake area (Parbery and Gale, 1984) are probably related to this structure and associated, more northerly-trending faults.

PAYUK LAKE ZONE

A wide zone of deformed basalts and diorite extends through Payuk Lake (Fig. GS-10-1) and is probably laterally equivalent to a "carbonatized and sheared" zone to the east, on Twin Lakes (Parbery and Gale, 1984). Rocks within the zone have been tectonically brecciated, with carbonate + quartz subsequently introduced into open spaces. This brittle deformation is overprinted by discrete zones of more intense, ductile deformation resulting in attenuation of tectonic fragments and the development of schistosity.

ROCK TYPES

Fieldwork in 1985 was reconnaissance in nature, so detailed description of rock types is premature. Most of the Amisk Group rocks in the area are basalts and basaltic andesites comprising mappable units differentiated by weathering colour and phenocryst content. Sill-like to irregular bodies of diorite and quartz diorite are common and vary widely in colour, grain size and texture. A large diorite complex south of Mink Narrows (Fig. GS-10-1, unit laA "dioritized greenstone" of Buckham, 1944) is composed of medium grained, inhomogeneous diorite and quartz diorite with locally abundant small, dark green mafic xenoliths.

A suite of medium to dark green weathering aphyric basalts and mafic volcanogenic sediments with minor interbeds of iron formation outcrops on the islands in the southeast part of Athapapuskow Lake. The basalts and sediments are intruded by sills of quartz diorite, diorite and gabbro and at least one of the sills has an ultramafic phase. Most of the supracrustal and intrusive rocks contain disseminated fine grained magnetite and are moderately to strongly magnetic. The distribution of these magnetiferous rocks on Athapapuskow Lake corresponds on recent aeromagnetic maps (Hosain, 1984) to a northeast-trending zone characterized by high magnetic total field and bands of positive and negative vertical gradient anomalies. This magnetic signature (Domain B in Hosain, 1984) is markedly different from the comparatively featureless magnetic signature of Amisk and Missi Group rocks to the north (Domain A in Hosain, 1984). The stratigraphic position and magmatic affinity of these distinctive basalts, relative to the low-magnetic suite to the north, will be of particular interest in subsequent phases of this project.

At Neso Lake another distinctive group of volcanic rocks is exposed. These are intermediate to felsic in composition (andesite, dacite and rhyolite), in contrast to the strongly bimodal basalt-basaltic andesite/minor rhyolite compositions which characterize the Amisk Group elsewhere in the Flin Flon-Athapapuskow region. The intermediate rocks are typically light buff, massive, plagioclase-phyric, and very weakly foliated. Primary flow structures (pillows, amygdales, flow breccia) are rare. An associated rhyolite unit is massive and contains quartz phenocrysts. At the north end of Neso Lake the intermediate volcanic suite is underlain by southeast-facing, aphyric, pillowed mafic flows.

METAMORPHISM

Greenschist facies mineral assemblages dominate in the Flin Flon-Athapapuskow region, but very low grade (prehnite-pumpellyite) assemblages have been reported in the Hook Lake area (Bailes and Syme, 1983). Work this year confirms that this very low grade zone extends south to the Schist Creek-West Arm (Schist Lake) area (Fig. GS-10-1). The Inlet Arm fault juxtaposes these weakly deformed very low grade rocks against much more strongly deformed greenschist facies rocks (Fig. GS-10-1); there are indications that the southern margin of the very low grade zone similarly terminates against a fault through West Arm (Schist Lake). In a parallel structural pattern, domains of very low grade Missi Group and Amisk Group rocks are bounded by major faults on Athapapuskow Lake (Fig. GS-10-1). Within all of the prehnite-pumpellyite zones primary structures and textures are very well preserved, and phenocrysts of clinopyroxene and amphibole are commonly fresh and unaltered.

Contact metamorphic aureoles occur around most of the felsic plutons in the Athapapuskow area. Heywood (1966) describes an upper greenschist to amphibolite facies aureole 1-1.4 km wide around the syntectonic, Kaminis hornblende granodiorite. During this year's reconnaissance work similar increases in metamorphic grade were noted adjacent to the post-tectonic biotite + hornblende granodiorite plutons east of Athapapuskow Lake (Fig. GS-10-1); however the aureoles do not appear to be as extensive as the one adjacent to the Kaminis granodiorite.

U-Pb ZIRCON GEOCHRONOLOGY PROJECT

An ongoing program to determine the ages of major units in the southern Churchill Province is being jointly conducted by the Geological Survey of Canada and the Manitoba Department of Energy and Mines. Recent results of this project, in the Lynn Lake and Rusty Lake metavolcanic belts, are reported by Baldwin et al. (1985, and in prep.). In the Flin Flon area, a precise U-Pb age of the Amisk Group has yet to be determined, despite sampling of virtually every major rhyolite in the area during this project and by previous workers (MacQuarrie, 1980). Heavy mineral separates from most rhyolite flows do not contain sufficient zircon to warrant isotope analysis. Rhyolite domes at Flin Flon Mine (Bailes and Syme, 1983) do contain zircon and were analyzed in 1985; however, the data are discordant and do not provide an accurate age. These rhyolites were resampled this summer in the hope that a concordant data set can be obtained. Zircon-bearing rhyolite crystal tuff (occurring as graded beds separating ferrobasalt flows in the Bear Lake Block [Bailes and Syme, 1979]) also was sampled and is now considered to be the prime age determination candidate for the Amisk Group in the Flin Flon area.

Samples for U-Pb analysis were obtained also from the Mikanagan Lake sill, one of the most prominent mafic intrusive bodies in the Flin Flon belt. The sill is 1.2 km thick (Bailes and Syme, 1980) and is differentiated from gabbronorite at the base, through gabbro, ferrogabbro, and quartz ferrodiorite zones to leucotonalite at the top. The leucotonalite was previously sampled as part of this geochronology project, but it was found to contain insufficient zircon for analysis. This summer, a sample of gabbroic pegmatite was taken in the hope that this material would contain enough zircons. A precise U-Pb age of the sill is important because, on the basis of field relationships alone, the age could range between syn-Amisk Group and post-Missi Group.

CONCLUSIONS

Reconnaissance mapping throughout the entire Athapapuskow Lake project area has confirmed that 1:20 000 mapping is feasible and would provide a significant improvement on existing outdated maps. Major faults, not shown on the older maps, disrupt Amisk Group volcanic stratigraphy, juxtapose domains of different metamorphic grade, and in some places appear to be the loci for gold mineralization. The definition of Amisk Group stratigraphy and geochemistry will extend the stratigraphy established in the Flin Flon-White Lake area (Bailes and Syme, in prep.) and permit stratigraphic analysis of stratabound mineral occurrences.

REFERENCES

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

1979: White Lake-Mikanagan Lake Project; **in** Manitoba Mineral Resources Divison, Report of Field Activities, 1979, p. 46-54.

1980: White Lake-Mikanagan Lake Project; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1980, p. 43-50.

1983: Flin Flon-Schist Lake Project; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 23-29.

in prep. Geology of the Flin Flon-White Lake area; Manitoba Energy and Mines, Geological Report.

Baldwin, D.A., Syme, E.C., Zwanzig, H.V., Gordon, T.M., Hunt, P.A. and Stevens, R.D.

1985: U/Pb zircon ages from the Lynn Lake and Rusty Lake metavolcanic belts, Manitoba: two ages of Proterozoic magmatism; **in** Program with Abstracts, G.A.C.-M.A.C. Annual Meeting, University of New Brunswick, Fredericton.

Buckham, A.F

1944: Athapapuskow Lake, Manitoba; Geological Survey of Canada, Map 807A, with descriptive notes.

Heywood, W.W.

1966: Ledge Lake area, Manitoba and Saskatchewan; Geological Survey of Canada, Memoir 337, 43 p.

Hosain, I.T.

1984: Interpretation of airborne magnetic gradiometer surveys of the area south of the Flin Flon-Snow Lake belt; Manitoba Mineral Resources Division, Open File Report OF84-2, 25 p.

MacQuarrie, R.

1980: Absolute age of the Flin Flon deposit (abstract); **in** Bulletin of the Canadian Institute of Mining and Metallurgy, v. 73, p. 53.

Parbery, D. and Gale, G.H.

1984: Mineral deposit investigations in the Flin Flon area; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 60-65.

Tanton, T.L.

1941: Schist Lake, Saskatchewan and Manitoba; Geological Survey of Canada, Map 633A, with descriptive notes.

GS-11 GEOLOGICAL INVESTIGATIONS IN THE CHISEL LAKE-REED LAKE AREAS

by Alan H. Bailes

INTRODUCTION

A thirty day field program was conducted at the east end of the Flin Flon volcanic and sedimentary belt to assess the feasibility of starting a 1:20 000 scale mapping program in either the Reed Lake or Chisel Lake area. A previous 1:20 000 scale mapping program at the western end of the Flin Flon belt (Bailes and Syme, 1980 and 1983) proved successful in defining stratigraphy of volcanic/sedimentary packages and for identifying major structural features. This type of data is also needed at the east end of the belt. During the field program samples for U-Pb zircon geochronology were collected.

On Reed Lake a combination of heavy moss and lichen growth on outcrops, small size of outcrops, and generally high level of recrystallization (particularly near felsic plutons) makes 1:20 000 scale mapping a difficult and relatively unproductive procedure. In contrast, the Chisel Lake area has a high proportion of large, closely spaced, burned-over lichen-free outcrop, with local excellent preservation of primary structures. Thus, the Chisel Lake area has been chosen for 1:20 000 scale mapping starting in 1986.

CHISEL LAKE AREA

A major goal of mapping in the Chisel Lake area is the development of a coherent regional volcanic stratigraphy. This will provide a much improved geological base for future mineral exploration in this base metal- and gold-rich mining district. Seven significant volcanogenic massive sulphide deposits, including the Chisel Lake Mine, Ghost Lake Mine and the newly discovered Morgan Lake Zn-Cu sulphide deposit, are located in the proposed Chisel Lake project area. (Fig. GS-11-1). The area also contains several gold showings (Fig. GS-11-1).

In addition to the fundamental need for a stratigraphic framework and for a detailed map of the Chisel Lake volcanic/sedimentary package, this project will address several additional problems including:

1) the distribution and main characteristics of hydrothermal alteration zones,
2) the nature and significance of the U-shaped quartz-megacrystic tonalite body located between Cook Lake and Anderson Lake (Fig. GS-11-1),
3) the stratigraphic position of Cu-Zn massive sulphide deposits in the volcanic/sedimentary package, and
4) the delineation of major fold structures, particularly those that predate the Threehouse syncline.

Prominent zones of hydrothermally altered rocks are abundant in the Chisel Lake area. These include zones of intense Fe-Mg addition (cf. Froese and Moore, 1978; Walford and Franklin, 1982) and zones of Si-Ca addition (cf. Harrison, 1949; Skirrow, 1985). In the metamorphically recrystallized rocks of the Chisel Lake map area, zones of Fe-Mg addition are indicated by rocks with abundant garnet-chlorite and

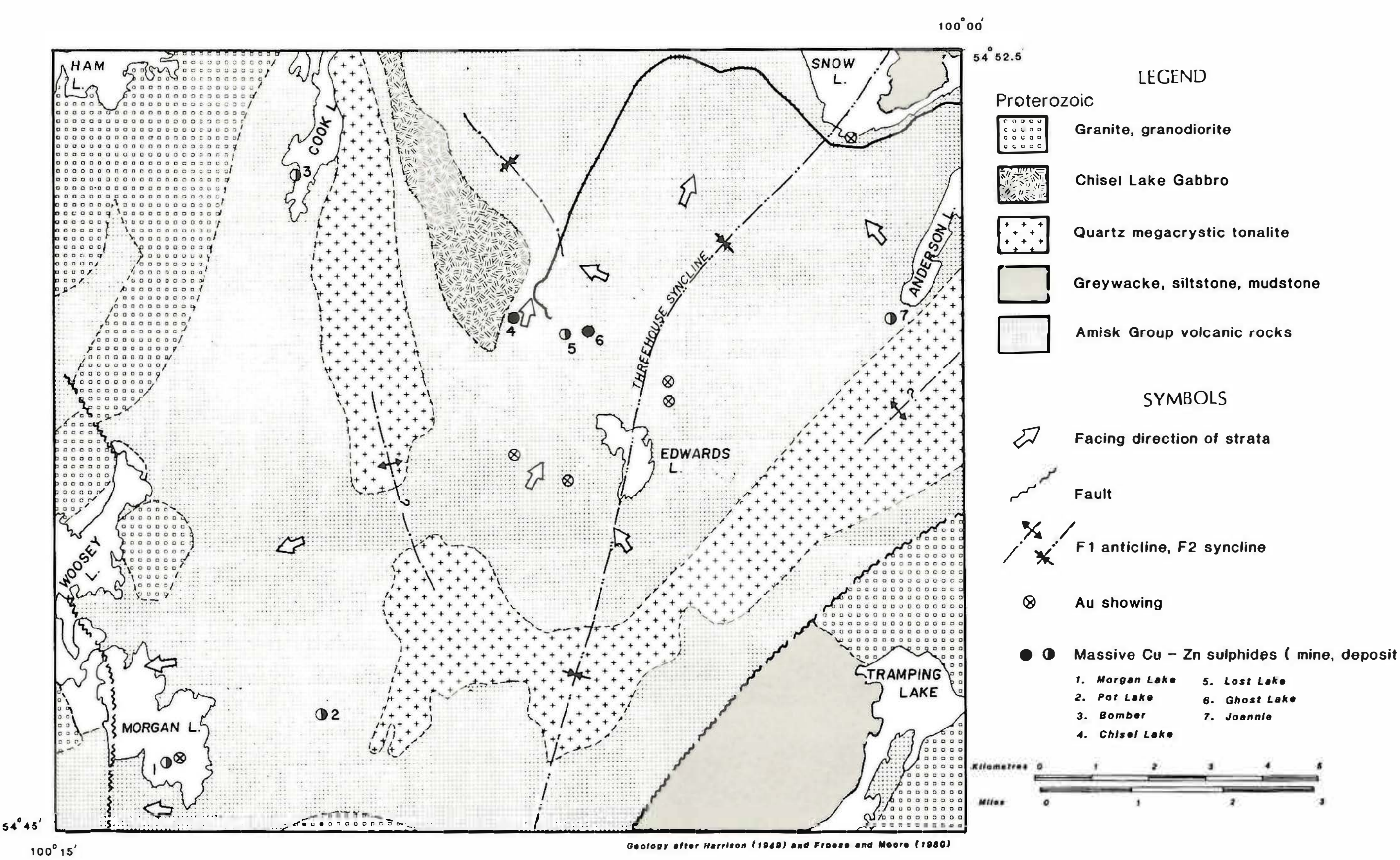


Figure GS-11-1: Simplified geology of the Chisel Lake area.

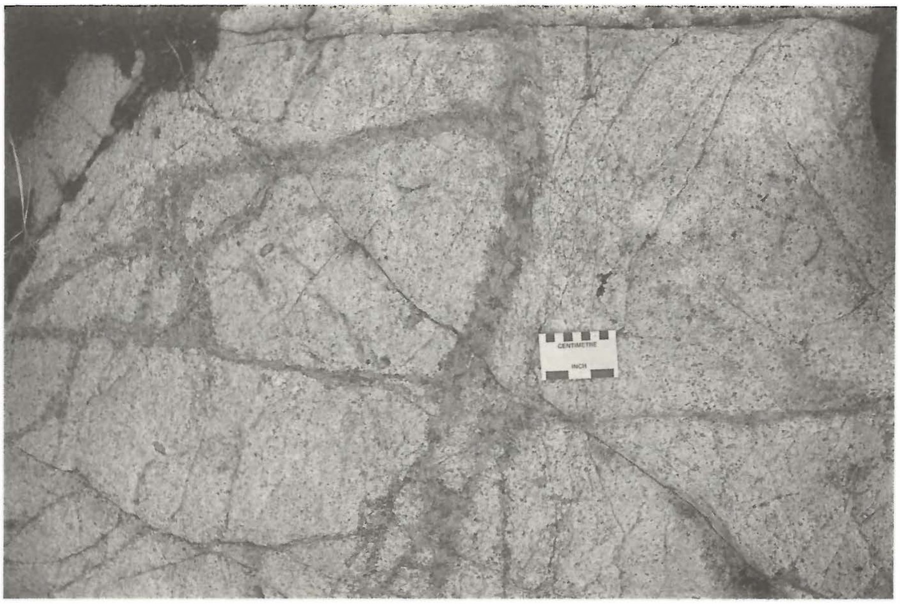


Figure GS-11-2: Altered quartz megacrystic tonalite, 2.3 km south of Cook Lake. Alteration follows fractures and is metamorphically recrystallized to a mixture of garnet and biotite.

staurolite-biotite-garnet-amphibole. Froese and Moore (1978) mapped some zones of intense Fe-Mg addition but observations this summer indicate that this type of alteration is widespread and inadequately defined. Zones of Si-Ca addition comprise pale coloured leucocratic zones in mafic rocks. They are characterized by unusually high contents of quartz and/or epidote. One such zone is located near Edwards Lake approximately 2 km south of the Chisel-Ghost Lake mine horizon (Skirrow, 1985). The Edwards Lake zone is the subject of a MSc thesis by R. Skirrow (Carleton University) under the supervision of J. Franklin (G.S.C.). This type of alteration appears to be widespread based on observations in the Edwards Lake area by Skirrow and Franklin (pers. comm.) and on scattered observations during this summer's reconnaissance of the Chisel Lake area. Harrison (1949) showed this type of alteration as unit A on his 1:63 360 map and attributed it to "granitization" by the quartz-megacrystic tonalite. However, Harrison included large amounts of slightly altered felsic volcanic rocks in this unit; thus remapping is required.

The U-shaped body of quartz-megacrystic tonalite between Cook and Anderson Lakes has been variously interpreted to be an intrusion (Harrison, 1949; Froese and Moore, 1978), a felsic pyroclastic rock (Williams, 1966) and a sedimentary rock (Russell, 1957). Harrison (1949) considered it to be the source of extensive "granitization" of mafic rocks and Walford and Franklin (1982) have suggested it was a subvolcanic intrusion that acted as a heat source for the extensive hydrothermal system associated with the volcanogenic massive sulphide deposits in the Chisel Lake map area. A few widely spaced observations by the author on the west limb of this body indicate that it is an intrusion. It is also likely subvolcanic as locally it is affected by the same type of alteration (Fig. GS-11-2) as that associated with the volcanogenic massive sulphide deposits.

Gale et al. (1977) and Walford and Franklin (1982) have suggested that two mineralized horizons are present in the northwestern part of the Chisel Lake area: a lower Cu-rich zone (Anderson Lake Mine, Stall Lake Mine, Joannie deposit) and an upper Zn-rich zone (Chisel Lake Mine, Ghost Lake Mine, Lost Lake deposit). Each has distinctive lead isotope values suggesting separate metal sources (Walford and Franklin, 1982). At this time mapping of the volcanic rocks in the Chisel Lake map sheet is inadequate to evaluate this hypothesis. If there is a lower Cu-rich and an upper Zn-rich zone then the newly discovered Zn-rich Morgan Lake sulphide deposit (Fig. GS-11-1) may be an extension of the Chisel-Lost-Ghost horizon. However, only detailed mapping of the volcanic rocks will allow for proper extrapolation and effective exploration of mineralized horizons in the Chisel Lake map area.

Rocks in the Chisel Lake area have been broadly folded about the north-northeast-trending Threehouse syncline (Fig. GS-11-1). They were tightly folded prior to imposition of the Threehouse syncline (Froese and Moore, 1978) but the precise position of these early folds is rarely known. Observations this summer indicate that a major pre-Threehouse fold axis is coincident with the west limb of the U-shaped body of quartz-megacrystic tonalite (Fig. GS-11-1). Gale et al. (1977) and Walford and Franklin (1982) indicate a pre-Threehouse fold coincident with the east limb of the quartz-megacrystic tonalite. One of the objectives of remapping the Chisel Lake area will be to identify facing directions for the volcanic strata so that these early folds can be more precisely defined. Facing directions are rare on the existing maps.

U-Pb ZIRCON GEOCHRONOLOGY

A U-Pb geochronology dating program, in co-operation with the Geological Survey of Canada, under the Federal-Provincial MDA, is underway in the Flin Flon volcanic and sedimentary belt. Four samples for geochronological analysis were collected during this year's reconnaissance of the Chisel Lake map-area: rhyolite breccia to date Amisk volcanism, quartz-megacrystic tonalite and felsic quartz-feldspar porphyry to determine whether these bodies are synvolcanic, and granite from the Tramping Lake pluton (Froese and Moore, 1978) to date one of the younger intrusions. These ages will permit comparison of the age of volcanic and intrusive events in the Snow Lake area with the age of similar events in the Flin Flon area, 100 km farther west. Such data is necessary to understand the development of the Flin Flon volcanic belt and its mineral deposits.

REFERENCES

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

1980: White Lake-Mikanagan Lake Project; Manitoba Mineral Resources Division, Report of Field Activities, 1979, p. 46-54.

1983: Flin Flon—Schist Lake Project; Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 23-29.

Froese, E. and Moore, J. M.
1980: Metamorphism in the Snow Lake area, Manitoba; Geological Survey of Canada, Paper 78-27, 16 p.

Gale, G. H., Koo J., Solkoski, L. and Southard, G.
1977: Evaluation of massive sulphide environments; **in** Non-Renewable Resource evaluation Program, First Annual Report 1975/76, Manitoba Mineral Resources Division, Open File Report 77/1, p.34-61.

Harrison, J. M.
1949: Geology and mineral deposits of the File-Tramping Lake area, Manitoba; Geological Survey of Canada, Memoir 250, 92 p.

Russell, G. A.
1957: Structural studies, Snow Lake-Herb Lake area; Manitoba Mines Branch Publication 55-3, 33 p.

Skirrow, R. G.
1985: Preliminary report on the petrography of altered rocks in the Edwards Lake area near Snow Lake, Manitoba; Unpublished report, 31 p.

Walford, P. C. and Franklin, J. M.
1982: The Anderson Lake Mine, Snow Lake, Manitoba; **in** Hutchinson, R. W., Spence, C. D. and Franklin, J. M. (eds): Precambrian sulphide deposits; Geological Association of Canada, Special Paper 25, p. 481-523.

Williams, H.
1966: Geology and mineral deposits of the Chisel Lake map area, Manitoba; Geological Survey of Canada, Memoir 348, 38 p.

GS-12 KISSEYNEW PROJECT

by Herman V. Zwanzig

INTRODUCTION

Key outcrops were revisited in the Kisseynew Project area and the mapping program (Zwanzig, 1983) was expanded to include Kississing Lake for scale mapping by D.C.P. Schledewitz (GS-13, this volume). One week of work was carried out at Lobstick Narrows in the 1:20 000 scale map area of Zwanzig (1984).

LOBSTICK NARROWS

Structural mapping was checked along the Kississing River fault zone (Zwanzig, 1984 p. 45) and geochemical sampling was carried out northeast of Lobstick Narrows.

The Kississing River fault zone, which extends east-southeast from the Saskatachewan border, terminates northeast of Lobstick Narrows along the Thunderhill Lake road (Fig. GS-12-1). Near its terminus, the fault and its footwall mylonite zone bifurcate into an east-trending branch that carries the biotite-garnet ± staurolite-sillimanite gneiss of the Nokomis Group in the hanging wall, and a southeast-trending branch that lies within the Sherridon Group. The wedge-shaped block between the faults (A in Fig. GS-12-1) has suffered less strain than the region as a whole. The block contains a succession of Sherridon Group gneisses whose volcanic and sedimentary protoliths are recognizable on most clean exposures. (See Table GS-12-1).

The presence of additional faults is suggested by changes in the Sherridon stratigraphy from the mixed lithologies at A to predominantly sediment-derived gneisses in block B and rhyolite- plus conglomerate-derived gneisses in block C. (See also Preliminary Map 1984 K-1). In the eastern blocks primary structures have been largely obliterated by high grade metamorphism and deformation.

Further detailed mapping is required to substantiate the block structure of the area and to define the volcanic origin of some of the gneisses.

Geochemical work was concentrated in the well preserved section in block A. Preliminary results indicate a range of compositions from basalt to rhyolite (Table GS-12-2).

REFERENCES

Zwanzig, H.V.

1983: Kisseynew Project: Lobstick Narrows; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 15-22.

1984: Kisseynew Project: Lobstick Narrows-Cleunion Lake, Puffy Lake and Nokomis Lake areas; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 38-45.

TABLE GS-12-1

STRATIGRAPHIC SUCCESSION IN BLOCK A

Varicoloured gneiss, metasandstone (Unit 8)[1]:
pink, grey and green weathering metasandstone, siltstone and mudstone with beds of calc-silicate rock; possible north-facing top;

Amphibolite - derived from basalt[2] and gabbro (Unit 10):
interlayered, fine grained metasedimentary rocks and beds of pink gneiss[2] (felsic tuff); a lower member contains glomeroporphyritic, locally amygdaloidal basalt flows, sills and possible layered flows;

Fine grained metasedimentary rocks (Unit 9):
dark grey, biotite-rich rock ± hornblende, probably derived from argillaceous siltstone and calcareous mudstone; pink, felsic member may be a tuff

Metasandstone (Unit 7):
fine grained, pink weathering, thin bedded, felsic metasedimentary rock grading downward into crossbedded, quartzose metasandstone;

Felsic gneiss (Unit 11a):
thick, uniform formation of buff- to pink-weathering felsic gneiss with flattened micaceous fragments, derived from tuff or reworked pyroclastic rock[2];

Felsic metasandstone and fragmental rocks (Unit 11c):
minor conglomerate and fragmental felsic rock interpreted to be derived from rhyolite breccia;

Heterolithologic rhyolite-boulder conglomerate (Unit 11b):
clasts are highly deformed; angularity and lack of sorting suggest a mass flow origin.

[1]Unit numbers after Zwanzig, 1984
[2]Sampled for geochemistry

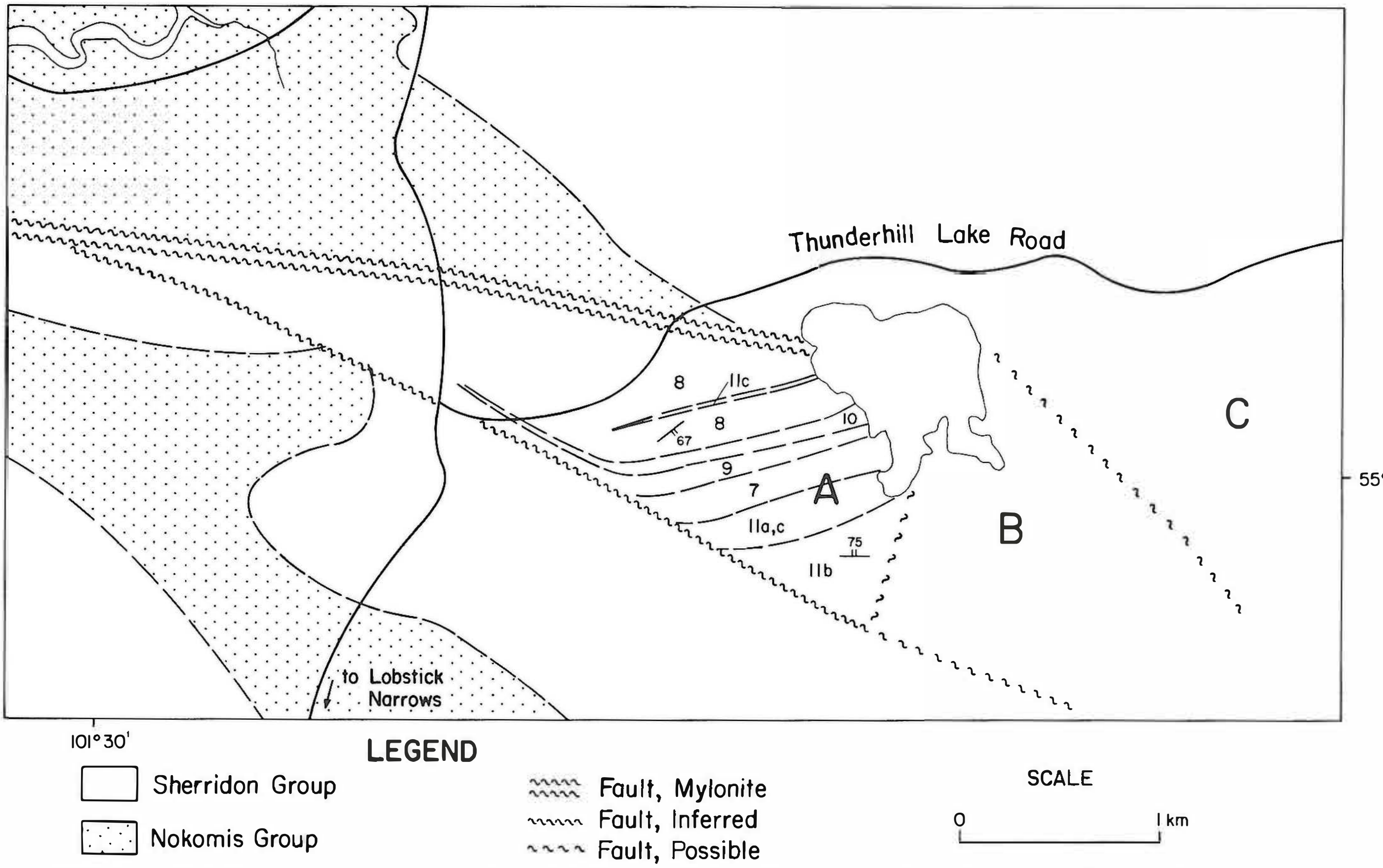


Figure GS-12-1: *Probable fault blocks northeast of Lobstick Narrows. Units in Block A as in Table GS-13-1 and Zwanzig (1984).*

TABLE GS-12-2 WHOLE ROCK CHEMISTRY AND SELECTED MINOR ELEMENTS, SHERRIDON GROUP

UNIT/ROCK TYPE	10/ Fine grained amphibolites of basaltic to andesitic composition											
SAMPLE NUMBER	12-84-591-2	12-83-439	12-83-238	12-85-1056-5	12-83-234-6	12-83-246-2	12-83-328-7	12-85-1015-2	12-83-328-9	12-83-231-6	12-85-1053-1	12-83-231-3
SiO_2%	48.6	49.7	49.9	50.6	50.7	50.8	51.3	51.6	52.9	53.1	53.5	54.4
Al_2O_3	18.1	15.2	20.4	17.3	17.3	18.1	16.1	22.3	17.1	18.0	17.4	17.4
FeO (T)	9.55	9.07	7.76	8.81	10.4	9.33	8.5	6.23	8.28	8.13	8.39	9.80
CaO	12.84	10.10	10.46	10.78	10.6	9.81	11.5	10.90	10.35	9.54	7.93	8.78
MgO	8.43	9.54	4.79	6.60	6.2	6.99	7.7	3.70	5.88	6.74	5.39	4.90
Na_2O	1.38	1.48	3.82	2.59	1.9	2.98	2.4	3.57	2.46	3.29	2.94	2.92
K_2O	0.20	1.75	0.43	0.31	0.2	0.27	0.4	0.61	0.58	0.26	1.28	0.54
TiO_2	0.86	0.69	0.73	0.68	0.83	0.68	0.58	0.62	0.63	0.61	0.85	1.00
P_2O_5	0.12	0.24	0.09	0.07	0.1	0.12	0.1	0.09	0.15	0.07	0.11	0.10
MnO	0.19	0.17	0.14	0.17	0.13	0.16	0.14	0.10	0.15	0.15	0.14	0.16
LOI	0.6	1.5	2.2	0.9	0.5	0.8	0.5	0.5	0.9	0.9	1.5	0.5
Total	100.9	99.4	100.7	98.8	98.9	100.0	99.2	100.2	99.4	100.8	99.4	100.5
MINOR ELEMENTS (ppm)												
Ni	123	151	74	96	120	74	121	76	57	116	89	86
Cr	388	484	162	358	71	49	264	174	137	104	202	81
Rb	2	31	4	<2	2	2	5	19	13	3	25	9
Sr	210	513	257	175	190	727	255	326	436	188	128	195
Ba	157	740	300	180	240	98	380	459	425	146	543	245
FeO (T)/MgO	1.13	0.95	1.62	1.33	1.68	1.33	1.10	1.68	1.42	1.21	1.56	2.0
COMMENTS	porph.	porph.	plag. por.			dyke(?)		plag. por.	amygd.		amygd.	layered

TABLE GS-12-2 WHOLE ROCK CHEMISTRY AND SELECTED MINOR ELEMENTS, SHERRIDON GROUP — continued

UNIT/ROCK TYPE	10/amphibolites-felsic rock				7/meta sandstone		11/felsic gneiss of rhyolitic composition				
SAMPLE NUMBER	12-85-1055	12-85-1056-3	12-85-1054	12-85-1053-2	12-85-1057	12-85-1057-B	12-85-1056-2	12-85-1056-1	12-83-328-11B	12-83-394	12-85-1071
SiO_2%	55.2	55.6	60.7	67.5	69.9	71.9	71.5	72.6	72.8	74.2	75.4
Al_2O_3	17.8	16.4	16.9	16.7	15.5	14.4	13.5	13.7	12.8	13.4	12.1
FeO (T)	9.57	9.67	6.63	3.43	3.21	2.59	3.07	3.07	2.59	1.72	1.77
CaO	8.35	8.30	6.88	3.80	1.39	1.70	1.23	1.95	1.18	0.96	0.47
MgO	4.06	4.97	3.60	1.69	0.62	0.60	0.36	1.01	0.50	0.15	0.41
Na_2O	3.07	3.19	3.12	4.30	4.25	3.72	3.89	2.92	2.73	3.62	2.65
K_2O	0.52	0.23	0.91	1.64	3.27	3.14	4.54	3.16	5.60	4.92	5.14
TiO_2	1.03	0.87	0.70	0.38	0.55	0.38	0.37	0.38	0.30	0.12	0.13
P_2O_5	0.15	0.09	0.12	0.07	0.14	0.12	0.07	0.07	0.06	0.01	0.02
MnO	0.17	0.16	0.12	0.05	0.04	0.07	0.04	0.06	0.02	0.02	0.03
LOI	.5	.3	.6	1.0	.9	.9	1.3	1.2	1.3	1.3	.7
Total	100.4	99.8	100.3	100.6	99.8	99.5	99.9	100.1	99.9	100.4	98.8
MINOR ELEMENTS (ppm)											
Ni	<2	17	47	16	14	9	<2	3	<2	<2	3
Cr	11	52	120	23	58	22	<6	12	6	<6	<6
Rb	7	<2	18	35	79	85	111	118	128	88	173
Sr	205	270	183	195	276	296	126	106	92	153	46
Ba	221	130	315	450	816	776	1262	829	1146	1472	837
FeO (T)/MgO	2.36	1.95	1.84	2.03							
COMMENTS	layered		porph.	porph.	crossbedded			fragm.	fragm?	tuff	fragm.

GS-13 KISSEYNEW PROJECT: KISSISSING LAKE, BIG ISLAND-YAKUSHAVICH ISLAND REGION

by D.C.P. Schledewitz

INTRODUCTION

The Big Island-Yakushavich Island area, at the northern end of Kississing Lake (approximately 50 km northeast of Flin Flon), lies within the Kisseynew gneiss complex. The last systematic mapping of the Kississing Lake area was carried out by Bateman and Harrison (1946: Kississing Lake east half) and Frarey (1961: Kississing Lake west half). Since that time the contiguous map areas have been completed by Robertson (1953); Kalliokoski (1952); Pollock (1964); and Baldwin (1979), and parts of Kississing Lake have been re-examined and remapped (Tuckwell, 1979; Froese, 1981).

The Kisseynew gneisses, which comprise a suite of metamorphic rocks of upper amphibolite facies, were initially subdivided by Bateman and Harrison (1946) in the east half of Kississing Lake. Further subdivision and revision of the initial stratigraphic relationships have evolved into two major suites of rocks—the Nokomis Group dominated by garnetiferous graphitic gneisses considered to be derived from a greywacke-shale succession and an overlying quartz-rich suite of rocks — the Sherridon Group. Froese and Goetz (1981) provide an excellent review of the stratigraphic relationships and regional correlations for the Kisseynew gneiss complex. They discuss the controversial origin of amphibolites in the Nokomis and Sherridon Groups and state that amphibolites, likely of both sedimentary and volcanic derivation, are present in both the Nokomis and Sherridon Groups.

GENERAL GEOLOGY

This summer's mapping in the area of Big Island and Yakushavich Island encountered garnetiferous-graphitic-biotite paragneiss and metatexites characteristic of the Nokomis Group, a quartz-rich suite of magnetiferous rocks, mesocratic magnetiferous rocks and a suite of amphibolites (Table GS-13-1). The quartz-rich magnetiferous rocks comprise a granoblastic leucocratic (biotite 8%) feldspar-quartz rock with sporadic epidote-quartz-rich layers and a more biotite-rich unit (15-20% biotite) that contains leucocratic **lits** with lenticular porphyroblasts of hornblende. These rock types may form thick layers or be interlayered on a scale from 2 to 3 metres thick. The magnetiferous mesocratic rocks contain (10-30%) hornblende and (10 to 15% biotite) and have a lower quartz content. These quartz-rich and mesocratic magnetiferous rocks have an intermediate to high magnetic signature. The mesocratic suite of rocks was mapped to the north boundary of the map area (Fig. GS-13-1). In the north part of Kississing Lake, in the Crow Lake map area, Baldwin (1979) mapped biotite-bearing magnetiferous quartzofeldspathic rocks and hornblende-biotite-magnetite-bearing mesocratic rocks which also exhibit an intermediate to high magnetic signature.

The quartz-rich leucocratic and biotite-bearing (15-20% biotite) magnetiferous granoblastic rocks can be tentatively assigned to the Sherridon Group since they meet the criteria of quartz enrichment which characterizes the Sherridon Group. The nature of the contact between these rocks and the Nokomis type garnet-biotite paragneiss and metatexites is extremely variable. It ranges from an apparent gradational contact of interlayered hornblende-garnet + magnetite-feldspar-quartz gneiss and biotite-garnet gneiss as on Sherritt Island to zones where a suite of massive medium- to coarse-grained amphibolite, garnetiferous amphibolite—in part interlayered with garnetiferous hornblende-biotite-feldspar gneiss such as at the southeast end of Big Island, or on the east and west side of Yakushavich Island—occurs between the Sherridon Group and Nokomis Group.

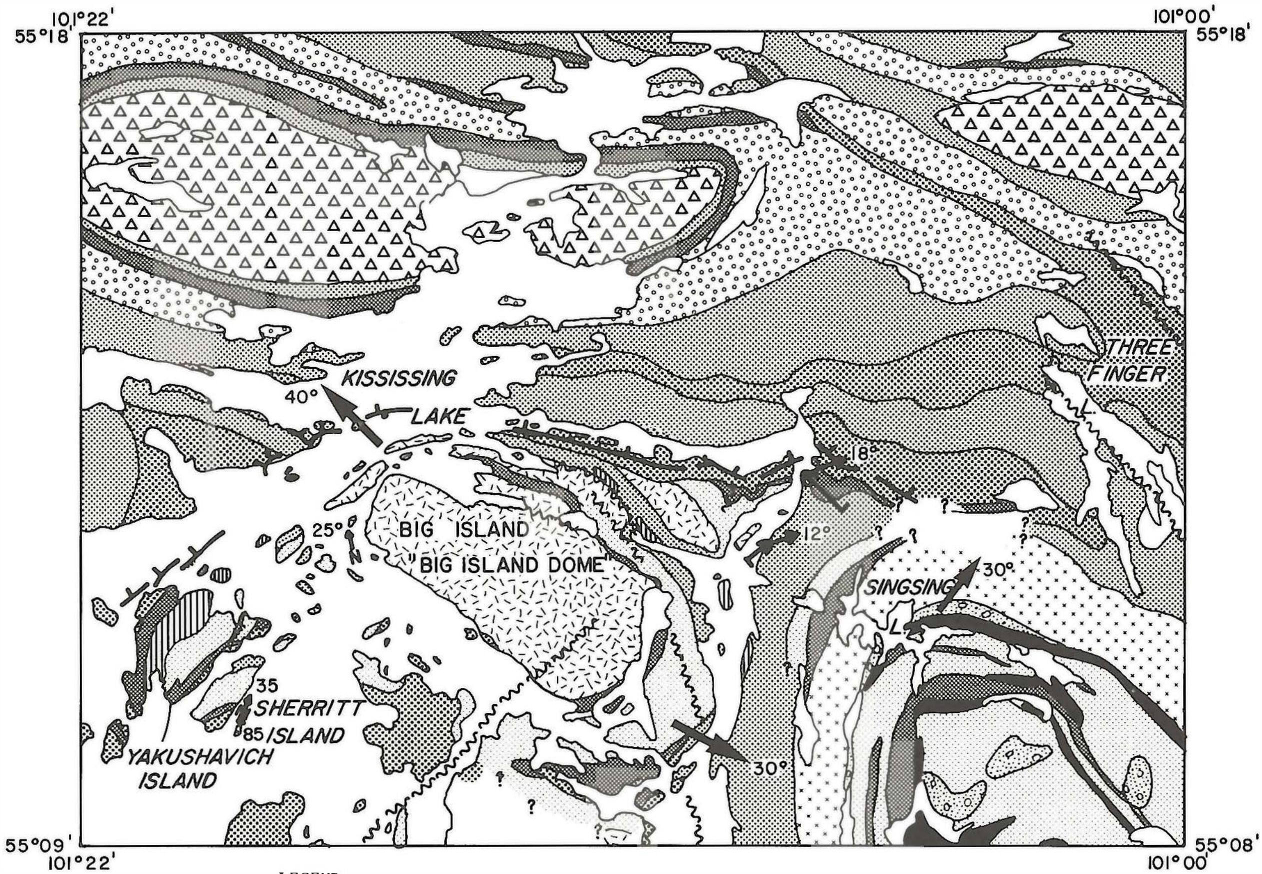
The mesocratic, variably magnetiferous hornblende-biotite-feldspar-quartz gneisses occur in a zone which appears to trend oblique to the regional layering and they appear to truncate the layering at the southeast end of Big Island. These rocks are best exposed along the east side of Big Island where locally they are coarse grained and exhibit petrographic characteristics of a meta-quartz diorite. This rock unit may thus represent a highly deformed intrusive rock.

TABLE GS-13-1: TABLE OF FORMATIONS

Group		Lithology
	15	Pink granite pegmatite
	14	Pink granite
	13	Aplite
	12	Medium grained to pegmatitic white granite
Intrusive Rocks	11	White fine grained granite ± garnet ± magnetite
	10	Medium to coarse grained biotite granite
	9	Magnetiferous-hornblende-biotite-quartz diorite
	8	Yakushavich hornblende-biotite granodiorite
	7	Magnetite-biotite monzogranite
Uncertain affinity	6	Mesocratic ± magnetite-hornblende-biotite gneiss
	5	Magnetite-biotite-hornblende-feldspar-quartz gneiss
	4	Magnetite-biotite (20%)-feldspar-quartz gneiss
	3	Siliceous leucocratic ± magnetite ± hornblende-biotite (8%)-feldspar-quartz gneiss with epidote-quartz lenses
Possible Sherridon Group	2	Amphibolite, massive, medium grained with lenses of diopside
	2a	Garnetiferous amphibolite to hornblende-garnet-plagioclase-quartz gneiss
	2b	Coarse grained amphibolite (metagabbro?)
	2c	Calc-silicate and interlayered carbonate
	2d	Amphibolite, garnetiferous, with interlayers of garnet-biotite-feldspar-quartz gneiss
	1	Garnet-biotite paragneiss to metatexite
Nokomis Group	1a	Biotite-garnet diatexite
	1b	Graphitic biotite-feldspar-quartz ± pyrite gneiss

The amphibolites vary from massive, medium- to coarse-grained rocks, suggestive of a metagabbro to metabasalt, to a medium grained garnetiferous amphibolite interlayered with garnet-hornblende-biotite-feldspar-quartz gneiss. Garnet-biotite-feldspar-quartz gneiss occurs sporadically interlayered with the amphibolites. Sulphide mineralization is commonly associated with zones of amphibolite and interlayered graphite-garnet-biotite-feldspar-quartz gneiss.

At Sherridon sulphides occur within the Sherridon Group quartz-rich leucocratic garnet-biotite gneiss. The ore bodies are hosted in these gneisses in a zone where a variety of amphibolites and calc-silicate rocks are most prevalent. Froese and Goetz (1981) place this zone in the lower section of the Sherridon Group as defined at Sherridon.



LEGEND

Intrusive Rocks

Granite ± magnetite

Metaquartz diorite

Metagabbro - Metapyroxenite

Rocks of Uncertain Affinity

Quartz-plagioclase gneiss ± magnetite

Mesocratic gneiss - hornblende - biotite (total mafics 25% - 45%) - variable hornblende content

± Cordierite ± sillimanite ± potassium feldspar - biotite - plagioclase quartz gneiss

Sherridon Group

Amphibolite ± garnet

Calc-silicate and/or marble

Leucocratic quartz-rich gneisses; commonly garnetiferous with garnet-biotite schist layers at Sherridon whereas at Kississing Lake it is commonly magnetiferous and has biotite - hornblende feldspar-quartz interlayers and sporadic epidote-quartz lenses.

Nokomis Group

Garnet - biotite - feldspar quartz gneiss to metatexite with areas of diatexite

Granitoid rocks undifferentiated

1 0 1 2 3 4 5

Kilometres

SYMBOLS

Trend of metamorphic layering; dipping 10° to 45°

Faults assumed, approximate

20° Plunge of major structures determined by metamorphic layering

Minor Folds

Assymetric Z shaped, (plunge and axial surface)

Symmetrical, (plunge and axial surface)

Figure GS-13-1: Simplified geology of the Kississing Lake, Big Island — Yakushavich Island region.

Tuckwell (1979) working along the east side of Kississing Lake has proposed an alternative stratigraphic interpretation. He has proposed the informal term "Cold Lake gneiss"; it consists of "hornblende-bearing gneisses often with magnetite and characterized by some epidote-rich calc-silicate horizons, and pink migmatitic veins. Within this sequence there are garnet- biotite gneisses which superficially resemble the Nokomis Group except they may contain layers with hornblende and/or magnetite and disseminated sulphides". One of these sulphide zones lies at the southeast end of Big Island. He suggests the Sherridon Group may be equivalent stratigraphically to this part of the Cold Lake gneiss but lithologically there is little similarity between the two sequences. In addition he points out that the Sherridon Group rock assemblages are unique in the area and suggests that they have been structurally emplaced.

STRUCTURE

A sequence of interlayered Nokomis type garnet-biotite metatexites and magnetiferous biotite-hornblende-feldspar-quartz gneisses and mesocratic magnetiferous rocks occurs at the north end of the map area (Fig. GS-13-1) and dips north at a shallow angle. These rocks structurally overlie a domed sequence of quartz-rich magnetiferous gneisses and amphibolites possibly equivalent to the Sherridon Group. The core of the domal structure is a magnetiferous monzogranite that outcrops on Big Island. The Big Island dome is elongated with a northwesterly trend and is overturned on its south flank. It plunges south of east at its southeast end and northwest at its northwest end.

Nokomis type metatexites on the west side of Yakushavich Island also overlie an interlayered sequence of magnetiferous quartz-rich gneisses and amphibolites. The amphibolites are frequently sulphide-bearing and on the east side of Yakushavich Island they are interlayered with garnet ± graphite ± sulphide-bearing biotite gneisses. The metamorphic layering dips to the northwest at shallow to intermediate angles. Intra-folial folds plunge to the north of east at shallow values. However, as the area of the northwest end of the Big Island dome is approached minor folds plunge to the northwest and secondary cross-cutting schistosities trend parallel or sub-parallel to the elongation direction of the Big Island dome. The Nokomis type metatexites appear to pinch out and recognizable layered sequences as seen on Yakushavich Island are no longer mappable in the area of the northwest end of the Big Island dome where numerous sills(?) of foliated magnetiferous monzogranite are present. A large area of garnetbiotite metatexite lies to the east of Yakushavich Island and to the south of the Big Island dome. It appears to underlie the quartz-rich magnetiferous rocks considered to be equivalents of the Sherridon Group.

If the biotite-garnet metatexites to the north and south of the Big Island dome are equivalent to the Nokomis Group then a structural overturning has placed the Nokomis over Sherridon type rocks north and west of the Big Island dome. The overturning of the Big Island dome may indicate thrusting from the north.

ECONOMIC GEOLOGY

Sulphide occurrences in the Kississing Lake area have been examined in detail by Tuckwell (1979) and Gale (1980). Gale examined sulphide occurrences at Yakushavich Island and Collins Point. He classified the occurrences by their sulphide type and host rock association; in summary they are:

i) amphibolite + garnet with pyrrhotite and pyrite;
ii) rusty biotite-feldspar-quartz granoblastic rock with intermediate to high silica containing sphalerite, galena, pyrite, pyrrhotite.

The rusty biotite-feldspar-quartz granoblastic rock may occur interlayered with amphibolite or associated with garnetiferous biotite-paragneiss to metatexite.

During the mapping in 1985 the most common mineralization observed was pyrrhotite and pyrite in massive and garnetiferous amphibolites. Chalcopyrite was observed in amphibolite + garnet at a site 300 m west of Sing Sing Lake. Examination of the trenched site indicates a siliceous zone and quartz veining in the mineralized amphibolite; assays are pending.

REFERENCES

Baldwin, D.A., Frohlinger, T.G., Kendrick, G., McRitchie, W.D., and Zwanzig, H.V.
1979: Geology of the Nelson House-Pukatawagan region (Burntwood Project); Manitoba Mineral Resources Division, Map 78-3-9.

Bateman, J.D. and Harrison, J.M.
1946: Sherridon, Manitoba: Geological Survey of Canada, Map 862A with descriptive notes.

Frarey, M.J.
1961: Collins Point, Manitoba: Geological Survey of Canada, Map 1068A with descriptive notes.

Froese, E. and Goetz, P.A.
1981: Geology of the Sherridon Group in the vicinity of Sherridon, Manitoba; Geological Survey of Canada, Paper 80-21.

Gale, G.H.
1980: Mineral deposit studies — Flin Flon/Kisseynew; **in** Manitoba Mineral Resources Division, Report of Field Activities 1980; p. 51-64.

Kalliokoski, J.
1952: Weldon Bay map area, Manitoba; Geological Survey of Canada, Memoir 270.

Pollock, G.D.
1964: Geology of the Duval Lake area; Manitoba Mines Branch, Publication 61-6.

Robertson, D.S.
1953: Batty Lake map-area, Manitoba; Geological Survey of Canada, Memoir 271.

Tuckwell, K.
1979: Stratigraphy and mineral deposits of the Sherridon area; **in** Manitoba Mineral Resources Division, Report of Field Activities 1979, p. 42-45.

GS-14 KISSEYNEW PROJECT: GEOLOGICAL RECONNAISSANCE OF KISSEYNEW LAKE WEST (63K/13 NW)

by W. D. McRitchie

INTRODUCTION

A two week reconnaissance was conducted in the Kisseynew Lake-Forester ("Old Witch")* Lake region, adjacent to the Saskatchewan border (63K/13 NW), as a preliminary to 1:50 000 scale geological mapping, scheduled over the next 2-3 years. Little documentation has been done in the region since it was first mapped at a scale of 1:63 360 by T. L. Tanton (1938) and much of this work was of a semi-reconnaissance nature.

Access in the northern part of the area has been greatly improved through the opening up of logging roads by MANFOR. To the south good shoreline exposures are available on Florence Lake and the numerous bays of Kisseynew Lake.

The project area lies to the north of the main Flin Flon-Snow Lake greenstone belt and in large part comprises gneisses and intrusive units lying on the southern flank of the Kisseynew complex. Recent interest has been sparked by the recognition of gold mineralization at Puffy and Nokomis Lakes in units that lie close to the boundary between Nokomis greywackes and Sherridon quartzofeldspathic gneisses. The units hosting the mineralization comprise laterally continuous amphibolites and associated quartz-rich gneisses that appear transitional between the two main Groups (Nokomis and Sherridon). The term "Kisseynew Metallotect" has been coined by Gale (1984) in reference to this stratigraphic interval that appears, at least locally, to host stratabound gold mineralization.

The initial objectives of the present study were: a) to determine the extent of the greywacke and quartzofeldspathic formations, b) to locate and determine the nature and extent of the associated amphibolite sequences as well as any indications of related mineralization (Table GS-14-1), and c) to provide a framework within which more detailed mapping can proceed to link existing coverage in the Lobstick Narrows region with that initiated this year in Saskatchewan.

The results of the reconnaissance are displayed in preliminary map 1985K-1 together with an interpretation of the regional setting (Fig. GS-14-1).

GENERAL GEOLOGY

The majority of units can be correlated with counterparts mapped by Pollock (1964) in the Duval Lake area to the north, and by McRitchie (1980) and Zwanzig (1983 and 1984) to the east.

East-trending belts of Nokomis garnet-biotite gneiss alternate with regionally dominant magnetic and non-magnetic Sherridon quartzofeldspathic gneisses, several types of amphibolite, and coarse grained granulitic garnet-hornblende gneisses. Intrusions are restricted to flattened ellipsoidal bodies several kilometres long, together with locally prominent thick pegmatite dyke swarms that are more common in the southwest corner of the area. The pegmatites are emplaced along the axial planes and axial planar foliation of tight, south-verging overturned isoclinal folds that are widespread throughout the area. Dips are dominantly north to northeast at moderate angles, fold axes plunge shallowly to the northwest or north (Fig. GS-14-2), and major faults/shear zones with associated retrogression strike easterly, subparallel to the trend of the regional foliation and layering.

A major ellipsoidal structure east of Florence Lake contains pink granitic phases at its westernmost hinge. Concentric and folded layering visible on aerial photographs indicates a complex internal structure that was not documented during the present study.

Facing criteria in the sedimentary gneisses are scarce; however, crossbedding and placer-magnetite-lined trough banding in quartzofeldspathic gneisses near Forester Lake confirm the stratigraphic sequence established elsewhere with the Sherridon Group overlying the Nokomis. Supracrustal formations in order of stratigraphic position are listed in Table GS-14-2.

Sillimanite, garnet and biotite occur throughout the area in both the garnet-biotite gneisses and the quartzofeldspathic units. Many paragneisses display minor granitic segregations but no evidence was observed for wholesale in situ anatexis. Prominent zones of retrogression along the south shore of Kisseynew Lake are taken to imply the presence of relatively late stage major east-trending fault zones.

UNIT DESCRIPTIONS

GARNET-BIOTITE GNEISS (1)

Grey weathering, variously layered, medium grained, foliated garnet-biotite-plagioclase-quartz-bearing gneisses, with ubiquitous graphite and minor white **lits** of pegmatite and granite, traverse the area in a series of east-trending belts ranging from 1-3.5 km wide. Quartz-rich varieties appear adjacent to the amphibolitic transition zone; however, throughout most of the region the units are typically feldspathic semipelites with only weak separation into psammitic and semipelitic layers.

Sillimanite-bearing schistose layers, containing 0.5-1.0 cm white knots and lenses of quartz, sillimanite and muscovite, occur sporadically and alternate with more common garnet-biotite gneiss. Highly garnetiferous varieties with a white feldspathic matrix occur along the north shore of Florence Lake and north of Nordick ("Margaret") Lake. However, these are uncommon and subordinate to the typical gneiss which contains 5-20 per cent evenly disseminated euhedral pink and red almandine garnets (1-4 mm) in a matrix of biotite, feldspar and quartz.

The unit also contains thin hornblende and epidote-bearing calc-silicate layers, lenses and pods, and sporadic thin (up to 1 m) amphibolites + garnet. Associated pegmatites are typically white and contain small pink garnets and clots of tourmaline and quartz. Near the south shore of Kisseynew Lake widespread retrogression alters the gneiss to a dull grey/black featureless unit.

GNEISSIC CONGLOMERATE (2)

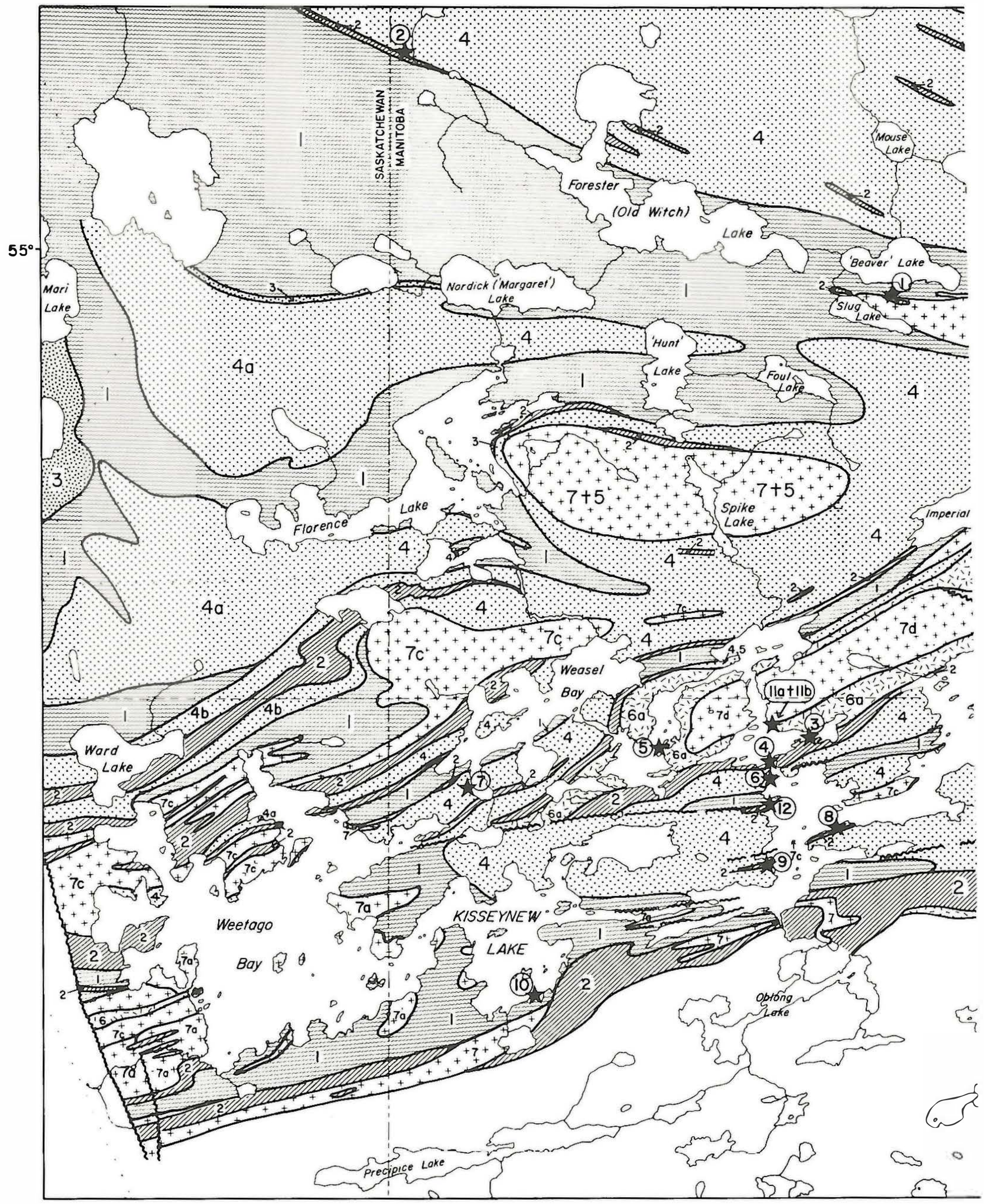
A shoreline exposure of gneissic conglomerate occurs at the west end of Nordick ("Margaret") Lake. The unit appears to be a westward extension of the 'northern' conglomerate mapped by Byers et al. (1965, p. 31) in Saskatchewan.

The conglomerate is matrix-supported, polymictic, non-magnetic and highly foliated. It contains flattened pebbles (1-40 cm long and 1-2 cm thick) ranging in composition from cream felsic and/or aplitic clasts to amphibolite, granite, metagreywacke and quartz, in a garnet-biotite matrix. Although isolated, the unit appears to lie close to the southern contact of a broad belt of Nokomis gneisses with a magnetically high belt of probable Sherridon to the south.

AMPHIBOLITE (3)

Garnet-amphibolite and diopside-amphibolite form prominent marker units throughout the area. The amphibolites are rarely more than 50 m thick, mesocratic to melanocratic, medium grained and highly

*MANFOR usage given in quotations.



4	QUARTZOFELDSPATHIC PARAGNEISS a) Biotite gneiss (Saskatchewan) b) Feldspathic quartzite-granulite (Saskatchewan) c) Hornblendic metasedimentary rock
3	GNEISSIC CONGLOMERATE AND METASANDSTONE
2	AMPHIBOLITE
1	GARNET-BIOTITE GNEISS

Figure GS-14-1: *Generalized geology, Kisseynew Lake West.*

7 FELSIC INTRUSIONS
a) Microcline granite/albite granite/pegmatite
b) Hornblende tonalite - orthogneiss
c) Granodiorite
d) Granulitic - granite

6 GNEISSIC DIORITE
a) Gabbroic and leucogabbroic gneiss/granulite
b) Norite - diorite

5 GRANITOID GNEISS

MINERAL LOCALITIES 1-12 ★

OTHER "OCCURRENCES" S●

FAULT

SCALE

1000m 0 1 2 3 4 km

TABLE GS-14-1
MINERALIZED LOCALITIES:
SEE PRELIMINARY MAP 1985K-1 AND FIG. GS-14-1

Location	Station #	
1	04-85-33	Prominent gossan zone on north shoulder of MANFOR Road near 'Slug' Lake. Associated garnet amphibolites (strike 300°/50°) contain sporadic blebs of scapolite? Alteration of biotite-garnet gneisses to bleached silicified layers some with anthophyllite + cordierite. Neighbouring pegmatite contains 1-2 cm magnetite clots.
2	04-85-86	Several 1-3 m thick fine-mg garnetiferous amphibolites with associated sandy garnet-biotite gneiss layers, and 1 m thick white quartzite with sporadic marginal 2-3 cm garnet blasts. Sporadic rose quartz in cross-cutting veins; minor associated gossan. Transition zone between garnet-biotite gneisses to south and magnetite bearing quartzofeldspathic gneisses to north.
3	04-85-338	Coarsely crystalline foliated and lineated hornblendite with 1-3 cm thick tightly folded garnetite layers. Host unit a hornblende metagabbro. Thin gossan zones to south.
4	04-85-331	10 m wide point of gossanous rubble with appreciable carbonate and associated garnet, and pyroxene-bearing amphibolite layers to north and south. Thin interbeds of faserkiesel-bearing quartzofeldspathic gneiss.
5	04-84-174,	Well layered amphibolite with carbonate-rich layers and associated thin pyritiferous quartzites. Several thin gossans parallel layering.
6	04-85-348	10 m thick coarsely crystalline pegmatite dykes with thin screens of quartzofeldspathic gneisses containing sporadic garnet clots. Pegmatites are parallel to axial planes of tight folds. Pink graphic potassium feldspar (up to 20 cm) in matrix of finer grained cream albite and minor grey quartz. Yellow uranophane staining and encrustations, patchy, commonly associated with coarser feldspathic phases 400-600 cpm. Several sampling locations.
7	04-85-100	Similar to above, pegmatites up to 15 m thick emplaced in white and grey highly recrystallized garnet-bearing flaser quartzofeldspathic gneiss. Uranophane present in patches and networks associated with coarse grained neutral/grey graphic potassium feldspar. Yellow staining in zones 1 m wide and 6 m long.
8	04-85-375	Several shallow trenches across 1-2 m wide highly magnetic massive sulphide zone (pyrite/pyrrhotite) with associated calc-silicate and garnetiferous amphibolite layers. Cross-cutting quartz vein in main trench (3 m x 1.5 m x 2.0 m) strongly mineralized. Footwall: schist, quartzose metasediment; hangingwall unit: quartzose hornblende gneisses and/or pink pegmatite and granite. Total strike length of zone 600 m; strike 265/30.
9	04-85-359	1.5 m thick gossan zone at water's edge in calc-silicate-rich layer at base of garnetiferous amphibolite with sporadic thin sandy biotite gneiss and quartzite layers.
10	04-85-285	Massive thick white pegmatite with abundant granitic phases. Yellow uranophane as patches and networks associated with coarse grained phases. Sporadic rafts of highly folded biotite gneiss.
11 a & b	04-85-343, 344	Foliated granitoid gneiss with thin highly sheared gossanous zones parallel foliation. Derived from older grey granite and intensely flattened and retrograded metagabbroic garnet-hornblende-quartz-plagioclase gneisses.

foliated and layered (0.5-50 cm). Garnet is typically present as 0.3-2 cm euhedral (and/or flattened) blasts in a finer grained matrix of hornblende, biotite, quartz and/or feldspar. Textural varieties include salt-and-pepper, feldspar-phyric, pseudo-gabbroic and garbenschiefer as well as the more typical well and thinly layered para-amphibolites with calc-silicate(diopside and epidote)-bearing layers, with or without associated carbonate and sulphides. Thin siliceous sandy interbeds are common in some units (localities 4, 9, 12 and 13 Fig. GS-14-1). North of Forester Lake 1 m thick white quartzite layers occur in an amphibolitic sequence that lies along the southern contact of quartzofeldspathic gneisses with garnet-biotite gneisses to the south. Garnetite layers 1-3 cm thick alternate with hornblendite layers in an amphibolitic sequence at locality 3 (Fig. GS-14-1).

QUARTZOFELDSPATHIC SUITE (4)

A type section from units 1 and 3 through 6 is exposed along the powerline southwest of Imperial Lake. Medium grey equigranular, homogeneous, foliated and medium grained hornblende-plagioclase-quartz gneisses and wackes (4g) commonly occur immediately adjacent to and stratigraphically above the principal amphibolite, and at the base of the main quartzofeldspathic sequence in the area. The gneisses are weakly layered and contain sporadic diopside-rich layers, and local thin (1-10 cm) hornblendite lenses.

Salmon-pink arkosic gneiss (4f), containing highly stretched light cream segregations, occurs locally above the hornblende-plagioclase gneisses. The gneiss is locally foliated and muscovite-bearing with a vague layering defined by rare magnetite laminae. Superficially, the unit resembles an aplite.

Light grey, buff and cream weathering quartzofeldspathic gneisses constitute the dominant rock type in the area. Several compositional variations occur, all being characterized by good layering due to variations in the principal mineral constituents as well as strikingly coloured zoned calc-silicate layers, pods and lenses.

The common quartzofeldspathic gneiss is fine-medium grained, foliated, well layered and contains quartz, plagioclase, microcline, muscovite and biotite. Major units are characterized by the presence or absence of magnetite which when present occurs as fine disseminations or placer concentrations lining the bedding planes of cross-stratification or trough banding. Some units contain faserkiesel-bearing layers with 0.5-1.0 cm white knots of quartz and sillimanite with muscovite overgrowths flattened in the plane of foliation. Garnet, though typically absent, may occur sporadically as pale pink segregations. Granitic segregations rarely exceed 10 per cent.

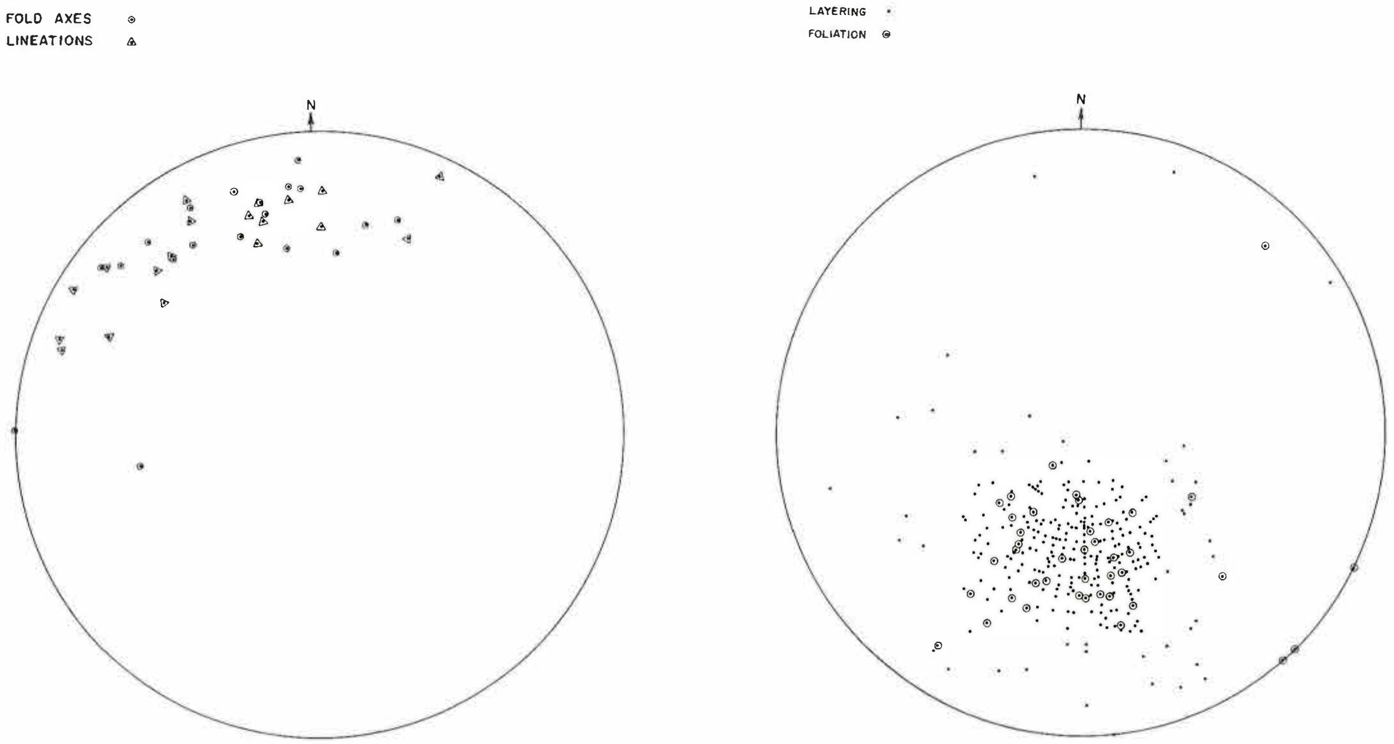


Figure GS-14-2: *Poles to layering; fold axes and lineations in the Kisseynew Lake West region.*

TABLE GS-14-2
TABLE OF SUPRACRUSTAL FORMATIONS

Well bedded quartz-rich biotite arenite ± sillimanite, garnet and magnetite, sporadic calc-silicate layers

Quartz arenite with calc-silicate gneisses and amphibolite

Leucocratic and layered garnet-hornblende-plagioclase-quartz gneisses and metadiorite sills

Feldspathic quartzite ± garnet, hornblende. Local carbonate-bearing layers

Thinly layered amphibolite ± garnet ± diopside. Grey and pink layered non-magnetic quartzo-feldspathic gneisses

Pink arkosic gneiss ± magnetite

Hornblende-plagioclase quartz wacke with minor interlayered amphibolite

Thin layer of garnetiferous semipelite

Amphibolite thinly layered diopside-bearing

Amphibolite thinly layered garnet-bearing ± quartzite layers containing garnet and/or sillimanite

Garnet-biotite gneisses and sillimanite schists typically containing graphite and minor mobilizate

UPPER ARENACEOUS SUITE AND UNDERLYING GARNET-HORNBLENDE GNEISSES AND AMPHIBOLITE (5, 6)

Immediately above the faserkiesel-bearing quartzofeldspathic gneisses a thinly layered diopside and garnet-bearing amphibolite (5) marks the re-entrance of garnet-bearing lithologies with, however, ubiquitous hornblende.

The amphibolite is overlain by well layered and foliated, relatively leucocratic plagioclase-garnet-hornblende quartz gneiss (6c) with common hornblende and quartz-rich calc silicate layers. Garnet occurs in euhedral, sieved porphyroblasts (0.5-3 cm) commonly containing rotated or S-shaped inclusion trails of quartz. The porphyroblasts in many instances are associated with feldspar stringers contained within the cross-foliation. Layering is defined by subtle variations in the abundance and size of the principal minerals.

Much of the southern area is underlain by buff weathering, coarse grained, quartzose biotite- and hornblende-bearing paragneisses that are well layered, strongly foliated and form prominent topographic ridges. There is some evidence that the unit is transitional with the garnet-hornblende gneisses and results from a gradational upward increase in quartz content and fall off in garnet and hornblende. Quartz foliae and layers exhibit a prominent knobby weathering that accentuates the layering/bedding. Amphibolites (up to 1 m thick) and quartz-rich calc-silicate layers (2-50 cm) alternate with more quartzofeldspathic beds and layers containing quartz-sillimanite knots + muscovite. Garnet occurs sporadically as does magnetite.

In many respects the unit possesses attributes of both the typical Nokomis garnet-biotite gneisses and the overlying quartzofeldspathic/arkosic group.

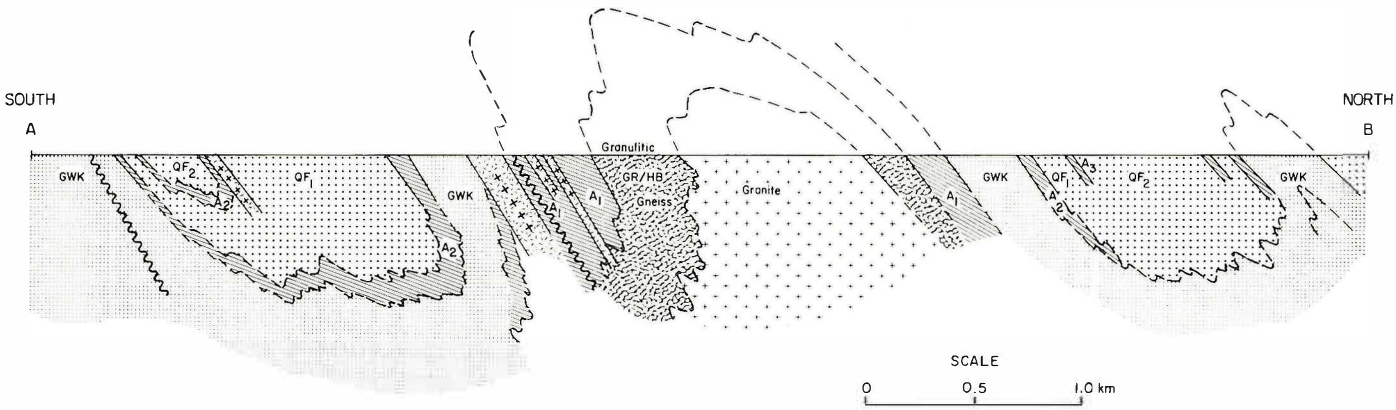


Figure GS-14-3: Hypothetical cross-section A-A' (Preliminary Map 1985K-1), Weasel Bay area, showing inferred relationship between amphibolites (A_1, A_2 and A_3), Nokomis (GWK) and Sherridon (QF_1 and QF_2) paragneiss and the granulitic garnet-hornblende-plagioclase gneiss. Note also axial-planar pegmatites (xxx) and faults rejuvenated along axial planar foliation.

GRANULITIC GARNET-HORBLENDE GNEISS (6d)

Granulitic garnet-hornblende-plagioclase-quartz gneisses (6d) mineralogically resemble the leucocratic plagioclase-garnet-hornblende gneisses (6c). However, their unique setting in the regional distribution of units could be interpreted to indicate a position below the grey garnet-biotite gneisses of Weasel Bay (see Fig. GS-14-1 and hypothetical cross-section Fig. GS-14-3*). In some respects the unit matches descriptions by Pollock (1964) of metadiorite in the Duval Lake area; however, the presence of well defined layering, inclusions of calc-silicates, the locally high quartz contents (verging on feldspathic quartzite), and apparent conformity with and gradational relationships into flanking amphibolites are taken to indicate a sedimentary rather than intrusive origin for the unit south of Weasel Bay.

A large body of well layered, coarse grained, leuco- to mesocratic granulitic garnet-hornblende-plagiociase-quartz-magnetite clot gneiss (6d) (Fig. GS-14-4) lies to the immediate south of Weasel Bay. The northern contact is marked by the occurrence of thick (150 m) well layered garnetiferous amphibolites, as is the more foliated and flattened southern contact. Extensions of the body can be traced at least 3 km to the east and 2 km west. The central granitoid phases are more leucocratic in composition.

The unit forms massive blocky jointed outcrops comprising well foliated and lineated gneiss with hornblende crystals and aggregates flattened and elongated into a penetrative 'l' fabric. Garnet is abundant and occurs as discrete, deep red euhedral crystals (0.2-2 cm) disseminated yet concentrated in various layers. Quartz content varies widely but is generally present in all phases except medium grained, dioritic hornblende-plagioclase layers up to 1 m thick. Quartz-rich phases with finely disseminated garnet aggregates approach feldspathic quartzite composition.

Amphibolite, calc-silicate, carbonate and highly siliceous layers on a point south of the channel north of Weasel Bay (location 3, Fig. GS-14-1), are of uncertain relationship to the rest of the body.

*The location of the cross-section, Figure GS-14-3, is shown on Preliminary Map 1985K-1.

Figure GS-14-4: Layered granulitic garnet and hornblende bearing dioritic and leuco-gabbroic gneisses, south of Weasel Bay.

INTRUSIVE AND GRANITOID ROCKS (7 - 11)

Granitoid rocks of varying ages occur throughout the area but rarely attain significant dimensions. Ellipsoidal bodies 1 x 3 km in extent occur east of 'Slug' Lake, north of Weasel Bay and on the main north-south channel of Kisseynew Lake, north of Oblong Lake. Pink microcline granite and associated pegmatite (10a) form a younger intrusive complex near the entrance to Weetago Bay. Offshoot pegmatites (11), some radioactive, form thick east-trending dyke swarms in the southwest corner of the region.

Dykes and sills 1-10 m thick of pale grey, homogeneous, equigranular, medium grained biotite granodiorite (10c) occur sporadically throughout the area. None are large enough to form mappable units. Locally preserved age relationships reveal the older granodiorite to be cut by boudinaged grey, cream and clear feldspar-bearing pegmatite and pegmatitic granites, which in turn are cut by narrow pink pegmatites, and even younger 005°-trending en echelon quartz veins.

East of 'Slug' Lake an ellipsoidal body of leuco- to mesocratic hornblende orthogneiss (8d) contains numerous rafts of hornblende-rich supracrustals and some thin garnet-bearing gneisses. The marginal phases along the road between Bath and 'Beaver' Lakes are highly foliated and lineated, and exhibit layering with local metagabbroic sills, diopside-bearing clots and stringers, garnetite pods and pink pegmatites with quartz-tourmaline intergrowths.

Layered pink and grey, medium grained non-magnetic, foliated granitoid gneisses (8a, b) outcropping along the south shore of Weasel Bay resemble some phases of the quartzofeldspathic suite. The units contain thin pink stringers of feldspathic mobilizate, slightly thicker pegmatite lits, and sporadic mafic sills. A consistent relationship with the grey units occurring to the north and on top of the pink unit, may favour a supracrustal origin.

Older gneissic diorites (7) and quartz diorite (9) form elongate bodies trending parallel to the regional layering and foliation.

A single dyke (15 cm thick) of mesocratic gabbro was recorded cutting the well defined layering of the leucocratic granulitic garnet-hornblende-plagioclase-quartz gneiss south of Weasel Bay.

ECONOMIC CONSIDERATIONS

Numerous amphibolites exhibit associated sulphide mineralization (Table GS-14-1). Prominent sulphide zones which have received previous attention from the exploration industry, tend to be confined to the southern part of the area, and constitute 70-90°-trending conductive zones. Many occupy major fractures or intensely foliated zones rejuvenated along axial planes of early folds, particularly in the large bay of Kisseynew Lake immediately east of the Saskatchewan border. Others are directly associated with amphibolites and appear to represent primary stratabound mineralization (localites 4 and 8, Fig. GS-14-1). Carbonate layers and associated gossan are particularly evident in localities 4, 5 and 8 where they represent an integral part of the amphibolitic sequence.

Throughout the area amphibolitic units, possibly an extension of the "Kisseynew Metallotect", were invariably recorded at the junction between the garnet-biotite gneisses and the quartzofeldspathic sequences. However, in the southernmost bay of Florence Lake quartz-rich garnetiferous semipelite is intimately interlayered with magnetite-bearing quartzose paragneisses, with no evidence of intervening amphibolite nor structural breaks. Elsewhere the amphibolites are generally well layered and can be broadly differentiated into garnet-bearing (garnetite at locality 3), and diopside and carbonate-bearing varieties. A provisional interpretation of the structure as determined from cross-section A-A' (Fig. GS-14-3) indicates the possibility of amphibolites at three different stratigraphic levels. However, the present data are extremely fragmentary and more detailed work will be required before a definitive stratigraphy can be compiled. Northwest of Forester Lake 1 m thick white quartzite layers occur within the garnetiferous amphibolites in a transitional sequence between the Nokomis garnet-biotite gneiss and overlying Sherridon Group.

Massive thick, locally radioactive, pink and white pegmatites, similar to those described by Byers et al. (1965) on Weetago Bay, are prominent in the southern part of the Weasel Bay area. Patchy yellow uranophane alteration was noted in several localities (6, 7, 10) some of which showed evidence of previous sampling (Table GS-14-1).

REFERENCES

Byers, A.R., Kirkland, S.J.T., and Pearson, W.J.
1965: Geology and Mineral Deposits of the Flin Flon Area; Saskatchewan Department of Mineral Resources, Report 62.

Gale, G.H.
1984: Stratabound gold mineralization in the Kisseynew gneiss terrain; **in**: Manitoba Mineral Resources Division, Report of Field Activities 1984, p. 73-80.

McRitchie, W.D.
1980: Cacholotte Lake (parts of 63K/13, 14 and 63N/3 and 4); **in**: Manitoba Mineral Resources Division, Report of Field Activities 1980, p. 65-69.

Pollock, G.D.
1964: Geology of the Duval Lake Area 63N/4; Manitoba Mines Branch Publication 61-6.

Tanton, T.L.
1938: Flin Flon Map-area; Geological Survey of Canada Map 632A, with marginal notes.

Zwanzig, H.V.
1983: Kisseynew Project: Lobstick Narrows; **in**: Mineral Resources Division, Report of Field Activities 1983, p. 15-22.
1984: Kisseynew Project: Lobstick Narrows-Cleunion Lake, Puffy Lake and Nokomis Lake area; **in**: Manitoba Mineral Resources Division, Report of Field Activities 1984, p. 38-45.

GS-15 INVESTIGATION OF MINERAL OCCURRENCES IN THE KISSEYNEW METASEDIMENTARY TERRAIN

by S. Peloquin, G. Ostry and G. H. Gale

INTRODUCTION

Investigations in the Kisseynew terrain focussed on defining the geological setting of known gold occurrences and an examination of the lateral extent of the 'Kisseynew Metallotect' (Gale and Ostry, 1984). Detailed mapping was carried out at Evans Lake and Wood Lake, sampling and detailed studies were conducted at Nokomis Lake, and a reconnaissance was made of specific map units on the Batty Lake map sheet (63N/2) in order to plan the 1986 field program (see Fig. GS-15-1).

NOKOMIS LAKE

A 'quartz-rich gneissic rock' containing quartz, hornblende, plagioclase and garnet with a thickness of approximately 20 m occurs within a unit of amphibolitic rocks (Gale and Ostry, 1984). This distinctive quartz-rich gneiss can be traced along strike for a least 8 km (Zwanzig, 1984). Locally, the quartz-rich gneiss contains lenses of 'quartzite' (chert?) with 10-15% sulphides; pyrite and pyrrhotite are the dominant sulphides with lesser arsenopyrite, chalcopyrite, sphalerite and galena. The highest gold values are associated with arsenopyrite.

Drilling by Riocanex established the presence of thin gold-bearing lenses in four zones over a strike length of three kilometres. In addition, several lower grade (less than 0.1 oz Au/ton) gold-bearing zones consist of discordant sulphide veinlets that probably represent mobilizate out of the surrounding quartz-rich gneiss.

The gold-bearing mineralized zones are essentially stratabound within the quartz-rich gneiss. In detail, individual lenses of sulphide and quartzite may vary in their relative position with respect to the structural top of the quartz-rich unit; however, the sulphide veinlets tend to occur toward the structural base of the quartz-rich gneiss. Sulphide veinlets were not found in the outcrops or drill core of either footwall or hanging wall amphibolites in the vicinity of the auriferous zones. Sulphide veinlets were observed in the structurally overlying amphibolites along the powerline north of Nokomis Lake.

Evidence of hydrothermal alteration has not been found in the Nokomis Group metasedimentary rocks. Several drill holes from the Riocanex drilling did, however, intersect a lense of 30-40% pyrite ± graphite with minor arsenopyrite near the structural base of the Nokomis Group. According to the current stratigraphic interpretation of the area (Zwanzig, 1984) this sulphide-graphite lens would occur stratigraphically below the garnet amphibolite layer and the quartz-rich gneiss containing the gold mineralization.

Disseminated magnetite was noted to be present in discrete layers/lenses within the quartz-rich gneiss away from the sulphide-bearing lenses (Gale and Ostry, 1984). Four profiles were obtained with a magnetometer at station spacings of 10 m along the profiles. Anomalous values of 3000-4000 gammas above the background of the amphibolites indicate that a narrow anomalously magnetic zone of 10-30 m width can be delineated in the quartz-rich gneisses. If this magnetic zone is identifiable on the 1985 gradiometer survey of this area it would facilitate delineation of the quartz-rich gneiss zone in areas that have not yet been mapped in detail.

Rock samples were collected from the quartz-rich gneiss and the enclosing amphibolites as part of the ongoing geochemical study of their trace and major element signatures. Analytical results obtained from samples collected in 1984 are presented in Table GS-15-1 and Table GS-15-2 with relative locations indicated on a schematic profile (Fig. GS-15-2).

EVANS LAKE

Reconnaissance of the Evans Lake area in 1984 revealed a geological setting for gold-bearing arsenopyrite mineralization similar to that at Nokomis Lake. The area was shown to be structurally complex (Robertson, 1953) and thus was mapped at a scale of 1:5000 (see preliminary map 1985 MI-2); however, operational exigencies precluded undertaking the planned follow-up detailed studies of the mineralization and sampling for geochemical investigations.

The detailed mapping confirms the similarities in regional stratigraphic position and lithologies between the auriferous zones at Nokomis Lake and Evans Lake (Gale and Ostry, 1984). The major rock units are, from east to west: magnetite-bearing quartzofeldspathic gneiss (Sherridon Group), amphibolitic gneiss and quartz-feldspar-biotite-garnet gneiss (Nokomis Group).

The amphibolitic gneiss contains four major subunits:

1) layered amphibolite;
2) quartz-rich gneiss;
3) massive amphibolite; and
4) calcareous amphibolite

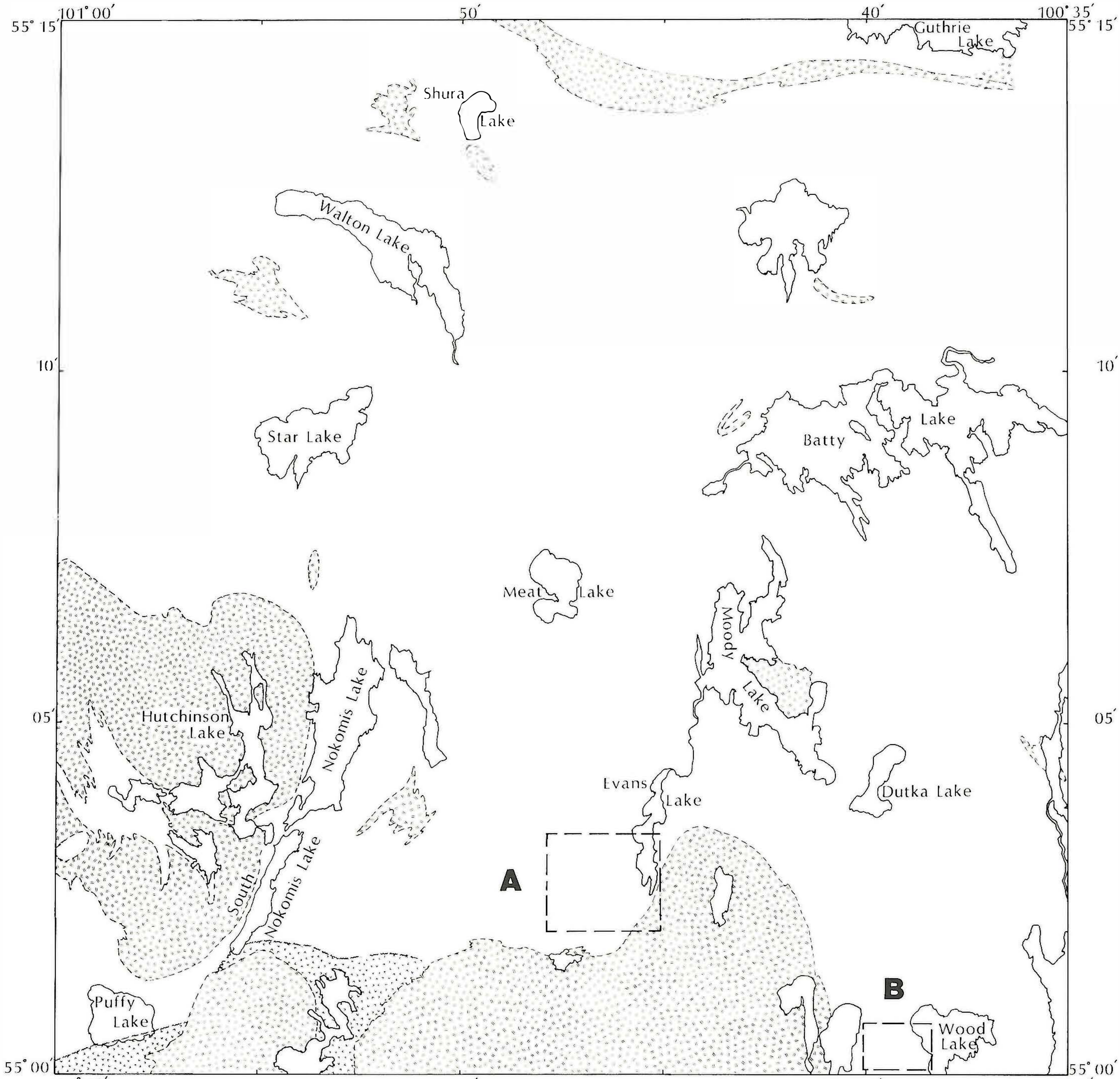
The 'layered amphibolite' is the structurally lowermost unit and throughout most of its outcrop area is a thinly layered (1-3 cm) mafic rock that was probably derived from basaltic volcanogenic sediments. Locally, this rock contains layers (beds) of calc-silicate material that probably represents original limy sediments. In several places this unit contains minor massive sections (30-50 cm thick) that may represent either basaltic flows or tuffs.

The 'quartz-rich gneiss' is a silicic rock that occurs between two amphibolitic rock units. The rock has a mottled appearance with rapid mineralogical changes on a cm or tens of cm scale. In general, this rock consists dominantly of quartz and feldspar; other minerals include, amphibole, biotite, garnet and calcite together with minor sulphide and magnetite. A typical thin section contains 65-75% quartz and feldspar, 20-25% hornblende, 2-3% calcite and approximately 1% opaque minerals. Megascopically this quartz-rich gneiss is quite similar to the auriferous quartz-rich gneiss at Nokomis Lake.

The quartz-rich gneiss is structurally overlain by a dark green 'massive amphibolite' unit. This unit consists mainly of fine- to medium-grained basaltic rock. In proximity to the quartz-rich gneiss this unit is layered and contains garnet. There is a unit of garnet-rich hornblendite adjacent to the quartz-rich gneiss. Locally the garnet content exceeds 30% by volume and the rock was mapped as a 'garnetite'.

Mafic rocks with a pale grey-green colour and a generally massive appearance have been mapped as calcareous amphibolite. In places, this rock is medium grained and massive, with a distinctive gabbroic appearance. In other exposures this rock has well developed layering and an overall tuffaceous appearance. Contacts with other rock units have not been observed. This rock does not appear to cut across the other rock units in the area and appears to maintain a roughly consistent distance from the quartz-rich gneiss, i.e. it appears to be conformable. In addition, no dykes of a similar rock type have been observed cutting the other rock types in the area. Consequently, this unit is tentatively considered to represent a unit of mafic (or ultramafic) flows and pyroclastic rocks.

The quartz-feldspar-biotite-garnet gneiss is a psammitic to semi-pelitic brown weathering metasedimentary rock that is similar to typical Nokomis Group gneiss.



FLIN FLON GREENSTONE BELT

FELSIC INTRUSIONS

A: EVANS LAKE PROJECT AREA

KISSEYNEW SEDIMENTARY GNEISS TERRANE

B: WOOD LAKE PROJECT AREA

Figure GS-15-1: Location Map, Batty Lake area (Part of 63 N/2).

TABLE GS-15-1
NOKOMIS ROCK SAMPLES

%	1A	1B	1C	1D	1F	2	3	3A	3B	3C	4A	4B	4C	5	5A	6	7A	7B	7E	7G	7I	8	9
SiO_2	64.5	66.2	65.2	56.9	46.8	67.0	64.6	78.9	59.3	55.9	55.5	66.7	68.1	66.9	44.5	42.5	68.0	67.1	66.9	63.2	69.0	47.0	48.3
Al_2O_3	11.2	11.0	10.2	12.5	10.8	6.6	8.7	6.4	9.2	9.4	9.8	11.0	9.6	10.2	11.7	9.8	10.9	10.7	10.4	11.3	10.7	13.2	15.1
$Fe_2O_{3(T)}$	12.5	7.9	10.2	11.1	28.4	12.7	13.8	7.1	15.0	16.8	16.8	7.0	7.1	8.4	27.6	30.6	6.3	11.5	11.5	13.1	8.3	10.8	8.1
CaO	4.7	7.4	7.7	10.3	6.4	3.5	3.9	4.5	4.1	5.5	11.2	7.9	9.8	5.6	6.9	7.7	6.1	3.7	3.5	4.9	5.4	11.6	13.7
MgO	0.5	0.9	0.6	0.6	2.5	0.6	0.5	0.3	0.7	0.6	1.2	0.5	0.5	0.5	4.4	4.1	0.7	0.7	0.4	0.5	0.6	12.9	11.6
Na_2O	4.5	3.4	4.4	4.7	2.0	2.5	3.2	1.9	3.3	3.7	2.5	3.7	2.1	5.0	2.4	1.9	5.6	4.2	4.3	5.2	3.5	1.4	1.1
K_2O	0.4	1.0	0.4	0.5	0.1	0.2	0.2	0.3	0.1	0.2	0.3	0.4	0.2	0.4	0.2	0.3	0.3	0.2	0.3	0.3	0.5	0.2	0.2
TiO_2	1.0	0.8	0.7	1.3	3.3	0.7	0.9	0.5	1.3	1.3	1.8	0.8	0.8	0.8	2.9	3.5	1.2	0.7	0.8	1.3	0.8	0.6	0.5
P_2O_5	0.15	0.15	0.15	0.37	0.15	0.31	0.24	0.09	0.32	0.42	0.48	0.14	0.12	0.15	0.07	0.05	0.17	0.11	0.10	0.16	0.10	0.01	0.04
MnO	0.12	0.09	0.13	0.15	0.37	0.09	0.10	0.07	0.12	0.15	0.18	0.09	0.06	0.10	0.32	0.33	0.08	0.12	0.12	0.13	0.10	0.18	0.11
LOI	0.4	1.0	0.7	0.8	1.0	4.8	3.0	0.6	7.0	5.2	0.7	1.8	2.3	0.5	0.1	0.6	1.3	1.6	0.5	0.5	1.0	0.2	0.6
S	0.78	0.12	0.18	0.01	0.1	3.34	3.09	0.14	4.88	4.03	0.01	0.01	0.01	0.89	0.12	0.26	0.07	0.01	0.07	0.05	0.01	0.01	0.01
ppm																							
Au	1.3	0.16	0.35	0.095	0.047	24.0	4.7	0.57	4.3	7.0	0.008	0.26	0.003	2.3	0.02	0.023	0.3	0.011	0.015	0.017	0.012	0.027	0.01
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Se	0.2	<0.2	<0.2	NA	0.2	1.4	0.2	<0.2	1.2	0.9	NA	<0.2	NA	0.2	NA	0.5	NA	NA	NA	NA	NA	<0.2	<0.2
Te	0.2	<0.2	<0.2	NA	<0.2	12.0	2.9	<0.2	11.2	8.0	NA	<0.2	NA	1.0	NA	<0.2	NA	NA	NA	NA	NA	<0.2	<0.2
B	17.0	54.0	40.0	NA	47.0	34.0	31.0	42.0	31.0	41.0	NA	37.0	NA	26.0	NA	40.0	NA	NA	NA	NA	NA	37.0	45.0
Hg	0.02	0.01	0.005	NA	0.005	0.04	0.01	0.005	0.005	0.02	NA	0.005	NA	0.005	NA	0.005	NA	NA	NA	NA	NA	0.005	0.005

NA = not analyzed

TABLE GS-15-2
GEOCHEMICAL (ICP) ANALYSES OF NOKOMIS ROCK SAMPLES

%	1A	1B	1C	1F	2	3	3A	3B	3C	4B	5	6	8	9
Fe_2O_3	5.33	2.43	2.00	4.42	9.88	9.13	1.84	11.72	10.99	2.84	4.14	4.96	1.16	0.44
CaO	1.61	2.43	2.60	1.20	1.47	1.22	1.69	1.10	1.47	3.54	3.33	1.55	2.47	4.83
P_2O_5	0.20	0.18	0.14	0.20	0.45	0.39	0.14	0.50	0.62	0.16	0.16	0.09	0.04	0.02
MgO	0.20	0.40	0.21	0.41	0.40	0.30	0.10	0.41	0.16	0.33	0.21	0.69	1.44	0.73
TiO_2	0.10	0.17	0.13	0.17	0.05	0.08	0.10	0.11	0.08	0.28	0.08	0.28	0.05	0.01
Al_2O_3	1.04	1.15	0.58	1.34	0.68	0.90	0.54	0.77	0.51	1.26	0.43	1.49	4.13	8.07
Na_2O	0.12	0.08	0.09	0.16	0.05	0.08	0.05	0.09	0.06	0.20	0.08	0.21	0.28	0.36
K_2O	0.05	0.06	0.03	0.03	0.01	0.02	0.02	0.01	0.01	0.08	0.02	0.06	0.02	0.03
ppm														
Mo	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Cu	60	18	2	37	78	109	15	140	108	5	10	112	173	32
Pb	2	4	4	4	10	7	2	13	7	3	11	5	15	2
Zn	17	14	9	20	17	14	11	15	12	38	10	23	14	4
Ag	0.1	0.1	0.1	0.1	0.9	0.2	0.1	0.2	0.8	0.1	0.1	0.1	0.1	0.2
Ni	1	2	1	1	1	1	1	1	1	1	1	4	38	13
Co	25	29	24	22	36	36	59	49	47	35	24	31	13	7
Mn	282	202	196	365	286	268	180	394	261	259	375	351	146	59
As	562	142	467	195	31,286	12,414	436	22,343	23,600	55	7,170	10	3	12
U	5	5	5	5	5	5	5	5	5	10	5	5	5	8
Au	ND	ND	4	ND	15	4	2	3	11	ND	2	ND	ND	ND
Th	4	4	1	1	1	1	1	2	3	3	2	1	1	1
Sr	8	21	18	7	13	10	15	10	11	30	24	8	31	118
Cd	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Sb	2	2	2	2	48	4	5	7	2	2	3	2	2	2
Bi	2	2	3	2	2	2	2	2	2	2	2	2	2	2
V	1	1	1	18	6	7	9	7	5	1	2	37	17	7
La	10	10	5	2	6	3	4	5	3	7	6	2	2	2
Cr	1	1	1	1	2	1	3	1	1	2	1	1	95	50
Ba	9	10	7	11	7	6	5	6	6	8	5	8	11	9
B	9	18	11	8	11	9	10	10	10	11	11	9	15	16
W	211	254	223	133	1421	885	1555	364	181	318	284	71	64	34

ND = Not detected

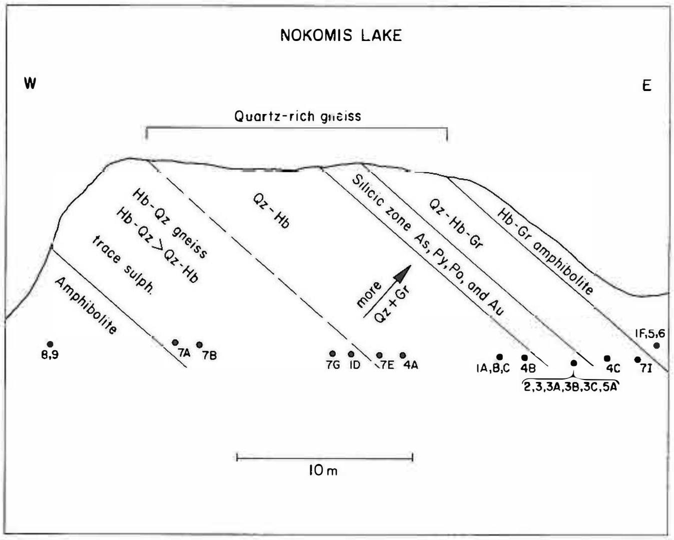


Figure GS-15-2: Location of analyzed rock samples from the Nokomis Lake gold occurrence. Schematic section after Gale and Ostry (1984).

Mineralization observed to date appears to be confined to the quartz-rich gneiss. Individual occurrences will be examined in detail in the upcoming field season.

WOOD LAKE

Robertson (1953) indicated the presence of gold associated with chalcopyrite, galena and arsenopyrite within crumpled sillimanite-bearing quartz-biotite gneiss of the Nokomis group immediately west of Wood Lake. Detailed mapping of an area centred on the reported location of this occurrence was undertaken during the field season in order to establish the geological setting at this elusive gold occurrence (cf. Gale, 1981 and Gale and Ostry, 1984).

Four major rock types were observed in the map area (Fig. GS-15-3):

1) quartzofeldpathic gneiss and
2) metaconglomerate, both typical of the Sherridon Group,
3) various mafic amphibolitic gneiss, and
4) felsic intrusive rocks

The western portion of the outcrop map, see Figure GS-15-3, is dominantly fine grained magnetite-bearing quartzofeldspathic gneiss and an amphibolitic metaconglomerate typical of the Sherridon Group. The metaconglomerate at Wood Lake, see Figure GS-15-4, is deformed (with flattening ratios of up to 20:1), polymictic, predominantly clast supported and has a dark magnetite-bearing amphibolitic matrix. Clasts are well rounded to angular, the former being predominant. Epidote alteration of clasts and/or matrix is common.

The amphibolites outcropping to the east and north of the quartzofeldspathic rocks of the Sherridon Group are problematic due to their variable compositions and textures and a lack of continous exposure. The amphibolite of unit 2 is termed a heterolithic metagabbro(?) since it exhibits extreme variability in texture and ranges from a medium grained gabbroic-looking rock to a coarse grained hornblendite and commonly contains blastic growths of magnetite and/or epidote alteration. These textural and compositional variations are visible in both hand samples and outcrops.

Unit 2 has been intruded by a rusty weathering, well foliated, medium grained tonalite/granodiorite (unit 4a on Figure GS-15-3). Unit 4b, a medium- to coarse-grained tonalite/granodiorite gneiss, represents the tectonized equivalent of unit 4a. Quartz veins, less than 1 metre wide, are erratically distributed throughout Unit 4. The intrusion and the quartz veins commonly contain up to 1 per cent pyrite and/or pyrrhotite. Samples of the quartz veins submitted for assay in 1984 did not yield anomalous gold values.

Amphibolites in Unit 1 are distinct from those of unit 2 in that they are fine- to medium-grained and have consistent textures and compositions throughout individual exposures. Three subdivisions were made in unit 1: 1a) fine grained amphibolite; 1b) fine grained garnetiferous (1-2 mm garnets) amphibolite; and 1c) fine- to medium-grained calcareous amphibolite.

Quartz-feldspar-biotite-garnet gneiss (metagreywacke), typical of the Nokomis Group was not found in the map area nor was the gold occurrence indicated by Robertson (1953). Rock types within the map area are not typical of those examined at the Nokomis and Evans Lake gold occurrences; however, the conglomerate at Wood Lake is similar to the conglomerate that overlies the ore zone at Puffy Lake. Further regional mapping should be undertaken to determine the stratigraphic position of rocks in the Wood Lake area.

RECONNAISANCE — KISSEYNEW

A reconnaissance of Shura, Walton, Dukta, Moody and west Hutchinson Lakes (Fig. GS-15-1) was undertaken to evaluate areas for further detailed mapping of the Kisseynew metallotect (Gale and Ostry, 1984). The host rocks to the Puffy, Nokomis and Kay Lakes occurrences were included in unit 3 and/or unit 12 by Robertson (1953) and are associated with amphibolites near the Nokomis/Sherridon Groups contact. At Moody Lake two areas mapped as diorite (Robertson, 1953; map unit 12) are exposed on the north and east shorelines. The mafic exposures on the east shore are similar to the amphibolite unit 2, see Figure GS-15-3, encountered at Wood Lake, i.e. extremely variable in texture and ranging in composition from a medium grained gabbroic rock to a coarse grained, in places magnetite-bearing, hornblendite. Mafic rocks exposed on a large peninsula on the north shore of Moody Lake are composed of interlayered fine- to medium-grained amphibolites and biotite-rich, in part garnetiferous, sedimentary gneiss. Since Nokomis type metagreywacke outcrops to the north of the peninsula and Sherridon quartzofeldspathic gneiss outcrops along the south shoreline at Moody Lake the interlayered amphibolite-sedimentary gneisses may represent the same stratigraphic position as the Puffy, Nokomis and Kay Lake occurrences. In contrast Robertson's unit 12, where exposed along the powerline south of Moody and Dukta Lakes, is a fine grained banded, probably metavolcanic, amphibolite that is dissimilar to the amphibolites intimately associated with the metalliferous strata seen elsewhere. Similar banded amphibolite and amphibolitic rocks outcropping along the southern shoreline of a small unnamed lake immediately west of Hutchinson Lake are interpreted as Amisk metavolcanics by Zwanzig (1984).

Nokomis and Sherridon type rocks were located at both Shura and Walton Lakes. At the southern margin of Robertson's map unit 3, northeast of Shura Lake, the amphibolitic and quartzofeldspathic gneiss observed are typical of the Sherridon Group rocks. Quartz-feldspar-biotite-garnet gneiss of the Nokomis Group was found on a short traverse north. Immediately south of the western half of Walton Lake both Nokomis type rocks (Robertson's unit 4) and Sherridon type rocks (Robertson's units 3 and 5) have been examined.

Detailed mapping of selected areas is planned for the upcoming field season.

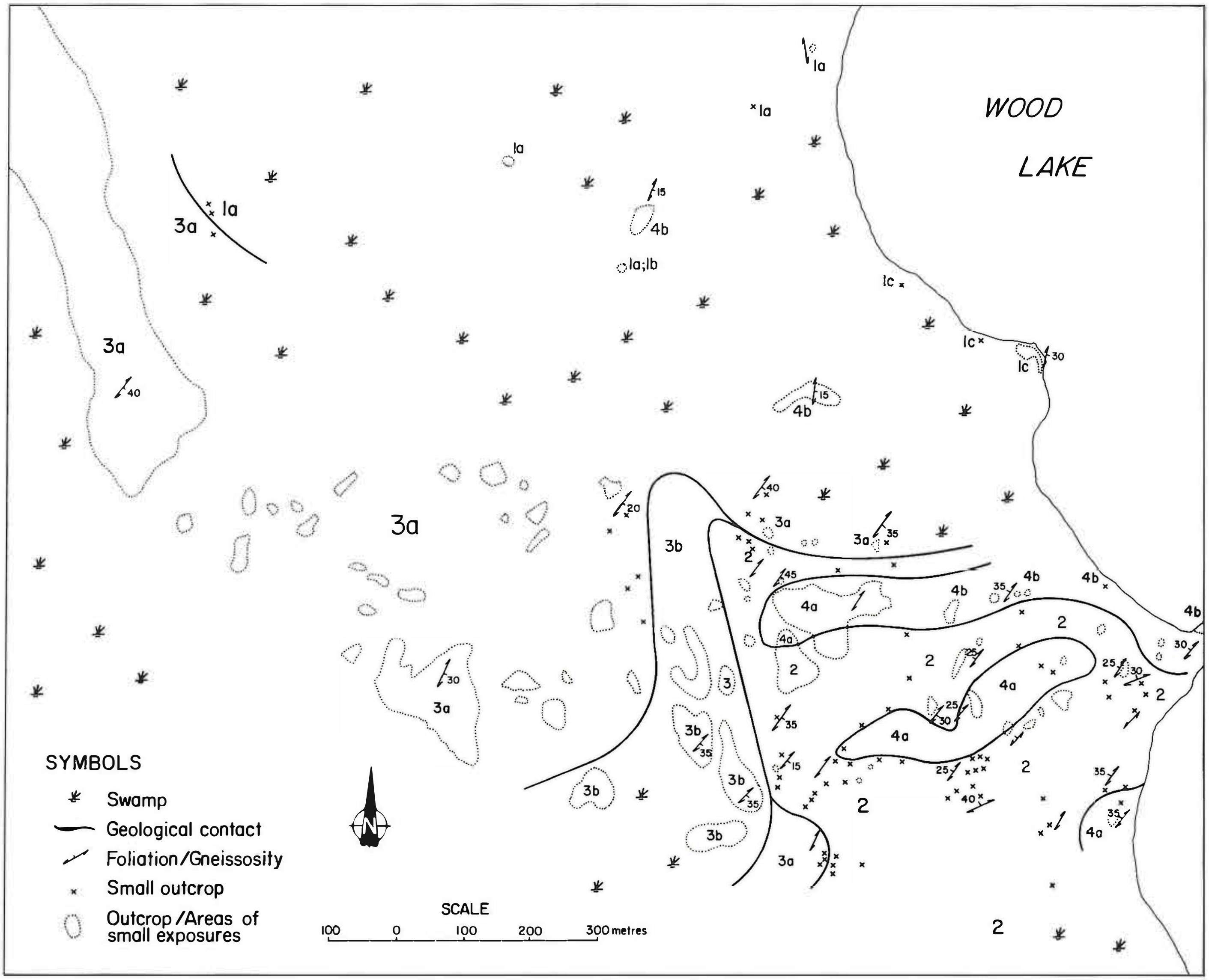


Figure GS-15-3: Geology of the northwest part of the Wood Lake area, Manitoba. Legend: 1a) fine grained amphibolite; 1b) fine grained garnetiferous amphibolite; 1c) fine- to medium-grained calcareous amphibolite; 2) heterolithic metagabbro(?); 3a) metasandstone; 3b) metaconglomerate; 4a) tonalite-granodiorite; and 4b) tonalite/granodiorite gneiss.

REFERENCES

Gale, G.H.
1981: Mineral deposit studies in the Flin Flon *area*; Manitoba Mineral Resources Division, Report of Field Activities, 1981, p. 45-55.

Gale, G.H. and Ostry, G.
1984: Stratabound gold mineralization in the Kisseynew sedimentary gneiss terrain; Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 73-80.

Robertson, D.S.
1953: Batty Lake map-area, Manitoba; Geological Survey of Canada, Memoir 271.

Zwanzig, H.V.
1984: Kisseynew Project: Lobstick Narrows-Cleunion Lake, Puffy Lake and Nokomis Lake areas; Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 38-45.

a)

Figure GS-15-4: *Polymictic metaconglomerate at Wood Lake, Manitoba: a) view normal to axis of elongation and b) view parallel to axis of elongation; note fragments to right of lens caps that are exposed in the plane normal to the axis of elongation.*

b)

GS-16 GEOLOGICAL SETTING OF THE TARTAN LAKE GOLD DEPOSIT

by S. Peloquin[1] and G.H. Gale

The Tartan Lake-Alberts Lake area contains a number of gold occurrences in proximity to a gabbroic and dioritic intrusive complex (Gale, 1981). A zone of gold mineralization containing 600 000 tons with 0.376 oz Au/ton has been delineated by Granges Explorations Ltd. in a shear zone adjacent to a gabbroic intrusion. This project is designed to provide a geological synthesis of the area around the Tartan Lake gold deposit and to investigate the source of the gold mineralization. Field work in 1985 was directed towards providing a geological framework for future mineral deposit studies that will include structural and geochemical analyses of the area.

VOLCANIC ROCKS

The area is underlain predominantly by basaltic to andesitic flows and pyroclastic rocks that have been intruded by several phases of dioritic to gabbroic rocks (Fig. GS-16-1). The mafic volcanic rocks have been tentatively separated into basaltic and andesitic varieties on the basis of overall colour index and texture. The southwestern part of the map area is underlain by fine grained ophitic and aphyric basaltic flows and pyroclastic rocks. Pyroxene phenocrysts are rare in these flows. Individual flow units are thick, pillowed and vesicular. Flow contacts are rarely observed; however, in several places a 5 cm cherty tuffaceous layer was observed at the flow top. Top determinations from pillows and vesicles indicate that this unit is younging northwards.

The basaltic pillowed flows are overlain by a unit of basaltic breccia that consists of variably textured basaltic fragments in a commonly vesicular basaltic matrix. Basaltic pyroclastic flows are present in both this unit and within the pillowed basaltic flow unit to the south.

Pyroclastic, pillowed and massive andesitic volcanic rocks occur north of the basaltic rocks and constitute the dominant volcanic rock types in the map area. These andesitic rocks are generally pyroxene-phyric. The andesitic debris flow and pyroclastic rocks in the southwest corner of the map area contain a distinctive pyroxene crystal tuff with more than 20 per cent pyroxene phenocrysts up to 5 mm in diameter. Layering within the pyroxene crystal tuff is variable and probably represents primary deposition on a slope. Andesitic clasts in the crystal tuff are highly amygdaloidal, pyroxene-rich and subangular. The concentration of pyroxene phenocrysts is greater in the matrix than in the fragments and locally the matrix is amygdaloidal. Pillowed and massive flows adjacent to the pyroxene-phyric pyroclastic rocks are both pyroxene-phyric and aphyric. Flow contacts are irregular and the flows are cut by aphanitic dykes (feeder dykes). This relationship may suggest proximity to a volcanic vent.

Pyroxene-phyric andesitic rocks in the area between Ruby Lake and Tartan Lake and north of the mineralized zone are predominantly pillowed flows. Flow contacts were not observed in these areas of small outcrops; however, the pillows have an overall east-west elongation. Top determinations from the pillowed units are inconclusive.

Two units of pyroxene-phyric andesitic flows in the area east of Ruby Lake are separated by thickly layered intermediate tuffaceous rocks. Two pyroxene-phyric andesitic flow units north of the mineralized zone are separated by thinly layered, in part siliceous, sedimentary and tuffaceous rocks. Further studies are required to determine whether these pyroxene-phyric flow units represent different effusive events or whether they represent one contiguous unit that has been complexly folded; tight isoclinal and open style folds with vertical axial planes have been observed in the metasedimentary rocks.

Intermediate tuffaceous rocks in the area of Ruby Lake, are thickly bedded. Thin (less than 30 cm) feldspar crystal tuff layers are present with rare cherty layers several centimetres thick. In some layers crystals are size graded. This unit also contains intermediate pillowed lavas and breccia.

A thick unit of thinly layered, generally less than 30 cm, intermediate to felsic sedimentary rocks is well exposed on a small peninsula northwest of the mineralized zone. This unit consists predominantly of fine grained intermediate rocks; however, locally felsic rocks with quartz phenocrysts are common and probably represent rhyolitic tuffs. These rocks are separated from a narrow unit of massive thickly layered (bedded?) felsic volcanogenic sedimentary rocks by a thick gabbroic sill.

Aphyric dacitic volcanic rocks exposed on an island at the northern extremity of the map area are interpreted to represent flows owing to the presence of local, indistinct pillow outlines.

GABBROIC ROCKS

A distinctive fine- to medium-grained gabbroic rock with aggregates of coarse grained feldspars and pyroxene that weather to produce a knotted surface is restricted to the northeast corner of the map area. This unit has been referred to as the 'knotted' gabbro. A thick 'sill' of medium grained 'leucogabbro' occurs north of Ruby Lake. A narrow dyke of the same rock occurs east of Ruby Lake, and the leucogabbro also forms the outer periphery of the 'gabbroic complex' that underlies the southeast corner of the map area. A fine grained gabbroic intrusion occurs in the northeast corner of the map area immediately south of the 'knotted' gabbro.

The 'gabbroic complex' in the southeast part of the area is a multiple intrusion of gabbroic and dioritic rocks. A medium- to coarse-grained leucogabbro, that varies to a coarse grained melanocratic gabbro, contains small 'segregation pods' of pyroxenite and is cut by aphanitic intermediate dykes, fine grained dioritic dykes, and feldspar porphyry felsic dykes. In addition aphanitic felsic veins and aplitic dykes occur locally.

Individual exposures of the 'gabbroic complex' commonly contain more than one rock type and an accurate delineation of the rock types is not possible at the 1:5000 scale of mapping. The subdivisions presented (Fig.GS-16-1) are a first attempt and can be refined with more detailed work. The complex has been subdivided on the basis of dominant lithologies into an outer margin of medium- to coarse-grained gabbro (see also Map 1985-MI-1), coarse grained melanocratic gabbro, diorite intrusions into leucogabbro, and an igneous breccia. The breccia consists of angular gabbroic to pyroxenite clasts in a matrix that is commonly fine grained diorite; locally some of the clasts have reaction rims.

Medium grained feldspar porphyry dykes are common in the gabbroic complex and in the area east of Ruby Lake. These dykes do not appear to have any preferred orientation; however, locally they are associated with zones of shearing, e.g. near the main zone of mineralization and in the southern part of the map area.

SHEAR ZONES, QUARTZ VEINS, AND CARBONATIZATON

Gold mineralization in the Tartan Lake area appears to be associated with zones of quartz and carbonate (Gale, 1981) and shear zones (P. DeVeaux, pers. comm., 1984). Although one of the main objectives of this project is to provide a detailed analysis of silicification, carbonatization and shearing there was insufficient time to undertake this aspect of the project in 1985. Consequently, the only information obtained on these aspects of the project are the observations noted during the course of the mapping project. A detailed analysis of alteration and structures will be undertaken during the 1986 field season.

[1]Universite de Quebec, Chicoutimi

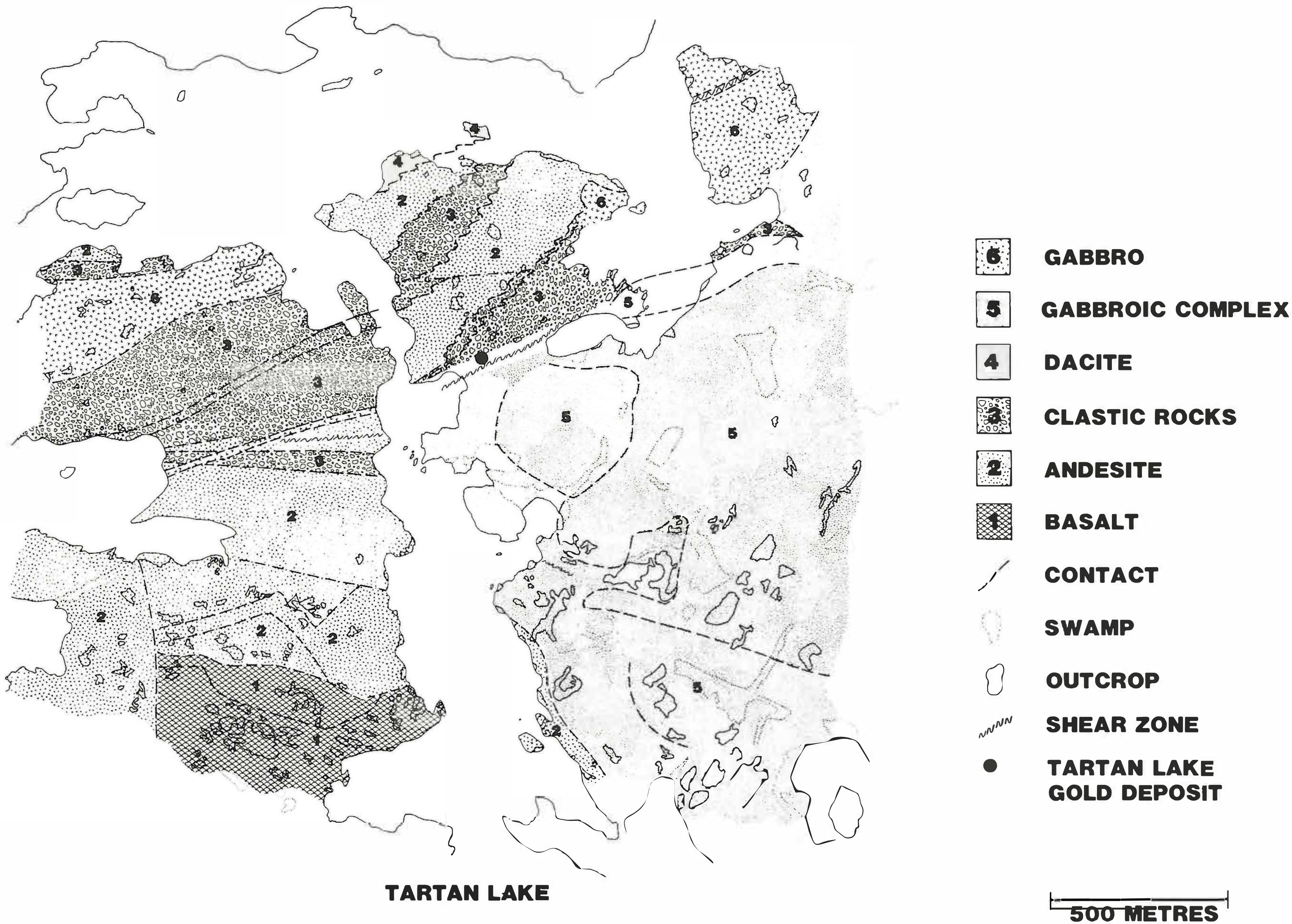


Figure GS-16-1: Geology of the Tartan Lake area.

REFERENCES

DeVeaux, P.

1984: Project Geologist, Tartan Lake, Granges Exploration Ltd., pers. comm. 1984.

Gale, G.H.

1981: Mineral deposit studies in the Flin Flon area; Manitoba Mineral Resources Division, Report of Field Activities, 1981, p. 45-55.

GS-17 GEOLOGICAL INVESTIGATIONS IN THE BAKER PATTON-CENTENNIAL MINE AREA

by D. Hayden-Luck and G.H. Gale

The Baker Patton-Centennial Project area (Fig. GS-17-1) covers a narrow belt of volcanic rocks extending from the Centennial Mine in the southwest to Leo (Mud) Lake in the northeast. This area contains several known massive sulphide deposits (Centennial, Pine Bay, North Star, Don Jon, Cabin Zone, and Amulet Lake). In addition, the area has attracted considerable attention in the past due to the presence of widespread, intensively altered felsic volcanic rocks at both Leo Lake and Baker Patton. During a detailed rock geochemical sampling program in the area in 1980 and 1981 it was recognized that the geological data base was inadequate for establishing the stratigraphic relationships between the known mineral occurrences and for interpretation of the rock geochemistry.

The main objectives of this project are: (1) to provide a detailed geological map of the Baker Patton-Leo Lake area, and (2) to establish the detailed volcanic stratigraphy and geochemical signature of hydrothermal alterations along strike from the Centennial Mine.

BAKER PATTON AREA

Detailed mapping at a scale of 1:100 was conducted during six weeks of the field season. The preliminary geological map (Fig. GS-17-2) represents a first attempt to subdivide the thick pile of felsic volcanic rocks in the Baker Patton-Leo Lake area.

The easternmost part of the area is underlain by a rhyolitic rock with two distinct size populations of quartz phenocrysts 4-5 mm and 1-2 mm. In the southeast this 'quartz-eye rhyolite' comprises a massive rhyolitic flow(?) or pyroclastic flow unit with feldspar phenocrysts. Structurally overlying this rock is a quartz-eye rhyolitic pyroclastic unit containing tuff and lapilli-tuff. The tuff is characterized by variable concentrations of quartz phenocrysts (up to 30 per cent of the rock) in a very fine grained homogeneous matrix. The lapilli-tuff contains monolithic quartz-eye rhyolitic fragments in a quartz-eye rhyolitic matrix. However, the quartz phenocryst content of these two components differs and in the matrix their distribution is not uniform. Lapilli-tuff layers show consistent organization of fragment distribution defined by an upward increase in size and abundance followed by a thin zone with rapid decrease in size and abundance of fragments and abundance of phenocrysts in the matrix. Lapilli-tuff units are tentatively interpreted to be ignimbrite deposits.

Rocks occurring west of the quartz-eye rhyolite are predominantly clastic. Although the origin of some sub-units must await further petrographic work, the western part of the map appears to consist of several heterolithic debris flows separated by bedded arenaceous to ashy sedimentary rocks that in places contain minor gritty lenses that locally appear to occupy scours.

The origins of the reddish weathering fragmental unit and the fine grained, amygdaloidal dacitic rock unit (Fig. GS-17-2) are uncertain. Fine- to medium-grained dioritic intrusions and silicic dykes of rhyodacitic composition containing 10-15% pyrite occur in the southern part of the map area.

Stratigraphic relationships are unclear between the quartz-eye rhyolite and the clastic rocks. Top determinations are rare but include a possible scour channel in the northwest corner of the map, graded ash beds near grid point 10N/150W, and three top determinations on ignimbrite sheets near ON/OW. Collectively these tentative stratigraphic top determinations indicate that locally the sequence is eastward facing. The absence of clasts of the quartz-eye rhyolite in the clastic rock units may be further evidence to support an eastward-facing sequence.

CENTENNIAL MINE AREA

This project involves examination of selected diamond drill cores obtained by Hudson Bay Exploration and Development from the general vicinity of the Centennial Mine. Ten drill cores were re-logged and sampled for geochemical and petrographic analysis.

REFERENCES

Bateman, J.D. and Harrison, J.M.
1945: Mikanagan Lake; Geological Survey of Canada, Map 832A.

Buckham, A.F.
1944: Athapapuskow Lake; Geological Survey of Canada, Map 807A.

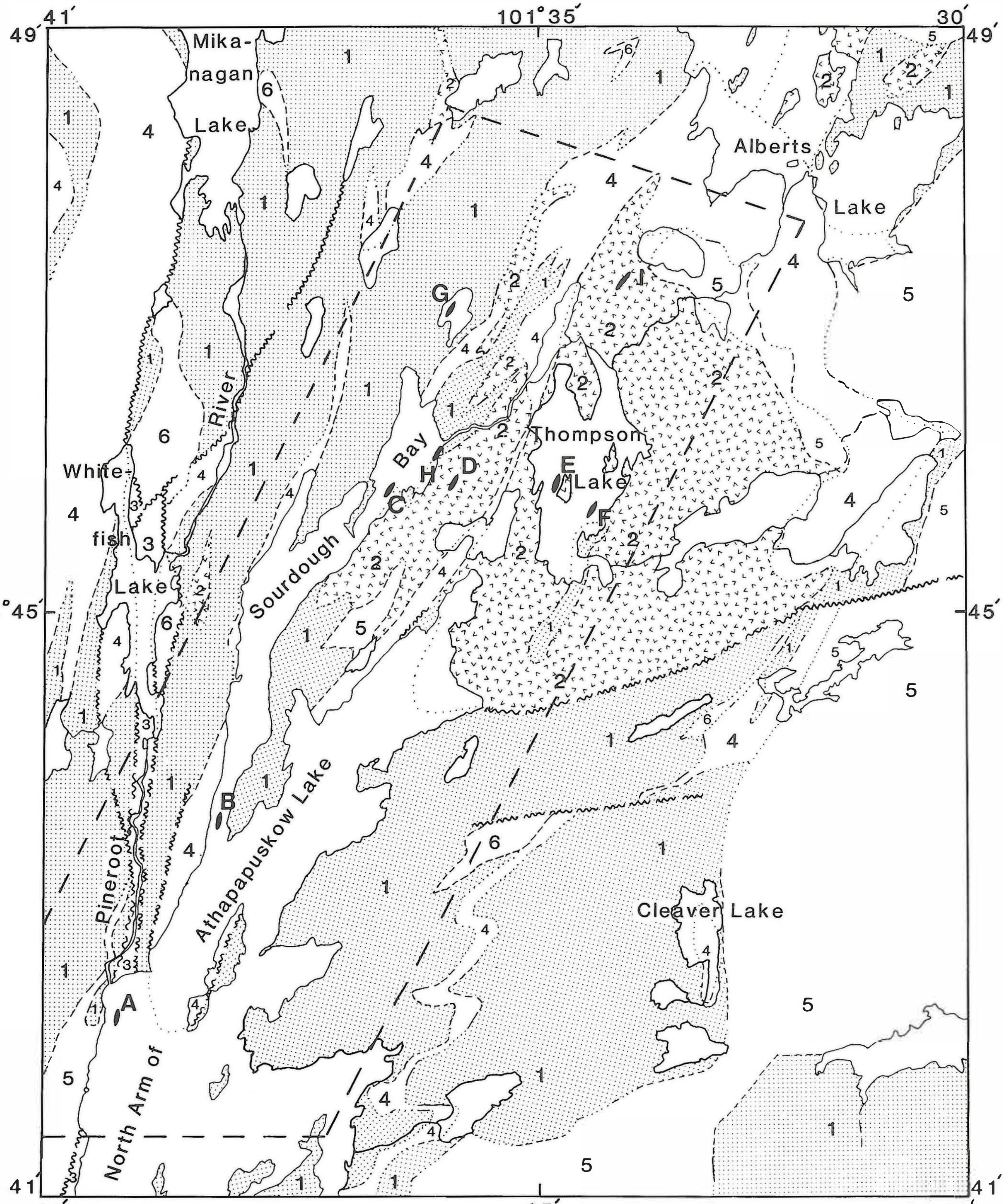


Figure GS-17-1: Regional geology of the Baker Patton-Centennial Area. A. Centennial Mine; B. Sourdough Bay deposit; C. Pine Bay Mine; D. Baker Patton deposit; E. North Star Mine; F. Don Jon Mine; G. Amulet Lake deposit; H. Cabin deposit; I. Mud Lake deposit.

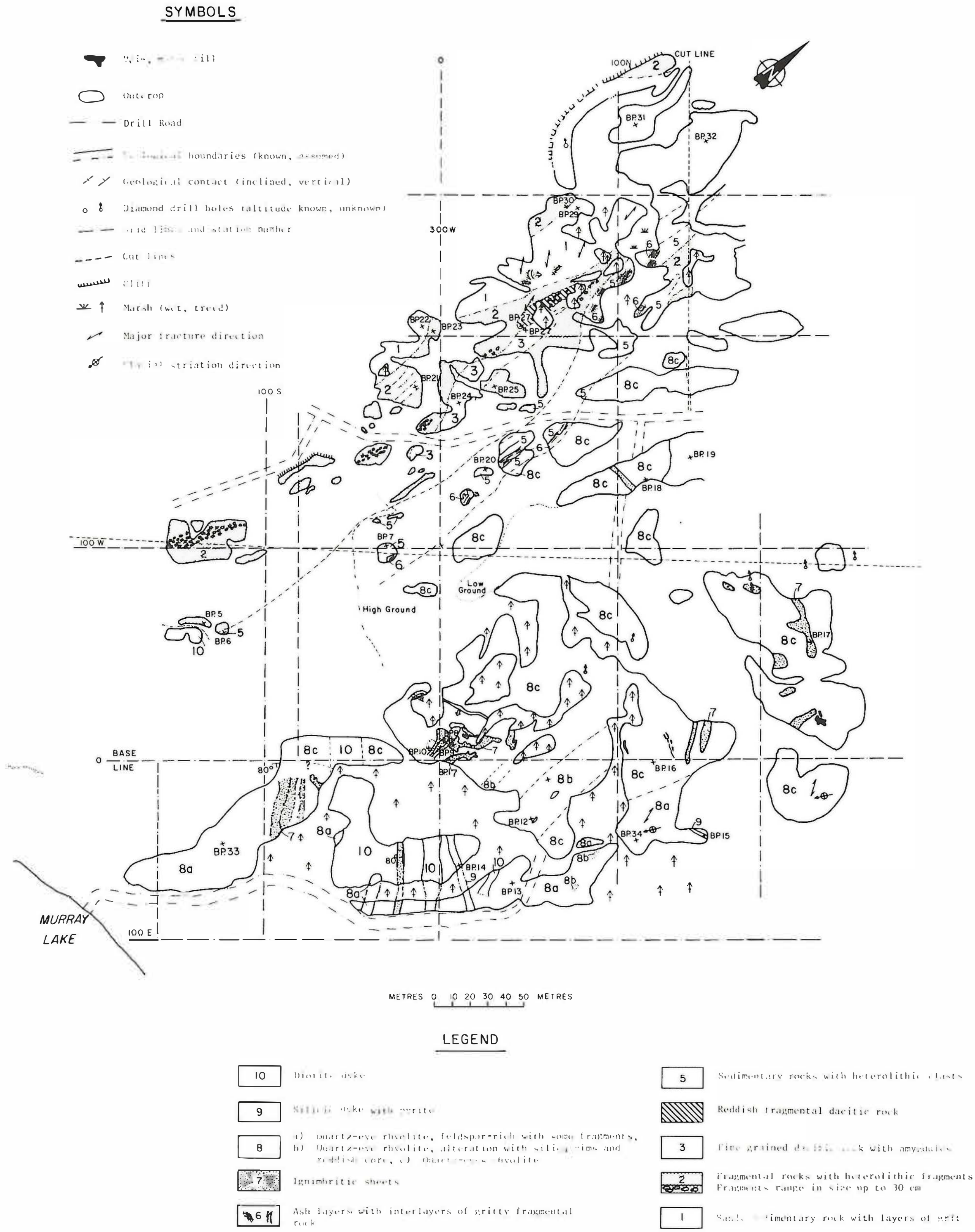


Figure GS-17-2: Geological map of the Baker Patton area.

GS-18 VAMP LAKE, GEOLOGY AND MINERALIZATION

by P. Laznicka and R.S. Wadien

INTRODUCTION

The Vamp Lake deposit (50 km northeast of Flin Flon) contains three zones of Fe, Cu and Zn sulphide mineralization with traces of Ag and locally significant values of Au, hosted by metavolcanic rocks and ?metasedimentary rocks of the Amisk Group. The deposit is the property of the Hudson Bay Exploration and Development Company, Ltd. This study has been undertaken with their permission and cooperation. The property has an exploration history of almost 50 years. Rita Wadien, a University of Manitoba graduate student, spent 3 months in the field, supervised by Peter Laznicka. The field work concentrated on mapping of a small area (2x3 km) at a scale of 1:5000 (Fig. GS-18-1); detailed mapping at outcrops on a larger island in the northern part of Vamp Lake at a scale of 1:240 (Fig. GS-18-2); mapping and sampling of the ore zones; and core logging. Vamp Lake is included in the reconnaisance map and memoir of McGlynn (1959).

GENERAL GEOLOGY

The rock units present are of three main associations:

(1) Amisk metavolcanic and ?metasedimentary rocks cropping out in a northeast-striking, steeply southeast-dipping keel, surrounded by association (3);

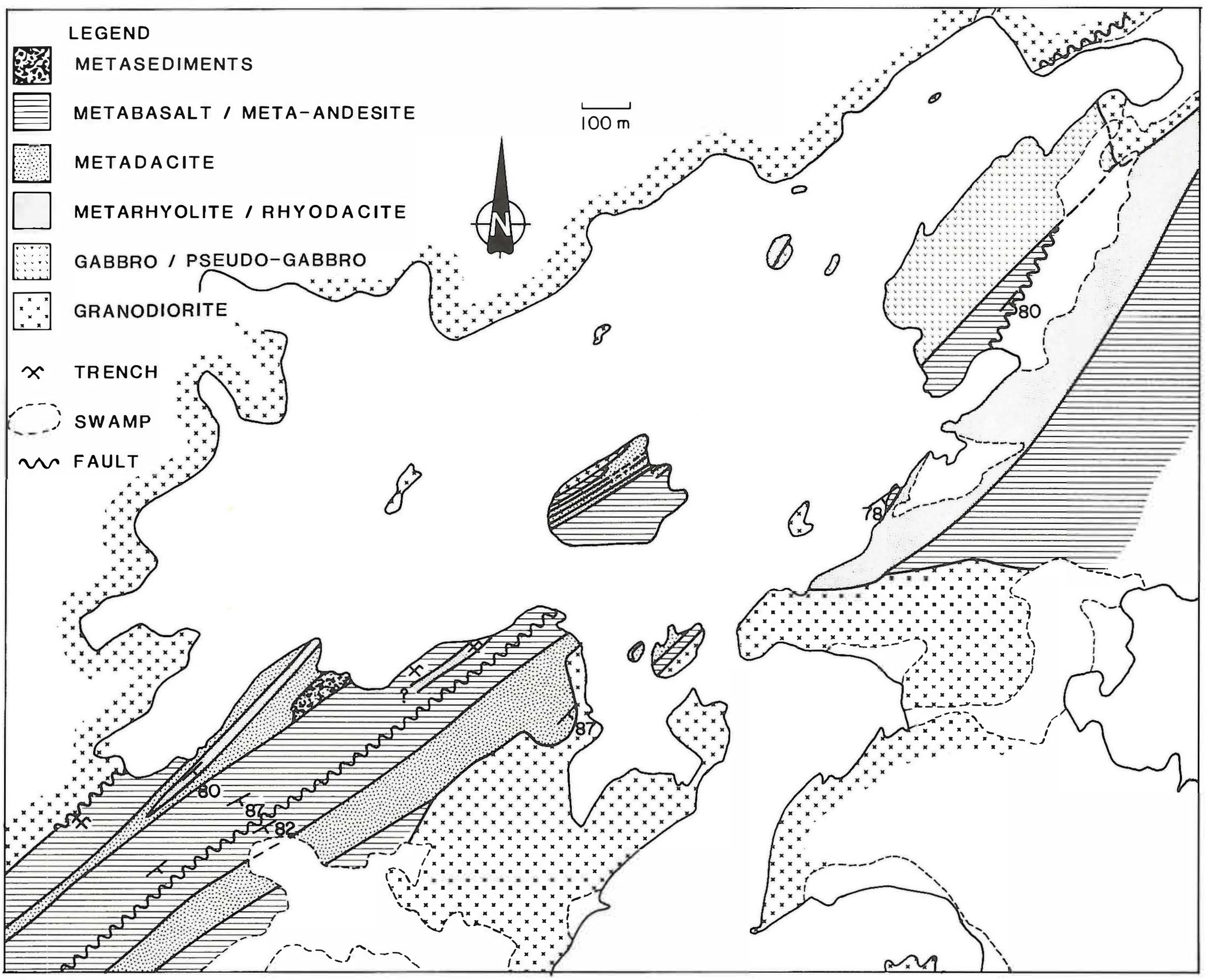


Figure GS-18-1: Geology of the Vamp Lake area, by R.S. Wadien.

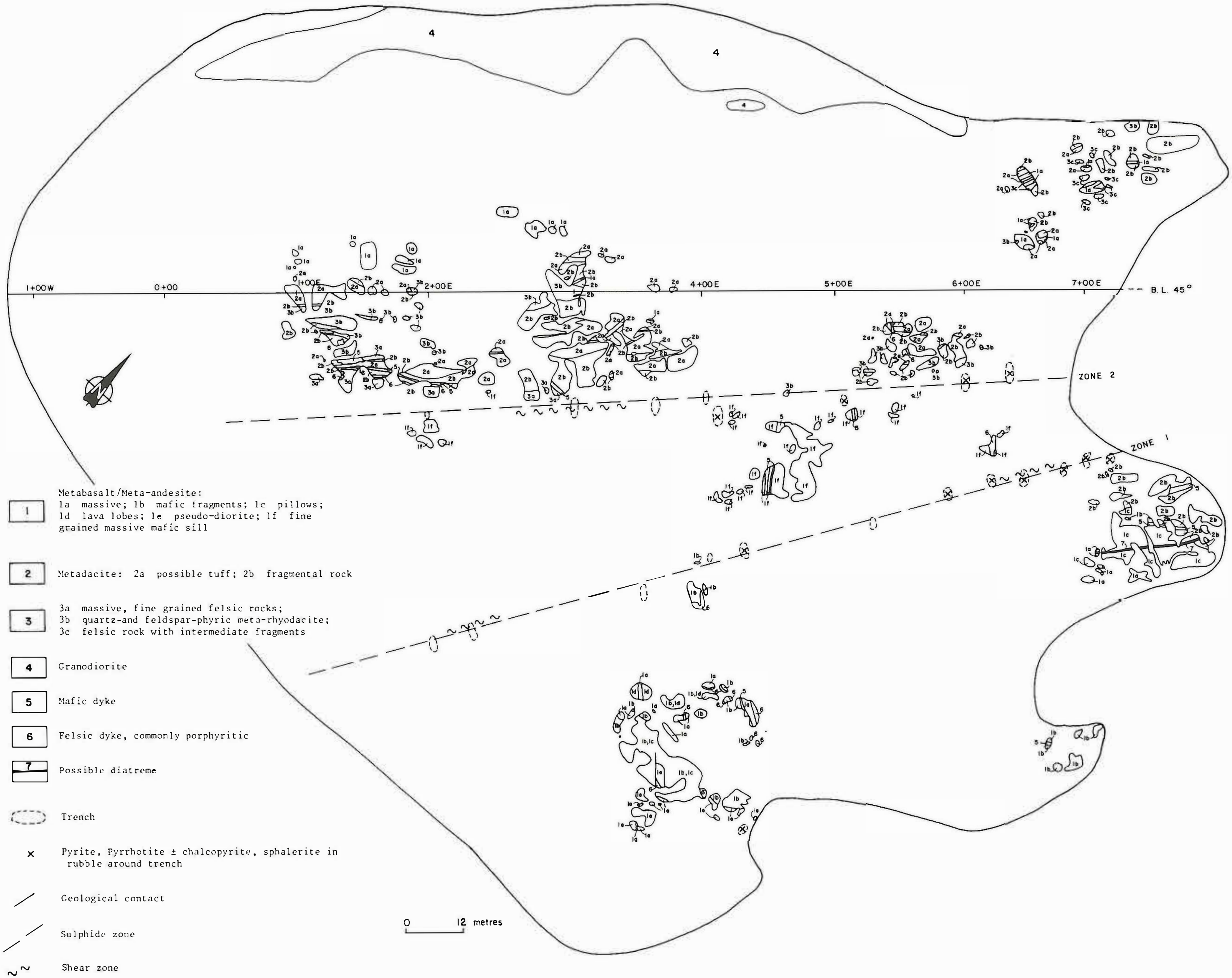


Figure GS-18-2: Outcrop map and detailed geology of a large island in the northern part of Vamp Lake (the ore discovery site), by R.S. Wadien.

(2) rocks of gabbroic to dioritic appearance, comagmatic with (1) or younger (these appear to be partly orthomagmatic, partly metasomatic in origin); and,
(3) granodioritic anatectite to migmatite.

The supracrustal rocks underwent (a) static regional metamorphism (greenschist facies) and dynamometamorphism in high-strain zones; (b) periplutonic thermal metamorphism and metasomatism on flanks or in the roof region of a thermal dome; and (c) hydrothermal metasomatism and sulphide emplacement predating, contemporary with and postdating the deformation and metamorphism.

Overlap of the depositional and metamorphic/metasomatic effects may be considerable at Vamp Lake and responsible for a significant genetic convergence: a single rock type could have formed by several alternative processes. There is, in particular, insufficient evidence regarding the original nature of the fine-grained light-coloured quartz, feldspar, biotite, amphibole rocks mapped, at this stage, under the traditional field names of "dacite" and "rhyolite". These names are based on the colour index only and their felsic metavolcanic origin has not been established.

(1) SUPRACRUSTAL ROCKS

The most abundant and non-controversial rock type is a metabasalt or meta-andesite. Relict structures comprise locally well preserved pillows, indistinct pillow breccia, ?massive flows and undivided fragmental rocks. Megascopically they range from almost massive, fine crystalline to almost aphanitic greenstones and amphibolites, to chlorite and biotite-chlorite schists in high-strain zones. Synvolcanic pores (mainly vesicles) as well as deformational dilations are now mostly filled by quartz and/or white feldspar and the pillow cores are in places epidotized.

Evidence, mainly from the drill core, indicates that there is an almost imperceptible transition from strained mafic metavolcanics and their dynamometamorphosed equivalents (hornblende, biotite and chlorite schists) into the "felsic metavolcanics". In the CON 8 diamond drill hole a foliated, white quartz and feldspar-streaked greenstone grades into a thinly laminated, brownish-gray "dacite" as the proportion of quartz, feldspar and biotite increases, while the relict structure of the greenstone appears to remain unchanged. Conspicuous coarse fragmental rock cropping out at several places on the largest island (Fig. GS-18-2) consists of 5-30 cm quartz-rich "ellipsoids", resting in a dark green silicate matrix. The relict structure suggests a pillow breccia.

The remainder of the "dacites" comprise relatively homogeneous, thinly banded to massive light gray granoblastites, locally containing eyes, augen and spots of probable metasomatic feldspar. Portions of the "dacites" and most of the light coloured "rhyolites" are probably concordant or discordant injections of anatectite or mobilizate, as well as dykes and/or silicified intervals.

(2) GABBROS

The gabbro is a conspicuous medium-crystalline dark green rock, ranging from probably orthomagmatic, homogeneous equivalents through metabasalt inclusion-rich gabbro and gabbroized metabasalt breccia, to a metabasalt (amphibolite) with coarse recrystallized patches corresponding to a hornblende gabbro.

(3) GRANODIORITE

Intrusive-textured anatexites are medium grained, light grey rocks of granodioritic appearance, that have locally a tendency towards augen development (white feldspar porphyroblasts enveloped by biotite-rich matrix). They appear to be gradational into garnetiferous migmatites. Along shears, the anatectites are retrogressed into biotite-muscovite phyllonitic tectonites. Zones of cataclasites marked by abundant chlorite-coated slickensides, hairthin fractures filled by chlorite, sericite, calcite and marked by distinct pink hues (hematite coatings, impregnations and/or low temperature feldspathization) are widespread along faults.

MINERALIZATION

Three sulphide ore zones subparallel with the northeast structural grain and steeply dipping to the southeast crop out on the surface (zones 1,2) and under the lake floor (zone 3). Zone 1 of the deposit has received the most detailed examination and the host rocks to this mineralization are tentatively interpreted as overturned and northwest-facing mafic metavolcanic rocks. Massive pillow metabasalts in the probable stratigraphic footwall grade into a breccia composed of arrowhead-shaped fragments, interrupted by a N35E shear filled by a coarse chlorite schist with metacrysts of pyrite. McGlynn (1959) interpreted the shear as a left lateral fault. The chlorite schist grades upwards into a silicified and biotite-chlorite altered breccia of amphibolite fragments, laced by stringers of pyrite, pyrrhotite, chalcopyrite and sphalerite. This is topped by a discontinuous zone of massive granular metacrystic or recrystallized pyrite and minor chalcopyrite in siliceous gangue. The ore is overlain by a fine grained (almost cherty) fresh looking amphibolite with a straight, planar foliation and minor accessory pyrite.

The mineralization intersected in DDH CON 8 (450-475') comprises a cherty-looking ("exhalitic") host displaying relict structures of the mafic metavolcanic unit. In the massive ore variety, fine biotite is dispersed in the siliceous matrix and chlorite coats fractures. Schistose intervals are marked by trains of coarser biotite flakes. Pyrite, pyrrhotite and lesser amounts of chalcopyrite and sphalerite form massive patches, stringers, veinlets and scattered grains within a 7-8 m wide interval.

REFERENCE

McGlynn, J.C.
1959: Elbow-Heming Lakes area, Manitoba; Geological Survey of Canada, Memoir 305, 72 p.

GS-19 MINERAL OCCURRENCE STUDIES IN THE NORTH STAR LAKE AREA OF MANITOBA

by G. Ostry

INTRODUCTION

Eight days of the 1985 field season were directed towards documentation of the sulphide occurrences in the North Star Lake area of the Flin Flon volcanic-sedimentary belt. Attempts were made at documentation of the North Star Group of gold occurrences situated to the east and southeast of North Star Lake however, the overgrown condition of the trenches and lack of exposure precluded detailed work. These gold occurrences have been described in detail by Stockwell (1935). In 1964 drilling by Hudson's Bay Exploration and Development intersected an alteration zone and a solid to near solid sulphide zone with zinc and copper values on their Lon claims situated approximately eight kilometres due north of North Star Lake (see Mineral Resources Division cancelled assessment files 91607 and 91608). The absence of exposures in the area of the Lon zone and unsuccessful attempts to find the drill core precluded documentation of this occurrence.

Four sulphide occurrences were documented and the respective mineralized zones sampled for geochemical analysis 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 to be available upon request.

SULPHIDE OCCURRENCES

Two occurrences of sulphide-rich strata located north of North Star Lake were examined: locations NS-1 and NS-2, Figure GS-19-1. At both locations sulphide-rich strata occur within mafic metavolcanic gneiss.

At NS-1 two trenches intersect a very fine grained siliceous volcanogenic metasedimentary unit (possibly tuff) and a slightly graphitic very fine grained laminated quartz-biotite-chlorite unit (pelite). Both rock types are mineralized. The siliceous rock contains up to 5 per cent disseminated fine grained pyrrhotite and/or pyrite. Fine- to medium-grained pyrrhotite, pyrite and minor (less than 1 per cent) chalcopyrite mobilizate constitutes up to 30 per cent of the pelitic rock. The rocks observed at location NS-1 represent a thin (on the order of metres) conformable zone.

A series of three trenches were investigated at location NS-2. All trenches intersect a solid to near solid sulphide unit hosted by a sulphide-rich very fine grained psammo-pelitic unit and a very fine grained siliceous metasedimentary unit (tuff?) similar to the siliceous unit observed at location NS-1. Exposure in the trenches has been totally effaced by oxidation thereby limiting data collection to adjacent rubble.

Disseminated fine grained pyrrhotite and irregular crosscutting, less than 1 cm, veins of fine- to medium-grained quartz, pyrrhotite, pyrite and scattered less than 5 mm blebs of sphalerite constitute up to 30 per cent of the psammo-pelite.

The solid to near solid sulphide unit consists of up to 80 per cent fine grained to coarse grained pyrrhotite with rare metamorphic pyrite as less than 2 cm cubic poikiloblasts. A very fine grained quartz-biotite-chlorite assemblage (pelite) represents the silicate fraction of this unit. Annealing of the sulphide has disrupted early quartz veining and the pelitic fraction resulting in silicate 'balls' within the pyrrhotite matrix. The lateral extent of this sulphide unit was not determined.

Two sulphide occurrences were documented south of North Star Lake at locations NS-3 and NS-4, Figure GS-19-1. Both occurrences represent stratiform zones within dominantly intermediate tuffaceous metavolcanic rocks.

At location NS-3 nine trenches extending over a distance of ninety metres intersect a fine grained sulphidic metasedimentary zone. The metasedimentary zone is approximately ten metres wide and contains up to 10 per cent sulphide as disseminations and laminae of fine grained pyrrhotite, scattered augen of metamorphic pyrite and the odd speck of chalcopyrite. The rusty weathering of these rocks made identification of lithologies difficult; however, it appears that the mineralized zone consists of bands less than 2 cm thick of finely laminated pelitic and tuffaceous metasedimentary rocks with a possible cherty component. Late quartz veins exposed in the trenches contain minor coarse grained pyrite as vug fillings and scattered blebs of chalcopyrite mobilizate.

A cribbed shaft and trench at location NS-4, Figure GS-19-1, intersect a solid to near solid (up to 80 per cent) pyrrhotite unit(s). Both exposures are heavily oxidized and data collection was limited to the adjacent rubble. The solid to near solid sulphide is dominantly medium- to coarse-grained pyrrhotite with rare cubic, less than 1 cm, pyrite poikiloblasts and very minor chalcopyrite as thin, less than 1 mm fracture controlled mobilizate. The silicate portion is a very fine grained quartz-biotite-chlorite assemblage (pelite). The silicates have been brecciated and have aggregated into 'balls' in response to annealing of the sulphides. Fine contorted laminae are recognizable in the pelite. This zone is at least several metres thick. The mineralization is hosted by laminated to banded, commonly garnetiferous, intermediate tuff and tuffaceous metasedimentary rocks. Within 40-50 m of the mineralized zone the host metavolcanic/metasedimentary rocks appear to have a chemical sedimentary component. The more felsic beds/bands commonly have a cherty appearance, and a number of thin, less than 2 cm, mafic beds/bands of predominantly amphibole and garnet with minor feldspar were also observed.

ACKNOWLEDGEMENTS

Allan Johnston is thanked for his efforts in assisting documentation of these mineral occurrences.

REFERENCES

Stockwell, C.H.
1935: Gold deposits of Elbow-Morton Lake area, Manitoba; Geological Survey of canada Memoir 186.

McGlynn, J.C.
1959: Elbow-Heming Lakes area, Manitoba; Geological Survey of Canada Memoir 305.

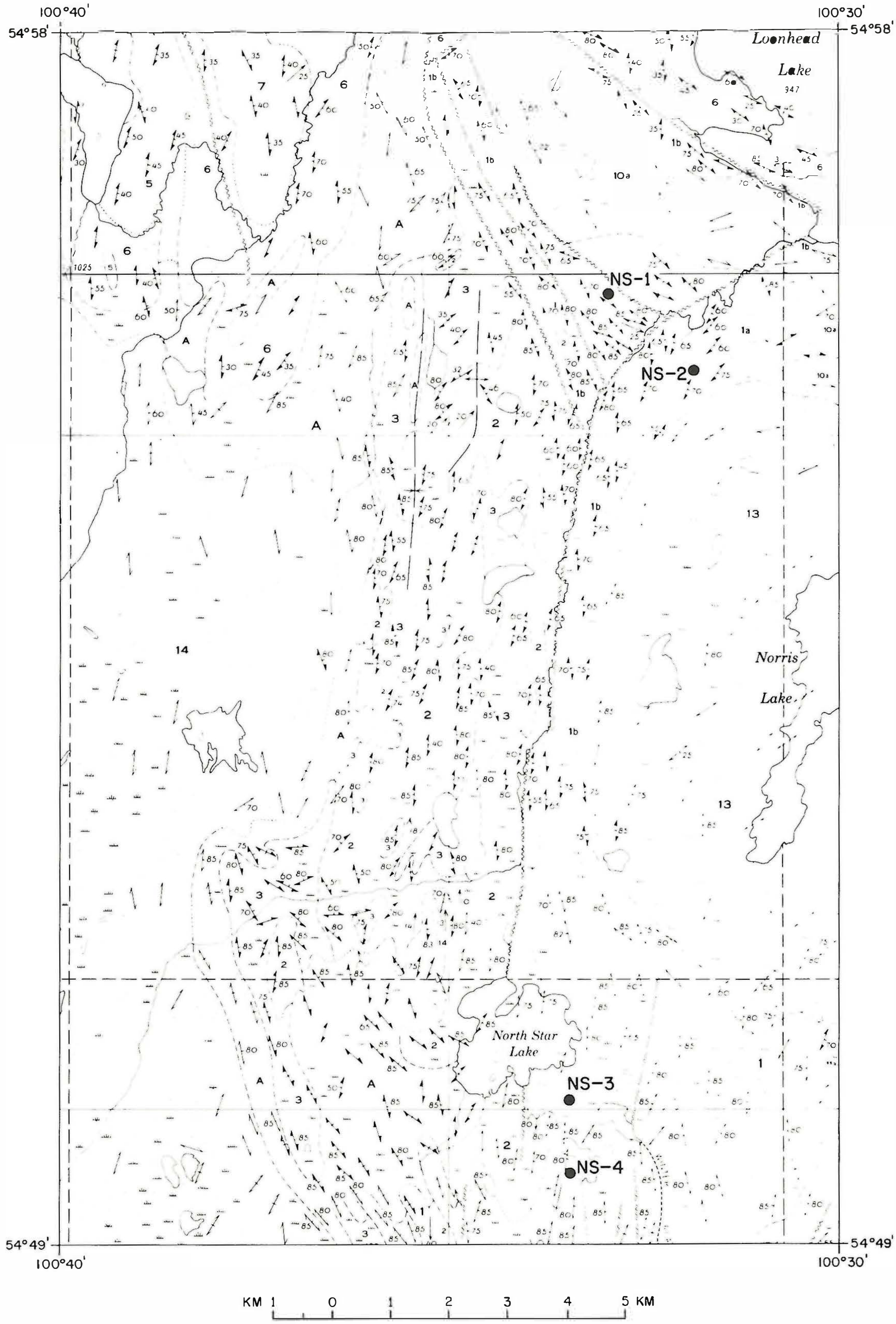


Figure GS-19-1: *Mineral occurrences in the North Star Lake area (Part of 63K/15). Geology base after McGlynn (1959).*

GS-20 MINERAL OCCURRENCE DOCUMENTATION AND ALTERATION ZONE MAPPING, SNOW LAKE AREA

by D.R. Eccles and M.A.F. Fedikow

INTRODUCTION

Mineral deposit studies initiated in the Snow Lake area in 1984 (Gonzales and Fedikow, 1984) were continued in 1985. Detailed geological maps were prepared and assay samples collected (when warranted) from 35 mineral occurrences shown on previously published geological maps. The locations of mineral occurrences examined in 1985 are plotted on Figures GS-20-1 through GS-20-4. The main sources of information for this year's mineral occurrence documentation program were geological maps published by Harrison (1949), Russell (1955) and Froese and Moore (1980) as well as the Manitoba Energy and Mines cancelled assessment files.

In addition to this aspect of the past summer's field work three areas in the general vicinity of the town of Snow Lake, characterized by altered sedimentary and volcanic rocks and associated with previously examined mineral occurrences, were mapped in more detail and sampled for geochemical analysis. These three projects represent larger scale programs developed as a result of initial mineral occurrence documentation.

Outcrop sampling of the major lithologic units in the Snow Lake area to determine background concentrations of a wide range of trace elements was continued this summer. A total of 160 bedrock samples were collected (Fig. GS-20-5) and will be analyzed for 30 elements by inductively coupled argon plasma (ICP) and for several other elements using selective analytical techniques. This information will be published as an open file report upon completion.

An innovative procedure designed to measure Hg gas evolution from base and precious metal deposits in the Snow Lake and Lynn Lake areas was also commenced this summer. Aurex Cup surveys were conducted over the Frances Lake (Zn, Pb, Ag, Au) massive sulphide deposit and the Rushed (Au) occurrence (part of the Agassiz Metallotect) in the Lynn Lake area as well as over the Stall Lake and Rod Cu-Zn massive sulphide deposits and the Kobar Pb-Ag massive sulphide occurrence in the Snow Lake area (Figs. GS-20-6, GS-20-7). These surveys are designed to test whether or not Hg gas evolving from mineral deposits buried beneath a mixed surficial cover of till, glaciolacustrine clays, wet and permafrost peat bog and sand can be detected by the measurement of Hg gas. No results for these surveys are available at this time; however, the Hg analyses will be presented in an open file report at a later date.

ALTERATION ZONE MAPPING

Three areas (Fig. GS-20-8) were selected for mapping on the basis of the presence of numerous mineral occurrences or due to particularly intense alteration. These zones are described in detail and illustrated in Figures GS-20-9 through GS-20-12.

JOANNIE DEPOSIT — ALTERATION ZONE #1

The Joannie deposit (AI-48; Fig. GS-20-1) is located southwest of Anderson Lake and is characterized by disseminated chalcopyrite, pyrite and pyrrhotite accompanied by intense chlorite-biotite-garnet alteration. The immediate host rock to the deposit is an intermediate volcanic rock characterized by abundant hornblende. Mineralization-related alteration of this unit produces a chlorite-biotite-garnet assemblage that is cut by later quartz veins containing vestiges of assimilated wall rock and very minor disseminated iron sulphides. The deposit and related alteration occur within a sequence of discontinuous mafic and intermediate volcanic rocks (Fig. GS-20-9) that have been subdivided into eight separate units which are described as follows:

HORNBLENDE ANDESITE (1)

These volcanic flow rocks are dark green to black and coarse grained. The rocks are cut by numerous, non-sulphidic quartz and carbonate veins with a primary trend of 60° and secondary trends of 47° and 332°. The unit is not mineralized.

FRAGMENTAL HORNBLENDE ANDESITE (2)

This is the predominant rock unit at the Joannie deposit. It is fine to medium grained, dark greenish black and has greyish-green weathering (alteration ?). Hornblende makes up 60-70% of the rock with plagioclase (25%) biotite and chlorite the remainder. The fragments within the unit may represent pillows and pillow breccias that have been flattened and distorted. The fragments range from 5 cm to 4 m and in several outcrops these ellipsoidal volcanic fragments are characterized by chlorite-magnetite-rich selvages and quartz-filled vesicles. A tenuous northwest stratigraphic younging direction can be obtained from fragments that closely resemble pillows.

CHLORITE-GARNET-BIOTITE SCHIST (3)

This rock is considered to represent a chemical and mineralogical reconstitution of Unit 2 as a result of mineralization-related activity. The rock is well foliated, effectively focussing deformation as a result of its altered nature.

AMYGDALOIDAL HORNBLENDE ANDESITE (4)

This rock unit is a fine grained, dark green andesite that occurs as interlayered massive flow units with amygdale-rich sections. The amygdales range from 2 mm to 6 mm and are filled with quartz. The amygdular portions of these flow rocks suggest stratigraphic younging to the northwest.

INTERBEDDED FRAGMENTAL HORNBLENDE ANDESITE AND BASALT (5)

Interbedded fragmental hornblende andesite (Unit 2) and a black, fine grained fragmental basalt characterize these rocks. The basalt is porphyritic with 10% feldspar phenocrysts. Fragments in the basalts may be distorted pillows. These interbedded units range from 20 cm to 1 m in thickness.

INTERBEDDED FRAGMENTAL HORNBLENDE ANDESITE, PORPHYRITIC BASALT AND FRAGMENTAL BASALT (6)

This interbedded sequence contains Unit 2 as well as feldspar-phyric and fragmental basalt (20% feldspar phenocrysts). The matrix to the fragmental basalt contains 40% hornblende, 25% plagioclase feldspar and 15% biotite. Fragments make up 10-25% of the bed and are feldspar-phyric and intermediate in composition.

BASALT (7)

This rock unit is black, fine grained, massive to fragmental/fragmented. The fragments are flattened ellipsoidal structures, resembling pillows. The basalt is feldspar-phyric and contains 10-20% phenocrysts.

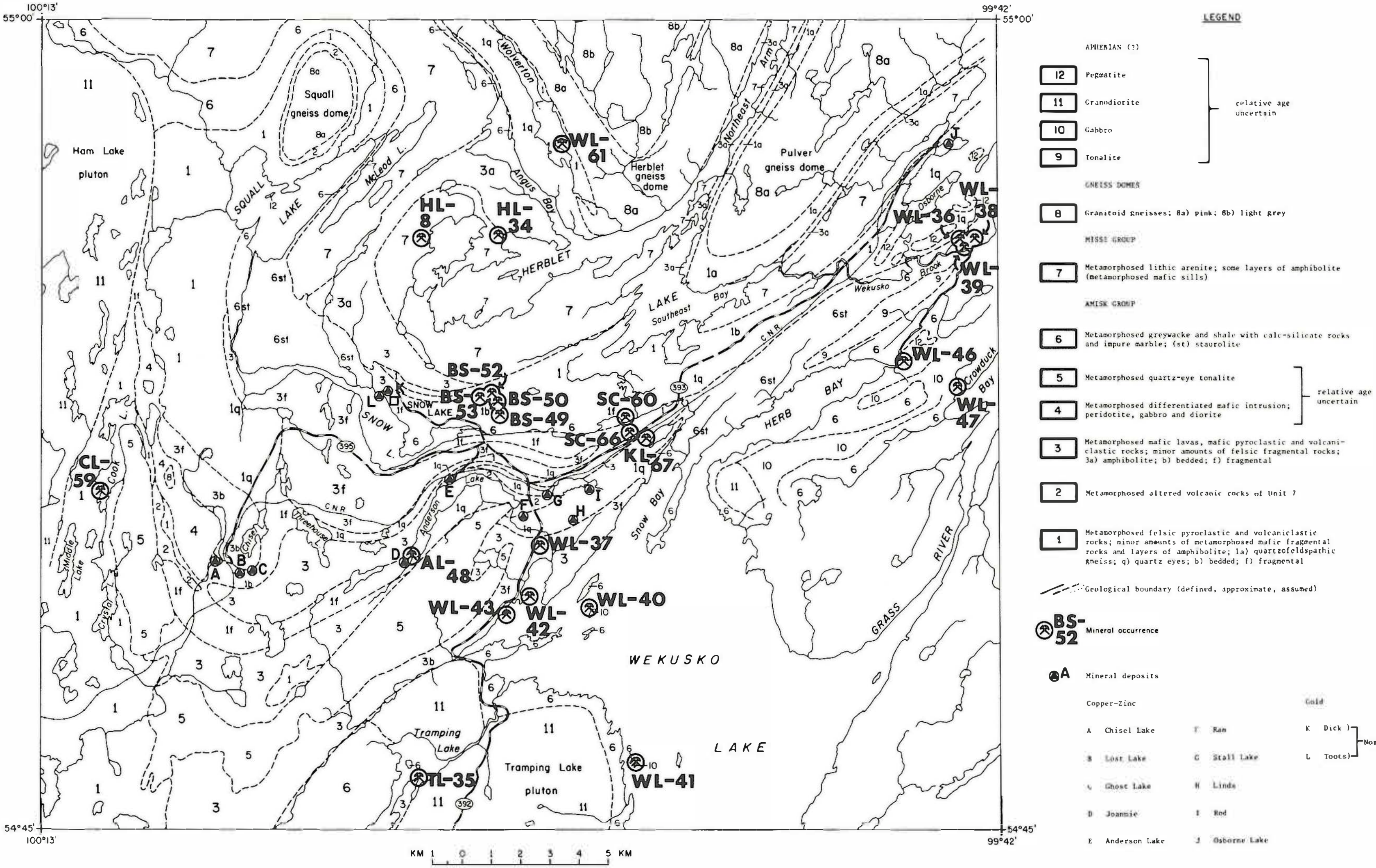
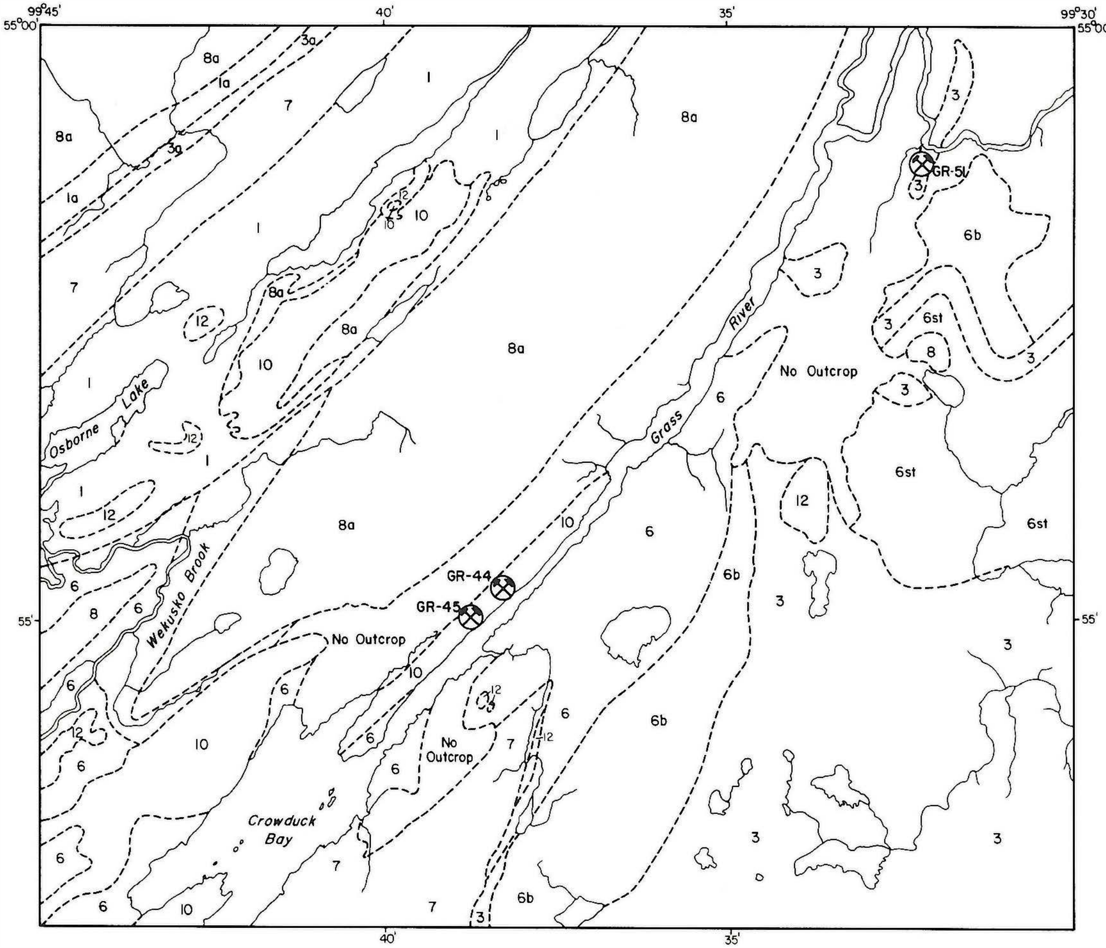


Figure GS-20-1: Mineral occurrences examined in the Herblet Lake-Wekusko Lake-Cook Lake area, 1985. Geology after Froese and Moore (1980).

CROWDUCK BAY - GRASS RIVER AREA

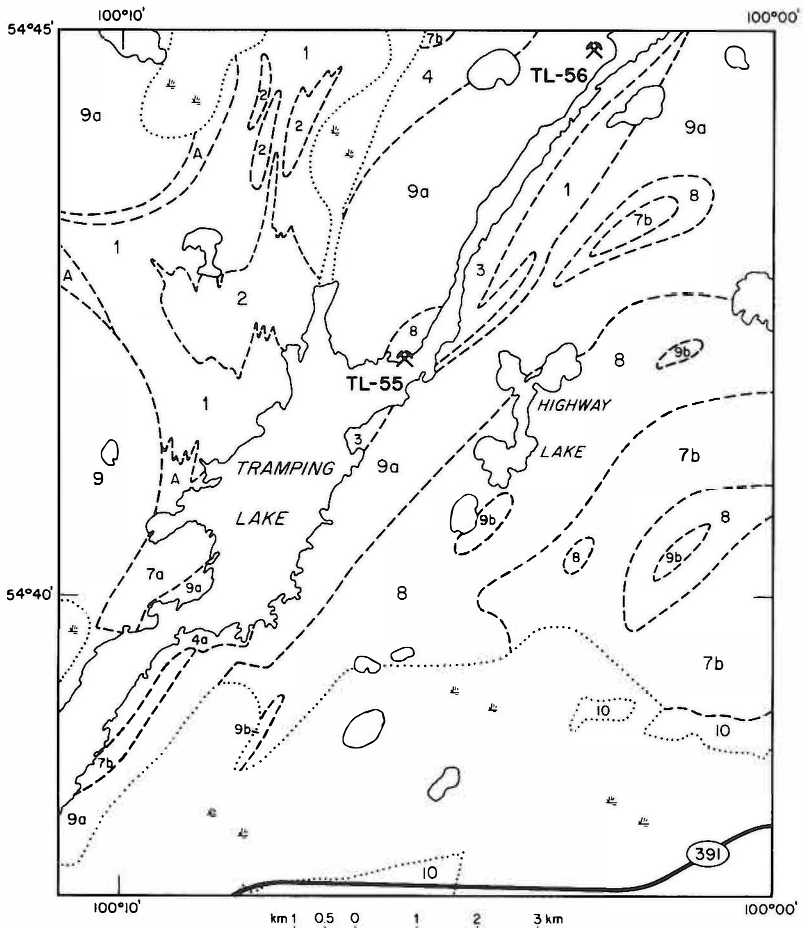


LEGEND

12	Pegmatite
10	Gabbro
8	a) pink granitoid gneisses
7	Metamorphosed lithic arenite; some layers of amphibolite (metamorphosed mafic sills)
6	Metamorphosed greywacke and shale; 6a) calc-silicate rocks and impure marble; 6b) coarse garnet schist; (st) staurolite
3	Metamorphosed mafic lavas, mafic pyroclastic and volcaniclastic rocks; minor amounts of felsic fragmental rocks; 3a) amphibolite; p) pillows, b) bedded, f) fragmental
1	Metamorphosed felsic pyroclastic and volcaniclastic rocks; minor amounts of metamorphosed mafic fragmental rocks and layers of amphibolite; 1a) quartzofeldspathic gneiss; q) quartz eyes, b) bedded, f) fragmental

KILOMETRES 1 0 1 2 3 4 5 KILOMETRES

Figure GS-20-2: Mineral occurrences examined in the Grass River area 1985. Geology after Frarey (1950 Map 987A) and Froese and Moore (1980).



LEGEND

ORDOVICIAN		
PALEOZOIC	10	Dolomite, dolomitic limestone
ARCHEAN OR PROTEROZOIC	9	Mainly grey to pink gneissoid biotite granite, granodiorite and allied rocks; 9a) massive pink biotite and biotite-hornblende granite, granodiorite, and allied rocks, in part coarsely porphyritic; 9b) contact breccia of gabbro and diorite; 7b) in granite (9a), containing less than 50 per cent (7b)
	7a,7b	7a) coarse-grained anorthositic gabbro, gabbro, and pyroxenite; some quartz gabbro and quartz diorite; 7b) fine- to medium-grained gabbro and diorite; minor quartz gabbro and quartz diorite; minor granite (9)
	8	Contact breccia of gabbro and diorite (7b) in granite (9a), containing more than 50 per cent (7b)
	6	Quartz-porphyry, in part chloritized; may be older than (4)
	4	Interbedded argillite and greywacke with minor slate arkose, quartzite, breccia, and pebble beds
		AMISK GROUP
	3	Basic volcanic breccia, agglomerate, and tuff; minor flows
ARCHEAN	2	Hornblende-feldspar gneiss and medium grained amphibolite and diorite derived from (1); in part probably intrusive
	1	Massive and pillowed andesite, dacite and basalt; minor pyroclastic members, hornblende-feldspar schists undifferentiated basic intrusions
	A	Rocks of graphitic texture derived from volcanic rocks (1,2,3) and minor sediments (4) by action of granites (9); in part garnetiferous
	⚒	Mineral Occurrences

Figure GS-20-3: Mineral occurrences examined in the Tramping Lake area, 1985. Geology after Stanton (1945).

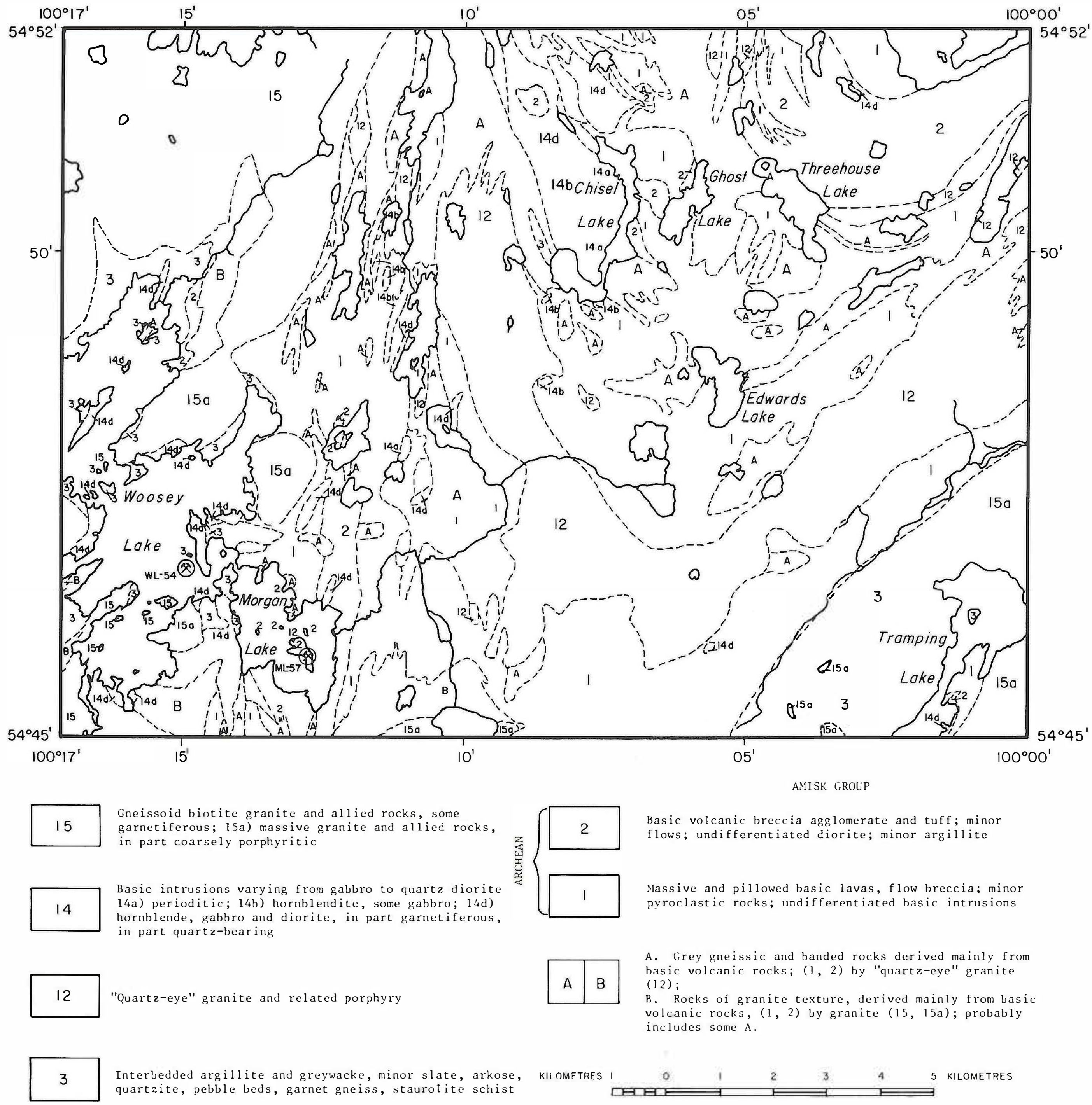


Figure GS-20-4: Mineral occurrences examined in the Morgan Lake-Woosey Lake area 1985. Geology after Harrison (1948).

FRAGMENTAL BASALT (8)

This feldspar-phyric basalt (20% phenocrysts) contains 10-40% felsic, fine grained fragments that range from 20 cm to 50 cm in length and 0.5 cm to 14 cm in width.

INTRUSIONS

Intermediate porphyritic dykes occur within the basaltic flows. Amphibole (50%) and plagioclase (50%) phenocrysts characterize the dykes which are generally less than 20 cm in thickness and as such are not mappable units.

Figure GS-20-10 represents a detailed geology map of the Joannie area showing outcrop locations, mineralization-related alteration, quartz veins and the positions of the trenches on the property. A suite of rock samples has been collected for assay and geochemical studies.

This deposit appears to be an example of disseminated strata-bound mineralization with associated intense alteration. The stratigraphic relationship to the nearby Anderson Lake mine is uncertain; the occur-

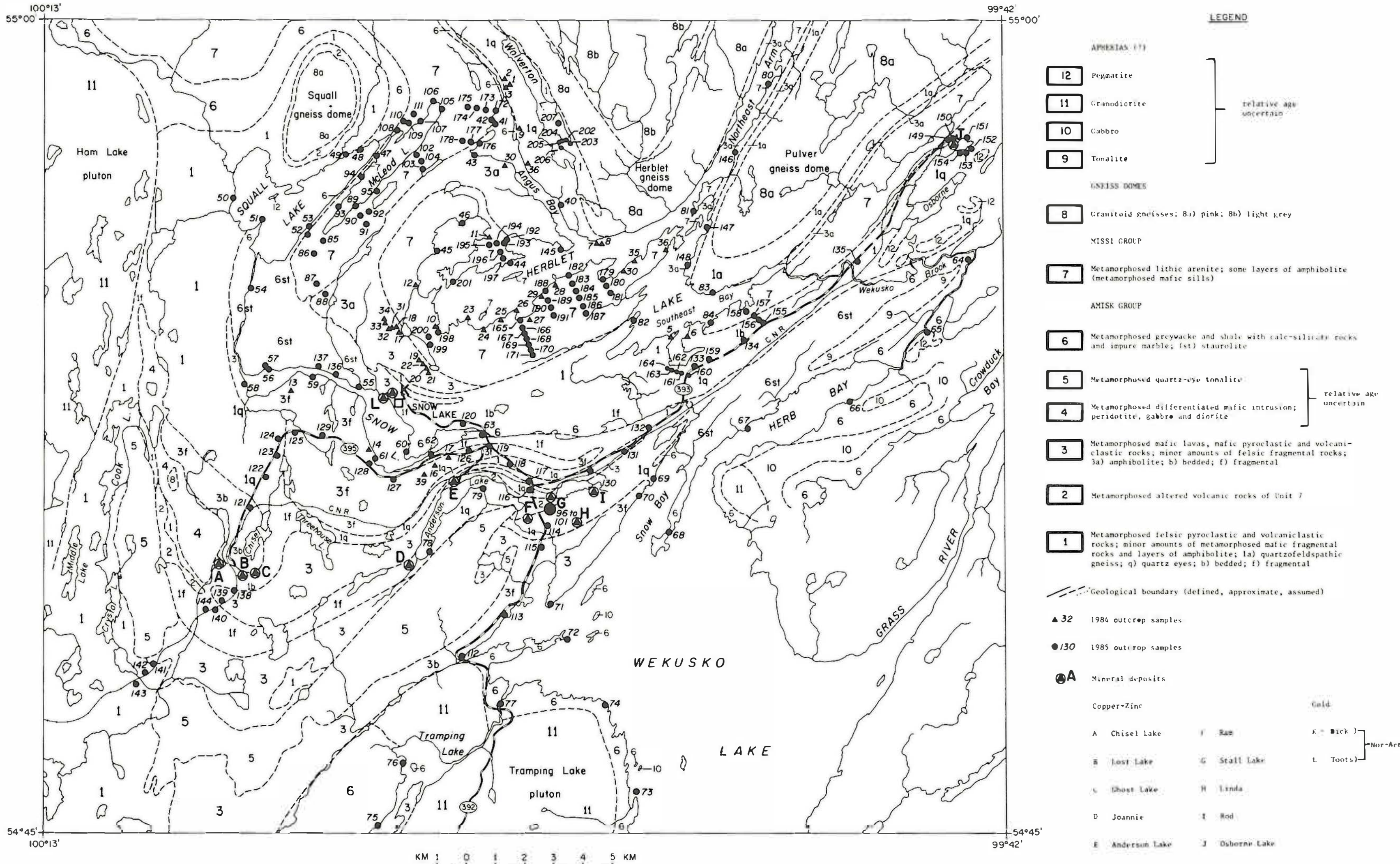


Figure GS-20-5: Outcrop sample locations, Snow Lake area, 1984 and 1985. Geology after Froese and Moore (1980).

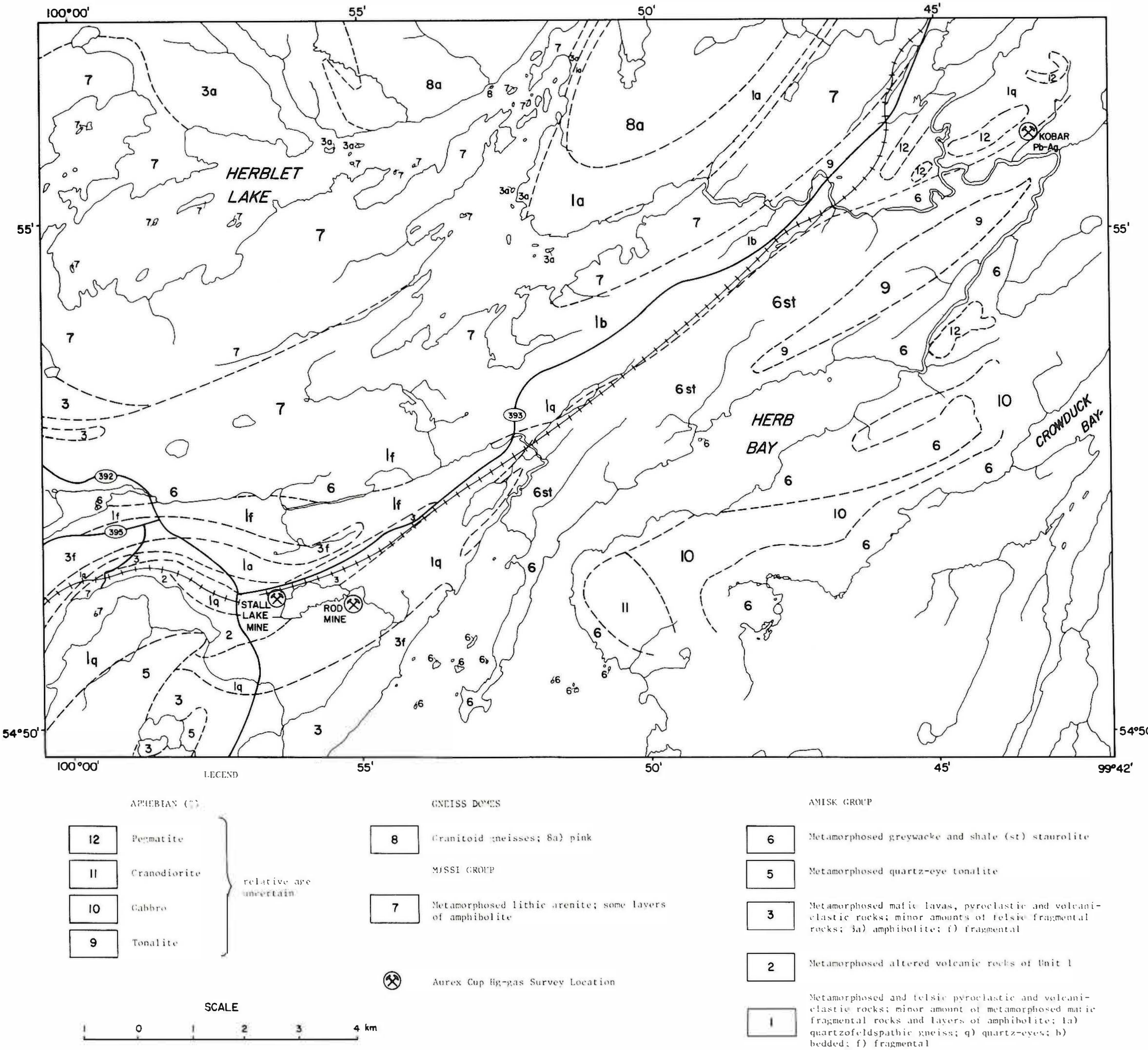


Figure GS-20-6: Mercury gas survey (Aurex Cups) sites, Snow Lake area, 1985. Geology after Froese and Moore (1980).

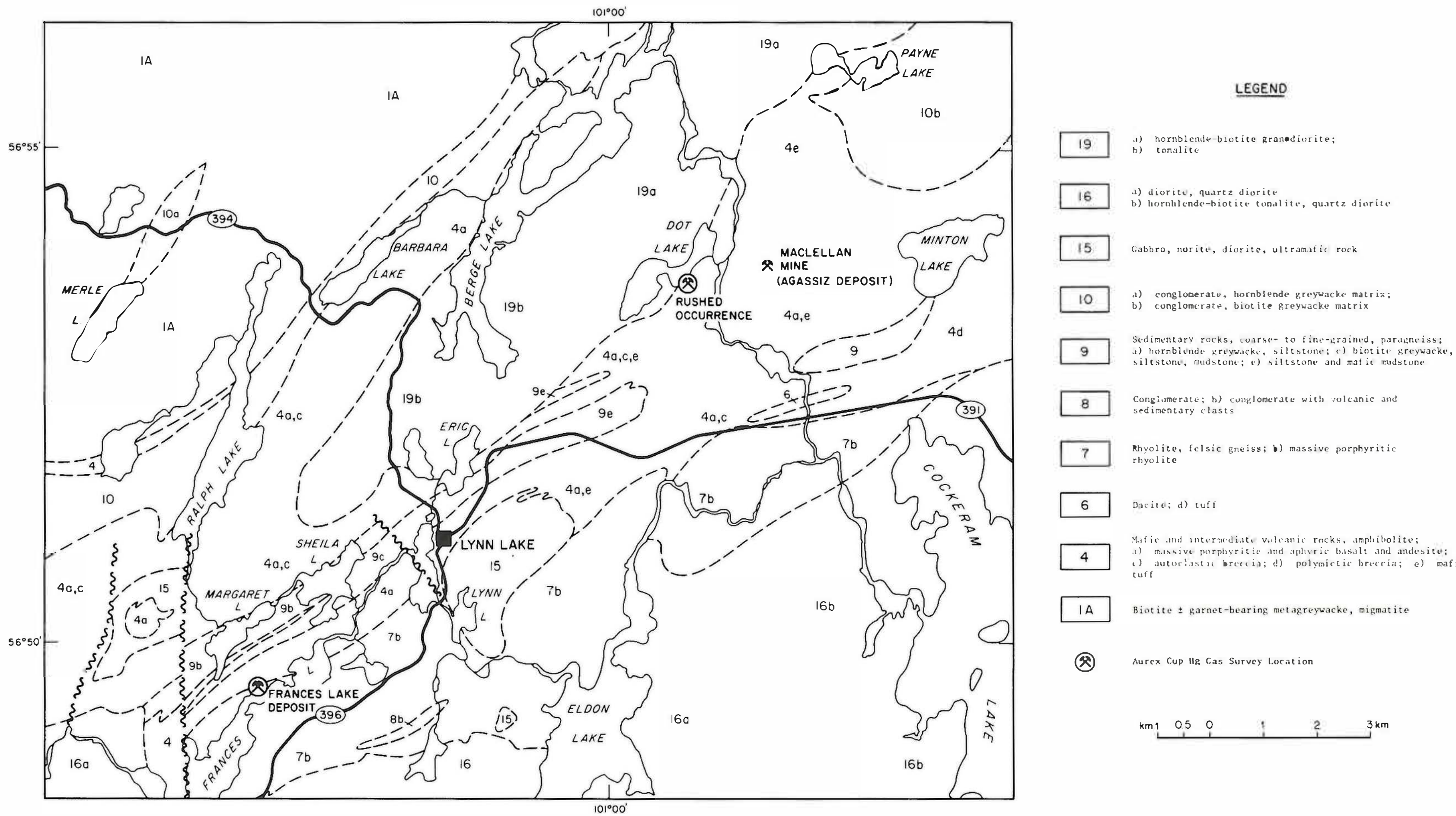


Figure GS-20-7: Mercury gas survey (Aurex Cups) sites, Lynn Lake area, 1985. Geology after Gilbert et al. (1980).

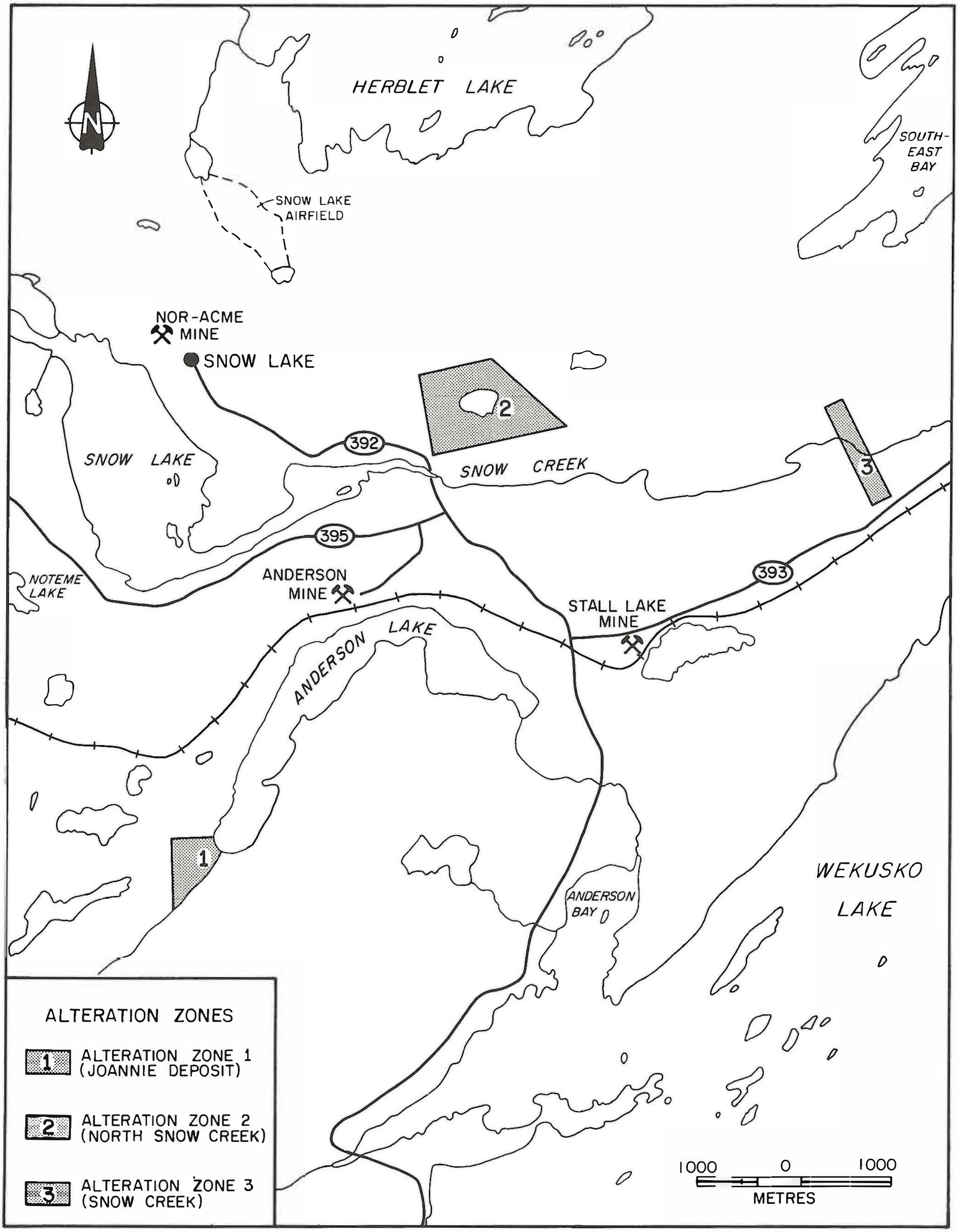


Figure GS-20-8: Location map for alteration zone mapping projects, Snow Lake area, 1985.

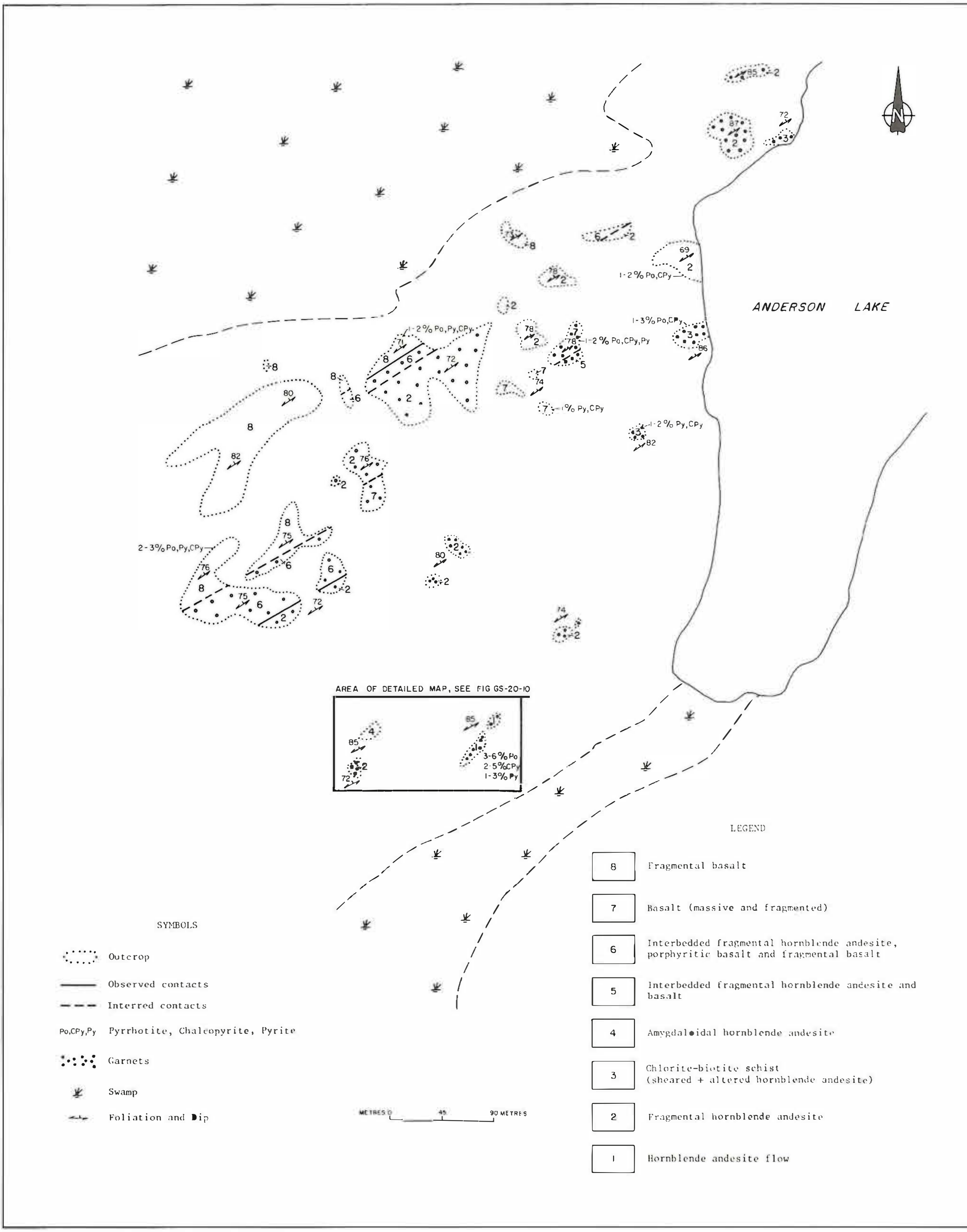


Figure GS-20-9: Geology in the vicinity of the Joannie deposit, Snow Lake.

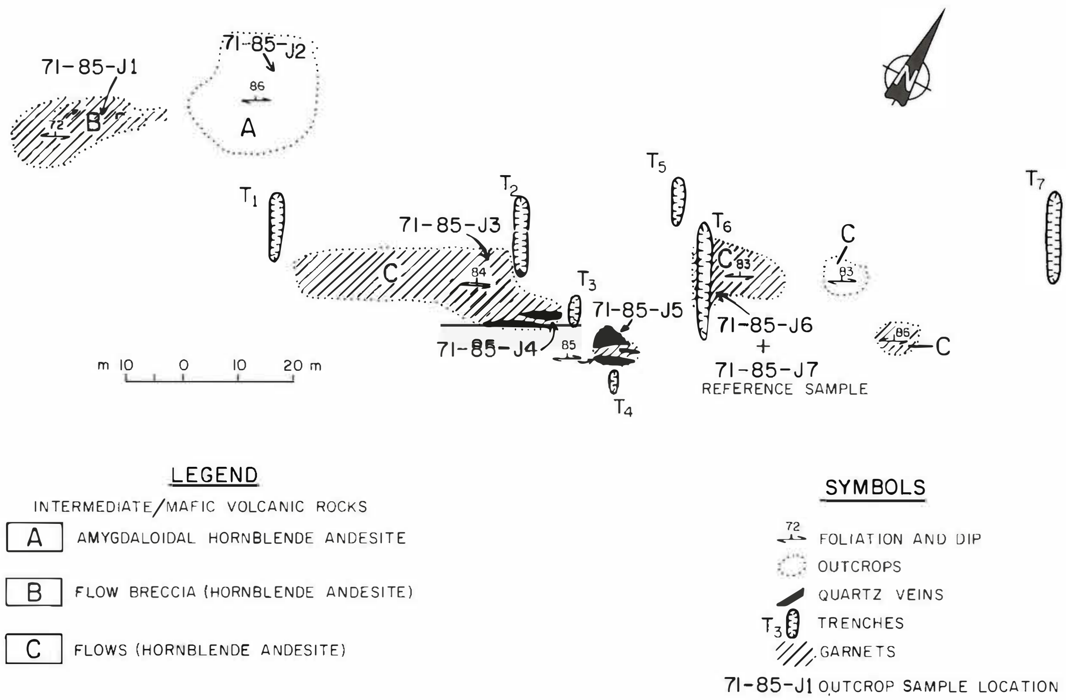


Figure GS-20-10: Detailed geology and trench map at the Joannie deposit, Snow Lake area.

rence could represent a discrete exhalative vent along the Anderson stratigraphy or it could represent the waning stages of sulphide deposition related to the downslope wasting of the Anderson mineralizing event (assuming the Joannie rocks are correlatable with the Anderson stratigraphy). The presence of the intense chlorite-garnet-biotite alteration at Joannie would tend to support the latter hypothesis.

NORTH SNOW CREEK — ALTERATION ZONE #2

The North Snow Creek area (Fig. GS-20-11) was selected for geological mapping on the basis of the presence of mineral occurrences BS-49, 59, 52 and 53 (Fig. GS-20-1). The characteristics of these occurrences are presented in Table GS-20-1 and may be summarized as representing disseminated arsenopyrite, pyrite, pyrrhotite $\pm$ chalcopyrite within and adjacent to quartz vein(s). The North Snow Creek area of immediate interest is 1 x 1.6 km and is characterized by interlayered felsic pyroclastic rocks and mafic fragmental rocks. This stratigraphy can be subdivided into nine discrete and interlayered rock units. These units are as follows:

PORPHYRITIC FELSIC VOLCANIC ROCKS (1)

This unit is a quartz and feldspar-phyric felsic volcanic rock with 1-3 mm feldspar phenocrysts (20%) predominant over 1-3 mm angular and rounded quartz phenocrysts (10%). In selected outcrops the feldspars are not as abundant due to their replacement by hematite. A pyroclastic origin is attributed to this unit.

PORPHYRITIC FELSIC FRAGMENTAL ROCKS (2)

A fragmental felsic pyroclastic rock with a matrix identical to Unit 1 and 3-20 cm elongate cherty and feldspar- and quartz-phyric fragments. Cherty fragments predominate to the east whereas the porphyritic fragments (feldspar phenocrysts - 25%; quartz phenocrysts - 10%) predominate to the west.

FELSIC TUFF (3)

This unit is a thinly bedded, fine grained, pyritic felsic tuff. Subangular to subrounded quartz phenocrysts characterize this unit. It is rusty weathered in outcrop.

INTERBEDDED PORPHYRITIC FELSIC FRAGMENTAL AND FELSIC TUFFACEOUS SEDIMENTARY ROCKS (4)

The porphyritic felsic fragmental rock is characterized by fragments of similar composition to the quartz and feldspar-phyric matrix as well as by collapsed and silicified pumiceous fragments. These rocks are interlayered with a felsic tuff made up of rounded feldspar and quartz phenocrysts in a recrystallized ash(?) matrix. Overall the tuff is fine grained and in part silicified. A minor component of this interbedded sequence is a hornblende-biotite-plagioclase-quartz gneiss.

INTERMEDIATE SEDIMENTARY AND TUFFACEOUS ROCKS (5)

The intermediate sedimentary rock unit comprises 40% feldspar, 30% biotite, 20% hornblende and 10% quartz. It is equigranular with bedding ranging from 4-10 cm wide. The tuffaceous rocks are fine grained and of intermediate composition with approximately 10% subrounded quartz phenocrysts.

FELSIC LAPILLI TUFF (6)

This rock unit is characterized by 1-10 cm long fine grained felsic fragments set in a recrystallized ash matrix. The matrix contains feldspar greater than quartz phenocrysts and is in places rusty weathered. Fragments have been elongated to give a length to width ratio of 3-4:1.

INTERBEDDED FELSIC FRAGMENTAL AND LAPILLI TUFF (7)

The lapilli tuff is characterized by 0.2-4 cm long fragments in a recrystallized ash matrix. Fragments in the felsic fragmental rock are more variable in size (1-10 cm) and elongate (l:w = 5). Both units are bedded on a scale of less than 0.5 m.

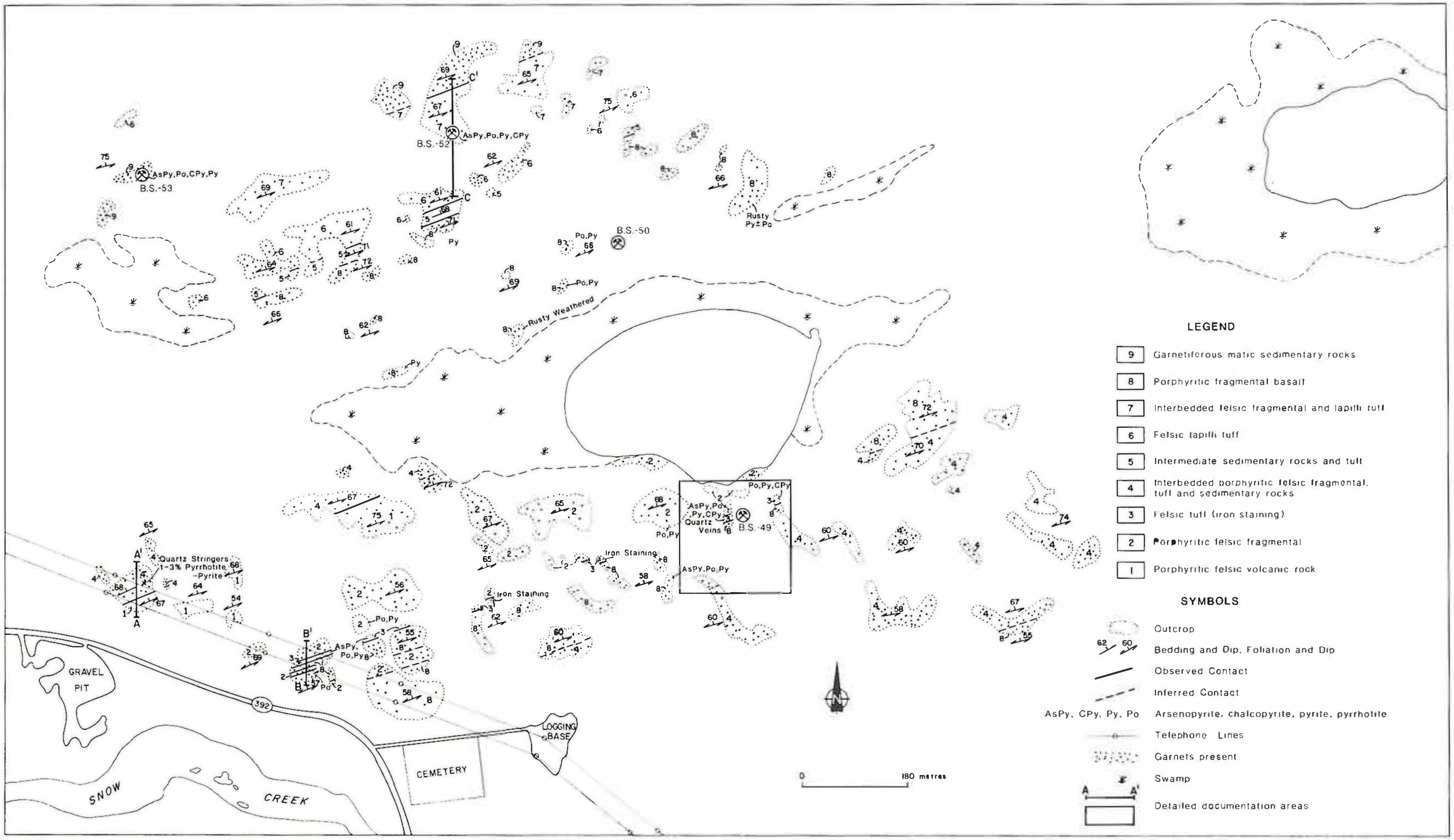


Figure GS-20-11: Geology in the vicinity of mineral occurrences BS-49, 50, 52 and 53 North Snow Creek area, Snow Lake.

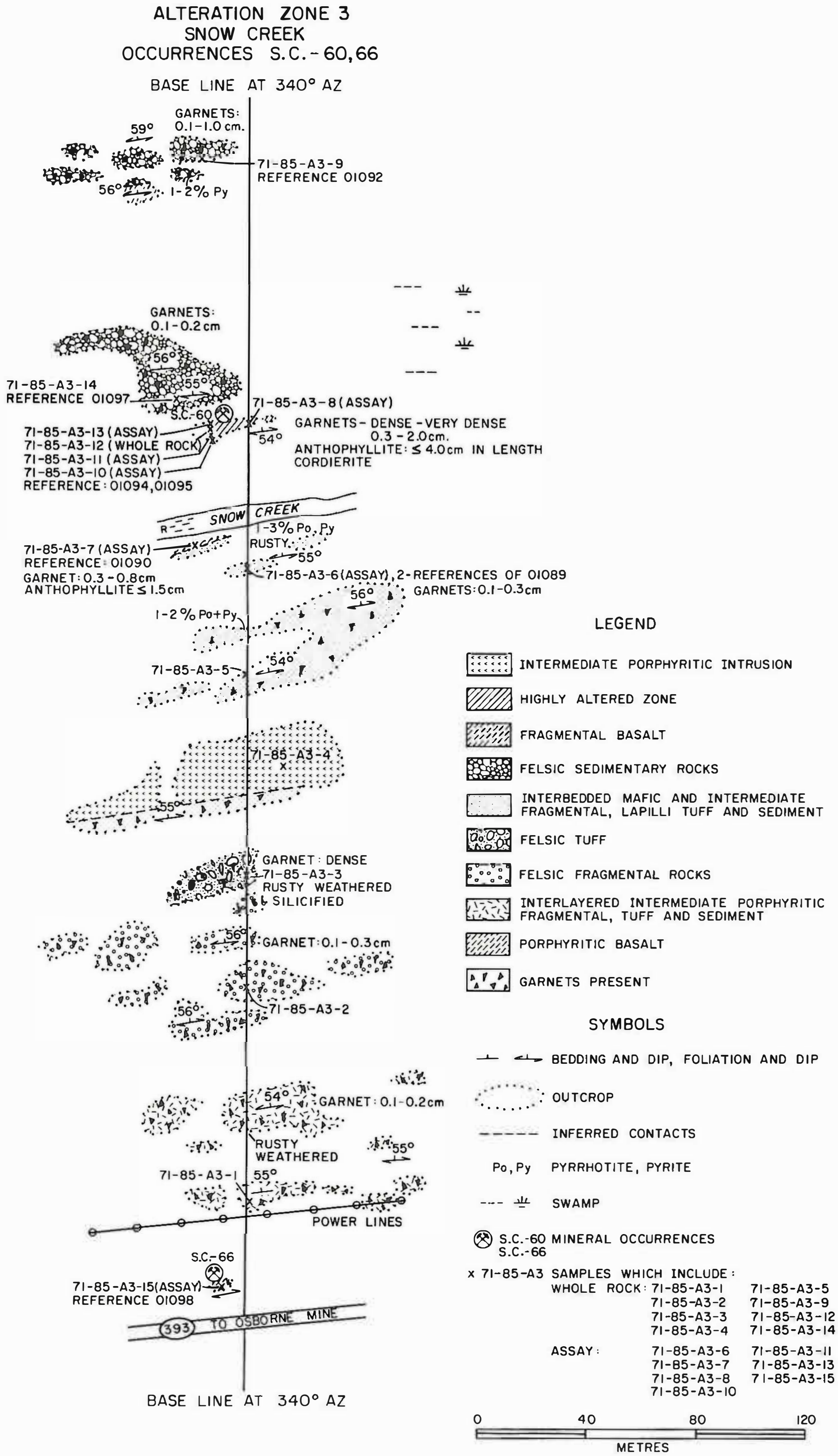


Figure GS-20-12: Detailed geology in the vicinity of mineral occurrences SC-60 and SC-66 Snow Creek area, Snow Lake.

TABLE GS-20-1
SUMMARY OF THE GEOLOGICAL CHARACTERISTICS OF MINERAL OCCURRENCES EXAMINED IN THE SNOW LAKE AND LYNN LAKE AREA, 1985.

Locality Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness	Comment/Reference
WEKUSKO LAKE					
WL-36 (Ruby/Kobar Pb-Ag; Osborne Creek)	sulphide stratum and quartz veins; 15 trenches, multiple ddh	near solid to solid sphalerite, galena, chalcopyrite, pyrite, disseminated galena, sphalerite, pyrrhotite in quartz veins	silicified biotite-quartz-feldspar-garnet gneiss	25 m	Froese and Moore (1980)
WL-37	sulphide stratum; quartz and carbonate veins	disseminated pyrrhotite and chalcopyrite	basalt	5 m	—
WL-38 (Osborne Creek)	sulphide stratum; quartz and carbonate veins; 1 trench: 6 x 3 x 1 m	disseminated pyrite	rusty weathered quartz-feldspar-biotite-muscovite schist	3 m	Froese and Moore (1980)
WL-39 (Osborne Creek)	sulphide stratum; 1 trench: 14 x 2 x 1 m 1 shaft - caved	disseminated pyrite and sphalerite	rusty weathered and silicified biotite-quartz-feldspar-garnet gneiss	1 m	Froese and Moore (1980)
WL-40 (Rice Island)	intrusion - outcrop	disseminated chalcopyrite, pyrrhotite, pentlandite (?)	rusty weathered, fractured gabbro	30 m	Russell (1955); Map 55-3
WL-41 (Eureka Island)	intrusion - outcrop	disseminated chalcopyrite pyrrhotite, pentlandite (?)	rusty weathered, fractured gabbro	10 m	Russell (1955); Map 55-3
WL-42 (vic. Bartlett's Landing)	sulphide stratum, quartz vein; outcrop	disseminated pyrite	sheared, porphyritic basalt	25 m	Froese and Moore (1980)
WL-43 (vic. Bartlett's Landing)	sulphide stratum, quartz vein; outcrop	disseminated pyrite	sheared, silicified and rusty weathered basalt	3 m	Russell (1955); Map 55-3
WL-46 (Osborne Creek)	diamond drill core	near solid and disseminated pyrite with graphite	anthophyllite-sericite schist	5 m	C.A.F. #90090
WL-47 (Crowduck Bay)	intrusion - outcrop; multiple trenches and ddh	disseminated pyrrhotite and chalcopyrite	rusty weathered, sheared gabbro	3 m	C.A.F. #90071
GRASS RIVER					
GR-44	quartz veins, outcrop	disseminated pyrite, chalcopyrite	rusty weathered granodiorite	5 m	—
GR-45	quartz veins, outcrop	disseminated veinlet and vug-filling pyrite	rusty weathered granodiorite	15 m	—
GR-51	outcrop	disseminated pyrite	rusty weathered and bleached sedimentary rocks interlayered with rusty weathered and silicified massive and pillowed basalts	10 m	C.A.F. #90084

Locality Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness	Comment/Reference
NORTH SNOW CREEK					
NSC-49 (Alteration Zone #2)	quartz vein	arsenopyrite, pyrite, pyrrhotite ± chalcopyrite halos in host rocks adjacent to vein; minor pyrrhotite, arsenopyrite in quartz veins	interlayered felsic and mafic volcanic rocks	3 m	—
NSC-50 (Alteration Zone #2)	outcrop; numerous caved and filled trenches	disseminated pyrite and pyrrhotite	porphyritic and fragmental basalt	—	Russell (1955); Map 55-3
NSC-52 (Alteration Zone #2)	quartz vein, 6 trenches	blocky arsenopyrite, disseminated pyrite, pyrrhotite ± chalcopyrite halos in wall rocks adjacent to quartz vein	fragmental felsic volcanic rocks	3 m	Russell (1955); Map 55-3
NSC-53 (Alteration Zone #2)	outcrop, 2 trenches: 2 x 2 x 1 m 4 x 2 x 1 m	disseminated, acicular arseno-pyrite, pyrrhotite, pyrite and chalcopyrite	garnetiferous mafic sedimentary rocks	2 m	Russell (1955); Map 55-3
TRAMPING LAKE					
TL-35	outcrop — alteration zone	disseminated pyrite	silicified, rusty weathered and chloritic basalt	75 m	Froese and Moore (1980)
TL-55 (Storm King — Au 1)	quartz vein, rubbly outcrop	disseminated, vug and fracture filling pyrite	rusty weathered and silicified greywacke	2 m	Harrison (1949); Map 906A
TL-56 (Dew Group — Cu 3)	shear and fracture zones in outcrop; 2 overgrown trenches	disseminated pyrite and arsenopyrite	rusty weathered granodiorite /diorite	2 m	Harrison (1949); Map 906A
HERBLET LAKE					
HL-8	quartz vein; outcrop	disseminated pyrite and arsenopyrite in quartz veins and wallrock	arkose with calc-silicate layers	20 m	Harrison (1949); Map 929A
HL-34	quartz vein; outcrop and 2 trenches 14 x 1 x 1 m 12 x 1 x 1 m	disseminated arsenopyrite, pyrite, sphalerite, galena in vein, disseminated pyrite, arsenopyrite in wallrock	greywacke	15 m	C.A.F. #90137
SNOW CREEK					
SC-60	outcrop	disseminated pyrrhotite, pyrite and minor chalcopyrite	anthophyllite, garnet, cordierite, staurolite-bearing, rusty weathered, sheared felsic sedimentary rock	20 m	Froese and Moore (1980)
SC-66	outcrop; overgrown and filled trench	disseminated pyrite, less than 2%	silicified and rusty weathered porphyritic basalt	3 m	—
KORMAN LAKE					
KL-67 (Pin Occurrence)	quartz vein; outcrop	disseminated pyrite, chalcopyrite, sphalerite, galena	mafic, volcaniclastic sedimentary rocks	10 m	D.V. Ziehlke; (H.B.M.S.)

Locality Designation	Type of Occurrence	Nature of Mineralization	Host Rocks	Thickness	Comment/Reference
WOLVERTON LAKE					
WL-61 (''Alteration Point'')	outcrop	disseminated pyrrhotite, chalcopyrite, magnetite	garnet-cordierite-anthophyllite-bearing, rusty weathered felsic gneiss	5 - 10 m	—
WOOSEY LAKE					
WL-54 (Doc 8)	outcrop; 2 trenches: 7 x 2 x 1 m 20 x 2 x 3 m	disseminated pyrite, pyrrhotite, chalcopyrite with graphite	argillite and siltstone	20 m	Harrison (1944); Map 929A
MORGAN LAKE					
ML-57 (Au 6)	outcrop; quartz veins	disseminated pyrite and pyrrhotite	rusty weathered and garnet-bearing fragmental felsic rock and porphyritic basalt	2 m	Harrison (1944); Map 929A
DION LAKE					
DL-58 (Gamma-Star Group)	outcrop; 16 trenches	not located	pegmatite and greywacke	?	C.A.F. #90093
COOK LAKE					
CL-59 (Bomber Zone)	outcrop; 1 trench: 2 x 1 x 1 m	disseminated pyrite	porphyritic basalt; silicified and bleached quartz and feldspar-phyric felsic volcanic rocks	2 m	Harrison (1944); Map 929A
ANDERSON LAKE					
AL-48 (Joannie; Alteration Zone #1)	alteration zone; quartz veins, multiple trenches and ddh	disseminated pyrite, chalcopyrite, pyrrhotite	andesite/basalt containing garnets, chlorite, quartz and carbonate stringers	10 m	Russell (1955); Map 55-3
NICKEL LAKE — LYNN LAKE AREA					
NL-62	outcrop and 9 trenches	disseminated pyrite and chalcopyrite	felsic pyroclastic volcanic rocks and high Mg basalt (''Agassiz Picrite'')	10 m	Milligan (1960)
NL-63	outcrop, quartz and carbonate veins	disseminated pyrite and chalcopyrite	interlayered siltstone and high Mg basalt (''Agassiz Picrite'')	undetermined	—
NL-64	drill core; quartz veins and sulphide stratum	disseminated pyrrhotite, pyrite and chalcopyrite	basalt and siliceous clastic sedimentary rocks	5 m	—
NL-65	outcrop; quartz and carbonate veins	disseminated pyrite and pyrrhotite	mafic volcanic and sedimentary breccia and massive, mafic volcanic flows	50 m	Questor (1976)

*NOTE: C.A.F. — Cancelled Assessment File

PORPHYRITIC FRAGMENTAL BASALT (8)

This rock is characterized by a matrix of hornblende (50%), plagioclase (15%) and biotite (15%) with prismatic hornblende crystals aligned parallel to the foliation. The fragments contain feldspar phenocrysts (30%) and quartz phenocrysts (15%) and appear to be more felsic in composition than the matrix. The fragments range from 5 cm to 1 m in length.

GARNETIFEROUS MAFIC SEDIMENTARY ROCKS (9)

Unit 9 is an equigranular, fine grained, hornblende and biotite-rich rock containing 3 mm—1 cm rounded, red garnets. The garnets compose 20% of the rock in the vicinity of mineral occurrence BS-52.

INTRUSIONS

The only recognized intrusive unit in the area is a coarse grained amphibolite. Characteristically the unit contains subhedral to euhedral amphibole phenocrysts and is observed in discordance with Units 1 and 3.

MINERAL OCCURRENCES

Four mineral occurrences are located within this stratigraphic sequence (Fig. GS-20-11). BS-49 is located 40 m south of the small westernmost lake and may be observed in outcrop as well as in two partially filled trenches. Host rock to the mineralization is a fine grained, thinly bedded felsic tuff. Mineralization occurs as haloes of blocky arsenopyrite, disseminated pyrrhotite, pyrite and chalcopyrite developed in the wallrock over a distance of 1 m from the vein-host rock contact. Some local shearing is evident by the presence of cleaved sericite schist. BS-50 is located 150 m north of this same lake and is hosted in porphyritic fragmental basalt. Two trenches at this locality are filled; disseminated pyrrhotite and pyrite are observed in the host rocks along strike from the trenches. BS-52 occurs southwest of the westernmost lake and is characterized by blocky and massive arsenopyrite with disseminated pyrrhotite, pyrite and chalcopyrite developed as haloes adjacent to quartz veins within felsic fragmental wallrocks. BS-53 is located to the northwest of the westernmost lake and comprises 2 small trenches in silicified, garnetiferous mafic sedimentary rocks. The trenches expose disseminated, acicular arsenopyrite as well as pyrrhotite, pyrite and chalcopyrite over an approximate thickness of 2 m.

The North Snow Creek area is characterized by interlayered felsic fragmental rocks of pyroclastic affinity and mafic volcanic and sedimentary rocks. The mineralization in the area appears to be related to (1) tectonically late quartz veins characterized by disseminated haloes of sulphide minerals, and (2) disseminated sulphides within sheared host rocks. Detailed geology and sampling maps for each of the mineral occurrences are available for viewing upon request.

SNOW CREEK-ALTERATION ZONE #3

The Snow Creek map area (Fig. GS-20-8) was selected for more detailed study because of the presence of mineral occurrences SC-60 and SC-66 and the association of SC-60 with coarse grained anthophyllite, cordierite, garnet and staurolite. The geology and mineral occurrences at this locality are presented in Figure GS-20-12. The rocks in the area have been divided into 9 separate units and are described as follows:

PORPHYRITIC BASALT (1)

Characteristically, this rock is rusty weathered and, in part, silicified. Feldspar phenocrysts make up 20% of the rock with hornblende, feldspar and biotite in the matrix.

INTERBEDDED INTERMEDIATE PORPHYRITIC FRAGMENTAL, ROCKS AND TUFFACEOUS AND CLASTIC SEDIMENTARY ROCKS (2)

The intermediate porphyritic fragmental unit is characterized by 20% feldspar phenocrysts in a matrix of 30% quartz, 30% hornblende, 10% biotite and 10% feldspar. The feldspar-phyric fragments are more felsic than the matrix, range from 4-10 cm in length and are aligned parallel to foliation. The tuffaceous units are fragmental, containing lapilli-sized felsic fragments; the clastic sedimentary rocks are non-fragmental, equigranular and more mafic in composition. Graded contacts are observed between the clastic and tuffaceous sedimentary rocks and indicate a local northwest stratigraphic facing.

FELSIC FRAGMENTAL ROCKS (3)

This unit contains 10-30% fragments that are feldspar- (20%) and quartz-phyric (5%) and range from 2-20 cm in length. The matrix is fine- to coarse-grained with angular quartz (40%), hornblende (30%), feldspar (15%) and biotite (10%). Garnets (1-2 mm diameter) are present in both matrix and fragments.

FELSIC TUFF (4)

These rocks are characterized by the presence of fine grained cherty, elongate lapilli-sized fragments up to 7 cm in length. The matrix is coarser grained than the fragments and contains quartz and feldspar phenocrysts. Garnets (0.3-1.5 cm) occur in both matrix and fragments.

INTERLAYERED MAFIC AND INTERMEDIATE FRAGMENTAL ROCKS, LAPILLI TUFF AND SEDIMENTARY ROCKS (5)

The rocks of this unit are thinly layered (less than 1 m) and variable. The fragmental units contain lapilli-sized felsic fragments with subangular feldspar phenocrysts. The fragments range from 0.5-2.0 cm in length and are elongate parallel to foliation. The matrix has variable proportions of hornblende, plagioclase and quartz. The sedimentary rocks are fine grained, equigranular and mafic in composition with characteristic mineral assemblages of hornblende (40%), biotite (20%) and quartz + feldspar (40%). Hornblende is aligned with the foliation.

FELSIC SEDIMENTARY ROCKS (6)

These sedimentary rocks are fine- to medium-grained equigranular units comprising 45% quartz, 30% hornblende and biotite and 25% feldspar. The mafic minerals are aligned parallel to foliation imparting a banded or gneissose texture to the rock. Quartz and carbonate stringers are abundant in this unit.

FRAGMENTAL BASALT (7)

This unit contains intermediate to felsic 5-15 cm long feldspar-phyric (10%) fragments. The matrix contains 60-70% hornblende with the remainder being plagioclase, biotite and quartz.

ALTERATION ZONE (8)

An intense coarse grained alteration mineral assemblage of anthophyllite, garnet, cordierite and staurolite is developed in sheared silicified and rusty weathered sedimentary rocks on the north and south side of Snow Creek. Alteration on the north side of the creek is developed in felsic sedimentary rocks and is characterized by the mineral assemblage anthophyllite-cordierite-garnet-staurolite-quartz whereas mafic sedimentary rocks on the south side of Snow Creek contain anthophyllite and garnet. Within the alteraton zones anthophyllite comprises 10-70% of the alteration assemblage and appears as black, bladed crystals 0.5-4.0 cm in length. Garnets are commonly 0.5-4.0 cm in diameter. Light to dark blue cordierite forms crystalline aggregates that make up 10-30% of the rock. Staurolite commonly occurs as reddish-brown anhedral grains and makes up a minor proportion of the alteration mineral assemblage. This alteration appears to be a concordant layer.

INTERMEDIATE PORPHYRITIC (?)INTRUSION (9)

This unit is classified as an intrusive rock due to the absence of bedding, grain size variations and fragments. It is characterized by coarse grained (1-3 mm) phenocrysts of amphibole (50%), feldspar (35%) and quartz (15%). Contact relationships were not observed.

Mineral occurrence SC-60 is associated with the intensely altered anthophyllite-cordierite-garnet-staurolite felsic sedimentary rock on the north side of Snow Creek. This rock is characteristically rusty weathered (2-5% iron sulphides) and sheared with sulphides concentrated in an anthophyllite-rich, 1 m wide bed. The coarse grained mineral assemblage accompanied by disseminated iron sulphides apparently confined to a single stratigraphic interval is suggestive of an exhalite layer. Mineral occurrence SC-66 occurs within rusty weathered porphyritic basalt. A caved and filled trench is located at this site; the basalts along strike from the occurrence contain 1-2% disseminated pyrite.

More detailed studies are required in the vicinity of occurrence SC-60 owing to the similarity of the observed alteration mineralogy at Snow Creek with that of some of the base metal massive sulphide deposits in the Snow Lake area.

OTHER OCCURRENCES

The remainder of the mineral occurrences examined this summer are summarized in Table GS-20-1; their locations are plotted on Figures GS-20-1 through GS-20-4.

Of particular interest is the Ruby/Kobar Pb-Ag occurrence (WL-36; Fig. GS-20-1) on Osborne Creek. Although outcrop in the vicinity of this occurrence is minimal an extensive trenching and stripping effort has exposed folded, rusty weathered and silicified sedimentary rocks hosting solid sulphide sphalerite, galena, chalcopyrite and iron sulphides. This mineralization has been crosscut by quartz veins that have mobilized galena, minor sphalerite and iron sulphides. The occurrence represents an exhalite-type layer in a sedimentary (quartz-biotite-garnet gneiss) sequence. The overall absence of outcrop in the immediate area precludes a more definitive study; however, the possibility of this stratigraphy continuing along strike will be examined by detailed mapping and detailed geochemical programs next summer. Detailed trench and geology maps with assay results are available for viewing upon request.

Long range programs were commenced on the Joannie alteration zone and on the Cook Lake property in conjunction with Hudson Bay Mining and Smelting Ltd. and Falconbridge Nickel Ltd., the respective operators. These studies comprise detailed geological mapping, diamond drill core logging and sampling with accompanying geochemical studies.

ACKNOWLEDGEMENTS

We acknowledge the able assistance of T. Robbie, C. Roney, G. Schmidt and S. Wilkins during the course of the mineral deposit studies in both Lynn Lake and Snow Lake this summer.

REFERENCES

Frarey, M.J.,
1950: Crowduck Bay, Geological Survey of Canada Map 987A.

Froese, E., and Moore, J.M.,
1980: Metamorphism in the Snow Lake area, Manitoba, Geological Survey of Canada Paper 78-27.

Gilbert, H.P., Syme, E.C. and Zwanzig, H.V.,
1980: Geology of the metavolcanic and volcaniclastic metasedimentary rocks in the Lynn Lake area; Manitoba Mineral Resources Division Geological Paper GP80-1.

Gonzales, A. and Fedikow, M.A.F.,
1984: Mineral deposit studies, Snow Lake area; Manitoba Mineral Resources Division, Report of Field Activities, p. 46-52.

Harrison, J.M.,
1948: Geology and mineral deposits of the File-Tramping Lakes area, Manitoba; Geological Survey of Canada Memoir 250, Maps 906A, 929A.

Russell, G.,A.,
1955: Structural studies, Snow Lake-Herb Lake area; Manitoba Mines Branch Publication, Map 55-3.

Stanton, M.S.,
1945: Tramping Lake; Geological Survey of Canada Map 906A.

GS-21 EVALUATION OF INDUSTRIAL MINERAL OCCURRENCES IN THE SNOW LAKE AREA

by W.R. Gunter and P.H. Yamada

A reconnaissance program was conducted to identify the industrial minerals potential of selected mineral occurrences in the Flin Flon-Snow Lake volcanic belt, the Kisseynew metasedimentary gneiss belt and the overlying Ordovician dolomite. The targets identified were:

- cross-cutting metamorphosed alteration zones adjacent to massive sulphide deposits or showings;
- garnet-anthophyllite-sillimanite gneiss along strike from stratabound massive sulphides;
- stratabound staurolite concentrations;
- specimen quality garnet;
- dolomite as a building stone;
- chromium-bearing metasediments; and
- amazonite-bearing granitic pegmatite as an ornamental stone.

The locations of the occurrences examined are shown in Figure GS-21-1.

The metamorphosed alteration zones in the Snow Lake area are associated with copper-zinc sulphide deposits and prospects. The locations examined are: the Anderson Lake Mine, the Osborne Lake Mine, the Ram Zone, the Joannie Zone, and the Chisel Lake Sandpit Zone.

The garnet-anthophyllite-sillimanite gneiss is associated with the Sherridon structure and was examined at locations south of Star Lake and at Batty Lake. The stratabound staurolite concentrations are associated with a thin band of turbidites in the Snow Lake-Wekusko Lake area, on the north side of Snow Lake, along Snow Creek, and on the islands and shoreline of Crowduck Bay.

Specimen quality garnet is associated with a metapelite, called the Corley Lake Member of the File Lake Formation. It was examined

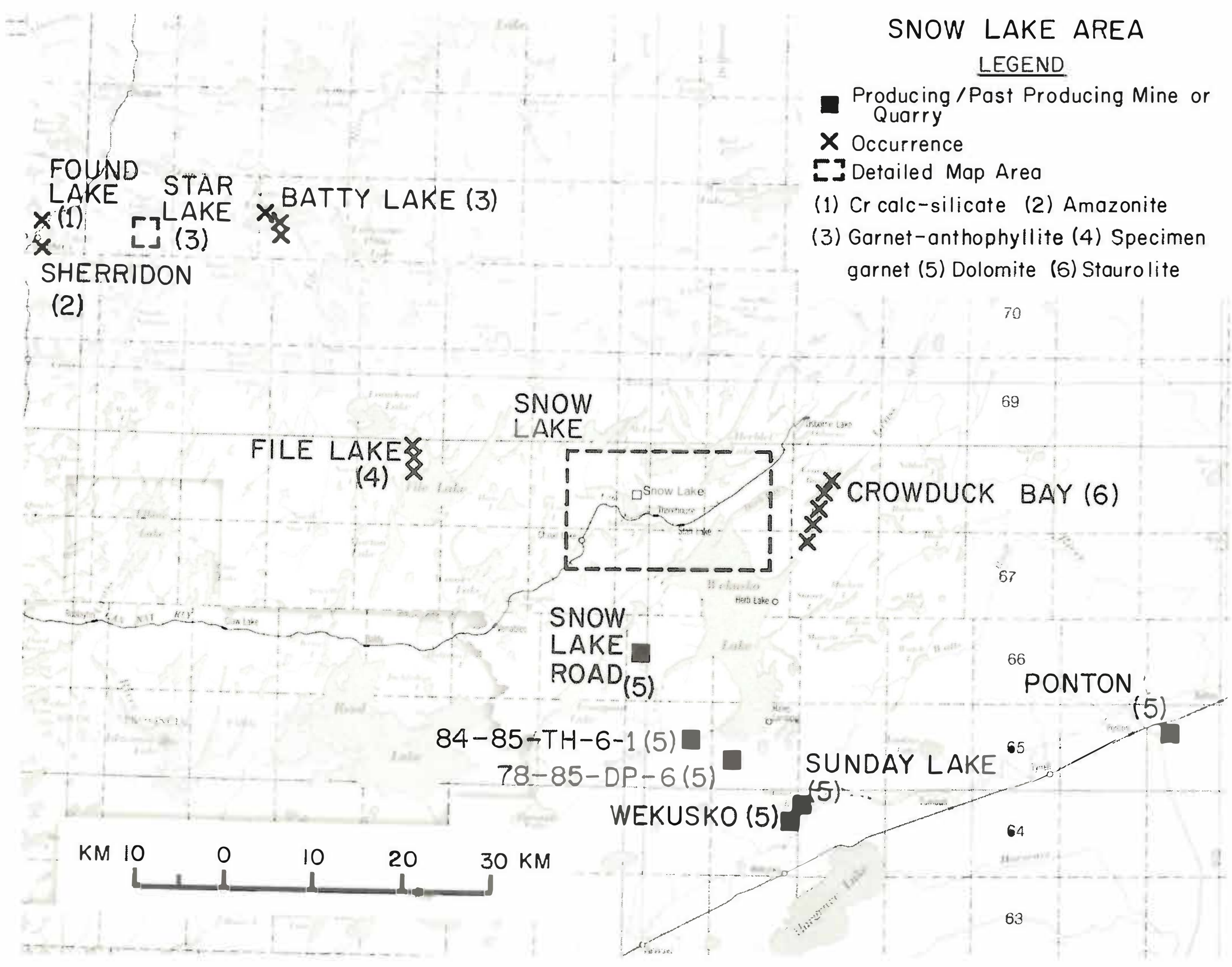


Figure GS-21-1: Location of industrial mineral occurrences in the Snow Lake area.

along a ridge of the member between northwestern File Lake and Corley Lake.

A chromium-bearing calcareous metasediment containing Cr-grossularite, Cr-amphibole, Cr-mica and chromite occurs in a railroad cut south of Found Lake near Sherridon.

A small pod of amazonite-bearing pegmatite approximately one metre by three metres occurs adjacent to the Sherridon massive sulphide deposit.

The dolomite occurs in Ordovician strata south of the Precambrian unconformity and was examined in roadside quarries along Highways 391 and 392 between Ponton and Snow Lake.

METAMORPHOSED ALTERATION ZONES

Individual metamorphosed alteration zone deposits contain a wide range of minerals. Within the alteration zones the predominant matrix material is commonly chlorite or sericite.

Common metamorphic mineral assemblages within alteration zones of the Snow Lake area are:

(1) kyanite-staurolite-chlorite;
(2) kyanite-chlorite;
(3) staurolite-chlorite;
(4) staurolite-garnet-chlorite;
(5) garnet-chlorite; and
(6) chlorite.

In assemblages 1, 2, 3 and 6 sericite can substitute for chlorite.

Several minerals such as anhydrite and blue kyanite with quartz occur locally in the Anderson Lake Mine. These minerals are volumetrically insignficant and are not described further.

Kyanite in assemblages (1) and (2) is the most significant industrial mineral in the Snow Lake district alteration zones. These minerals occur as discrete bodies within the alteration zones and are adjacent to the sulphide bodies. Exposures at the Anderson Lake Mine and the Ram zone contain the largest quantities of these assemblages; small quantities are present in the waste rock dumps of the Osborne Lake Mine.

There appears to be a correlation between the appearance of kyanite and the absence of garnet in these alteration zones; kyanite and garnet do not occur together—however, either can be associated with staurolite.

ANDERSON LAKE MINE

In the Snow Lake area (Fig. GS-21-2) the most promising concentration of an industrial mineral is the kyanite in the footwall of the Anderson Lake Mine. The kyanite occurs in two subunits: as a large body of chlorite-kyanite + biotite schist, and on the west side of this subunit, as a portion of the sericitic envelope that surrounds the sulphide body.

Mappable concentrations of kyanite have been noted on all levels of the mine by HBM&S geologists. The presence of kyanite was also recorded during both stope mapping and pre-production core logging. A detailed study could be made to determine the volume and grade of the kyanite-bearing rock.

An examination of the Anderson Lake Mine dumps was undertaken to determine if a significant kyanite resource exists on the surface. A series of 60 cm deep test pits revealed that despite the surface appearance of a loosely consolidated aggregate, the dump is not a volumetrically important source of kyanite. A compact, iron stained rubble was uncovered in the pits. All the durable fragments that were identifiable were biotite schist. It is possible that the less durable kyanite-bearing fragments within the dump have disintegrated leaving a sericite-rich powder. Thus any bulk sample taken from the pile would be unrepresentative.

Bulk samples of the maximum and minimum concentrations of kyanite-bearing material should be submitted to EMR in Ottawa in order to establish the effectiveness of present flotation systems for the production of a saleable kyanite concentrate.

RAM ZONE

The Ram Zone is situated on an island in the southeast corner of Anderson Lake behind the dam on Anderson Creek. A detailed survey of the island was undertaken to determine the distribution of mineral assemblages. A large area of kyanite-chlorite with small beds of kyanite-staurolite-chlorite occurs on the south portion of the island. The kyanite-chlorite is constant in appearance and contains 11 per cent kyanite (average of four point counts). The northern portion of the island contains a more complex set of assemblages. Three north-trending sub-parallel zones, each consisting of thin units of assemblage (5) sub-parallel to one another, are separated from each other by zones of siliceous chlorite schist.

The plunge of the Ram Zone is toward the north and drilling by HBM&S indicates that the zone joins the alteration pipe of the Anderson Lake Mine at depth.

OTHER OCCURRENCES

Other known occurrences of alteration zones are relatively small or are not known to contain industrial minerals of economic interest. Those are listed below together with the minerals that are of interest as industrial minerals.

Chisel Sandpit Zone	garnet-staurolite-chlorite
Joannie Zone	garnet-chlorite ± staurolite
Chisel Lake Mine Dump	garnet-amphibole
Nor Acme Mine Dump	staurolite-garnet-axinite
Osborne Lake Mine Dump	gahnite, anthophyllite, kyanite, apatite, cordierite

The Osborne Lake Mine Dump may be a source of garnet, as fragments found on the dump are very similar to the Star Lake garnet-anthophyllite unit (see below). The volume of these fragments is not known and test pits into the dump with a backhoe may be advisable.

GARNET-ANTHOPHYLLITE-SILLIMANITE GNEISS

The garnet-anthophyllite-sillimanite gneiss (GAS) is a coarse grained rock which forms identifiable outcrops that are quite different from the surrounding gneisses. The occurrences at Star Lake and Batty Lake were mapped as a distinct unit by Robertson (1950). Detailed mapping of the Sherridon structure by Goetz (1980) recorded a series of discontinuous lenses of GAS. Outcrop-scale mapping was undertaken in 1985 to quantify the occurrence of garnet-rich rocks.

The GAS unit was found in more extensive outcrops than indicated by Goetz (1980). As shown in Figure GS-21-3 the outcrops form several elongate ridges in swampy terrain. Contacts between the GAS unit and the surrounding gneisses were found in only two places. The highest concentration of garnet occurs in a three-metre wide reaction zone, at the base of the GAS unit. This zone which is underlain by a biotite gneiss and consists of layers of massive sillimanite, garnet-biotite and garnet-anthophyllite. Exposure 84-85-StL-11-5 (see Fig. GS-21-3) contains a series of intercalated GAS units and a quartzitic gneiss with a thickness of four metres. Three of the GAS units in this exposure have knife-sharp conformable contacts with the quartzitic gneisses.

The GAS unit has been intruded by pegmatite in a number of locations. The contacts are sharp with little or no exchange of either Al from the pegmatite or Fe and Mg, from the GAS. It is possible that the pegmatites were intruded along faults. The large outcrop at 84-85-STL-11-1 was cut by at least five pegmatites. The GAS units between the pegmatite dykes are internally constant but cannot be correlated across the pegmatite.

The best exposed example of the internal stratigraphy of the GAS unit is outcrop 84-85-STL-9. The outcrop is a double plunging synform 70 metres in length caused by refolding of the regional antiformal structure.

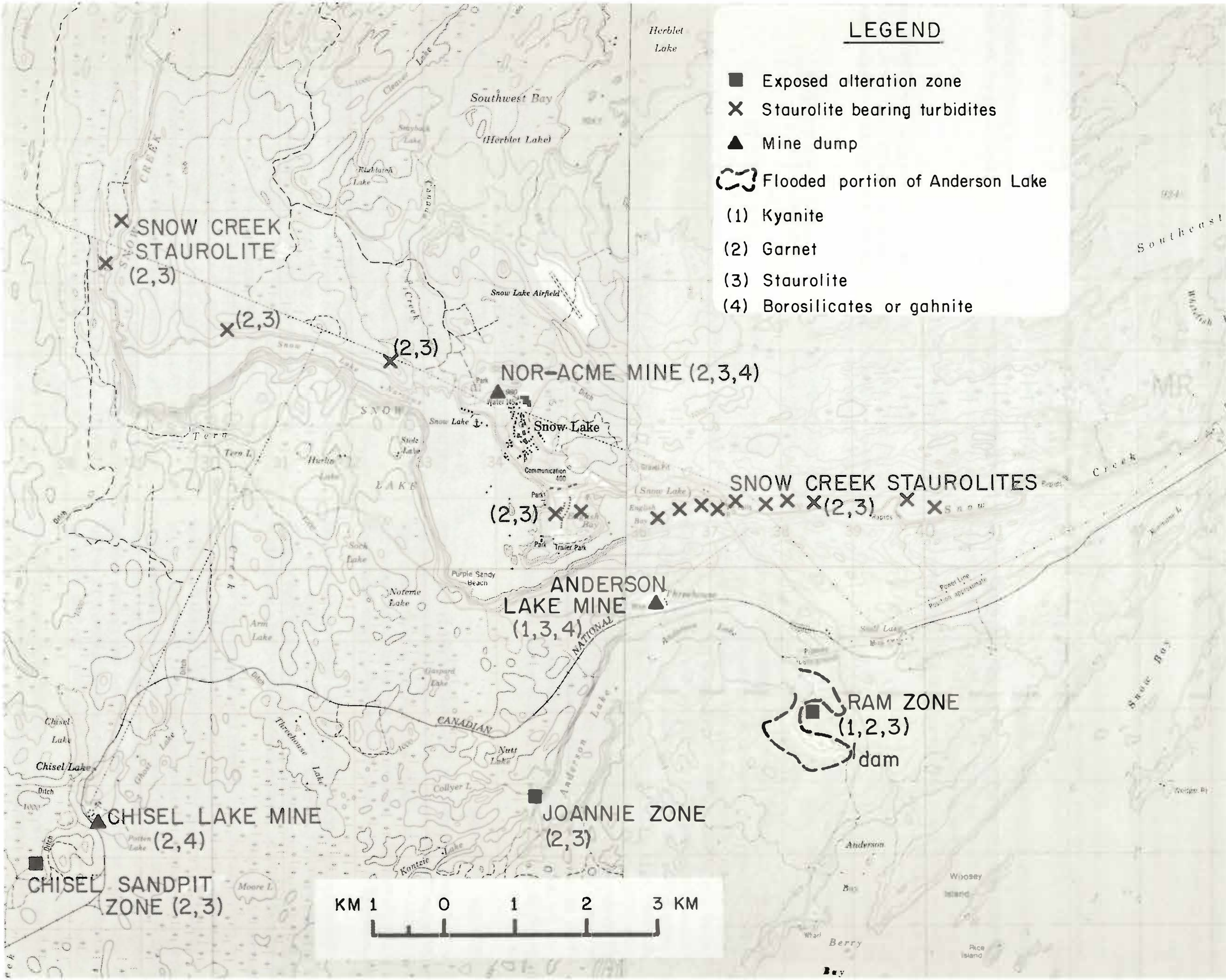


Figure GS-21-2: Industrial mineral occurrences near the town of Snow Lake.

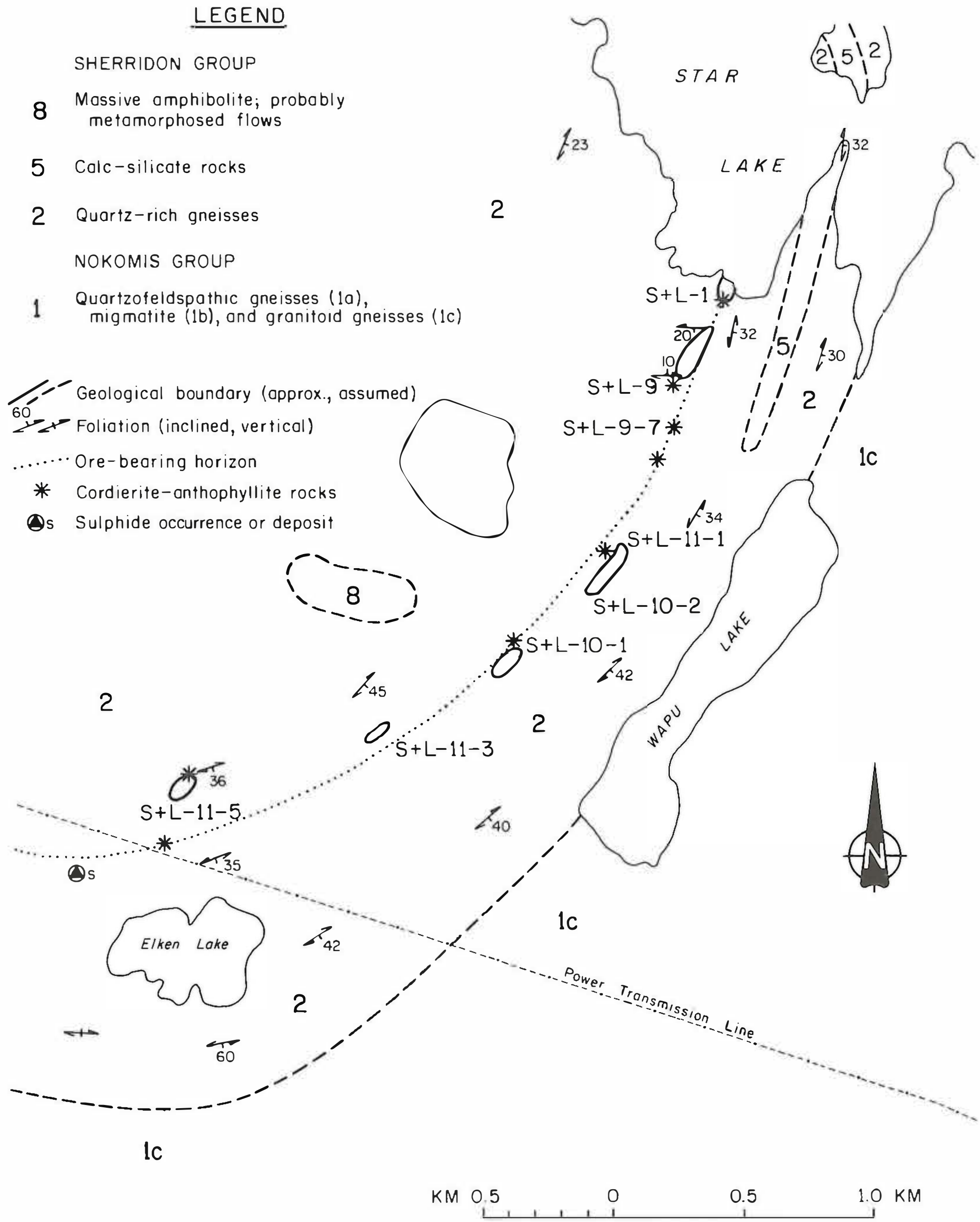


Figure GS-21-3: Star Lake garnet-anthophyllite-sillimanite schist. Geology after Froese and Goetz (1980).

Several mineralogical trends were noted within the area mapped. The volume of cordierite decreases rapidly from 10% to 15% by volume in the outcrop on the south shore of Star Lake to nearly zero at the south end of 84-85-STL-9, and remains low throughout the remainder of the area mapped. The amount of quartz increases from 5% in the northern outcrops to 60% in garnet-quartz pods in the southern outcrops. The only located outcrop with an old trench was 84-85-STL-11-5. This trench contains minor amounts of copper staining; however, it does not contain any noticeable evidence of rusty weathering. This was the only locality with any evidence of metallic mineralization within the GAS Unit.

Within the GAS unit the volume of garnet ranged from a high content of more than 20%, to a normal garnet content of 5%-10%; it may contain less than 5%. The highest volume recorded was 54%; this is close to the ideal packing for spheres. The variation in the garnet volumes as determined by point counting on five outcrops is given below.

Basal Unit

84-85-STL-9	0+00 m	22%	
0+10 m	23%		
	0+20 m	13%	Av. 20%
78-85-STL-2-2		9%	
78-85-STL-2-5		2%	
		4%	Av. 3%
84-85-STL-10-1		54%	
84-85-STL-11-2		11%	
		20%	Av. 15%

BATTY LAKE

In the Batty Lake area, a detailed investigation of the GAS unit was undertaken to evaluate the potential of the garnet concentrations, and to correlate the Batty Lake GAS unit with the unit at Star Lake. The Batty Lake unit occurs in three areas immediately west of the central peninsula. These areas are aligned in a southeasterly direction across the width of the lake (Fig. GS-21-1).

The GAS unit consists of quartz-biotite-anthophyllite + garnet + magnetite + cordierite. The garnets range from 0.1 cm anhedral crystals to 4 cm poikiloblastic snowball-shaped aggregates. The mineral assemblage and textures are similar to the GAS unit at Star Lake.

The outcrops on the north shore consist of two areas of massive poikiloblastic snowball garnet and one area of anthophyllite with little or no garnet. The island outcrop has little or no garnet but abundant anthophyllite. The south shore outcrop has 5-10% garnet in 1 x 1 cm poikiloblastic snowball shaped aggregates on the east side of the outcrop. The garnets decrease in both size and abundance to near zero within ten metres from the east side of the outcrop.

The Batty Lake GAS unit is considered to have a low potential as a source of garnets. The unit lacks a significant volume of massive poikiloblastic snowball garnet. The GAS unit at Batty Lake does not exhibit any detectable stratigraphic variations of the garnets similar to those found at Star Lake.

STRATABOUND STAUROLITE CONCENTRATIONS

SNOW LAKE

Staurolite occurs as a metamorphic mineral within unit 6 (metamorphosed greywacke and shale) of Froese and Moore (1978). Abundant staurolite occurs at Snow Creek and Crowduck Bay; however, these two areas do not appear to be related.

Staurolite occurs in an east-trending belt along Snow Creek and along the north shore of Snow Lake. The staurolites decrease in both size and volume towards the west end of Snow Lake. On the eastern end of this belt, at the second rapids on Snow Creek, both the outcrops and the volume of staurolites decrease markedly.

The second area of abundant staurolite is on the islands and shoreline of Crowduck Bay narrows and the islands in the south part of the bay. The staurolite-bearing unit strikes north and is exposed along the shoreline. This exposure does not allow an interpretation of variations in volume of the staurolites. Point counts for locations in both areas are given in Table GS-21-1. The Snow Creek staurolites are more abundant, easier of access and would be utilized first in the event that a market was found.

Staurolite occurs as a minor mineral in many of the alteration zones in the Snow Lake area; however, no volumetrically significant bodies of staurolite have been found at any of the locations examined.

SPECIMEN QUALITY GARNET

The garnet occurrence at File Lake is within the Corley Lake Member of the File Lake Formation. The area was mapped and the metamorphism described by Bailes (1978) and a brief survey conducted by Yamada (1984). The possible use of the good quality garnets as mineral specimens, or as abrasives, prompted a more detailed mapping of the area. The Corley Lake Member forms a thin peninsula on File Lake and it also forms a 5 km lichen and moss covered ridge which is nearly continuous from File Lake northwards to the south shore of Corley Lake. Three forms of garnet were noted in the examination of this unit. Dodecahedral crystals are the dominant garnet type present. Trapezohedral crystals occur in one small area south of the power line. Complex parallel growth crystals occur in stratabound lenses throughout the Corley Lake Member. The crystals range in size from almost 5 cm to less than 2 mm. Garnets within the felsic units or in proximity to a quartz lens were generally at least twice as large as the crytals in the surrounding undisturbed pelite. Towards the north end of the ridge the garnets become deformed and at 84-85-FiL-14-18, 1355 m north of the base line, they form euhedral tablets with a length:width:thickness ratio of 3:2:1.

The distorted crystals are oriented with the long axis at 324°, parallel to the strike, the middle axis at 84°E, parallel to the dip and the short axis oriented east-west. The euhedral nature of the garnets plus their orientation suggests that they are a late metamorphic mineral. They probably formed after the main stress in the area, otherwise the euhedral habit would have been destroyed.

The garnet content generally decreases northward, as shown by point counting, Table GS-21-1. The best garnet mineral specimens occur in an outcrop immediately south of the power line. Here the garnets form dodecahedrons, trapezohedrons and combinations of the two forms. The garnets are generally free from fractures and a large proportion of them break directly from the matrix with only minimal damage.

DOLOMITE AS A BUILDING STONE

Red and buff coloured dolomite from the Ponton-Snow Lake-Cormorant Lake area was used as an ornamental stone for a number of years. Several quarries for this stone were opened along the Hudson Bay Railroad in the 1920s. These quarries were closed in the 1930s, probably due to a lack of capital during the depression.

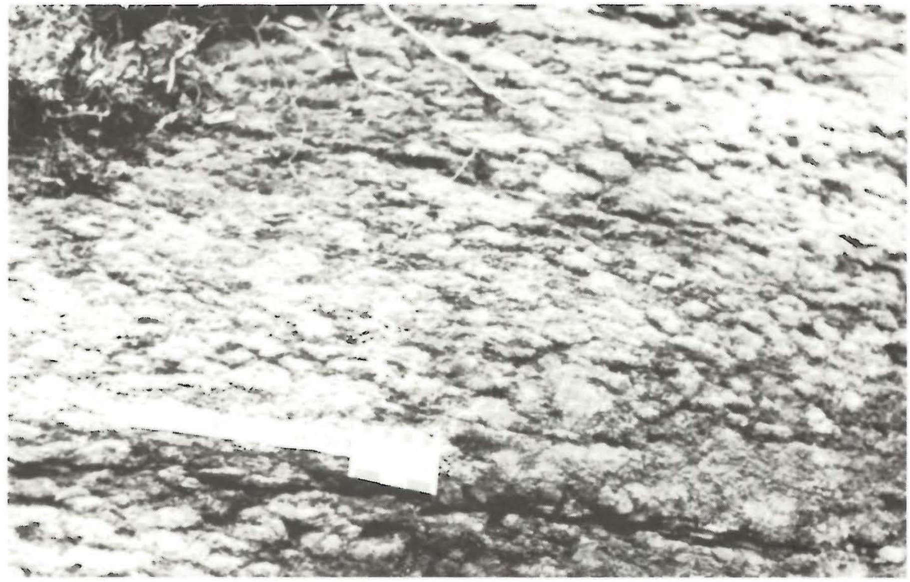
Six quarries were investigated along the Thompson-Snow Lake Road. Five quarries occur between Ponton and the Snow Lake junction; the sixth is located along the Snow Lake Road (Fig. GS-21-1).

TABLE GS-21-1
MINERAL ABUNDANCES FOR INDUSTRIAL MINERAL OCCURRENCES IN THE SNOW LAKE AREA

LOCATIONS	MINERAL	PERCENTAGE LOW	HIGH	AVERAGE*
Star Lake	garnet	2	54	18
Batty Lake	garnet	7	63	25
File Lake	garnet	1	12	5
Chisel Lake Sand Pit	garnet	1	13	8
	staurolite	4	13	7
Crowduck Bay	staurolite	8	23	14
Ram Zone	garnet	10	18	14
	staurolite	3	25	10
	kyanite	8	14	11
Snow Lake	staurolite	2	15	6
Snow Creek:				
West of Snow Lake Bridge	staurolite	7	24	19
1.1 km east of the Snow creek bridge	staurolite	1	47	11
2.5 km east of the Snow Creek bridge	staurolite	4	38	12

*Average represents the arithmetic mean

Figure GS-21-4: Garnet-rich garnet-anthophyllite-sillimanite unit at 84-85-StL-9 south of Star Lake.



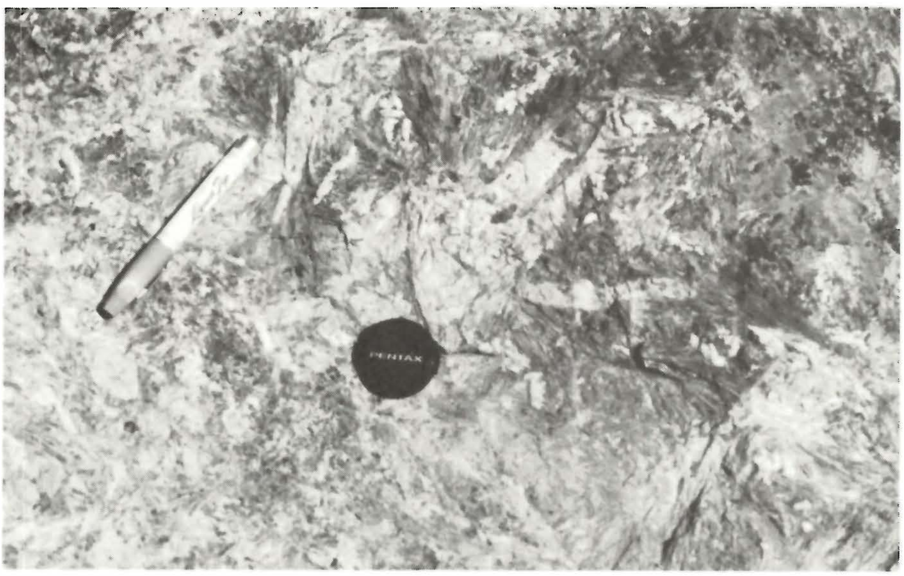


Figure GS-21-5: Massive anthophyllite unit at the structured top of the garnet-anthophyllite-sillimanite unit.

Figure GS-21-6: Garnet-rich unit below anthophyllite unit, Figure GS-21-5.

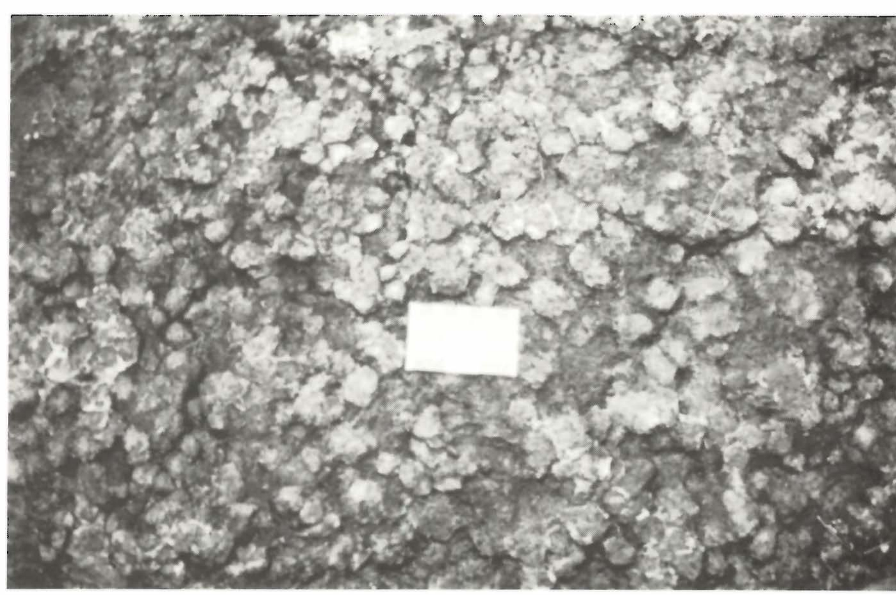


Figure GS-21-7: *Garnet-biotite zone between garnet-rich unit (GS-21-6) and sillimanite unit (GS-21-8).*

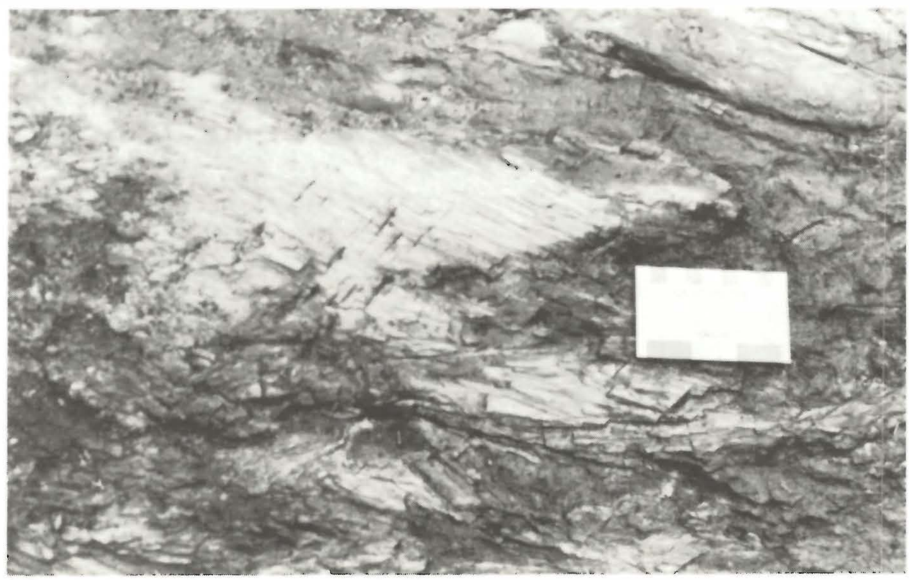


Figure GS-21-8: *Sillimanite unit at the structural base of the garnet-anthophyllite-sillimanite unit.*

Figure GS-21-9: *3 cm staurolite crystals 2.5 km east of Snow Creek bridge, south of Snow Lake.*

The quarry beside the railroad south of Ponton is in a buff coloured slightly porous, mottled dolomite that resembles Tyndall stone in texture. There was no indication of a red coloration in this quarry. The abundance of fossils is slightly below normal and their preservation is good to fair.

The Sunday Lake quarry is a very fine grained dolomite that is locally banded red and buff. A 3 m thick red dolomite layer occurs at the top of the quarry. The underlying buff to light red dolomite is vuggy to nodular and is not banded.

The four quarries west of the Sunday Lake quarry are all within the red fine grained dolomite. These western quarries, especially 84-85-Th-6-1, contain significant amounts of chert. The chert occurs as hard, chalky white porous nodules. The nodules make up 5% to 8% of the rock in 84-85-Th-6-1, but constitute only 2% to 3% in the other three quarries. The approximately 10 cm diameter chert nodules would be a detriment to the use of this rock as a building stone since the nodules would not take a polish and would probably pluck from the rock during the processing of the cut stone.

Beds are about 5 to 8 cm thick in all of the quarries and have slightly to strongly wavy partings. The very wavy bedding grades locally into a friable, nodular mass; however, this could easily be avoided during the quarrying process.

Large, 2 m x 2 m x 1 m, blocks of red, banded dolomite, without major fractures, have been left on the floor of several quarries. This indicates that large blocks can survive the intense blasting required to produce road stone.

The overburden on the limestone is shallow and seldom exceeds 1 metre in thickness. The quarries normally occupy the crest of a knoll or a small escarpment. Except for the Snow Lake quarry, there is an adequate supply of rock for any extensive quarrying operation. As the Snow Lake Road quarry is within a Paleozoic outlier surrounded by Precambrian rock and swamp, its reserves are limited.

A common problem with all of the quarries is a high water table and the low height of the bedrock ridges. The quarry faces are seldom more than 6 metres in height and most of the quarry floors have been excavated close to, or below, the water table; however, considerable reserves are present at each site lateral to the present workings. A drilling program of several ten to twenty metre deep holes around each of the quarries would serve to outline additional reserves. In addition, there are several locations near the quarries where limestone pavement is at surface, for example on the road to Wekusko Station.

CHROMIUM-BEARING METASEDIMENT AND AMAZONITE

A chromium-bearing calc-silicate rock occurs near Found Lake. Froese and Goetz (1981) refer to this as a meta- limestone. The outcrop is approximately 50 metres long and 1 to 3 metres high. The rock is layered in part and has an abundance of green, chromium-bearing minerals. There are no recognizable marker beds within the unit. The mineralogy and chemistry of the calc-silicate is unusual. The presence of chromium in this calc-silicate rock suggests that it could be of exhalative origin. Abundant disseminated sulphides throughout the body make this an unacceptable building stone, despite its attractive appearance. It is, however, a good location for collecting crystals of chromiferous grossularite-uvarovite.

The amazonite-bearing rock at Sherridon is a late pegmatite exposed for only 1 m x 3 m. It is a leucocratic, equigranular granitic pegmatite with a grain size averaging 3 cm and a composition of 20 to 25% amazonite, 30 to 40% white feldspar, 30 to 40% quartz and less than 5% mafic minerals. Its unstrained, granoblastic texture implies that it is a late stage intrusion. Since the body is emplaced within one metre of the upper contact of the Sherridon sulphide lens, the green colour of the amazonite is probably caused by lead derived from the massive sulphide deposit.

This body could produce a good building stone since there are few joints, it has no obvious shears, it lacks mafic minerals, and has a pleasing green and white mottled colour. However, the small size of the exposed body indicates that there is insufficient volume of the material present to warrant further investigation.

REFERENCES

Bailes, A.H.

1971: Preliminary compilation of the geology of the Snow Lake-Flin Flon-Sherridon area; Manitoba Mines Branch Gological Paper 1/71.

1980: Geology of the File Lake area; Manitoba Mineral Resources Division, Geological Report 78-1.

Bailes, A.H. and McRitchie, W.D.

1978: The transition from low to high grade metamorphism in the Kisseynew sedimentary gneiss belt, Manitoba; **in** Metamorphism in the Canadian Shield, (ed.) T.A. Fraser and W.W. Heywood; Geological Survey of Canada, Paper 78-10.

Frarey, M.J.

1950: Crowduck Bay; Geological Survey of Canada, Map 987A.

Froese, E. and Goetz, P.A.

1981: Geology of the Sherridon Group in the vicinity of Sherridon, Manitoba; Geological Survey of Canada Paper 80-21.

Froese, E. and Moore, J.M.

1980: Metamorphism in the Snow Lake area, Manitoba; Geological Survey of Canada, Paper 78-27.

Gale, G.H., Sommerville, R.C., Chornoby, J., Haystead, B., Provin, N., Braun, D., Mundy, D. and Walker, A.

1982: Geological Setting of the mineral deposits at Ruttan, Thompson, Snow Lake and Flin Flon; GAC-MAC Joint Annual Meeting Winnipeg, Manitoba, Field Trip 14.

Goetz, P.A.

1980: Depositional environment of the Sherridon group and related mineral deposits near Sherridon, Manitoba; Ph.D. thesis, Carleton University, Ottawa.

Gordon, T.M.

1981: Metamorphism in the Crowduck Bay area, Manitoba; **in** Current Research, Part A; Geological Survey of Canada, Paper 81-1A, p. 315-316.

Gordon, T.M. and Gall, Q.

1982: Metamorphism in the Crowduck Bay area, Manitoba; **in** Current Research, Part A; Geological Survey of Canada, Paper 82-1A, p. 197-201.

Harrison, J.M.

1949: Geology and Mineral Deposits of the File-Tramping Lakes area, Manitoba; Geological Survey of Canada, Memoir 250.

Phillips, K.A.

1978: Minerals of Manitoba Vol. 1, Non-metallic and pegmatitic; Manitoba Mineral Resources Division, Educational Series 78-1.

Robertson, D.S.

1953: Batty Lake map area, Manitoba; Geological Survey of Canada, Memoir 271.

Sabina, A.P.
1972: Rocks and minerals for the collector, LaRonge Creighton Saskatchewan, Flin Flon, Thompson, Manitoba; Geological Survey of Canada, Paper 71-27.

Syme, E.C., Bailes, A.H., Price, D.P. and Ziehlke, D.V.
1982: Flin Flon volcanic belt: geology and ore deposits at Flin Flon and Snow Lake, Manitoba; GAC-MAC Joint Annual Meeting, Winnipeg, Manitoba, Field Trip 6.

Williams, H.
1966: Geology and Mineral deposits of the Chisel Lake map area, Manitoba; Geological Survey of Canada Memoir 342.

GS-22 PROJECT CORMORANT — SUB-PALEOZOIC INVESTIGATIONS SOUTH OF FLIN FLON AND SNOW LAKE

by W. D. McRitchie and I. Hosain

In 1985 the Geological Survey of Canada extended previous Project Cormorant airborne vertical gradient (gradiometer), total field magnetometer and VLF surveys, as part of cooperative MDA programming with the Province, to provide additional coverage in the Moose Lake, Namew Lake and Nokomis Lake areas, as well as linking up with contiguous surveys being flown this year in Saskatchewan between latitudes 54° and 55° (Fig. GS-22-1).

The results of these surveys will be published as 1:20 000 scale contoured maps and 1:50 000 scale colour composites in 1986. Previous maps in the series constitute GSC Open Files 756, 876, 877 and 937, and colour maps C20340G to C20352G (total field) and C40081G to C40093G (vertical gradient).

The Province drilled sixteen (16) holes in the area south of Lake Athapapuskow and Cranberry Lakes, bringing the total number of holes completed in this region, since 1982, to 41. The drilling program was carried out to determine the cause of the various gradiometer signatures. Ground magnetic traverses were run prior to drilling to pinpoint the drill locations. Drill hole summaries for Precambrian intersections are provided in Table GS-22-1, and more extended logs of Paleozoic intervals in Report GS-43 this volume by H.R. McCabe.

Ultrabasic and metagabbroic lithologies, with associated mineralization, encountered in holes M-5-85 and M-22-85, are of particular interest as they confirm the potentially widespread distribution of mafic intrusions below the Paleozoic carbonates (see also McRitchie and Hosain, 1983, 1984).

Preliminary comparisons of the magnetic data and bedrock information have been completed by Hosain (1984) and more recently by Millar and Hall (1985) as part of an applied geoscience research agreement between Manitoba Energy and Mines and the Department of Earth Sciences, University of Manitoba. The trace of the various gradiometer signatures, from the exposed part of the Flin Flon-Snow Lake belt southwards along strike, combined with the drill hole data, confirmed the continuation of the volcanic rocks below the Paleozoic sediments. The susceptibility measurements carried out by the University proved that the gradiometer data accurately reflect the susceptibility of the rock outcrops.

A more extensive analysis of all available geophysical and geological data has been contracted out by the Geological Survey of Canada, with the aim of generating synoptic geological compilation maps of the basement lithologies in parts of NTS areas 63J and 63K.

TABLE GS-22-1

PROJECT CORMORANT DRILLING PROGRAM 1985 PRECAMBRIAN DRILL HOLE INTERSECTIONS - SUMMARY DESCRIPTIONS

M-4-85 (Location 11)*	Precambrian 18.40 to 24.45 m. Weathered bleached kaolinized saprolite from 18.40-20.40 m. Homogeneous equigranular medium- to coarse-grained, weakly foliated gneissic granite. Biotite, sericite and epidote-bearing with accessory sphene and zircon. Clear feldspars up to 1 cm, local myrmekite. Weakly magnetic throughout.
M-5-85 (Location 8)	Precambrian 47.80-84.40 m. Weathered zone 47.80-49.0 m, minor carbonate veining. Coarse grain ed hornblende-rich ultra-basic with local finer grained mafic and gabbroic phases. Euhedral clinopyroxene concentrated in some layers. Mineralized sections from 61.26-61.92 m and 63.34-64.0 m contain pyrrhotite, pyrite, and magnetite associated with 2-3 hornblende megacrysts. Feldspar content increases near base of hole. Sporadic pink and white pegmatite veins contain coarse grained (1—5 cm) biotite.
M-6-85 (Location 16)	Precambrian 63.1-72.25 m. Highly weathered and bleached from 63.1-66.18 m. Biotite/tonalite/quartz diorite with accessory apatite, and opaques, trace zircon and secondary carbonate. Grey homogeneous equigranular, medium- to coarse-grained with sporadic bleached intervals adjacent to retrograde zones. Local pegmatitic patches massive and unfoliated.
M-7-85 (Location 2)	Precambrian 55.14-72.25 m. White kaolinized granite 55.14-55.50 m. Intensely weathered zone 55.50-56.11 m. Pink homogeneous equigranular, medium grained granite, and pink and white veins of pegmatite in dominant mesocratic hornblende and biotite-bearing gneisses with epidote, apatite and sphene. Core ranges from non- to moderately magnetic. Dip 80-90°.
M-8-85 (Location 28)	Precambrian 20.74-44.75 m. Weathered zone 20.74-27.18 m. Fine- to medium-grained homogeneous thinly layered, hornblende and hornblende-biotite schists/metasediments with sporadic carbonate veining throughout. Dip 65-70°.
M-12-85 (Location 9)	Precambrian 26.50-44.50 m. Weathered zone to 30.05 m. Medium- to coarse-grained heterogeneous foliated and layered gneissic complex with grey-white quartz-rich zones with sporadic biotite spots, and grey granite layers in medium grained mesocratic hornblende and biotite-rich epidote-bearing amphibolites. Sporadic pink pegmatite intersections and 'pinked' feldspars in thin veinlets. Non-magnetic throughout; dip about 75°.
M-13-85 (Location 3)	Hole abandoned after encountering 17.7 m bouldery overburden.

*Location numbers refer to sequence used in program planning and are for internal reference only.

TABLE GS-22-1

PROJECT CORMORANT DRILLING PROGRAM 1985
PRECAMBRIAN DRILL HOLE INTERSECTIONS
- SUMMARY DESCRIPTIONS (Cont'd)

Hole M-16-85 (Location 3)	Hole abandoned after encountering 29.65 m bouldery till.
M-14-85 (Location 14)	Precambrian 57.00-75.30 m. Strongly weathered to 69.70 m. Grey heterogeneous medium grained generally equigranular granodiorite with coarser grained biotitic and hornblendic segregations, and medium grained hornblende-rich mesocratic layers, cut by 1 m pink homogeneous equigranular medium grained granite and coarser grained pegmatite dykes (40 cm). Non-magnetic throughout.
M-15-85 (Location 19)	Precambrian 30.0-53.41 m. Interlayered complex of biotite-bearing mesocratic gneisses and granitoid layers with sporadic pink and white granitic and pegmatitic **lits**. Some layers of garnet amphibolite. Sporadic segregations of pyrite throughout in seams parallel to layering. Core is moderately magnetic throughout. Dip about 60°.
M-17-85 (Location 23)	Precambrian from 60.43-87.50 m. Weathered to 63.18 m. Coarse grained pink and locally grey, locally porphyritic heterogeneous moderately foliated inequigranular granite with significant biotite. Feldspars brick-red in coarse grained pegmatite veins prominent at 71.35, 83.6 and 85.5 m. Mesocratic zone of inclusions at 83.6-84.0 m. Generally non-magnetic.
M-18-85 (Location 12)	Precambrian from 27.34-43.20 m. Weathered to 29.63 m. Interlayered complex of medium- to coarse-grained hornblende-bearing mesocratic gneisses with locally dominant sills (1-20 cm) of white and pink granite, and pink seriate granite and pegmatite. Non-magnetic.
M-20-85 (Location 15)	Precambrian 63.70-82.30 m. Weathered to 69.58 m. Alternating layers of coarse grained hornblende-bearing granite and medium grained homogeneous mesocratic equigranular hornblende gneiss. 1-10 cm grey-white feldspathic veinlets throughout.
M-21-85 (Location 18)	Precambrian 35.9-38.70 m. Weathered, foliated, heterogeneous, green, chlorite and hornblende-bearing mesocratic gneisses with thin white granitic stringers and feldspathic segregations.
M-22-85 (Location 5)	Precambrian 23.71-56.85 m. Gabbroic unit with abundant heterolithic inclusions of finer grained highly magnetic, orthopyroxene-bearing metasedimentary, texturally variable, supracrustal units ranging from 1-40 cm. Noticeable hornblende blastesis and prograde hornfelsic recrystallization adjacent to gabbro dykelets. Sporadic coarse grained interstitial veinlets of pyrite, chalcopyrite and magnetite. Local pink pegmatite veins up to 50 cm thick.
M-23-85 (Location 6)	Precambrian 33.03-50.95 m. Thinly layered and foliated mesocratic heterogeneous medium- to coarse-grained biotite and hornblende-bearing granitoid-dioritic gneisses with abundant thin stringers, lenses and veinlets of pink and white granitic and pegmatitic segregations. Sporadic 10-20 cm intersections of mafic medium- to fine-grained hornblende and epidote-bearing gneiss. Pegmatites occur as 1-5 cm segregations and cross-cutting veinlets. Younger pink homogeneous equigranular medium- to fine-grained granite dyke has 1 cm thick pegmatite margins. Sporadic and minor widely disseminated pyrite.

REFERENCES

Hosain, I.T.

1984: Interpretation of airborne magnetic gradiometer surveys of the area south of the Flin Flon-Snow Lake belt (parts of NTS 63K and 63J); Manitoba Mineral Resources Division, Open File Report OF84-2.

McRitchie, W.D. and Hosain, I.T.

1983: Geophysical and geochemical surveys; **in:** Manitoba Mineral Resources Division, Report of Field Activities 1983, p. 144-147.

1984: Project Cormorant - subPaleozoic investigations south of Flin Flon and Snow Lake; **in:** Manitoba Mineral Resources Division, Report of Field Activities 1984, p. 82-84.

Millar, T.W. and Hall, D.H.

1984: Surface sampling of magnetic properties of rocks (Flin Flon-Snow Lake area); Unpublished report on file with Geological Services Branch, Manitoba Energy and Mines.

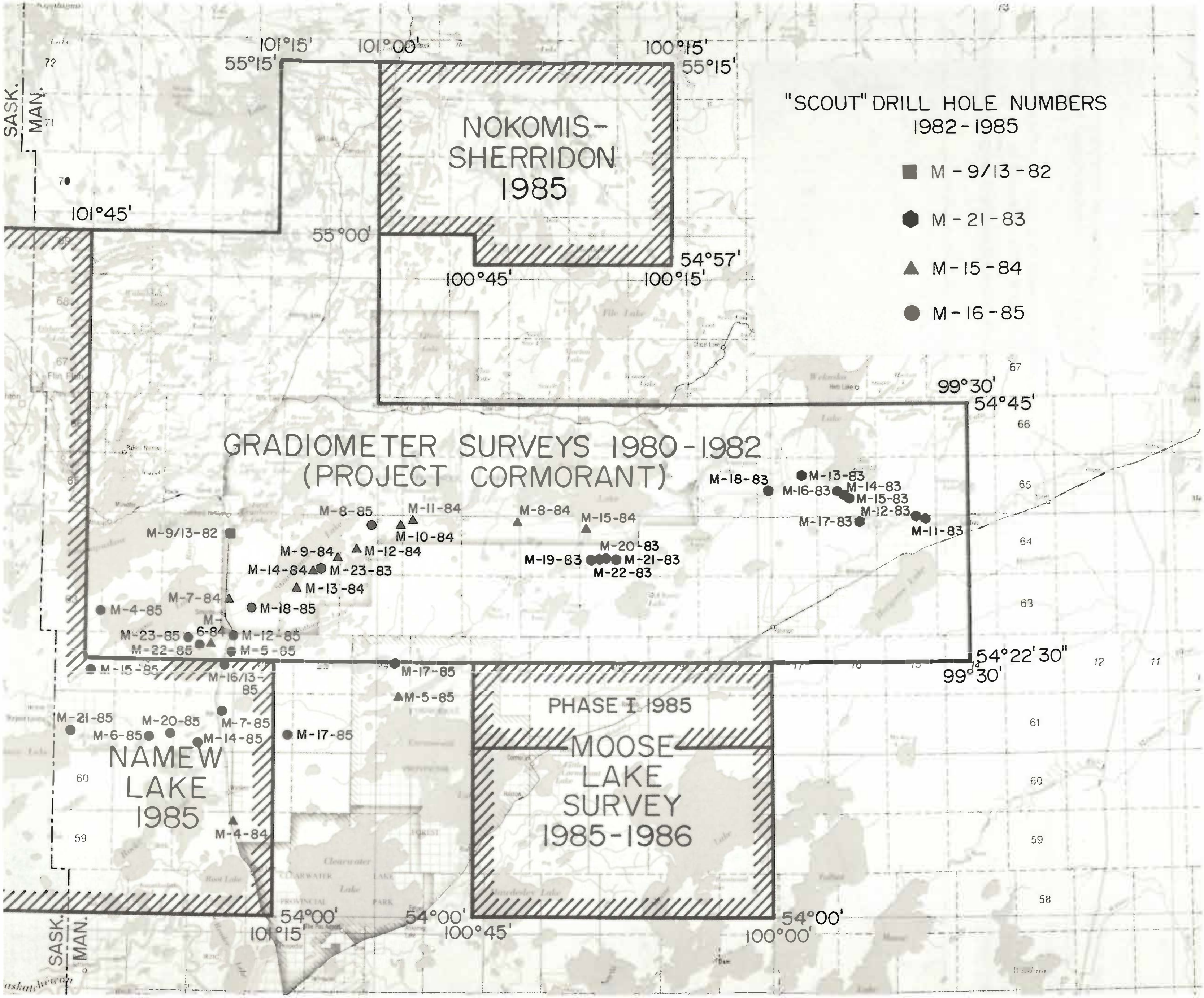


Figure GS-22-1: *GSC gradiometer surveys in the Project Cormorant area, and locations of "scout" drilling 1985 (see also Report GS-43 this volume, by H.R. McCabe).*

GS-23 GEOLOGICAL INVESTIGATIONS IN THE STORMY LAKE AREA

by D.M. Seneshen and D.J. Owens

INTRODUCTION

Geological mapping was conducted in the southeastern portion of the Rice Lake greenstone belt at a scale of 1:10 000. The map area is outlined in Figure GS-23-1. Previous comprehensive mapping was done by Stockwell (1945) and, as part of Project Pioneer, by Weber (1971) and Zwanzig (1969, 1971).

Excellent exposure created by a forest fire in the summer of 1983 warranted remapping of the Stormy Lake area to:

- obtain more detailed information on stratigraphy and structure

[1]Department of Earth Sciences, University of Manitoba
[2]Lithostratigraphic terminology after Weber (1971)

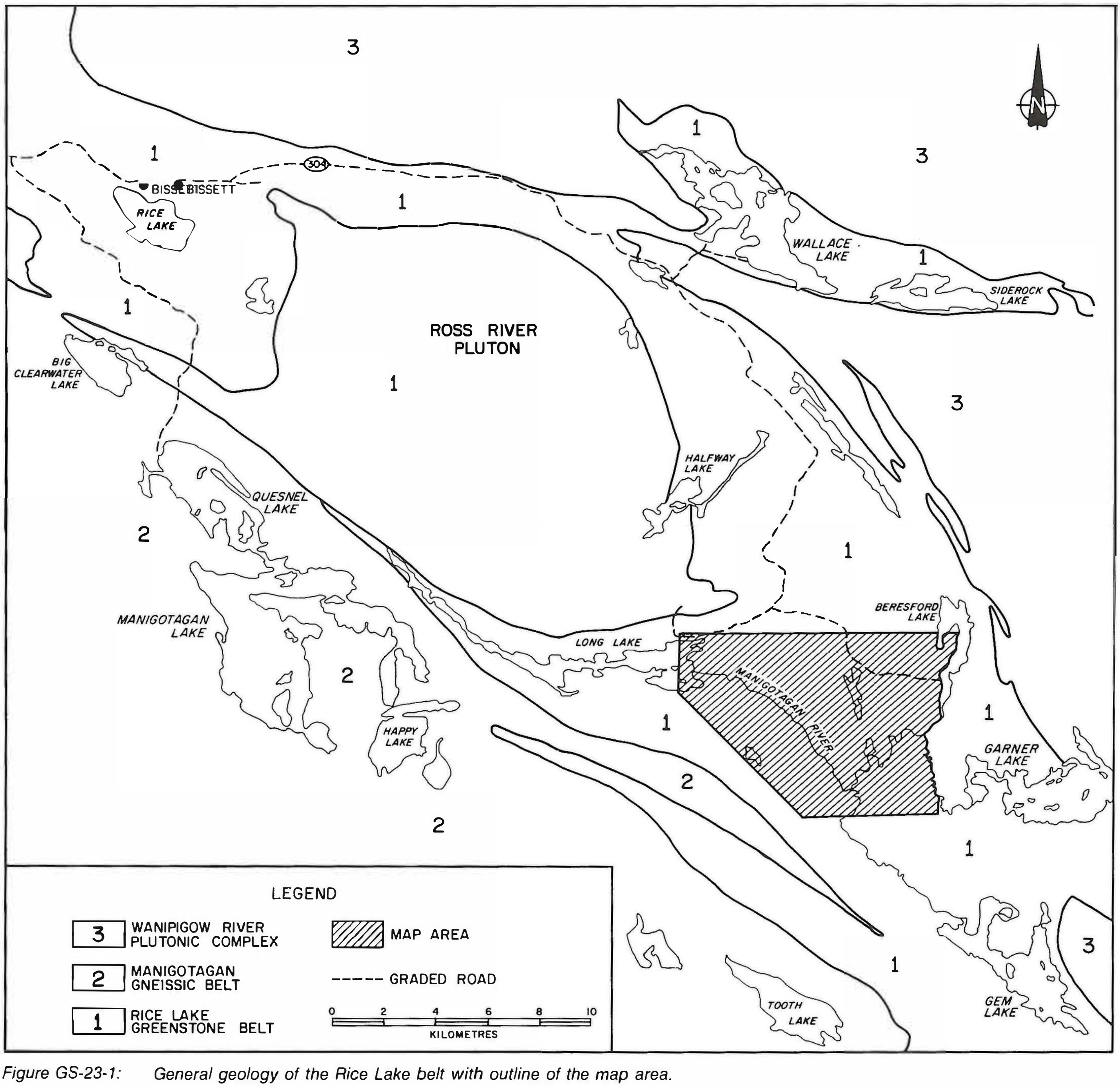


Figure GS-23-1: General geology of the Rice Lake belt with outline of the map area.

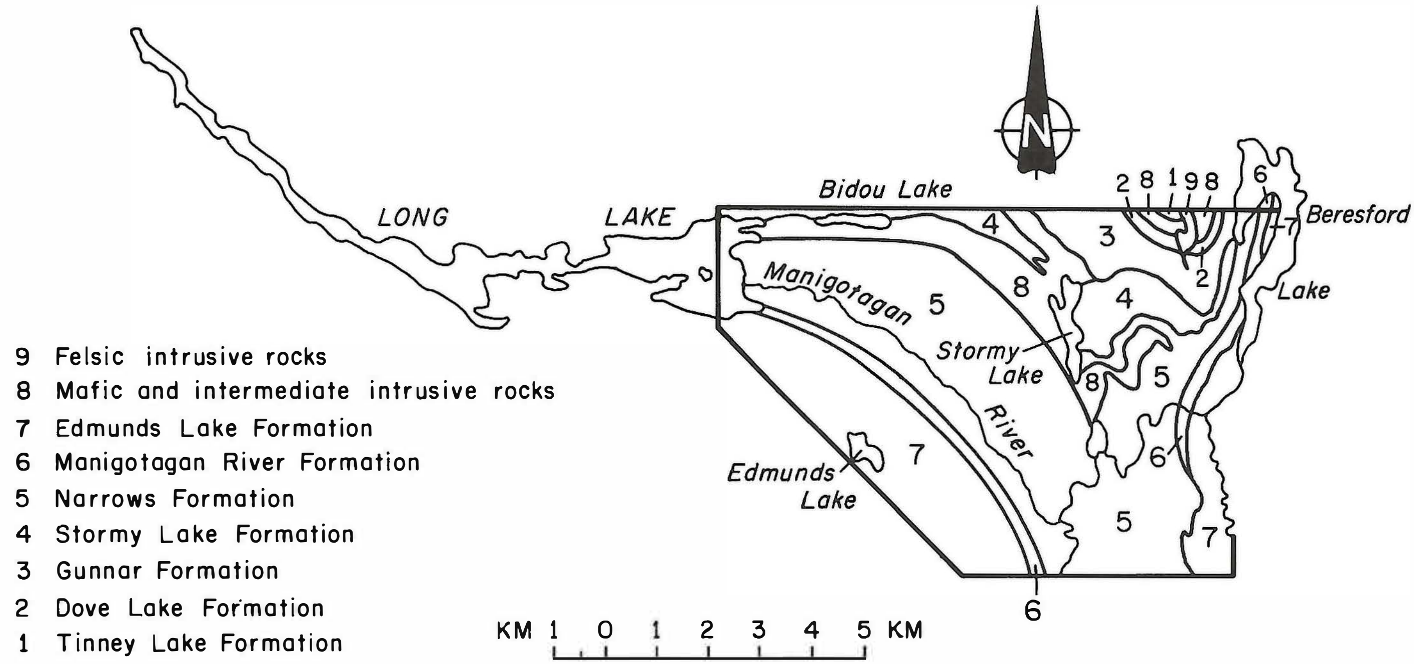


Figure GS-23-2: *General geology of the Stormy Lake area.*

- examine certain stratigraphic units such as volcanogenic sediments and iron formation to assess their potential for gold mineralization.

SUMMARY OF RESULTS

Mapping in the Stormy Lake area (GS-23-2) yielded the following results:

(1) The Stormy Lake Formation contains considerably more gabbroic intrusions than previously mapped.
(2) The structural and stratigraphic complexities of the Narrows Formation were documented.
(3) A new formation, the Manigotagan River Formation, was defined and its stratigraphy was established.
(4) The symmetry of the large-scale southeasterly plunging anticlinorium was better defined by tracing the marker Manigotagan River Formation on the northeast limb of the fold.
(5) Shear zones in gabbro are commonly carbonatized and silicified and appear to be favourable for gold mineralization.

GENERAL GEOLOGY

Volcanic and sedimentary rocks of the Rice Lake Group consist of the older Bidou Lake Subgroup and the younger Gem Lake Subgroup (Fig. GS-23-1). Both subgroups are overlain by argillaceous sediments of the Edmunds Lake Formation. The Bidou Lake subgroup has been further subdivided into a number of units.

TINNEY LAKE FORMATION (1)[3]

This, the oldest formation of the map area, was observed in only one outcrop located in the northeast corner. It comprises mainly dark green, massive and pillowed basalt with minor brecciated basalt flows (see Campbell, 1971, for a more complete description of this formation).

DOVE LAKE FORMATION (2)

This formation comprises mainly brownish interbedded siltstone, greyish cherts and coarse greywackes. Also present are heterolithic tuff breccias. The tuff breccias contain 2 to 10 cm size intermediate feldsparphyric and fine grained mafic clasts. The greyish intermediate matrix contains approximately 30 per cent 1 to 2 mm long feldspar crystals. Bedding thicknesses within this formation range from 10 to 20 cm.

GUNNAR FORMATION (3)

This formation consists mainly of massive and pillowed basalt flows with minor brecciated basaltic flows. These flows are vesicular in places. Locally vesicles are filled with quartz. Rarely, thin (10 cm) beds of greyish white feldspathic siltstone and reddish brown ferruginous shale are intercalated with the basalt.

STORMY LAKE FORMATION (4)

The Stormy Lake Formation has been divided into four subunits as illustrated on Preliminary Map 1985 R-1. Two new units were added to the formation, namely tuff breccia and volcanic conglomerate. The tuff breccias are similar to those of the Narrows Formation. However, as part of the Stormy Lake Formation, the tuff breccia is intercalated with reddish brown fine grained pillowed and massive basalt. The volcanic conglomerate is polymictic with ovoid, greyish white pitted felsic volcanics as dominant clasts, ranging in size from 2 to 30 cm. Subordinate clast types include dark greenish grey, irregularly shaped, intermediate to mafic volcanics which range from 1 to 30 cm in size. The matrix of the conglomerate is a tuffaceous sandstone.

Field observations indicate that the Stormy Lake Formation is "brecciated" on a large scale by numerous gabbroic intrusions. Therefore, it is difficult to define the exact upper and lower boundaries of the formation, and the stratigraphic relationships with the underlying Gunnar basalts and the overlying Narrows Formation pyroclastics remain as yet unresolved.

[3]Unit numbers refer to Preliminary Map 1985 R-1

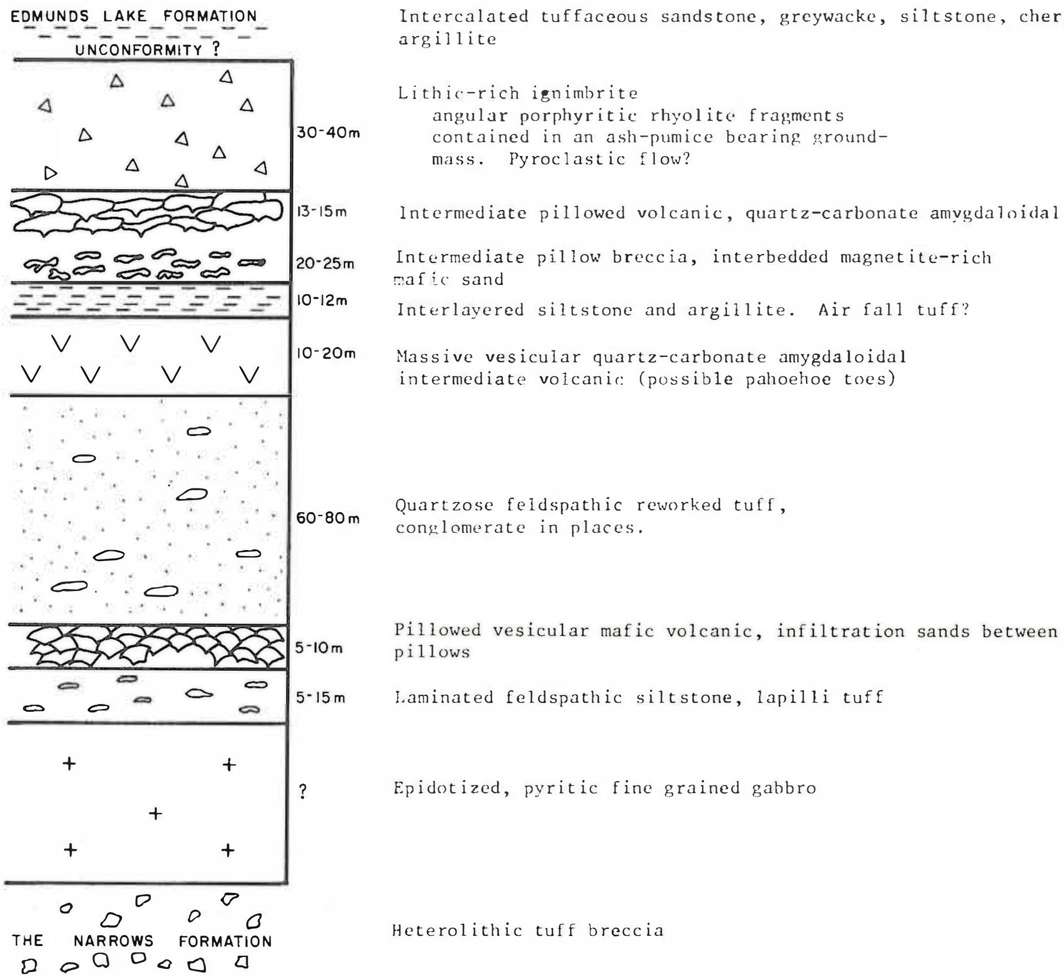


Figure GS-23-3: Cross-section of the Manigotagan River Formation (southeast facies).

THE NARROWS FORMATION (5)

The Narrows Formation has been subdivided into three separate units. The basis for this subdivision is the size and abundance of lithic fragments within the various units.

Unit 5a is a lapilli tuff, which is mainly crystal tuff with accessory lithic fragments. The crystal tuff is composed primarily of subhedral and euhedral plagioclase phenocrysts embedded within an aphanitic feldspar-chlorite-sericite matrix. In thin section the plagioclase shows partial replacement by sericite and carbonate. Plagioclase crystals range in abundance from 10-60% and in size from 1 to 5 mm. Smoky grey quartz phenocrysts are commonly subround, range in size from 1 to 3 mm and in abundance from 1 to 15%. Lithic fragments are sporadically distributed throughout the crystal tuff. Most common fragments are ovoid, olive-green, epidotized felsic volcanics 1 to 4 cm in size. Dark grey vesicular scoria fragments, 1 to 3 cm across, are observed in places in the crystal tuff.

Units 5b and 5c include both heterolithic volcanic tuff breccia and breccia, respectively. The dominant fragment type contained in these breccias is buff coloured, medium grained plagioclase-quartz-phyric dacite. Crystal content within these fragments ranges from 5-35%. In outcrop these fragments have a similar appearance to the crystal tuff matrix. The fragments are commonly lensoid and flattened in the foliation plane. Most extreme flattening is observed on the eastern shore of Long Lake. The fragments range in size from 0.5 to 200 cm. Subsidiary fragment types within the breccias include cream coloured aphanitic aphyric and quartz-phyric rhyodacites and dark greenish grey quartz plagioclase-phyric intermediate volcanics.

MANIGOTAGAN RIVER FORMATION (6)

The Manigotagan River Formation is newly introduced here for the "transition zone" between the Narrows Formation and the Edmunds Lake Formation. The northwestern facies of the formation (near the eastern end of Long Lake) consists mainly of graded tuffaceous sandstones with interbeds of dark green chloritic sandstone and mudstone. The southeastern facies of the formation comprises mafic and intermediate volcanics intercalated with feldspathic sediments (Fig. GS-23-3).

The base of the formation (Unit 6d) consists of laminated feldspathic siltstone interbedded with lapilli tuff. Brownish grey, fine grained, vesicular pillowed mafic volcanics (Unit 6c) overlie Unit 5d (Fig. GS-23-4). The base of this mafic flow is marked by a dense vesicular zone (Fig. GS-23-5). Near the top of the flow fine grained brown massive and crossbedded sands are contained within fractures and interpillow areas (Sig. GS-23-6). The nature of these sands suggests a beach depositional environment and hence, a paleo-strandline between subaqueous and subaerial deposition. Microscopically, the mafic volcanics are primarily composed of microcrystalline chlorite and feldspar with accessory epidote, biotite and pyrite. The volcanics contains 10% carbonate-quartz amygdules which range in size from 0.1 to 0.5 mm.

Figure GS-23-4: *MANIGOTAGAN RIVER FORMATION (6): Well preserved vesicular, pillowed, mafic volcanic flow with tops towards southwest.*

Figure GS-23-5: *MANIGOTAGAN RIVER FORMATION (6): Dense, vesicular base of mafic volcanic flow.*

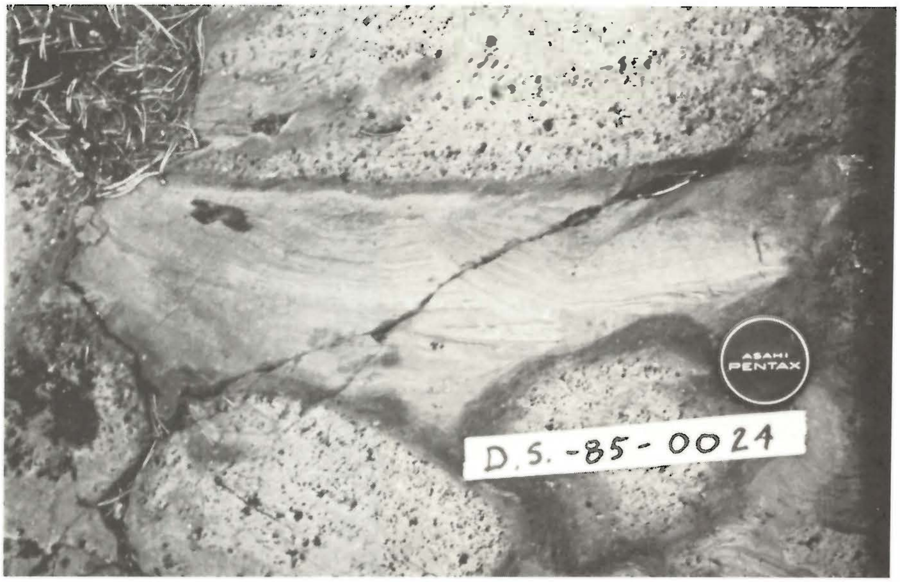


Figure GS-23-6: *MANIGOTAGAN RIVER FORMATION (6): Crossbedded infiltrated sand into interpillow cavity.*

Figure GS-23-7: *MANIGOTAGAN RIVER FORMATION (6): Well graded intercalated reworked tuff and mudstone showing tops towards the southwest.*

Unit 6c is overlain by well layered, conglomeratic, quartzose, feldspathic reworked tuff. The layered appearance is due to variable proportions of chlorite within beds. Thin (2-3 cm) beds of mudstone are in places intercalated with the reworked tuff. Plagioclase-phyric felsic volcanic clasts are sporadically distributed within the reworked tuff. Numerous top indicators are observable within this unit. Excellent normal grading is exposed 1 km south of the Manigotagan bridge (Fig. GS-23-7). Alternative top indicators include load structures and dropstones (Fig. GS-23-8). These sedimentary structures ubiquitously indicate tops towards the southwest. Microscopically, the reworked tuff is composed mainly of sericitized subrounded plagioclase with minor chlorite, quartz and lithic fragments. Unit 6b is overlain by light grey, fine grained, vesicular, massive intermediate volcanics. Further up in the section the intermediate volcanics are pillowed and brecciated. Microscopically, the intermediate volcanics consist of a fine grained groundmass of mostly chlorite and feldspar. Secondary carbonate patches are scattered throughout the groundmass. Quartz-carbonate amygdules are subrounded and consist of a microcrystalline quartz mosaic core surrounded by a rim of carbonate. Interbeds of dark grey magnetite-bearing mafic sands and light grey siltstone occur within the intermediate volcanics. Unit 6a is capped by a lithic igimbrite, composed of dark grey porphyritic, angular rhyolite fragments embedded in an ash-pumice matrix. Pumice fragments are 2-3 mm in size and are only recognizable in thin section. This unit is overlain by argillaceous sediments of the Edmunds Lake Formation.

EDMUNDS LAKE FORMATION (7)

The Edmunds Lake Formation has been divided into three subunits. Polymictic conglomerate (7a) occurs as thin lensoid bodies to the northeast of Edmunds Lake. Clast types include white granular felsic volcanics, greenish grey intermediate volcanics, black argillite,

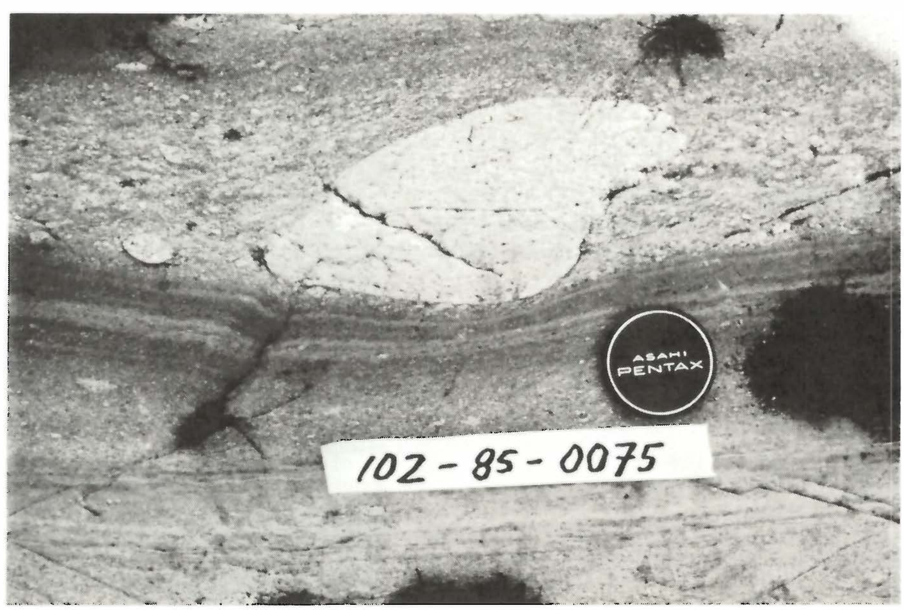


Figure GS-23-8: ***MANIGOTAGAN RIVER FORMATION (6): Felsic volcanic dropstone in conglomeratic, reworked tuff.***

dark grey rhyolite and milky white quartz. All clasts are well rounded and range in size from 1 to 20 cm. The matrix consists of a brownish grey quartzose feldspathic sandstone.

The most common unit within the formation (7b) comprises massive tuffaceous sandstone and feldspathic greywacke with minor interbeds of mudstone and oxide facies iron formation. Soft sediment slump features are observed in this unit.

The basal part of the Edmunds Lake Formation (7c) is characterized by chert and argillite interbeds contained within tuffaceous sandstone. The chert and argillite beds are 2 to 10 cm thick and show a prominent fracture cleavage.

Top indicators within the formation include graded beds, mud rip-ups and scours, and show a consistent top towards the southwest.

MAFIC TO INTERMEDIATE INTRUSIVE ROCKS (8)

The mafic to intermediate intrusive rocks are interpreted to be the second youngest rocks in the map area as they have intruded all other map units except for the felsic intrusions. Actual age relationships between the various phases is not completely resolved yet, but field geological criteria lead to the following interpretations:

1) Coarse grained to fine grained gabbro. This phase is commonly massive to well layered. It contains approximately 35 to 40% amphibole, 60-65% plagioclase plus minor sulphides. Minor magnetite-rich phases are present. Textures include ophitic, oikocrystic, porphyritic (both amphibole and plagioclase-phyric) phases and equigranular (mainly medium- to fine-grained) phases.

2) Anorthositic gabbro (coarse- to medium-grained). This phase is seen to intrude the above coarse- to fine-grained gabbro in the form of small dykes. It is generally massive but it is well layered in places. It is most abundant approximately 200 metres southeast of Stormy Lake where 100 metre thick intrusions are present.

   This phase commonly contains 20 to 25% amphibole, 75 to 80% plagioclase, plus minor pyrite. The plagioclase occurs as 1-5 cm aggregates (Fig. GS-23-9). Near contacts with country rocks, up to 90% of the plagioclase occurs in the form of blocks or balls commonly 2 to 10 cm in size ("marshmallow" texture).

   Anorthositic gabbro also contains pegmatoid phases forming 5 to 30 cm lenses or pods concordant with layering in the gabbro. They commonly contain 80 to 85% 0.1 to 1.0 cm plagioclase crystals and 15 to 20% 1 to 2.0 cm reddish green amphibole.

3) A slightly less mafic, medium- to coarse-grained anorthositic gabbro extends from the west shore of Stormy Lake to the east shore of Long Lake. It contains approximately 15 to 20% amphibole and 80 to 85% plagioclase. It is generally massive, with no modal layering, and equigranular; it is amphibole-phyric in some areas.

4) Greyish, intermediate, porphyritic dykes (0.5-4 m) are concordant and discordant to layering in the rocks which they intrude. They contain either plagioclase or amphibole phenocrysts.

5) Fine grained diabase dykes range in thickness from 0.5 to 4.0 metres and occur either concordant or discordant to bedding in sedimentary rocks. They commonly contain 35 to 40% amphibole, 60 to 65% plagioclase, and 1 to 2% pyrite.

The gabbroic rocks mentioned occur mainly in the form of sills which have intruded the Tinney, Dove Lake, Gunnar, Stormy Lake, Narrows, and Manigotagan River Formations. The smaller concordant and discordant mafic to intermediate dykes have intruded the Stormy Lake, Narrows, Manigotagan River, and Edmunds Lake Formations. They have also intruded gabbroic sills that have previously intruded the Narrows Formation. All of the mafic to intermediate intrusions show the same foliation as observed in the sedimentary rocks. Field mapping indicates that the larger bodies have been folded in a similar fashion to the older sedimentary and volcanic rocks within the map area. Therefore, they can be considered pre-tectonic intrusions.

FELSIC INTRUSIVE ROCKS (9)

The felsic intrusive rocks have been interpreted as the youngest rocks in the map area. Two distinct phases have been observed. These include a coarse grained quartz-feldspar porphyry and a fine grained aplitic phase.

Figure GS-23-9: *MAFIC INTRUSIVES (8): Plagioclase glomeroporphyritic gabbro in contact with felsic lapilli tuff.*

Figure GS-23-10: FELSIC INTRUSIVE ROCKS (9): Aplite dykes intruding mafic volcanics of the Gunnar Formation.

The fine grained aplitic phase intrudes Gunnar Formation mafic volcanics and quartz-feldspar porphyry 450 metres north of the abandoned Gunnar Mine (Fig. GS-23-10).

The quartz-feldspar porphyry commonly occurs as dykes 4 to 5 metres thick, within the Stormy Lake and most frequently in the Gunnar Formation. The age relationship of the quartz-feldspar porphyry and mafic gabbro is exposed in an outcrop approximately 100 metres south of the abandoned Gunnar Mine, where quartz-feldspar porphyry dykes cross-cut both gabbro sills and bedding within tuffaceous sandstone.

STRUCTURAL GEOLOGY

Throughout the map area a main penetrative foliation is observed. This schistosity is approximately parallel to the curvilinear axial trace of a large-scale southeasterly plunging anticlinorium. A secondary penetrative foliation transects the above mentioned foliation. The intersection of these two foliations produces minor asymmetric kink folds with axis azimuths in the range of 045° to 060°. These kink folds are especially apparent in chloritic ductile shear zones. Well developed shear folds occur within the Narrows Formation tuff breccia 650 metres west of southern Beresford Lake (Fig. GS-23-11).

The most recent deformation in the map area is represented by large-scale shear zones subparallel to the curvilinear axial trace of the anticlinorium. Lateral displacements of up to 5-10 m have been observed along some of these shear zones, especially in a zone immediately to the south of Stormy Lake.

In the Narrows Formation the shear zones are commonly chloritized and silicified and contain minor sulphide concentrations. Shear zones along lapilli tuff/gabbro contacts and those within the gabbros are commonly silicified and carbonatized, host more sulphides and appear to be more favourable for gold mineralization than shear zones within the Narrows Formation. A more detailed synopsis of the structural geology is contained in Zwanzig (1969).

REFERENCES

Campbell, F.H.A.

1971a: Stratigraphy and sedimentation of part of the Rice Lake Group in Manitoba; Ph.D thesis, University of Manitoba

1971b: Stratigraphy and sedimentation of part of the Rice Lake Group, Manitoba; in Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer); ed. W.D. McRitchie and W. Weber; Manitoba Mines Branch, Publication 71-1, p. 135-188

Stockwell, C.H.

1945: Beresford Lake area; Geological Survey of Canada, Map 809A

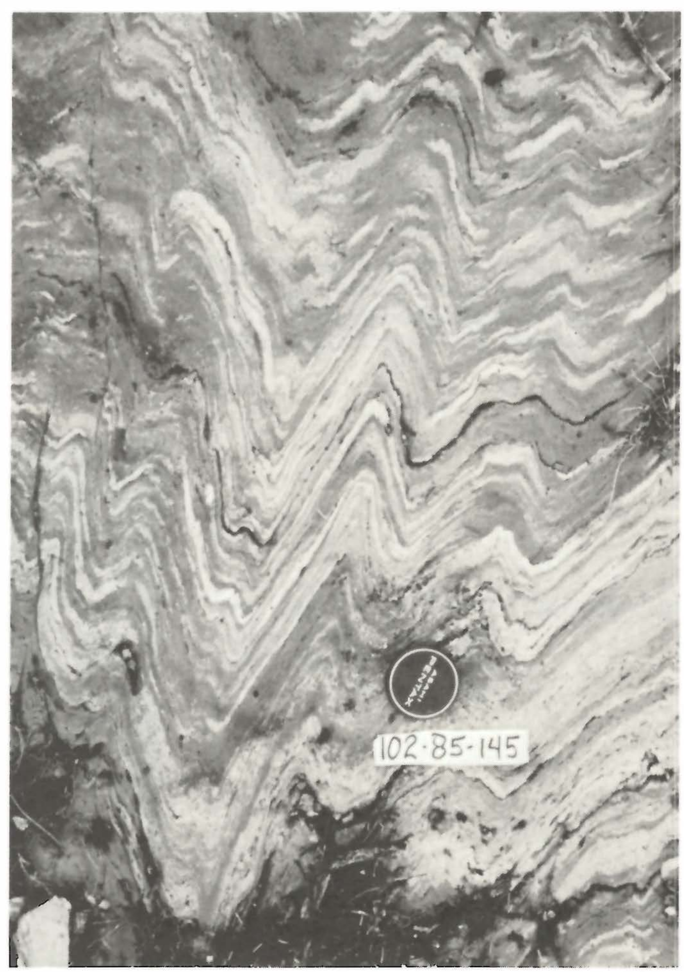


Figure GS-23-11: THE NARROWS FORMATION (5): Shear-folded tuff breccia in a ductile, chloritized shear zone.

Weber, W.
1971: Geology of the Long Lake-Gem Lake area; **in** Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer); ed. W.D. McRitchie and W. Weber; Manitoba Mines Branch, Publication 71-1, p. 63-106 and Maps 71-1/4 and 1/5

Zwanzig, H.V.
1969: Structural geology of the Long Lake area, Manitoba; M.Sc. Thesis, University of Manitoba, 74 p.
1971: Structural geology at Long Lake, Manitoba; **in** Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer); ed. W.D. McRitchie and W. Weber; Manitoba Mines Branch, Publication 71-1, p. 285-298

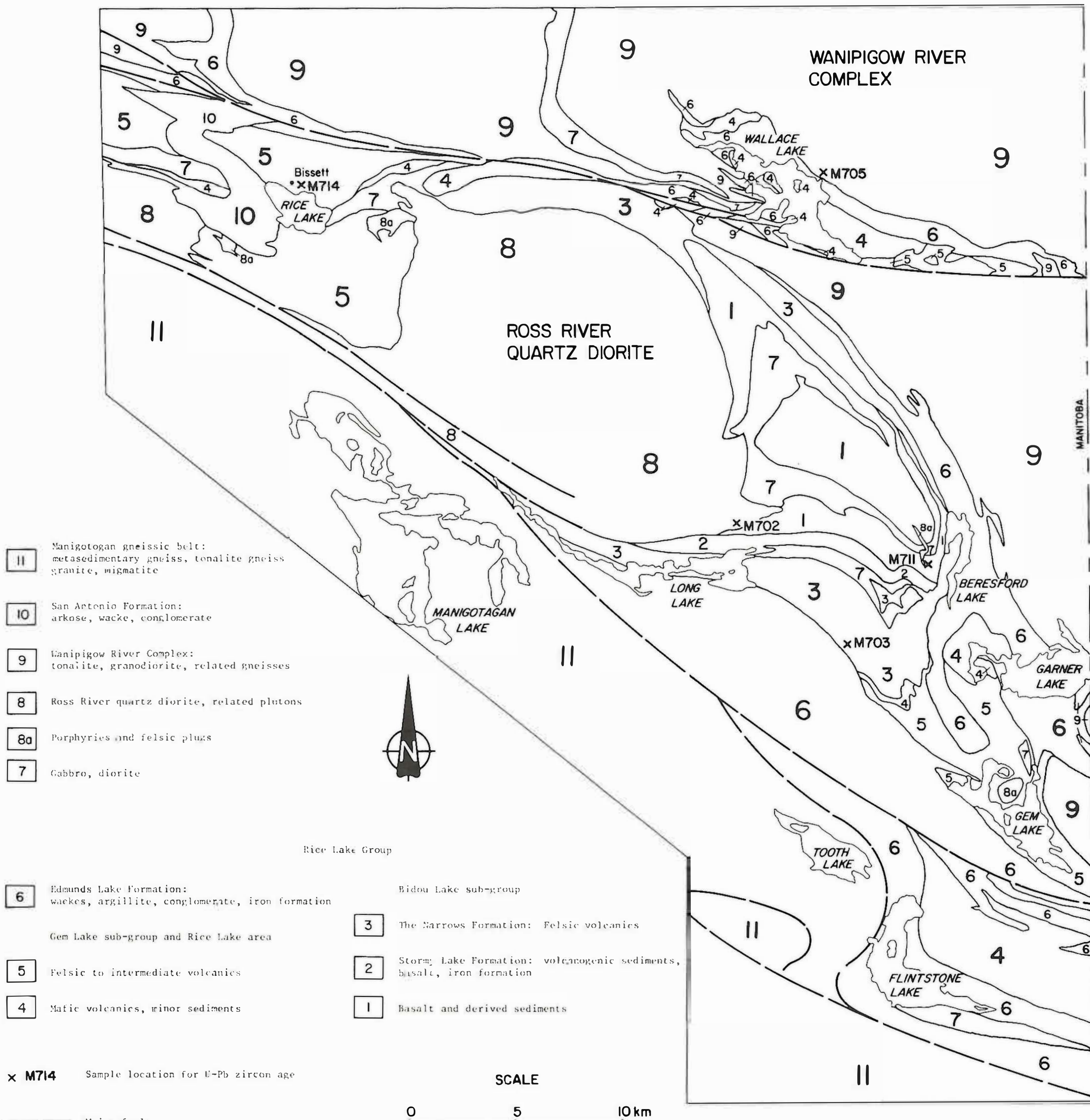


Figure GS-24-1: Generalized geology of Rice Lake greenstone belt, and sample localities for U-Pb zircon geochronology.

GS-24: U-Pb ZIRCON GEOCHRONOLOGY OF THE RICE LAKE AREA

by A. Turek[1], W. Weber and W.R. Van Schmus[2]

The Rice Lake greenstone belt is largely composed of mafic to felsic volcanics and associated sedimentary and subvolcanic rocks. The supracrustal rocks are intruded by granitoid plutons, such as the Ross River quartz diorite (Fig. GS-24-1). The belt is flanked on the north by granitoid rocks of the Wanipigow River plutonic complex and along the south by the Manigotagan gneissic belt of the English River belt.

This geochronology study was undertaken to provide a time framework for the formation of the greenstone belt and the related granitoid rocks to better understand the timing of the widespread gold mineralization. Most of the area has been mapped at 1:63 360 or greater detail between 1966 and 1969 (McRitchie and Weber, 1971). Rb-Sr ages for several units were obtained by Turek (1971) as part of this mapping project. However, the limitation of this technique precluded the establishment of a precise evolutionary history of the belt.

RESULTS AND DISCUSSION

A total of 16 samples were collected from the area for U-Pb age determinations on zircons. Mineral separations have been completed on all samples. Although all samples contained zircons, in about half of the samples the quantity and quality of the zircons precludes isotopic analyses.

The ages obtained to date are listed in Table GS-24-1 and the locations of the samples dated are shown in Fig. GS-24-1. The Narrows Formation dacite (M703) from the Bidou Lake Subgroup, the supposedly older subgroup of the Rice Lake Group, contains excellent euhedral zircons and the concordia age is 2731 ± 1.5 Ma. The Northern granite (M705) from the Wanipigow River plutonic complex, collected on the north shore of Wallace Lake, has the same age — 2730.7 ± 4.7 Ma. The Gunnar porphyry (M711), a quartz-feldspar porphyry dyke that cuts the Gunnar Formation pillow basalts at the old Gunnar mine at Beresford Lake, yields an age of 2730.7 ± 6 Ma and thus provides a minimum age for the supposedly oldest mafic volcanics of the belt. The central Ross River quartz diorite (M702) was sampled north of Long Lake. The isotopic results obtained to date are incomplete and we estimate an age range of 2712 to 2765 Ma for this unit. Additional analyses are in progress and additional sampling is planned. Zircons from intermediate to felsic volcanics at Bissett — Satellite Dish porphyritic andesite (M 714) — are high in Pb and Th and do not give a reliable age. Possible 207Pb/206Pb minimum ages are 2525 and 2718 Ma and a Pb-Pb isochron age would be 2808 Ma. However, these ages are not precise and a second, recently collected sample from Hares Island is being analyzed.

CONCLUSION

The ages for the Narrows Formation dacite, the Northern granite at Wallace Lake and the Gunnar porphyry are identical — 2731 Ma. Analytically these are very precise ages, and the geologic implication is that they formed as volcanic and plutonic rocks during the same magmatic event. The Ross River quartz diorite may also be part of the same event. Intermediate to felsic volcanics at Bissett may be older, ca. 2800 Ma. Analytical work on four additional samples of volcanics and plutonics is in progress.

REFERENCES

McRitchie, W.D., and Weber, W. (eds.)
1971: Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer); Manitoba Mines Branch Publication 71-1, 430 p., 15 maps.

Turek, A.
1971: Geochronology of the Rice Lake-Beresford Lake area; **in** Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer), W.D. McRitchie and W. Weber, eds.; Manitoba Mines Branch Publication 71-1, p. 313-324

Weber, W.,
1971: Geology of the Wanipigow River-Manigotagan River region; **in** Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer), W.D. McRitchie and W. Weber, eds.; Manitoba Mines Branch Publication 71-1, Map 71-1/4.

[1]Dept. of Geology, University of Windsor
Windsor, Ontario N9B 3P4
[2]Dept. of Geology, University of Kansas,
Lawrence, Ks. 66045

TABLE GS-24-1. PRELIMINARY U-Pb ZIRCON AGES FROM THE RICE LAKE AREA

	Sample*	Latitude	Longitude	Age (Ma ± 2σ)
M703	Narrows Formation dacite Unit 7a	50°50'13"	95°19'07"	2731.0 ± 1.5 (Concordia age)
M705	Northern granite Unit 32a	51°02'32°	95°20'00"	2730.7 ± 4.7 (Concordia age)
M711	Gunnar porphyry Unit 22g	50°52'45"	95°13'23"	2730.7 ± 6.0 (Concordia age)
M702	Ross River quartz diorite Unit 22d	50°54'57"	95°21'59"	2712 to 2765 (Concordia limits)
M714	Satellite Dish porphyritic andesite Unit 7b	51°02'51"	95°40'33"	2525 to 2718 (207/206 age) 2808 (Pb isochron)

*Rock units refer to Map 71-1/4 (Weber, 1971).

GS-25 CAT CREEK PROJECT (PARTS OF 52L/1,8)

by J.J. Macek

INTRODUCTION

As an integral part of the geological evaluation of the Bird River Sill structure its northern limb along Cat Creek was investigated. Geological mapping is severely hampered by moss and lichen covered outcrops and sparse exposure in large swampy areas accessible by a few unimproved logging roads. The substantial improvement in location of contacts and extent of geological units was aided by selectively placed ground magnetic surveys. Good geological information was obtained from isolated clean outcrops in the timber cutting locations and along the new road (see Preliminary Map 1985C-1). Presently available geological information is by Watson (1984), Scoates (1983), Trueman and Macek (1971), Davies et al. (1962) and Springer (1949, 1950).

GENERAL GEOLOGY

The high relief area north of Cat Creek is underlain dominantly by granite. Poorly exposed felsic and intermediate fragmental rocks were found in the low relief area. High ridges immediately south of Cat Creek consist of texturally variable layered metagabbro. The dominantly flat and low relief ground farther south consists of metabasalt intruded locally by small granite bodies, pegmatite and metagranodiorite to metadiorite dykes. The sequence tops to the northwest and is intensely tectonized.

METAGABBRO

A dominant feature of the metagabbro unit is layering defined by variable textural relationships between cumulate plagioclase and interstitial hornblende (Fig. GS-25-1). The thickness of the layers ranges from a few centimetres to tens of metres. The lateral continuity and definition of layers varies considerably even on the outcrop scale.

The size of cumulate plagioclase ranges from 2 mm to 8 cm. Crystals may be isolated or concentrated to form anorthositic aggregates (Fig. GS-25-2). Plagioclase is distinctly zoned, twinned and irridescent (Fig. GS-25-3a).

Hornblende is distinctly oikocrystic (15-25 cm long) in some layers (Fig. GS-25-3b) but more commonly forms an interstitial, complex network (Fig. GS-25-4a) with a tendency to concentrate into diffuse patches (Fig. GS-25-4b) or monomineralic irregular aggregates (Figs. GS-25-5a,b). Preliminary microscopic examination of oikocrystic hornblendes reveals inhomogeneous extinction and pleochroically different cores suggesting that the original mafic mineral was likely clinopyroxene. The latest replacement of hornblende consists of felty aggregates of uralite. The locally distinctly brownish colour of interstitial weathered hornblendes is caused by hematite impregnation along fine fractures and cleavages. Hematite and sulphide impregnation also occurs in the

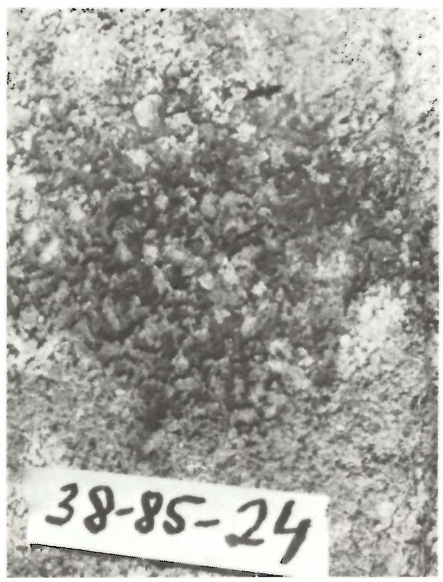
Figure GS-25-1: Layered metagabbro.

Figure GS-25-2: Layered metagabbro (variable grain size).

Figure GS-25-3a: Zoned plagioclase.

Figure GS-25-3b: Oikocrystic hornblende reflecting in sunlight.

Figure GS-25-4a,b: Various shapes of interstitial hornblende in metagabbro.



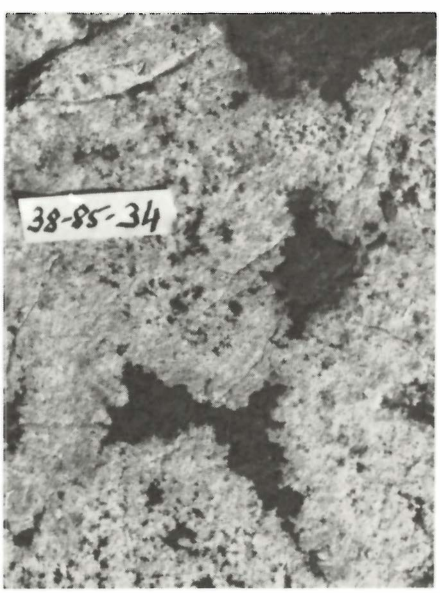


Figure GS-25-5a,b: Various shapes of interstitial hornblende in metagabbro.

vicinity of severely tectonized deformation (Fig. GS-25-6) and forms narrow gossans.

Relatively limited in occurrence is gabbro of mega-ophitic (Fig. GS-25-7a) or of heterogeneous stictiolite-like texture (Fig. GS-25-7b). The latter might be the result of advanced resorption in a heterogeneous and chaotic xenolith zone (Fig. GS-25-8,9) similar to that described by Scoates (1983) from the southern limb of the structure. In the southern part, poorly exposed, medium grained, heterogeneous, xenolitic melagabbros with disrupted anorthosite layers or rafts (Fig. GS-25-10a) and locally containing metamorphically rimmed amphibole clots (Fig. GS-25-10b) are associated with sheared hematite and sulphide impregnated mafic schists.

METAVOLCANIC SEQUENCE

The metavolcanic sequence consists of a morphologically diverse group of dominantly metabasaltic rocks:

1) Fine grained pillowed metabasalt (Fig. GS-25-11) with selvages of variable thickness containing hyaloclastic breccias, calc-silicate, or defining amoeboid pillows. Others may contain well preserved cavities (Fig. GS-25-12) and/or numerous vesicules close to the rim.
2) Fine grained pillowed metabasalt as above but charged with variable amounts of plagioclase phenocrysts (Fig. GS-25-13).
3) Fine grained massive metabasaltic flows with or without plagioclase phenocrysts (Fig. GS-25-14) often grading into pillowed flows.
4) Fine grained mafic bodies with graded and rhythmic layering (Fig. GS-25-15).
5) Medium grained, plagioclase-phyric metadiabase (Fig. GS-25-16) forming planar and perhaps concordant bodies with other flows.

Figure GS-25-6: Lineated plagioclase in a shear zone of metagabbro.

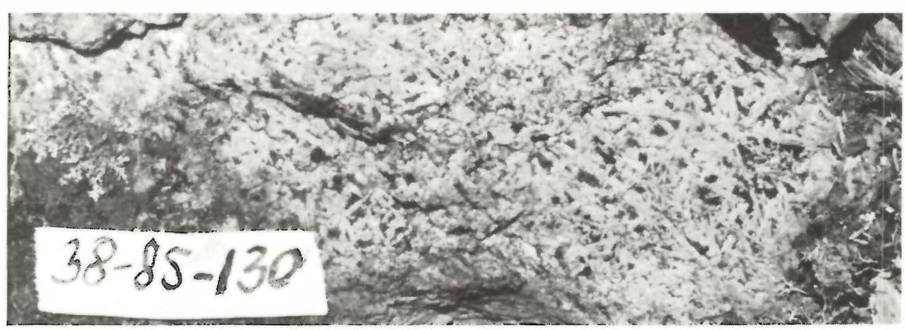


Figure GS-25-7a: Mega-ophitic metagabbro.

Figure GS-25-7b: Stictiolite-like metagabbro.

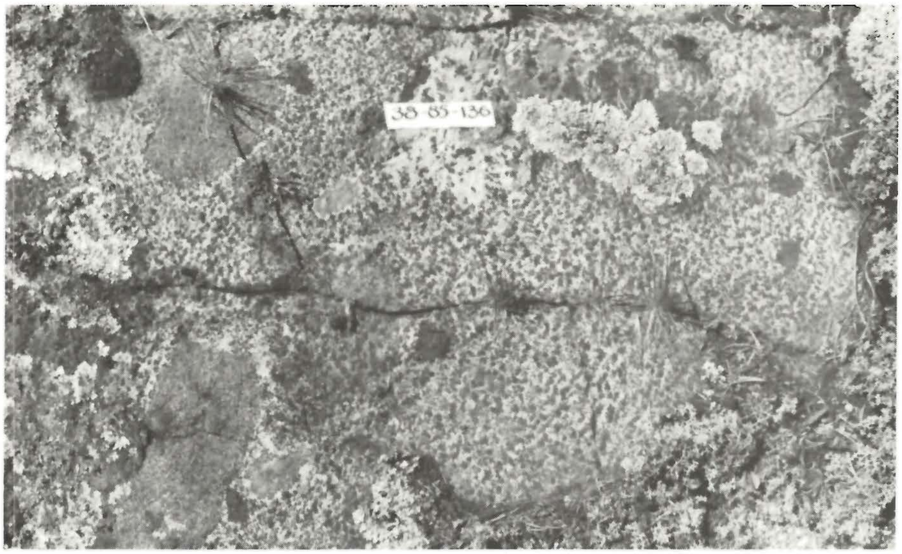
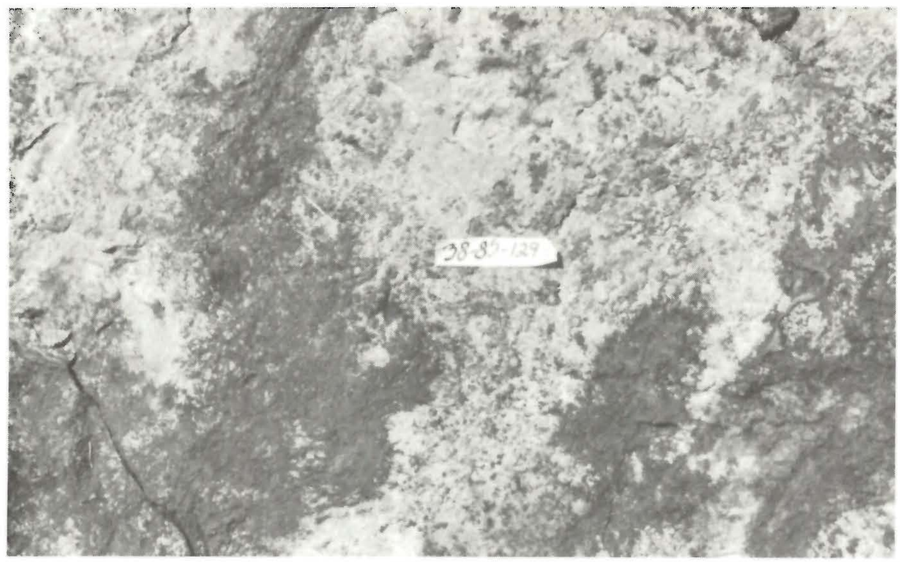


Figure GS-25-8: *Metagabbro of xenolith zone.*

Figure GS-25-9: *Metagabbro of xenolith zone (resorption high).*



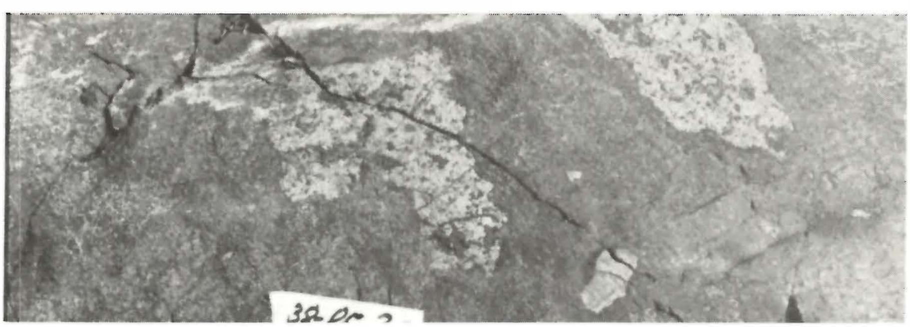


Figure GS-25-10a: *Melagabbro with disrupted anorthositic layers.*

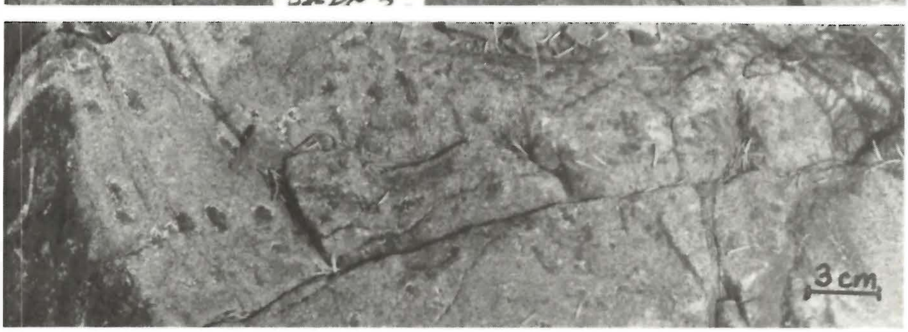


Figure GS-25-10b: *Melagabbro with rimmed amphibole clots.*

Figure GS-25-11: Fine grained pillowed flow.

Figure GS-25-12: Moderately transposed pillow with central originally subhorizontal cavity.

Figure GS-25-13: Pillowed flow charged with plagioclase phenocrysts.

Figure GS-25-14: Fine grained massive flow charged with plagioclase phenocrysts.

Figure GS-25-15: Graded and rhythmic layering in mafic body.

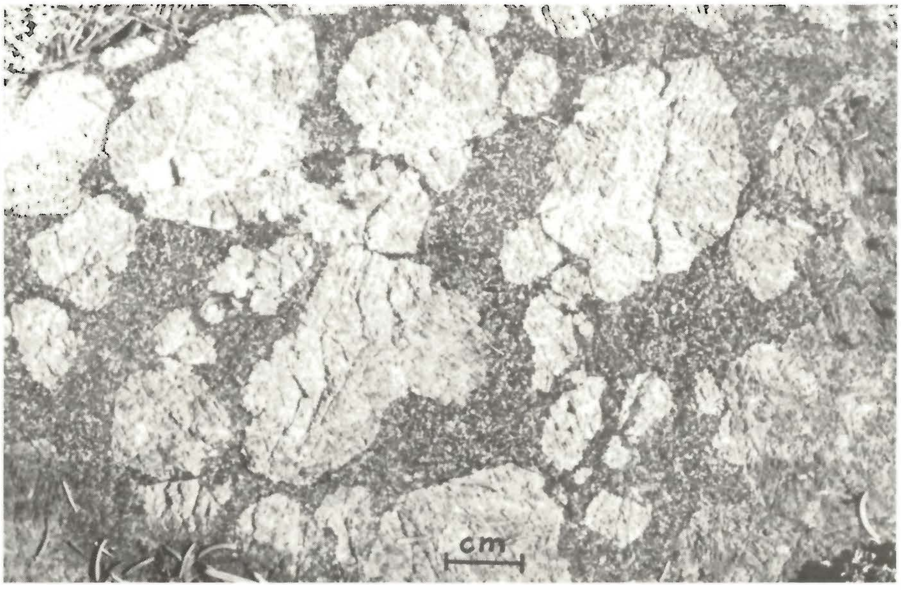
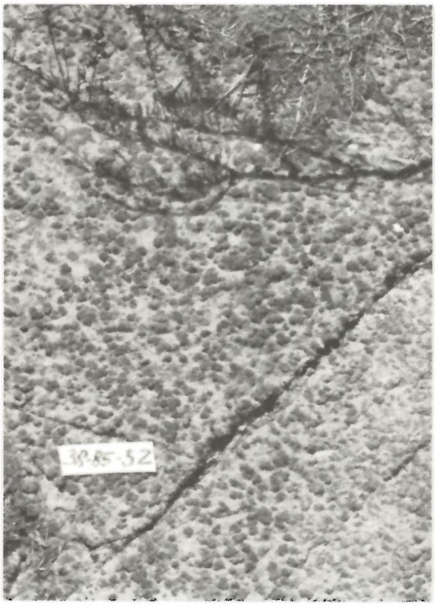


Figure GS-25-16: Plagioclase-phyric meta-diabase.



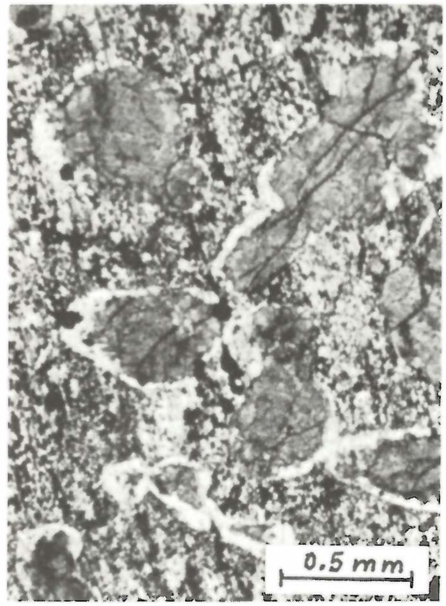


Figure GS-25-17a: Plagioclase-bearing(?) olivine pyroxenite.

Figure GS-25-17b: Microscopic texture of Figure GS-25-17a; olivine in clinopyroxene.

Locally within this sequence occur highly magnetic, in places layered ultramafic bodies, conspicuous by their knobby weathering surface (Fig. GS-25-17a). Microscopic examination (Fig. GS-25-17b) shows olivine enclosed in poikilitic clinopyroxene (knobs) surrounded by uralite, minor chlorite and magnetite dust. The original rock is thus likely plagioclase-bearing(?) olivine pyroxenite.

GROUND MAGNETIC SURVEY

Areas of gabbro and metavolcanic sequences are separated by a 300-400 m wide swamp where linear base metal mineralization was reported to occur in gabbro and associated peridotite (Davies et al., 1962). However, no peridotite has been found to outcrop in the vicinity of the swamp. A ground magnetic survey across the swamp was conducted by I.T. Hosain. According to his interpretation of the magnetic profile there is no evidence of an ultramafic unit below the swamp (Fig. GS-25-18). Some magnetic highs (500 gammas) could be caused by magnetite enrichment within altered volcanics.

Another ground magnetic survey was conducted over the metavolcanic sequence, where isolated outcrops of plagioclase-bearing(?) olivine metapyroxenite occur. This rock unit produced a 7500 gamma anomaly (Fig. GS-25-19). The estimated width of the body is 40 m and minimal length is 70 m (before the bush became too dense for continuation of the survey).

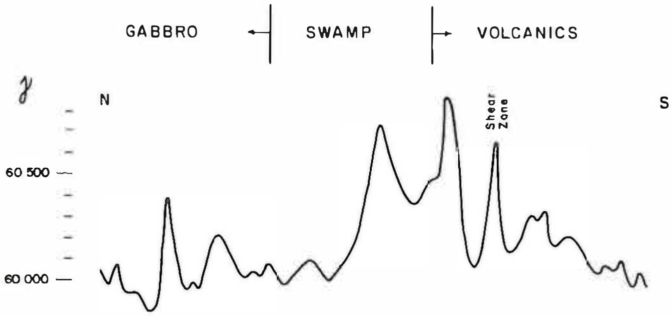


Figure GS-25-18: Ground magnetometer survey across the swamp.

CONCLUSIONS

Despite unfavourable exposure, the retrieved geological information allows comparison between the geological features of the northern and southern limbs of the Bird River Sill structure. The available observations are summarized in Table GS-25-1.

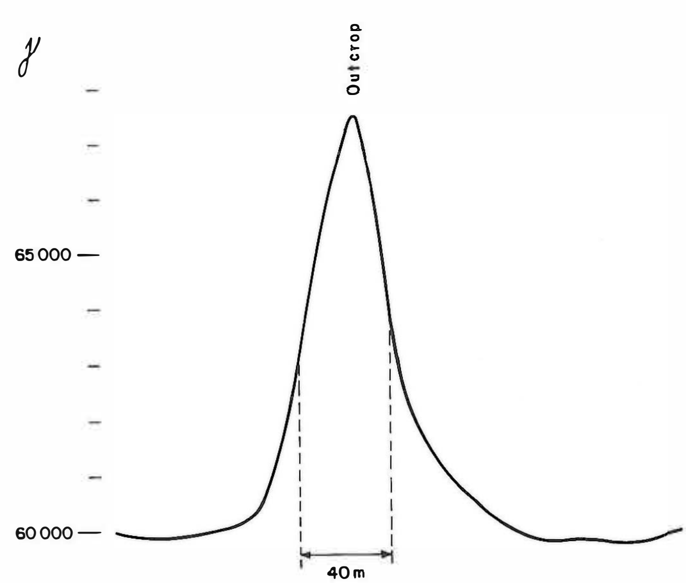


Figure GS-25-19: Magnetometer profile across plagioclase-bearing(?) olivine pyroxenite.

TABLE GS-25-1: BIRD RIVER SILL STRUCTURE

	Southern limb	Northern limb (Cat Creek)
Megadendritic peridotite	extensive	absent
Dunites, peridotites, chromitites	extensive	absent
Transition zone	limited	absent
Gabbroxenolith bearing	extensive	substantial
Gabbrolayered	sporadic	extensive
Metapyroxenite or derived schists	absent	present in limited volume
Penetrative deformation, transposition, shearing	relatively moderate	very intensive

The listed features above display remarkable asymmetry. The only correlatable unit common to both limbs is the heterogeneous gabbro xenolith zone. This could be interpreted that at the time of intrusion of the Great Falls pluton, the Bird River Sill was not completely solidified, particularly the inner portion of stratigraphically lower gabbros. This could have served as a distinct zone of weakness in the sill structure in the initial stages of the Great Falls intrusion. With subsequent intensification of tectonism associated with the Great Falls intrusion, an extensive xenolith gabbro zone originated. Finally, the structure of the Bird River Sill split asymmetrically along the probably still unconsolidated gabbro xenolith zone. The lower, generally more dense part of the structure was transported some distance to the south, while the dominantly upper portion of the relatively less dense structure was carried over a greater distance to the north. A considerably more intense penetrative deformation, transposition and shearing of the northern limb would support this concept. The presented geological observations would suggest that intrusion of the Great Falls pluton was contemporaneous with development of the late stages of the Bird River Sill structure, which is in agreement with recent U-Pb zircon ages.

REFERENCES

Davies, J.F., Bannatyne, B.B., Barry, G.S. and McCabe, H.R.
1962: Geology and Mineral Resources of Manitoba; Manitoba Mines Branch, Special Publication, 190 p.

Scoates, R.F.J.
1983: GS-12 A preliminary stratigraphic examination of the ultramafic zone of the Bird River sill (part of 52L/5NE); **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 70-83.

Springer, G.D.
1949: Geology of the Cat Lake—Winnipeg River area; Manitoba Mines Branch Preliminary Report and Map 48-7, 15 p.
1950: Mineral deposits of the Cat Lake-Winnipeg River area; Manitoba Mines Branch Publication 49-7, 14 p.

Timmins, E.A., Turek, A., Symons, D.T.A.
1985: U-Pb zircon geochronology and paleomagnetism of the Bird River greenstone belt, Manitoba; Abstracts Geological Association of Canada, Mineralogical Association of Canada Joint Annual Meeting 1985, Fredericton, New Brunswick, p. A62.

Trueman, D.L. and Macek, J.J.
1971: Geology of the Bird River sill; Manitoba Mines Branch, Preliminary Map 1971-A-1.

Watson, D.M.
1984: Bird River chromite project; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p.105-106.

GS-26 SUB-QUATERNARY PRECAMBRIAN INVESTIGATIONS IN THE WHITEMOUTH LAKE AREA

by W. Weber

As reported in GS-43, the Branch-owned drill was able to complete only two holes into Precambrian basement, out of a planned seven. The drill core is described in Table GS-26-1 and the locations are shown in Figure GS-26-1.

Hole M-10-85 was of particular interest because it was close to an oval aeromagnetic high (Geological Survey of Canada, 1969) which was thought to possibly represent a syenite such as the Falcon Island stock in Kenora (Ontario Geological Survey, 1981) or a mafic-ultramafic complex such as the Falcon Lake stock. The drill location was placed over the highest magnetic value (along the road south of the main anomaly) which was determined by a ground survey using a Proton Precession Magnetometer (sensitivity 1 gamma, 50 m spacing).

The drill core M-10-85 indicates that the basement is a mixture of amphibolite (metavolcanic rocks?) and younger granodiorite. The cause of the anomaly was apparently not determined. An area of relatively high magnetic signature and long wavelength northeast of Whitemouth Lake coincides with granodiorite and mafic inclusions exposed 50 km southeast of East Braintree (Lamb, 1975). The magnetic high investigated is a positive anomaly within this regional magnetic high and requires further exploration.

M-11-85 was spotted in an area which was thought to be underlain by granitoid rocks. However, the hole intersected mainly psammitic biotite gneiss, migmatite of biotite gneiss and granodiorite and 10 m of a massive, carbonatized diabasic gabbro. The psammitic biotite gneiss is likely derived from supracrustal rocks, possibly volcaniclastic rocks as described from Minnesota (Ojakangas et al., 1979). The diabase is probably correlative with northwest-trending Early Proterozoic dykes known from the Traverse Bay area, Lake of the Woods (Ojakangas et al., 1979).

REFERENCES

Geological Survey of Canada
1969: Kenora, Manitoba-Ontario; Aeromagnetic Series, Map 7106; 1:253 440.

Lamb, C.F.
1975: Southeast Manitoba-Revised Compilation; Manitoba Mineral Resources Division, Preliminary Map 1975F-8.

Ojakangas, R.W., Mossler, J.H., Morley, G.B.,
1979: Geological Map of Minnesota, Roseau Sheet; State of Minnesota, University of Minnesota, 1:250 000.

Ontario Geological Survey
1981: Kenora-Fort Frances; Geological Compilation Series, Map 2443, 1:253 440.

TABLE GS-26-1: PRECAMBRIAN DRILL INTERSECTIONS WHITEMOUTH LAKE AREA

TABLE M-10-85

Depth in m	
44.61	Generally pink, partly greyish-pink, foliated, inequigranular, partly porphyritic, compositionally somewhat inhomogeneous biotite granodiorite to granite; intrusive into
45.78	Dark green-grey, medium- to coarse-grained amphibolite with a few leuco-granodiorite veins 5-10 cm wide. Fine grained disseminated sulphides; intruded by
48.90	Dominantly pink, partly grey inequigranular to porphyritic biotite granodiorite to granite
51.51	End of hole

HOLE M-11-85

53.95	Pinkish grey, inequigranular medium- to coarse-grained, massive leuco-granodiorite
54.10	Layered, fine grained psammitic biotite gneiss; 5-10 cm (retrogressed) chlorite schist at 54.80 and 56.15 m
56.20	Migmatite of medium grained psammitic biotite gneiss and grey-pink leuco-granodiorite
68.15	Green, carbonate-bearing, chloritic, altered mafic dyke(?)
71.40	Fine grained massive, weakly carbonatized mafic dyke with scattered plagioclase phenocrysts and country rock clasts; hematite-bearing; plagioclase carbonatized
72.00	Green, carbonate-bearing, chloritic altered mafic rock
73.40	Mafic dyke, as 71.40 - 72.00 m
77.50	Leucogranodiorite, as 53.95 - 54.10 m
79.20	Migmatite, as 56.20 - 68.15 m
81.00	Layered fine grained, psammitic biotite gneiss with 1-2 cm wide leucogranitic lits
84.80	Medium grained, pink to greyish-pink granodiorite
85-30	Fine grained psammitic biotite gneiss
87.20	Migmatite of medium grained, psammitic biotite gneiss and grey-pink leuco-granodiorite
88.23	End of hole.

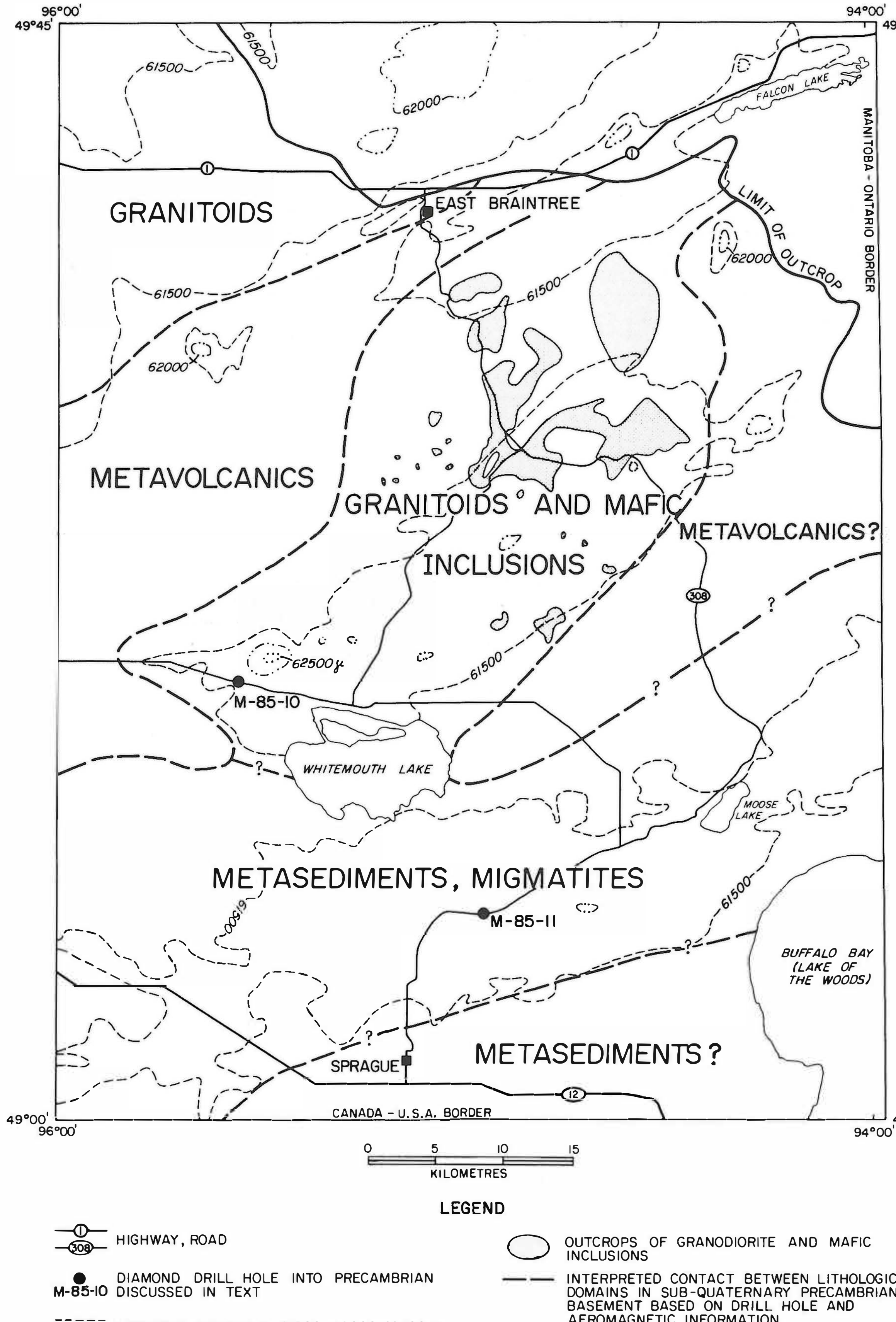


Figure GS-26-1: *Location of 1985 diamond drill holes into sub-Quaternary Precambrian, and interpreted geology of Precambrian based mainly on aeromagnetic data and drill hole information.*

GS-27 MINERAL DEPOSIT INVESTIGATIONS IN THE RICE LAKE GREENSTONE BELT

by P. Theyer

Mineral deposit investigations in the Bissett area concentrated mainly on the documentation of the geological settings of known mineral occurrences (Gaba, GS-29, and Stewart, GS-28, this volume). Other activities focussed on a re-evaluation of metallogenetic concepts utilized to account for the origin of selected gold deposits in the area (Theyer, 1984). The re-evaluation of these concepts was required as a result of a field trip to the area during which the concensus favoured an intrusive rather than sedimentary origin (Theyer, 1983, 1984) for the felsic rocks between the Jeep Mine and the Johnston gold occurrence.

The Jeep Mine was a gold deposit marked by a high tenor of gold in the ore (26.6 grams/tonne). If the gold was not derived by mobilization from rocks located south of the mine, then the source of the gold mineralization is critical to further evaluation of gold-bearing occurrences in this area.

Since anomalously high gold values were obtained in two rock samples collected a few hundred metres southeast of the Jeep Mine (Theyer, 1984) and the Johnston gold deposit occurs in similar rocks 3 km eastwards, a systematic rock geochemical sampling of the area was undertaken (Theyer, 1984). Analyses of this material yielded a wide range of Au (1-18 ppb), As (1-100 ppm) and Sb (0.2-4.3 ppm) values. Two to six sample anomalies are present for each of these elements from this sample population. The data are undergoing a more rigorous examination; however, these results would indicate that gold mineralization and associated dispersion halos in this area may be restricted to discrete occurrences that are substantially narrower and smaller than the distances between rock samples collected along the sampling grid (100 m average separation).

An area of intermittent outcrop, approximatly 250 m east of the Jeep Mine, was cleared of vegetation, rubble and overburden with a high pressure water pump. This area is underlain by aphanitic slightly carbonatized siliceous rocks that locally resemble cherts. These silicic rocks are characterized by faint dark banding and rare disseminated pyrite. These rocks grade laterally into coarse siliceous rocks composed mainly of subrounded to rounded grains of light blue quartz in an aphanitic matrix. These rocks are foliated, disrupted by shear folding and form irregular contacts with the surrounding gneisses.

REFERENCES

Theyer, P.

1983: Geology of gold environments in the Bissett-Wallace Lake portion of the Rice Lake greenstone belt; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 101-106.

1984: Mineral deposit investigations in the Rice Lake greenstone belt; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 87-91.

GS-28 MINERAL OCCURRENCE DOCUMENTATION IN THE RICE LAKE GREENSTONE BELT

by P. W. Stewart

INTRODUCTION

An objective of the Canada-Manitoba Mineral Development Agreement (MDA) is to document and sample known mineral occurrences in the major greenstone belts of the province (i.e. Lynn Lake, Flin Flon/Snow Lake, and Rice Lake greenstone belts). One intent of this investigation is to compile an inventory of the mineral occurrences in each belt. Investigations of mineral occurrences conducted in 1984 in the Rice Lake greenstone belt were reported by Schmidtke (1984), Gaba and Theyer (1984) and Theyer (1984). Earlier investigations in the area by Mineral Resources Staff (e.g. Fedikow, 1981, 1982, 1983 and Theyer, 1983) will be incorporated into this inventory. The enumeration system adopted for the Rice Lake greenstone belt mineral occurrence inventory and previously unpublished analytical data from earlier investigations are presented. Summary data from the 1985 investigations are also presented, (see Fig. GS-28-1).

SYSTEM OF ENUMERATION

The Rice Lake greenstone belt consists of a relatively narrow band of metavolcanic and metasedimentary rocks of Archean age (McRitchie and Weber, 1971). This belt extends easterly from the vicinity of the mouth of the Wanipigow River on Lake Winnipeg to near Wallace Lake and then southeasterly toward the Manitoba/Ontario border (Fig. GS-28-2). The greenstone belt and associated intrusive rocks underlie portions of 62P/1, 52M/3, 52M/4, 52L/11, 52L/13 and 52L/14 of the National Topographic System 1:50 000 map sheets. Mineral occurrences are numbered consecutively within each 1:50 000 map sheet in approximate order of decreasing degree of productivity and/or development based on data in Davies (1953) and Stephenson (1971), i.e. 1) former productive mines, 2) sites of underground development — little or no production, 3) sites of exploration shafts — little or no development; these are followed by the locations of exploration shafts or former mine workings noted on Mining Claim Maps. The occurrences investigated by Schmidtke (1984) have been re-numbered in a roughly west to east and north to south sequence (Table GS-28-1, Fig. GS-28-1). Additional localities can be added to the inventory consecutively as they are investigated (Table GS-28-2).

ANALYTICAL RESULTS — 1984

Geochemical analyses for gold have been obtained for selected samples from most mineral occurrences investigated by Schmidtke (1984) (Table GS-28-1). Approximately three-quarters of this data was produced by Fire Assay methods at the Geochemical Laboratory of the Manitoba Department of Energy and Mines. Other analyses were determined by Fire Assay/DC Plasma techniques at Bondar-Clegg and Co. of Ottawa. Detection limits are 0.01 oz Au/ton and 1 ppb Au for each lab respectively. Samples with more than 20,000 ppb Au were resubmitted to Bondar-Clegg for oz/ton determinations. Data for occurrences investigated by Fedikow (1981) were produced by Fire Assay methods at the provincial Geochemical Lab (Table GS-28-1). The locations of the mineral occurrences and a symbolic representation of the maximum gold content at each are shown in Figure GS-28-1.

DOCUMENTATION — 1985

Schmidtke (1984) concentrated on known mineral occurrences in the Rice Lake-Bissett area, i.e. surrounding the former gold-producing San Antonio Mine (Fig. GS-28-3). In 1985, investigations were concentrated in the area srrounding the former gold-producing central Manitoba, Gunnar and Ogama-Rockland Mines on NTS map sheet 52L/14 (Fig. GS-28-4). Investigations were concentrated on occurrences with physical evidence of previous exploration, i.e. trenches and pits.

The location of each mineral occurrence has been plotted on 1:15 840 scale airphotos. Geological sketch maps were prepared for each occurrence with sulphide and/or gold mineralization or appreciable shearing. At least one sample has been collected for gold analysis from almost every occurrence listed in Table GS-28-2. These are 2-7 kg chip samples, with the chips usually collected every 10 cm or less across the exposed mineralized zone. Wherever possible, weathered material was removed from the sample. The intent of this sampling is to provide some measure of the gold content of either the vein and/or the sheared host. Where mineralization or shearing appeared to be relatively persistent along strike, more than one chip sample was collected across the mineralized zone. In addition, representative hand samples of the host rock lithologies and mineralization present were collected. These representative samples and geological sketch maps will be stored in Mines Branch facilites in Winnipeg for examination by Mines Branch staff, and upon request by any parties interested in a particular property.

GENERAL OBSERVATIONS

The primary characteristic of mineralization in the Rice Lake greenstone belt appears to be the erratic distribution of both the shear zones and quartz and sulphide mineralization within the shear zones. It is also significant that the shear zones are typically narrow (less than 2 m) and the contained quartz bodies (commonly less than 1 m thick) do not persist along strike. As observed by Schmidtke (1984) and other previous workers, quartz and sulphide mineralized shear zones occur in all lithologies in the Rice Lake greenstone belt. The predominance of mafic rocks as host to the occurrences examined (Table GS-28-2) probably reflects both the greater areal extent of mafic rocks relative to other lithologies in the study area and the higher potential for gold mineralization to occur in quartz veins in mafic rocks, as indicated by previous workers (e.g. Stockwell and Lord, 1939; Russell, 1952; Davies 1953; Stephenson, 1971). Consequently, most early exploration programs were directed toward shear zones and quartz veins in the historically most productive host lithologies.

In Table GS-28-2, specific genetic names (e.g. gabbro: sites 52L/14-41, 42, 43, 44) have been assigned to mafic igneous rocks only for those locations where volcanic textures (i.e. pillowed, fragments) or intrusive contact relations were observed.

ACKNOWLEDGEMENTS

Phil Southam and Bruno Wischnewski are sincerely thanked for their assistance in the documentation studies this summer.

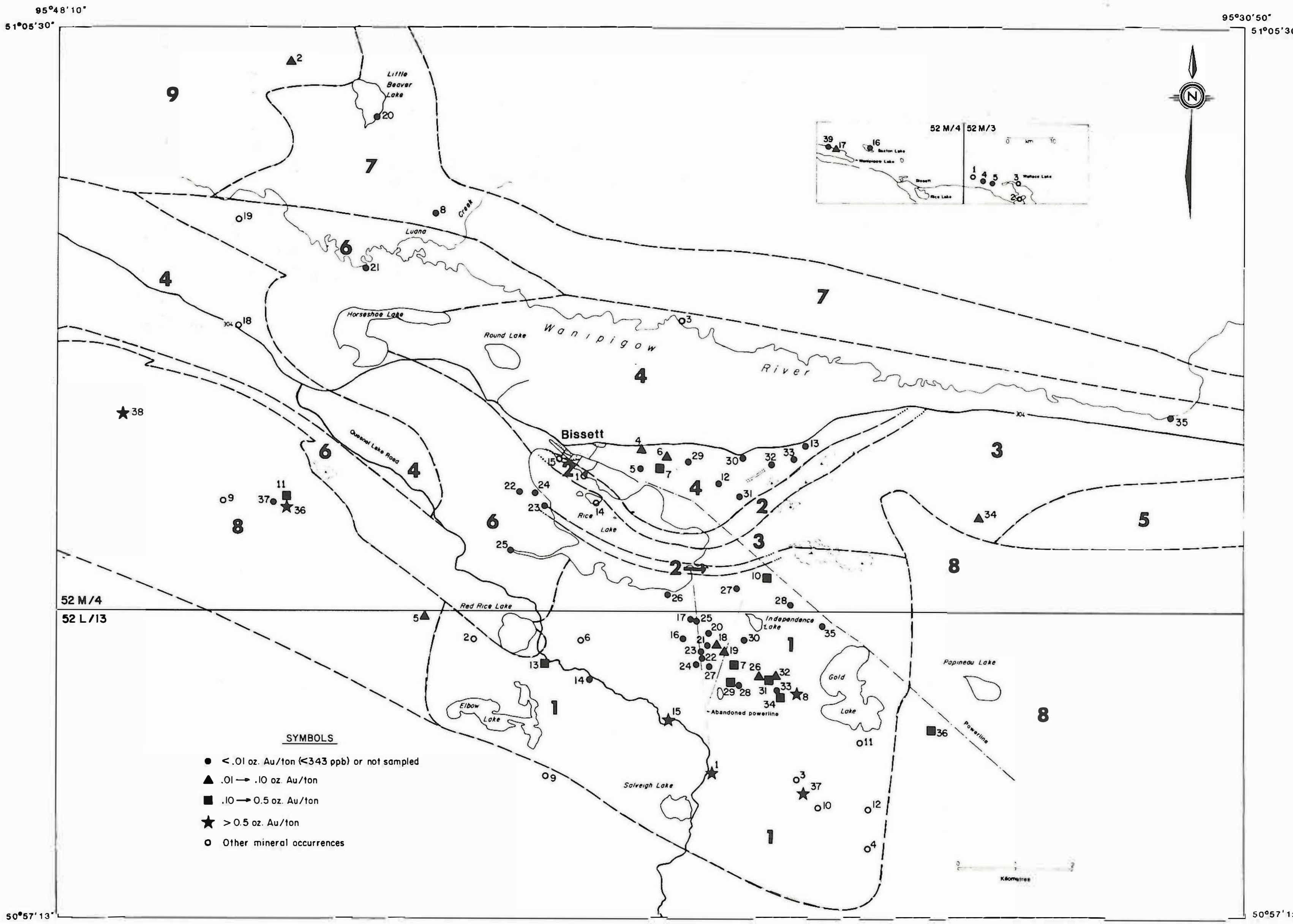


Figure GS-28-1: *Analytical data for mineral occurrence localities investigated by Schmidtke (1984). Other occurrences include those investigated by Fedikow (1981), Stewart (1985) and those not yet examined. Legend: 1. Massive, porphyritic and fragmental felsic volcanic rocks; 2. SAM unit (see Theyer, 1983, 1984); 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.*

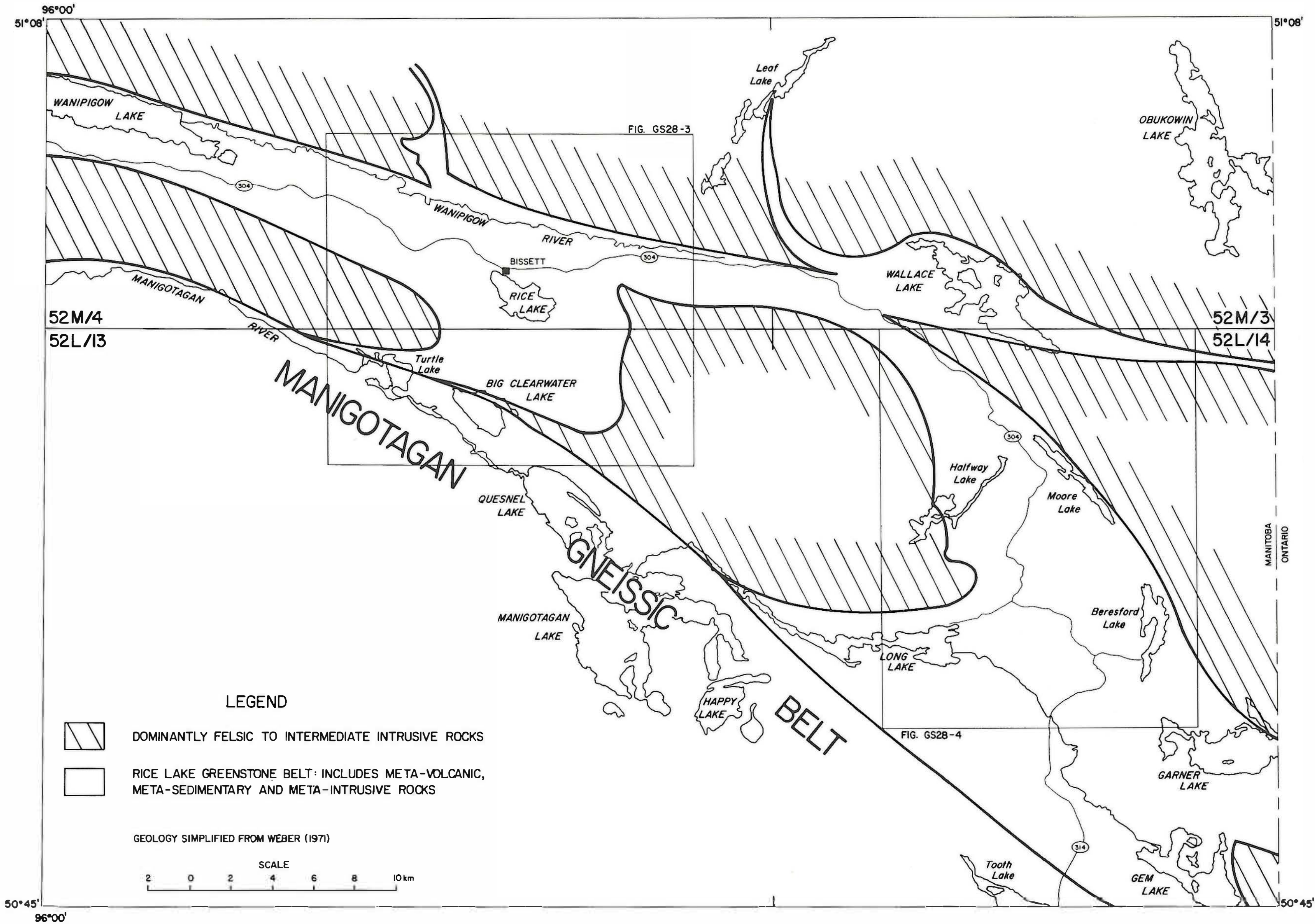


Figure GS-28-2: *Map of the Rice Lake-Beresford Lake region of the Rice Lake greenstone belt with generalized regional geology from Weber (1971).*

TABLE GS-28-1
GOLD CONTENT OF MINERAL OCCURRENCES INVESTIGATED BY SCHMIDTKE (1984).

OCCURRENCE #	SCHMIDTKE 1984 #	NAME	SAMPLE #	SAMPLE DESCRIPTION	Au CONTENT	
			PART A: NTS AREA 52M/4			
1	—	San Antonio Mine				
2	2	Poundmaker shaft	77-4-125	granodiorite; grab sample	8	ppb
			77-4-126	quartz vein; grab sample	0.046	oz/ton
3	—	Vanson shaft	—			
4	46	Gold Cup shaft	77-4-15	quartz vein with sulphides; grab sample	0.06	oz/ton
			77-4-16	sheared fsp-rich volcaniclastic rock		trace
5	47	Big Four shaft	77-4-14	fsp-rich volcaniclastic rock; grab sample		nil
6	49	Gold Field shaft	77-4-17	quartz vein, with minor sulphides and carb; grab sample	0.01	oz/ton
			77-4-18	fsp-rich volcaniclastic rock; grab sample		trace
7	48	Gold Standard shaft	77-4-11	quartz vein; sampled along strike of trench	0.17	oz/ton
			77-4-12	fsp-rich volcaniclastic rock, sheared		nil
			77-4-13	fsp-rich volcaniclastic rock, less sheared than 77-4-12		nil
8	4	Luana shaft	77-4-127	interbedded siliceous and mafic tuff/sed; grab sample	8	ppb
9	—	Eva shaft	—			
10	42	Independence shaft	77-4-93	rhyolite breccia, with sulphides and irregular quartz stringers		trace
			77-4-94	same as previous, but sheared	0.009	oz/ton
			77-4-95	quartz with minor carb and sulphide; from discontinuous vein	41	ppb
			77-4-96	sulphide-bearing quartz; grab sample from trench	0.424	oz/ton
			77-4-97	sulphide-bearing quartz; grab sample from shaft	0.769	oz/ton
11	7	Apex shaft	77-4-3	sulphide-bearing quartz; grab sample	0.36	oz/ton
12	51	Emperor shaft	77-4-19	fsp-rich, volcaniclastic rock; grab sample		nil
13	56	San Norm shaft	77-4-1	sheared siliceous rock with fsp fragments		nil
14	—	Albany shaft	—			
15	—	Gabrielle shaft	—			
16	61	Clinton shaft	—			

TABLE GS-28-1 (Cont'd)
GOLD CONTENT OF MINERAL OCCURRENCES INVESTIGATED BY SCHMIDTKE (1984).

OCCURRENCE #	SCHMIDTKE 1984 #	NAME	SAMPLE #	SAMPLE DESCRIPTION	Au CONTENT
17	59	Grand Central shaft	77-4-79	quartz vein with chl (and Fe carb?); grab sample from trenches	0.03 oz/ton
18	—	York shaft	—		
19	—	Outlook shaft	—		
20	3	Little Beaver (Sink)	77-4-124	sheared, fsp-rich andesite with disseminated py, cpy and sph in vein; grab sample	0.007 oz/ton
21	5	North Horseshoe	77-4-99A	sulphide-bearing quartz vein	0.008 oz/ton
			77-4-99B	SAF quartzite with sulphides	0.003 oz/ton
22	10	OK #9	77-4-26	minor sulphide-bearing quartz vein; grab sample	nil
			77-4-27	rusty weathering SAF quartzite	nil
			77-4-24	quartz veinlet in quartzite	nil
23	12	OK #10	77-4-28	rusty weathering SAF quartzite; grab sample	nil
24	11	Cessna	77-4-25	rusty weathering SAF quartzite	nil
25	13	Little Three	77-4-22	sulphide-bearing quartz vein; grab sample	nil
			77-4-23	rusty weathering SAF feldspathic quartzite; grab sample	nil
26	40	Trail	77-4-130	sheared felsic volcanic rock; grab sample	10 ppb
27	41	Otter	77-4-102	siliceous f.g. rhyolitic rock with deformed pebbles and cobbles; grab sample	4 ppb
28	43	Rice Lake Gold Mines (RLG), #11	77-4-88	quartz vein with chl and carb	trace
			77-4-89	v.f.g. siliceous rock with amphibole	nil
			77-4-90	rhyolitic rock with biotite(?) and minor sulphides	nil
29	50	Gold Field, #7 vein	77-4-29	quartz vein with chl, carb, and minor sulphides	nil
			77-4-30	sheared, fsp-rich volcaniclastic(?) rock	nil
30	53	Burmese Tiger Trap (BTT)	77-4-76	quartz vein; grab sample	nil
			77-4-77	sheared mafic host rock	nil
31	52	Normandy 18	77-4-73	quartz vein in shear zone; grabs from 2 pits	nil
			77-4-74	highly sheared rhyolitic(?) rock (quartz-sericite schist)	trace
			77-4-76	mafic volcanic rock; south of shear zone	nil

TABLE GS-28-1 (Cont'd)
GOLD CONTENT OF MINERAL OCCURRENCES INVESTIGATED BY SCHMIDTKE (1984).

OCCURRENCE #	SCHMIDTKE 1984 #	NAME	SAMPLE #	SAMPLE DESCRIPTION	Au CONTENT
32	54	Normandy 19	77-4-70	quartz vein with minor sulphides; grab sample; 3 m south of creek	nil
			77-4-71	sheared quartz-sericite schist, with sulphides; 3 m south of creek	nil
			77-4-72	sheared "metadiabase"; from outside of trench	nil
			77-4-85	quartz vein with malachite; grab sample; 40 m east of creek	nil
			77-4-86	sheared, green siliceous fragmental rock; 40 m east of creek	nil
			77-4-87	inter. volcaniclastic with aligned biotite crystals	nil
33	55	Normandy 20	77-4-78	quartz vein with minor sulphides; grab sample in pit	trace
			77-4-98	sheared mafic pillowed volcanic rock with sulphides; 10 m south of pit	19 ppb
34	57	'F' Group	77-4-F1	silicified mafic-inter. volcanic rock with cpy and py	trace
			77-4-F2	mafic flow breccia(?)	trace
			77-4-F3	mafic flow breccia, similar to F2	trace
			77-4-F4	QFP	nil
			77-4-F5	fsp-phyric mafic volcanic rock	trace
			77-4-F6	QFP	0.03 oz/ton
			77-4-F7	silicified(?) mafic volcanic rock	trace
			77-4-F8	m.g. mafic volcanic rock	trace
			77-4-F9	mafic volcanic rock	nil
			77-4-F10	mafic volcanic rock	nil
			77-4-F11	m.g. mafic volcanic rock	nil
			77-4-F12	fsp-phyric gabbroic rock (dyke?)	nil
			77-4-F13	mafic volcanic rock	nil
			77-4-F14	mafic volcanic rock with py	nil
			77-4-F15	m.g. mafic volcanic rock	trace
			77-4-F16	gabbroic textured mafic rock	trace
35	58	Birch Falls	77-4-2	quartz stringers with sulphides, grab sample from pit	trace
36	8	Apex II	77-4-6	sheared, sulphide-bearing granodiorite host	0.032 oz/ton
			77-4-7	quartz vein with minor sulphides	0.03 oz/ton
			77-4-8	quartz vein and sulphidic granodiorite, grab sample	0.81 oz/ton
37	6	Splay	77-4-4	quartz vein with very minor sulphide in sheared qtz monzonite(?)	trace
			77-4-5	quartz vein in sheared intrusive; 75 m east of 77-4-4	trace
38	1	Bard	77-4-131	quartz vein with py, brown carb, and minor malachite staining; grab sample from several pits south of major trench	0.212 oz/ton
			77-4-132	quartz vein; grab sample from trench	0.684 oz/ton
			77-4-133	quartz diorite host; grab from trench	22 ppb
39	60	Wan II	77-4-80	cherty rock with some sulphides	nil
			77-4-81	f.g. bluish, magnetite-bearing meta-sedimentary rock	nil

TABLE GS-28-1 (Cont'd)
GOLD CONTENT OF MINERAL OCCURRENCES INVESTIGATED BY SCHMIDTKE (1984).

OCCURRENCE #	SCHMIDTKE 1984 #	NAME	SAMPLE #	SAMPLE DESCRIPTION	Au CONTENT
			PART B: NTS AREA 52 M/3		
1	—	Jeep	—		
2	—	Conley shaft*	SEMWLCO		
			81-1-1	grey siliceous unit with carb coating along joints and fractures (silicified carbonate??), drusy qtz within fractures	0.02 oz/ton (0.06 oz Ag/ton, 0.02% Cu, 0.02% Pb)
			81-1-2	graphitic slate, rusty weathered and malachite stained; leached-some py casts, 1 mm white qtz veins	trace (0.02% Cu, 0.02% Pb)
			81-1-3	graphitic slate containing 1-5 mm bands py	trace (0.06 oz Ag/ton)
			81-1-4	cherty siliceous unit with 1-5 mm bands py, cut by 2-3 mm qtz veins	0.03 oz/ton (0.03% Cu, 0.06% Ni)
			81-1-5	rusty weathered, graphitic slate, no visible sulphides, minor qtz and carb veining	trace (0.02% Ni, 0.02% Pb)
3	—	Gatlan*	SEMWLGAT		
			81-1-1	massive apy within sericite schist	1.99 oz/ton (0.26 oz Ag/ton, 0.02% Cu)
			81-1-2	disseminated apy in sericite schist (derived from sheared, siliceous "volcanic grit")	0.14 oz/ton (0.12 oz Ag/ton)
4	62	Hodgson	77-4-20	sulphidic (plus malachite) qtz vein, 0.5 m wide, in sheared diorite; grab sample in trench	trace
			77-4-21	qtz plus (minor) sulphide-bearing sediment	trace
5	63	Johnston	—		
			PART C: NTS AREA 52L/13		
1	17	Pilot shaft	77-4-48	quartz vein with chl, minor sulphides and malachite; north of shaft	0.09 oz/ton
			77-4-49	sheared rhyolitic rock; same location as previous	trace
			77-4-50	quartz vein with sulphides; north of 48, 49	nil
			77-4-51	quartz vein without sulphides; same location as 50	nil
			77-4-52	rosy quartz vein with minor sulphides, north of 50, 51	trace
			77-4-53	rhyolitic host to 52	nil
			77-4-54	quartz vein with chl, malachite and minor sulphides; north of 52, 53	nil
			77-4-55	rhyolitic host to 54	trace
			77-4-56	quartz vein with sulphides; north of 54, 55	trace
			77-4-57	rusty, sheared QFP(?); same location as 56	trace
			77-4-58	rusty, fsp-phyric breccia(?); same location as 56, 57	nil
			77-4-59	quartz vein with minor chl, carb and sulphides; north of 56, 57, 58	trace

TABLE GS-28-1 (Cont'd)
GOLD CONTENT OF MINERAL OCCURRENCES INVESTIGATED BY SCHMIDTKE (1984).

OCCURRENCE #	SCHMIDTKE 1984 #	NAME	SAMPLE #	SAMPLE DESCRIPTION	Au CONTENT
			77-4-60	silicified(?) mafic dyke(?); same location as 59	nil
			77-4-61	rusty quartz vein with chl; south of shaft	0.03 oz/ton
			77-4-62	sheared rhyolitic host to 61	0.01 oz/ton
			77-4-63	quartz vein with cpy; grab sample south of 64, 65	1.16 oz/ton
			77-4-64	rusty, sheared rhyolite(?) fragmental rock; south of 61, 62	trace
			77-4-65	quartz vein with abundant sulphides; same location as 64	0.25 oz/ton
2	—	Packsack shaft	—		
3	—	Gold Pan shaft	—		
4	—	Moose shaft	—		
5	9	Gilbert shaft	77-4-9	quartz vein with py and cpy	0.08 oz/ton
			77-4-10	mafic rock with minor py and carb	0.07 oz/ton
6	—	Wolfe shaft	—		
7	27	Ranger Gold Mines (RGM) shaft	77-4-101A	qtz vein and sheared host, cpy, py and carb present; south of shaft; chip sample across 1 m	0.367 oz/ton
			77-4-101B	quartz vein and sheared QFP host, more sulphides in host than in vein; grab sample	0.004 oz/ton
			77-4-101C	fsp and amphibole porphyry with sulphides; north of shaft	0.004 oz/ton
			77-4-101D	mafic rock with carb, py, and minor cpy; north of 101C	0.008 oz/ton
			77-4-101E	silicified(?) mafic host; grab sample near shaft	6 ppb
8	19	Chicamon shaft	77-4-112	fsp-phyric siliceous host rock; grab sample	28 ppb
			77-4-113	quartz vein with c.g. py euhedra and carb; grab sample	0.162 oz/ton
			77-4-114	sheared cherty rhyolitic host rock; grab sample	1.723 oz/ton
			77-4-115	fsp-phyric, siliceous rubble from near shaft	86 ppb
			77-4-116	quartz vein and brecciated host with sulphides and carb; rubble near shaft	0.382 oz/ton
9	—	Pendennis shaft	—		
10	—	Gold Seal shaft	—		
11	—	Brooklyn shaft	—		
12	—	Gold Vein shaft	—		
13	14	Red Rice Lake	77-4-134	quartz vein with disseminated py and cpy; grab sample from trench	0.171 oz/ton
			77-4-135	altered felsic-inter. breccia (lapilli tuff?)	13 ppb

TABLE GS-28-1 (Cont'd)
GOLD CONTENT OF MINERAL OCCURRENCES INVESTIGATED BY SCHMIDTKE (1984).

OCCURRENCE #	SCHMIDTKE 1984 #	NAME	SAMPLE #	SAMPLE DESCRIPTION	Au CONTENT
14	15	Yankee Girl	77-4-31	quartz vein with minor sulphides; grab sample	nil
15	16	Sosueme	77-4-32	moderately sheared rhyolite; from adit face	trace
			77-4-33	highly sheared rhyolitic rock, rusty weathering; from adit face	0.01 oz/ton
			77-4-34	moderately sheared rhyolite with sulphides; from adit face	0.02 oz/ton
			77-4-35	altered(?) volcanic conglomerate with cpy; from adit face	0.07 oz/ton
			77-4-36	QP with sulphides; from adit face	0.01 oz/ton
			77-4-37	volcanic conglomerate with sulphides and patchy alteration; 5 m east of adit	0.01 oz/ton
			77-4-38	sheared QP with sulphides; 10 m north of 37	0.01 oz/ton
			77-4-39	sheared rhyolite, banded; 5 m north of 37	trace
			77-4-40	altered ('frothy'), siliceous rock; 5 m north of 39	0.66 oz/ton
			77-4-41	altered (silicified) host with qtz stringers; 5 m northwest of 40	0.27 oz/ton
			77-4-42	weathered, altered (frothy) host with sulphides; 10 m north of 41	0.80 oz/ton
			77-4-43	altered QP with minor qtz stringers; 7 m northeast of 42	0.38 oz/ton
			77-4-44	altered QP with minor sulphide-bearing qtz vein; 6 m north of 42	0.07 oz/ton
			77-4-45	qtz vein with sulphides; 7 m north of 44	0.25 oz/ton
			77-4-46	silicified(?) f.g. mafic-inter. unit; 10 m north of 45	nil
			77-4-47	rhyolite host; rubble south of adit	0.07 oz/ton
16	37	Geneva	77-4-82	quartz vein, with Fe rust	nil
			77-4-83	sheared andesitic tuff(?)	nil
			77-4-84	quartz vein, rusty weathering; grab sample in largest trench	nil
17	39	Cliff	—		
18	31	RLG,#2	77-4-128	quartz vein and sheared felsic fragmental rock, disseminated py in both; grab sample	0.088 oz/ton
19	30	RLG,#3	77-4-107	quartz vein with carb and sulphides; grab sample from rubble and pit face	0.024 oz/ton
20	36	RLG,#4	—		
21	35	RLG,#5	77-4-111	quartz-carbonate vein; grab sample from largest trench	15 ppb
22	32	RLG,#6	77-4-109	quartz vein with carb and sulphide	3 ppb
23	34	RLG,#7	77-4-110	quartz-carb vein material; grab sample from rubble	12 ppb

TABLE GS-28-1 (Cont'd)
GOLD CONTENT OF MINERAL OCCURRENCES INVESTIGATED BY SCHMIDTKE (1984).

OCCURRENCE #	SCHMIDTKE 1984 #	NAME	SAMPLE #	SAMPLE DESCRIPTION	Au CONTENT
24	33	RLG,#8	77-4-108	felsic fragmental host rock (sheared) and quartz-carb vein; chip sample in trench	4 ppb
25	38	RLG,#9	77-4-129	quartz vein (lens) with minor carb and chl, trace sulphides	11 ppb
26	24	RLG,#10	77-4-105	rhyolite with disseminated sulphides and carb; grab sample	0.004 oz/ton
			77-4-106	quartz vein (lens) with minor sulphides	0.010 oz/ton
27	29	Curly	—		
28	25	Ranger Gold Mines (RGM),#2	77-4-104	quartz vein with carb and minor sulphides, grab sample	65 ppb
29	26	RGM,#3	77-4-103	sheared rhyolite adjacent to veined QFP dyke	0.169 oz/ton
30	28	RGM,#6	77-4-100	sheared rhyolite with qtz stringers, carb and sulphides	40 ppb
31	23	RGM,#7	77-4-119	quartz vein with sulphides and carb	0.194 oz/ton
32	22	RGM,#8	77-4-120	rusty weathering felsic fragmental rock, with sulphides and carb	0.044 oz/ton
33	21	Lost Hammer	77-4-118	siliceous fsp-phyric dyke with sulphides; grab sample	0.008 oz/ton
34	20	Fox	77-4-117	quartz vein in felsic fragmental rock; grab sample	0.410 oz/ton
35	44	RLG,#12	77-4-91	carbonate vein in sheared rhyolite	nil
			77-4-92	quartz vein in sheared rhyolite	nil
36	45	September Morn	77-4-121	granodiorite with sulphides, host to qtz vein; grab sample	0.095 oz/ton
			77-4-122	quartz vein; grab sample	0.371 oz/ton
			77-4-123	granodiorite; from drill core, hole location unknown	0.008 oz/ton
37	18	Bengie	77-4-66	quartz vein; grab sample from near shaft	0.42 oz/ton
			77-4-67	quartz vein with abundant sulphides; grab sample from near shaft	0.75 oz/ton
			77-4-68	siliceous host to vein, with sulphides	0.04 oz/ton
			77-4-69	mafic rock, possibly a dyke, with sulphide	trace

Abbreviations used: fsp — feldspar, qtz — quartz, chl — chlorite, carb — carbonate, py — pyrite, cpy — chalcopyrite, apy — arsenopyrite, po — pyrrhotite, sph — sphalerite, v.g. — visible gold, inter. — intermediate, QP — quartz porphyry, QFP — quartz-feldspar porphyry, SAF — San Antonio Formation, v.f. or v.f.g. — very fine grained, f. or f.g. — fine grained, m.g. — medium grained, c.g. — coarse grained.

*Mineral occurrence investigated by Fedikow (1981); sample numbers, sample descriptions and analytical data previously unpublished.

TABLE GS-28-2
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED, 1985
PART A: N.T.S. AREA 52L/14

Site #	Name	Type of Occurrence	Host Rock	Nature of Mineralization	Remarks
4	Oro Grande-Solo shafts	2 capped shafts, tailings trenches	m.g. mafic igneous rocks	disseminated py in host; rare streaks of py in host near qtz veins	shear zone (about 2 m wide); py most abundant near qtz veins but few sulphides in veins; Open Assessment Files # 91347, 91399
5	Cryderman shaft	capped shaft, tailings, 5 trenches	f.-m.g. mafic igneous rocks; fsp-phyric dyke	py and cpy in qtz vein; py disseminated in foliated host; rare v.g. in qtz vein	shear zone (generally less than 3 m wide, about 400 m long) but some qtz appears to be post-shearing
6	Moore Lake shaft*	30 trenches	mafic volcanic rocks, minor inter -felsic volcaniclastics and/or dyke	py disseminated in host; py and cpy in qtz vein	several parallel shear/qtz vein zones, up to 300 m long; one possible speck of v.g. observed
7	Mandalay shaft	open shaft, 6 trenches	f.-m.g. mafic igneous rocks	disseminated py in sheared host	within shear zone-qtz veins are not abundant; largest veins present are barren and appear to be extensional in origin; examination incomplete
8	Mirage shaft*	3 trenches	f.g. mafic igneous rocks	disseminated py in sheared host	shear zone, most qtz veins appear to be post-shearing and extensional in origin; v.g. found in rubble
10	Elora shaft*	1 very large trench (more than 60 m long)	v.f.-m.g. mafic-inter. igneous rocks; fsp-physic dyke; inter. intrusive rock in immediate vicinity	qtz vein; py on fractures in host	very little exposed qtz vein remaining in trench; not clearly a shear zone, fsp-phyric dyke is not displaced across vein zone
11	Valley Vein shaft	capped shaft, 8 trenches	granodiorite/qtz diorite	disseminated py in qtz vein and sheared host; possibly apy present also	shear zone, 300 m long and up to 5 m wide but not pervasive over these widths; qtz veins less than 0.4 m wide
12	Eldorado shaft	1 capped shaft, 1 fenced shaft, 15 trenches	granodiorite/qtz diorite	py in qtz vein and weakly disseminated in host adjacent to vein	narrow shear zone (less than 2 m), 500 m long
13	Walton shaft	capped shaft, 12 trenches	qtz diorite, f.g. inter. volcanic rock	py, cpy and possibly po and apy disseminated in host and as rare veinlets within shear zones	2 parallel shear ones, up to 260 m long, with irregular qtz bodies; shear diminishes relatively abrupting upon leaving intrusive rock.
14	Gold Hill shaft*	9 trenches	v.f.-f.g. mafic-inter. volcanic rocks	disseminated py in host adjacent to qtz vein, malachite on some fractures	shear zone, weakly mineralized
15	Quartz Lake	4 trenches	f.-m.g. mafic igneous rock	py and cpy as clots in qtz veins, py disseminated in host	shear zone, about 130 m long
16	Midway	22 trenches	v.f.-f.g. mafic volcanic (some tuffaceous?) rock; QFP dyke	py weakly disseminated in some qtz veins; py and possibly cpy disseminated in QFP dyke	shear zone, less than 3 m wide, more than 500 m long; dyke appears to be partially chloritized and sericitized.
17	Ace	6 trenches	f.-c.g. mafic igneous rocks	thin (2-3 mm) py veinlets in qtz vein; py and minor cpy disseminated in vein; py disseminated in host	two short (less than 30 m) shear zones; cpy only seen in northern shear

TABLE GS-28-2 (Cont'd)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED, 1985
PART A: N.T.S. AREA 52L/14

Site #	Name	Type of Occurrence	Host Rock	Nature of Mineralization	Remarks
18	Paty I	5 trenches	f.-m.g. mafic igneous rocks	minor py disseminated in qtz vein and in host adjacent to vein	shear zone, about 100 m long; larger barren extensional qtz vein in immediate vicinity
19	Bermuda	9 trenches	v.f.-f.g. volcanic rocks; v.f.-f.g. felsic dyke	disseminated py in felsic dyke; weakly disseminated py in mafic host	shear zone, 300 m long; qtz veins and sulphides tend to be localized in felsic dyke
20	Lucky	2 trenches	f.g. mafic igneous rock	py and cpy erratically disseminated in qtz vein; py disseminated in host adjacent to vein	shear zone, less than 100 m long
21	Paty II	1 trench	mafic-inter. volcaniclastic(?);	py disseminated in host adjacent to qtz vein; minor py disseminated in host	shear zone, only exposed for 20 m
22	Golden Bird	6 trenches	m.g. mafic igneous rock	minor py disseminated in qtz vein; py locally disseminated in host adjacent to vein	shear zone, about 100 m long
23	Marie #1	6 trenches (several more at Marie #2 to east)	v.f.-f.g. laminated mafic-inter. volcaniclastics	minor py disseminated in host adjacent to qtz veins	shear zone, more than 100 m long; Marie #2 appears to be a barren, extensional qtz vein, about 100 m to east
24	M.W.	5 trenches	v.f.-m.g. mafic igneous and possibly volcaniclastic rocks	py (and po?) disseminated and as streaks in mafic host	probable shear zone, qtz vein appears to postdate shearing
25	Hope #7	light trenching and stripping	f.g. mafic volcanic rocks	py and cpy locally disseminated in qtz vein; py disseminated in host adjacent to vein	shear zone about 200 m long; qtz vein consistent along strike
26	Don I	1 trench	f.g. mafic igneous rocks	qtz vein	barren, extensional qtz vein
27	Moore Lake I	1 trench, stripping	f.-m.g. mafic igneous rocks and v.f.g. siliceous seds (or silicified host?)	py disseminated in v.f.g. siliceous rock; qtz veinlets in shear zone(?)	probable shear zone (less than 100 m long) with later qtz veining localized in v.f.g. siliceous beds (or result of silicification?)
28	North Star	10 trenches	f.-m.g. mafic igneous rocks, typically m.g.	py, po and cpy (?, only malachite observed) in fractures in qtz vein; very minor py disseminated in host	shear zone, more than 250 m long
29	Lakeshore	light trenching and stripping	f.-m.g. mafic igneous rocks, typically f.g.	rare py and cpy in qtz vein	long (more than 500 m) massive qtz vein (1-5 m wide), that appears to postdate shearing and is extensional in origin
30	Port I	4 trenches, many small pits	f.-c.g. mafic igneous rocks, typically m.g. with blue qtz eyes	po (and py?) disseminated in host; py mineralization on fracture surfaces	no evidence of shearing; qtz veins appear to be extensional in origin
31	Port II	3 trenches	f.g. mafic igneous rock	qtz vein with minor py; py disseminated in host	same as #30 (above)

Site #	Name	Type of Occurrence	Host Rock	Nature of Mineralization	Remarks
32	Port III	1 trench	f.-m.g. mafic igneous rocks	py disseminated and as streaks in host	weak folition in host but no clear evidence of shearing
33	Macketta	numerous trenches (8-15)	f.g. mafic volcaniclastic (?) rocks; qtz diorite/ granodiorite	qtz vein/shear zone; py on fracture surfaces	shear zone less than 200 m long, dies out shortly after entering intrusive rock; see map in Open Assessment File #91339
34	Eve	numerous trenches (30?), abundant stripping w/bull dozer	mafic volcanic rocks; quartzo-feldspathic seds (reworked tuffs?)	py and apy in sheared host (occasionally 10% sulphides); stibnite in qtz veins and as 1-5 cm veins	numerous discontinuous mineralized shear zones over large area (60 x 500 m); stibnite-bearing veins cut shearing zones and are extensional in origin
35	Northcliff	light trenching	mafic-inter. volcanic rocks	py on fracture surfaces; minor py disseminated in host; qtz vein	possibly a small shear zone; qtz vein postdates-shearing
36	Cliff I	1 trench	v.f.g. mafic seds/tuffs (?)	py (possibly apy and cpy also) disseminated in qtz vein and in host adjacent to vein	shear zone, with discontinuous qtz vein; exposed for less than 50 m
37	Cliff II	2 trenches	f.g. mafic volcaniclastic rock	py disseminated in qtz vein; malachite in rubble around trench	shear zone; qtz vein appears to postdate shearing; vein exposed for less than 30 m
38	Beresford I	7 trenches	felsic volcaniclastic rocks (lapilli and ash-sized units) diabasic dyke	py disseminated in host and as rare, thin (2-4 mm) veinlets within shear/qtz vein zone	shear zone, appears to be localized in finest grained felsic units in area; qtz veins appear to be extensional in origin; good exposure — in burn
39	Bear #1	light trenching, stripping	f.g. mafic igneous rock	minor py in host adjacent to qtz vein	shear zone (?), 100 m long; qtz vein appears to postdate shearing
40	Albena	2 trenches, several shallow pits	f.g. mafic-inter. volcanic and/or volcaniclastic rocks	qtz vein	no good evidence of shearing; qtz vein is barren and postdates foliation
41	Grassy Rice I	7 trenches	gabbro	minor py in sheared host adjacent to qtz vein	shear zone, less than 100 m long, with discontinuous qtz vein; extensional qtz veins occur in zone also; good exposure-in burn
42	Grassy Rice II	6 trenches	gabbro	minor py in host adjacent to largest qtz veins	combined shear/extension zone, more than 150 m long; qtz veins both parallel foliation and clearly postdate foliation; good exposure-in burn
43	Grassy Rice III	6 trenches	gabbro	minor py in host adjacent to largest qtz veins	shear zone, 150 m long, with discontinuous qtz veins; good exposure-in burn
44	Grassy Rice IV	abundant trenches and pits	gabbro	py and apy, possibly cpy also in silicified host(?) adjacent to shear/qtz vein zone	very complex area structurally, many discrete zones of shearing and extension with qtz veins and/or rusty weathering host have been pitted and trenched; examination incomplete; good exposure in burn

TABLE GS-28-2 (Cont'd)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED, 1985
PART A: N.T.S. AREA 52L/14

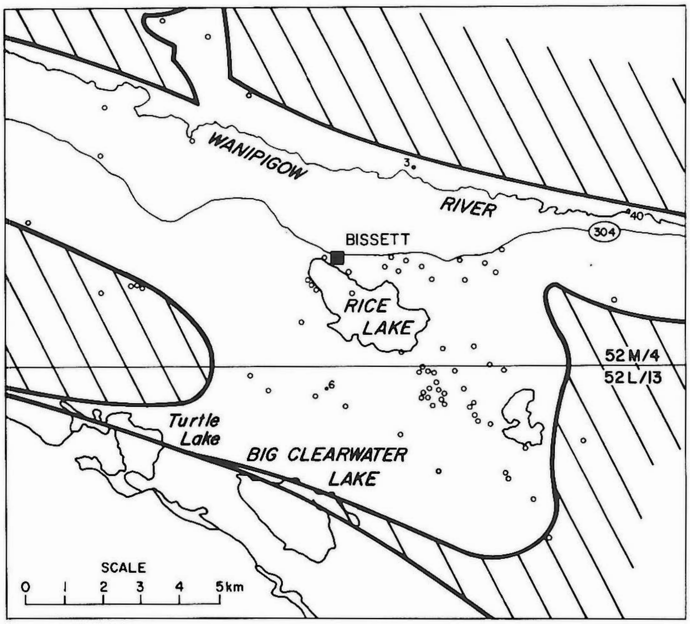
Site #	Name	Type of Occurrence	Host Rock	Nature of Mineralization	Remarks
6	Wolfe shaft*	3 trenches	fsp-rich volcaniclastic rocks	py and cpy locally disseminated in qtz veins	wide vein (3-4 m); examination incomplete but vein probably in a shear zone

PART C: N.T.S. AREA 52M/4

Site #	Name	Type of Occurrence	Host Rock	Nature of Mineralization	Remarks
3	Vanson shaft	fenced shaft, 2 trenches	sandy and silty sedimentary rocks; most siliceous, but some minor chlorite-rich beds	py disseminated in qtz vein; py disseminated in v.f.g. moderately soft sediment	no clear evidence of shearing; some qtz veins definitely extensional; generally poor exposure except in immediate vicinity of shaft
40	Brott	outcrop	f.g. seds/tuffs(?) with interbedded v.f.g. units (cherts?)	py disseminated in several v.f.g. siliceous beds	poor exposure; visible only when water level in Wanipigow River is low; offers potential for stratabound Au mineralization

Abbreviations used: fsp - feldspar, qtz - quartz, chl - chlorite, carb - carbonate, py - pyrite, cpy - chalcopyrite, apy - arsenopyrite, po - pyrrhotite, sph - sphalerite, v.g. - visible gold, inter - intermediate, QFP - quartz-feldspar porphyry, v.f. or v.f.g. - very fine grained, f. or f.g. - fine grained, m.g. - medium grained, c.g. - coarse grained.

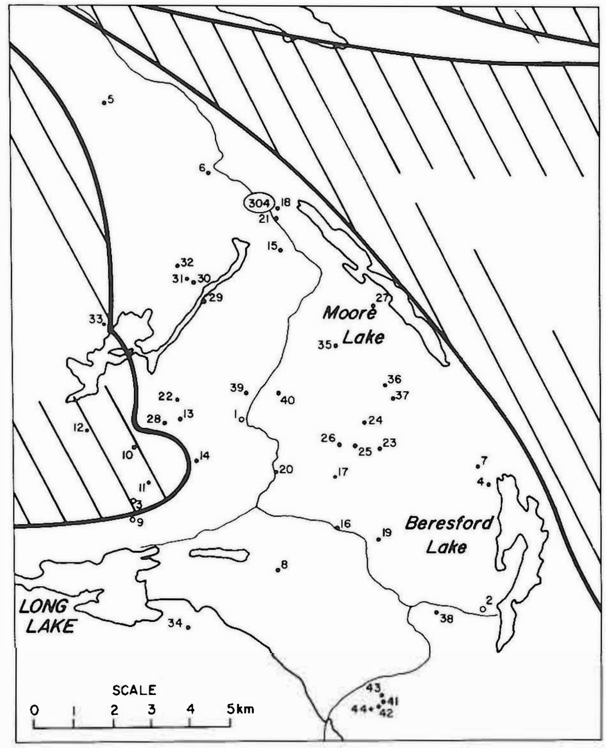
*no evidence of a mining shaft located, generally indicates a deep pit or trench (5 m)



•1 MINERAL OCCURRENCE EXAMINED IN 1985

o MINERAL OCCURRENCE PREVIOUSLY EXAMINED OR UNEXAMINED

Figure GS-28-3: *Mineral occurrence location map of the Rice Lake area.*



•1 MINERAL OCCURRENCE EXAMINED IN 1985

o1 MINERAL OCCURRENCE PREVIOUSLY EXAMINED OR UNEXAMINED

Figure GS-28-4: *Mineral occurrence location map of the Beresford Lake area.*

REFERENCES

Davies, J. F.

1953: Geology and gold deposits of southern Rice Lake, Rice Lake Mining Division; Manitoba Mines Branch, Publication 50-2, 16 p.

Fedikow, M. A. F.

1981: Mineral deposit studies - Superior Province - Southeastern Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities, p. 64-73.

1982: Mineral deposit investigations - Southeastern Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities, p. 58-59.

1983: Geochemical Studies at the San Antonio Gold Mine, Bissett, Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities, p. 107-109.

Gaba, R.G. and Theyer, P.

1984: The Gatlan gold occurrence, Wallace Lake; **in** Manitoba Mineral Resources Division, Report of Field Activities, p. 100-101.

McRitchie, W.D. and Weber, W., (eds.)

1971: Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer); Manitoba Mines Branch, Publication 71-1, 430 p.

Russell, G. A.

1952: Structural studies of the Long Lake-Halfway Lake area, Rice Lake Mining Division; Manitoba Mines Branch, Publication 49-6, 10 p.

Schmidtke, R.H.

1984: Mineral deposit documentation in the Bissett area; **in** Manitoba Mineral Resources Division, Report of Field Activities, p. 92-99.

Stephenson, J.F.

1971: Gold deposits of the Rice Lake-Beresford Lake Greenstone Belt, Southeastern Manitoba; **in** Geology and geophysics of the Rice Lake region, Southeastern Manitoba, Manitoba Mines Branch, Publication 71-1, p. 337-374.

Stockwell, C. H. and Lord, C. S.,

1939: Halfway Lake-Beresford Lake area, Manitoba; Geological Survey of Canada, Memoir 219, 67 p.

Theyer, P.

1983: Geology of gold environments in the Bissett/Wallace Lake portion of the Rice Lake greenstone belt (52M/3, 4 and 52L/14); **in** Manitoba Mineral Resources Division, Report of Field Activities, p. 101-106.

1984 Mineral deposit investigations in the Rice Lake greenstone belt; **in** Manitoba Mineral Resources Division, Report of Field Activities, p. 87-91.

Weber, W.

1971: Geology of the Wanipigow River-Manigotagan River Region, Map 71-1/4; **in** Geology and geophysics of the Rice Lake region, southeastern Manitoba (Project Pioneer); Manitoba Mines Branch, Publication **71-1**.

GS-29 MINERAL DEPOSIT INVESTIGATIONS IN THE WALLACE LAKE-SIDEROCK LAKE AREA

by R.G. Gaba

Geological studies in the Wallace Lake portion of the Rice Lake greenstone belt focussed on: (1) mineral occurrence documentation in the Wallace Lake-Siderock Lake area; (2) the Gatlan gold occurrence and; (3) investigation of the gold potential of iron formation in the Wallace Lake-Siderock Lake area.

MINERAL OCCURRENCES IN THE WALLACE LAKE-SIDEROCK LAKE AREA

Documentation of mineral occurrences in the Wallace Lake-Siderock Lake area is part of an ongoing mineral documentation program in the Rice Lake greenstone belt. Each mineral occurrence location has been plotted on an aerial photograph (at a scale of 1:16370), examined and sampled. Information collected during this program will be included in a Mineral Deposit Open File available to the public upon request.

The locations of mineral occurrences investigated are shown on Figure GS-29-1. A summary of data collected for each occurrence is presented in Table GS-29-1.

THE GATLAN GOLD OCCURRENCE

Geological studies of the Gatlan gold occurrence, initiated in 1984 (Gaba and Theyer, 1984), included detailed mapping of the occurrence and the surrounding area (Gaba, 1984).

At the Gatlan occurence gold occurs with arsenopyrite, pyrite and chalcopyrite in disseminated to massive intergrown lenses and layers in chlorite- and sericite-rich sandstone and siltstone. The gold is present as microscopic blebs of native metal along microfractures within arsenopyrite. The metallic mineral concentrations are stratabound.

Two trenches were blasted during the summer of 1985. They are located 4 m and 10 m southwest of the Gatlan Shaft across the strike of the sedimentary rocks hosting the Gatlan occurrence (see Gaba, 1984). Each trench (about 1 m to 2 m x 7 m) was sampled for geochemical and petrographic analyses. A continuous sample was taken using a portable rock saw along the length of the trench close to the Gatlan Shaft where the stratabound gold-bearing mineralized zones are exposed. The Gatlan host rock sequence (i.e. garnetiferous sandstone, iron formation and conglomerate) is restricted to the northwest part of

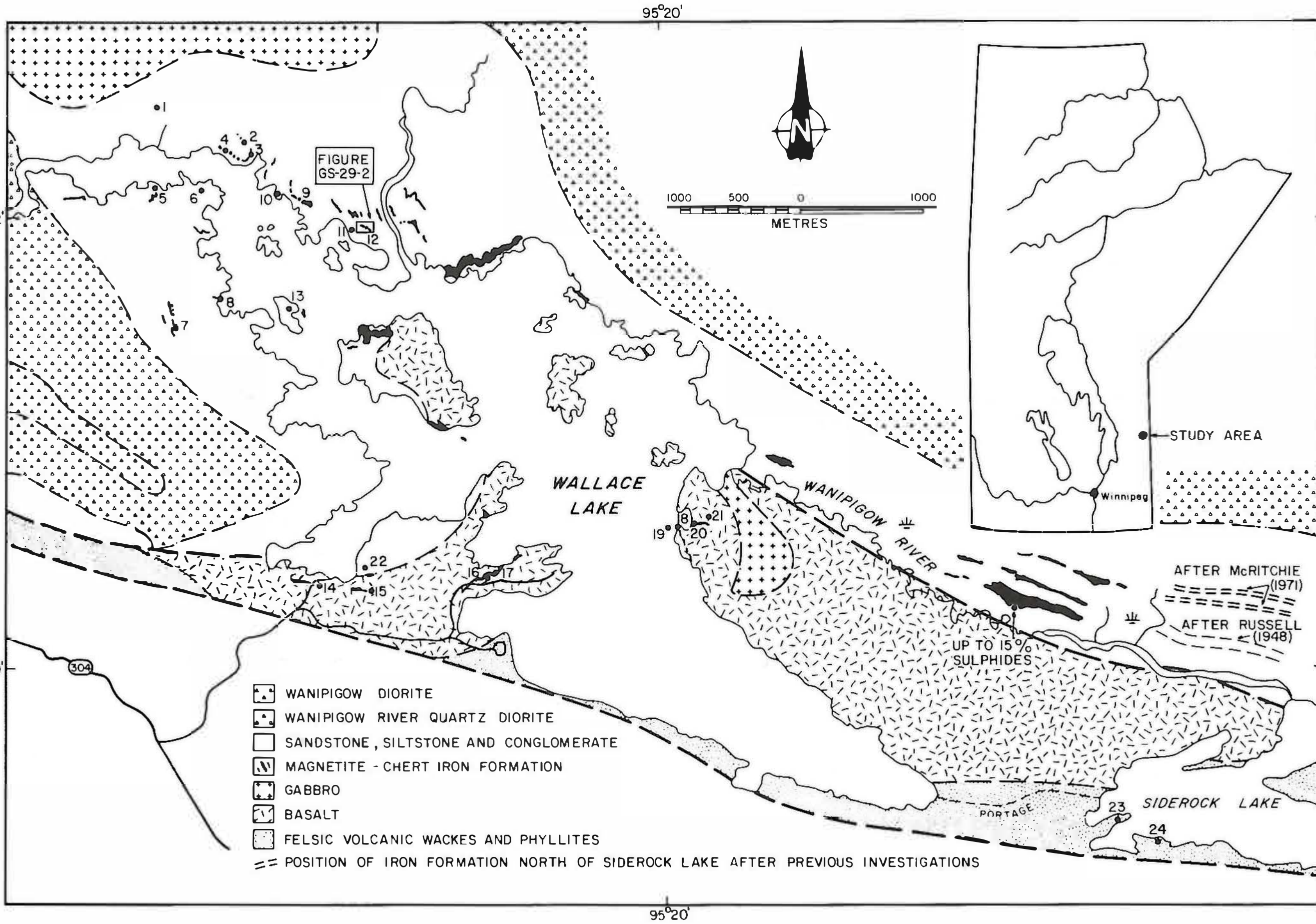


Figure GS-29-1: Mineral occurrences and iron formation in the Wallace Lake-Siderock Lake area. General geology after McRitchie (1971).

the Wallace Lake area. This sequence hosts only one other gold occurrence that is similar to the Gatlan occurrence (see Table GS-29-1: location 4).

INVESTIGATIONS FOR GOLD IN IRON FORMATION

A number of important gold deposits worldwide are hosted by Archean iron formation; some Canadian examples include the Hard Rock and MacLeod-Cockshutt Mines in the Geraldton area, Ontario, and the Lupin Mine at Contwoyto Lake, N.W.T.

Gold in iron formation-hosted deposits is intimately associated with sulphide minerals. Magnetite-chert iron formation in the Wallace Lake-Siderock Lake area contains sulphide concentrations. Iron formation in the Twin Bays area, Figure GS-29-2, consists of interlayered pyrite-chert and magnetite-chert. The pyrite-chert appears to be concentrated in the hinges of isoclinal folds where axial-planar sulphide- and fuchsite-bearing quartz veins are present. Magnetite-chert occurs in both fold hinges and limbs. Pyrite-chert grades into magnetite chert-rich areas.

Magnetite-chert iron formation north of the Wanipigow River between Wallace Lake and Siderock Lake also hosts significant sulphide mineral concentrations (Fig. GS-29-1). Up to 15% disseminated pyrite plus arsenopyrite occupy the iron formation which has a well developed foliation.

ACKNOWLEDGEMENTS

Mr. Bill Conley is thanked sincerely for his assistance in locating many of the mineral occurrences, and for his generous hospitality on numerous occasions.

REFERENCES

Gaba, R.G.
1984: Geology of the Gatlan area, Wallace Lake; Manitoba Mineral Resources Division, Preliminary Map 1984R-2.

Gaba, R.G. and Theyer, P.
1984: The Gatlan gold occurrence, Wallace Lake; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 100-101.

McRitchie, W.D.
1971: Geology of the Wallace Lake-Siderock Lake greenstone belt; Map 71-1/6; **in** Geology and geophysics of the Rice Lake region, southeastern Manitoba; Manitoba Mines Branch, Publication 71-1.

Russell, G.A.
1984: Geology of the Wallace Lake area; Manitoba Mines Branch, Publication 47-1, 15p.

San Antonio Gold Mines Ltd.
1950a: San Antonio Gold Mines drill report, Gatlan property, Wallace Lake, Manitoba; unpublished report.
1950b: San Antonio Gold Mines assay report; unpublished reports.

Stephenson, J.F.
1972: Gold deposits of the Rice Lake-Beresford Lake area, southeastern Manitoba; unpublished Ph.D. Thesis, University of Manitoba.

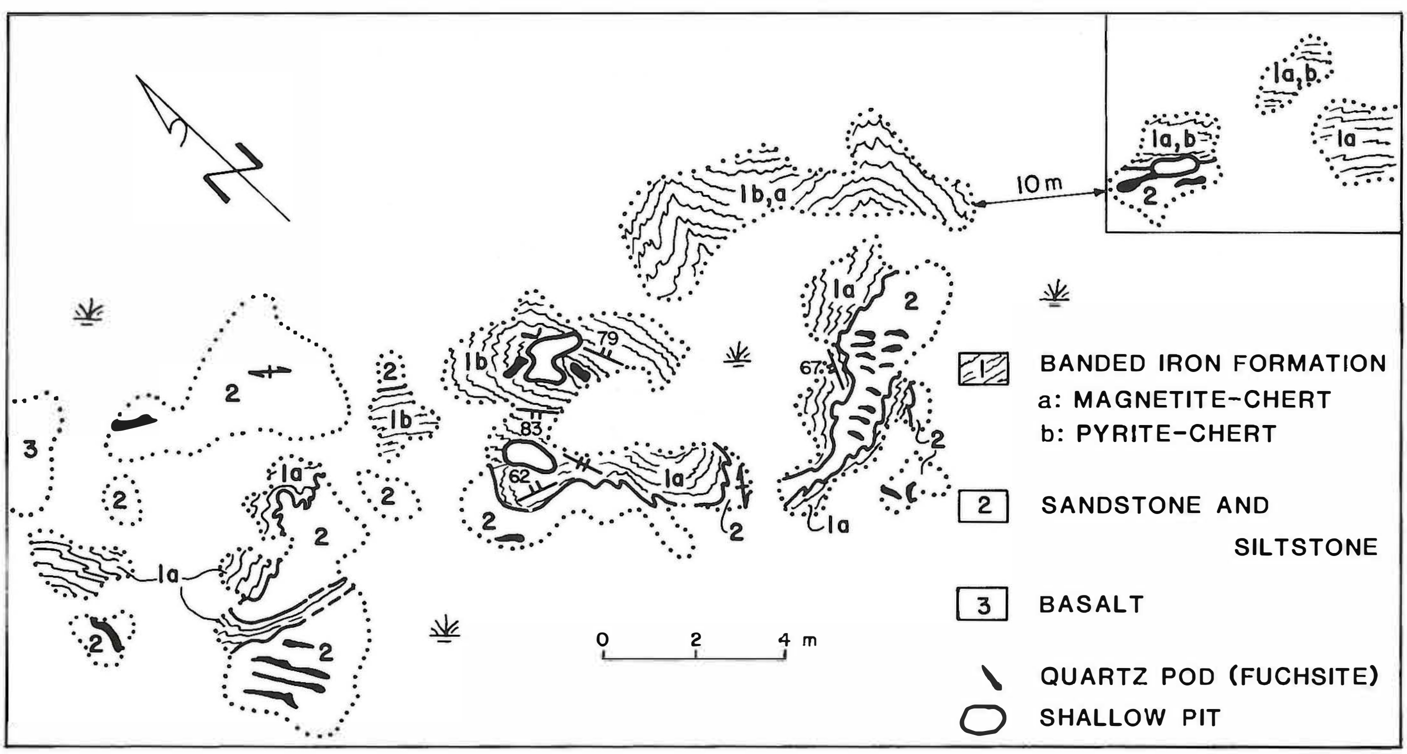


Figure GS-29-2: Geological sketch map of the pyrite-rich iron formation north of Twin Bays (see Fig. GS-29-1 for location).

TABLE GS-29-1

SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE WALLACE LAKE AREA

LOCATION DESIGNATION	TYPE OF OCCURRENCE	NATURE OF MINERALIZATION	HOST ROCKS	THICKNESS: LENGTH OF EXPOSURE	COMMENTS	REFERENCES
1	1 trench: 2 m x 2 m x 1 m	Diss. py and asp in chloritic qtz stringers and in adjacent host rock; patchy massive as accumulations	Massive to weakly foliated qtz sandstone	1 m; ?		
2 (Gatlan)	2 shafts 6 trenches 5 ddh	Massive to diss. acicular asp with py; euhedral py in grey to blue qtz veinlets; minor cp and po	Sericite- and chlorite-rich zones in garnet-bearing qtz sandstone, siltstone and pebbly feldspathic sandstone	5 m; 10 m	Mineralized zones appear to be strata-bound; reported assays up to 2 oz/ton Au	Russell (1948), San Antonio Gold Mines Ltd. Drill Report (1950a), Gaba and Theyer (1984)
3 (Moore vein)	1 trench: 2 m x 2 m x 0.5 m, 3 ddh	Diss. py in qtz vein; patchy diss. py and asp in adjacent host rock	Garnet-bearing greywacke and siltstone	0.5 m; 20 m(?)	San Antonio Gold Mines report assays as high as 1.15 oz/ton Au	San Antonio Gold Mines Ltd. Drill Report and Sample Report (1950a, b)
4	5 trenches	Diss. py and asp in qtz stringers; diss. py and asp in sheared host rock	Garnet-bearing qtz sandstone; cobble para-conglomerate; garnetiferous siltstone	1 m; discontinuous along 30 m	Reported local concentrations up to 0.50 oz/ton Au	W. Conley (Pers. Comm. 1985)
5 (Banning Trench)	1 trench: 2 m x 1 m x 1.5 m	Diss. py (with minor cp) in qtz-carbonate veins and chert layers	Magnetite-chert iron formation	0.2 m; 1 m	W. Banning reported an assay of 0.05 oz/ton Au (1930's)	W. Conley (Pers. Comm. 1985)
6	1 trench: 1 m x 1 m x 0.5 m	Veinlets and diss. of py and cp; minor po and malachite	Magnetite-chert iron formation and basalt; pebbly sandstone	1 m; 5 m	Sulphides mainly in magnetite-rich layers of iron formation	
7	4 trenches	Mo and cp in qtz stringers and adjacent host rock; irregular distribution	Garnet-bearing magnetite-chert iron formation; pebbly feldspathic sandstone; polymictic cobble paraconglomerate; small feldspar porphyry dykes	10 m; 40 m 15 m; 30 m		
8	1 trench: 2 m x 2 m x 1.5 m	Py veinlets and dissemin-ations in qtz veins	Magnetite-chert iron formation containing epidote and carbonate-rich layers	1.5 m; ?	Cp and native Cu reported	W. Conley (Pers. Comm. 1985)
9 (Boundary Zone)	2 trenches: 6 m x 2 m x 2 m; 4 m x 2 m x 1.5 m	Py veinlets and diss. in qtz veins and in adjacent host rocks	Magnetite-chert iron formation; silicified basalt (andesite ?); amphibolite	0.5-1.0 m; ?	San Antonio Gold Mines report an assay of 0.24 oz/ton Au	San Antonio Gold Mines Ltd. Assay Report (1950b)
10	1 trench: 3 m x 3 m x 1 m	Trace to diss. py	Magnetite-chert iron formation and basalt			
11 (Twin Bays 1)	1 trench: 15 m x 3 m x 2 m	Diss. py, cp, po and mt in white qtz veinlets of cp and py in qtz and host rock; massive fuchsite zones	Sheared basalt; qtz sandstone and siltstone	10 m; 50 m	Majority of qtz vein is not miner-alized; some zones reportedly yield up to 0.1 oz/ton Au.	W. Conley (Pers. Comm.)

TABLE GS-29-1 (Cont'd)
SUMMARY OF MINERAL OCCURRENCES INVESTIGATED IN THE WALLACE LAKE AREA

LOCATION DESIGNATION	TYPE OF OCCURRENCE	NATURE OF MINERALIZATION	HOST ROCKS	THICKNESS: LENGTH OF EXPOSURE	COMMENTS	REFERENCES
12 (Twin Bays IF)	3 trenches; 1 m x 1 m x 0.5 m; 1 m x 0.75 m x 0.5 m; 1 m x 0.5 m x 0.5 m	Diss. py, cp, fuchsite and garnet in qtz veins; massive m.g. euhedral py interlayered with chert — some py veinlets crosscutting chert layers	Py-chloritic chert iron formation; mt-chert iron formation; qtz sandstone and garnet-bearing siltstone	2 m; 20 m	Py-chlorite chert iron formation localized in tight fold noses of mt-chert iron formation; also see Figure GS-29-2	
13	1 trench: 8 m x 2 m x 1.5 m	F.g. py in magnetite-chert iron formation; qtz veins in basalt contain trace py	Mt-chert iron formation; basalt	1.5 m; ? up to 2 mm thick	Concordant py layers within mt-chert iron formation	
14	1 trench: 5 m x 2 m x 1.5 m	Massive to diss. m.g. to c.g. euhedral py	Mt-chert iron formation and black carbonaceous slate	5 m; ?	Up to 15% py; abundant jarosite along fracture surfaces	
15	1 trench: 7 m x 3 m x 2 m	Trace py	Mt-chert iron formation and black carbonaceous slate and chert	7 m; ?		
16	1 trench: 2 m x 1 m x 1 m	Trace py	Mt-chert iron formation			
17	1 trench: 5 m x 2 m x 1m	Trace py in qtz veins and mt-chert iron formation	Mt-chert iron formation			
18 (Lauson Pit)	1 trench: 2 m x 1 m x 1 m	Diss. py in qtz veins	Mt-chert iron formation; sheared and silicified basalt	0.3 m; ?	Reported assays up to 0.5 oz/ton Au	W. Conley (Pers. Comm., 1985)
19	1 trench: 1 m x 1 m x 1 m	Qtz-carbonate veins with minor diss. py	Mt-chert iron formation	0.7 m; ?		
20 (Vandebrink showing)	1 trench: 5 m x 1.5 m x 1.5 m	Diss. py and asp in qtz veins; py in mt-chert iron formation	Basalt and mt-chert iron formation	5 m; ?		
21	1 trench 5 m x 2 m x 1.5 m	Diss. py in qtz veins	Mt-chert iron formation; basalt	2 m; ?		
22 (Conley)	10 trenches 24 ddh	Shear with qtz stringers containing py, cp, sp, ga and native Cu; malachite and azurite encrustations	Interlayered carbonaceous slate, grey (brownish-weathering) silicified limestone and carbonaceous chert; basalt; pebbly qtz sandstone	1 m-5 m; ?	Erratic surface and drill core sample assays: up to 4 oz/ton Au and up to 186 oz/ton Ag	Stephenson (1972)
23	3 trenches	Diss. py in qtz veins	Qtz sandstone and black slate			
24	3 trenches	Trace to diss. py in qtz veinlets	Feldspathic greywacke (and felsic fragmental rock)			

py — pyrite; asp — arsenopyrite; po — pyrrhotite; cp — chalcopyrite; mt — magnetite; sp — sphalerite; ga — galena, Cu — copper; Au — gold; Ag — Silver; qtz — quartz; mo — molybdenite; ddh — diamond drill hole; f.g. — fine grained; m.g. — medium grained; c.g. — coarse grained; diss. — disseminated.

GS-30 FLUID INCLUSION STUDIES — SAN ANTONIO MINE

by D.F. Strong and G.H. Gale

Samples of quartz-vein material from the San Antonio Mine were collected by M.A.F. Fedikow as part of a study of fluid inclusions in gold-bearing quartz veins in the Bissett area. This study will complement the detailed mineralogical and geochemical studies of the San Antonio Mine, undertaken on this deposit (Fedikow, 1983).

The gold-bearing quartz veins occur within several rock types formerly referred to as "diabase" but now shown to be predominantly a sequence of volcanic rocks referred to as the San Antonio Mine unit (Theyer, 1983). This approximately 200 m thick sequence of rocks consists mainly of massive fine grained basaltic flows, minor ophitic basaltic flows, and basaltic, intermediate and felsic (rhyolitic ?) tuffaceous rocks. These volcanic rocks have undergone sericitization, silicification, carbonatization and pyritization.

Large quantities of silica were introduced into fracture systems within the San Antonio Mine unit. Samples for fluid inclusion study were collected from both stockworks and veins. The stockworks have bulbous outlines and are an anastomosing and coalescing network of veins and partially digested wall rock material. The veins are vertical to subvertical quartz sheets that cross-cut the volcanic sequence and have sharp contacts with the various rock types intersected.

Fluid inclusion studies have been completed on 50 samples of auriferous quartz. Doubly polished quartz wafers were subjected to heating and freezing experiments. A majority of the inclusions contain a liquid and a gas (CO_2) phase. Filling temperatures range from 50°C to 290°C with a majority of the inclusions yielding temperatures in the range of 200°C-250°C. This temperature range is characteristic of fluid inclusion filling temperatures in quartz from Archean gold deposits (Smith et al., 1984). The analytical data are being synthesized and will be presented at a later date.

REFERENCES

Fedikow, M.A.F.
1983: Geochemical Studies at the San Antonio Gold Mine, Bissett, Manitoba; Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 102-109.

Smith, T.J., Cloke, P.L., and Kessler, S.E.
1984: Geochemistry of fluid inclusions from the McIntyre-Hollinger gold deposit, Timmins, Ontario, Canada; Economic Geology, v. 79, p. 1265-1285.

Theyer, P.
1983: Geology of gold environments in the Bissett/Wallace Lake portion of the Rice Lake greenstone belt; Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 101-106.

GS-31 EVALUATION OF DIMENSION STONE POTENTIAL OF GRANITE ROCKS IN SOUTHEASTERN MANITOBA

by B.E. Leathers

INTRODUCTION

A project was initiated in 1985 to assess Precambrian intrusive rocks in southeastern Manitoba as potential sources of dimension stone. Abandoned quarries, test pits and exposures within one and a half kilometres of a road were examined. Sites with the features desired in a dimension stone were later documented in detail. First priority was given to the youngest intrusions in the area and then to intrusions with black, red, white, grey and pink colorations. The two producing quarries in the area (Coldspring Granite Company Limited, southwest of Lac du Bonnet on highway *11 and the Shield Quarry, 14 km northeast of Whitemouth) were also examined in order to determine the physical properties of rock suitable for use as both monument and building stone.

Some of the ideal characteristics of a suitable dimension stone are:

1) widely spaced, orthogonal, vertical joint sets and widely spaced horizontal joint sets (Fig. GS-31-1);
2) aesthetically appealing homogeneous colour;
3) homogeneous, unfoliated texture without xenoliths or clots of mafic minerals;
4) unaltered mineral constituents;
5) outcrops with high relief and an area of at least 100 m square;
6) proximity to road or railway; and,
7) an absence of sulphide and oxide minerals.

Some flaws are generally tolerated since few rock occurrences have all of these characteristics. For example, a slight foliation may not be detected on a polished surface that has been cut parallel to the plane of foliation and small xenoliths or mafic clots can be tolerated if they are distributed evenly throughout the rock. In addition, more flaws are permitted in deposits with the rarer colours than in deposits with common colours. For example, a black diorite or gabbro containing isolated grains of pyrite and closely spaced shallow dipping joint sets will probably be in greater demand than a pink granite with all of the ideal characteristics because of the high price that black rocks command on the market.

The information obtained from the sites investigated is documented in Table GS-31-1. Their locations are shown in Figures GS-31-2 and GS-31-3.

This information together with the aesthetic appeal of polished slabs from selected samples was used to determine sites for more detailed investigations as potential stone producers.

LAC DU BONNET BATHOLITH — SITES 46 AND 48

The Lac du Bonnet batholith is the youngest body of granitic rock in the study area and is a multiple intrusion (McRitchie, 1971). It extends approximately 50 km in a northeasterly direction from Lac du Bonnet to Pointe du Bois. The batholith has been extensively mapped by Atomic Energy of Canada Limited since 1979 (Tammemagi, 1979, McCrank, 1985). This intrusion is predominantly pink, massive, relatively unaltered and has a uniform medium grained porphyritic texture.

Only the grey and orange-red varieties of this rock were selected for further study since the Cold Spring Quarry already produces a "heather pink" porphyritic granite. Most of the outcrops of this batholith are orange-red or pink. These colours are attributed to iron from hydrothermal fluids moving through fractures. The orange-red granite was sampled between Lac du Bonnet and Lee River along Provincial Roads 433 and 313 and in outcrops also occurring in fields north of Beausejour (McRitchie, 1969). The rock is a medium grained porphyritic granite. At site 46 the rock exhibits three sets of widely spaced vertical joints, widely spaced horizontal joints and contains evenly spaced northeast-trending pegmatites. It has medium- to coarse-grained phenocrysts of plagioclase and potassium feldspar in a fine- to medium-grained groundmass of plagioclase, potassium feldspar, quartz and biotite. Accessory minerals are sphene, magnetite and zircon.

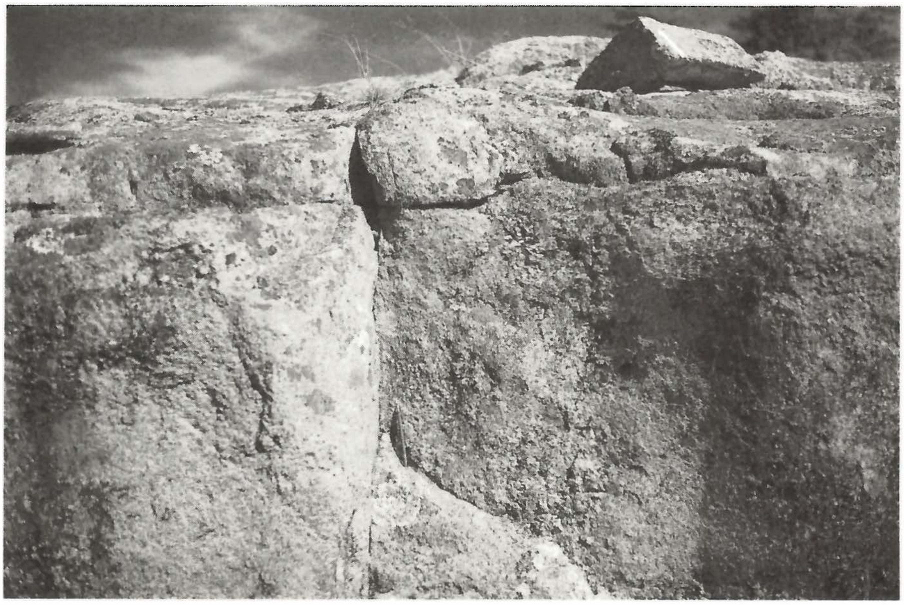


Figure GS-31-1: Vertical and horizontal jointing in the Lac du Bonnet Batholith at site 46 between Lac du Bonnet and Lee River.

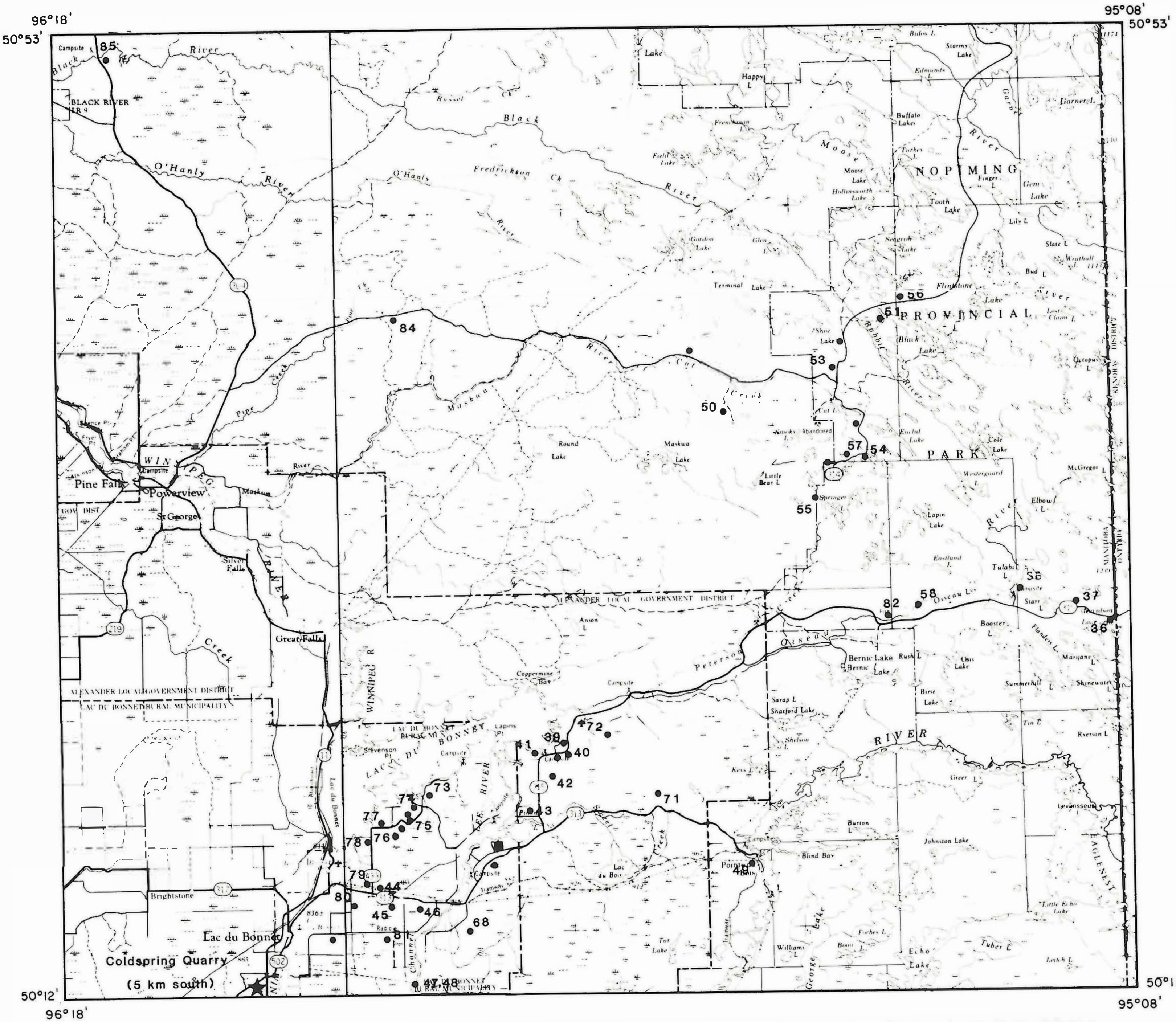


Figure GS-31-2: *Location maps for sites in the north half of the dimension stone study area. Numbered locations indicate units described in Table GS-31-1.*

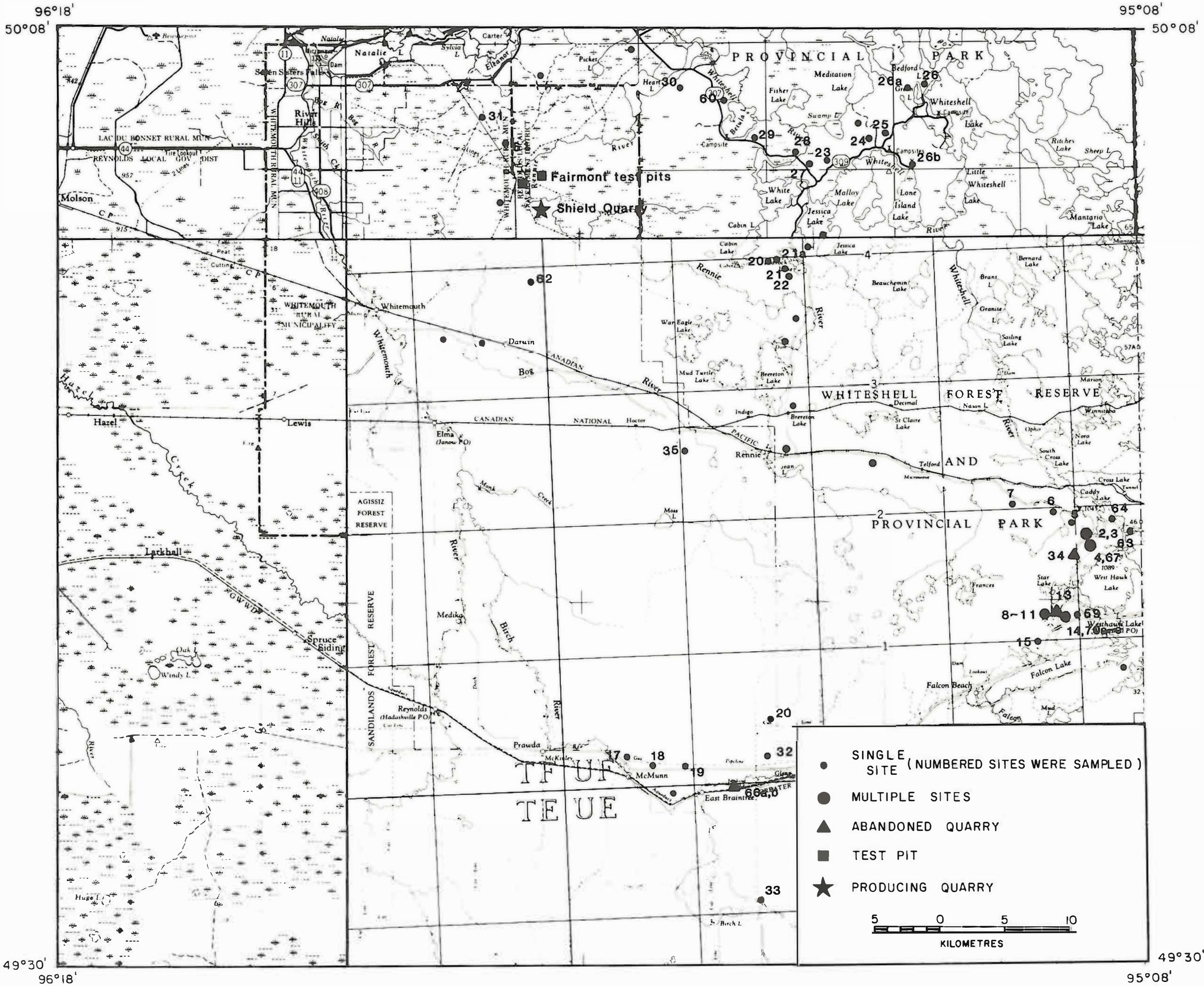


Figure GS-31-3: *Location map for sites in the south half of the dimension stone study area. Numbered locations indicate units described in Table GS-31-1.*

TABLE GS-31-1
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

SITE	ROCK TYPE	MINERALOGY	COLOUR	TEXTURE	JOINTING
2	granodiorite	plag + K-feldspar + qtz + bio	grey with patches of pink	gneissic with porphyroblasts of K-feldspar	3 vertical joint sets with 1 m spacing; 1 m spaced sheeting
3	granodiorite	plag + K-feldspar + qtz	grey-white	gneissic	
4	granodiorite	plag + k-feldspar + qtz + bio + mg	grey with patches of pink	gneissic	3 vertical joint sets with 1-2 m spacing; 1-2 m spaced sheeting
5	granodiorite	plag + K-feldspar + qtz + bio	grey with pink	gneissic with porphyroblasts of K-feldspar	vertical joint sets show 1-2 m spacing
6	granodiorite	plag + K-feldspar + qtz + bio	grey with pink	gneissic with porphyroblasts of K-feldspar	
7	granodiorite	plag + K-feldspar + qtz + bio	grey with pink	gneissic with porphyroblasts of K-feldspar	
8a,b	granodiorite	plag + K-feldspar + hbl + qtz + bio	dark grey	porphyritic	2 joint sets with 1 m spacing
9	qtz monzonite	plag + K-feldspar + hbl + qtz + bio	dark grey	porphyritic	2 orthogonal joint sets minimum spacing 5 m
10	qtz monzonite	plag + K-feldspar + hbl + qtz + bio, some scattered grains of sulphide minerals	dark grey	m.g. granitic	
11	granodiorite	plag + hbl + K-feldspar + qtz + bio	blue-grey	c.g. granitic to porphyritic	0.5-2.5 m joint spacing
13	gabbro	plag + hbl + qtz + bio, some sulphide mineral-ization	very dark grey to black	c.g. granitic	1-2 m spaced jointing (some of the joints are shallow dipping and some are vertical)
14	diorite	plag + hbl + qtz + bio	very dark grey to black	c.g. granitic	1-2 m joint spacing
15	diorite	plag + hbl + qtz + bio + sulphides	very dark grey to black	c.g. granitic	3 joint sets with up to 4 m spacing
17	granite	K-feldspar + plag + qtz + bio	dark pink	f.g. granitic with localized concen-trations of biotite	joint spacing up to 10 m
18	granodiorite	plag + K-feldspar + qtz + bio + apatite + sulphides	light grey	f.g.-m.g. granitic, slight foliation	
19	granite	K-feldspar + plag + qtz + bio	pink	f.g.-m.g. granitic with localized foliation	1-1.5 m joint spacing
20	granite	K-feldspar + plag + qtz + bio	pink	slightly foliated	joint spacing up to 4 m; 0.5-2 m sheeting
21	granite	K-feldspar + plag + qtz + bio + sphene	orange-pink and grey	porphyritic	3 vertical joint sets
22	granite	K-feldspar + plag + qtz + bio + sphene	orange-pink	porphyritic	
23	granite	K-feldspar + plag + qtz + bio + sphene	orange-pink	porphyritic	orthogonal jointing, with 2-3 m spaced sheeting

TABLE GS-31-1 (Cont'd)
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

OUTCROP FORM	ACCESS	TOPO SHEET	COMMENTS	REFERENCES
high ridge	junction of P.R. 301 and Hwy. 44	52E/14	Outcrop is variable in colour	Springer (1952) Davies (1954) Janes (1976)
10 x 10 m area located on same ridge as Site #2	junction of P.R. 301 and Hwy. 44	52E/14	Outcrop is too small for further consideration	Springer (1952) Davies (1954) Janes (1976)
high ridge	P.R. 312	52E/14	Outcrop is variable in colour	Springer (1952) Davies (1954) Janes (1976)
ridge	Hwy. 44	52E/14	Outcrop is strongly foliated. Pegmatite dykes are abundant.	Springer (1952) Davies (1954) Janes (1976)
ridge	Hwy. 44	52E/14	Outcrop is similar to that of Site #5	Springer (1952) Davies (1954) Janes (1976)
ridge	Hwy. 44	52E/14	Outcrop is similar to that of Site #5	Springer (1952) Davies (1954) Janes (1976)
small, low, poorly exposed outcrops	road to Sunbeam-Kirkland Mine	52E/11	Outcrop is part of the Falcon Lake Stock	Pers. Comm., B. Mandziuk (1985)
	road to Sunbeam-Kirkland Mine	52E/11	Outcrop is part of the Falcon Lake Stock	Pers. Comm., B. Mandziuk (1985)
ridge	road to Sunbeam-Kirkland Mine	52E/11	Outcrop is part of the Falcon Lake Stock	Pers. Comm., B. Mandziuk (1985)
low ridges	road to Sunbeam-Kirkland Mine	52E/11	Outcrop is part of the Falcon Lake Stock	Pers. Comm., B. Mandziuk (1985)
low ridge	cottagers' wood-cutting road	52E/11	Outcrop is part of the Falcon Lake Stock	Pers. Comm., B. Mandziuk (1985)
series of ridges	P.R. 301	52E/11	Outcrop is part of the Falcon Lake Stock	Pers. Comm. B. Mandziuk (1985)
high, flat, extensive outcrops	Trans-Canada Hwy. #1	52E/12	Widest joint spacing observed in the Falcon Lake Stock	Pers. Comm., B. Mandziuk (1985)
flat outcrop at ground level	behind McMunn Hotel off Hwy. #1 West	52E/12	Very few joints and surface cracks	Janes (1976)
road cut	Hwy. #1 West	52E/12	Rust stained qtz veins; dyke or xenolith of chlorite schist; numerous shallow dipping pegmatites; intruded by a pink granite	
low ridge	Access rd. to pipeline north of Hwy. #1 West	52E/12		Janes (1976)
ridges	rd. to gravel pit north of Hwy. #1 West	52E/12		Janes (1976)
ridges	ski trail behind Red Rock Lake Bible Camp	52L/2		Janes (1976)
ridge	P.R. 307 south of Red Rock Lake	52E/13	Rock is heterogeneous in both colour and texture	Janes (1976)
	P.R. 309	52L/3		Janes (1976)

TABLE GS-31-1 (Cont'd)
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

SITE	ROCK TYPE	MINERALOGY	COLOUR	TEXTURE	JOINTING
24	granite	K-feldspar + plag + qtz + bio + sphene	orange-pink	porphyritic	0.1-0.5 m spaced joints
25	granite	K-feldspar + plag + qtz + bio + sphene	red	m.g. granitic	
26,26a, 26b	granite	K-feldspar + qtz + plag + bio	red	c.g. porphyritic	orthogonal jointing with up to 8 m spacing
27	granite	K-feldspar + plag + qtz + bio	grey with pink	porphyritic	3 widely spaced joint sets
28	granite	K-feldspar + plag + qtz + bio	grey with pink	porphyritic with a slight foliation	
29	granite	K-feldspar + qtz + plag + bio	red	granitic	
30	granite	K-feldspar + plag + qtz + bio + sphene	pink	porphyritic	3 vertical joint sets, average spacing of 2 m
31	granite	K-feldspar + plag + bio	pink with black streaks	m.g. granitic with biotite schlieren	
32	diorite	plag + hbl + qtz + bio	black and green	f.g.-m.g. granitic	vertical joints with an average spacing of 1 m
33	granite	K-feldspar + plag + qtz + bio	pink to red	porphyritic	
34	granodiorite	plag + K-feldspar + qtz + bio	white with patches of pink	f.g.-m.g. gneissic	3 vertical joint sets with an average spacing of 1 m
35	granite	K-feldspar + plag + qtz + bio	red-grey	m.g. foliated with biotite schlieren	3 vertical joint sets; 0.5 m sheeting
37	granodiorite	plag + K-feldspar + qtz + bio	varies from pink to white	m.g. granitic	
38	granite	K-feldspar + plag + qtz + bio + mg	pale pink	f.g.-c.g. granitic	
39	granite	K-feldspar + plag + qtz + bio + sphene	dark pink	m.g.-c.g. foliated	4 vertical joint sets; 1 m sheeting
40	granite	K-feldspar + plag + qtz + bio + sphene + mg	dark pink	porphyritic	4 vertical joint sets; with 1-2 m spacing;
41	granite	K-feldspar + plag + qtz + bio + mg	dark pink	m.g. granitic	4 vertical joint sets with 1-2 m spacing
42	granite	K-feldspar + plag + qtz + bio + sphene + mg	pink	porphyritic	3 vertical joint sets with 1-2 m spacing
43	granite	K-feldspar + plag + qtz + bio + sphene + mg	dark pink	porphyritic	4 vertical joint sets with 2 m spacing; 1 m sheeting
44	granite	K-feldspar + plag + qtz + bio + sphene + mg	orange-pink	porphyritic	
45	granite	K-feldspar + plag + qtz + bio + sphene + mg + zircon	orange-pink	porphyritic	3 vertical joint sets with 2 m spacing; 1-3 m sheeting
46	granite	K-feldspar + plag + qtz + bio + sphene + mg + zircon	orange-pink	porphyritic	4 vertical joint sets with up to 4 m spacing; 1-3 m sheeting
47	granite	K-feldspar + plag + qtz + bio + sphene + mg	grey	porphyritic	2-3 vertical joint sets with 4 m spacing

TABLE GS-31-1 (Cont'd)
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

OUTCROP FORM	ACCESS	TOPO SHEET	COMMENTS	REFERENCES
high, flat outcrop	dump rd. north of P.R. 309	52L/3		Janes (1976)
high ridges	P.R. 309	52L/3	Very deep red colour	Janes (1976)
extensive, high flat outcrops	P.R. 309	52L/3	Very coarse grained and of a very deep red colour	Janes (1976)
small, low road-side outcrop	P.R. 307	52L/4	Alignment of phenocrysts; high biotite content	Janes (1976)
	P.R. 307	52L/4		Janes (1976)
small, low road-side outcrop	P.R. 307	52L/4	Very friable on the surface of the outcrops	Janes (1976)
rounded hill	dump rd. south of P.R. 307 between Heart Lake and Nutimik Lake	52L/4	Phenocrysts of K-feldspar are up to 5 cm in length	Janes (1976)
low ridge	fireguard rd. between P.R. 307 and Hwy. 44	52L/4	Numerous biotite schlieren	Janes (1976)
dyke	cut line north of Hwy. #1 West	52E/12	Old Glenn quarry	Janes (1976)
small rounded outcrop	P.R. 208	52E/12	Very little exposure, area is mostly swamp	Janes (1976)
ridge	P.R. 312	52E/14	Contains closely spaced pegmatites	Janes (1976) Springer (1952)
rounded ridge	Hwy. 44	52E/13	The texture is heterogeneous	Janes (1976)
hill	P.R. 315	52L/6	The colour is hetero-geneous	Cerny et al. (1981)
high ridges	P.R. 315	52L/6	Feldspars show alter-ation to epidote	Cerny et al. (1981)
high ridges	P.R. 315	52L/5	Lac du Bonnet Batholith	Cerny et al. (1981) McRitchie (1971) Tammemagi (1980)
low road cut	P.R. 315	52L/5	Lac du Bonnet Batholith	McCrank (1985)
hill	P.R. 315	52L/5	Lac du Bonnet Batholith	McCrank (1985)
20 m high ridge	P.R. 315	52L/5	Lac du Bonnet Batholith	McCrank (1985)
low road cut	P.R. 315	52L/5	Lac du Bonnet Bathloth	McCrank (1985)
5 m high ridge	P.R. 313	52L/5	Lac du Bonnet Batholith	McCrank (1985)
small roadside outcrop	P.R. 313	52L/5	Lac du Bonnet Batholith	McCrank (1985)
ridge	P.R. 313	52L/5	Lac du Bonnet Batholith	McCrank (1985)
flat shoreline area	Old Pinawa Dam Site	52L/4	Lac du Bonnet Batholith	McCrank (1985)

TABLE GS-31-1 (Cont'd)
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

SITE	ROCK TYPE	MINERALOGY	COLOUR	TEXTURE	JOINTING
48	granite	K-feldspar + plag + qtz + bio	pink	porphyritic	2 m joint spacing
49	tonalite and granite		grey intruded by pink	migmatitic	
50	gabbro	plag + serpentinized olivine and pyroxene	green	glomeroporphyritic	0.5-1 m joint spacing
51	granite	K-feldspar + plag + qtz + bio	varies from pink to white	granitic; contains xenoliths of sediments	3 vertical joint sets with 1-1.5 m spacing
52	granite	K-feldspar + plag + qtz + bio	pink	foliated; qtz-rich bands	no joint sets observed
53	granite	K-feldspar + plag + qtz + bio	pink	f.g.-m.g. granitic	3-4 vertical joint sets
54	granite, qtz diorite		pink intruded by grey	contact of two granitic rocks	
55	granodiorite	plag + K-feldspar + qtz + bio	grey-pink	m.g. granitic	
56	granite	K-feldspar + plag + qtz + bio + garnet	pink-white	f.g.-m.g. granitic	
57	diorite	plag + hbl and bio + K-feldspar + qtz	dark grey with red	m.g. granitic	1 m joint spacing
58	gabbro	plag + serpentinized olivine and pyroxene	green	glomeroporphyritic	up to 2 m joint spacing
59	gabbro	plag + serpentinized olivine and pyroxene	black	f.g.-m.g. porphyritic	1-2 m joint spacing
60	granite	K-feldspar + plag + qtz + bio + sphene	red	porphyritic	2 orthogonal, vertical joints sets
61	granite	K-feldspar + plag + bio	orange-pink	f.g.-m.g. granitic; slightly foliated; biotite schlieren	1-2 m sheeting
62	granite	K-feldspar + plag + qtz + bio	red with black streaks	biotite schlieren throughout	
63	granodiorite	plag + K-feldspar + qtz + bio	peach-pink	gneissic	
64	granite	K-feldspar + plag + qtz + bio + mg	pale pink	m.g. granitic; xenolithic	
65	granite		grey		
66a	granite	K-feldspar + plag + qtz + bio	deep pink; blue schiller on plag	pegmatitic	2 orthogonal, vertical joint sets with 1-3 m spacing
66b	granodiorite	plag + K-feldspar + qtz + bio	grey	gneissic and porphyroblastic	
67	granodiorite	plag + K-feldspar + qtz + bio + garnet	white; pink around joints and fractures	gneissic	1-3 m spacing for vertical joints; 0.5-2 m sheeting
68	granite	K-feldspar + plag + qtz + bio + sphene	grey	porphyritic; biotite schlieren	2 vertical joint sets with 4 m spacing

TABLE GS-31-1 (Cont'd)
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

OUTCROP FORM	ACCESS	TOPO SHEET	COMMENTS	REFERENCES
shoreline and ridges	Old Pinawa Dam Site	52L/4	Lac du Bonnet Batholith	McCrank (1985)
high ridge	P.R. 313 within town of Pointe du Bois	52L/5		Cerny et al (1981)
small rounded ridges	Donner Lake Rd.	52L/12		Cerny et al (1981)
	P.R. 314, south of Black Lake Campground	52L/11	Heterogeneous in both colour and texture	Cerny et al (1981)
ridge	P.R. 314, Shoe Lake wayside stop.	52L/11	Some iron staining on outcrop	Cerny et al (1981)
rounded 10 m high hills	P.R. 314	52L/11		Cerny et al (1981)
10-15 m high ridges	P.R. 314	52L/11	Outcrop surface is highly fractured. May be due to fire.	Cerny et al (1981)
low flat outcrops 1-2 m above ground level	P.R. 314	52L/11	Outcrop is heterogeneous in both colour and texture	Cerny et al (1981)
	P.R. 314	52L/11	Yellow staining on joint surfaces; pin-head sized rust spots on surface of outcrops	Cerny et al (1981)
low rounded ridges 1.5 m high	P.R. 314	52L/11		Cerny et al (1981)
islands	by boat from south shore of Bird Lake	52L/6		Pers. Comm., D. Watson (1985)
flat poorly exposed outcrop	Trans-Canada Hwy. #1	52E/11	Some white veins and sulphide mineralization throughout exposure	Pers. Comm., Bill Mandziuk (1985)
long high ridge 10-15 m high	dirt road north of Betula Lake off P.R. 307	52L/4	Similar to sample #26 but with a less vibrant colour	Janes (1976)
flat outcrop 3-4 m high.	fireguard rd. between P.R. 307 and Hwy. 44	52L/4	Heterogeneous texture	Janes (1976)
flat well exposed outcrops at road level	fireguard rd. between P.R. 307 and Hwy. 44	52L/4	Heterogeneous in colour and texture.	Janes (1976)
high extensive ridges	P.R. 312	52E/14	Heterogeneous in colour and texture.	Janes (1976) Springer (1952)
high rounded ridges and hills	P.R. 312	52E/14	Contains pegmatite pods and qtz veins	Janes (1976) Springer (1952)
low ridges and rounded hills	P.R. 308	52E/12	Very nice deep pink colour but the texture is heterogeneous	Janes (1976)
low ridges and flat outcrops	P.R. 308	52E/12		Janes (1976)
low ridges	Hwy. 44	52E/14	White to blue-grey	Springer (1952)
flat exposure	URL site south of P.R. 313 at Lee River	52L/4	Grades into pale pink xenolithic granite	McCrank (1985) Pers. Comm., Jon. Cramer (1985)

TABLE GS-31-1 (Cont'd)
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

SITE	ROCK TYPE	MINERALOGY	COLOUR	TEXTURE	JOINTING
70 (a-e)	gabbro		very dark grey to black	c.g. 'granitic'	
71	granite	K-feldspar + plag + qtz + bio + garnets	white to grey	pegmatitic	
72	granite	K-feldspar + plag + qtz + bio + garnets	grey	pegmatitic; gneissic	
73	granite		pink	foliated	3 vertical joint sets with 0.5-1 m spacing
74	granite		pink	m.g.-c.g. granitic	3 vertical joint sets
75	granite		pink	porphyritic; biotite schlieren in road cut	
76	granite		pink	porphyritic; biotite schlieren	2 vertical joint sets with 0.1-1 m spacing
77	granite		pink	porphyritic	
78	granite		pink	porphyritic	
79	granite		pink	porphyritic	
80	granite		pink	porphyritic with some biotite schlieren	
81	granite		pink	porphyritic	3 orthogonal, vertical joint sets with 2 m spacing
82	granite	K-feldspar + plag + qtz + bio + accessories	pale pink	m.g. granitic	2 vertical joint sets with 2 m spacing; 1-3 m sheeting
83	granite	no sample taken	pale pink to white	gneissic	
84	granite	K-feldspar + plag + qtz + bio	dark pink with black and grey xenoliths	xenolithic; f.g.-m.g. granitic	2 vertical joint sets with up to 2 m spacing
85	granodiorite	plag + K-feldspar + qtz + bio + msc	blue-grey to white; pink coloration around joints and pegmatites	m.g.-c.g. granitic	3 vertical joint sets with 2 m spacing

Footnote:
Abbreviations: bio — biotite; hbl — hornblende; K-feldspar — potassium feldspar; mg — magnetite; msc — muscovite; plag — plagioclase; qtz — quartz
f.g. — fine grained; m.g. — medium grained; c.g. — coarse grained
Hwy. — Highway; P.R. — Provincial Road; rd. — road

The grey variety of this rock is considered to be the pristine form of the batholith. Its fracture density is lower than that of the pink granite and therefore it underwent less alteration from hydrothermal fluids (Jon Cramer, AECL, Pers. Comm. 1985).

The grey variety is known to outcrop at four localities:- Location 47, the Old Pinawa Dam Site; Location 68, the AECL Underground Research Lab lease area; and sites 71 and 72 east of the junction of Provincial Roads 313 and 315. This rock is mineralogically and chemically similar to the pink granite of the batholith. It consists of microcline, plagioclase, quartz and biotite with sphene, magnetite and apatite as accessory minerals (McCrank, 1985). The colour is a distinctive grey on polished surfaces. The texture is medium grained porphyritic. The occurrence on AECL's lease locally contains streaks and clots of biotite. Outcrops of the grey granite have been mapped by McCrank (1985).

QUARTZ MONZONITE — SITES 61 and 86

This intrusion is a fine- to medium-grained quartz monzonite with compositional banding and scattered biotite schlieren. Frontenac Granite (1979) produces a fine grained pink dimension stone from this body at the Shield Quarry. Dark brown-pink rock of the same intrusion (site 61) was tested by Fairmont Granite Company and deemed suitable for building stone (B. Bannatyne, Pers. Comm., 1985). A dark red medium- to coarse-grained rock (site 86) was also tested near the Shield Quarry.

TABLE GS-31-1 (Cont'd)
DESCRIPTIONS OF SITES EXAMINED FOR DIMENSION STONE IN SOUTHEASTERN MANITOBA

OUTCROP FORM	ACCESS	TOPO SHEET	COMMENTS	REFERENCES
series of parallel ridges	Outcrops are located between P.R. 301 and Hwy. #1.	52E/11	Colour and texture do not change across the series of ridges, but the strikes of the joint sets do change	Pers. Comm., B. Mandziuk (1985)
low ridge	Hwy. 313	52L/5	Heterogeneous in texture; garnets throughout	McCrank (1985)
high extensive ridges	Tall Timber Lodge airfield runway off P.R. 315.	52L/5	Outcrop contains pods and dykes of pegmatites that are up to 4 m in width	McCrank (1985)
	P.R. 433	52L/5		McCrank (1985)
	P.R. 433	52L/5		McCrank (1985)
	P.R. 433	52L/5		McCrank (1985)
	P.R. 433	52L/5		McCrank (1985)
	P.R. 433	52L/5	Some variation in grain size	McCrank (1985)
road cut	P.R. 433	52L/5		McCrank (1985)
	P.R. 433	52L/5		McCrank (1985)
old quarry	P.R. 313	52L/5		McCrank (1985)
rounded ridges	P.R. 313	52L/4		McCrank (1985)
high ridges and hills	rd. to firetower north of P.R. 315 by Bird Lake	52L/6	Alteration of feldspars	Cerny et al (1981)
high ridges	Maskwa Lake Rd. and Cat Lake Rd.	52L/12	Heterogeneous in colour and texture	Cerny et al (1981)
extensive hills and ridges	Cat Lake Rd.	52L/12		Cerny et al (1981)
low poorly exposed outcrops	P.R. 304	62I/16	Contains some xenoliths of mica schist	McRitchie (1969)

BLACK RIVER — SITE 86

A medium- to coarse-grained granodiorite outcrops along Provincial Road 304 at the Black River bridge. The rock is white in colour and consists of plagioclase, microcline, quartz, biotite and muscovite. The outcrop extends for at least 80 m east of the highway and 80 m south of the bridge.

The rock contains only two subvertical joint sets and horizontal joints are not obvious on any of the outcrops. Iron staining occurs around fractures, and shallow dipping pegmatites and large xenoliths of mica schist are present.

RED MICROCLINE GRANITE — LOCATION 26

A coarse grained red microcline granite occurs in the vicinity of Big Whiteshell Lake (Janes, 1976). An outcrop northeast of Green Lake was selected for detailed study. The rock is massive and coarse grained (up to 3 cm). It is composed of deep red subhedral to euhedral microcline, smoky quartz, anhedral plagioclase and biotite. Accessory minerals are magnetite and sphene. Carlsbad twinned microcline gives the polished slab an attractive sparkle. Widely spaced (1 to 4 m) horizontal joints and three widely spaced (2 to 7 m) vertical joint sets were noted.

STAR LAKE — SITES 16 and 63

Site 16 is an abandoned quarry in gabbroic rocks of the Falcon Lake Stock that was quarried by L.H. Sprange from 1938 to 1952 under the name "Winblack granite". This rock is very black when polished due to the translucence of the plagioclase crystals that allows the dark colour of the mafic minerals to show through them. However, this rock includes some sulphide mineralization and contains shallow dipping joints. Although extensive areas of the Falcon Lake stock were examined the most attractive black rock is that occurring at the old quarry site.

A fine grained gabbro within the stock (site 63) was also studied. The outcrop is flat, poorly exposed and extends approximately 250 m north from the Trans-Canada Highway with a width of approximately 150 m along the highway. This rock is porphyritic, has a joint spacing of up to 2 m, and polished samples have an attractive appearance.

EAST BRAINTREE (SITES 66a AND 66b)

Two abandoned quarries at East Braintree were mapped and sampled. One is a grey porphyroblastic, gneissic granodiorite that was quarried by the Brookeville Granite Company in the early 1900's under the name "St. Cloud Grey". The rock contains xenoliths of mafic material and has a strong foliation. The other quarry is in a dark pink pegmatitic granite that intrudes the granodiorite. This rock was quarried by the Brookeville Granite Company under the name "Oxblood". The plagioclase crystals of the granite are peristeritic, showing a blue schiller in bright light; however, the rock is heterogeneous in texture and contains large books of biotite.

A brochure will be produced by the Regional Mineral Division of the Mineral Policies Section of the Canada Department of Energy and Mines under sector 'C' of the Canada-Manitoba Mineral Development Agreement.

This brochure will contain library quality photographs of flamed, honed and polished samples from the presently producing dimension stone quarries and six other sites selected during the course of this study. Small, flamed, honed and polished samples will be available on request.

REFERENCES

Cerny, P., Trueman, D.L., Ziehlke, D.V., Good, B.E., and Paul, B.I.
1981: The Cat Lake-Winnipeg River and the Wekusko Lake Pegmatite Fields, Manitoba; Manitoba Department of Energy and Mines, Economic Geology Report ER80-1.

Davies, J.F.
1952: Geology of the Oiseau (Bird) River area; Manitoba Mines Branch, Publication 51-3.
1954: Geology of the West Hawk Lake, Falcon Lake Area; Manitoba Mines Branch Publication 53-4.

Janes, D.A.
Preliminary Maps; Manitoba Mineral Resources Division.

Kamineni, D.C., Dugal, J.J.B., and Ejeckan, R.B.
1984: Geochemical investigations of granitic core samples from boreholes at the Underground Research Laboratory Site near Lac du Bonnet, Manitoba; AECL Report TR-221.

McCrank, G.F.D.
1985: A Geological Survey of the Lac du Bonnet Batholith, Manitoba; AECL Report AECL-7816.

McRitchie, W.D.
1969: Project Pioneer Extension; Manitoba Mines Branch, Preliminary Maps 1969F-1 to 1969F-7.
1971: The petrology and environment of the acidic plutonic rocks of the Wanipigow-Winnipeg Rivers region, Southeastern Manitoba; Manitoba Mines Branch, Publication 71-1, Report 2, p. 7-61.

Springer, G.D.
1952: Geology of the Rennie-West Hawk Lake Area; Department of Mines and Natural Resources, Publication 50-6.

Stone, D., Kamineni, D.C., and Brown, A.
1984: Geology and fracture characteristics of the Underground Research Laboratory Lease near Lac du Bonnet, Manitoba; AECL Report TR-243.

Storey, C.C.
1984: Preliminary Report of the Building and Ornamental Stone Inventory, Part 2, Kenora and Rainy River Districts; Ontario Geological Survey Open File Report 5522.

Tammemagi, H.Y., Kerford, P.S., Requeima, J.C., and Temple, C.A.
1980: A Geological Reconnaisance Study of the Lac du Bonnet Batholith; AECL Report G439.

GS-32 CROSS LAKE SUPRACRUSTAL INVESTIGATIONS IN THE EASTERN PIPESTONE LAKE AREA

by M.T. Corkery

Geological mapping at a scale of 1:20000 was initiated two years ago (Corkery, 1983, Corkery and Lenton, 1984) in conjunction with rare element pegmatite studies (Lenton and Anderson, 1983) and titanium-vanadium investigations in the Pipestone Lake Intrusive Complex (Cameron, 1984). Mapping in 1985 extended coverage to the east end of Pipestone Lake (Preliminary Map 1985N-2).

GENERAL GEOLOGY

The major geologic events, documented in the Cross Lake area, are summarized in Table GS-32-1. Figure GS-32-1 shows the distribution of major units and tectonic zones in the Pipestone Lake area.

The **late metasedimentary rocks** (Corkery 1983) have been consistently documented as unconformably overlying the **early supracrustal rocks** and an early tonalite intrusion on the north tip of Cross Island. It is suggested that the name Cross Lake group be applied to the sequence of **late metasedimentary rocks** which includes subareal-fluvial metasediments (Units 5, 6, 8 and 9 on Preliminary Maps 1984N-2, N3 and 1985N-2) felsic fragmentals and associated rocks (Unit 7 Preliminary Map 1984N-2) and basalt (Unit 9d, Preliminary Map 1985N-2). As yet no group name has been suggested for the **early supracrustal rocks** (Units 1 and 2 on Preliminary Maps 1984N-2, N-4 and 1985N-2). Horwood (1934) included the early volcanic-sedimentary rocks in the Hayes River series; however, evidence of correlation of these rocks to the Hayes River group defined by Hubregtse (1985) and Gilbert (1985) in the Oxford-Knee-Gods Lakes area has yet to be documented.

At Pipestone Lake basalts of the **early supracrustal rocks** occur on the north and south shores. Preservation of primary structures and stratigraphy is very good in the large bay on the northeast side of the lake. The west shore, islands and peninsulas are underlain by Cross Lake group rocks. The contact between **early supracrustal rocks** and the Cross Lake group, in all but two locations where unconformable relationships are observed, is defined by major fault zones (Fig. GS-32-1).

TABLE GS-32-1: ORDER OF GEOLOGICAL EVENTS: CROSS LAKE AREA

11	Late faulting shown by fault breccia, pseudotachylite and erratic foliation developed in some Molson dykes.
10	Intrusion of the Molson dyke swarm into major shear zones.
9	Periodic reactivation of shear zones and minor folding.
8	Intrusion of late granitoid plugs and pegmatites, largely controlled by major linear shear zones.
7	Peak of thermal metamorphism
6	Intrusion of major granitoid batholiths with concomitant folding and activation of major linear shear zones.
5	Intrusion of small gabbro-diorite dykes and plugs.
4	Deposition of Cross Lake group metasediments and metavolcanics.
3	Uplift and erosion of **early supracrustal rocks**, tonalite batholiths and early layered gneisses.
2	Intrusion of Pipestone Lake layered anorthosite-gabbro and later tonalite batholiths.
1	Development of **early supracrustal rocks.**

Two major zones of ductile-brittle deformation converge toward the east end of Pipestone Lake. The zone along the north shore, which trends about 315°, is rarely more than 200 m wide and, where observed, affects only basalts of the **early supracrustal rocks**. In most outcrops primary features such as pillows are recognizable but extremely flattened with discrete 20 cm to 5 m wide ductile shear zones. Deformation along the south shore is more severe in a belt striking 285° which exceeds 500 m in width in some areas. Mafic volcanic rocks (Unit 1) and anorthosite-gabbro (Unit 3) are the major rock types affected; however, they are locally tectonically interlayered with sandstones and siltstones (Units 8 and 9). Primary features are rarely preserved and basalts outcrop as finely laminated and layered amphibole schists. In many outcrops this lamination is disrupted to form augen-bearing cataclastic rocks (Fig. GS-32-2).

UNIT DESCRIPTIONS

The major units and characteristic features are briefly summarized in Table GS-32-2. More detailed unit descriptions are contained in previous field reports (Corkery, 1983, Corkery and Lenton, 1984). Unit descriptions in this report are restricted to previously described or new units and subunits, for which new data have been collected.

BASALT (1)

A section of pillowed and massive flows approximately 1400 m thick is exposed along the northeast shore of Pipestone Lake. These basalts are best preserved on the southwest-facing limb of an open fold which conforms with the shoreline embayment on the north shore of the lake (Fig. GS-32-3).

Preservation of primary features is somewhat variable throughout this region but for the most part is very good. A number of north- to northeast-trending ductile shear zones offset the stratigraphy shown in Figure GS-32-3 and this complicates the lateral extrapolation of most beds. However, one massive flow approximately 110 m thick forms an excellent marker horizon which has been traced for about 6 km (Fig. GS-32-3). Figure GS-32-4 shows a composite section (AA', Fig GS-32-3) which depicts the major variations in primary features in the basalt sequence and the lateral extent of these features is shown, where possible, on Figure GS-32-3.

Flows are generally from 5 to 15 m thick with a few up to 40 m thick. The thickest flow is 110 m thick. Pillowed basalt is the most abundant with subordinate massive basalt and amoeboid pillows in flow-top breccia. The organization of flows displays many of the characteristic features described by Dimroth et al. (1978) and Baragar (1984). Individual flows commonly consist of several divisions distinguished by primary structures. Flows with a massive base and pillowed upper segment, containing irregular megapillows, as well as flows with a pillowed base and a massive central zone capped by flow-top breccia are common. Simple flows composed solely of pillowed basalt or massive basalt also are abundant.

Pillow form and size vary significantly and display many of the characteristics described by Dimroth et al. (1978). Selvages are typically 3 to 5 mm thick with hyaloclastite either absent or filling the triple junctions near the base of the sequence (Fig. GS-32-5). There is a tendency toward thicker selvages (up to 1 cm) and more abundant intrapillow hyaloclastite and breccia higher in the sequence (Fig. GS-32-6). Vesicularity is highly variable from flow to flow but is generally absent in the lower portion of the section, and is only sporadically developed in the upper 400 m of the section. Pipe vesicles, rarely observed around

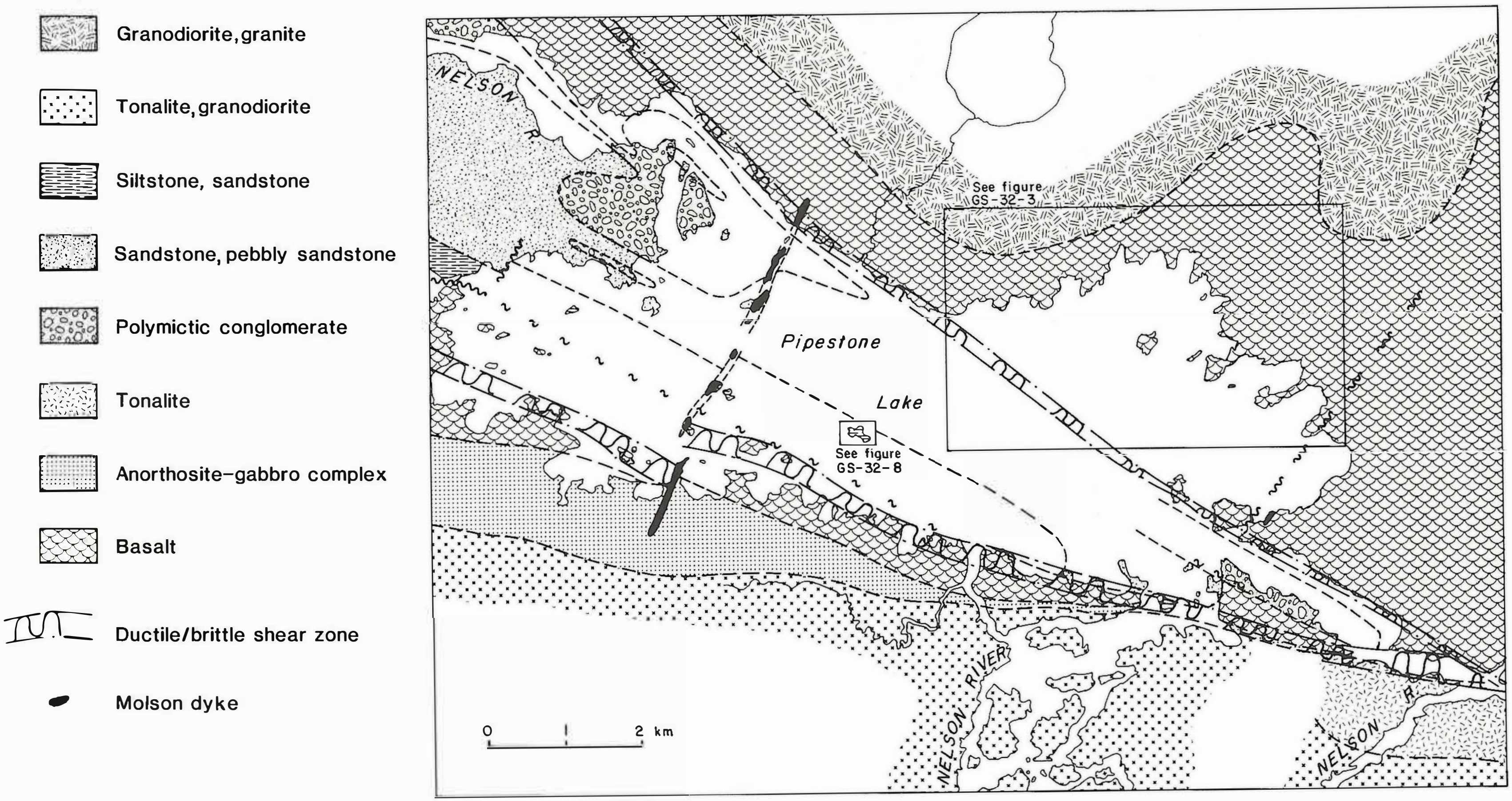


Figure GS-32-1: *Simplified geological map of the Pipestone Lake area.*

Figure GS-32-2: Tectonized basalt (unit 1) from the major ductile-brittle fault zone on the south shore of Pipestone Lake.

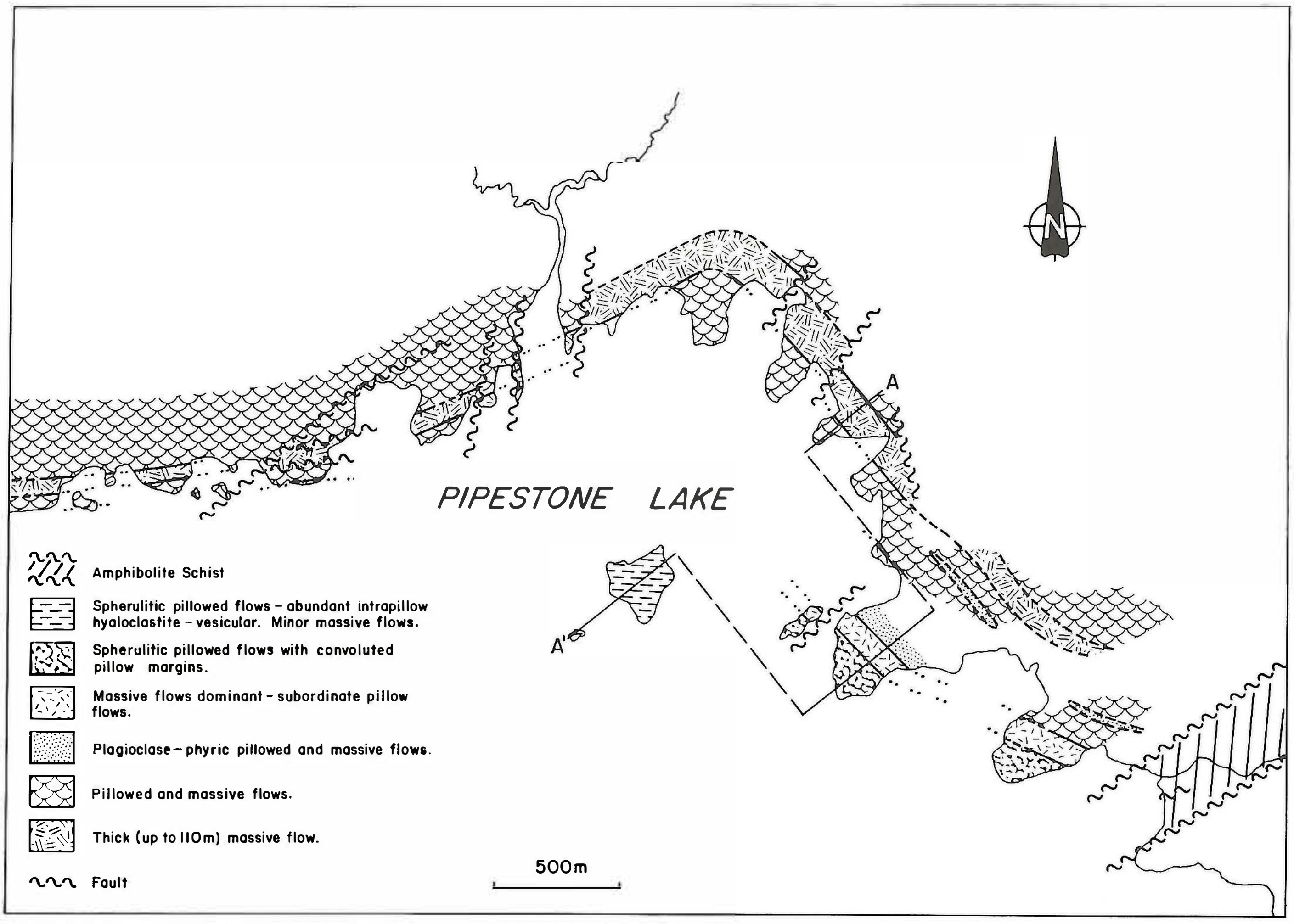


Figure GS-32-3: Structure and stratigraphy of basalt (unit 1) in the northeast Pipestone Lake area. Location shown on Figure GS-32-1.

TABLE GS-32-2 TABLE OF FORMATIONS, CROSS LAKE AREA

PRECAMBRIAN			
PROTEROZOIC			
Molson Swarm	20	Mafic dykes	
ARCHEAN			
	19	Pegmatitic granite and pegmatite	19a) leucocratic granite, 19b) pegmatitic leucocratic granite, 19c) rare-element-enriched pegmatite
Core Granite	18	Seriate leucogranite	
	17	Porphyritic leucogranodiorite and granite	
Young Intrusive Group	16	Massive granodiorite	
	15	Porphyritic grey granodiorite	
Eves Rapids Complex	14	Porphyritic hornblende granodiorite and tonalite	
Clearwater Bay Complex	13	Tonalite	
Whiskey Jack Complex	12	Augen-granodiorite	
North Plug	11	Quartz-feldspar porphyry	
	10	Gabbro, diorite	
	9	Metamorphosed shale and silty shale	
	8	Metasandstone metasiltstone minor calcarenite, porphyritic metabasalt	8a) muscovite-sillimanite-bearing lithic greywacke, 8b) muscovite-bearing feldspathic sandstone 8c) quartzite, 8d) porphyritic basalt, 8e) volcanogenic sediments
CROSS LAKE GROUP	7	Felsite porphyry and felsic metasediments	7a) felsite porphyry, 7b) fragmental felsite, 7c) felsite fragment conglomerate, 7d) felsic sandstone and siltstone
	6	Metasandstone, pebbly metasandstone	6a) quartz-rich arkosic sandstone and pebbly sandstone, 6b) feldspar-rich arkosic sandstone, 6c) lithic sandstone
	5	Polymictic metaconglomerate	5a) regolith, 5b) basal polymictic conglomerate, 5c) sand matrix polymictic conglomerate, 5d) polymictic conglomerate with a dominance of grey feldspar porphyry clasts, 5e) polymictic conglomerate with a dominance of mafic volcanic clasts
Early Plutonic Rocks	4	Tonalite	4a) leucocratic quartz-biotite tonalite, 4b) biotite ± hornblende tonalite
	3	Mafic-ultramafic intrusive rocks	3a) mafic dykes and sills, 3b) anorthosite, leucogabbro, 3c) metagabbro, 3d) layered ultramafic sill
Early Supracrustal	2	Metasedimentary rocks	2a) volcanic conglomerate, 2b) metagreywacke, 2c) iron formation
Rocks	1	Mafic metavolcanic rocks	1a) pillowed and massive flows, 1b) pillowed and massive plagioclase-phyric flows, 1c) oligomictic flow breccia, 1d) layered amphibolite, 1e) chlorite-talc schist

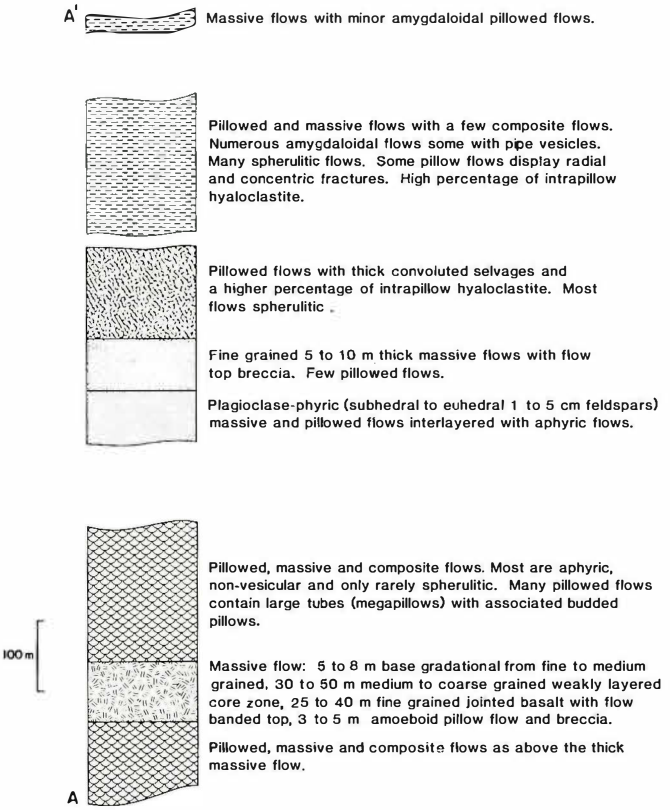


Figure GS-32-4: Cross-section through the basalts (unit 1) (A-A' Figure GS-32-3) describing the major variations in primary features.

the margins or upper margins of pillows, range in size from 1 to 3 mm by 5 mm to 2 cm. Vesicles are filled with quartz and carbonate ± epidote.

Multiple drainage cavities occur within some pillows, and megapillows with reentrants of pillow crust and abundant budded pillows (Fig. GS-32-5), suggest tube structures through which lava flowed.

Flow-top breccias are common in massive flows but are rare in pillowed flows. They consist of amoeboid pillows, pillow fragments and hyaloclastite (Fig. GS-32-7).

BASALT (8d)

Six massive flows ranging from 5 to 10 m thick, interbedded with volcanogenic sediments (8e) and overlain by trough-crossbedded pebbly sandstone (8a), occur on an island in central Pipestone Lake. This isolated occurrence represents the only association of mafic volcanic rock interbedded with fluvial sediments in the map area and preliminary interpretation is that this sequence is part of the younger Cross Lake group.

The flows are fine grained amphibole and plagioclase-phyric basalt. The ground mass consists of very fine grained amphibole, epidote, biotite and minor plagioclase and quartz. Fine disseminated carbonate and quartz-carbonate veins occur throughout the basalt. Rhombic black pseudomorphs, ranging in size from 1 to 5 mm, form 1 to 3 per cent of the rock. These are comprised of optically continuous clinoamphibole intergrown with biotite and epidote. Feldspar phenocrysts occur in all flows and vary significantly in size and abundance. In sparsely feldspar-phyric flows phenocrysts 0.5 to 1 mm in size form less than 1 per cent of the rock; 3 to 5 mm feldspar phenocrysts form a maximum of 4 per cent in other flows.

VOLCANOGENIC SEDIMENT (8e)

Interbedded with the massive basalt (8d) is a sequence of metasediments (8e) which are derived predominantly from basalts of the same compositon as subunit 8d. The sediments are comprised of siltstone, sandstone and pebble to pebble-cobble oligomictic and polymictic conglomerates.

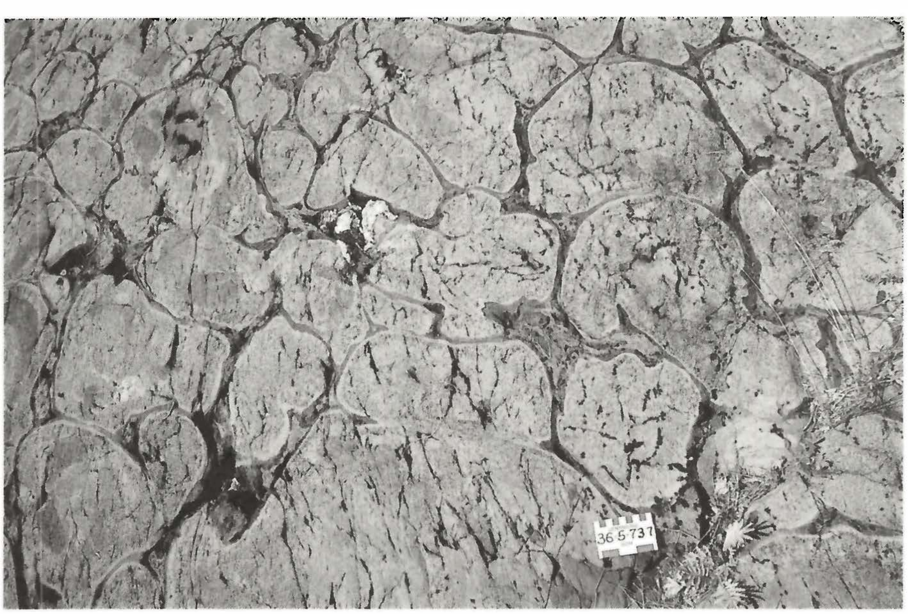


Figure GS-32-5: Pillowed basalt (unit 1) with thin pillow selvages, minor intrapillow hyaloclastite and numerous budded pillows.

Figure GS-32-6: *Pillowed basalt (unit 1) with convoluted pillow margins and thick intrapillow hyaloclastite.*

The siltstones-sandstones form discrete 2 to 20 cm thick layers. On the weathered surface the rock varies from olive-green to green-grey, and on the fresh surface it is green-grey. It is comprised of 0.5 mm or smaller, black to pale green lithic grains in a fine grained pale to dark green matrix with a few per cent feldspar grains. Compositionally it is similar to the basalts (8d).

Massive and graded-bedded, immature sandstones and pebbly oligomictic matrix-supported conglomerates form the bulk of the sequence (Fig. GS-32-8). Bedding ranges from 2 cm to 2.5 m thick. Beds in the lower portion of the section are massive; higher in the section they are frequently normally graded and may have a parallel laminated top (Fig. GS-32-9). Grain size ranges from fine sand to granule with up to 15 per cent 3 to 4 cm angular pebbles in beds in excess of 1 m thick. The matrix and coarse clasts are derived exclusively from phyric basalts similar to the massive flows (Unit 8d).

Polymictic, matrix-supported and rare clast-supported conglomerates occur as 1 to 3 m thick lenses or layers. The matrix is the same immature sandstone as described above. Angular clasts of basalt up to 6 cm are common as well as well rounded 3 to 30 cm light brown weathering, feldspar-phyric, intermediate volcanic clasts.

Figure GS-32-7: *Flow top of 110 m thick massive basalt flow comprised of amoeboid pillows, pillow breccia and hyaloclastite.*

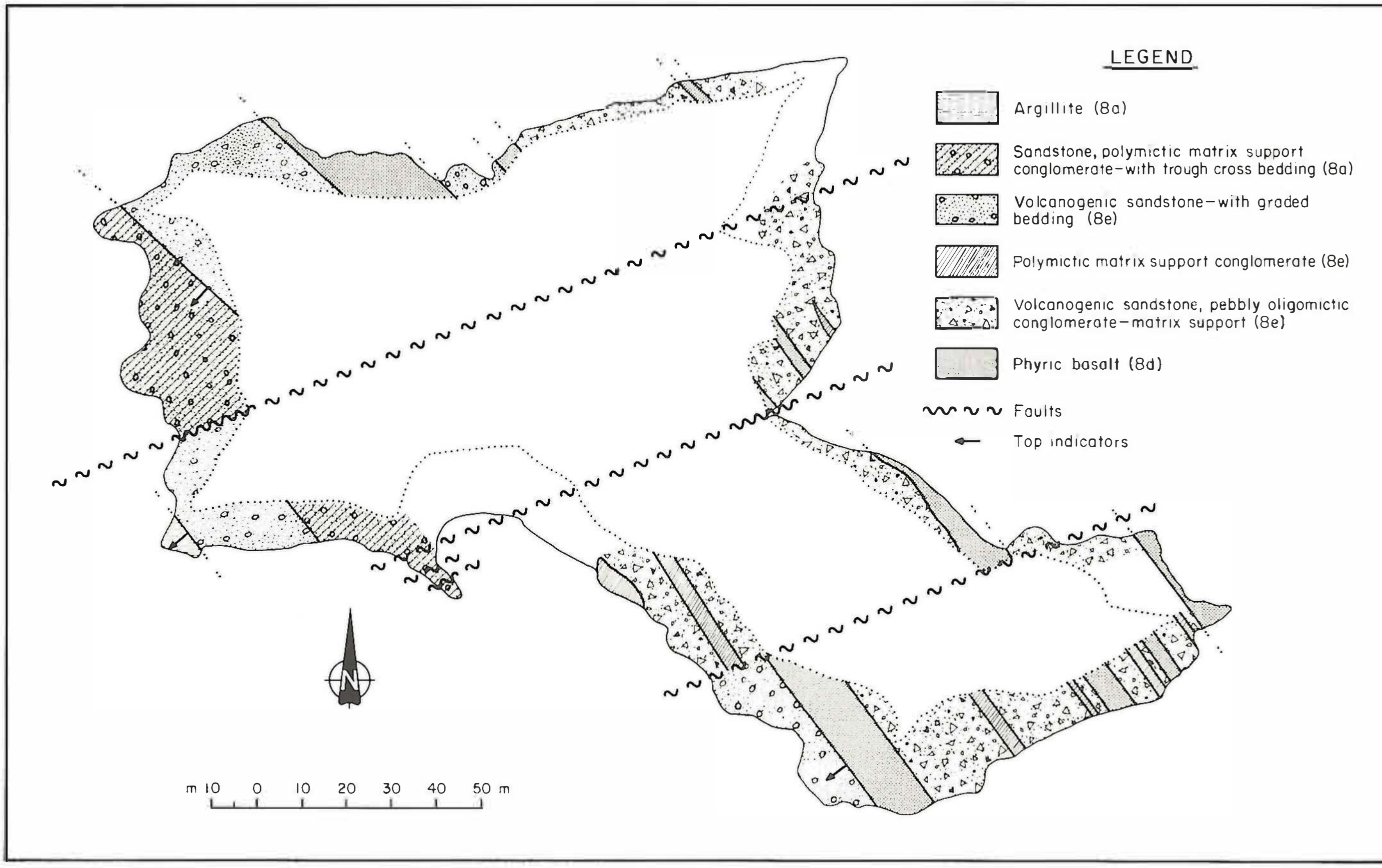


Figure GS-32-8: *Distribution of basalt (unit 8d), volcanogenic sediments (unit 8e) and greywacke (unit 8a). Location shown on Figure GS-32-1.*

Figure GS-32-9: ***Graded beds in volanogenic sediments (unit 8e).***

REFERENCES

Baragar, W.R.A.
1984: Pillow formation and layered flows in the Circum-Superior Belt of eastern Hudson Bay; Canadian Journal of Earth Sciences, v. 21, p. 775-792.

Cameron, H.D.M.
1984: Pipestone Lake intrusive complex; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, p. 107-116.

Corkery, M.T.
1983: Cross Lake supracrustal investigation; **in** Manitoba Mineral Resources Division, Report of Field Activities 1983, p. 32-45.

Corkery, M.T. and Lenton P.G.
1984: Southeast Cross Lake-West Pipestone Lake; Manitoba Mineral Resources Division Preliminary Map 1984 N-2
1984: Central Cross Lake; Manitoba Mineral Resources Division Preliminary Map 1984 N-3
1984: Cross Lake supracrustal investigation; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, p. 107-109.

Dimroth, E., Cousineau, P., Leduc, M. and Sanschargrin, Y.
1978: Structure and organization of Archean subaqueous basalt flows, Rouyn-Noranda area, Quebec, Canada; Canadian Journal of Earth Sciences, v. 15, p. 902-918.

Gilbert, H.P.
1985: Geology of the Knee Lake-Gods Lake area; Manitoba Energy and Mines, Geological Services, Geological Report GR83-1B.

Horwood, H.C.
1934: The Cross Lake map-area, Manitoba; unpublished Ph.D. thesis; Massachusetts Institute of Technology.

Hubregtse, J.J.M.W.
1985: Geology of the Oxford Lake-Carrot River area; Manitoba Energy and Mines, Geological Services, Geological Report GR83-1A.

Lenton, P.G. and Anderson, A.J.
1983: Granite-pegmatite investigation, Cross Lake; **in** Manitoba Mineral Resources Division, Report of Field Activities 1983, p. 46-49.

GS-33 PIPESTONE LAKE INTRUSIVE COMPLEX: GEOLOGICAL AND GEOPHYSICAL INVESTIGATIONS

by H.D.M. Cameron

INTRODUCTION

Investigation of a layered gabbro-anorthosite complex at Pipestone Lake (Cameron, 1984) continued with special emphasis on the titanium, vanadium and magnetite-bearing phases and their relationship with other units of the complex.

This year's fieldwork included:

1) Extension of the ground magnetometer survey to the east of the 1984 survey.
2) Detailed mapping of a group of outcrops on the south shore of Pipestone Lake, containing typical examples of layered magnetite rock and magnetite-bearing gabbros (Preliminary Map 1985N-3).
3) Mapping of existing trenches in the magnetite-bearing layers.
4) Extensive sampling of the main magnetite-bearing units; and
5) Geologic mapping at a scale of 1:20 000 in conjunction with both the magnetometer survey and the supracrustal mapping program (Corkery, GS-32 — this volume).

The locations described as stations 43, 19 and 90 in the Report of Field Activities 1984 are here designated Locations 1, 2 and 3, respectively (Fig. GS-33-1).

GENERAL GEOLOGY

The Pipestone Lake intrusive complex is a layered anorthosite and gabbro body which was mapped from Cross Lake to the east channel of the Nelson River, a distance of approximately 15 km. At its maximum thickness, south of Pipestone Lake, it is 1 to 1.5 km wide, narrowing to 100 m at the Nelson River (Fig. GS-33-2).

Most of the rock within the body is megacrystic anorthosite containing 5 to 20 cm ovoid labradorite phenocrysts. The megacrystic anorthosite commonly grades into a massive, coarse grained, homogeneous phase through decrease of interstitial mafic material. Oikocrystic anorthosite having elongate clots of chloritized hornblende appears to be a recrystallization product of megacrystic anorthosite and occurs as a transitional phase between anorthosite and leucogabbro. Large pods and sheared layers of megacrystic anorthosite are found within the lower part of the early supracrustal rocks to the north.

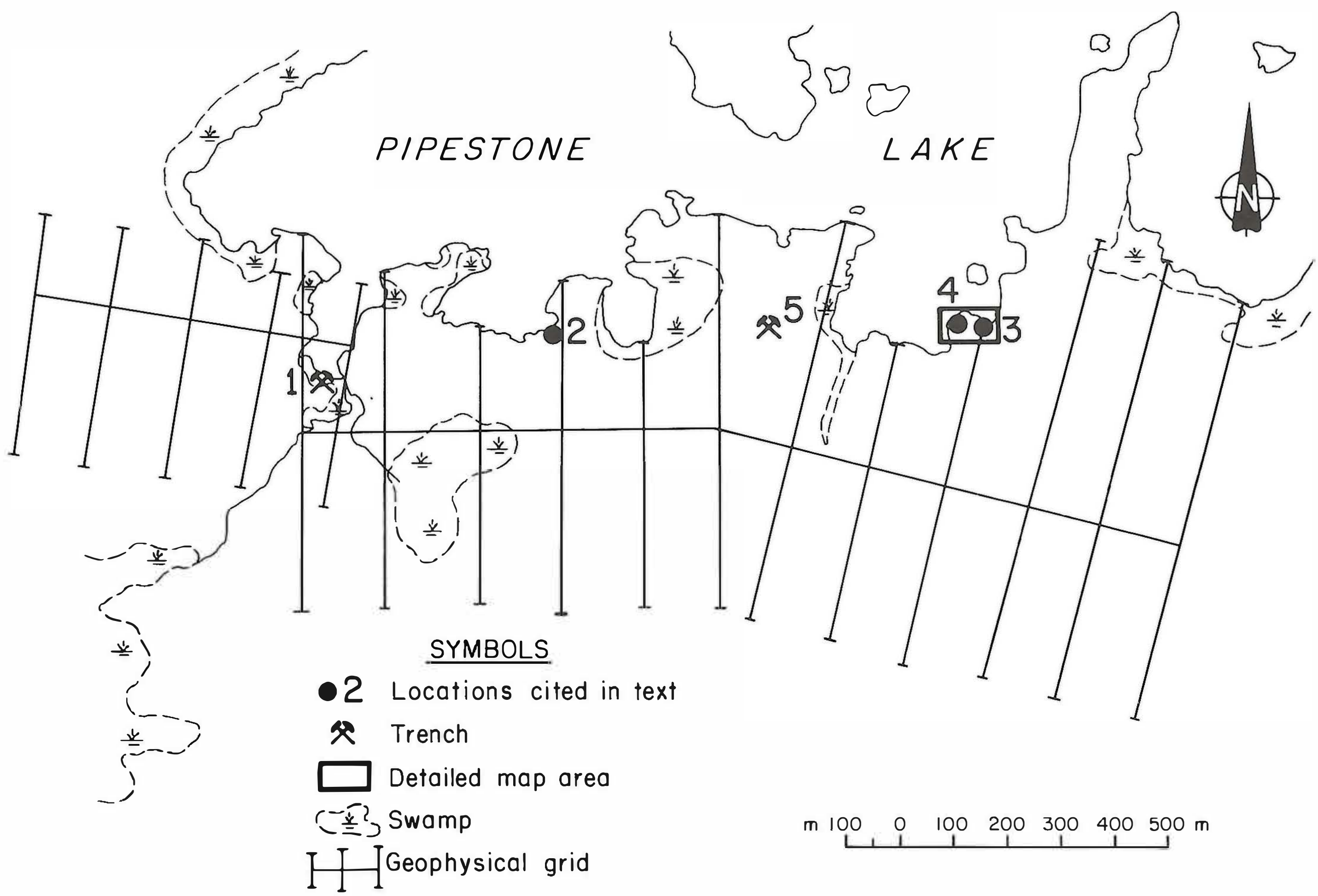


Figure GS-33-1: Pipestone Lake study area, 1985.

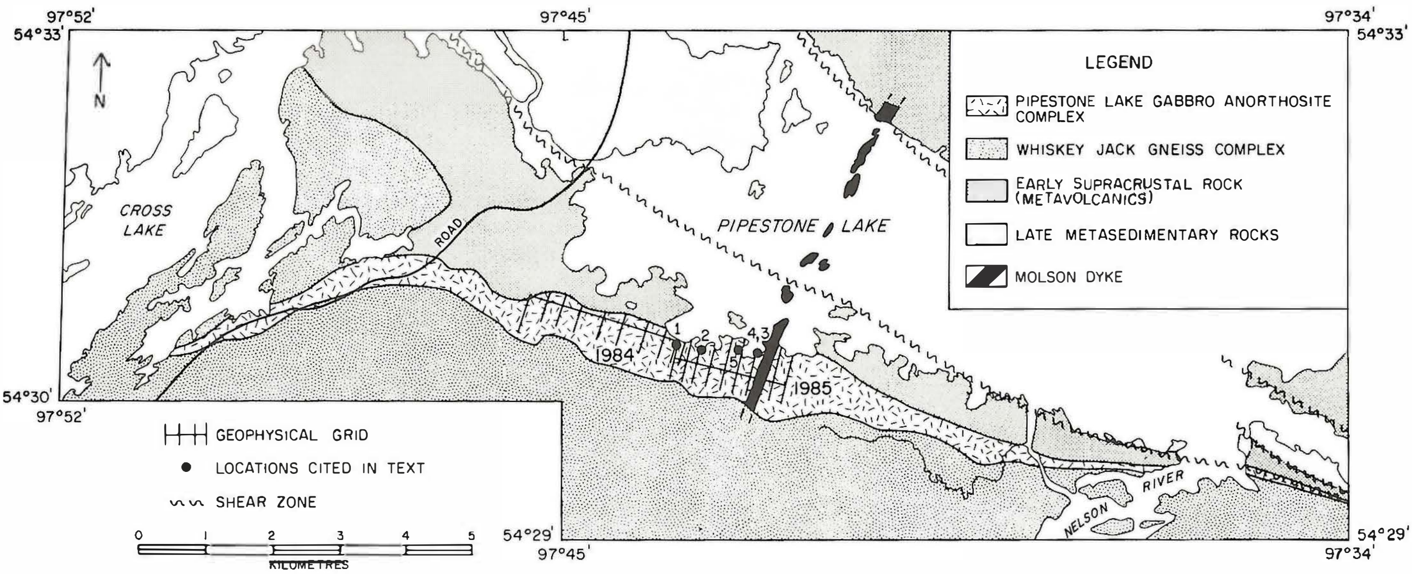


Figure GS-33-2: *Pipestone Lake intrusive complex.*

Near the northern margin of the body, several phases of leucogabbro and melagabbro are exposed. The leucogabbro is closely associated with anorthosite. Melagabbro occurs as discontinuous layers 20 to 50 m thick along the south shore of Pipestone Lake. It commonly contains disseminated magnetite and significant amounts of titanium and vanadium. Magnetite-bearing melagabbro has been traced as far as the east channel of the Nelson River.

Massive magnetite rock, in layers 50 cm to 3 m thick, is found along the northern margin of the leucogabbro, separating it from the melagabbro layers to the north. The leucogabbro immediately surrounding the magnetite layers contains disseminated magnetite and is commonly garnetiferous. Reports by Bell (1982), Rousell (1965) and Rose (1967, 1973) described the occurrence of titanium and vanadium in the massive magnetite layers and magnetite-bearing gabbros which led to the present work.

The southern margin of the complex is intruded by veins of granodiorite and feldspar porphyry associated with the Whiskey Jack gneiss complex.

MAGNETOMETER SURVEY

Starting from a point 200 m south of the massive magnetite showing at Location 2, a baseline was flagged 1200 m east and 450 m west, following the strike of the units and overlapping the 1984 survey by approximately 60 m. Crosslines were established at 150 m intervals, extending 330 m south of the baseline and as far north as the shore of Pipestone Lake (200 to 540 m).

A Scintrex model MP2 proton precession magnetometer with a sensitivity of 1 gamma was used to carry out the survey. Readings were taken at 15 m intervals on the crosslines and the baseline with duplicate readings and times recorded at 90 m intervals. Diurnal fluctuations ranged from 0 to 300 gammas.

Results of the survey (Figs. GS-33-3 and 4) show a gradual rise from approximately 60,800 gammas at 330 m south to 61,000 gammas at the baseline. This large, relatively flat area corresponds with the main megacrystic anorthosite body. A broad magnetic high (62,000 to 64,000 gammas) begins to the north with one to three major peaks ranging from 65,000 to 100,000+ gammas. The weaker southern peaks are associated with the magnetite-bearing melagabbro layers and those in the 75,000 to 100,000 range with the layers of magnetite rock. The peaks associated with the magnetite rock are only about 30 m wide and readings to the north rapidly drop back into the 60,000 to 62,000 gamma range.

Toward the eastern end of the survey area a 100 m wide Molson diabase dyke has intruded the complex, truncating the magnetic highs.

Work was begun to re-survey the 1984 grid at 15 m intervals, adding 150 m crosslines to maintain consistency between the two surveys. This remains incomplete at present, having proceeded to 600 m west (Fig. GS-33-5).

DETAILED MAPPING

LOCATION 4

On the south shore of Pipestone Lake, adjacent to Location 3, a group of outcrops contain layers of magnetite rock as well as magnetite-bearing phases of both the leuco- and melagabbros (Location 4). These outcrops were mapped in detail in order to better understand the distribution of the titanium- and vanadium-bearing rocks. A grid was established to cover the site, an area 90 x 40 m, and the outcrops marked in 1 m squares. The outcrops were bleached to remove lichen and iron stains and sketch maps of the outcrops were prepared and subsequently compiled into a large-scale map of the area. Several magnetometer surveys were carried out on the site, the most practical having readings taken at 1 m intervals on crosslines 5 m apart (Fig. GS-33-6).

The southern part of the area comprises a series of pods of oikocrystic anorthosite and leucogabbro. Contacts between the two phases are often gradational although faulting and fracturing have modified the field relationships to a great extent. The margins of the pods are rimmed with several phases of fine grained mesocratic amphibolite. Some of these intrude the anorthosite whereas others are intruded by anorthosite veins.

A fairly continuous layer of dark green chlorite-magnetite schist 5 to 20 cm wide can be traced around the pods for a distance of 50 m. Two layers of massive magnetite rock, 50 cm to 1 m thick, cross the site in the most northerly layers of leucogabbro. The leucogabbro adjacent to the magnetite layers is magnetiferous. A series of small faults trending 300° have caused left lateral displacements in these layers.

North of the magnetite layers the rocks are fine- to medium-grained, meso- to melanocratic amphibolite and gabbro, varying from homogeneous and equigranular to feldspar-phyric and containing 2 to 10 cm magnetite layers. These mafic rocks appear to represent finer

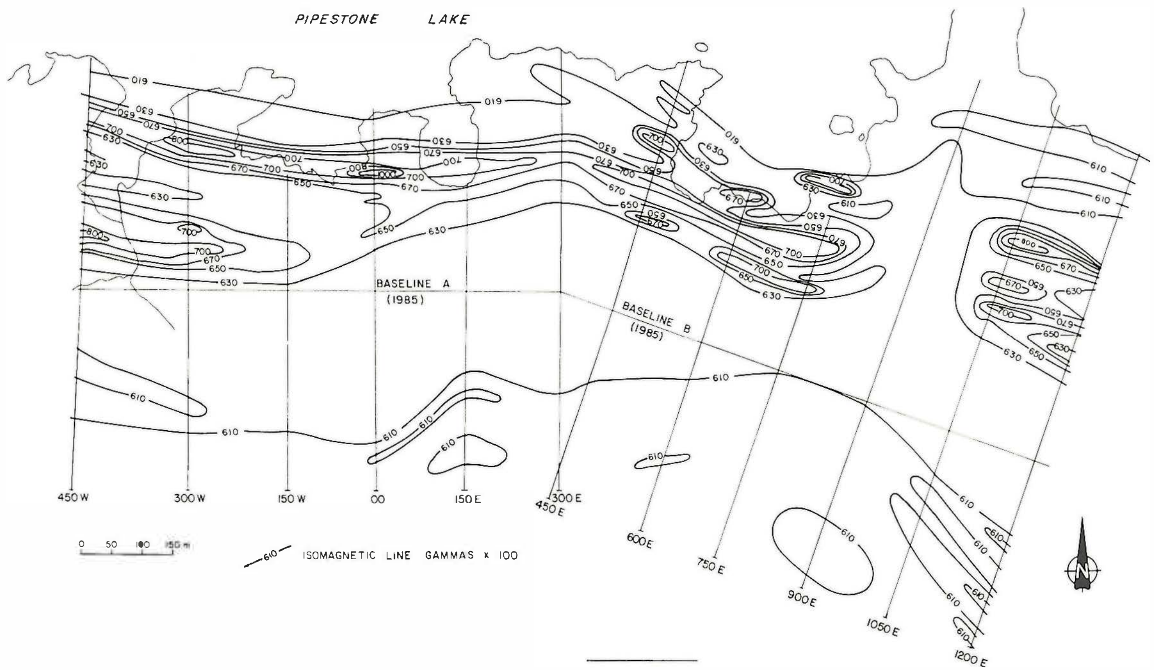


Figure GS-33-3: Isomagnetic contour map of the eastern grid area (1985), Pipestone Lake intrusive complex.

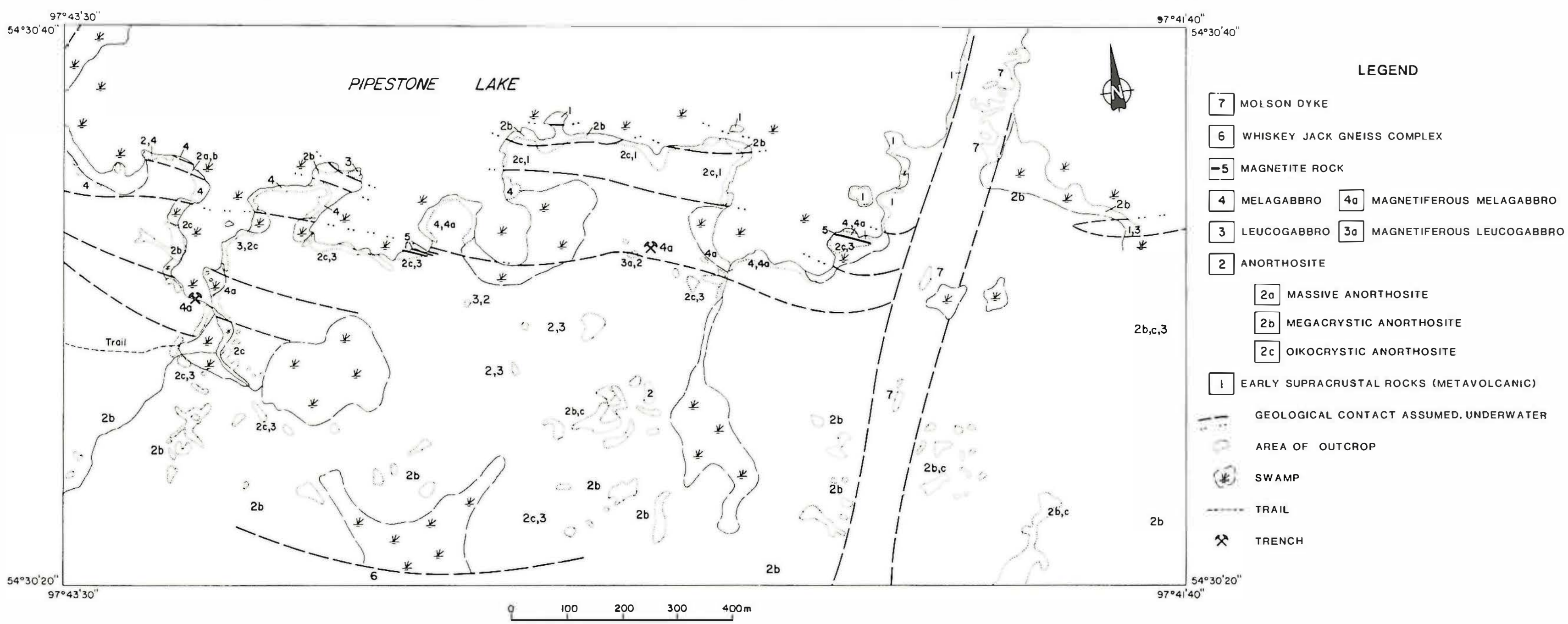


Figure GS-33-4: Geologic map of the Pipestone Lake study area (1985).

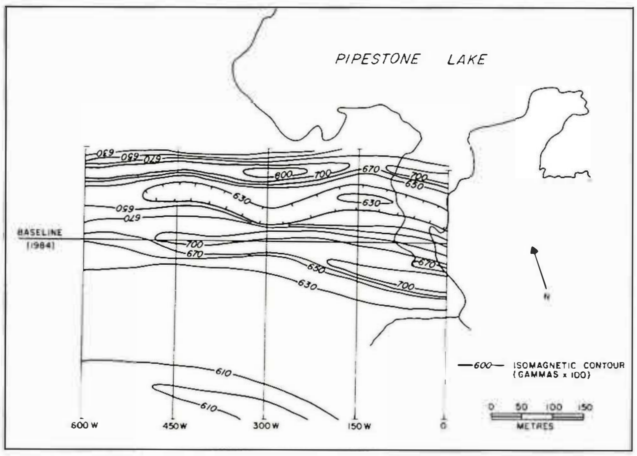


Figure GS-33-5: Isomagnetic contour map of the western grid area (1984), partial re-survey.

grained phases of melagabbro with both non-magnetic and disseminated magnetite phases being present. The strike of the units varies from 280 to 290° with dips to the north at 64° to 70°.

The magnetometer survey results show a gradual rise from background readings of less than 62,000 gammas south of the outcrop area. Readings increase to 65,000 at the first occurrence of the chlorite-magnetite veins and continue to rise at a moderate rate across the anorthosite and leucogabbro into the 70,000 to 80,000 gamma range. Upon reaching the layers of massive magnetite and magnetite-bearing leucogabbro the readings go off scale for a distance of 4 to 10 m, then rapidly drop back to 65,000 gammas over the magnetite-bearing melagabbro. Continuing north into the non-magnetic amphibolite and gabbro the readings fall below 60,000 gammas.

The magnetic high at the south end of line 00 corresponds to an outcrop of porphyritic melagabbro and amphibolite immediately south of the grid area. The break in the off-scale readings at the north end of line 45W may indicate that the magnetite layers have been boudinaged.

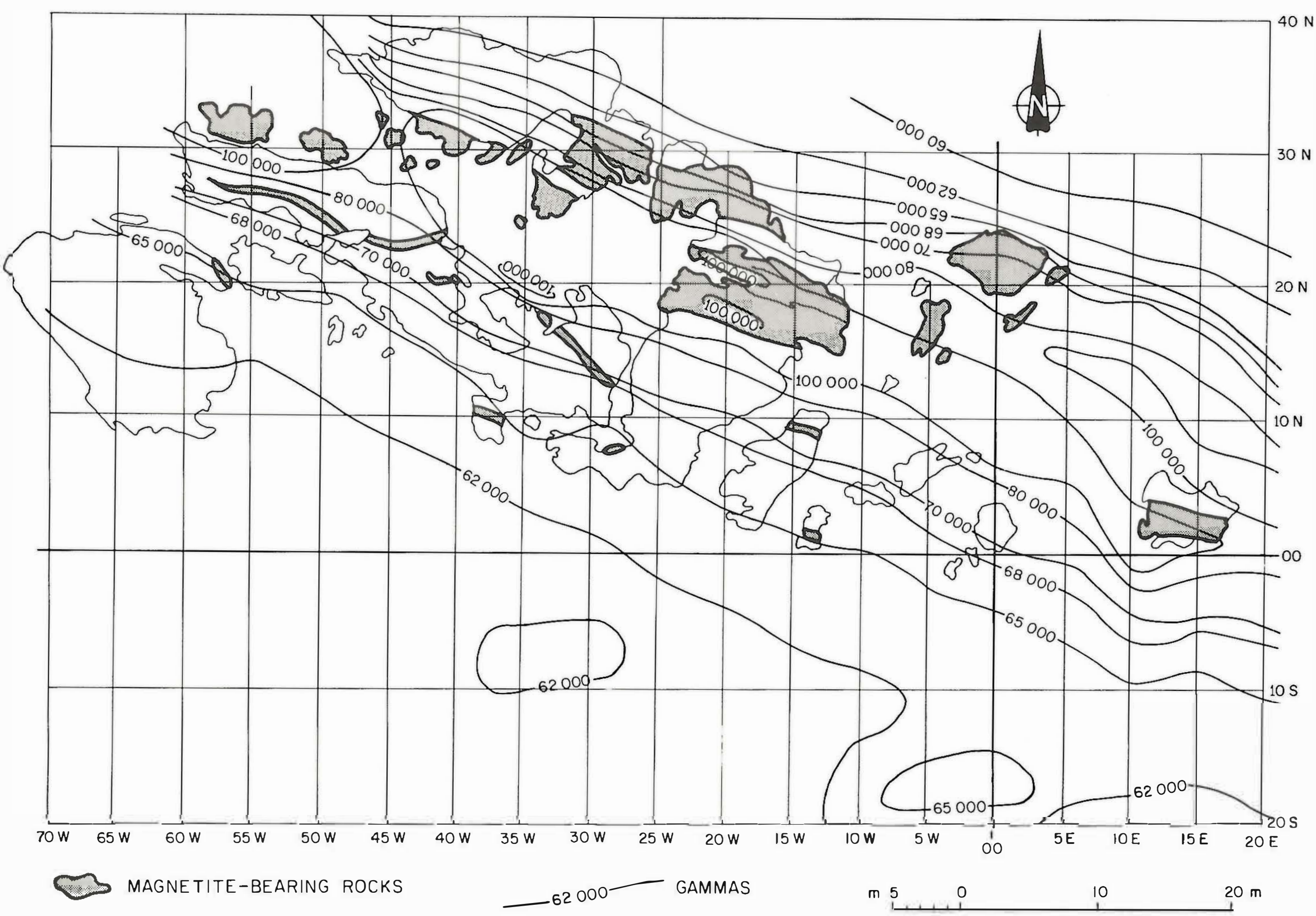


Figure GS-33-6: Isomagnetic contour map, Location 4.

LOCATION 5

In 1984 a trench in magnetite-bearing melagabbro at Location 1 was mapped and sampled for geochemical analysis. During the 1985 field season a search was carried out for six more trenches reported to exist in the area. Due to the vigour of local flora, only one additional trench was found (Location 5). The trench consists of a series of shallow, step-like pits across a 4 x 10 m section of outcrop (Fig. GS-33-7). The southern half of the exposure is made up of oikocrystic anorthosite and leucogabbro with discontinuous layers of melagabbro and rare 10 cm labradorite megacrysts. The northern 6 m comprises melagabbro and amphibolite interlayered with anorthosite and leucogabbro. The mafic layers contain abundant 1-3 mm magnetite phenocrysts and discontinuous magnetite layers 3 mm - 1 cm thick and 2 to 20 cm long. Visible magnetite is also present in the leucocratic phases.

A magnetometer survey was carried out over the exposure with readings taken at 1 m intervals on lines 1 m apart. The results (Fig. GS-33-8) are consistent with the magnetite content of the layers.

GEOCHEMICAL SAMPLING PROGRAM

Following publication of the Report of Field Activities 1984 representative samples of the major phases in the complex were submitted for geochemical analysis (Fig. GS-33-9, Table GS-33-1). Values obtained indicate weight per cents of approximately 45% total iron (as FeO) and 8% TiO_2 in the magnetite-bearing melagabbro and 60 to 70% iron (as FeO) and 12 to 14% TiO_2 in the layered magnetite rock. Of particular interest is the direct correlation between vanadium and niobium content in the magnetiferous rocks, where the amount of niobium present is equal to the vanadium values reduced by a factor of 10.

During the 1985 field season sampling programs were carried out at Locations 2, 3, 4 and 5 to collect complete sets of serial samples across all magnetite layers as well as representative samples of all the gabbros and anorthosites. Further chemical analyses are currently under way.

Plans for 1986 include the completion of the magnetometer survey and mapping in the eastern and western parts of the complex.

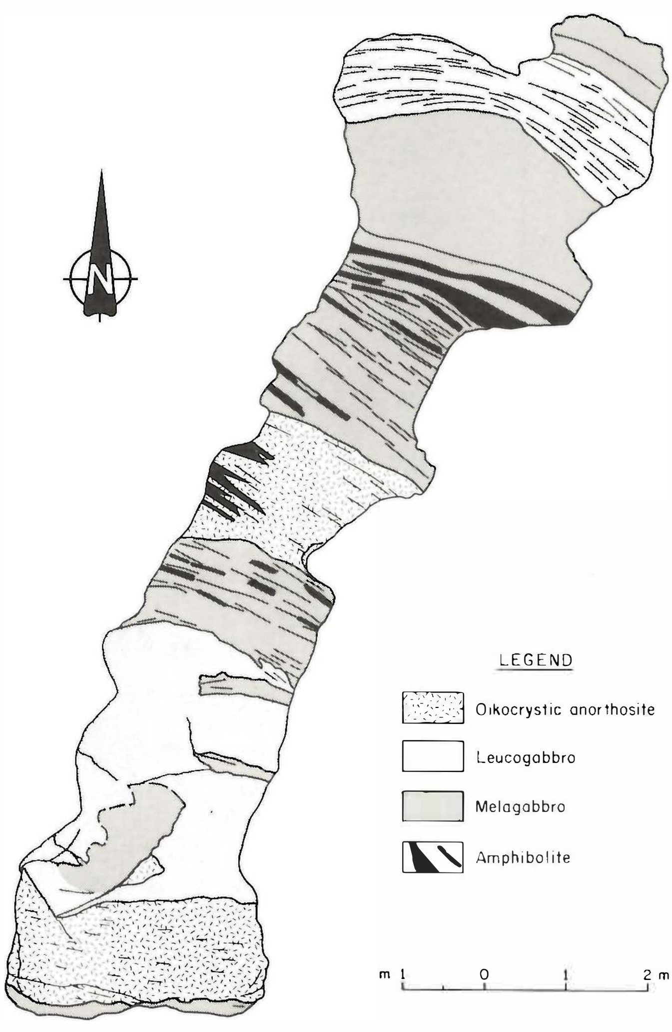


Figure GS-33-7: Geological sketch map of the trench at Location 5 - magnetite-bearing gabbro.

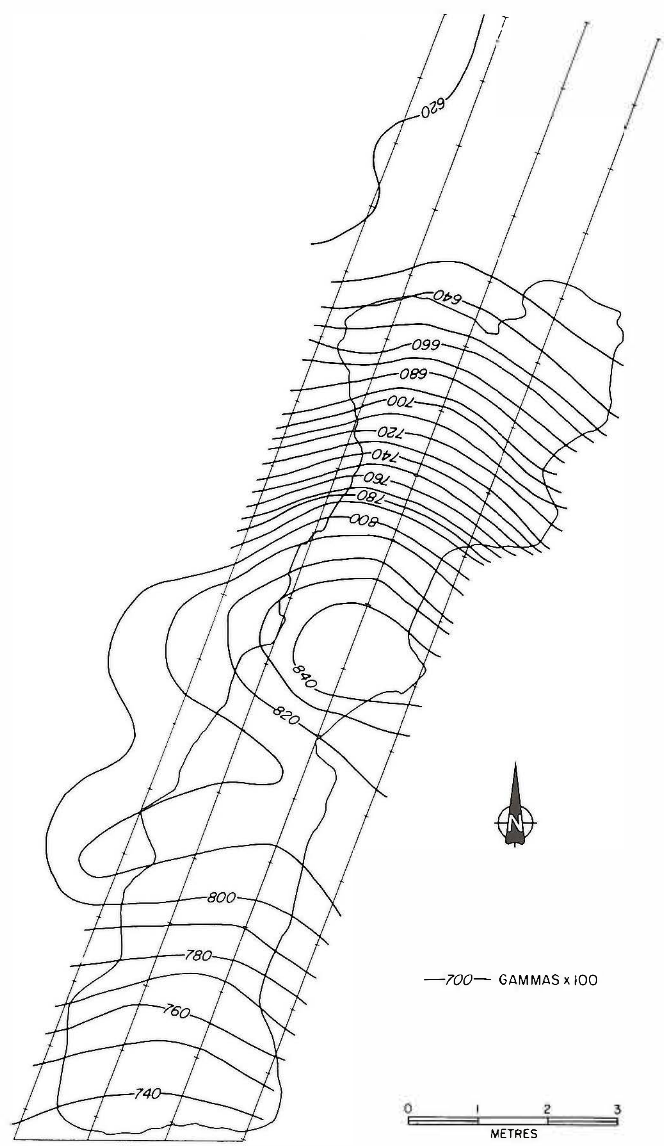


Figure GS-33-8: Isomagnetic contour map of the trench of Location 5.

TABLE GS-33-1 PIPESTONE LAKE INTRUSIVE COMPLEX, ASSAY VALUES

Sample No.	Rock Type	Wt. % ΣFeO	Wt. % TiO_2	ppm V	ppm Nb	ppm Ni	ppm Cr
1	melagabbro	22.60	4.90	230	<1	0	0
2	diorite	15.04	3.09	294	41	0	0
3	melagabbro	21.90	4.66	289	<1	0	0
4 (Location 1)	MG-melagabbro	44.50	7.47	4560	420	264	81
5	melagabbro	20.70	3.72	76	<1	0	0
6	MG-melagabbro	46.40	7.76	4260	409	242	55
7	leucogabbro	14.92	3.30	113	3	15	0
8	leucogabbro	8.78	1.23	227	21	26	0
9 (Location 2)	leucogabbro	16.72	3.56	1260	97	162	141
10	magacrystic anorthosite	9.28	0.14	62	<1	103	0
11	leucogabbro	22.50	1.53	23	<1	0	0
12 (Location 2)	leucogabbro	15.68	2.67	538	31	56	55
13	oikocrystic anorthosite	8.71	0.94	56	<1	0	0
14	oikocrystic anorthosite	2.91	0.29	90	<1	0	0
15 (Location 2)	oikocrystic anorthosite	11.91	1.55	549	32	0	0
16	massive anorthosite	2.07	0.21	15	<1	0	0
17	massive anothosite	2.91	0.21	24	<1	0	0
18	massive anorthosite	1.05	0.08	19	<1	0	0
19	megacrystic anorthosite	4.14	0.30	76	<1	0	0
20	megacrystic anorthosite	1.74	0.09	34	<1	28	77
21	late mafic dyke	14.82	1.04	314	<1	887	2210
22 (Location 2)	magnetite rock	58.86	12.40	5480	453	196	447
23 (Location 2)	magnetite rock	67.20	13.85	7540	635	220	217

REFERENCES

Bell, C.K.
1962: Cross Lake map area, Manitoba; Geological Survey of Canada, Paper 61-22.

Cameron, H.D.M.
1984: Pipestone Lake intrusive complex; **in** Manitoba Mineral Resources Division, Report of Field Activities 1984, p. 110-116.

Rose, E.R.
1967: Vanadium occurrences in Canada; Geological Survey of Canada, Paper 66-57.
1973: Geology of vanadium and vanadiferous occurrences of Canada; Geological Survey of Canada, Economic Geology Report No. 27, p. 65-67.

Rousell, D.H.
1965: Geology of the Cross Lake area; Manitoba Mines Branch, Publication 62-4.

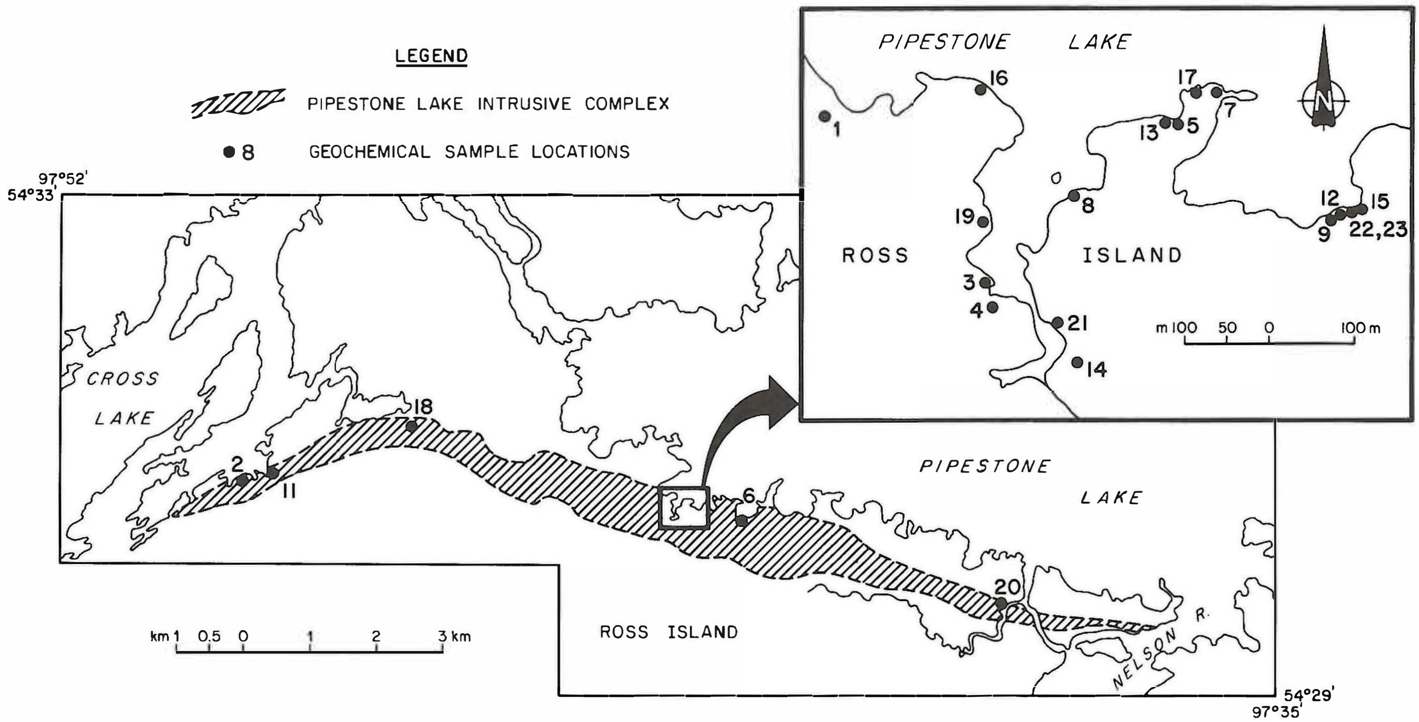


Figure GS-33-9: *Geochemical sample locations, Pipestone Lake intrusive complex.*

GS-34 NORTHEASTERN CROSS LAKE PROJECT
PARTS OF 63-I/11,14

by J.J. Macek

Geological mapping at a scale of 1:50 000 filled the remaining information gap in the area between latitude 54°40'-54°42' and longitude 97°15'-97°30'. The terrain is underlain by granodiorite to tonalite gneiss and migmatitic gneiss with minor slivers of supracrustal rocks (metavolcanics). A few gabbro-diabase dykes of the Molson swarm were found. The preserved field characteristics of some gneisses suggest that these are retrogressed granulites. The basic geological features are similar to those described earlier from the same area (Albino and Macek, 1983, and Macek, 1984).

REFERENCES

Albino, K.C. and Macek, J.J.

1983: GS-9 Walker Lake project (parts of 63I/7,9,10,14,15); Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 51-60.

Macek, J.J.

1984: GS-30 Northeastern Cross Lake project; Manitoba Energy and Mines, Mineral Resources, Report of Field Activities, 1984, p. 117-119.

GS-35 GEOLOGICAL INVESTIGATIONS IN THE PHILLIPS LAKE AREA (PART OF 63-0/12)

by J.J. Macek

INTRODUCTION

Geological mapping at 1:20 000 scale was conducted in the Phillips lake area between Setting Lake (albino and Macek, 1981) and Paint Lake (Charbonneau et al., 1979) in order to provide up-to-date information for geological compilation of the Thompson Nickel belt. Shoreline mapping was somewhat hampered by unusually high water level.

GENERAL GEOLOGY

The southern shoreline of Grass River between Pisew Falls and Phillips Lake is underlain by rather monotonous cataclastic stromatic (layered) migmatites. In contrast, the northern shoreline (including Soab Creek) displays a variety of geological units thus indicating a major fault separating the shores (Grass River lineament).

Pillowed metabasalts and derived amphibolites form a substantial portion of the shoreline east of the Soab Creek inlet. These are closely associated with magnetic, knobby weathering ultramafics (metapyroxenites, porphyritic metapicrites?) similar to those on Liz Lake (Macek and Russell, 1978). Major ultramafic outcrops are also located on the eastern shore of Soab Creek and a few were encountered as reefs west of the Soab Creek inlet, indicating a considerable lateral continuity. The rest of the shoreline is underlain by schollen migmatites and compositionally variable, folded stromatic migmatites invariably containing garnet and locally intruded by biotite leucogranites and pegmatites.

The northern shore of Phillips Lake is underlain by cataclastic, stromatic and locally folded migmatites. East of the Grass River inlet they host a poorly exposed segment of shallowly dipping, layered, medium grained garnet-hornblende-plagioclase gneiss identical to that described by Macek and Russell (1978) from a metagabbro complex on Paint Lake. A large portion of the opposite shore to the east is underlain by medium grained, light grey-green weathering gneiss similar to that described from Paint Lake (op. cit.) as retrograded enderbitic gneiss. The occurrence of these distinct lithologies in two different localities may be the result of dextral faulting (along Grass River lineament and/or subparallel lineament to the north) with a lateral offset of 40-50 km.

The migmatites on the southern shore contain inclusions and boudinaged rafts of metamorphically zoned ultramafics with orthopyroxene, clinopyroxene, garnet, hornblende and plagioclase assemblages. The orthopyroxene was formed during granulite facies metamorphism and has been preserved during younger migmatization and tectonic overprint.

The geology of Grass River area between Phillips Lake and Paint Lake is characterized by cataclastic, stromatic migmatites (Fig. GS-35-1) which invariably contain garnet. These migmatites locally host thin sheets and rafts of amphibolites and are intruded by granites and pegmatites. Migmatites grade in a few places into medium grained, foliated, garnet-bearing leucogneiss segments (2-3 km long) showing characteristics of leucogranulites (Fig. GS-35-2) in the Pikwitonei domain, e.g. at Sipiwesk Lake. One medium grained gabbro dyke of the Mackenzie Dyke swarm was confirmed (Coats et al., 1972).

Figure GS-35-1: Cataclastic stromatic migmatite.

Figure GS-35-2: Garnet-bearing leucogneiss.

REFERENCES

Albino, K.C. and Macek, J.J.
1981: Thompson Nickel Belt Project — Setting Lake (parts of 63-O/12 and 63J/15); Manitoba Mineral Resources Division, Report of Field Activities, 1981, p. 30-36.

Charbonneau, R., Scoates, R.F.J. and Macek, J.J.
1979: Thompson Nickel Belt Project (Parts of 630/8,9; 63P/5,12); Manitoba Mineral Resources Division, Report of Field Activities, 1979, p. 20-24.

Macek, J.J. and Russell, J.K.
1978: Thompson Nickel Project — Paint and Ospwagan Lakes; Manitoba Mineral Resources Division, Report of Field Activities, 1978, p. 43-46.

Coats, C.J.A., Quirke, T.T., Bell, C.K., Cranstone, D.A. and Campbell, F.H.A.
1972: Geology and mineral deposits of the Flin Flon, Lynn Lake and Thompson areas, Manitoba, and the Churchill-Superior Front of the western Precambrian shield; XXIV International Geological Congress, Montreal, Quebec, Excursions A31 and C31, 1972.

GS-36 U-Pb GEOCHRONOLOGY PROGRAM: THOMPSON BELT AND PIKWITONEI DOMAIN

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

INTRODUCTION

During the first year of this project twenty-six selected zircon fractions from six rock units were analyzed, one from the Molson Lake domain, three from the Pikwitonei domain and two from the Thompson belt. (Fig. GS-36-1.)

During the 1985 field season 32 additional samples were collected, most of them from the Thompson belt and the Pikwitonei domain. Analyses of 10 zircon fractions were completed by the beginning of October.

PRELIMINARY RESULTS OF U-Pb GEOCHRONOLOGY

A. MOLSON LAKE DOMAIN

1. Jackfish Bay granite (02-84-309): This unit represents one of the youngest (late tectonic) granitoid rocks in the Molson Lake batholithic domain and, on the basis of field geological evidence, it was interpreted as having been derived as partial melt from pre-existing crustal material (Weber et al., 1982).

A two point line with data 0.5 and 2.8% discordant indicates an age of 2680 + 2.5/-1.9 Ma for this unit. A sphene age of 2650 Ma indicates regional cooling at about this time (or possibly partial resetting during a younger event) below a temperature of about 500°C.

B. PIKWITONEI DOMAIN, CAUCHON LAKE

1. Granulite facies (M_2) pegmatoid melt (02-76-138): This unit is interpreted to represent a melt produced during the M_2 granulite facies metamorphism (cf. Weber, 1977; Hubregtse, 1980). Most zircons are brown and they yielded a concordia age of 2695 $\pm$ 2 Ma. A minor zircon component of pink euhedral grains and pink fragments formed between 2685 and 2690 Ma. (Both populations are within 0.5% of the concordia).

2. Amphibolite facies (M_1) melt (02-77-483): This unit is considered to have formed during M_1 metamorphism since it occupies S_1 structures. One zircon population yielded an age of 2637 $\pm$ 2 Ma defined by two relatively concordant fractions 0.4 and 1.4% discordant.

3. Biotite tonalite with S_1 structures and discordant (S_2) orthopyroxene-bearing M_2-mobilizate (02-77-477): This tonalite unit is considered as one of the granitoid units preceding, or contemporaneous with, the M_1 (amphibolite facies) metamorphism, and affected by the M_2 metamorphism which at this location just reaches conditions of the granulite facies (close to the orthopyroxene isograd). An apparently older population of euhedral, low colour zircons, forming in part the core of an apparently younger brown euhedral zircon population, yielded an age of 2695 $\pm$ 5 Ma. The brown overgrowth component and similar, brown, core-free, zircons yielded a two point concordia intercept age of 2653 $\pm$ 16 Ma.

C. THOMPSON BELT

1. Wintering Lake granodiorite (02-84-310): This granodiorite is considered to have been emplaced during the early Proterozoic into gneisses which were derived from Archean granulites through deformation and retrogression under amphibolite facies conditions associated with late Aphebian (Hudsonian) metamorphism.

A sample from near the margin of this granitoid body yielded large Archean zircons of about 2600 Ma and small euhedral grains with a probable apparent age of 1893 $\pm$ 18 Ma.

2. Paint Lake Pegmatite (TK-84-9): This pegmatite intrudes an ultramafic block and is considered to be the result of the youngest metamorphism in the Thompson belt. A precise age of 1786.2 $\pm$ 2.7/-2.2 Ma is defined by four zircon fractions and one monazite.

DISCUSSION (by W.W.)

The ages from the Molson Lake domain and the Thompson belt are within the expected range and confirm earlier ages (cf. Ermanovics and Wanless, 1983) . The 1786 Ma pegmatite age is the first precise age for a late Hudsonian magmatic event in the Thompson belt. Additional samples were collected this summer to confirm this age, and to provide a more complete framework of metamorphic and magmatic events in the Thompson belt.

The ages from the Pikwitonei domain appear to contradict in part the field geological evidence.

A preliminary interpretation is that 2695 $\pm$ 2 Ma (for 02-76-138) and 2695 $\pm$ 5 Ma (for 02-77-477) is the time of tonalite intrusion and partial melting of pre-existing crust, preceding, or synchronous with, M_1 metamorphism. This would imply that the so-called M_2 melt (02-76-138) was not formed but only remobilized and recrystallized during the M_2 granulite facies metamorphism. The M_2 metamorphism may be dated as 2685-2690 Ma from 02-76-138.

In contrast, the younger age of 2653 $\pm$ 16 Ma from 02-77-477 may date the M_1 or M_2 event (at that location). The similar age of 2637 $\pm$ 2 Ma for the nearby 02-77-483 would favour it to be the age for the M_1 event which would imply that M_2 is even younger. This in turn would not agree with the M_2 timing derived from 02-77-138. Further data are obviously required to determine the chronology of events. In relation to events dated in the Superior Province farther south, the U-Pb ages from the Pikwitonei domain correspond to, or are younger, than the youngest magmatic events dated by U-Pb ages in greenstone and plutonic belts.

REFERENCES

Ermanovics, I.F. and Wanless, R.K.
1983: Isotopic age studies and tectonic interpretation of Superior Province; **in** Manitoba; Geological Survey of Canada, Paper 82-12, 22 p.

Hubregtse, J.J.M.W.
1980: The Archean Pikwitonei granulite domain and its position at the margin of the northwestern Superior Province (central Manitoba); Manitoba Mineral Resources Division, Geological Paper GP80-3.

Weber, W.
1977: Odei-Burntwood Rivers region, Cauchon Lake region; **in** Manitoba Mineral Resources Report of Field Activities 1977, p. 58-61.

Weber, W., Schledewitz, D.C.P. and Soonawala, N.M.
1982: Airborne radiometric anomalies caused by late-kinematic granitic rocks in the Molson-Red Sucker Lake area, east-central Manitoba; **in** Uranium in granites, ed. by Y.T. Maurice; Geological Survey of Canada, Paper 81-23, p. 119-124.

[1]Department of Mineralogy and Geology, Royal Ontario Museum, Toronto, Ontario.

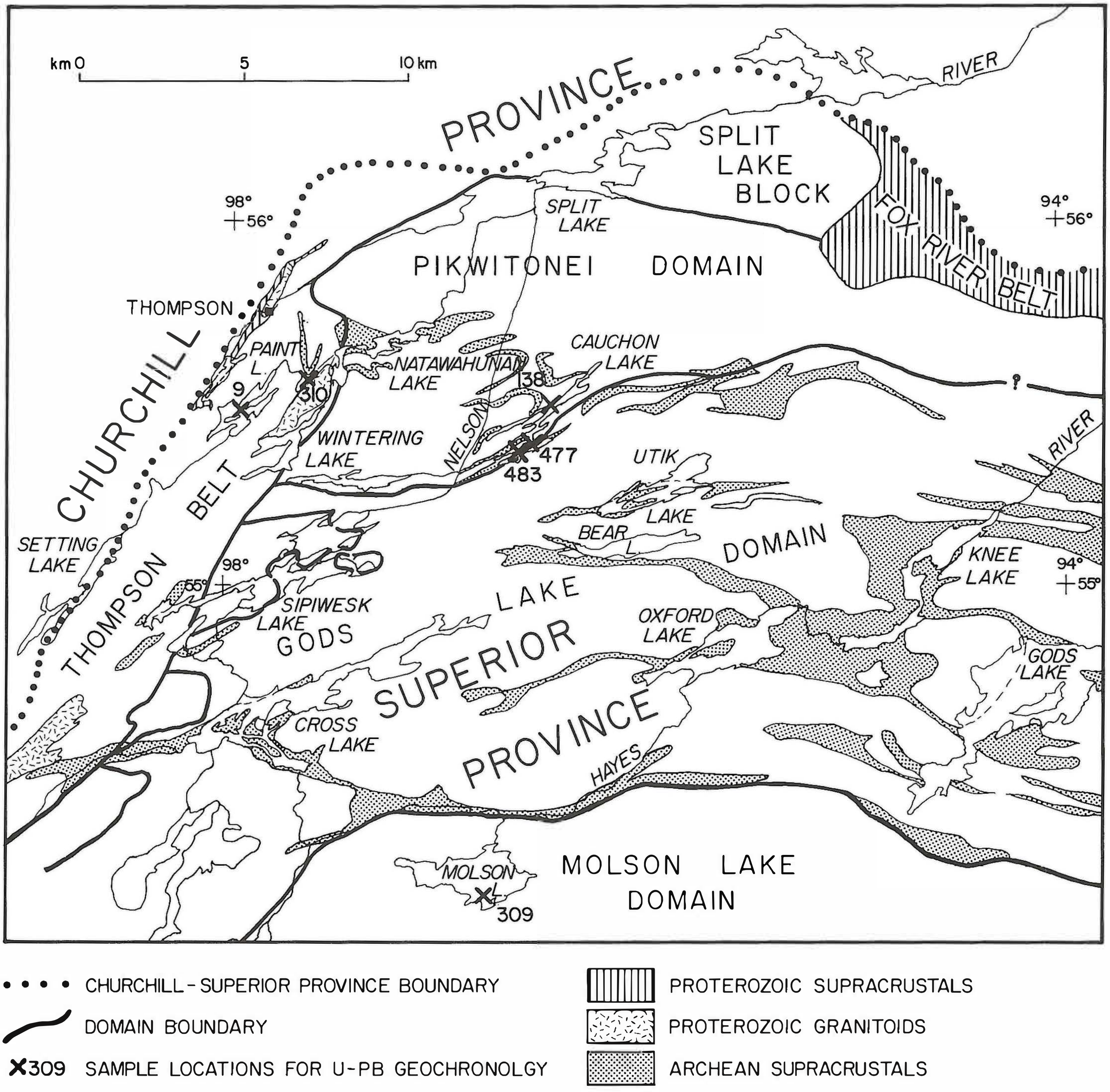


Figure GS-36-1: Generalized geology of northwestern Superior Province and sample locations for U-Pb geochronology discussed in text.

GS-37 EVALUATION OF INDUSTRIAL MINERAL OCCURRENCES IN THE THOMPSON AREA

by W.R. Gunter and P.H. Yamada

A reconnaissance program was conducted to identify deposits with the potential to contain industrial minerals in the Thompson Nickel Belt and surrounding areas. The investigation concentrated on: the carving quality of serpentine-soapstone rocks, the use of calc-silicate "skarn" as a building stone and the use of cordierite-bearing pegmatite as an ornamental stone. The locations of the investigated sites are shown in Figure GS-37-1.

THOMPSON MINE, PIPE LAKE MINE AND MANIBRIDGE MINE

The Thompson Nickel Belt is one of the most important mineral producing areas in Manitoba. Access was gained to mine dumps at the exhausted Manibridge and Pipe Lake Mines and the producing Thompson Mine. The Thompson Open Pit was not accessible during 1985. Serpentine from the Pipe Lake Mine has all of the characteristics required for a superior carving stone. The calc-silicate "skarn" from the Pipe Lake and Thompson Mines are potential ornamental and building stones. The Manibridge Mine was examined; however, no suitable carving or building stone material was found.

Carving-quality serpentine was selectively stockpiled by INCO during the operation of the Pipe Lake Mine Open Pit. Frost shattering has a destructive effect on the serpentine and the surface of the stockpile is littered with more or less friable remnants of serpentine blocks. The serpentine has a similar friable texture inside the stockpile, as seen in a test pit dug by INCO. It appears that the blasting within the pit as well as frost shattering has affected the stability of the serpentine. The small amount of in situ serpentinite on the north end of the Pipe Lake Mine

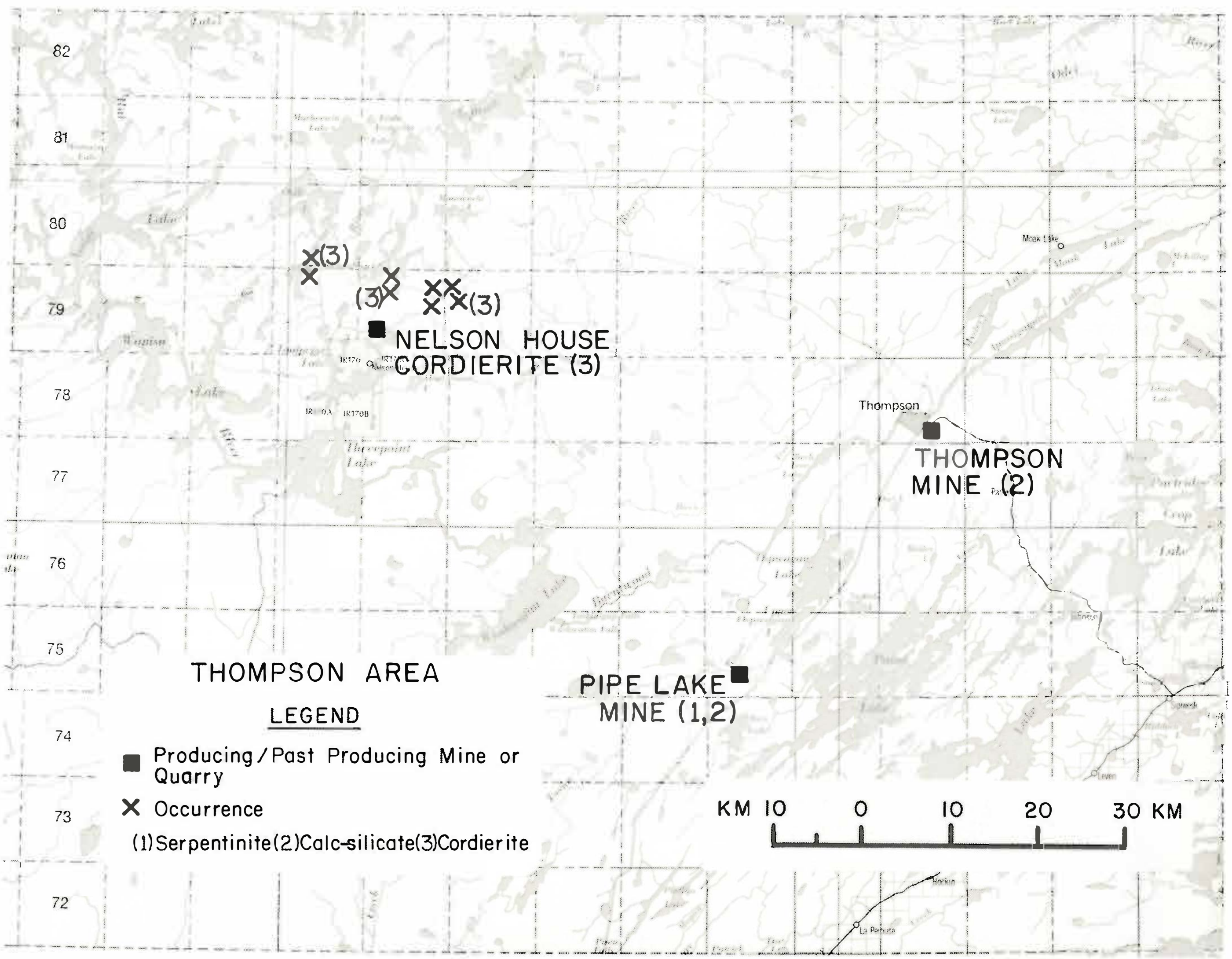


Figure GS-37-1: Location of industrial mineral occurrences in the Thompson area.

Open Pit might be an even better carving stone than the stockpiled material if it was removed by building stone quarrying techniques. Three types of serpentine occur randomly throughout the stockpile. These are: a grey-black moderately friable, asbestos-bearing serpentine; a light green granular magnetite-bearing serpentine; and a very fine grained light- to dark-green secondary serpentine. The secondary serpentine occurs in cross-cutting veins that are often associated with minor asbestos. The veins are generally two to five centimetres in thickness; however, in places they are up to 1 metre thick.

Asbestos veinlets are very common in the serpentine and most large blocks contain at least one veinlet. These veinlets are largely less than 2 cm in size and the overall asbestos content is considerably less than 1%. The only use for the asbestos is as specimens of interlayered asbestos and serpentine.

Parts of the "skarn" are fine- to medium-grained dolomitic calc-silicate. In the Pipe Lake Mine the "skarn" is a siliceous dolomite with minor disseminated sulphides, biotite, diopside and other calc-silicate minerals. The dolomite is a tough competent rock with complex patterns of silicates, that has potential as a marble facing stone. The dump outside the Pipe Lake Mine gate has many 2 x 2 x 2 m, or larger sized blocks of "skarn" without major fractures.

The "skarn" observed underground in the Thompson Mine (Zurbrigg, 1963) has a higher percentage of calc-silicates and very little free carbonate. This is a less desirable building stone than that at the Pipe Lake Mine since the calc-silicate minerals will not polish as well as the carbonate. The "skarn" at the Thompson Mine is more intensely fractured than the "skarn" in the Pipe Lake Mine.

"Skarn" samples from the Thompson Mine Open Pit are similar to those from the Pipe Lake Mine. The potential for economic recovery is possible either from the dumps of the Pipe Lake mine or from the Thompson Mine Open Pit. The Thompson Mine Open Pit appears to offer the best opportunity for development because the "skarn" rock can be separated during mining and stockpiled for further processing.

CORDIERITE-BEARING PEGMATITE

The gneisses west of Thompson have undergone upper amphibolite grade metamorphism and are now part of a migmatite terrain. Within this terrain there are bodies that are rich in unaltered cordierite and a cordierite-garnet rock has been described from the Rat River (Baldwin, 1971). Cordierite occurs within pegmatitic segregations of migmatite in road cuts on the Thompson-Lynn Lake Road, on both sides of the Nelson House junction. An extension of this body occurs in a roadstone quarry aproximately 6 km along the road towards Nelson House. The cordierite is a deep blue-violet colour and is moderately fractured; however, at least a portion of the fracturing associated with the sampled cordierite may be due to the heavy blasting in the road cuts and the quarry. Other minerals present in the pegmatitic segregations are: almandine, biotite, quartz, feldspars and undetermined fine grained alteration products. The garnet is detrimental to the stone as it will affect the polish on a cordierite-quartz aggregate; however, the garnet could be avoided by selective quarrying.

Euhedral cordierite occurs in a pegmatite in the road cut immediately west of the Footprint River Bridge. The rarity of euhedral cordierites and the strong colour of the massive cordierite would make this a good location for collecting specimen quality material.

REFERENCES

Baldwin, D.A.
1971: Garnet-cordierite-anthophyllite rock at Rat Lake, Manitoba; unpublished M.Sc. thesis, University of Manitoba, 53 p.

Gale, G.H., Somerville, R.C., Chornoby, T., Haystead, B., Provins, N., Braun, D., Mundy, D. and Walker, A.
1982: Geological setting of the mineral deposits at Ruttan, Thompson, Snow Lake and Flin Flon; GAC-MAC Joint Annual Meeting, Winnipeg, Manitoba, Field Trip Guidebook, Field Trip 14.

Theyer, P.
1980: Ultramafic rocks, nickel occurrences and interpreted stratigraphic relationships; Manitoba Department of Energy and Mines, Economic Geology Report ER79-2.

Zurbrigg, H.F.
1963: Thompson Mine geology; Bulletin of The Canadian Institute of Mining and Metallurgy, v. 56, p. 451-560.

GS-38 GEOLOGICAL INVESTIGATIONS IN THE ISLAND LAKE-STEVENSON LAKE AREA

(53E/13 NE and NW; 53E/16 SE and SW; 63H/16 NE)

by H.P. Gilbert

INTRODUCTION

Four weeks of field work were required to map the greenstone belt at Stevenson Lake, together with parts of the granitoid terranes to the north and south. A unit of polymictic cobble conglomerate (Unit 8, Figs. GS-38-1 and 2) was mapped through the central part of the belt, which thus extends the known limit of the Island Lake Group sedimentary basin to the west end of Stevenson Lake. The greenstone belt at Stevenson Lake is highly attenuated, and interpreted as a major synclinal structure with possible subsidiary folds and fault slices (Preliminary Maps 1985I-1, 2 and 5).

Seven weeks of mapping were undertaken at Island Lake; coverage of the greenstone belt from Collins Bay in the west to Long. 94°00' in the east has now been completed. A variety of mafic flows, intermediate volcanic breccias and fine grained sedimentary rocks extends through the archipelago between Grand and Savage Islands (Preliminary Map 1985I-4). Five major folds have been identified in that area. Sporadic peridotite intrusions occur within that section at a volcanic/sedimentary interface, and at the south margin of the belt at, or close to, the contact with granitoid rocks to the south. North of the Island Lake Group sedimentary basin (Sinclair-Lawrence Islands area) a minor branch of the greenstone belt was mapped in the Whiteway Island-Loonfoot Island area (Preliminary Map 1985 I-3). This section is synclinorial, and consists largely of pillowed basalt, intruded by a large mafic sill (Whiteway Island gabbro).

STEVENSON LAKE AREA

STRUCTURE

The greenstone belt at Stevenson Lake is a narrow (1.2-2.5 km) strongly deformed extension of the greenstone belt at Island Lake, 40 km east of the east end of Stevenson Lake. At least two phases of folding, severe attenuation and regional amphibolite facies metamorphism have resulted in very limited structural data. However, the lithologic units are comparable with those in the section at Island Lake, which has been utilized in the interpretation of the stratigraphy. The greenstone belt at Stevenson Lake is interpreted as synclinal, with conglomerate (unit 8) occupying the axial zone (Fig. GS-38-2. A few occurrences of graded bedding in greywacke and arkosic wacke (4,8) are consistent with this structure. Intercalation of units 1 and 8 is interpreted as a result of repeated folding and/or faulting. Major faults parallel and subparallel to the east trend of the greenstone belt are indicated by narrow very highly sheared zones and the irregularity of the stratigraphic sequence in sections through different parts of the belt. Faults roughly perpendicular to the trend of the belt have been inferred locally from air-photo lineaments which coincide with stratigraphic discontinuities.

STRATIGRAPHY

Aphyric basalt and pillowed basalt (1) extend along the south margin of the greenstone belt and are interpreted as the basal unit of the Hayes River Group. These rocks are intruded by tonalite-granodiorite (5) to the south. The mafic section (up to 550 m thick) is overlain in the west part of the lake by up to 180 m of fine grained sedimentary rocks (4), extensively intruded by felsic porphyry. A massive felsic volcanic unit (3) up to 120 m thick extends laterally in sporadic outcrop for over 7 km in the vicinity of Wapawongank Narrows. The felsic rocks apparently overlie the basalt (1) but the relative ages of units 3 and 4 is uncertain. A minor (60 m) unit of intermediate to felsic volcanic breccia and lapilli tuff (2) occurs close to the southeast corner of Wagner Island. Granitoid intrusive rocks (5) intrude the Hayes River Group and are interpreted as predominantly pre-Island Lake Group (8); minor granodiorite and pink pegmatite phases which intrude unit 8 have been included in unit 5. Mafic intrusive rocks (7) pre-date the conglomerate (8), which is interpreted to overlie these intrusives and the Hayes River Group unconformably. The unconformity has been well documented at Island Lake (Gilbert and Weber, 1983; Gilbert, 1984) but the contact between the Hayes River and Island Lake Groups at Stevenson Lake is not clearly defined and probably largely faulted. Fine grained sediments associated with conglomerate (8) are similar to some Hayes River Group sedimentary rocks (4) and thus the contact between these units is uncertain. Several exposed contacts between units 8 and 1 are strongly sheared, and minor units of basalt are tectonically emplaced within the conglomerate. The conglomerate also contains minor veins and dykes of amphibolite (10) which are similar to the tectonic enclaves of basalt. The conglomerate directly overlies massive tonalite (5) at Matowokamank Narrows at a locality interpreted as a felsic volcanic centre by Ermanovics et al. (1975). The conglomerate extends throughout the belt for at least 45 km; the maximum width of the unit is 300 m, but the true thickness is interpreted as 150 m (maximum). The unit is well preserved at the east end of the lake, but strongly deformed and gneissic at the west end, where the conglomerate is pervaded by pink pegmatite in the inferred axial zone of the syncline.

The north limb of the syncline is represented by approximately 450 m of aphyric basalt north of Matowokamank Narrows and a body of fine grained sedimentary rocks (4) 600 m wide to the west. An enclave of basalt also occurs in the granitoid terrane to the north at Wapaskank Narrows. Farther west, the north limb is represented by remnants of mafic volcanic rocks within the granitoid terrane north of the greenstone belt. This terrane contains extensive areas of hybrid gneisses interpreted as the products of reaction between unit 5 and the Hayes River Group (1-4, predominantly 1); similar gneisses occur in one part of the granitoid terrane south of the belt.

LITHOLOGIC UNITS

The supracrustal rocks at Stevenson Lake are similar to equivalent lithologies described at Island Lake. Basalt flows (1) are aphyric, moderately to strongly foliated and locally display pillow structure or derived metamorphic layering; facing direction was determined at only one locality south of Wagner Island where pillows face north. Alteration of basalt is confined to minor narrow zones (locally with sulphides), in contrast to the Island Lake area, where the mafic flows are commonly partly silicified or carbonatized. Minor gabboic units (1-5 m) within the basalt are interpeted as synvolcanic. Massive felsic volcanic rocks (flows and/or tuffs or sills) are aphyric with minor plagioclase-phyric phases; no primary structures have been recognized, and a fine diffuse lamination is interpeted as tectonic. Intermediate to felsic volcanic breccia and lapilli tuff contain angular, unsorted clasts (up to 40 x 8 cm) in a tuffaceous matrix (Fig. GS-38-3). Intermediate to felsic greywacke and siltstone (4) are micaceous, well layered and locally graded. Refolded folds are defined by bedding at one locality at the west end of Stevenson Lake (Fig. GS-38-4). Rare porphyroblasts include garnet and cordierite (C.R. McGregor, pers. comm.) at the west end of the lake. Minor chert interlayers occur at several localities within the greywacke (Fig. GS-38-5). Very fine grained felsitic rocks with a diffuse lamination within the intermediate greywacke are interpreted as reworked felsic tuffs. These rocks occur close to the felsic volcanic unit east of Wapawongank Narrows and within the greywacke in the southwest part of Stevenson Lake. Polymictic conglomerate (8) contains subangular to rounded clasts of

APHEBIAN	INTRUSIVE ROCKS	11	Gabbro, diabase
ARCHEAN		10	Diabase, amphibolite, hornblendite
		9	Plagioclase ± quartz porphyry, felsite
			INTRUSIVE CONTACT
	ISLAND LAKE GROUP*	8	Sedimentary rocks: polymictic pebble/boulder conglomerate, arkosic wacke, lithic and feldspathic greywacke; minor quartz wacke and siltstone; related paragneiss
			UNCONFORMITY
	INTRUSIVE ROCKS	7	Mafic intrusive and related rocks: gabbro, melagabbro and hornblendite; quartz gabbro, granophyric gabbro, leucogabbro and leucotonalite; diorite and quartz diorite
		6	Ultramafic intrusive rocks: serpentinized peridotite, hornblendite
		5	Granitoid intrusive and related rocks: tonalite, quartz diorite, granodiorite, granite; pegmatite, aplite; diorite, migmatite and orthogneiss
			INTRUSIVE CONTACT
	HAYES RIVER GROUP*	4	Sedimentary rocks: feldspathic greywacke, siltstone, argillite, argillitic wacke, polymictic cobble conglomerate, carbonate, chert, iron formation; related schist and gneiss
		3	Felsic volcanic rocks: flows and/or sills, tuff, breccia; related sericite schist and fuchsite schist
		2	Intermediate volcanic rocks: flows, tuff, breccia
		1	Mafic 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-38-1 *Table of Formations-Stevenson Lake and Island Lake areas.*

tonalite-granodiorite (predominant), felsic and intermediate (volcanic or sedimentary) fine grained rocks, amphibolite (after basalt and gabbro), plagioclase porphyry and minor quartz (Fig. GS-38-6). The clasts (up to 40 x 12 cm) are generally unsorted. The conglomerate is commonly very strongly attenuated and variously altered to paragneiss containing rare garnet. Minor sandstone interbeds are generally intermediate greywacke, but felsic to arkosic wacke and quartz wacke are associated with the conglomerate just west of Deer Rapids. Massive to gneissoid gabbro and melagabbro (7) occur as minor dykes and sills (up to 150 m thick) within the Hayes River Group and close to the south margin of the greenstone belt. Serpentinized peridotite was not found at Stevenson Lake.

The granitoid rocks (5) south of the greenstone belt are predominantly massive to gneissoid, medium- to coarse-grained biotite-tonalite to granodiorite, locally with subporphyritic texture (quartz or rare plagioclase phenocrysts). Minor phases within this terrane include fine- to medium-grained leucotonalite, hornblende quartz diorite and diorite. The granitoid terrane north of the greenstone belt contains similar granitoid rocks together with massive, coarse grained microcline-phyric granite and hybrid gneisses interpreted as reaction products of unit 5 and the Hayes River Group (Fig GS-38-7); these gneisses have been interpreted as basement to the greenstone belt by Ermanovics et al. (op. cit.). Late pink pegmatite and minor aplite are more common in the granitoid terrane north of the belt than in the area to the south.

ECONOMIC GEOLOGY

Sulphide mineralization is largely confined to the basaltic rocks (1) where 0.5-3.0 m wide zones containing pyrite ($\pm$ pyrrhotite) occur sporadically, together with related ferruginous, rusty zones. Silicification of the host basalt is common in these zones, which occur within the mafic section or close to the contact with overlying felsic volcanic rocks, or at the contact with granitoid rocks at the south margin of the belt, where the mineralized rock is either basalt or, at one locality, a felsite dyke. Pyrite, pyrrhotite, chalcopyrite and galena occur in a highly sheared silicified mafic unit (3.5 m thick) at the contact between tonalite (5) and conglomerate (8) at Matowokamank narrows. An assayed sample from this locality contains Au = 0.02 oz/ton and Ag = 3.8 oz/ton (Ermanovics et al., op. cit.).

ISLAND LAKE: GRAND ISLAND-SAVAGE ISLAND AREA

STRUCTURE

The 3.6 km wide Hayes River Group section between Grand and Savage Islands contains at least 5 major folds; these are indicated by graded bedding in sedimentary rocks and (less commonly) volcanic fragmentals (Fig. GS-38-8). Only one pillow top was determined among the numerous pillowed flows in the area; at the northwest shore of Savage Island aphyric basalt (1) faces south, away from conglomerate (8) in a "back to back" relationship. Savage Island is synclinorial, with a minor inlier of basalt (1) within fine grained sedimentary rocks (4) in the axial zone of the structure. A series of islands between Savage and Chain Islands, consisting of highly deformed mainly sedimentary rocks, are interpreted as the axial zone of a major fold or several folds, although there are no top directions preserved to confirm this. Approximately 700 m to the south an anticlinal fold extends through Chain Islands, and a parallel syncline occurs 500 m further south. Between that fold and the south margin of the greenstone belt the section (up to 2.4 km wide) is devoid of structural indicators, but is provisionally interpreted as homoclinal.

Rare tight to isoclinal minor folds in greywacke bedding are interpreted as early (F_1), contemporaneous with the major folds. Minor F_2 folds are widely developed, especially in fine grained sedimentary rocks (4); these deform the S_1 foliation which transects bedding at several places, although the latter is almost invariably parallel to the regional (S_1) foliation. F_2 folds are open to tight or isoclinal; both F_1 and F_2 folds are moderately to steeply plunging or vertical, with axial planes roughly parallel to the regional foliation.

Shear zones parallel to the major folds occur sporadically and faulting and dislocation are common at the axial planes of minor folds. A fault has been inferred parallel to the axial plane of the syncline in the north part of Savage Island to account for the stratigraphic discontinuity across this fold. An east-trending fault is inferred close to the south margin of the belt, parallel to the north shores of Grand and York Islands. The occurrence of minor ultramafic bodies along this margin is consistent with a major fracture at or close to the contact with granitoid rocks to the south. These locally contain minor enclaves of amphibolite related to the basaltic section further north and hybrid gneisses probably resulting from assimilation of supracrustal rocks. Northeast- and northwest-trending faults are mostly minor (0.5-2 m displacement); a northeast-trending fault of at least 160 m left lateral displacement is inferred at the termination of the pillowed basalt unit at the north shore of Savage Island.

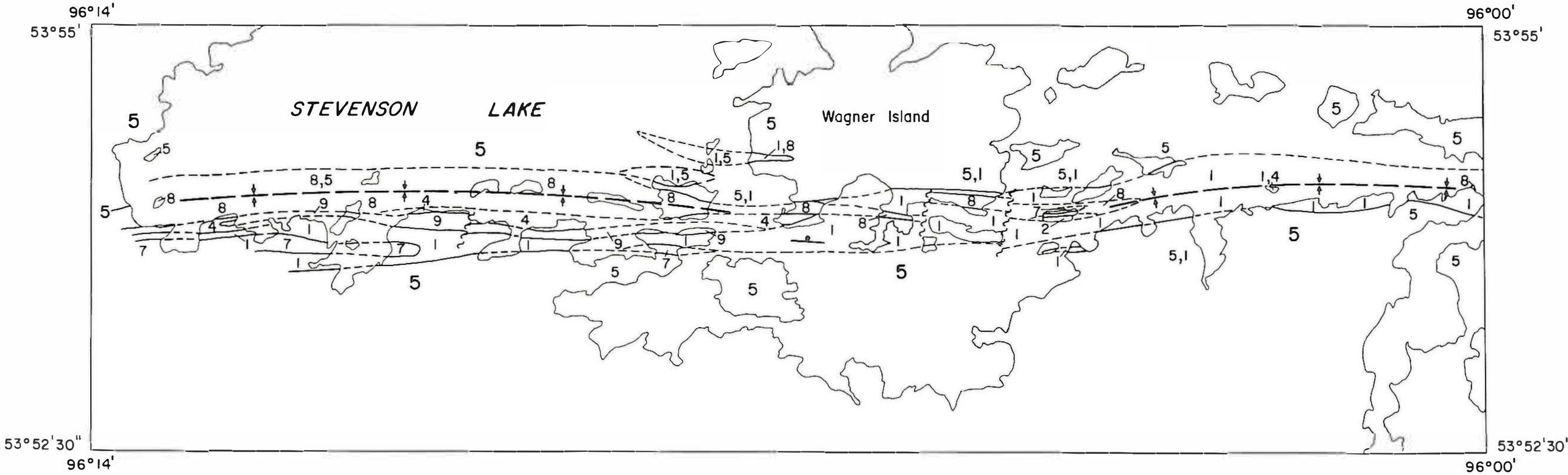
STRATIGRAPHY

The Grand Island-Savage Island section (Figs. GS-38-8 and 9) consists of basalt (unit 1, 30 per cent), intermediate and felsic volcanic breccia and tuff (2 and 3, 30 per cent), fine grained sedimentary rocks (4, 25 per cent) and gabbro (7, 15 per cent). Aphyric basalt (with minor related gabbro and amphibolite) is the oldest unit, occurring at the margins of the section, in the axial zone of the anticline through Chain Islands and in the southern (homoclinal) part of the belt north of Grand and York Islands, where the mafic flows are up to 650 m thick. Pillows are less widespread than in the Whiteway-Loonfoot Islands section, and the basalt is more commonly deformed and altered to amphibolite and related schist. South of Keespakotik Island pillowed basalt is laterally transitional with mafic tuff (at least 180 m thick) to the east, distinguished from the flows by a detrital texture. Minor mafic tuff and related schist units (0.5-4 m thick) also occur within the basalt sections at Chain Islands and north of York Island. Gneissic amphibolite (1) within the fine grained sedimentary unit (4) southeast of Savage Island is interpreted as a structural inlier of basalt or mafic tuff. Aphyric pillowed basalt (250 m thick) at the northwest corner of Savage Island is relatively undeformed and highly silicified (white weathering) in the southeast part of the unit; silicification was not observed elsewhere in the Grand-Savage Islands section, except in minor mineralized zones. A rare 0.5 m autoclastic breccia unit marks one flow contact at northwest Savage Island. Megaphyric basalt and related gabbro up to 10 m thick (interpreted as unit 1) extend for 3 km along the contact between units 1 and 5 at the north shore of Grand Island. Plagioclase euhedra (up to 2 cm) and hornblende pseudomorphs (1-3 mm) constitute 10-50 per cent and up to 35 per cent of the rock respectively.

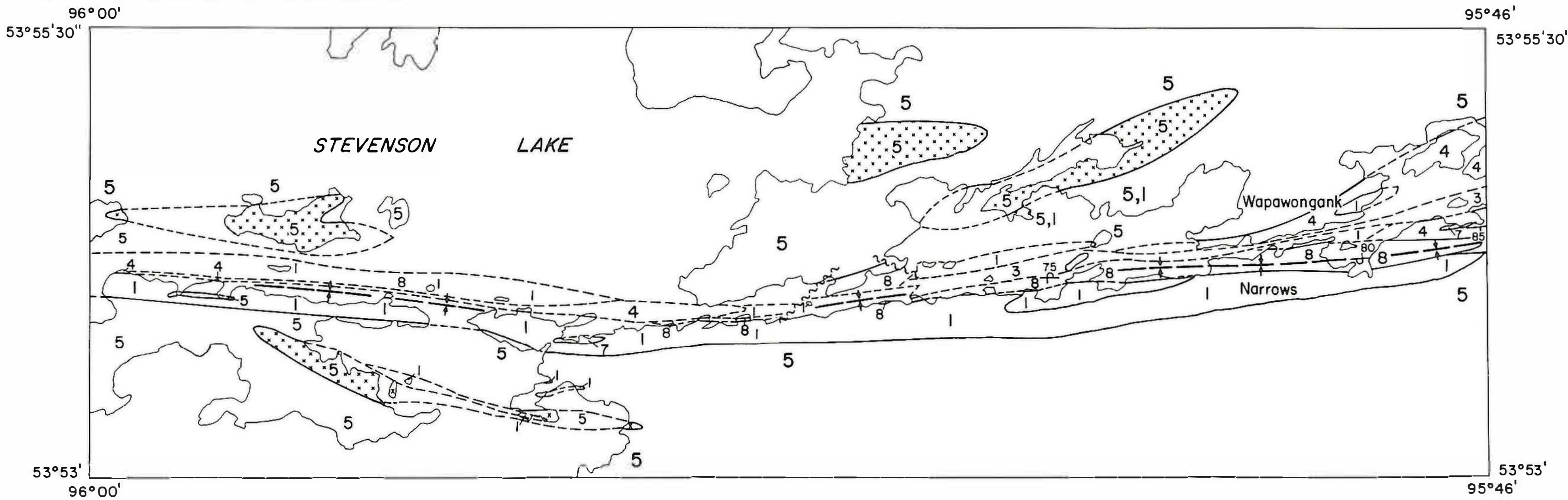
Intermediate to felsic volcanic breccia and minor related tuff and flows (2, 3) extend from Holdstock Island in the west (Gilbert et al., 1983) to the area north of York Island. The unit is approximately 850 m wide both in the west (at Henderson Island) and central part (north of Grand Island), and extends laterally for 16 km (Henderson Island felsic volcanics, Gilbert and Weber, 1983). The breccia, which is interpreted as a subaqueous pyroclastic deposit, occurs within the mafic volcanic section of the southern, homoclinal part of the greenstone belt (Fig. GS-38-9). Related breccia occurs close to the south margin of the belt east of York Island. Aphyric and plagioclase-phyric felsic clasts and subordinate mafic types occur in an intermediate to mafic tuff matrix. Clasts (up to 1.8 m x 15 cm) are locally angular but in general highly attenuated (up to 25:1); unsorted breccia units up to 10 m thick are associated with relatively massive units interpreted as intermediate tuffs and minor flows.

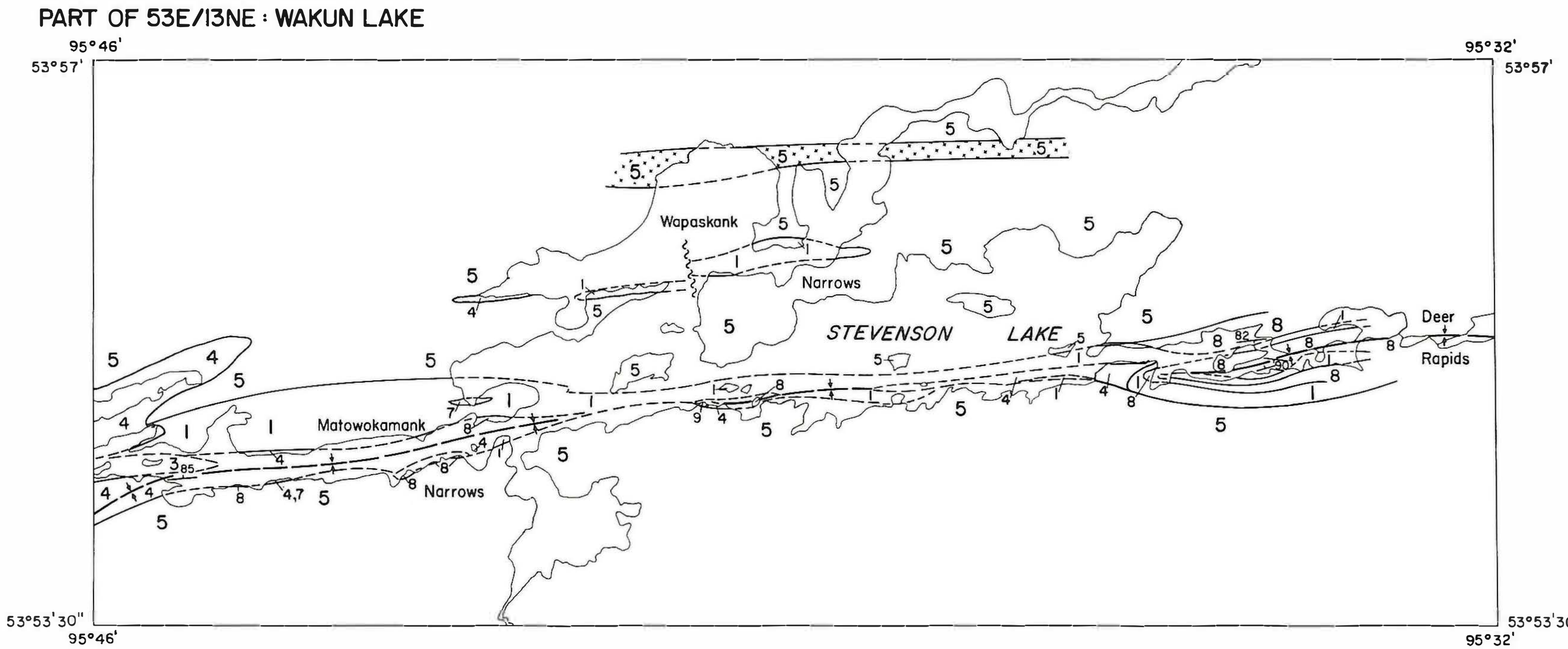
Intermediate and felsic tuff, crystal tuff and volcanic breccia (2,3) directly overlie mafic volcanic rocks along the north side of Chain Islands. This unit and similar fragmental rocks in the west part of Savage Island are probably stratigraphically equivalent; the two units are separated by fine grained sedimentary rocks (4) in a synclinal or synclinorial struc-

PART OF 63H/16NE : WAGNER ISLAND



PART OF 53E/13NW : OGIT LAKE





SYMBOLS

	Geological contact (approximate, underwater)
85 90 75	Bedding, tops known (inclined, vertical, overturned, amount of dip unknown)
	Pillows, tops known, inclined
	Axial trace of syncline
	Fault, inferred
1 to 9	Geological units (correspond to table of formations, Fig.GS-38-1)
5	Area of hybrid gneisses within unit 5

SCALE

0 1 2 3 4 km

Figure GS-38-2 Geology of the Stevenson Lake area.

Figure GS-38-3 Intermediate to felsic volcanic breccia (2), west part of Stevenson Lake.

ture. The intermediate to felsic fragmentals are also probably contemporaneous with the Henderson Island felsic volcanics. The unit at Chain Islands (approximately 180 m thick) is generally highly deformed and altered to quartz-sericite-gneiss and schist, in contrast to the Savage Island unit (approximately 700 m thick) which is undeformed. Crystal tuffs are predominant in both units, generally massive but locally with a diffuse lamination or rare graded bedding at Chain Islands, where 0.5-5 m thick felsic volcanic breccia interlayers are highly attenuated and pseudolaminated, with clasts up to 75 x 1 cm. Breccia at the west end of Savage Island contains subangular to subrounded plagioclase-phyric felsic clasts (up to 1 x 0.35 m); coarse fragmental layers (up to 5 m thick) are unsorted and gradational with crystal tuff and tuff-breccia. Felsic fragmental rocks (3) east of the major fault through Savage Island are probably part of the unit to the west, but coarse breccia units are absent, and the composition is more siliceous; felsic crystal- and lithic-tuffs are predominant with minor lapilli tuff and massive plagioclase-phyric rhyolite flows or minor intrusive units. The tuffs (2,3) at Savage Island are devoid of layering, but distinguished from flows by a detrital texture and association with coarser fragmental units. Rare argillitic enclaves within the felsic tuff at northeast Savage Island indicate a subaqueous environment.

The upper part of the Hayes River Group consists of fine grained sedimentary rocks (4) which occupy the axial zones of synclines in the south part of Savage Island and south of Chain Islands (Fig. GS-38-8). Minor (0.5-5 m thick) chert and greywacke-siltstone interlayers (4) within basalt (1) close to the margins of these two sedimentary sections indicate a transitional contact between units 1 and 4. Unit 4 includes the following lithologies: intermediate to felsic greywacke, siltstone and argillite (predominant); minor quartz wacke, iron formation and sporadic occurrences of chert and quartz-pebble conglomerate. Massive greywacke or argillite units (> 2 m thick) occur locally but the sediments are more commonly well layered (at 0.5-50 cm) and locally graded. Argillite, largely confined to the section at Savage Island, is invariably pervaded by quartz veins and commonly highly folded. Interlayers of quartz wacke and a hybrid argillaceous wacke occur locally in the argillite. Carbonatization occurs sporadically in the fine grained sediments and in some mafic dykes in the Savage Island section. Greywacke at the northeast shore of Savage Island is gradational with older felsic tuff (3) to the north, from which it is probably partly derived;

Figure GS-38-4 Refolded folds in thinly layered greywacke-siltstone (4), west end of Stevenson Lake.

Figure GS-38-5 Chert (4) interlayered with greywacke and amphibolite, west part of Stevenson Lake.

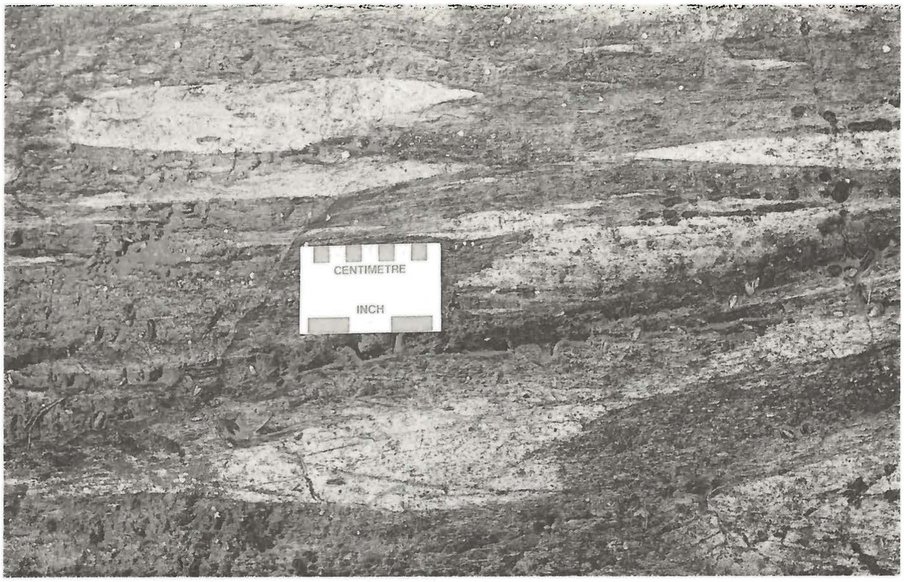
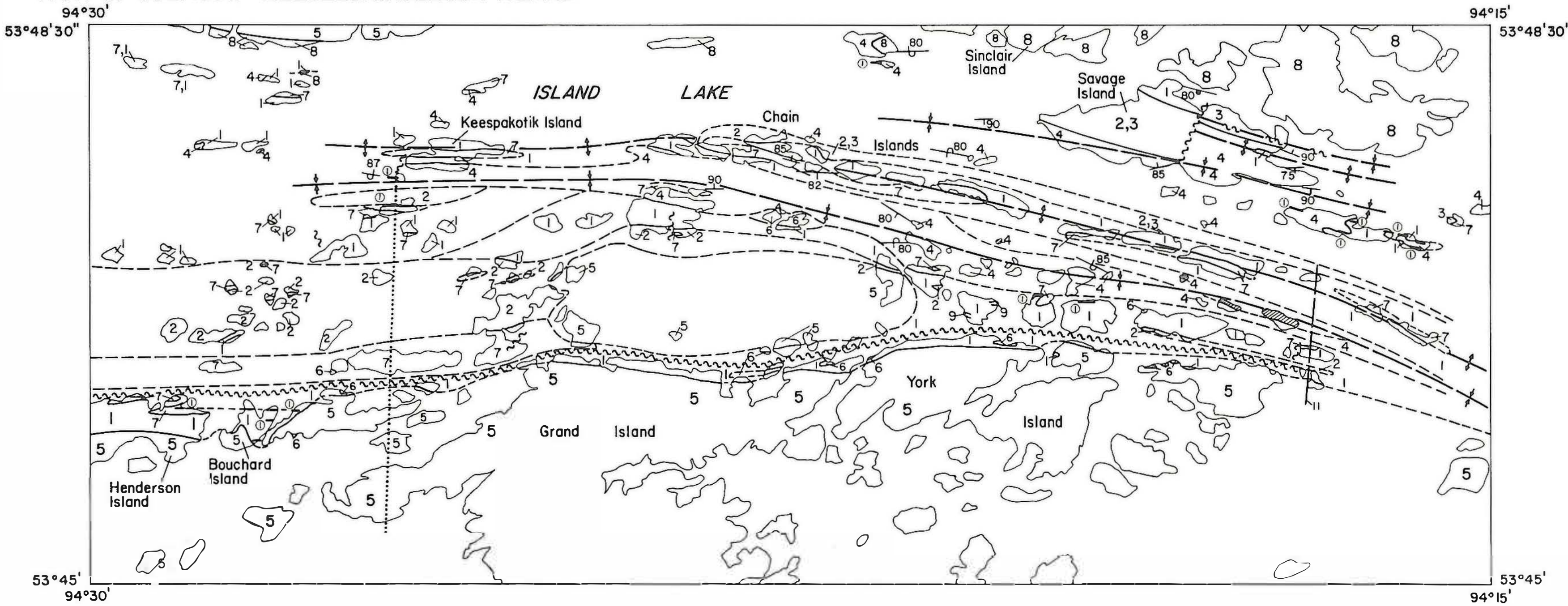


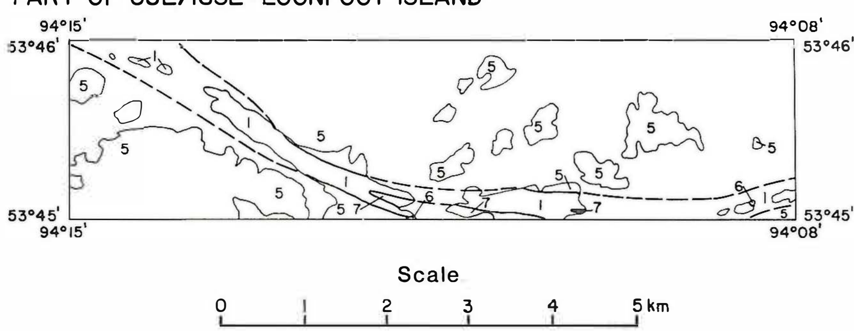
Figure GS-38-6 Polymictic cobble conglomerate (8), east end of Stevenson Lake.

Figure GS-38-7 Orthogneiss (5), west-central part of Stevenson Lake.

PART OF 53E/16SW : MEEGEESIWASEESON ISLAND



PART OF 53E/16SE : LOONFOOT ISLAND



SYMBOLS

Geological contact (approximate, underwater)

Bedding, tops known (inclined, vertical, overturned)

Pillows, tops known, inclined

Axial traces of anticline, syncline

Fault (inferred)

Iron formation

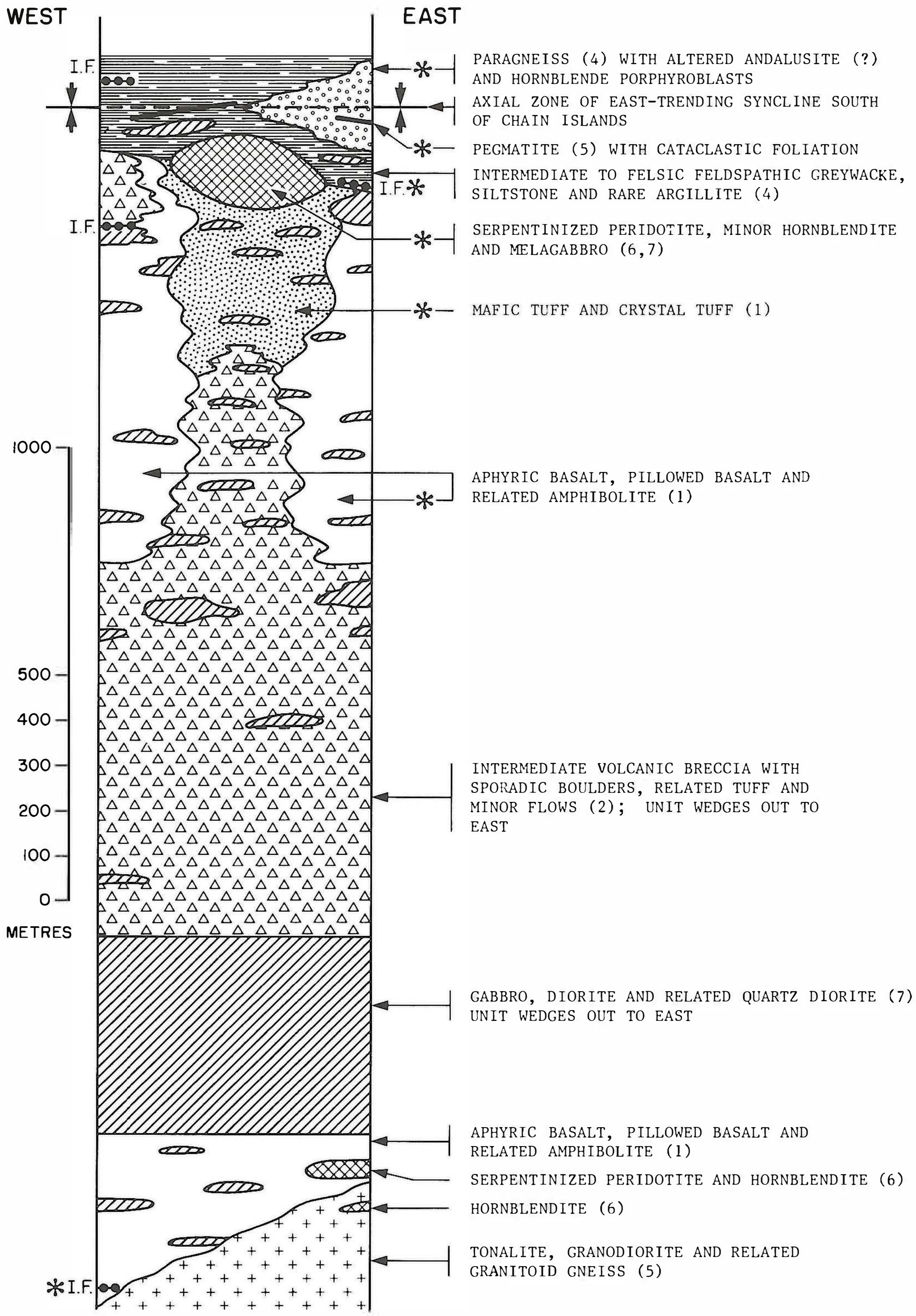
Webber Lake gabbro dyke (11)

Line of stratigraphic section (Fig.GS-38-9)

I to II — Geological units (correspond to table of formations, Fig.GS-38-1)

Area of porphyroblastic paragneiss within unit 4

Figure GS-38-8 *Geology of the Grand Island-Savage Island area, Island Lake.*



NOTE:

MINOR GABBRO SILLS (7) IN UNITS 1, 2 AND 4 ARE DIAGONALLY SHADED

I.F. = IRON FORMATION

* UNIT OCCURS DOWNSTRIKE FROM LINE OF SECTION

UNIT NUMBERS CORRESPOND TO THOSE IN FIG. GS-38-1

Figure GS-38-9 *Stratigraphic section through the Island Lake greenstone belt from Keespakotik Island to Grand Island.*

the section in the south part of Savage Island consists largely of felsic wacke and very fine grained siliceous siltstone. Quartz-pebble conglomerate and quartz wacke (4) occur 3 km west of Savage Island, close to the contact with the Island Lake Group to the north. The sedimentary section south of Chain Islands is up to 750 m wide (375 m true thickness) and contains, in the east part, a 200 m section of paragneiss with stratabound porphyroblasts of possible andalusite (up to 5 cm across) and hornblende (up to 1 cm). Cataclastically foliated pegmatite occurs in the paragneiss and greywacke further west in the axial zone of the syncline.

Iron formations (4) occur throughout the Hayes River Group as follows:

(a) within amphibolite derived from basalt and gabbro (1) at the south margin of the greenstone belt at Bouchard Island;
(b) at the contact between intermediate tuff and volcanic breccia (2) and gabbro (7) south of Keespakotik Island;
(c) at the contact between basalt (1) and greywacke (4) north of York Island;
(d) within greywacke (4) in the axial zone of the syncline south of Chain Islands;
(e) within amphibolite (1), fine grained sedimentary rocks (4) and at the contact between these units southeast of Savage Island; and
(f) within greywacke and siltstone (4) close to the contact with the Island Lake Group 2 km west of Savage Island.

Types (a) to (c) contain 20-60 per cent massive magnetite laminae (alternating with chert); types (d) to (f) contain 0-10 per cent magnetite, disseminated in chert or very fine grained amphibolite laminae (alternating with minor hematitic chert and/or siltstone laminae). The iron formations (generally 1-5 m, up to 11 m thick) are very finely layered (at 2-20 mm) and commonly contain pyritic zones and stringers, especially types (d) to (f); pervasive calcium metasomatism occurs at one locality of type (d).

Ovoid stocks of massive, medium- to coarse-grained tonalite-granodiorite (5) occur within the greenstone belt close to the south margin north of Grand Island and south of Heart Island (4.5 km and 10 km long respectively). These homogeneous intrusions are distinguished from the granitoid terrane (5) south of the belt, which locally contains contaminated zones and related orthogneisses, and is moderately to well foliated. Several minor tonalite intrusions (5) in hornblendite (6) indicate a granitoid phase postdates the ultramafic unit.

Massive serpentinised peridotite and hornblendite (6) occur in a sill (160 m thick) at the contact between mafic tuff (1) and greywacke (4) north of Grand Island, and a minor peridotite body occurs in basalt (1) close to the same contact south of Savage Island. Peridotite within basalt at the northeast shore of Grand Island locally contains pseudomorphs probably after olivine; a genetic relationship is inferred with an olivine melagabbronorite sill 8 km further west at Henderson Island (Gilbert et al., 1983). Sporadic minor intrusions of peridotite and hornblendite occur for 12 km further east along the south margin of the greenstone belt and within adjacent granitoid rocks.

Gabbro sills (7) one to 100 m thick are abundant in mafic and intermediate volcanic rocks (1,2) at Chain Islands and the area to the south, less common in fine grained sedimentary rocks (4), and absent in intermediate and felsic volcanic fragmentals (2,3) at Savage Island. A major sill (300-600m thick) extends from the north shore of Grand Island for 10 km to the west end of Henderson Island (Gilbert et al., 1983).

Plagioclase $\pm$ quartz porphyry and related felsite dykes (9) occur sporadically in all units, except for 2 and 3 at Savage Island and north of Chain Islands; the felsic dykes are especially abundant in mafic volcanic and sedimentary rocks (1,4) just east of the granitoid stock (5) north of Grand Island.

A massive 22 m thick gabbro dyke (11), trending 005°, transects the south contact of the greenstone belt with granitoid rocks 2 km east of York Island; this intrusion is part of the Webber Lake dyke, a Molson dyke of inferred Aphebian age which extends south from the Fox River Belt for 220 km (Scoates and Macek, 1978). The dyke is locally associated with a magnetic anomaly on the ground, but only a slight response is registered on the aeromagnetic map at this locality (York Lake, Map 4023 G, Federal-Provincial Aeromagnetic Series). Minor related diabase intrusions occur at islands southeast of Savage Island.

ECONOMIC GEOLOGY

Most sulphide occurrences (pyrite $\pm$ rare chalcopyrite and malachite) occur in minor greywacke or chert interlayers within mafic volcanic rocks (e.g. south and east of Keespakotik Island) but minor mineralized zones also occur within the greywacke section south of Chain Islands and in argillite in the south part of Savage Island. Pyritic stringers occur in several iron formations, and minor (0.5-2 m) altered zones of sulphides occur sporadically in basalt, gabbro, and intermediate volcanic breccia. Pyritohedra (up to 1 cm) constitute 15 per cent of plagioclase porphyry and amphibolitic schist close to the contact between basalt (1) and overlying greywacke (4) at the southeast corner of Keespakotik Island.

ISLAND LAKE: WHITEWAY ISLAND-LOONFOOT ISLAND AREA

STRUCTURE

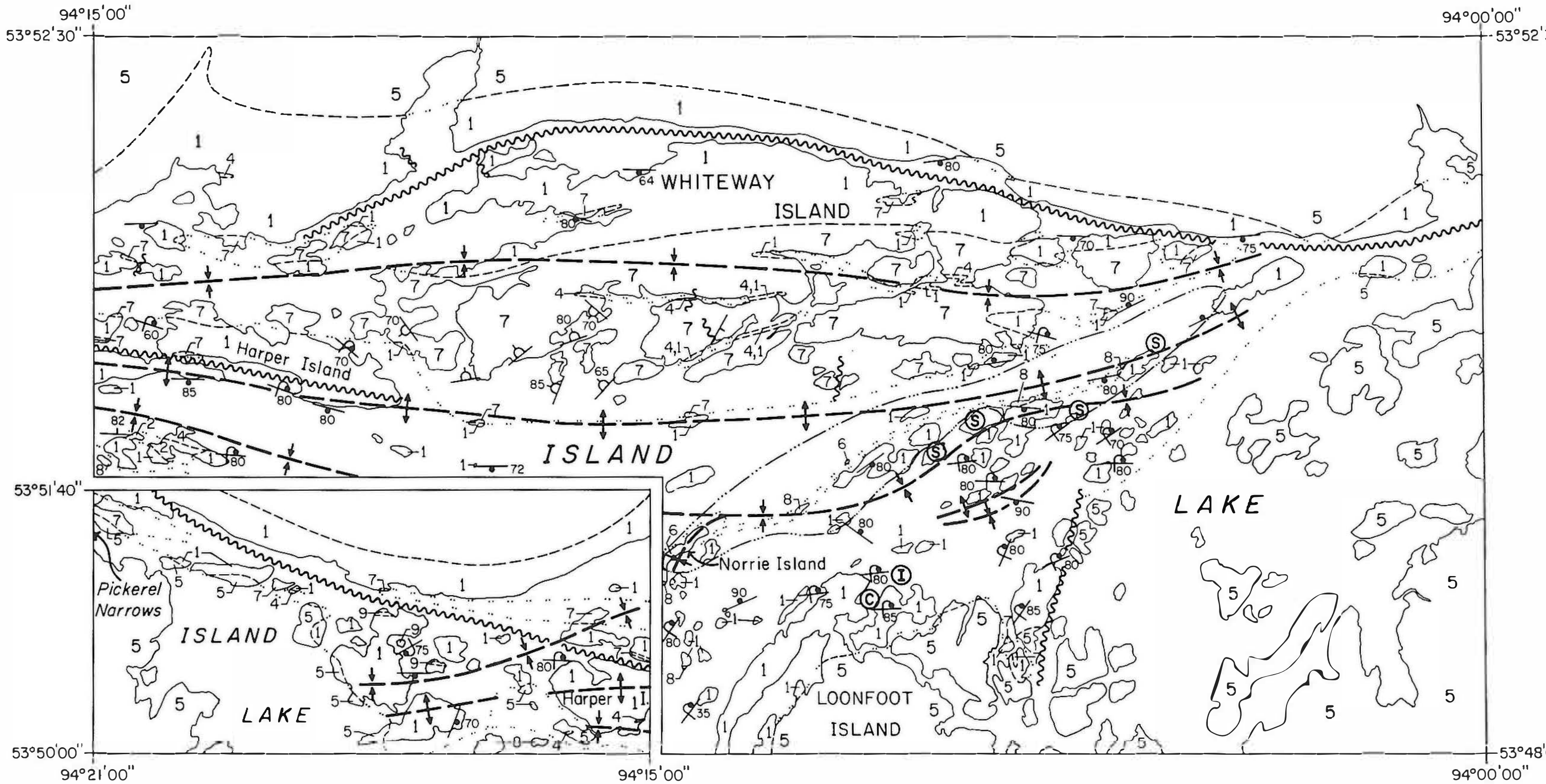
Abundant pillow top directions indicate a synclinorial structure, with three major folds and a minor anticline-syncline pair in the section between Whiteway and Loonfoot Islands (Fig. GS-38-10). The regional foliation of the basalt at the north margin of the belt is generally parallel to the contact with the granitoid rocks but minor flexures are indicated by local discordances close to that contact. Faults parallel to the regional foliation are indicated locally by very highly sheared zones; related faults have been inferred from prominent topographic lineaments (e.g. along the channel north of Whiteway Island, and through the central part of Harper Island). Northeast- and northwest-trending faults are also indicated by stratigraphic discontinuities, locally with exposure of sheared zones.

STRATIGRAPHY

The section between Whiteway and Loonfoot Islands is composed largely of pillowed basalt (1) with minor synvolcanic gabbro; the section is up to 6.5 km wide and the basalt approximately 2 km thick. The basalt is largely aphyric, with minor sparsely plagioclase-phyric flows and a conspicuous 70 m thick megaphyric unit (Fig. GS-38-11) at the isthmus of Loonfoot Island (containing up to 60 per cent plagioclase euhedra up to 1.5 cm). A plagioclase-hornblende-phyric flow/sill unit occurs at the southwest corner of Harper Island. A minority of flows display variolitic, vesicular or amygdaloidal textures. Pillows are largely undeformed between Whiteway and Loonfoot Islands and range from 0.5-1 m across, up to 3 x 1 m. Elsewhere the pillowed flows vary from slightly flattened to highly attenuated and pseudolaminated or altered to amphibolitic gneiss or schist. Autoclastic breccia units up to 4 m thick are locally gradational with and define the tops of pillowed flows. Silicification of basalt occurs

(a) sporadically within the section,
(b) commonly in mineralized (sulphide) zones,
(c) close to the contact with granitoid rocks north of Loonfoot Island and,
(d) below the unconformable contact with conglomerate (8) southeast of Whiteway Island.

Increased grain size and gneissic texture occur in some basalt in contact with younger granitoid rocks (5). Carbonatization is relatively uncommon, compared to the section extending southeast from Heart Island. An 8 m wide carbonatized zone occurs in basalt close to the isthmus of Loonfoot Island, roughly on-strike with a 2 m slightly magnetiferous iron formation 600 m to the northeast. Carbonatization



SYMBOLS

Geological boundary (approximate, underwater)

Isogan delineating high aeromagnetic anomaly

Bedding, tops known (inclined, dip unknown)

Pillows, tops known (inclined, vertical, overturned, dip unknown)

Igneous layering, tops unknown (inclined, dip unknown)

1 to 9 Geological units (correspond to table of formations, fig. GS-38-1)

Axial trace of anticline

Axial trace of syncline

Fault (inferred)

Ⓘ Ⓒ Ⓢ Iron formation; Carbonatization; Silicification

KM 1 0 1 2 3 4 KM

Figure GS-38-10 Geology of the Whiteway Island-Loonfoot Island area, Island Lake.

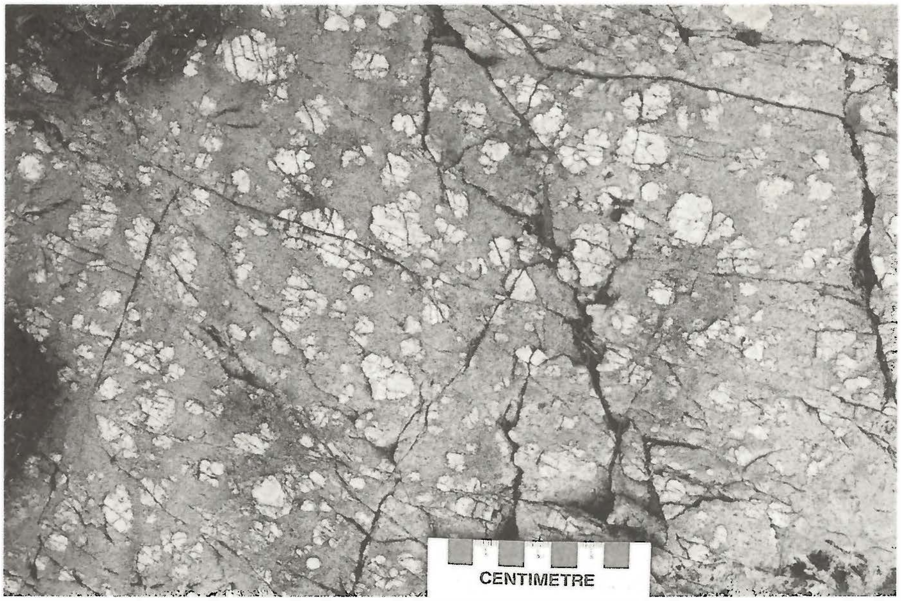


Figure GS-38-11 ***Megaphyric basalt (1) at the isthmus of Loonfoot Island, Island Lake.***

is also locally pervasive in the matrix of autoclastic breccia, and at one locality where the basalt is in contact with conglomerate (8).

Fine grained sedimentary rocks (4) are a very minor part of the Whiteway-Loonfoot Islands section. These rocks occur as minor enclaves within the Whiteway Island gabbro and as rare interlayers within the basalt. These range from 5 to 20 m thick, except for one unit south of Harper Island which is at least 200 m thick. At that locality, north-facing pillowed basalt (350 m thick) at the contact with conglomerate (8) to the south is overlain by 140 m of intermediate to mafic tuff, lapilli tuff and unsorted volcanic breccia (2) interpreted as a subaqueous pyroclastic deposit. The top of the basalt is locally partly incorporated in the basal breccia deposit. The pyroclastic unit (2) is overlain by polymictic pebble/cobble conglomerate, greywacke, siltstone and minor argillite (4); the contact between these two units is marked by a highly sheared and carbonatized mafic schist.

The Whiteway Island gabbro (7), up to 2 km thick, extends through the central part of the mafic volcanic section for at least 14 km, possibly 20 km if gabbro close to Pickerel Narrows is part of the same intrusion. The predominant phase is massive, medium- to coarse-grained mesocratic gabbro, gradational to subordinate melagabbro. Quartz gabbro, granophyric gabbro and minor hornblendite, anorthosite and leucogabbro are also present. Convection during emplacement is indicated by the orientation of igneous layering in the southwest part of the intrusion (Fig. GS-38-12). The gabbro postdates the foliation of inclusions of sedimentary rocks (4). Enclaves interpreted as roof pendants include basalt (1), polymictic pebble/cobble conglomerate, greywacke, siltstone, minor argillite and chert (4). Differential weathering of these enclaves within the gabbro has resulted in a complex system of channels in the south part of Whiteway Island. Several sedimentary enclaves may be part of unit 8 (in erosional contact with the gabbro) but these

Figure GS-38-12 ***Igneous layering in gabbro (7), southwest part of Whiteway Island, Island Lake.***

have all been mapped provisionally as unit 4. The sedimentary units (up to at least 25 m thick) are locally graded and at one locality, crossbedded.

The Island Lake Group (8) was not mapped, except for minor occurrences of this unit at three localities between Whiteway and Loonfoot Islands. These consist of polymictic cobble conglomerate with related arkosic wacke (8) at least 60 m thick which extends northeast for 4.4 km through the mafic volcanic section. The conglomerate (8) occurs immediately north of south-facing pillowed basalt (1) in a "back to back" relationship. A fault is indicated by strong shearing and alteration of the conglomerate to schist at the northeast end of the unit.

The Norrie Island intrusion (Gilbert et al., 1984) is a highly carbonatized ultramafic (probably peridotite) intrusion (6). Serpentinized peridotite occurs on-strike at a small islet 2 km to the northeast. These intrusions are coincident with a related aeromagnetic anomaly which extends from Norrie Island for 8 km to the northeast (York Lake, Map 4023G, Federal-Provincial Aeromagnetic Series); the three localities of conglomerate (8) are also within the anomaly. The association of these intrusions with the zone of conglomerate indicates a possible stratigraphic control and post-Island Lake Group age of emplacement. Alternatively, the occurrence of these units (6 and 8) in a narrow zone within the basalt (1) may be a result of major faulting.

Plagioclase ± quartz porphyries and related felsite (9) are widespread in the Hayes River Group and include at least two different phases, both pre- and post-Island Lake Group. Medium grained and coarse grained phases have been distinguished (phenocrysts 1-4 mm and 0.4-1 cm respectively).

ECONOMIC GEOLOGY

Prominent malachite staining (± pyrite ± chalcopyrite) occurs in tonalite (5) at the north margin of a small stock within basalt 400 m west of Harper Island, and in basalt adjacent to tonalite and plagioclase porphyry dykes at the west end of Harper Island. Similar mineralization occurs 2 km northeast of Loonfoot Island in a tonalite dyke in basalt close to the margin of a granitoid batholith to the east. Sporadic occurrences of pyrite (± chalcopyrite and malachite) within the mafic volcanic section between Whiteway and Loonfoot Islands are commonly located in basalt close to the margins of felsic dykes, or within felsite or derived sericitic schist units. Gabbro (7) commonly contains minor disseminated pyrite but significant concentrations have not been found in this unit. Conglomerate (8) 1 km east-northeast of Norrie Island contains pyrite in a 1 m wide rusty zone.

REFERENCES

Ermanovics, I.F., Park, G., Hill, J. and Goetz, P.
1975: Geology of Island Lake map-area (53 E), Manitoba and Ontario; Geological Survey of Canada, Geological Paper 75-1, Part A, p. 311-316.

Gilbert, H.P.
1984: Island Lake Project; **in** Manitoba Mineral Resources Division Report of Field Activities, 1984, p. 120-125.

Gilbert, H.P., Neale, K.L., Weber, W., Corkery, M.T., and McGregor, C.R.
1983: Island Lake; Manitoba Mineral Resources Division, Preliminary Map 1983 I-1.

Gilbert, H.P., Pertson, R., and Power, B.A.
1984: Loonfoot Island; Manitoba Mineral Resources Division, Preliminary Map 1984 I-1.

Gilbert, H.P. and Weber, W.
1983: Island Lake Project; **in** Manitoba Mineral Resources Division Report of Field Activities, 1983, p. 63-69.

Scoates, R.F.J. and Macek, J.J.
1978: Molson Dyke Swarm; Manitoba Mineral Resources Division, Geological Paper 78-1, 53 p.

Wright, J.F.
1928: Island Lake area, Manitoba; **in** Geological Survey of Canada, Summary Report 1927, Part B, p. 54-80.

GS-39 GEOLOGICAL INVESTIGATIONS IN THE KNIGHT LAKE-BIGSTONE LAKE AREA (53E/11 NW)

by K.L. Neale

INTRODUCTION

As part of a two-year programme to remap the Bigstone Lake greenstone belt, geological coverage was extended eastward of last year's map area (Neale, 1984) to include Knight Lake and the northern part of Wass Lake. Stratigraphic continuity between western (Bigstone Lake) and eastern (Knight Lake) portions of the belt has been disrupted by a northwest-trending shear zone. Movement along this zone has a dextral sense; however, tectonic interleaving of geological units adjacent to the fault commonly obscures the actual amount of displacement.

STRATIGRAPHY

NORTHWARD OF WASS LAKE

Mafic flow rocks of the lower volcanic cycle (unit 1, Fig. GS-39-1) which have an apparent average thickness of 1400 m, are generally pillowed and aphyric; however, the intra-pillow areas locally contain 8-10% mega-phyric plagioclase. Stratigraphically above the mafic flows are typically unlayered plagioclase-phyric ash deposits (2), 250 m thick, which occupy the southwestern shore of Knight Lake (see Preliminary Map 1985B-1). Magnetite-bearing iron formation (3) was rarely observed within units 1 and 2, in contrast to the southeastern part of Bigstone Lake where both pyrite and magnetite iron formation are laterally recurrent (Neale et al., 1984).

*Subunits refer to Preliminary Map 1985B-1.

FIGURE GS-39-1: TABLE OF FORMATIONS, BIGSTONE LAKE-KNIGHT LAKE AREA

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-39-1: Table of Formations, Bigstone Lake-Knight Lake area.

Conglomerate (6a1*, Fig. GS-39-2), near the base of the upper succession (units 6-10), locally occurs along (i) the southern shore of Knight Lake and (ii) the southern shore of the east-trending peninsula to the north. In both places the conglomerate is succeeded by mafic and intermediate flows (8 and 9, 250 m maximum thickness) and then a fine grained gabbro (8), a lithologic repetition which is possibly thrust-induced. Intermediate flow rocks (9) on the east-trending peninsula were originally interpreted as rhyodacites (Ermanovics et al., 1975) and rhyolites (McGregor and Petak, 1976); however, widespread outcrop stripping revealed strewn-out selvages of moderately silicified pillowed flows.

In the northeastern part of Wass Lake, biotite tonalite (11) has intruded quartz diorite (5) and intercalation of the two rock types commonly gives a banded appearance. The quartz diorite was here sampled for zircon dating, whereas unit 11 was sampled on the largest island in Knight Lake adjacent to a contact with mafic flow rocks (8).

STRUCTURE

The Knight Lake strata have in general been synclinally folded along a west-northwest-trending axis; however, facing indicators were restricted to pillowed flows (1) and graded wackes (6) and therefore the extent of large-scale refolding is not known. Regional foliation related to the major syncline has been obliquely intersected by east-southeast-trending shear zones.

In the central section of Knight Lake there is an apparent structural discordance between north-northeast-striking ash deposits (2) and east-west oriented mafic flow rocks of unit 8. The two rock types were nowhere observed in direct contact, but are interpreted to be fault-bounded.

ALTERATION AND MINERALIZATION

KNIGHT LAKE

Laterally extensive silicification and, to a lesser degree, carbonatization are restricted to rocks exposed on the east-trending peninsula, in contrast to Bigstone Lake where both types of alteration are widespread. The most prominent sulphide mineralization, which is eastward of and on strike with the peninsula, is of three types: (i) a 50 cm thick massive pyrite-pyrrhotite layer within weakly silicified mafic flows (8); (ii) a sheared pyrite-pyrrhotite-enriched mafic flow (8) adjacent to a tonalitic intrusion (11); and (iii) pyrite-bearing quartz veins within the tonalite body (11).

At the easternmost end of Knight Lake there is a discontinuous 400 m long pyrite-pyrrhotite zone hosted by quartz-rich feldspathic wacke (6). The setting of this moderately sheared iron oxidized zone is reminiscent of the stratigraphically equivalent, sulphide-enriched conglomerate (6a1) exposed on the northwest shore of Bigstone Lake (Neale, 1984). Along the northeast shore of Wass Lake, oxidized areas within the mafic flow rocks (1) locally contain disseminated pyrite and pyrrhotite.

BIGSTONE LAKE

Assay values for samples containing notable amounts of one or more of pyrite, chalcopyrite, pyrrhotite, magnetite, garnet, arsenopyrite and sphalerite, are given in Table GS-39-1. Sample locations are shown on Figure GS-39-3.

The majority of samples were taken from moderately sheared iron stained zones in which the mineralization is locally concentrated in dendritic silica-rich veinlets. Sheared oxidized surfaces were not observed

Figure GS-39-2: Conglomerate (6a1) displaying clasts of feldspar-coated quartz, siltstone and argillite.

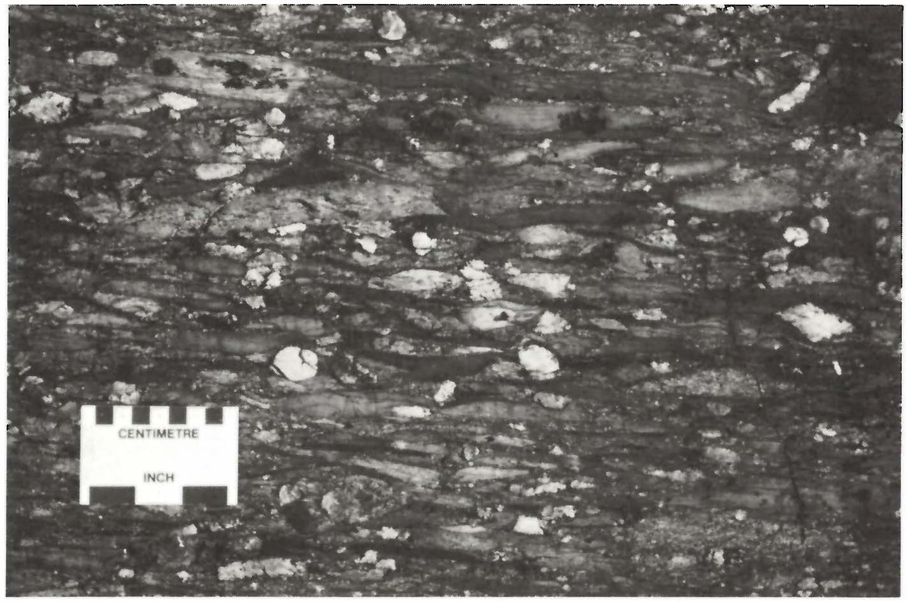


TABLE GS-39-1 ASSAY VALUES FOR MINERALIZED SAMPLES COLLECTED DURING THE 1984 FIELD SEASON. SAMPLE NUMBERS CORRESPOND TO LOCALITIES PLOTTED ON FIGURE GS-39-3. UNLESS OTHERWISE STATED, VALUES ARE GIVEN IN PPM

Sample Number	Host Rock	oz/ton Au	Ag	Cu	Zn	Pb
50	Quartz-phyric feldspathic wacke	nil	<1	262	93	<2
53	Fuchsitic mafic flow	trace	<1	384	59	<2
80	Garnet-bearing iron formation	0.01	<1	50	92	<2
95	Feldspathic wacke	0.01	<1	353	82	30
103	Feldspathic wacke	nil	<1	490	75	<2
131	Feldspathic wacke	trace	<1	198	84	4
328	Locally silicified intermediate flow	nil	<1	0.15%	24	<2
441	Weakly silicified mafic flow	trace	1	0.11%	0.28%	<2
443	Mafic flow	trace	<1	275	126	<2
466	Mafic flow	trace	1	0.17%	226	261
467	Intermediate flow	trace	1	506	127	<2
471	Conglomerate	trace	1	181	135	5
482	Silicified intermediate flow	nil	nil	162	NA[1]	NA
556	Quartz-phyric gabbro	trace	1	63	95	3
644	Feldspathic wacke (southwestern shore)	0.02	<1	243	11	4
735	Mafic flow	0.01	<1	128	175	<2
751	Plagioclase-quartz porphyry	trace	<1	48	0.15%	<2
753	Plagioclase-quartz porphyry	trace	1	34	0.10%	<2
754	Massive pyrite layer	0.01	1	55	184	72
773	Weakly silicified quartz porphyry	trace	1	62	8.1%	<2
1110	Mafic flow	0.03	2	0.29%	0.10%	<2

[1]NA = not analyzed

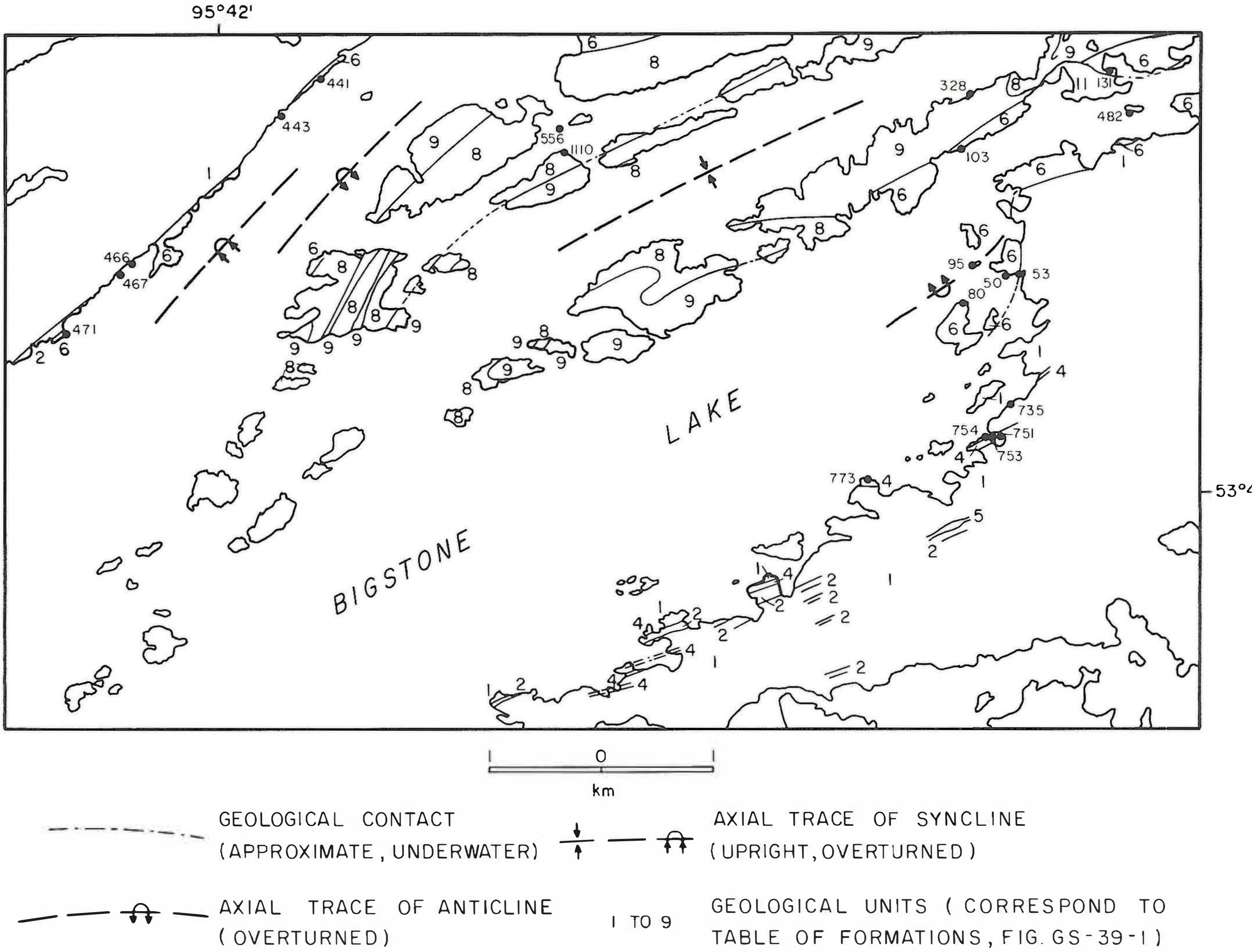


Figure GS-39-3: Location of samples collected for assay in 1984 together with the general geology of Bigstone Lake. Assay results are given in Table GS-39-1.

at station #80 (garnetiferous iron formation of unit 6) nor station #556 (magnetite-bearing gabbro, 8). Copper values of 0.11% and 0.17% correspond to oxidized zones within flow rocks (441 and 446) exposed on the northwest shore of the lake. In the central part of the lake, analysis of a mafic flow rock revealed 0.29% copper, 0.10% zinc and 0.03 oz./ton gold.

The highest zinc values (0.10%, 0.15% and 8.1%) occur in plagioclase-quartz porphyries of the southeastern shore. Interesting to note is that the massive pyrite-pyrrhotite layers (e.g. #754), which are commonly associated with the porphyries at the contact between intermediate and mafic flow rocks, have comparatively low (184 ppm) zinc values. Several of these strata-bound sulphide layers were sampled in 1985 in order to validate/refute this statement.

REFERENCES

Ermanovics, I.F.
1975: Island Lake map-area, Manitoba; Geological Survey of Canada, Open File 282.

Ermanovics, I.F., Park, R.G., Hill, J. and Goetz, P.
1975: Geology of Island Lake map-area (53E), Manitoba and Ontario; Geological Survey of Canada, Paper 75-1A, p. 311-316.

McGregor, C.R. and Petak, H.W
1976: Knight Lake (53E/11 NW); in Manitoba Mineral Resources Division, Report of Field Activities, 1976, p. 60-61.

Neale, K.L.
1984: Bigstone Lake Project; in Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 126-128.
1985: Knight Lake-Wass Lake; Manitoba Mineral Resources Division, Preliminary Map 1985B-1.

Neale, K.L., Bardsley, J.G. and Lemoine, R.M.
1984: Bigstone Lake; Manitoba Mineral Resources Division, Preliminary Map 1984B-1.

GS-40 GRANITE-PEGMATITE INVESTIGATIONS: KNEE LAKE-MAGILL LAKE AREA

by P.G. Lenton

INTRODUCTION

Examination and sampling of pegmatites and granites in the northern Superior Province continued this summer, concentrating in the Knee Lake-Magill Lake area (Fig. GS-40-1) and completing the program in the Cross Lake area (Lenton and Anderson, 1983, Corkery and Lenton, 1984). Field work in the Knee Lake-Magill Lake area involved mapping of a large body of leucocratic and pegmatitic granite at Magill Lake and examination and sampling of pegmatites at the south end of Knee Lake, on Hawkins Lake and at McLaughlin Lake. A nepheline-cancrinite syenite and associated syenite pegmatite at Cinder Lake also was examined and sampled.

MAGILL LAKE GRANITE

The Magill Lake granite is located 7 km south of Knee Lake in the Archean Oxford Lake-Gods Lake greenstone belt. It was previously mapped by Barry (1959) and Gilbert (1985). The granite is a triangular-shaped intrusion approximately 8 km in the north-south direction and 8 km (maximum) in the east-west direction (Fig. GS-40-2). It lies wholly within metasediments of the Oxford Lake Group: metamorphosed greywacke, argillite, conglomerate and iron formation. A second, almost circular granite plug approximately 3 km in diameter, lies to the east of the main body, separated by a 1 km septa of metagreywacke.

Contact relationships with the surrounding Oxford Lake Group rocks indicate a passive dilational intrusion with numerous angular, stoped inclusions near the contact and a complex series of sills and dykes in the country rock. The metagreywacke was foliated and deformed before intrusion of the granite with granite dykes commonly being axial planar; however, since the granite is foliated and dykes are commonly folded and boudinaged, the granite is likely a late-kinematic rather than a post-kinematic intrusion.

The supracrustal rocks in the vicinity of Magill Lake appear to be middle amphibolite grade of low to moderate pressure Abukuma type (andalusite stable). Garnet is ubiquitous and muscovite abundant in aluminous rocks. Mafic assemblages comprise green amphibole, plagioclase, quartz and epidote/calcite.

The dominant lineation in the vicinity of the Magill Lake granite indicates a regional plunge of moderate value (45° to 55°) to the west. The internal structure and zonation of the pluton indicates a similar westerly plunge for the granite body.

The south margin of the Magill granite intruded Oxford Lake Group metasediments with dykes and sills extending into the Hayes River Group metavolcanic rocks farther south. The south margin of this belt of Hayes River Group, 2 km south of the Magill granite, has undergone cataclasis that brought Hayes River Group in tectonic contact with the Bayly Lake complex of cataclastic tonalite, quartz monzonite, and tonalitic mylonite gneiss (see Gilbert, 1985, for details). Dykes show a progressive increase in deformation and foliation towards this cataclastic zone, suggesting extensive movement in this zone after the intrusion of the Magill granite. Although exposure is limited, no pegmatite dykes were observed in the cataclastic zone.

The south central area of the intrusion contains many large stoped blocks of Oxford Lake rocks indicating dilation above the apical portion of the plug.

INTERNAL ZONING OF THE MAGILL GRANITE

Five textural units can be recognized in the Magill granite defining a roughly concentric zonation in the granite (Fig. GS-40-2):

1. fine grained, foliated biotite granite;
2. coarse to very coarse, peraluminous, leucocratic granite with biotite, garnet, tourmaline and sporadic muscovite;
3. pegmatitic leucocratic granite comprising graphic microcline-quartz intergrowth, plagioclase and accessory biotite, garnet, tourmaline and muscovite;
4. fine grained, garnetiferous, sodic aplite with accessory tourmaline;
5. pegmatite consisting of blocky non-graphic microcline and quartz surrounding a quartz core. Common accessories are biotite, muscovite, garnet and tourmaline.

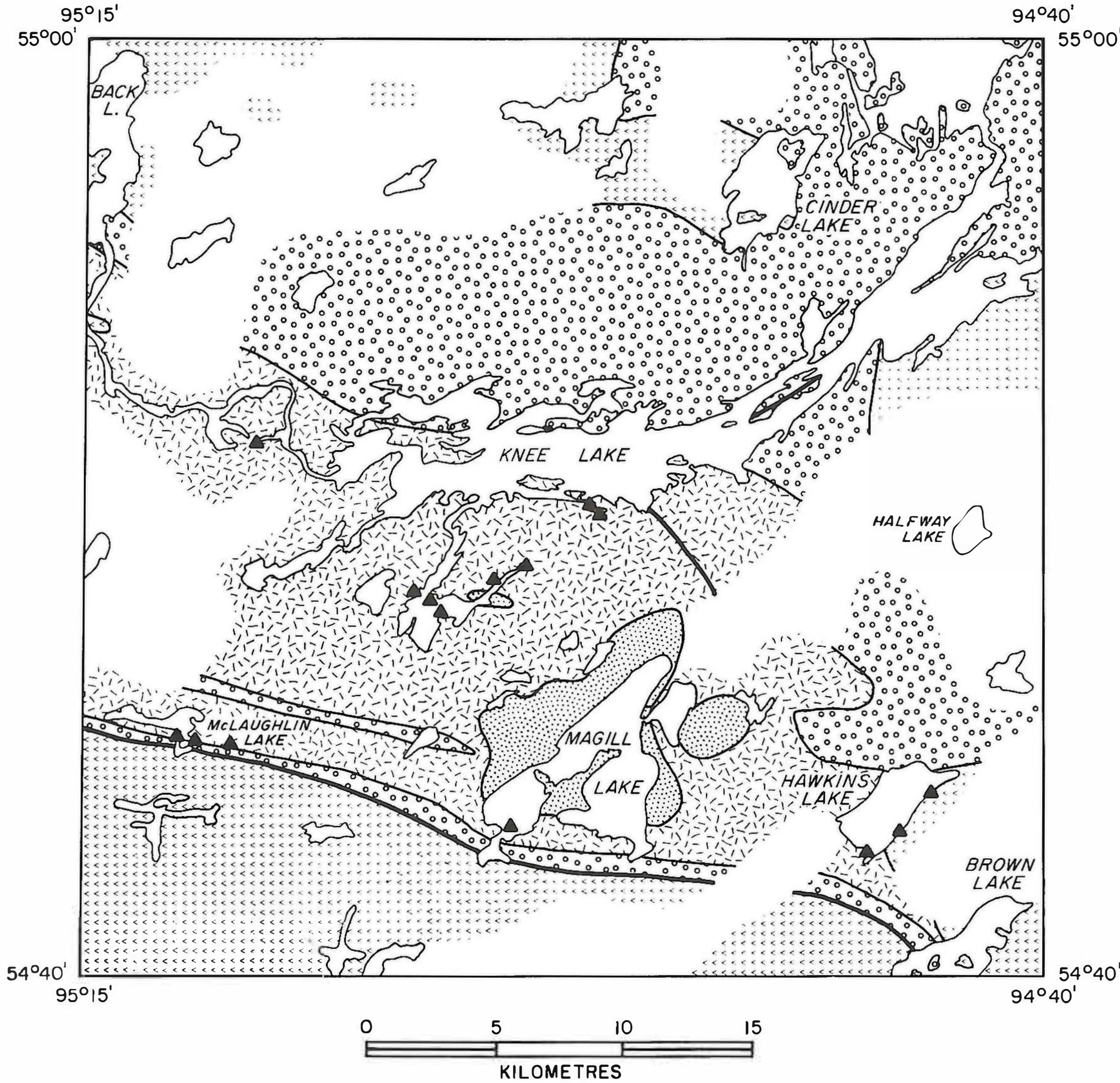
The biotite granite is homogeneous, equigranular (grain size 1 mm) and pinkish grey weathering, and is composed of quartz, microcline, plagioclase and biotite. Mafics never exceed 2 volume per cent. This unit outcrops in one small area on the west shore of Magill Lake. It is extensively intruded by pegmatite dykes and pegmatitic leucocratic granite. Diffuse inclusions of biotite granite occur in the pegmatitic granite. Bleached zones 2 to 5 cm thick occur along the contacts with pegmatite dykes. Garnet is common in the pegmatite and pegmatitic granite but absent in the biotite granite.

The coarse leucocratic granite is equigranular to seriate and white weathering with less than one volume per cent of mafics (Fig. GS-40-3). Grain size varies from 4 to 8 mm with scattered microcline megacrysts up to 5 cm long. It normally contains biotite and muscovite, but varieties with only muscovite or biotite also occur. Garnet always occurs in small amounts and tourmaline is a common accessory. Pegmatites occur as both dykes and isolated pods. Pegmatitic leucocratic granite is commonly intimately associated with the coarse granite with gradational contacts. Aplite is rare in the coarse granite. Although extensive in occurrence, the coarse granite is restricted to the central region of the intrusion around the biotite granite.

Pegmatitic leucocratic granite is very coarse to pegmatitic, comprising quartz, microcline, biotite and plagioclase with accessory garnet, tourmaline and muscovite. It contains large megacrysts of graphic microcline-quartz intergrowth. Locally it comprises 30 to 50 cm subhedral graphic microcline (with biotite inclusions) in a quartz-biotite matrix (Fig. GS-40-4). This is the most extensive unit of the intrusion, extending from the coarse granite core to the margins in association with garnetiferous aplite and pegmatite.

The garnetiferous sodic aplite, Figure GS-40-5, is fine grained (less than 1 mm) comprising quartz, plagioclase, microcline and muscovite. It always contains red garnets, commonly segregated into layers up to 2 mm thick that are continuous for more than a metre. Layering can also be defined by coarser (2 to 3 mm) muscovite crystals or by tourmaline. Aplite units occur throughout the pegmatitic granite as layers up to 1 m thick, but are rarely continuous for more than 5 m. Aplite increases in abundance toward the margin of the intrusion, especially toward the south and west where locally it is the dominant textural phase. Aplite layers commonly contain pods of pegmatite in the core regions. Aplites in the pegmatitic granite commonly have graphic microcline-quartz crystals up to 1.5 m long which are rooted in the aplite layer and have grown into the pegmatitic granite.

Pegmatites comprise massive quartz cores surrounded by subhedral, non-graphic microcline crystals. Garnet, tourmaline, biotite and muscovite are common along the margins of the quartz core. One pegmatite contains several grains of arsenopyrite. Microcline is mottled with common pink, white and blue-grey varieties. Pegmatites occur throughout the intrusion and in the country rock. Within the intrusion



LEGEND

GRANITE, PEGMATITIC GRANITE, PEGMATITE

OXFORD LAKE GROUP - METAMORPHOSED VOLCANIC AND SEDIMENTARY ROCKS

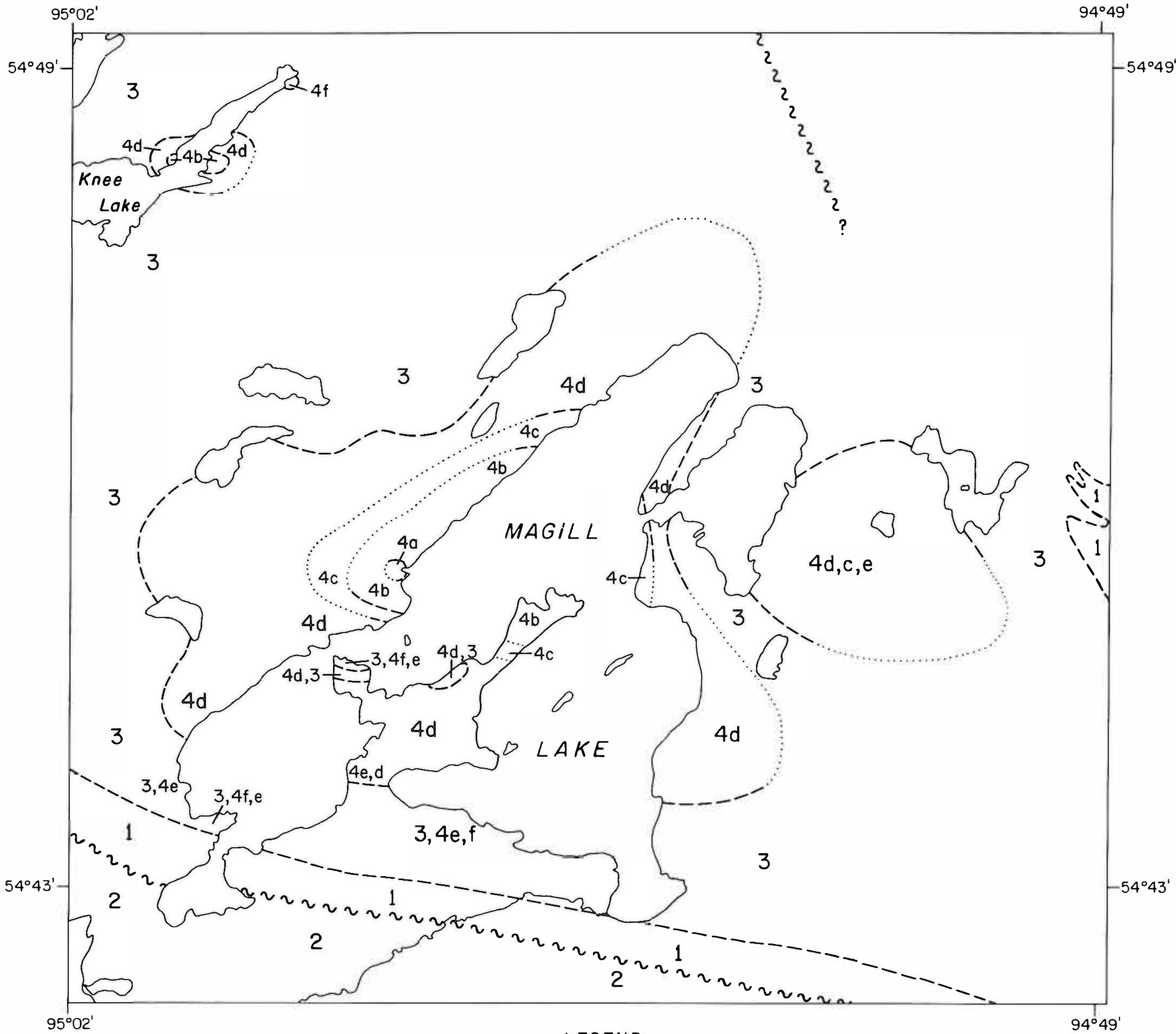
BAYLY LAKE COMPLEX - METAMORPHOSED INTRUSIVE ROCKS OF TONALITE TO SYENITE COMPOSITION

HAYES RIVER GROUP - METAMORPHOSED VOLCANIC AND VOLCANOGENIC SEDIMENTARY ROCKS

PEGMATITE LOCATION

FAULT

Figure GS-40-1: General geology of the Magill Lake-Knee Lake area modified from Gilbert (1985).



LEGEND

MAGILL LAKE GRANITE

4
- a Biotite granite
- b Leucocratic granite
- c Coarse leucocratic granite
- d Pegmatitic leucocratic granite
- e Garnetiferous sodic aplite
- f Pegmatite

OXFORD LAKE GROUP

3 Metamorphosed sedimentary and volcanic rocks

BAYLY LAKE COMPLEX

2 Orthogneisses and paragneisses

HAYES RIVER GROUP

1 Metavolcanic rocks

KM 1 0 1 2 KM

Figure GS-40-2: Geological sketch map of the Magill Lake granite modified after Gilbert (1985).

Figure GS-40-3: *Coarse leucocratic granite from the centre of the Magill Lake granite.*

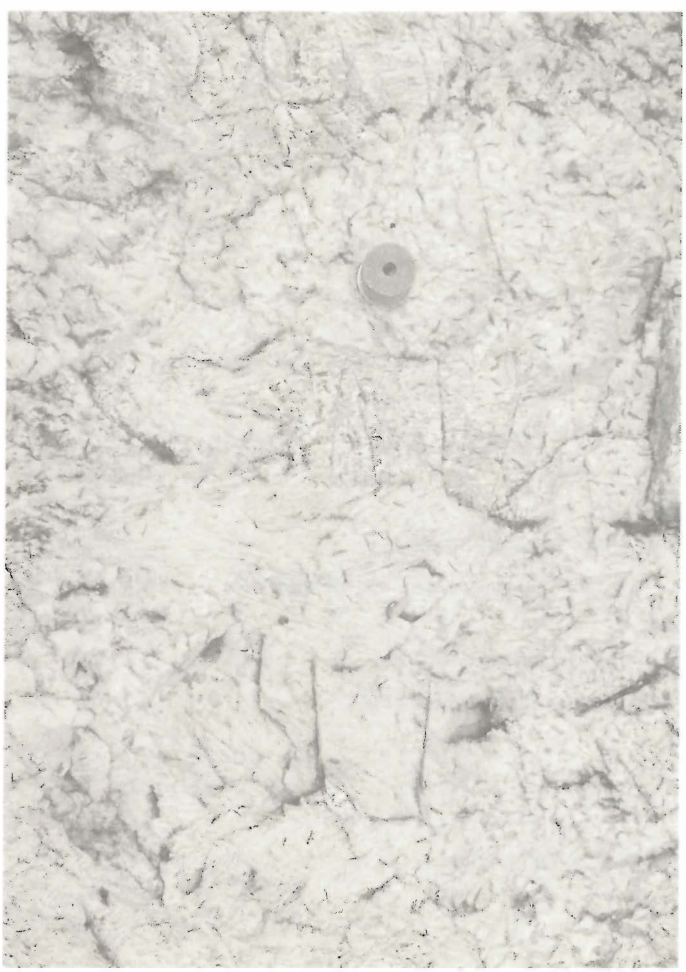


Figure GS-40-4: Biotite-rich graphic granite in the pegmatitic leucocratic granite at Magill Lake.

they occur as dykes or, more commonly, as discontinuous pods and lenses that rarely exceed 1.5 m in thickness. Aplite is a common marginal phase of pegmatites within the country rock. In general, pegmatites are most abundant in the pegmatitic granite zone.

There is a marked asymmetry to the zoning of the intrusion with the thickest section of pegmatitic granite-aplite-pegmatite occurring in the west and south. This is accompanied by a zonation of peraluminous minerals with an east to west sequence of: biotite; biotite plus muscovite; biotite, muscovite plus garnet; muscovite, biotite, garnet plus tourmaline and muscovite, garnet, tourmaline. This zonation, combined with structural evidence and the presence of a region of large stoped blocks in the southwest suggests a plunging attitude in a westerly direction. If a rare-element-enriched pegmatite halo exists about the Magill granite, the region to the west of Magill Lake would be the most probable area for such a body. Unfortunately, this area is swampy with little bedrock exposure.

MCLAUGHLIN LAKE

McLaughlin Lake lies near the south margin of the supracrustal belt. Barry (1959 and 1962), Gilbert (1985) and Bannatyne (1985) reported pegmatites within Oxford Lake Group metagreywacke-metasiltstone along the south shore of the lake.

The largest dyke has a lenticular shape with a maximum thickness of 2.5 m and an exposed strike length of 11 m. The dyke comprises quartz, cleavelandite, grey microcline, muscovite, spodumene, garnet and tourmaline. Traces of triphylite-lithiophilite [$Li(Fe,Mn)PO_4$] and jarosite [$KFe_3(SO_4)_2(OH)_6$] were identified in the central portion of the dyke. Spodumene averages 3 to 4 volume per cent. The dyke exhibits very little zonal structure. The contact has a 1 cm border zone of medium grained grey plagioclase, quartz and tourmaline. There is a general inward increase in grain size with the largest blocky microclines and spodumenes near the centre of the dyke. Oval pods up to 20 cm long of fine grained lath albite, pale orange-pink garnet, muscovite and tourmaline occur in the central region and along the dyke margins. These are late sodic replacement units. Microcline crystals show extensive corrosion along the contacts with replacement units. Spodumene shows very little replacement during the albitization event other than a surface coating of green, secondary muscovite. Spodumene forms pale green, subhedral to euhedral crystals up to 15 cm long. It shows an alignment parallel to the dyke margins.

Other dykes examined on McLaughlin Lake and to the east of the lake have a simple quartz, albite, microcline, muscovite, garnet and tourmaline mineralogy with no zonal development other than rare segregations of quartz into pods 15 to 25 cm long which are randomly distributed in the dyke. Secondary muscovite (probably shear induced) is common. All dykes examined show slight tourmalinization of the metagreywacke at the contact, but rarely more than 2 mm thick.

All dykes examined were constrained to the regional foliation plane and showed an internal penetrative foliation that locally developed into zones of moderate shearing. This shear fabric is parallel to the faulted contact of the Bayly Lake complex to the south.

KNEE LAKE

Gilbert (1985) mapped several small pegmatite dykes and one body 1.5 by 0.6 km of pegmatite along the southern shore of Knee Lake. These bodies were examined and sampled to determine if they represent a pegmatite differentiate of the Magill Lake granite.

The largest body, located in a narrow bay south of Knee Lake (Fig GS-40-2) is a small plug of leucocratic granite, pegmatitic leucogranite, garnetiferous aplite and pegmatite. The textural diversity and mineralogy of this body is the same as the Magill granite suggesting that it likely represents a small offshoot of that granite. The pegmatites in the vicinity are probably derived from this plug rather than the main intrusion. The pegmatites are generally less deformed than around the Magill body and rarely show evidence of shearing. The dykes are commonly anastomosing, controlled by dilational fractures rather than constrained to the regional foliation.

Although very few pegmatites are exposed, some increase in differention is indicated along a northeast trend. Internal zoning becomes better developed and accessory minerals such as garnet, apatite and molybdenite become more abundant. The dyke farthest east appears to represent the highest level of differentiation. It is a 1 m thick, steeply dipping dyke parallel to the west-trending foliation. The dyke is symmetrically zoned with garnetiferous sodic aplite on both margins. Intermediate zones are coarse microcline-albite-quartz-garnet-tourmaline pegmatite surrounding a core of euhedral, blocky, pink and grey mottled microcline crystals in a quartz matrix. The intermediate zone and sodic aplite contain abundant subhedral, up to 5 mm wide, pale green beryl. This is the only beryl occurrence discovered in the Knee Lake-Magill Lake area. Pegmatites do not occur farther to the northeast. Chemical analyses of mineral samples collected from the pegmatites may verify this differentiation trend.

HAWKINS LAKE

Pegmatite dykes within the Bayly Lake gneiss complex east of Magill Lake were sampled to determine if differentiated pegmatites derived from Magill Lake granite extend eastwards along the east-trending shear at Magill and McLaughlin Lakes.

All dykes examined on Hawkins Lake are simple unzoned pegmatites comprising coarse graphic intergrowth of microcline and quartz with minor plagioclase and accessory biotite and garnet. They are weakly foliated planar dykes that follow a westerly trend cutting the cataclastic fabric of the gneiss complex.

CROSS LAKE

Sampling of granites and pegmatites, started on Cross Lake in 1983, was completed this summer. Sampling of granites was extended to the west and south of the areas previously mapped (see Corkery and Lenton, 1984) to the immediate vicinity of Jenpeg.

A small body of rubidium-enriched, differentiated granite (Whiskey Jack granite of Anderson, 1984) was extended along strike to the east and west to a total strike length of 5 km. Both extremities terminate at faults. The body forms a thick sill (up to 1 km) within the supracrustal rocks conformable to the margin of the major batholith to the south. It comprises three different units, an early grey feldspar porphyry intruded by a pink biotite granite and a quartz-rich muscovite-biotite-garnet granite. All three units exhibit enrichment in Rb, Nb, F and Ga and depletion of Sr, Mg and Ba with the garnetiferous phase showing the highest level of differentiation.

One additional pegmatite not examined by Anderson (1984) was sampled. It is a 2 m thick, subhorizontal, poorly zoned dyke belonging to the northern group of beryl-bearing pegmatites. It lies 1.5 km northeast of the main group of beryl-bearing pegmatites within a layer of metamorphosed pelitic-matrix conglomerate. It comprises microcline, albite, muscovite, quartz, garnet and tourmaline. Beryl is absent, being replaced by small anhedral masses of chrysoberyl ($BeAl_2O_4$). It also contains traces of a greenish-black phosphate mineral tentatively identfied as graftonite [$(Fe,Mn,Ca)_3(PO_4)_2$].

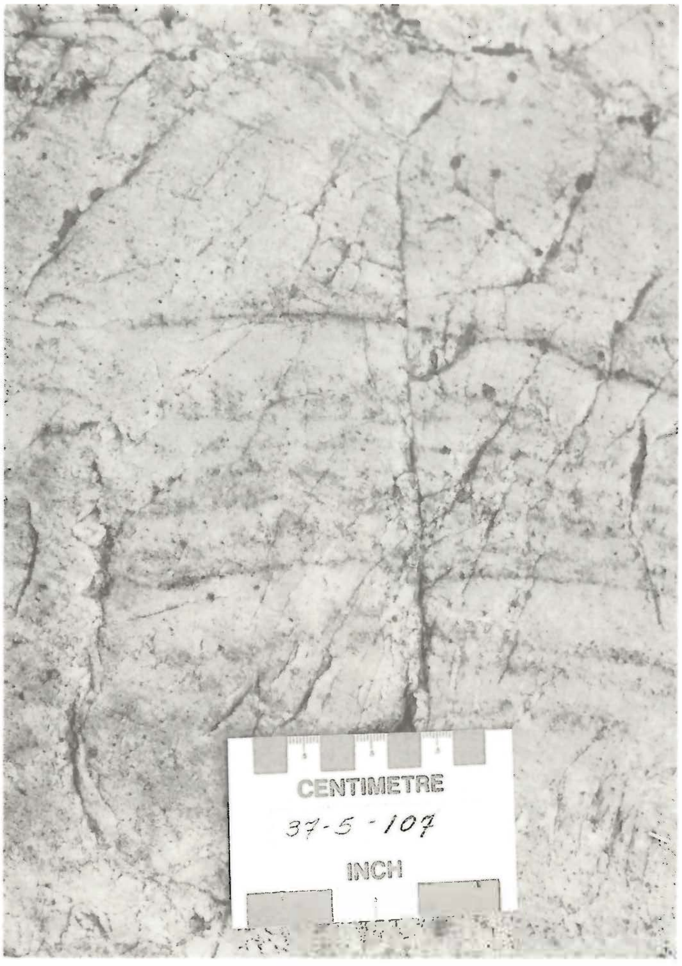


Figure GS-40-5: *Layered garnetiferous sodic aplite of the Magill granite.*

CINDER LAKE

A body of syenite previously mapped by Elbers (in Gilbert, 1985) was examined and sampled. It is a grey weathering fine grained nepheline syenite comprised of microcline, albite, nepheline, cancrinite, blue-green amphibole, clinopyroxene, biotite, calcite, fluorite, andradite, sphene, apatite, magnetite, pyrite and zircon. A large body of syenite pegmatite on the east shore of Cinder Lake comprises 1 to 5 cm crystals of microcline and plagioclase in a fine grained matrix of calcite and

Figure GS-40-6: ***Partially altered melanite (andradite) crystals in a syenite pegmatite on Cinder Lake.***

muscovite with subordinate fluorite. This body is weakly layered with local development of layers containing concentrations of partially altered black melanite crystals up to 5 cm wide (Fig. GS-40-6).

Samples of the syenite are to be analyzed to determine the REE, niobium, titanium and phosphorus content.

REFERENCES

Anderson, A.J.
1984: The geochemistry, mineralogy and petrology of the Cross Lake pegmatite field, central Manitoba; unpublished M.Sc. thesis, University of Manitoba.

Bannatyne, B.B.,
1985: Industrial minerals in rare-element pegmatites of Manitoba; Manitoba Energy and Mines, Economic Geology Report, ER84-1.

Barry, G.S.,
1959: Geology of the Oxford House-Knee Lake area; Manitoba Mines Branch, Publication 58-3.
1962: Geology of the Munro Lake area; Manitoba Mines Branch, Publication 61-1.

Corkery, M.T. and Lenton, P.G.,
1984: Cross Lake supracrustal investigations; in Manitoba Energy and Mines, Report of Field Activities, 1984, p. 107-109.

Gilbert, H.P.,
1985: Geology of the Knee Lake-Gods Lake area; Manitoba Energy and Mines, Geological Report GR83-1B.

Lenton, P.G. and Anderson, A.J.,
1983: Granite-pegmatite investigations, Cross Lake; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 46-50.

GS-41 PEGMATITIC GRANITES, PEGMATITES AND OTHER FELSIC PLUTONIC ROCKS AT GODS LAKE AND RED CROSS LAKE, MANITOBA

by L.E. Chackowsky[1], X. Wang[1], R. Eby[1] and P. Cerný[1]

INTRODUCTION

Pegmatitic granites and pegmatites at Red Cross Lake, and one pegmatite at Gods Lake, were documented and sampled for geochemical, mineralogical and petrological studies. Additional plutonic rocks were sampled on a regional scale at Gods Lake (units 4 and 7, Fig. GS-41-1). These rocks intrude metavolcanic and metasedimentary rocks of greenstone belts located in the Gods Lake (Sachigo) Subprovince of the Superior Province.

GODS LAKE

A single homogeneous, spodumene-bearing pegmatite exposure occurs about 100 m inland from the north shore of Johnson Bay, Gods Lake (Fig. GS-41-1). The pegmatite intrudes sheared metabasalts in an east-striking greenstone belt. The exposure is roughly 50 m long, and 3 to 10 m wide. The spodumene grains, typically 0.5 x 2 x 10 mm, are strongly aligned striking 150 to 160° which is approximately concordant to the strike of the schistosity of the country rocks, but discordant to the strike of the exposure. Other primary minerals include quartz, plagioclase, K-feldspar and white mica. Younger, deep purple mica occurs locally in veins oblique to the foliation of the pegmatite. These veins are oriented in an E-W direction, which is subconcordant to the strike of narrow shear zones that sporadically offset the foliation.

No other pegmatite or pegmatitic granite, nor leucogranites possibly parental to the pegmatite, were found in the region.

A regional reconnaissance sampling was carried out in the felsic plutonic rocks of the Bayly Lake complex (units 4 and 7, Fig. GS-41-1), to study the petrochemistry of these rocks and their possible relationship to the pegmatites.

[1]Department of Earth Sciences, University of Manitoba

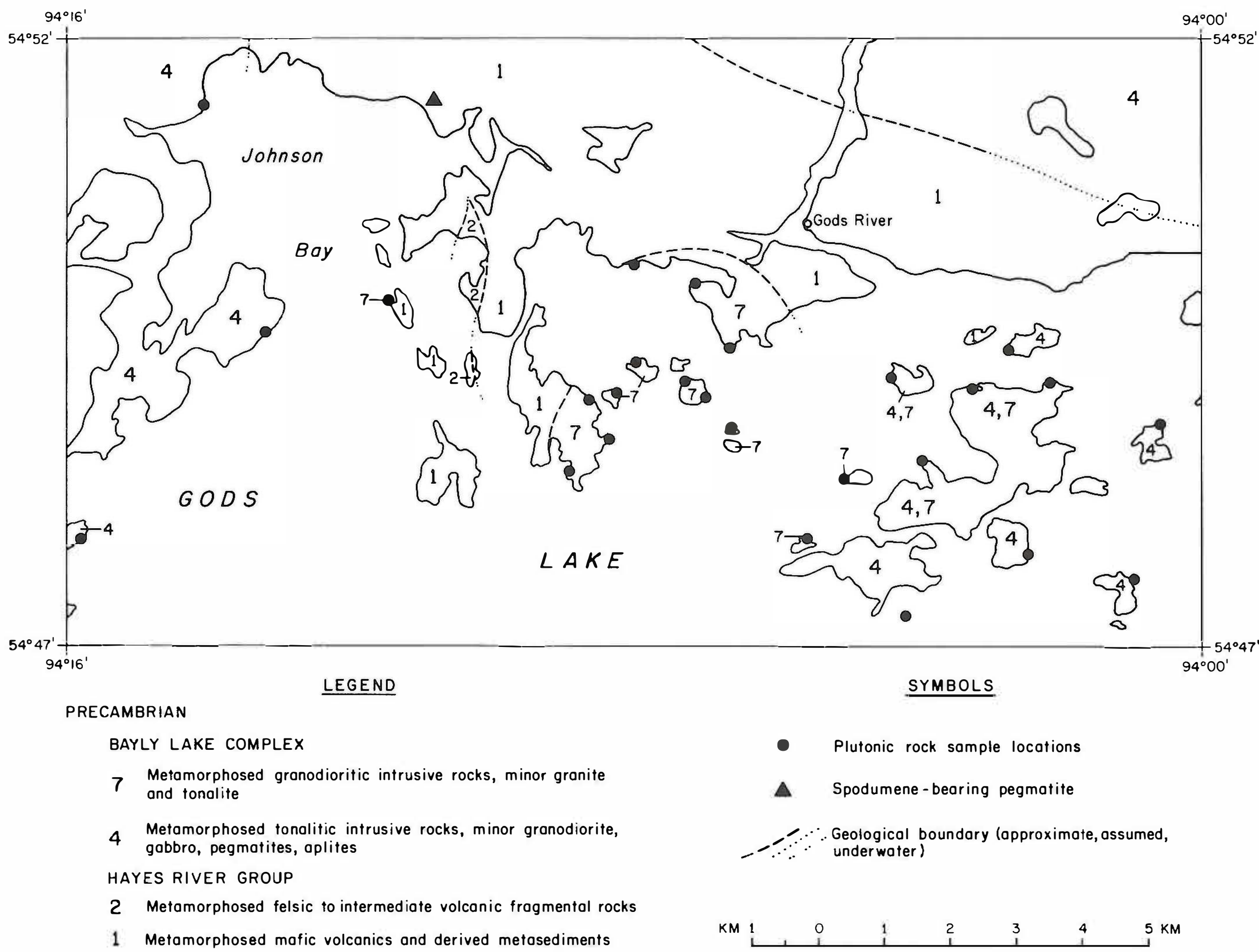


Figure GS-41-1: Location of pegmatite and sample sites of other felsic plutonic rocks, north shore of Gods Lake.

RED CROSS LAKE

A group of pegmatitic granites and two pegmatite sequences occur at Red Cross Lake, intruding an E-striking greenstone belt (Fig. GS-41-2; see also Potter, 1962, Jambor and Potter, 1967, and Sopuck, 1971).

The pegmatitic granites form two major E-W striking series of exposures (Fig. GS-41-2). The granites from the northern series are strongly sheared and banded, containing K-feldspar, plagioclase, quartz, muscovite, schorl and garnet with muscovite commonly concentrated into bands at exposures N1, N3 and N5 (Fig. GS-41-3). As these rocks are strongly fractionated (P. Černý, unpublished data), they were sampled in detail in the present study. However, only two of the southern outcrops were exposed due to very high water levels. They are finer grained and not as sheared as the northern pegmatitic granites.

A swarm of 17 parallel pegmatite dykes intrudes metabasalts along the shore of the northeastern part of the lake (location RB, Fig. GS-41-2). The dykes are extremely sheared, consisting of parallel narrow bands of purple Rb-rich lepidolite alternating with white fine grained quartzofeldspathic material (Fig. GS-41-4). Zoning is only obvious in one dyke which contains several 3 to 5 cm-wide units in which 0.5 to 1 cm white bands border deep purple central cores. Transparent rubellite (0.5 to 3 mm long) and blocky, grey K-feldspar form the only macroscopic mineral grains. One K-feldspar sample had been found to contain the highest recorded Rb-content to date (Černý et al., 1985). Due to the fine grain size of these dykes, large whole-rock samples were taken for the purpose of mechanical, electromagnetic and heavy-liquid mineral separations. Oriented samples of the pegmatites and country rocks will be used for petrofabric studies.

Three grey, closely spaced, spodumene-bearing pegmatite dykes, 0.6 m wide, have been described by Potter (1962) and Jambor and Potter (1967) as occurring on the southeast shore of a small lake 0.8 km north of the northwest end of Red Cross Lake. These dykes could not be located during the 1985 field season probably due to the high water levels. However, a 5 m wide north-striking pegmatite dyke is exposed on the shore of the same small lake (location SL, Fig. GS-41-2), consisting of K-feldspar, quartz, schorl and minor muscovite. Whole-rock and mineral samples were collected from this dyke.

FURTHER WORK

Laboratory work has started on the samples collected during the 1985 field season, and is being carried out concurrently with mineralogical, geochemical and petrological studies on the Red Sucker Lake and Cross Lake pegmatite fields examined in the field during the 1983 and 1984 seasons.

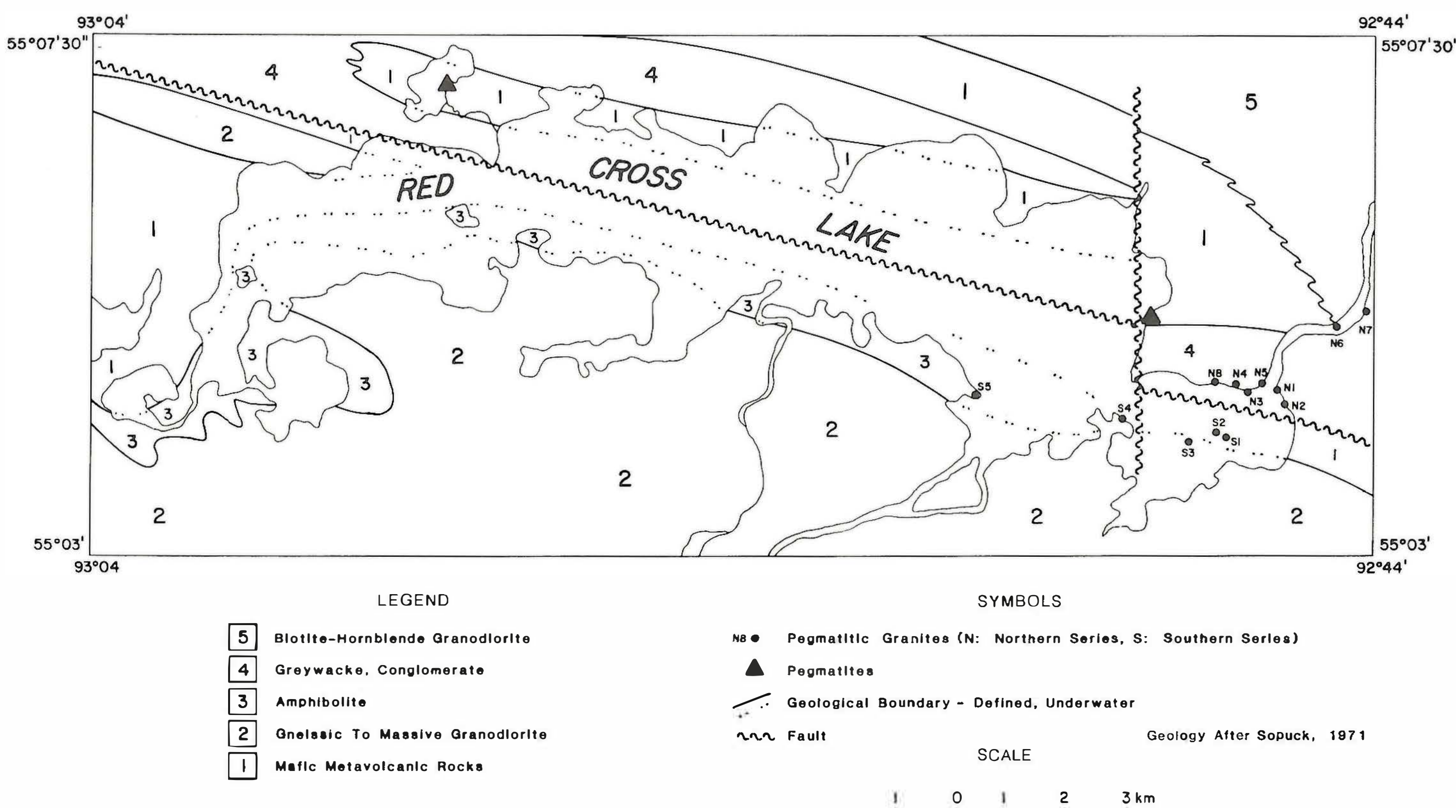


Figure GS-41-2: Location of pegmatitic granites and pegmatites, Red Cross Lake area.

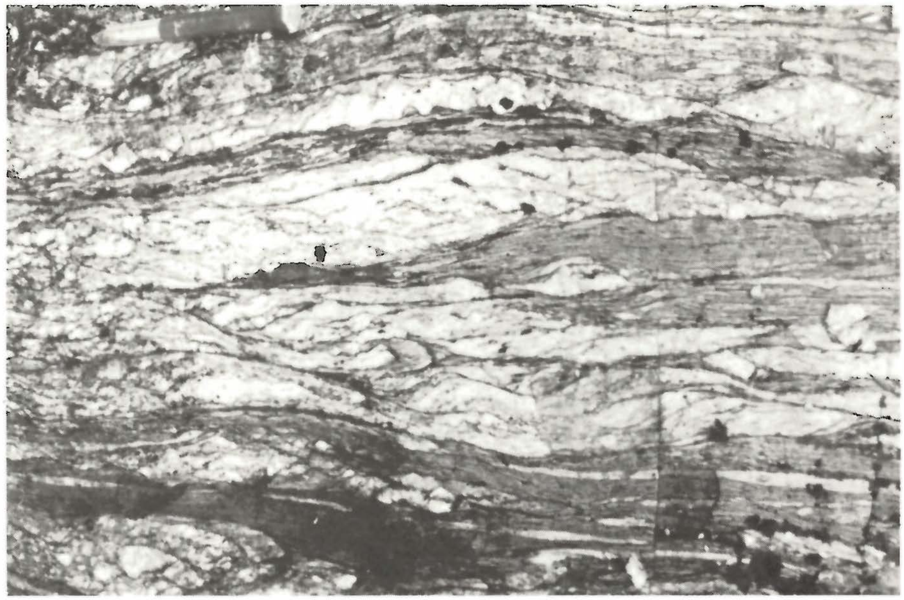


Figure GS-41-3: *Muscovite-rich (dark) and quartzofeldspathic (light) bands in sheared pegmatitic granite, location N3. Chisel is 20 cm in length.*

Figure GS-41-4: *Alternating purple lepidolite-rich (dark) and quartzofeldspathic bands in extremely sheared pegmatite dyke, location RB. Scale bar is 4 cm in length.*

REFERENCES

Černý, P. Pentinghaus, H., and Macek, J.J.
1985: Rubidian microcline from Red Cross Lake, northeastern Manitoba; Bulletin Geological Society of Finland, v.57, p. 217-230.

Jambor, J.L. and Potter, R.R.
1967: Rubidium-bearing dykes, Gods River area, Manitoba; Geological Survey of Canada, Paper 67-5.

Potter, R.R.
1962: Gods River Map area, Manitoba; Geological Survey of Canada, Paper 62-8.

Sopuck, V.
1971: Report of geological investigations in Reservation 105, Wilsie-Red Cross area, Manitoba; Manitoba Mines Branch, Assessment file 91808.

GS-42 LIMESTONE RIVER COMPILATION (54D/5-16)

by W. D. McRitchie

INTRODUCTION

A helicopter-borne reconnaissance was made of the northern two-thirds of the Stephens Lake area (NTS 54D/5-16) in order to provide additional bedrock information for incorporation into the synoptic 1:250 000 scale geological map to be completed under the Canada-Manitoba Mineral Development Agreement. The region south of the Nelson River was mapped by Hubregtse (1975) and the river corridor itself by Haugh and Elphick (1968), Frohlinger (1974) and Corkery (1975, 1985). Little information was available for the northern sector other than observations recorded by Quinn (1961) from a traverse down Limestone River and a few scattered outcrops noted by Quinn (1961) and Lenton and Corkery (1980) in the extreme northwest along Little Churchill River and Recluse Lake.

1250 line km of traversing with a Bell 206 helicopter provided further data from this 8000 km^2 region; however, few outcrops were recorded north of Limestone River and east of the Little Churchill. Thick and continuous surficial till deposits blanket the bedrock, and river sections display sand and clay deposits many tens of metres thick reaching maximum thickness in the northeast along and flanking Weir River.

Traverses were made along all principal river courses in the region including Sky Pilot Creek, Limestone River, McMillan Creek and Weir River as well as most of the associated tributaries (see Fig. GS-42-1). Recent forest fires in the southern area, together with abnormally low water levels in the rivers, provided good visibility for outcrop discrimination.

GENERAL GEOLOGY

The majority of outcrops recorded during the present survey comprised granitic rocks and granitoid gneisses with vague schlieren and rafts of supracrustal gneisses in an advanced state of assimilation. Prominent pink porphyritic quartz monzonite plutons were encountered along the Limestone River, whereas to the south a broader range of grey and pink tonalitic intrusions occur.

East of Moose Lake the only two occurrences noted with distinct Churchill affinities were a unique coarse grained garnet- and hornblende-bearing metasedimentary gneiss identical to garbenschiefer ("metagabbro") recorded west of Rock Lake (McRitchie, 1977), and well layered and foliated quartzose hornblende and magnetite-bearing "arkosic" gneisses affiliated with the Sickle Metamorphic Suite.

The garbenschiefer is a distinctive unit containing coarsely blastic pink garnet ellipsoids (up to 5 cm) and leaf-shaped hornblende megablasts (up to 3-4 cm) growing oblique to the foliation. The unit is over 100 m thick and displays layering throughout with minor components of garnet, biotite and amphibole-bearing paragneiss interlayered with the dominant garnet-hornblende-bearing garbenschiefer. Some layers, almost entirely composed of amphibole, also contain well formed clinopyroxene crystals up to 2 cm in length. Pyrite mineralization occurs throughout but is particularly noticeable along the south wall of the quarry at the extreme northeast corner of 54D-5.

Garnet-biotite gneisses recorded on Stephens and Moose Lakes were not observed, presumably a direct result of their recessive weathering characteristics. West of Stephens Lake and south of Limestone River several occurrences were noted of amphibolite or greenstone rafts in a white granitic host rock. Most outcrops display repeated Z-folding and local strongly developed transposed layering with penetration of the axial planes by the granitic phases (Fig. GS-42-2).

Immediately north of Gull Rapids outcrops display characteristics of the Superior Province with equigranular gabbroic dykes (1 cm chilled margins) cutting granite, and/or numerous ultrabasic/hornblendite rafts suspended in a coarse grained tonalitic maxtrix. The latter commonly consist of segmented fold noses and are identical to units observed on Blank and Split Lakes to the west.

Near the western boundary of the area, (UTM 6252300N 317000E) Assean Lake metasediments and associated mafic volcanic rocks were encountered in two quarries 0.5 km north of the road to Gillam. Although strongly transposed, mylonitized and tightly folded, the generally low grade metasediments can still be recognized as a series of highly siliceous cherts, and wackes with sporadic thin basalt flows (50-100 m) and thicker possibly high magnesium, soft, greenish-black basalts. Other lithologies include biotite schists, silicified tuffs, pink feldspathic wackes and abundant thin white quartz veins.

REFERENCES

Corkery, M.T.
1985: Geology of the Lower Nelson River Manitoba Geological Services Branch, Geological Report GR82-1.

Corkery, M.T. and Hubregtse, J.J.M.W.
1975 Nelson River—Ilford Area; **in** Manitoba Mineral Resources Division, Summary of Geological Fieldwork, 1975.

Corkery, M.T. and Lenton, P.G.
1980: Lower Churchill River Project, South Half; **in** Manitoba Mineral Resources Division, Report of Field Activities 1980.

Frohlinger, T.G.
1974: Geology of the Kettle Rapids—Long Spruce Rapids Area; **in** Manitoba Mineral Resources Division, Summary of Geological Fieldwork, 1974.

Haugh, I. and Elphick, S.C.
1968: Kettle Rapids-Moose Lake area; **in** Manitoba Mines Branch, Summary of Geological Fieldwork 1968.

Hubregtse, J.J.M.W.
1975: Ilford-Butnau Lake area; **in** Manitoba Mineral Resources Division, Summary of Geological Fieldwork, 1975.

McRitchie, W.D.
1977: Harding-Rock Lake Regions; **in** Manitoba Mineral Resources Division, Summary of Geological Fieldwork, 1975.

Quinn, H.A. and Currie, K.L.
1961: Geology of Kettle Rapids, Manitoba; Geological Survey of Canada, Map 9-1961.

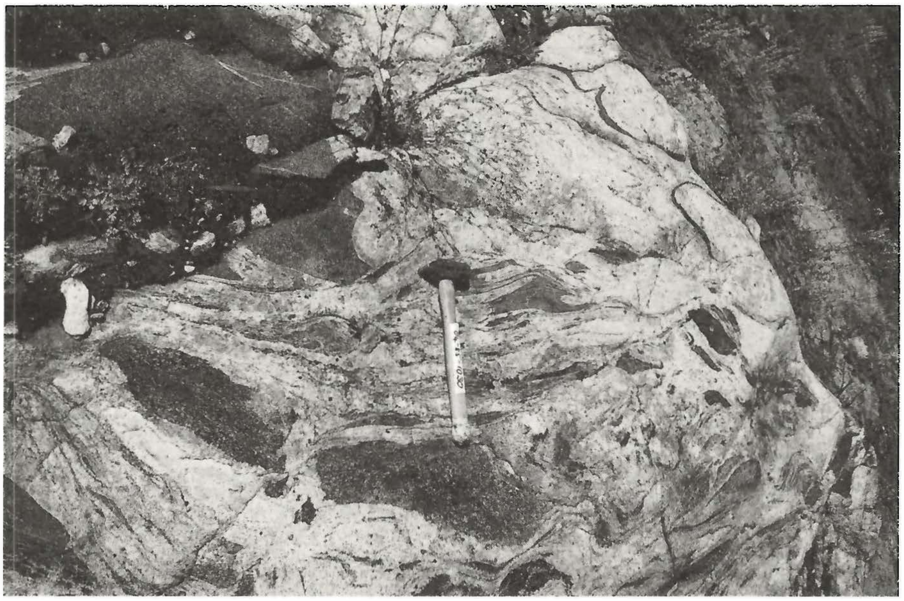
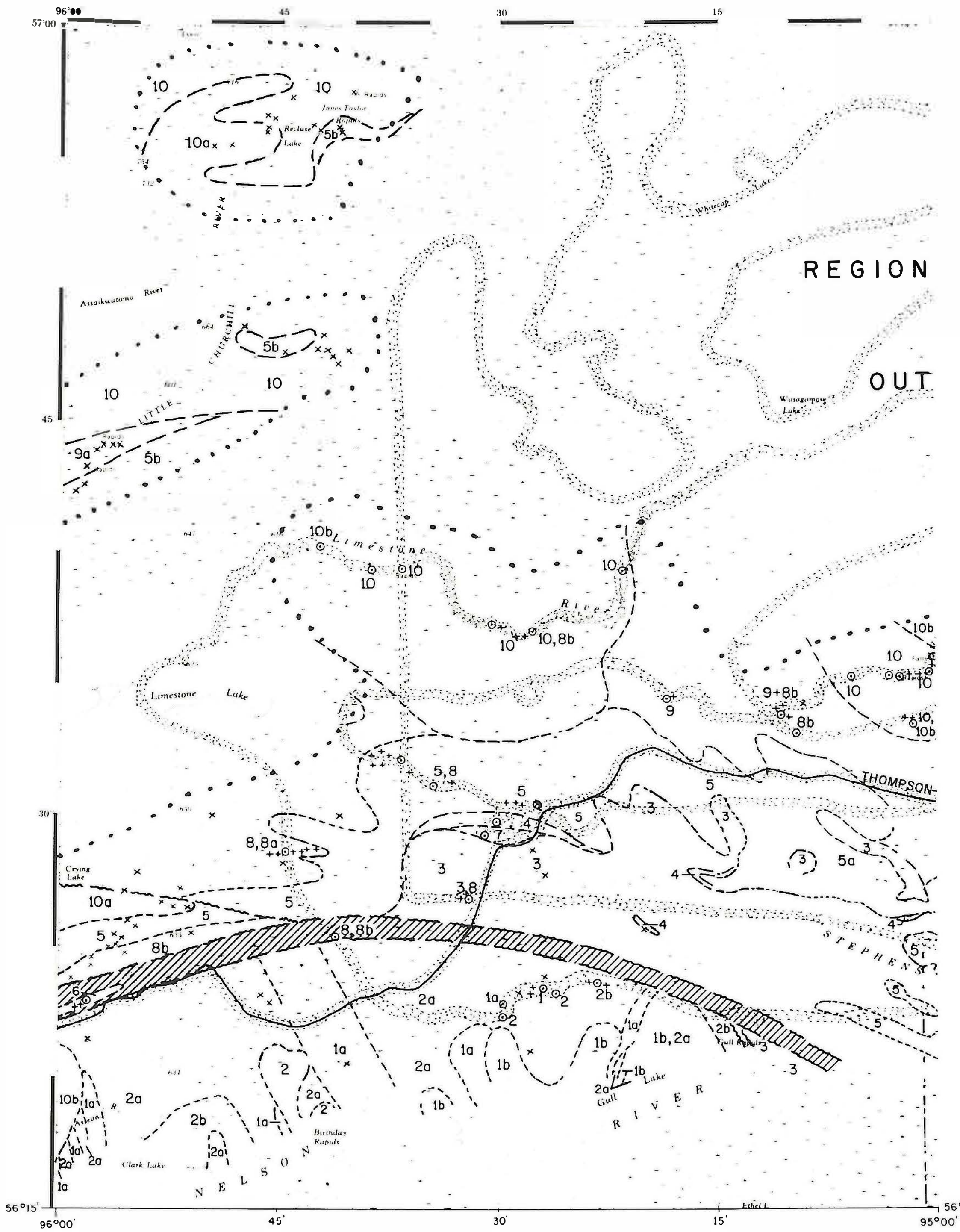


Figure GS-42-2: *Amphibolite rafts in white leucogranite southeast of Limestone Lake.*



CHURCHILL PROVINCE

10 Coarsely porphyritic pink granite-quartz monzonite;
a) locally porphyritic pink granite with pegmatite and aplite.
b) magnetite clot, pink pegmatite and schlieric granite.

9 Grey granite, phaneritic, homogeneous, equigranular.
a) tonalite to granite.

8 White granite, locally with abundant rafts of amphibolite/gabbro/metabasalt; a) granitoid gneiss with dioritic schollen and skialiths; b) hornblende and hornblende - biotite gneiss of unknown origin.

7 Diorite, metagabbro

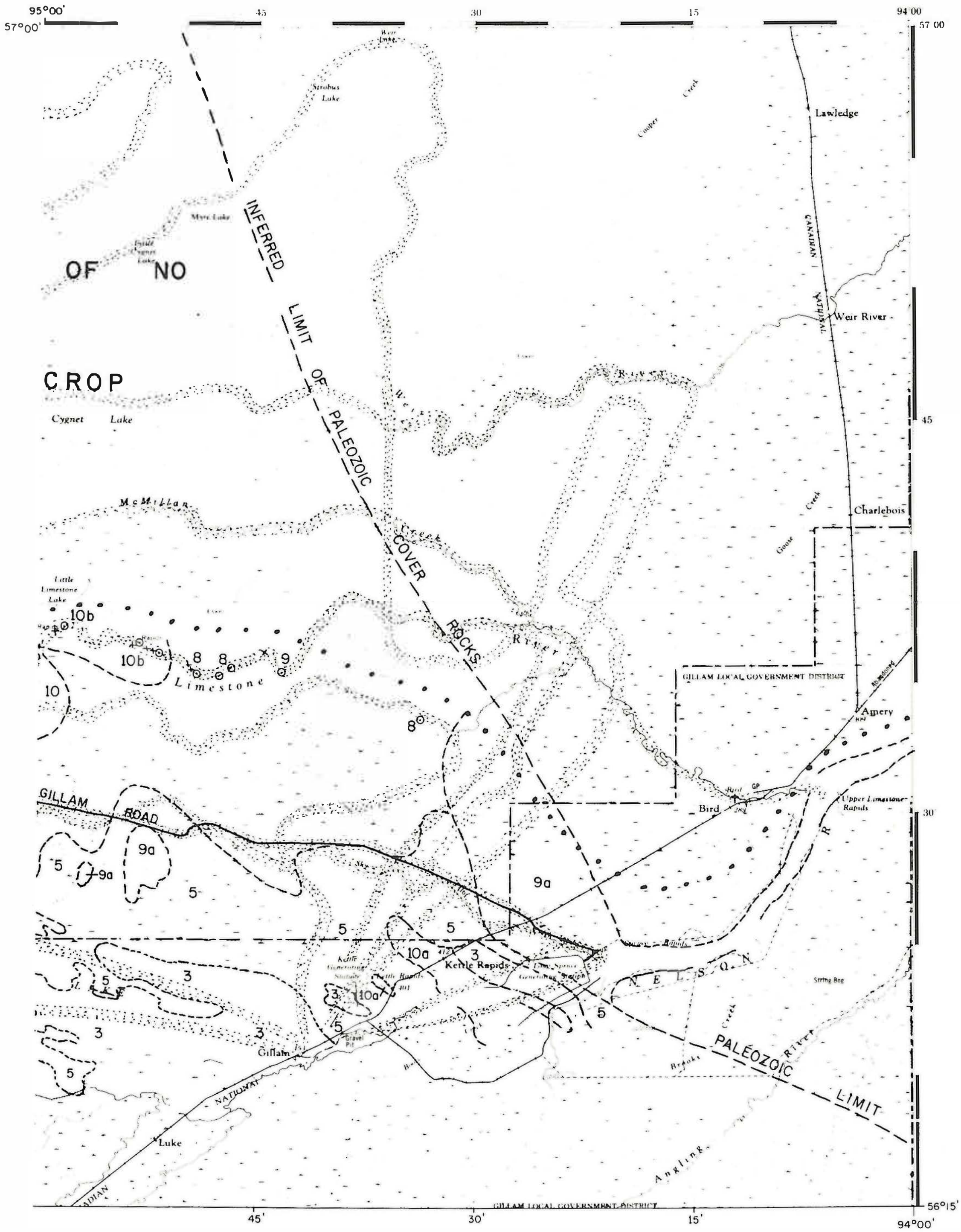
6 Siliceous wackes, cherts, biotite-chlorite schists and associated mafic volcanics (Assean Lake 'Group').

5 Sickle Metamorphic Suite; a) layered highly quartzose and possibly conglomeratic magnetite and hornblende-bearing paragneiss; b) arkosic gneiss of uncertain affinity.

4 Garnet amphibolite and associated garnet-biotite gneiss.

3 Burntwood Metamorphic Suite; garnet-biotite gneiss with local staurolite.

Figure GS-42-1: *Geological sketch map of the region north of the Nelson River and Stephens Lake (NTS 54D/5 to 16). Geology modified from Lower Nelson River Compilation 1:250 000 Geological Map GR82-1-5 (Corkery, 1985).*



LEGEND (con't.)

SUPERIOR PROVINCE

2 Tonalite with ultrabasic rafts and xenoliths; a) agmatite and venite; b) tectonized complex of reworked Kenoran migmatites.

1 White to pink granite and gabbro cut by mafic dykes; a) gabbro dominant; b) granite to granodiorite.

TECTONIZED ZONE

location of flight path

sample locations (1985)

outcrops detected (1985)

outcrops previously recorded

limit of outcrop

KM 5 0 5 10 15 20 KM

GS-43 STRATIGRAPHIC MAPPING AND STRATIGRAPHIC AND INDUSTRIAL MINERALS CORE HOLE PROGRAM

by H.R. McCabe

The 1985 core hole program involved drilling 23 holes for a total of 1319 metres. Most of the holes (19) were drilled to determine the regional geology of the Precambrian basement beneath areas of Phanerozoic cover. Sixteen of these holes were for Operation Cormorant (NTS Sheet 63 K), a continuation of the program initiated in 1982. In addition, three test holes were drilled in southeastern Manitoba, in the area of thick Pleistocene cover. Two of these intersected Precambrian. Four stratigraphic test holes were completed to provide reference sections for stratigraphic mapping programs, structural data, and input for the Mineral Investigations Section's continuing studies of the potential for base metal deposits in Phanerozoic strata.

Stratigraphic studies consisted of detailed shoreline mapping of North Moose Lake, and completion of mapping of the southern part of Cormorant and Little Cormorant Lakes. Lake sediment and lake bottom-water geochemical sampling was carried out for both areas, concurrent with the stratigraphic mapping.

A) BRADY LAB TEST (M-1-85) (Fig. GS-1, Site 43A)

A single core hole was put down at the Brady St. core and sample storage facility to check the condition of drill equipment and also to determine if suitable groundwater might be obtained for use at the lab. Water Resources Branch had indicated that water in the area probably would be too saline for use, and tests confirmed this. Total salinity of water obtained from upper Red River strata was approximately 4000 ppm.

B) KINOSOTA TEST (M-2-85) (Fig. GS-1, Site 43B)

Analyses of samples from a previous core hole at Kinosota (M-8-71) had shown above-background base metal values, and additional drilling was requested by the Mineral Investigations Section. Core samples for hole M-2-85 have been submitted for analysis. In addition it was hoped to obtain data as to the lithology and thickness of the underlying Winnipegosis reef. Drilling problems, however, forced abandonment of the hole after penetrating only 31 m of Upper Winnipegosis reefal strata. The problem was caused by sand infiltration into the hole, at a depth of 57 m. This same problem has been encountered previously in almost all core holes attempted in this area, with the sand zone occurring near the middle of the Winnipegosis section. The source of the sand has not been determined, but it certainly represents a much younger sand emplaced in fractures or solution channels relatively deep within the Paleozoic section. The sand most likely is of Jurassic or Cretaceous age and may be related to solution and incipient karst development below the Pre-Mesozoic erosion surface. A similar sandy zone, in Ordovician strata, forced abandonment of the M-19-85 test hole (see section D).

C) DAWSON BAY PROJECT (M-3-85) (Fig. GS-1, Site 43C)

Ground truthing of a seismic profile along the Pelican Rapids Road by means of core hole drilling was initiated in 1984 (see Report of Field Activities 1984, Section GS-36). Hole M-3-84, located on top of a Winnipegosis reef structure, had to be abandoned before penetrating to the base of Devonian (because of sand infiltration). Hole M-3-85, located at the same site, intersected the base of the Winnipegosis (i.e. top of Ashern Formation) at the same elevation as the off-reef core hole (M-2-84), indicating that no appreciable structural relief occurs below the Winnipegosis Formation. The "apparent" structure shown by the seismic profile (Fig GS-43-1A) thus appears to be the result of complex velocity variations within the near-surface section, rather than true structure.

The nature of the velocity variations can be determined, in general terms, by "correcting" the seismic profile so as to conform to the core hole data. In Figure GS-43-1B the Lower Paleozoic reflectors on the profile have been flattened and raised so as to conform to the uniform elevation on the base of the Winnipegosis. Also the Winnipegosis thickness has been reduced by a factor of 42% at the M-2-84 location so that the "corrected" seismic thickness at hole M-2-84 conforms to the true thickness of 55.6 m. The depth of the R-1 reflector has been reduced by 25% to conform to the depth to the Second Red Bed marker.

The following factors are evident:

1 The seismic thickness of the Lower Paleozoic (Ordovician + Silurian) agrees with the known Lower Paleozoic thickness as determined from the nearby Husky Mafeking 6-16-44-25 test hole, so the assigned formation velocities are accurate. The apparent structural relief on the "corrected" Precambrian surface could represent either true structural or paleotopographic relief, or minor velocity anomalies within the Lower Paleozoic succession

2 The uncorrected seismic thickness of the Winnipegosis is considerably greater than the true thickness, indicating that the velocity attributed to the Winnipegosis was too high (by a factor of approximately 40% at hole M-2-84)

3 The correction factor for the Winnipegosis seismic thickness at hole M-2-84 does not provide a true Winnipegosis thickness value at hole M-3-85, indicating that lateral velocity anomalies occur within the Winnipegosis. The variation suggests that reefal velocities are higher than inter-reef or off-reef velocities—a not unexpected variation

4 The R-1 reflector presumably represents the top of the Second Red Bed marker, the only stratigraphic break between surface and top of Winnipegosis. The required 25% reduction to correct the depth to the R-1 reflector indicates that velocities attributed to the near-surface interval were slightly too high. Possible factors contributing to this "error" are shown by the complex lithology intersected in core from this interval, namely the local occurrence of the Middle Dawson Bay shale unit and the shaly Mesozoic red beds. Also, variation in depth to water table may have affected seismic velocity.

The coincidence of the R-1 reflecter with the true top of Winnipegosis (Fig. GS-43-1A) points out the possibility that the R-1 reflector could actually be the top Winnipegosis. This possibility cannot be ruled out, but would not invalidate most of the "corrections" noted.

A comparison of Figures 1A and 1B shows that one of the main sources of error apparently arises in the R-1/Winnipegosis interval (i.e. Second Red Beds), which is much thicker and more variable than indicated by core. Extensive and variable brecciation of the Red Beds, and in places the uppermost transition zone of the Winnipegosis, probably contributes to the velocity variation in this interval. Surprisingly the velocity attributed to this interval appears to have been too high by a factor of about 4.

The above-noted "corrections" to the seismic profile are purely mechanical adjustments made to conform the seismic profile to the true core hole data. The writer must stress that the basic seismic data are accurate. Any inaccuracy arises in the velocity anomalies attributed to the various units, and possibly of more importance, any velocity variation occurring within the stratigraphic units. The sole purpose of this discussion has been to point out, and possibly explain, the nature of

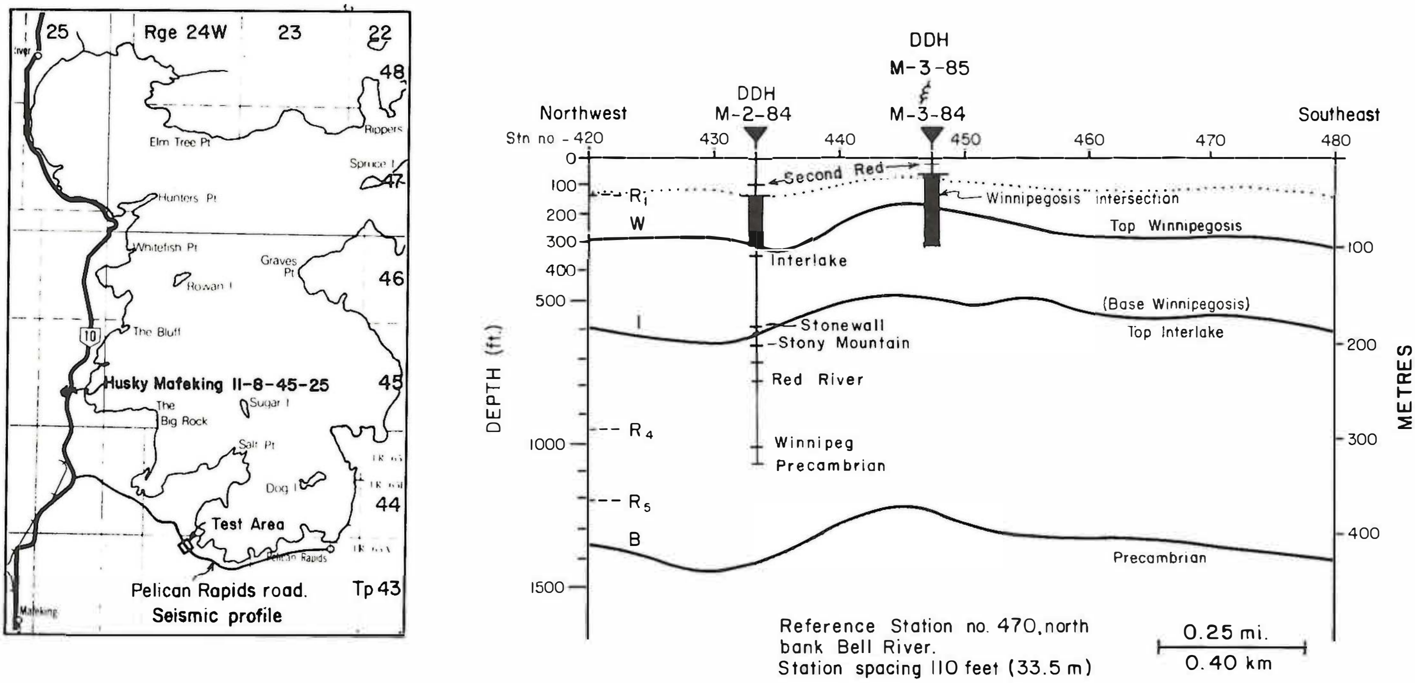


Figure GS-43-1A: Reprocessed seismic profile, Bell River Dome area, after Ingram (1978), showing 1984 and 1985 core hole intersections. The estimated Lower Paleozoic formation tops are based on data from the Husky Mafeking 11-8-45-25 deep test hole.

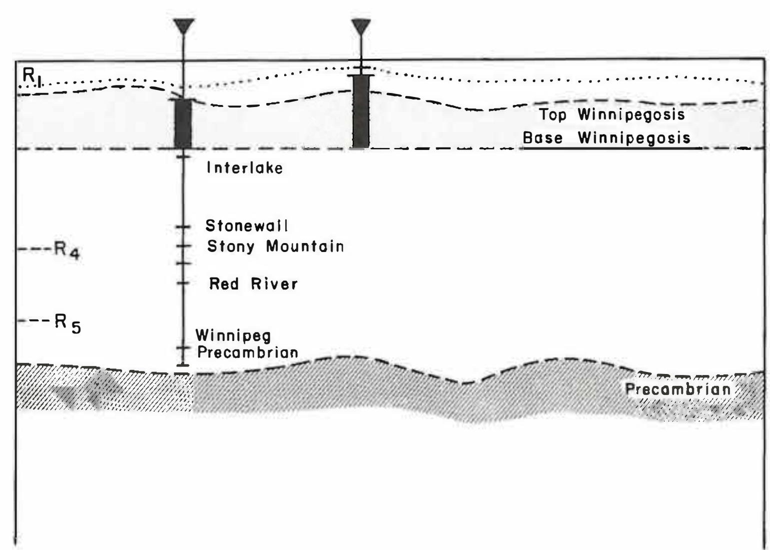


Figure GS-43-1B: Geologically modified seismic profile, Bell River Dome area.

these velocity variations, as an aid to deriving a more accurate seismic profile. Unfortunately, the complexity of the factors affecting the seismic velocities will make derivation of an accurate seismic profile extremely difficult, if not impossible.

D) MOOSE LAKE PROJECT (Fig. GS-1, Site 43D)

Test hole M-19-85 was located on the southernmost portion of the Moose Lake Road in order to provide the thickest possible stratigraphic section of Silurian strata, as a reference section for the 63K and 63F map sheets. It was hoped to obtain Ordovician and possibly Precambrian structural and stratigraphic data from this hole but the hole had to be abandoned in Upper Red River strata when drilling problems were encountered due to infiltration of sand and clay into the hole at the 90-95 m level. The sand was quartzose, well rounded and very fine grained, and, as in the case of the Kinosota hole, probably represents infiltration of Mesozoic sand and shale along fractures or solution channels.

Correlations for the lower Silurian and upper Ordovician strata in this hole are reasonably well defined, but the sandy-argillaceous marker beds of the middle Silurian Cedar Lake Member were not intersected. Further drilling and mapping will be necessary to confirm the indicated correlations and to determine if the widespread Cedar Lake marker unit is in fact missing in this area.

E) SOUTHEAST MANITOBA PROJECT (Fig. GS-1, Area 43E)

Most of the Precambrian Shield area of southeastern Manitoba, as well as a considerable area of bordering Phanerozoic strata, is buried by a cover of glacio-lacustrine deposits as much as 150 metres thick. Mapping of the Precambrian bedrock geology in this area has been based largely on interpretation of aeromagnetic maps supplemented by limited outcrop and core hole data.

Manitoba Water Resources Branch informed the Geological Services Branch that they would be undertaking a regional groundwater mapping project in the area, involving drilling of up to 20 test holes to Precambrian basement. The drill rig used for this project was not capable of obtaining samples from basement, so arrangements were made with Water Resources Branch whereby the contractor for the water well program would run casing in selected test holes when water testing had been completed, and the Geological Services drill rig would then set up on these holes and core the Precambrian basement. Direct drilling of an appreciable thickness of till is beyond the limited capability of the Branch's diamond drill equipment.

A total of seven locations were originally identified as suitable for Precambrian test holes that would permit more accurate interpretation of the aeromagnetic signatures. However, drilling problems were encountered by both the water well driller and the Geological Services rig. In particular, "basement" for the water well rig at times proved to be only large granitic boulders in till. Only 3 holes were attempted, and only two of these recovered Precambrian core. These holes (M-9-85, M-10-85, M-11-85) are listed in Table GS-43-1, and detailed comments on the Precambrian geology are reported by W. Weber in section GS-26 of this report.

All of the Water Resources Branch test holes except one intersected only glacio-lacustrine deposits. The exception was a hole drilled near Wampum (approx. 30-1-13E). This hole reportedly intersected a gypsum-shale sequence below the glacio-lacustrine deposits, at a depth of 104-110 m, resting directly on Precambrian basement. These sedimentary strata are believed to be of Jurassic age and probably comprise an extension of the Jurassic strata deposited in the major east-trending channel incised deeply into Lower Paleozoic strata in the Dominion City area (see Geological Map of Manitoba 79-2).

F) STRATIGRAPHIC MAPPING (Fig. GS-1, Area 43F)

Detailed shoreline mapping of Ordovician and Silurian strata was carried out on Northern Moose Lake, on the southern portion of Cormorant Lake and on Little Cormorant Lake. This almost completes the remapping of accessible parts of the Cormorant map sheet (NTS 63K), except for mapping of road outcrops on the Moose Lake, Cormorant Lake and Sturgeon Landing roads. All mapped outcrops are shown in Figure GS-43-2A.

A total of 35 lake sediment and lake bottom-water samples were taken in the above areas, and these samples have been submitted to the Mineral Investigations Section for geochemical studies. Most of the larger accessible lakes in the Phanerozoic portion of the Cormorant map sheet have now been sampled, and analyses of these results should give some idea as to the base metal distribution in lake sediments in a carbonate-hosted terrane, and possibly aid in the evaluation of the potential for base metal deposits in Paleozoic strata.

Outcrop belts for the lower Silurian Atikameg, Moose Lake and Inwood Formations are well defined in the southern portion of the Moose Lake area, but basal Silurian (Fisher Branch) and upper Ordovician (Stonewall) strata are poorly exposed, and detailed mapping of these units will be difficult. The northernmost outcrops are of the Stony Mountain Formation.

Outcrops on the southern portion of Cormorant Lake consist of buff, dense, sublithographic dolomites that are not easily correlated stratigraphically, but probably form the upper part of the Stony Mountain Formation. Stony Mountain strata also outcrop to the northeast, on Little Cormorant Lake, and the large topographic high south of the town of Cormorant (Tp 60, Rge 22W) comprises an outlier of uppermost Ordovician and Silurian strata (Stonewall to Fisher Branch), including several shaly marker beds and a distinctive zone of conglomerate.

Integration of available core hole data with the outcrop data and detailed topographic and structural data will permit delineation of a much more accurate map of Paleozoic strata in the Cormorant map sheet.

G) HIGH ROCK LAKE (Fig. GS-1, Site 43G)

Although no further field studies have been carried out relative to the High Rock Lake crater structure (refer to Report of Field Activities 1982, section GS-13), some preliminary paleontologic data have been obtained. Samples from post-crater sedimentary rocks forming the central crater fill (op. cit.) have been sent for microfossil (conodont) study in an attempt to determine the time of crater formation. Sample processing (by David Kennedy of Brock University) has obtained a good conodont fauna from several samples, and preliminary indications are that the crater-fill beds probably are Upper Ordovician to Silurian in age. This is in agreement with the writer's previous suggestion (op. cit.) based on the lithology of the crater fill.

Since Upper Ordovician Stony Mountain strata are involved in the structural disturbance, and the crater fill is probably Upper Ordovician to Silurian, the crater must have been formed during a period of general tectonic subsidence. Therefore the crater probably represents a submarine, but very shallow water, impact structure. Furthermore, the central portion of the crater fill must be almost perfectly preserved beneath the post-crater sedimentary fill, and post-crater erosion will have been minimal, affecting only the uplifted rim of the crater. There is a possibility that ejecta from the crater could be preserved in the area immediately to the southwest, where younger Silurian strata are preserved.

H) OPERATION CORMORANT (Fig. GS-1, Area 43H)

A total of 16 test holes were drilled to obtain samples of Precambrian basement rocks from beneath Paleozoic cover in the Cormorant map sheet (63K). Most of the drilling was carried out in the western part of the map sheet (Fig. GS-43-2A). General drilling data are shown in Table GS-43-1, and a detailed description of Precambrian geology is presented by McRitchie in section GS-22 of this report. A total of 273 m of Precambrian was drilled, for an average of about 20 m per hole.

In general, the new data conform to the regional structural pattern established by previous drilling (see Report of Field Activities 1984, Fig. GS-36-3). The trend on the Precambrian erosion surface changes from east-northeast (approx. 075°) in the eastern part of the Cormorant sheet to almost due east (090°) in the western part of the map area. The closer spacing of the 1985 holes suggests minor gentle structural (or paleotopographic) relief on the Precambrian surface. Data have been included from recently available INCO drilling. It is worth noting that the 1984 mapping reported one occurrence of Red River strata beneath Stony Mountain beds on the northwestern shore of Rocky Lake (outcrop M-34-84). All other outcrops on Rocky Lake consist only of Stony Mountain strata, so it was evident that a slight structural roll — only for a few metres — was responsible for bringing Red River strata to surface. The writer assumed that the relief might be a depositional feature, but INCO drilling in the same area indicates a slight structural high (3-12 m?) on the Precambrian at this same location. The feature thus may reflect true post-Ordovician structural deformation.

All Branch drill holes, except one, intersected Paleozoic carbonate strata ranging in thickness from 16.2 m to 60.8 m. The thickest intersection includes up to 16 m of massive Stony Mountain dolomite, overlying 45-50 m of Red River strata. Correlatable argillaceous and cherty marker beds characterize the upper 15 m of the Red River Formation (Fort Garry Member). A thin basal zone of mottled pyritic dolomitic sandstone, intersected in all holes, is included as part of the Red River Formation on the basis of contained fossils that are characteristic of the Red River (e.g. **Receptaculites**). Most holes also intersected a non-dolomitic argillaceous sandy unit below the dolomitic sandstone. These

TABLE GS-43-1 SUMMARY OF CORE HOLE DATA

HOLE NO.	LOCATION AND ELEVATION	SYSTEM/FORMATION/ MEMBER	INTERVAL METRES	SUMMARY LITHOLOGY
M-1-85	16-23-9-2E		0 - 20.65	Overburden.
(Brady Rd)	+ 233 m	Ordovician-Red River	20.65 - 26.6	Dolomite, dense.
M-2-85	6-25-22-11W	Devonian-Dawson Bay	0 - 6.15	Limestone, buff, mottled purplish red sublithographic, slightly argillaceous.
(Kinosota)	+ 251 m		6.15 - 16.88	Dolomite, argillaceous, microgranular, buff to reddish and purplish mottled.
		Second Red Beds	16.88 - 25.75	Dolomitic shale, variably mottled buff to red and grey, some breccia.
		Winnipegosis	25.75 - 57.0	Dolomite, massive to partly banded, fine to coarsely crystalline, granular, good intergranular porosity, faint relict fossil content (Upper-reefal facies).
M-3-85	9-33-43-24W	Devonian-Dawson Bay	0.0 - 4.7	Limestone, brachiopod biomicrite, partly dolomitized towards base.
(Bell River)	+ 269.1 m		4.7 - 5.6	Dolomite, buff to partly grey mottled, massive, very finely crystalline, granular, slightly argillaceous.
		Second Red Beds	5.6 - 17.17	Argillaceous dolomite to dolomitic shale, massive to partly brecciated, grey to buff and red. Some limestone fragments.
		Winnipegosis	17.17 - 17.48	Limestone, light grey, finely crystalline, dense, fine irregular shaly partings.
			17.48 - 54.17	Dolomite massive, pelletal banded at top, becoming "reefal" with some coral and stromatoporoid, good porosity.
			54.17 - 89.73	Dolomite, finely crystalline granular, dark brown bituminous partings toward base (inter-reef ?).
			89.73 - 100.3	Dolomite, medium brown, finely crystalline, moderately granular, fossil fragments, argillaceous bands and streaks (platform ?).
		Ashern	100.3 - 108.9	Argillaceous dolomite to dolomitic shale buff to brownish red, some breccia.
M-4-85	7-13-63-29W		0 - 2.5	Overburden.
(Site # 11)	+ 295 m	Ordovician-Red River	2.5 - 16.7	Dolomite, massive, pale yellowish brown, faintly mottled, partly burrowed, very finely crystalline dense to moderately granular.
			16.7 - 18.4	Sandy dolomite to dolomitic sandstone, prominent blackish (pyritic) mottling.
		Precambrian	18.4 - 19.6	Lost core (weathered zone?).
			19.6 - 20.4	Highly weathered, granitic.
			20.4 - 24.45	Relatively fresh gneissic granite.
M-5-85	10-25-62-27W		0.0 - 9.3	Overburden.
(Site # 8)	+ 302 m	Ordovician-Red River -Fort Garry	9.3 - 17.0	Dolomite, buff, mottled and argillaceous dolomite, buff to reddish grey, burrow-mottled.
		-Lower Red River	17.0 - 45.68	Dolomite, buff, earthy at top grading to finely crystalline, mottled.
			45.68 - 47.82	Dolomitic sandstone and silty argillaceous sandstone, abundant nodular pyrite.
		Precambrian	47.82 - 48.2?	Lost core (weathered zone ?).
			48.2 - 53.9	Highly weathered zone.
			53.9 - 82.2	Relatively fresh basic to ultrabasic.

TABLE GS-43-1 SUMMARY OF CORE HOLE DATA (Cont'd)

HOLE NO.	LOCATION AND ELEVATION	SYSTEM/FORMATION/ MEMBER	INTERVAL METRES	SUMMARY LITHOLOGY
M-6-85	11-10-61-28W		0.0 - 2.1	Overburden.
(Site #16)	+ 290 m	Ordovician-Stony Mountain	2.1 - 16.4	Dolomite, light brownish buff to slightly reddish faintly mottled to nodular bedded, very finely crystalline dense to slightly granular.
		Red River-Fort Garry	16.4 - 30.72	Argillaceous dolomite, cherty dolomite, and microcrystalline dense to earthy dolomite.
		Lower Red River	30.72 - 60.08	Dolomite, massive, buff mottled, finely crystalline, dense to moderately granular, pinpoint porosity.
			60.08 - 62.92	Sandy dolomite to dolomitic sandstone, pronounced irregular blackish mottling.
		Winnipeg	62.92 - 63.10	Sandstone, brownish grey, medium grained, silty, argillaceous.
		Precambrian	63.10 - 65.21(?)	Lost core (weathered zone?).
			65.21 - 66.18	Highly weathered granitic rock, white quartz-kaolin at top.
			66.18 - 72.25	Relatively fresh quartz diorite with minor weathering along fractures.
M-7-85	15-26-61-27W		0.0 - 3.5	Overburden.
(Site #2)	+ 296 m	Ordovician-Stony Mountain	3.5 - 9.5	Dolomite, very finely crystalline, dense, faintly mottled buff to reddish, massive.
		Red River-Fort Garry	9.5 - 23.45	Argillaceous dolomite, cherty dolomite and dolomite, variably mottled buff to reddish grey, microcrystalline, dense to partly granular.
		Lower Red River	23.45 - 53.9	Dolomite, massive, light buff, faintly mottled, finely crystalline, slightly to moderately granular.
			53.9 - 54.72	Mottled sandy dolomite to dolomitic sandstone, pyritic.
		Winnipeg (?)	54.72 - 55.14	Sandstone, silty, argillaceous, medium grained, pyritic. Sharp irregular contact with:
		Precambrian	55.14 - 56.5	(0.41 m lost core) Quartz and kaolin. Highly weathered granitic rock with 0.1 m "porous" granite at base.
			56.5 - 72.25	Relatively fresh pink granite and hornblende-biotite gneiss.
M-8-85	11-34-64-24W		0.0 - 3.3	Overburden.
(Site #28)	approx. + 317 m	Ordovician-Red River	3.3 - 19.5	Mottled dolomite.
			19.5 - 20.74	Sandy dolomite to dolomitic sandstone, mottled, pyritic.
		Precambrian	20.74 - 22.02	Lost core, weathered zone?
			22.02 - 27.18	weathered zone — grades to:
			27.18 - 44.75	Relatively fresh hornblende-biotite schist.
M-9-85	9-3-5-16E		0 - 37.75	Cased (overburden).
	+ 354 m		37.75 - 41.85	Overburden, till.
M-10-85	2-18-4-13E		0.0 - 44.45	Cased (overburden).
	+ 343 m		44.45 - 44.61	Overburden, till.
		Precambrian	44.61 - 51.51	Unweathered granodiorite with amphibolite.
M-11-85	7-19-2-15E		0.0 - 53.95	Cased (overburden).
	+ 340 m	Precambrian	53.95 - 88.23	Unweathered biotite gneiss, migmatite, diabasic dyke.

TABLE GS-43-1 SUMMARY OF CORE HOLE DATA (Cont'd)

HOLE NO.	LOCATION AND ELEVATION	SYSTEM/FORMATION/ MEMBER	INTERVAL METRES	SUMMARY LITHOLOGY
M-12-85	6-36-62-27W	Ordovician-Red River	0.0 - 24.66	Dolomite, buff, mottled.
(Site #9)	+ 288 m		24.66 - 26.05	Dolomitic sandstone.
		Winnipeg	26.05 - 26.50	Sandy shale to argillaceous sandstone, very fine to medium grained, light buff.
		Precambrian	26.50 - 26.86	Lost core (weathered zone?).
			26.86 - 30.05	Totally weathered zone, dark grey to reddish at top grading to bright red at base. Grades sharply to:
			30.05 - 44.8	Fine grained granitic gneiss with pegmatite.
M-13-85	16-14-62-27W		0 - 17.7	Overburden: sand and boulders.
(Site #3)	+ 289 m			
M-14-85	3-16-61-27W		0.0 - 4.77	Overburden.
(Site #14)	+ 284 m	Ordovician-Stony Mountain	4.77 - 8.15	Dolomite, finely crystalline, light buff to yellowish mottled.
		Red River-Fort Garry	8.15 - 24.6	Dolomite, microcrystalline, dense, argillaceous dolomite, cherty dolomite and microgranular earthy burrow-mottled dolomite.
		Lower Red River	24.6 - 55.2	Dolomite, finely crystalline, massive, mottled grey to buff.
			55.2 - 56.0	Dolomitic sandstone, mottled, pyritic.
		Winnipeg	56.0 - 56.42	Argillaceous silty sandstone and sandy shale, fine to very fine grained, patchy pyrite.
		Precambrian	56.42 - 59.32?	Lost core — weathered zone?
			59.32 - 69.7	Completely weathered granodiorite. Mostly white quartz plus kaolinite with scattered biotite, bright greenish interband. Passes sharply to:
			69.7 - 75.3	Relatively fresh granodiorite with pegmatite patches — minor weathering along fractures.
M-15-85	13-10-62-29W		0.0 - 4.4	Overburden.
(Site #19)	+ 284 m	Ordovician-Red River	4.4 - 29.0	Mottled dolomite.
			29.0 - 29.6	Dolomitic sandstone, mottled, pyritic
		Winnipeg	29.6 - 30.0	Interbedded medium to coarse poorly consolidated sandstone and sandy silty shale, medium brownish grey.
		Precambrian	30.0 - 32.0	Lost core, weathered zone?
			32.0 - 34.0	Highly weathered zone. White quartz plus kaolin at top grading to medium dark grey with relict gneissic banding. Grades sharply to:
			34.0 - 53.41	Relatively unaltered hornblende-biotite gneiss with granite and pegmatite.
M-16-85	16-14-62-27W		0.0 - 29.65	Overburden.
(Site #3)	+ 289 m			
M-17-85	9-35-60-25W	Ordovician-Stony Mountain	0.0 - 9.0	Dolomite, light buff to slightly reddish mottled. microcrystalline, dense, thin nodular bedded.
(Site #23)	+ 282 m		9.0 - 15.68	Dolomite, massive, light buff faintly mottled reddish, finely crystalline, crinoid fragments.
		Red River-Fort Garry	15.68 - 31.05	Dolomite, buff, microcrystalline, dense, argillaceous dolomite and cherty dolomite. In part reddish mottled and streaked. Grades to:
		Lower Red River	31.05 - 59.18	Dolomite, mottled, finely crystalline, in part moderately granular.
			59.18 - 60.43	Dolomitic sandstone, mottled, pyritic.
		Precambrian	60.43 - 62.88	Lost core, weathered zone?
			62.88 - 63.18	Highly weathered porous granitic rock. Grades sharply to:
			63.18 - 87.5	Pink to grey granite, fresh except minor weathering associated with fractures.

TABLE GS-43-1 SUMMARY OF CORE HOLE DATA (Cont'd)

HOLE NO.	LOCATION AND ELEVATION	SYSTEM/FORMATION/ MEMBER	INTERVAL METRES	SUMMARY LITHOLOGY
M-18-85	13-15-63-26W		0.0 - 3.2	Overburden.
(Site #12)	+ 299 m	Ordovician-Red River	3.2 - 26.45	Mottled dolomite.
			26.45 - 26.7	Dolomitic sandstone, mottled, pyritic, vuggy.
		Winnipeg	26.7 - 27.22	Sandy shale and argillaceous sandstone, mottled, burrowed(?).
		Precambrian	27.22 - 29.25	Lost core, weathered zone?
			29.25 - 29.63	Highly weathered, light grey at top passing down to bright green with quartz stringers and grading sharply to:
			29.63 - 43.2	Hornblende gneiss, granite, pegmatite.
M-19-85	13-10-55-22W		0.0 - 3.18	Overburden.
(Moose Lake Road)	+ 258 m	Silurian-Interlake	3.18 - 17.3	Dolomite, variable, buff to orangy stained, patchy excellent vuggy porosity, finely crystalline to sublithographic, partly fossiliferous and calcarenitic, 2.7 m dense grey argillaceous bed at base.
		Atikameg?	17.3 - 21.6	Dolomite, buff to yellowish, medium crystalline, granular, vuggy.
		Moose Lake?	21.6 - 26.5	Dolomite, buff, sublithographic.
		Inwood?	26.5 - 32.8	Dolomite, as above with some fine fossil fragments, slightly coarser grained.
		Fisher Branch	32.8 - 37.4	Dolomite, fossiliferous (brachiopods), light buff mottled, very finely crystalline.
		Ordovician(?)-Stonewall	37.4 - 48.0	Dolomite, breccia zone at top, medial reddish argillaceous zone, mostly buff microcrystalline dense, to buff mottled partly granular, slightly fossiliferous and vuggy.
		Stony Mountain	48.0 - 84.93	Dolomite, grey to reddish argillaceous bands in upper 6 m, mostly light buff to partly reddish and yellowish mottled, very finely crystalline, partly granular, nodular, several horn corals towards base.
		Red River-Fort Garry	84.93 - 95.86	Dolomite, argillaceous dolomite to dolomitic shale interbeds, partly brecciated, microcrystalline, dense, grading down to microgranular earthy, in part fine dark bituminous(?) laminae.
M-20-85	14-12-61-28W		0.0 - 1.8	Overburden.
(Site #15)	+ 292 m	Ordovician-Stony Mountain	1.8 - 10.65	Dolomite, buff, sublithographic, partly mottled, partly thin platy bedded.
			10.65 - 15.55	Dolomite, faintly mottled and streaked pale yellowish to reddish buff, scattered crinoid fragments, finely crystalline.
		Red River-Fort Garry	15.55 - 34.3	Dolomite, argillaceous dolomite to dolomitic shale, and cherty dolomite, dense to granular. Grades to:
		Lower Red River	34.3 - 60.0	Dolomite, buff mottled and burrow-mottled.
			60.0 - 60.42	Dolomitic sandstone, mottled, pyritic.
		Winnipeg?	60.42 - 61.0	Sandy shale to argillaceous sandstone, pyritic.
		Precambrian	61.0 - 64.25	Lost core, weathered zone?
			64.25 - 69.58	Highly weathered zone, quartz-kaolin at top.
			69.58 - 82.3	Mixed granite and hornblende gneiss — some weathered zones associated with fractures.
M-21-85	1-20-61-29W	Ordovician-Red River	0.0 - 31.5	Mottled dolomite.
(Site # 18)	+ 270 m		31.5 - 31.65?	Dolomitic sandstone, buff.
		Precambrian	34.0 approx.	Lost 5.97 m — "flowing sand"?
			37.6 - 38.7?	Highly weathered zone, mixed mafic and granitic weathered material.

TABLE GS-43-1 SUMMARY OF CORE HOLE DATA (Cont'd)

HOLE NO.	LOCATION AND ELEVATION	SYSTEM/FORMATION/ MEMBER	INTERVAL METRES	SUMMARY LITHOLOGY
M-22-86	1-33-62-27W		0.0 - 5.15	Overburden.
(Site #5)	+ 287 m	Ordovician-Red River	5.15 - 20.46	Mottled dolomite.
			20.46 - 21.34	Dolomitic sandstone, mottled, pyritic.
		Winnipeg	21.34 - 22.16	Sandstone, medium grained, rounded, friable, partly argillaceous, rounded pyritic grains.
		Precambrian	22.16 - 23.71	Lost core, weathered zone?
			23-71 - 25.21	Highly weathered, variable, highly irregular contact preserved. Grades sharply to:
			25.21 - 56.85	Mixed gabbro with metasediments and pegmatite, unweathered.
M-23-85	14-32-62-27W		0.0 - 5.2	Overburden.
(Site #6)	+ 298 m	Ordovician-Red River	5.2 - 31.12	Mottled dolomite
			31.12 - 31.66	Dolomitic sandstone, mottled.
		Winnipeg	31.66 - 33.0	Silty sandy shale to argillaceous sandstone,
		Precambrian	33.0 - 34.03	Lost core, weathered zone.
			34.03 - 34.45	Highly weathered, quartz and clay. Grades sharply to:
			34.45 - 50.95	Biotite-hornblende gneiss with granite and pegmatite, minor weathering along fractures.

beds are tentatively correlated with the Winnipeg Formation, but the irregular variations in thickness of the two sandy units suggest that they may be, in part, facies equivalents.

Two holes at the Egg Lake site (M-13-85, M-16-85) intersected thick drift cover, up to 30 m. This location may possibly form a window in the Paleozoic cover, but the estimated depth to Precambrian at this location was 35 m, so a thin Paleozoic cover could still be present at depth. Elsewhere, drift cover was thin, ranging from zero to a maximum of 9.3 m, and averaging about 3 m.

In all holes some core was lost at the Paleozoic/Precambrian unconformity, with the loss ranging from 0.31 m to a maximum of 6 m. In general it is not possible to determine exactly where the core loss occurred, as the actual unconformity is rarely preserved. The general quality of recovery suggests, however, that most or all of the core loss occurs in the weathered zone at the top of the Precambrian. For logging purposes (Table GS-43-1) **all** lost core has been attributed to the weathered zone. On this basis, the thickness of the weathered zone is seen to range from 1.36 to 13.28 m, averaging 4-5 m. In most cases the transition from highly weathered material to relatively fresh unaltered rock is rather abrupt, occurring over a few tenths of a metre. Minor weathering occurs at greater depths in association with fractures. Where preserved, the Paleozoic/Precambrian contact is irregular but sharp, with almost no residual basement material included in the basal Paleozoic sandy beds.

Although the thickness of Paleozoic cover above Precambrian basement increases to the south, away from the erosional edge of the Paleozoic, the rate of southward thickening is not as great as might be expected from the regional structural trends. The southerly dip on the Precambrian surface is approximately 2 m/km but the regional topographic elevation decreases to the southeast at about 1 m/km. In addition, local topographic relief ranges up to 80 m. Because of the rather complex variation in depth to Precambrian, resulting from the above factors, a depth to basement map has been prepared (Fig. GS-43-2B).

The known depth to Precambrian for drill holes (all available data not yet compiled) are shown. Also, depth estimates have been made for known spot elevations and for most topographic highs and lows, using available topographic maps, and subtracting the elevation of Precambrian basement (as shown by the structure contours) from the spot elevation. Based on the accuracy of the depth estimates made for the 1985 drill sites, the probable error in depth estimates is ± 5 m, and the maximum error probably does not exceed about 10 m — provided accurate topographic elevations are available. For areas with accurate detailed topographic coverage, detailed 10 metre contour maps can be compiled showing depth to basement, or Paleozoic thickness. Such maps will aid greatly in predicting outcrop geology for inaccessible portions of the Cormorant map sheet.

REFERENCES

Ingram, R.M.
1978: The application of deconvolution to field recorded CDP reflection data; unpublished M.Sc. thesis, University of Manitoba.

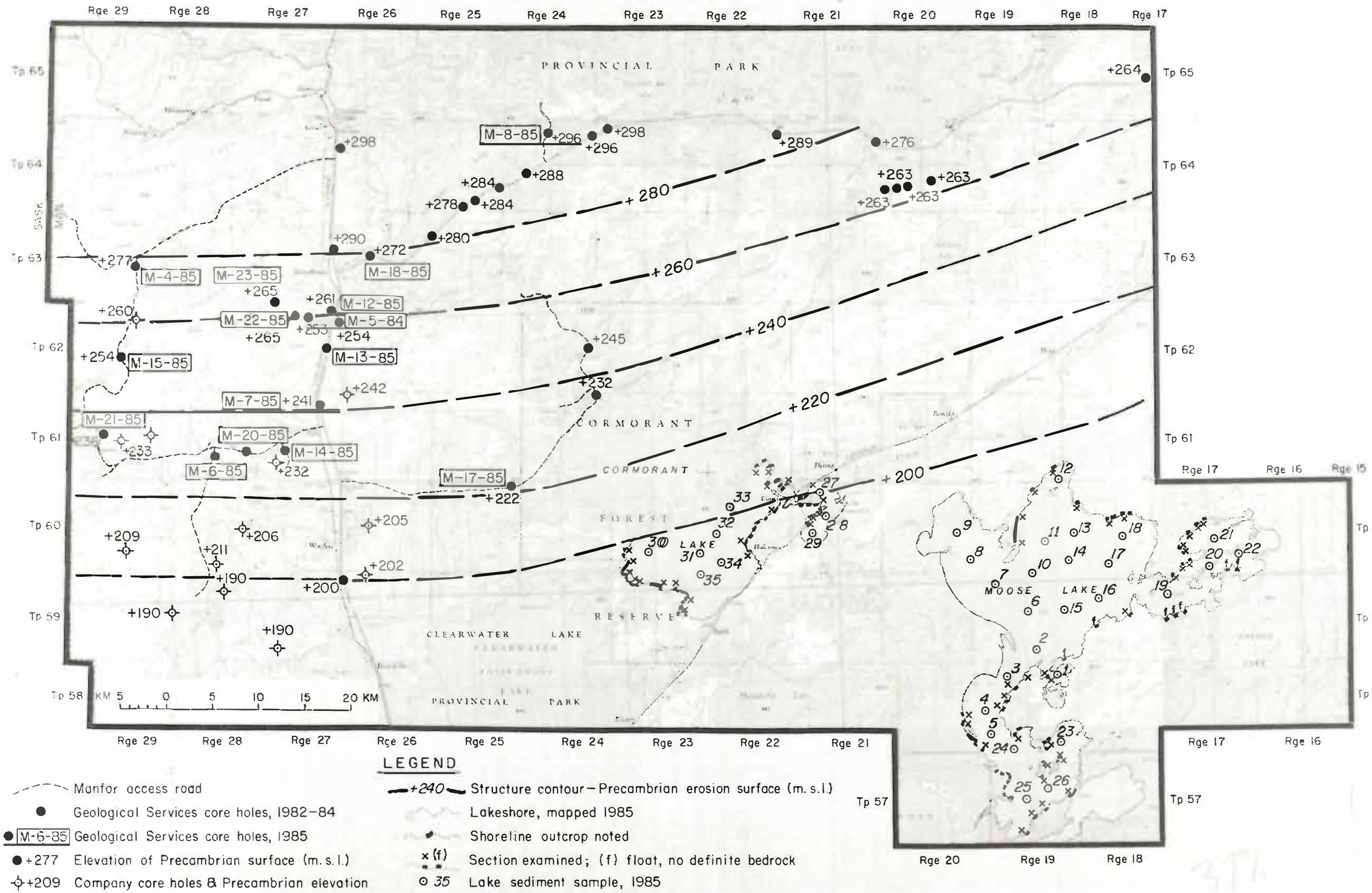
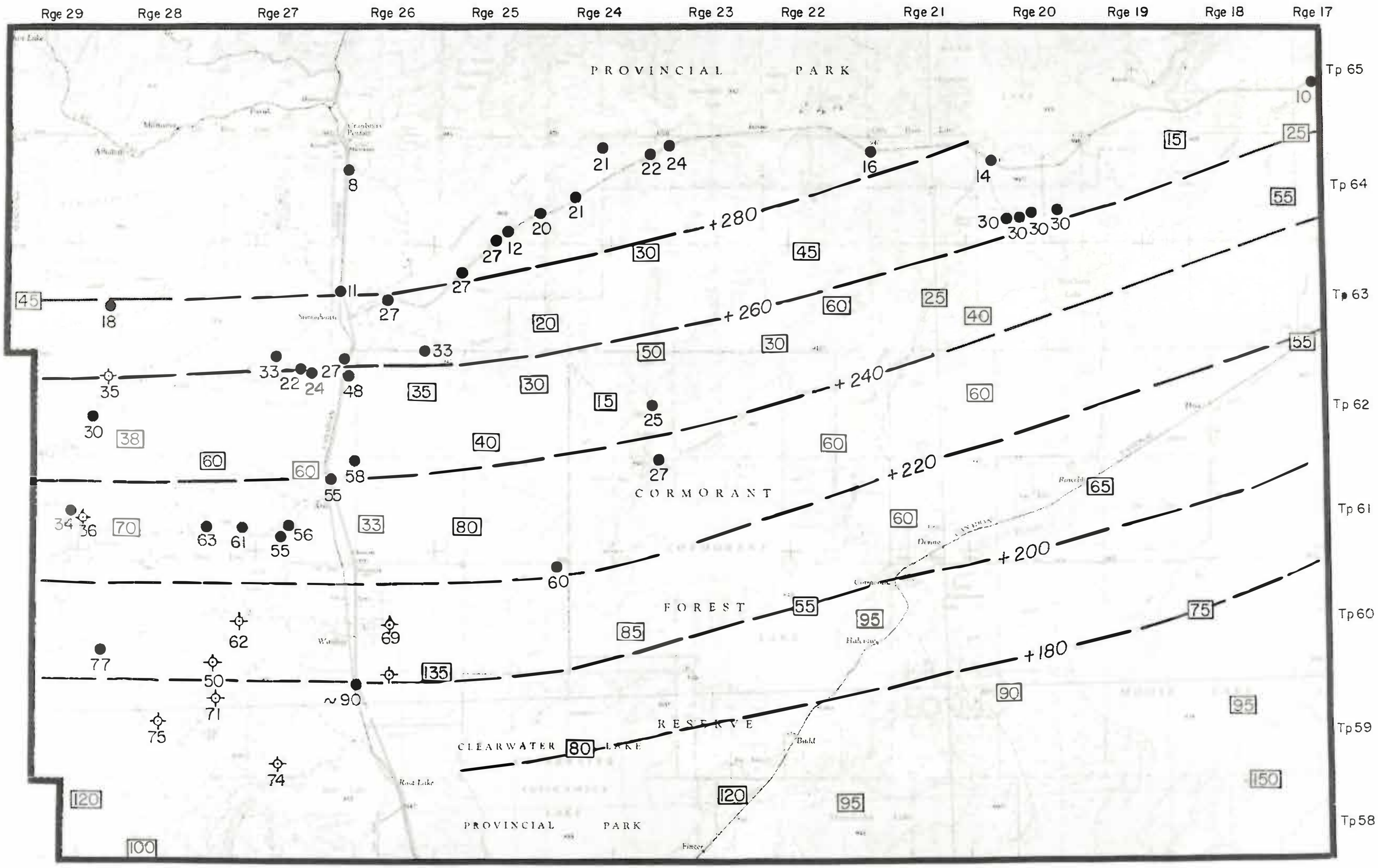


Figure GS-43-2A: Stratigraphic mapping, lake sediment samples, and core hole locations Cormorant Map area (NTS 63K, 63F/NE part, 63J/SW part).



LEGEND

●17 Depth to Precambrian basement, known from Geological Services core hole

-◇-33 Depth to Precambrian basement, reported from mineral exploration core hole

[60] Depth estimated at specific topographic features or survey points, generally highest and lowest points

+180 Structure contour, top Precambrian basement

KM 5 0 5 10 15 20 KM

Figure GS-43-2B: Depth to Precambrian basement, Cormorant Lake map sheet (NTS 63K).

GS-44 INDUSTRIAL MINERALS OF THE SWAN LAKE AREA (NTS 63C)

by D.M. Watson

INTRODUCTION

The presence of various industrial minerals in the Swan Lake area including salt, limestone and silica sand has been documented for over 100 years (Tyrrell, 1889). There has also been commercial production of small amounts of moulding sand. This project initiates the first of a new series of regionally oriented industrial mineral projects. It will document the occurrence of the various industrial minerals within an NTS map area, and will result in a mineral potential map outlining areas for possible future development.

GENERAL GEOLOGY

The Swan Lake area is underlain by rocks ranging in age from Devonian to Recent. Carbonate rocks of Devonian age occur in the northern and eastern portions of the area. These rocks range in composition from dolomite to high-calcium limestone (Bannatyne, 1975). Rocks of Cretaceous age occur on the flanks of the hills (Porcupine Mountain, Duck Mountain and Thunder Hill), and in the Swan River Valley.

INDUSTRIAL MINERAL OCCURRENCES

LIMESTONE AND DOLOMITE

Limestone and dolomite occur in the northern and eastern portions of the map sheet, Norris et al. (1982). Analyses of the limestones are given by Bannatyne (1975). Only one deposit is currently being quarried, the Mafeking Quarry of Genstar Limited. This quarry is developed in high-calcium limestone of the Point Wilkins Formation.

In the Dawson Bay area, limestone occurs in structurally low areas between buried reefs of dolomite in the Winnipegosis Formation. The variable size and erratic occurrence of these reefs precludes an accurate prediction of their distribution. There are, however, many areas of limestone that are large enough to support future development.

SALT

Although the salt- and potash-bearing beds of the Middle Devonian Prairie Evaporite have been removed by solution during later Devonian time, salt is present in a number of salt springs in that part of the map sheet underlain by Devonian rocks. These salt springs, which flow at rates ranging up to 25 litres per minute, contain salt concentrations of up to 50 grams per litre.

In addition to sodium chloride, the springs also contain high amounts of calcium sulphate. At the site of the old salt plant near the Red Deer River, bubbles were observed rising to the surface of the spring. Samples of this gas were analyzed by the Saskatchewan Research Council in Saskatoon, and were found to cantain a 1000-fold enrichment of helium over normal atmospheric concentrations. Bubbles were also observed at all other springs in the area.

GLAUCONITE

An occurrence of glauconite along the Steeprock River near Mafeking was reported by Watson and Kohuska (1984). This site and several other occurrences of this mineral were investigated.

Glauconite is found as a minor constituent of the Skull Creek Member of the Ashville Formation throughout the area. This unit lies unconformably on top of the Swan River sandstone. The contact between these two units is very irregular with scour and fill structures and other evidence of erosion. Glauconite forms layers of varying thickness (1-4 cm) in shales near the contact with the underlying sands.

In the Mafeking area, exposures of glauconitic shale both in the Highway 10 roadcut (Nielsen and Watson, GS-46, this volume) and in the banks of the Steeprock River are considered to be within blocks of material that have been displaced due to slope failures on the edges of the Porcupine Hills.

A 25 m thick intersection of glauconitic material was encountered in the Steeprock River area; however, it occurs within a small slump block. Other occurrences of this material did not have similar thicknesses and it is possible that the stratigraphy was tectonically thickened during emplacement of this block.

BENTONITE

Several beds of bentonite ranging in thickness up to 0.5 m were observed in the Thunder Hill-Benito area. The thickest of these beds corresponds to the bentonite marker bed of the middle Favel Formation. In both examples the layers were deeply weathered and crumbly. No fresh material could be obtained even when the seams were dug out to a depth of more than a metre. The bentonite layers occur either singly or in pairs separated by more than a metre of hard shale. No sequence of bentonite layers was found that was thick enough to warrant further detailed work.

SILICA SAND

The Swan River Formation consists mainly of interbedded silica sand and thin clay seams. The silica sand has been extensively sampled by Watson and Kohuska (1984) with chemical and physical analyses reported by Watson (1985). The silica resources of the area are considerable and will undoubtedly be exploited at some time in the future.

OTHER OCCURRENCES

In addition to the widespread occurrence of the above minerals, single exposures of oil shale and lignite were found.

Oil-bearing shale is exposed in a low outcrop in the banks of the East and West Favel Rivers, approximately 8 km south of Minitonas. Some work has been done in the past on the oil contents of these shales and available information has been summarized by Macauley (1984). The northern limit of these shales coincides with the northern limit of map 63C; however, there are extensive exposures of the shale to the south and more work is anticipated on this material in the near future.

Lignite occurs as a minor constituent of the shales in the Swan River Formation. Where it occurs in the banks of the Swan River lignite makes up approximately 10 per cent of the shale. This occurrence is of limited extent and similar lignite occurrences were not observed within the map area.

REFERENCES

Bannatyne, B.B.

1975: High-calcium limestone deposits of Manitoba; Manitoba Mineral Resources Division, Publication 75-1.

Macauley, G.

1984: Geology of the oil shale deposits of Canada; Geological Survey of Canada, Paper 81-25.

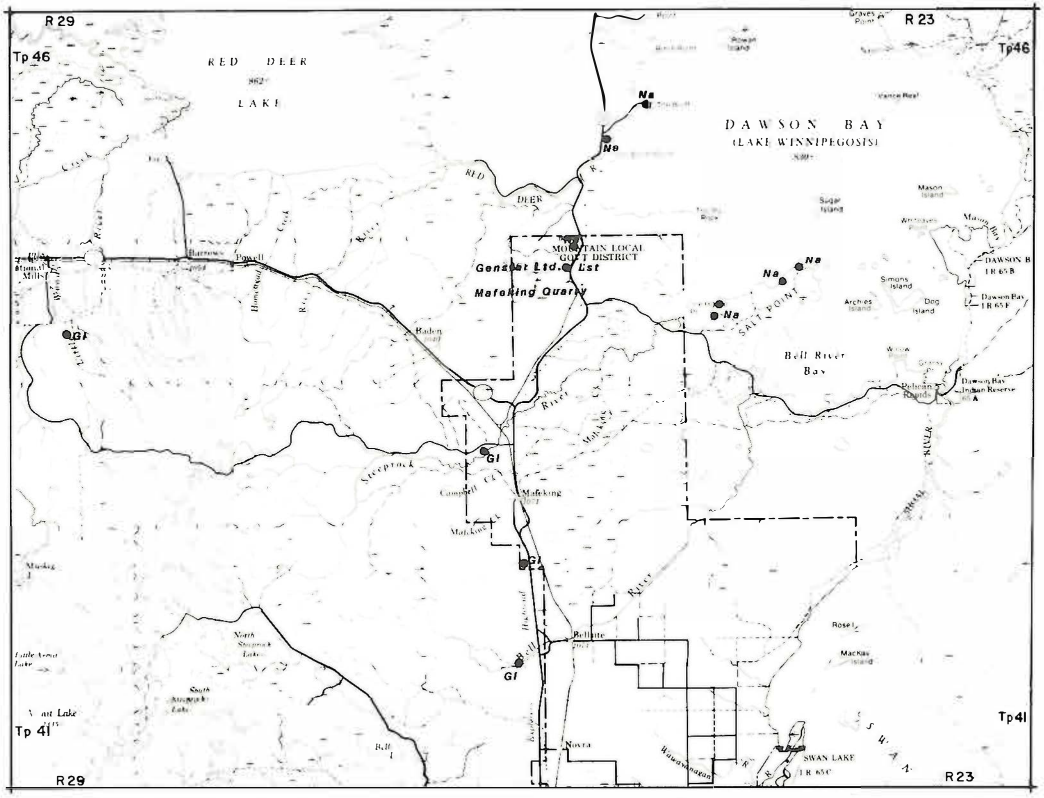


Figure GS-44-1: Industrial mineral occurrences in the northern Swan Lake area.

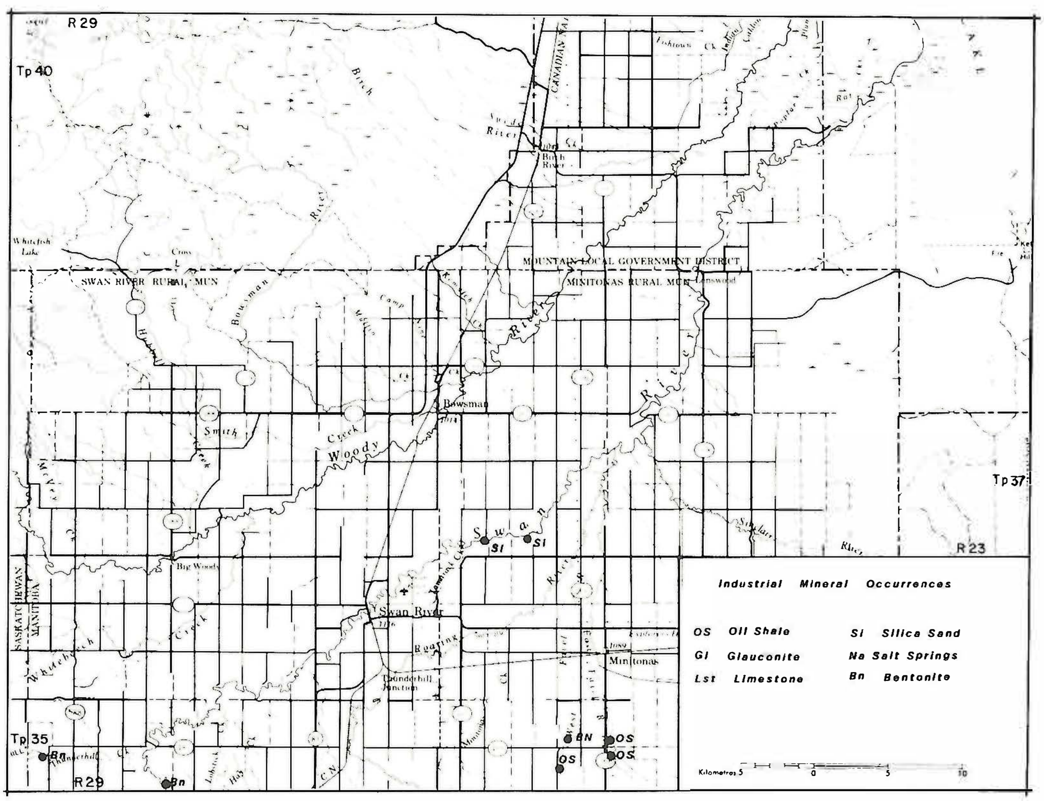


Figure GS-44-2: Industrial mineral occurrences in the southern Swan Lake area.

Norris, A.W., Uyeno, T.T., and McCabe, H.R.
1982: Devonian rocks of the Lake Winnipegosis-Lake Manitoba outcrop belt, Manitoba; Geological Survey of Canada Memoir 392 and Manitoba Mineral Resources Division Publication 77-1.

Tyrrell, J.B.
1889: Report on Northwestern Manitoba; Geological Survey of Canada, Annual Report Part E, v. 5.

Watson, D.M.
1985: Silica in Manitoba; Manitoba Energy and Mines, Economic Geology Report ER84-2.

Watson, D.M., and Kohuska, C.
1984: GS-38 Industrial minerals investigations, 1984; **in** Manitoba Energy and Mines, Report of Field Activities, 1984.

GS-45 INDUSTRIAL MINERAL INVESTIGATIONS: SOUTHERN MANITOBA

by D.M. Watson and W.R. Gunter

SAND AT RICHER

A province-wide investigation of silica resources was completed in 1984 (Watson, 1985). A drilling program was undertaken in the Richer area (Fig. GS-45-1) in response to requests for additional information. Four holes were augered with a Copco Minuteman drill. Samples were collected every metre and analyzed for grain size distribution and silica-alumina content. The results of the analysis are presented as Table GS-45-1 and Figure GS-45-2.

This sand does not meet the industry specifications for a silica sand, as outlined in Watson (1985) and is not a viable source of silica sand.

ANHYDRITE AT GYPSUMVILLE

Two quarries in the Gypsumville area were examined to establish the presence and extent of anhydrite in response to an industry request. A visual survey of the main Gypsumville quarry indicated little or no anhydrite is present in that gypsum quarry. The Whippoorwill Hill quarry was excavated into a thick bed of anhydrite that has a thin, 1 m to 1.5 m, weathered skin of gypsum below the soil horizon.

The sulphates from both quarries were submitted for chemical analysis to determine the ratio of gypsum/anhydrite in the samples.

KAOLIN AT BLACK ISLAND

Most kaolin that is used as paper filler comes from the southeastern United States (Georgia, North Carolina). Enquiries from paper mills in Manitoba and Alberta indicate an interest in the development of a Canadian source of kaolin.

Kaolin at Black Island occurs as the main component of kaolinized schist. The kaolin is white, and very fine grained; more than 90% of the material passes through a 325 mesh sieve.The only other minerals visible in hand specimen are quartz (up to 10%) and pyrite (trace to 2%) as large (up to 10 cm) blocks that appear to be relict quartz-vein material.

Samples were collected from several localities on Black Island and are being tested at the Mineral Processing Laboratories of the Federal Department of Energy, Mines and Resources in Ottawa.

REFERENCES

Watson, D.M.
1985: Silica in Manitoba; Manitoba Energy and Mines, Economic Geology Report ER84-2.

TABLE GS-45-1 ANALYSIS OF PLEISTOCENE SANDS, RICHER, MANITOBA

Sample #84-85EH	1-1	1-2	1-3	1-4	1-5	2-1	2-2	3-1	84-85EH 3-2
Lab. #85	1928	1929	1930	1931	1932	1933	1934	1935	85-1936
SiO_2	78.2	78.2	79.1	78.4	77.8	64.3	70.3	78.1	77.9
Al_2O_3	10.2	10.3	10.2	10.2	10.1	7.8	7.6	10.2	10.2
Fe_2O_3(T)	2	1.8	1.7	1.5	1.5	1.3	.9	1.7	1.7
CaO	2.4	2.4	2.3	2.5	2.7	9.6	7.5	2.3	2.4
MgO	.6	.6	.5	.6	.7	3.5	2.2	.6	.6
Na_2O	3.1	3.3	3.3	3.2	3.2	2.3	2.4	3.1	3.2
K_2O	1.7	1.7	1.7	1.7	1.7	1.4	1.4	1.7	1.8
TiO_2	.3	.2	.1	.1	0	0	.1	.1	.1
P_2O_5	0.11	0.09	0.08	0.08	0.08	0.06	0.05	0.11	0.10
MnO	0.02	0.02	0.02	0.01	0.02	0.03	0.01	0.03	0.02
LOI	1.2	.7	.6	.7	1	10.3	7.3	1.3	1.3
TOTAL	99.8	99.3	99.6	99	98.8	100.6	99.8	99.2	99.3

Sample #84-85EH	3-3	3-4	3-5	3-6	4-1	84-85EH 4-2
Lab. #85	1937	1938	1939	1940	1941	85-1942
SiO_2	77.7	77.9	78.8	79.2	58.8	44.9
Al_2O_3	10.2	10	10.2	9.9	8.0	6.2
Fe_2O_3(T)	1.7	1.6	2	1.5	1.7	1.5
CaO	2.5	2.4	2.7	2.3	11.8	19.3
MgO	.6	.6	.7	.5	3.6	5.5
Na_2O	3.2	3.2	3.2	3.2	2.3	1.9
K_2O	1.7	1.8	1.7	1.9	1.4	1.1
TiO_2	.1	.1	.1	0	0	.2
P_2O_5	0.09	0.09	0.10	0.08	0.09	0.07
MnO	0.03	0.02	0.03	0.02	0.04	0.03
LOI	.8	1	1	.6	12.6	19.4
TOTAL	98.6	98.7	100.5	99.2	100.3	100.1

GENERALIZED GEOLOGICAL MAP OF MANITOBA

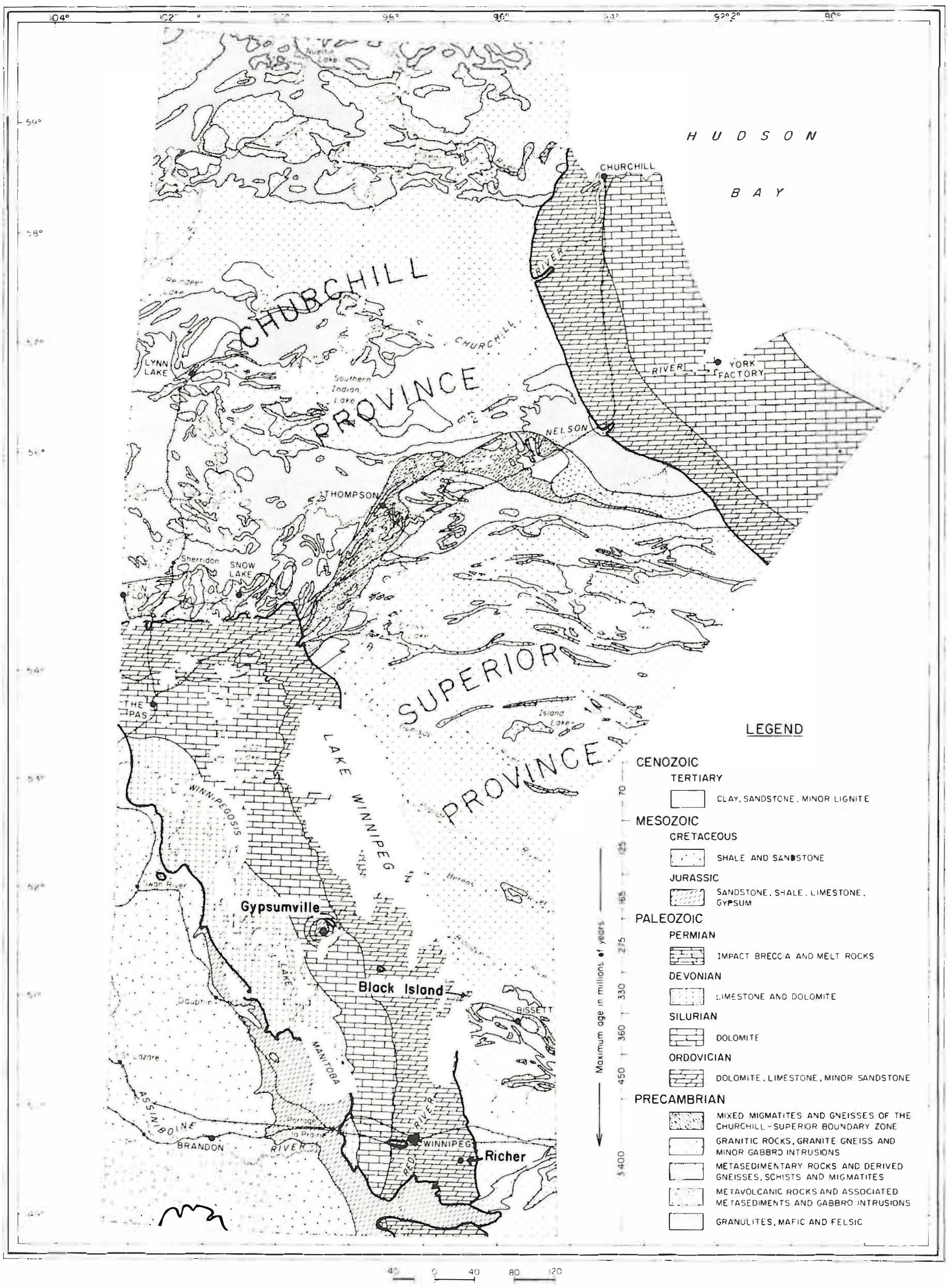


Figure GS-45-1: Location map of described industrial mineral occurrences.

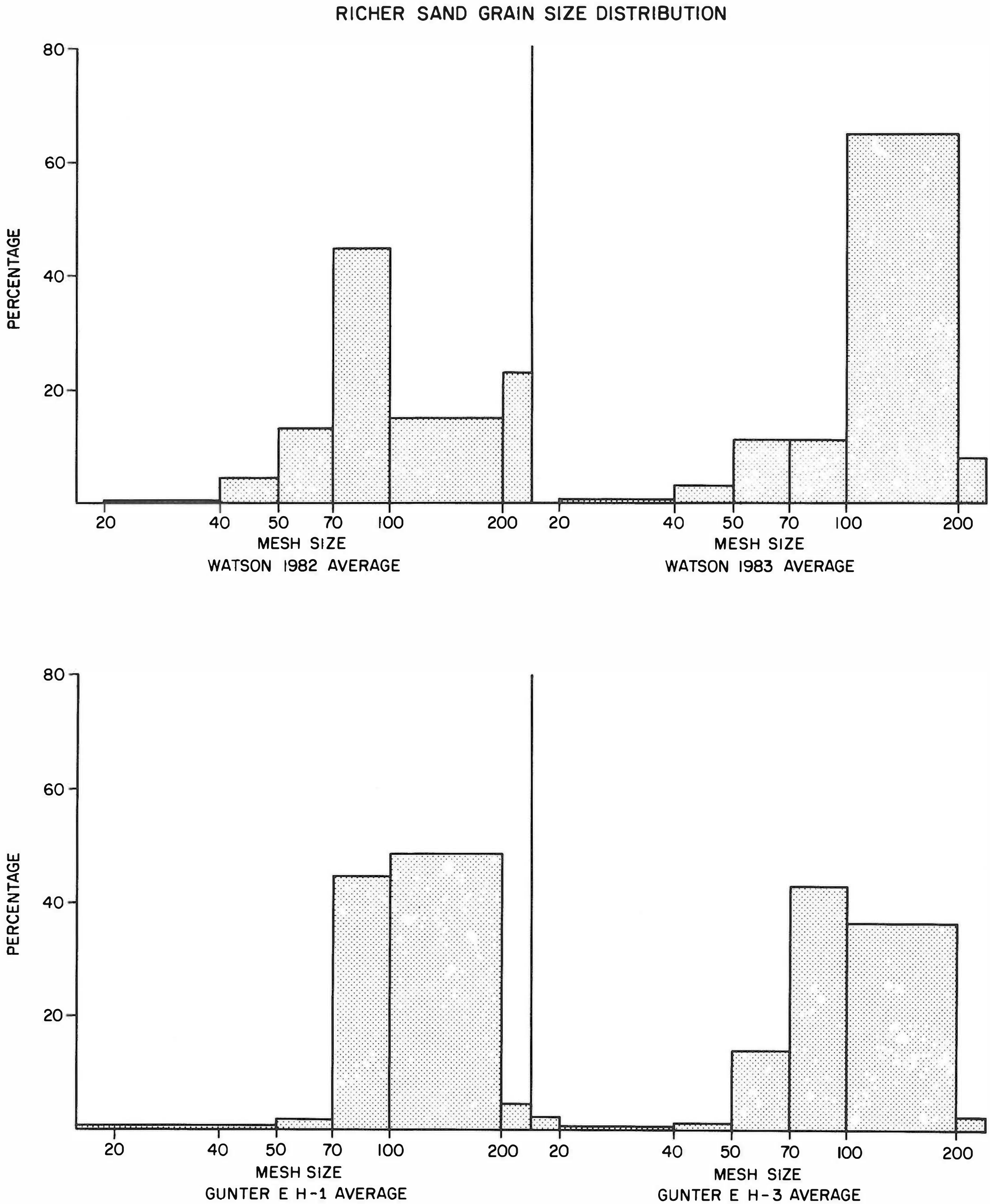


Figure GS-45-2: *Grain size distribution of Pleistocene sands, Richer.*

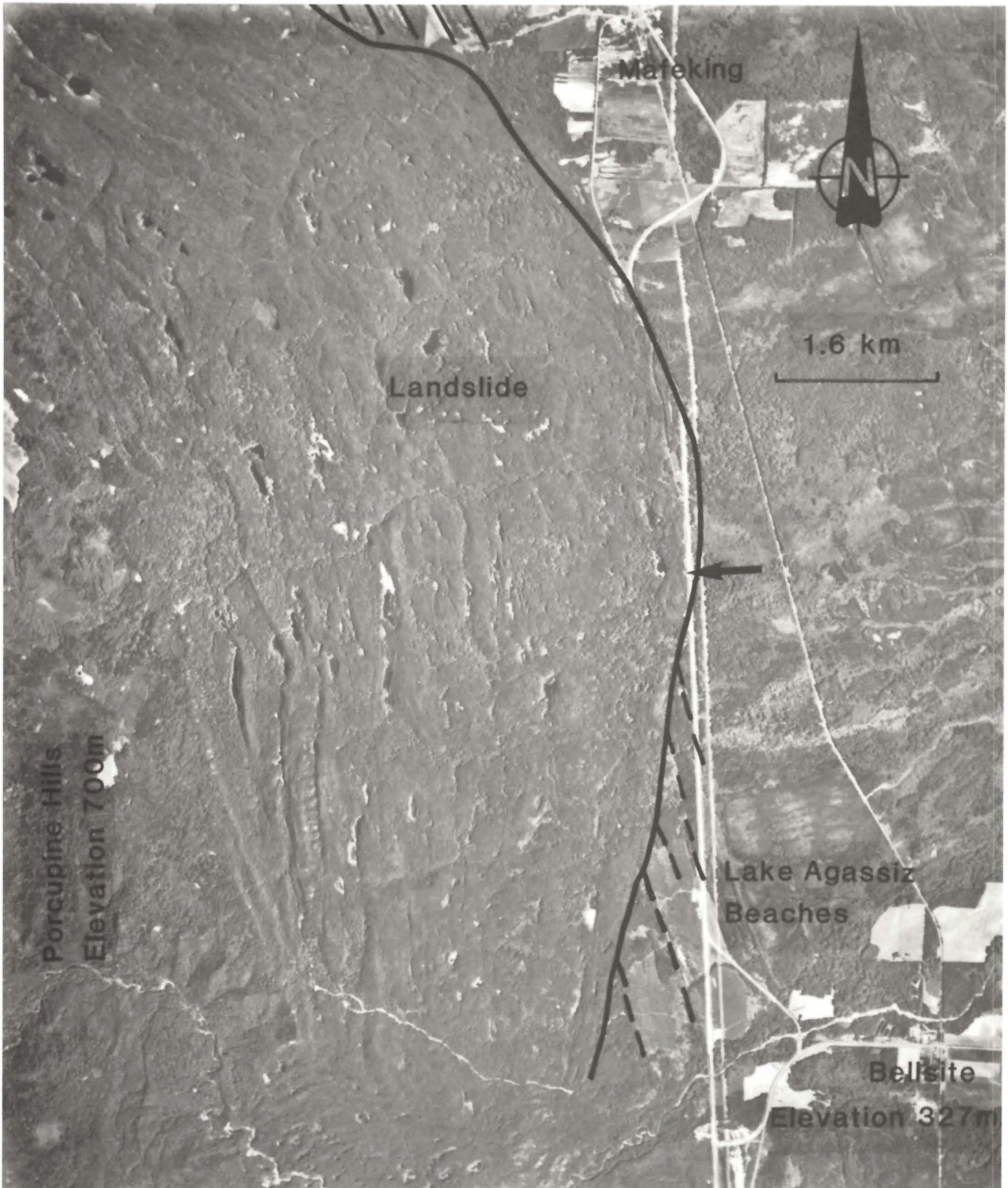


Figure GS-46-1: Airphoto showing part of the landslide area along the east side of the Porcupine Hills. Exposures in the toe of the slide are indicated by an arrow.

GS-46 STRATIGRAPHY AND AGE OF LANDSLIDES ALONG PORCUPINE HILLS

by Erik Nielsen and Dave Watson

INTRODUCTION

Extensive areas of landslides along the eastern and northeastern sides of Porcupine Hills (Fig. GS-46-1) were first described by Wickenden (1945). Scott and Brooker (1968) mapped part of the landslide area between Bellsite and Mafeking and postulated that the "decreases in shear strength of the (Cretaceous) bentonites in the zone of groundwater discharge could have initiated small failures which retrogressed to form the broad belt of failure . . .". They established the timing of the landslides as postdating the high levels of Lake Agassiz as beaches are truncated by the slide. Furthermore, they felt that postglacial uplift may have contributed to the slope failure by increasing the groundwater discharge gradient.

Recent work by the Manitoba Department of Highways along Highway 10 between Mafeking and Bellsite has produced sections in the toe of the slide which hitherto have not been exposed. Subsequent drilling by the PFRA[1] has provided a better understanding of the stratigraphy of the slide (Fig. GS-46-2).

The toe of the slide can be divided into two broad units: (1) a lower zone approximately 4 m thick consisting of chaotically mixed black Cretaceous glauconitic shale of the Skull Creek Member and sand, gravel and till of Pleistocene and Holocene age (Fig. GS-46-3), and (2) an upper 4 m thick zone consisting of poorly exposed sand of late Pleistocene or early Holocene age. The upper sand unit consists of massive, highly deformed sand mixed with faulted, poorly stratified sand with minor intermixed Cretaceous shale.

Prior to slumping, the sand unit was probably deposited in a glaciodeltaic or near-shore glaciolacustrine environment of Lake Agassiz or in an earlier ice-marginal lake ponded between the Arran Sublobe occupying the Manitoba Interlake and the Porcupine Hills during late glacial time.

AGE

As the landslide truncates the Lower Campbell beach of Lake Agassiz at an elevation of 370 m the maximum age of the landslide is about 9500 years BP (Nielsen et al., 1984). Wood (**Populus** sp.) recovered from the lower chaotic facies (Fig. GS-46-4) indicates the slide was active 340 ± 70 years BP (BGS-1040).

Although this radiocarbon date indicates the landslide was active in relatively recent time it does not exclude the possibility that the slide was also active in early Holocene time as postulated by Scott and Brookes (1968).

REFERENCES

Nielsen, E., Gryba, E.M., and Wilson, M.C.
1984: Bison remains from a Lake Agassiz spit complex in the Swan River valley, Manitoba: depositional environment and paleoecological implications; Canadian Journal of Earth Sciences, v. 21, p. 829-842.

Scott, J.S., and Brooker, E.W.
1968: Geological and engineering aspects of upper Cretaceous shales in western Canada; Geological Survey of Canada, Paper 66-37, 75 p.

Wickenden, R.T.D.
1945: Mesozoic stratigraphy of the eastern plains, Manitoba and Saskatchewan; Geological Survey of Canada, Memoir 239, 87 p.

[1]Prairie Farm Rehabilitation Administration

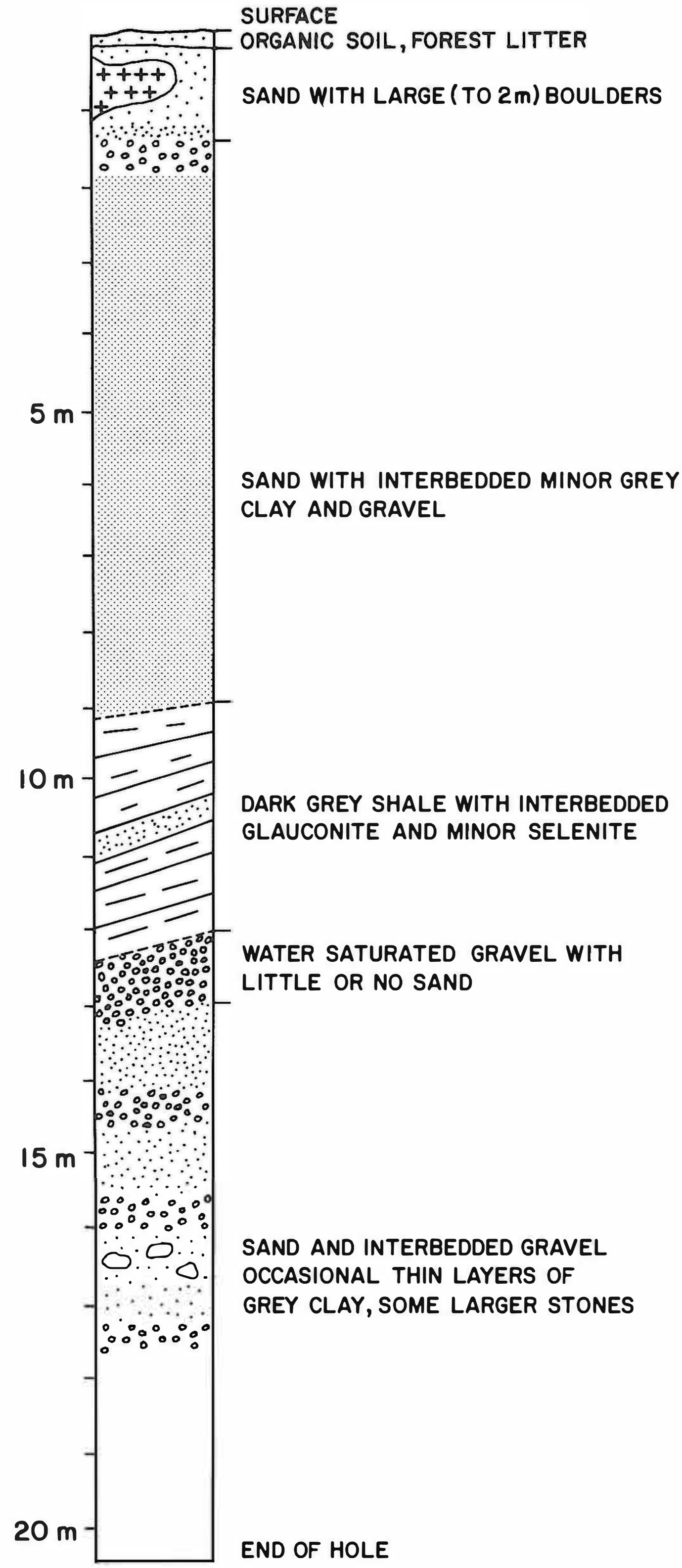


Figure GS-46-2: Composite stratigraphic section through the slide (data from PFRA and Department of Highways drilling).

Figure GS-46-3: *The toe of the landslide exposed along Highway 10 north of Bellsite. The radiocarbon-dated wood is indicated by an arrow.*

Figure GS-46-4: *Wood dated at 340 years BP (indicated by arrow) in the upper part of the lower chaotic zone. The wood is from stratified sand draped over a large dolomite boulder and capped by Cretaceous shale.*

GS-47 LEAD-ZINC POTENTIAL IN PALEOZOIC ROCKS OF SOUTHERN MANITOBA

by E. Nielsen and G.H. Gale

Basal till sampling to investigate the source of galena float in southern Manitoba (Gale et al., 1981, Nielsen and Gale, 1982, 1983, and Gale et al., 1984) was extended into the Dawson Bay area. Drill cores of Paleozoic rocks were sampled for rock geochemical studies.

TILL SAMPLING

A total of 52 backhoe pits resulting in 68 samples were put down at approximately half kilometre intervals along the road to Pelican Rapids (Fig. GS-47-1).

Devonian bioherms of the Dawson Bay Formation outcrop extensively along the south shore at Dawson Bay (Norris et al., 1982). Striations preserved at only one site record the flow of the Arran Sublobe towards 250°. The till is similar to the Arran till described from the Swan Lake area (Gale et al., 1984).

Arran till was sampled from 45 pits but could not be reached in the other seven pits. Iceberg turbate sediments consisting of mixed till and glaciolacustrine sediment are widespread to the west but give way to deep water Lake Agassiz sediments to the east. The iceberg turbate and clay deposits are generally thin and were in most cases easily penetrated before till was reached. Fossiliferous beach ridges, 3 and 6 m above the present lake level and tentatively attributed to post-Lake Agassiz tilting of Lake Winnipegosis, locally overlie the deep water Lake Agassiz clay and iceberg turbate deposits (Fig. GS-47-2).

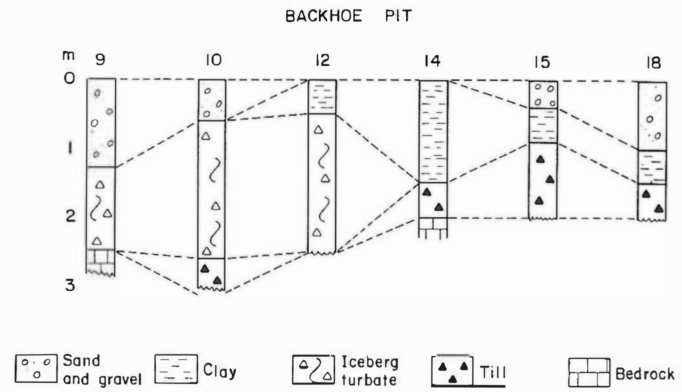


Figure GS-47-2: *Stratigraphic cross-section of the surficial deposits in the Dawson Bay area.*

TILL GEOCHEMISTRY

The less than 2 micron fraction, and the heavy mineral fraction will be analyzed for Cu, Pb, Zn, Ni, Co, Cr, Fe, Mn and Ba. Heavy mineral concentrates and the less than 2 micron fraction from till samples collected in 1984 (Gale et al., 1984) were analyzed. No anomalous values of Pb, Zn, Ni, and Co were found.

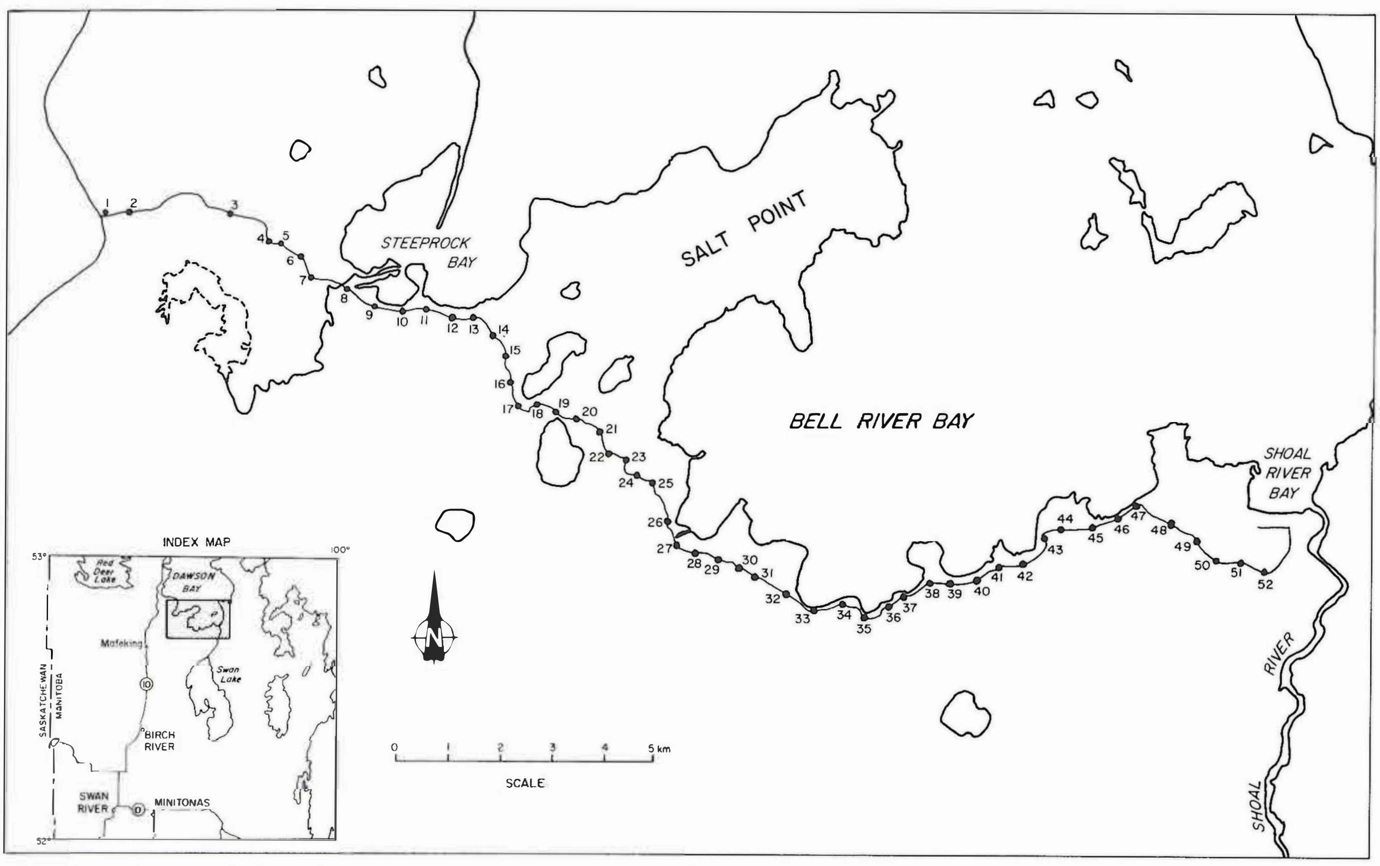


Figure GS-47-1: *Location of till samples collected in the Dawson Bay area.*

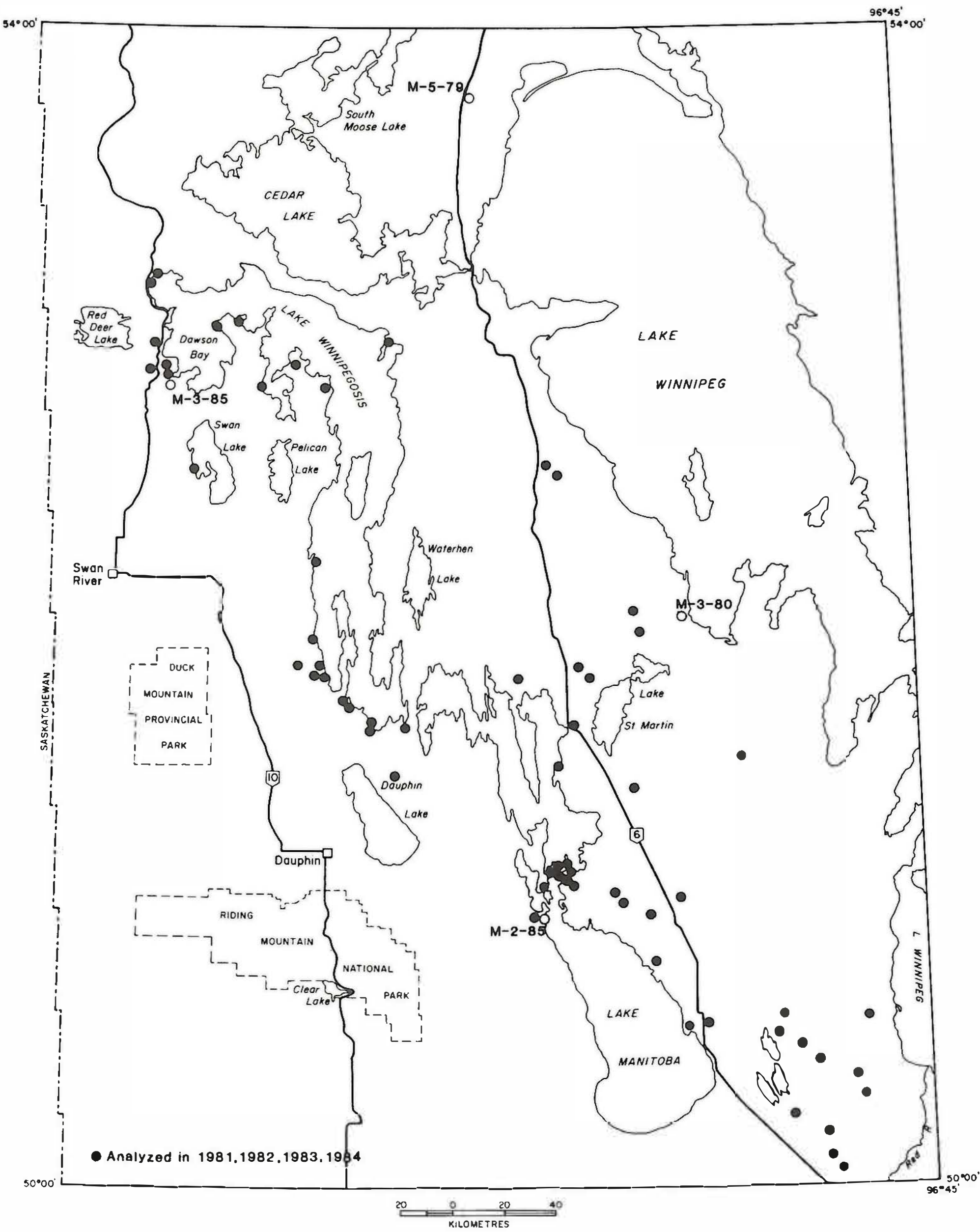


Figure GS-47-3: Location of Paleozoic drill cores sampled in 1985.

BEDROCK GEOCHEMISTRY

Drill cores from five drill holes (Fig. GS-47-3) were sawn to provide continuous sampling over one metre intervals. The 459 samples obtained will be analyzed for Cu, Pb, Zn, Ni, Co, Cd, Mn, Fe, Ba, and Hg.

This season's sampling completes the first phase of this project. Geochemical data have been entered into computer files and an open file report will be prepared prior to undertaking any further studies.

REFERENCES

Gale, G.H., Nielsen, E. and McCabe, H.R.

1981: Mineral deposit studies in Phanerozoic rocks of southern Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1981, p. 57-62.

1984: Investigation of lead-zinc potential in Paleozoic rocks of southern Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 159-161.

Nielsen, E. and Gale, G.H.

1982: Mineral deposit studies in Phanerozoic rocks of southern Manitoba; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 115-121.

Norris, A.W., Uyeno, T.T. and McCabe, H.R.

1982: Devonian rocks of the Lake Winnipegosis-Lake Manitoba outcrop belt, Manitoba; Manitoba Mineral Resources Division, Publication 77-1 (also: Geological Survey of Canada, Memoir 392).

MINES BRANCH

EXPLORATION SERVICES AND AGGREGATE RESOURCES

ES-1 MANITOBA'S PRECAMBRIAN DRILL CORE COLLECTION PROGRAM

by J.K. Filo and P.J. Doyle

INTRODUCTION AND HISTORY

The Exploration Services Section of the Department of Energy and Mines has collected Precambrian diamond drill core for systematic storage since the early 1970s. Before 1970 the then Mines Branch only collected core as an aid to 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 various exploration companies. During the 1970s emphasis was given to core collection; however, because of limited staff and resources, comprehensive cataloguing was not 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. 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 year. Most of the effort was directed toward the libraries in Lynn Lake and The Pas which underwent major reorganizations. Core racking and inventory procedures were standardized but much of the individual box relabelling was not completed. Twelve core retrievals were completed during 1983 which resulted in the addition of 24 329 metres of core to the provincial library system.

In April, 1984 the Government of Canada and the Manitoba Government finalized the Mineral Development Agreement. A portion of the funds available under the five year term of the agreement have been allocated to the provincial core libraries program. The completion of a new wing to the core library in The Pas was the highlight of the first year. This addition has expanded our storage capacity in the Flin Flon-Snow Lake Belt by 300 per cent. All interior finishing work and core rack construction was completed on schedule by individuals involved in The Pas Human Resources Opportunity Centre, a community oriented job training program. This project resulted in the creation of 665 person days of meaningful work during 1984. Twenty core collection projects were undertaken during the year which resulted in the addition of 26 169 metres of core to the system. Public use of the facilities increased by 39 per cent with 38 core inspection visits. The library holdings in Thompson and Winnipeg were consolidated into well organized, properly labelled outside crosspiles. These two reorganization projects involved the physical handling of more than 12,000 individual boxes. During the 1984 Drill Core Program a total of 665 person-days were spent in the field at various sites throughout the province.

1985 PROGRAM

In addition to a series of ongoing retrieval projects, the 1985 program had two specific objectives. The first of these was a reorganization, relabelling and selected reduction of our holdings in both The Pas and Winnipeg. The second objective was to compile a master file system by hole and project which would include drill logs, collar locations and other pertinent information for all core stored in the provincial inventory as a prelude to computerization of our inventory files. Smaller scale inventory updating and labelling projects were completed in Thompson and Lynn Lake in order to incorporate core collected during recent winter retrievals.

The limited outside storage in Winnipeg was improved by selectively reducing a number of high-density drill projects to representative holes. In The Pas, numerous limestone sections were transferred to the Geological Services Branch's Phanerozoic Stratigraphic Studies group for selective storage. Core reduction efforts in both Winnipeg and The Pas resulted in the removal of 1944 boxes of core equivalent to 38,881 feet or 11 851 metres.

A sharp rise in the level of exploration activity during the winter of 1984-85 resulted in an increase in the amount of footage drilled in the province. This produced an increased number of core retrieval requests and days of library use. Section staff involved in the drill core program compiled 327 person days of field work (See Fig. ES-1-1 and 2). By September 1 of 1985, 24 industry requests have been answered and the libraries have been utilized for 41 days. During 1985, 13 418 metres of core have been added to the provincial libraries system with the majority of the collections in the Lynn Lake and Flin Flon regions.

PRESENT HOLDINGS IN CORE LIBRARIES

The four libraries currently hold 189 104 metres of core.

(A) The Pas Library: (See Fig. ES-1-3)

This library, located in the Natural Resources Compound at Grace Lake, contains 71 110 metres (233,300 feet) of core collected from the Flin Flon-Snow Lake district. The present facility has an estimated capacity of 171 949 metres. The library is currently 41 per cent full.

Examples of current holdings include:

Espina Copper; 3 projects, 38 holes, 1 609 metres
Freeport Exploration; 3 projects, 158 holes, 26 902 metres
Granges Exploration; 33 projects, 345 holes, 17 684 metres
Hudson Bay Exploration; 21 projects, 100 holes, 8 664 metres
Manitoba Mineral Resources; 9 projects, 58 holes, 5 456 metres
Maverick Mountain Resources; 1 project, 29 holes, 1 286 metres

BP-Selco, Camflo Mines, Cominco, Newmont, W.B. Dunlop, Inco, W.B. Kobar, Pronto Exploration, Shell Canada Resources, Red Earth Energy, etc.

(B) Lynn Lake

This building situated on Eldon Lake near Parsons Airways floatplane base, houses 41 081 metres of exploration drill core from the Lynn Lake greenstone belt, northern part of the Kisseynew basin and northern Manitoba in general. The current capacity of the facility is 58 960 metres. A substantial amount of core was placed in the library during 1985 as a result of the increased level of diamond drilling in the Lynn Lake region. Consequently, the volume of core stored currently occupies 68 per cent of the building's total storage capacity.

Examples of current holdings include:

Granges Exploration; 4 projects, 140 holes, 11 107 metres
Hudson Bay Exploration; 3 projects, 60 holes, 4 584 metres
Manitoba Mineral Resources; 12 projects, 164 holes, 12 466 metres
S.M.D.C.; 2 projects, 44 holes, 4 285 metres

Figure ES-1-1: Winter core retrieval, Lynn Lake.

Figure ES-1-2: Industry core inspection—The Pas.

BP-Selco; 1 project, 17 holes, 1 457 metres
Falconbridge; 2 projects 8 holes 847 metres

Cyprus Exploration, Gigantes Exploration, Knobby Lake Mines, McIntyre Mines, Rock Ore Exploration, Shell Canada Resources, Denison Mines, etc.

(C) Thompson:

This shed located at the Burntwood River floatplane base, has a capacity of 30 693 metres and is overflowing with 63 627 metres of core. The overflow has been piled neatly outside on covered pallets in a fenced storage compound adjacent to the library. This facility holds core from the Nickel Belt and the Central-Eastern Superior greenstone belts. This library will be the focus of our selective reduction program during the summer of 1986.

Examples of current holdings include:

Canamax Resources; 23 projects, 224 holes, 35 167 metres
Cominco; 1 project, 50 holes, 6 242 metres
Falconbridge; 2 projects, 14 holes, 2 573 metres
Granges Exploration; 3 projects, 16 holes, 5 542 metres
Hudson Bay Exploration; 3 projects, 7 holes, 2 079 metres
INCO; 1 project, 3 holes, 799 metres
Manitoba Mineral Resources, Manitoba Hydro, Nufort Resources, etc.

(D) Winnipeg:

The Winnipeg facility has no indoor racked storage at present. Plans are currently underway through the Minerals Agreement to alleviate this situation. Present inventory of 23 286 metres of core is piled neatly in logical groups on covered pallets in a secure outside storage compound at the Brady Road site.

Figure ES-1-3: *The Pas Core library.*

Examples of our current holdings:

Dumbarton Mines; 4 projects, 59 holes, 5 401 metres
Falconbridge Nickel; 5 projects, 44 holes, 6 120 metres
Brinco; 1 project, 16 holes, 829 metres
BP-Selco; 2 projects, 15 holes, 1 811 metres
Manitoba Mineral Resources; 5 projects, 51 holes, 2 274 metres
Maskwa Nickel Chrome Mines; 2 projects, 11 holes, 695 metres
J. Donner, Footloose Resources, Schmirf Exploration, etc.

HOW TO USE THE CORE LIBRARIES

The core libraries at The Pas, Lynn Lake and Thompson are now well organized 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 be made to:

J.K. Filo, Drill Core Geologist
P. Doyle, Special Projects Geologist
or
B. Esposito, Assessment Geologist
Exploration Services Section
Manitoba Energy and Mines
555-330 Graham Avenue
Winnipeg, Manitoba R3C 4E3
Phone: (204) 945-8633/945-8204/945-6535

Arrangements will then be made with appropriate local Government representatives who have keys to the northern libraries. These are:

The Pas: 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 Natural Resources
675 Halstead Street
Lynn Lake, Manitoba ROB OWO
Phone: (204) 356-2413

Thompson: H. Schumacher or W. Comaskey
Manitoba 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.

For a more comprehensive outline of Manitoba's Precambrian Drill Core Libraries Program please refer to the recently released bilingual brochure of the same title produced under the Minerals Agreement. This is available free of charge from the Winnipeg office.

ES-2 COMPILATION, PROMOTION AND EXPLORATION SERVICES (MDA PROJECT 5.9)

by J.D. Bamburak

INTRODUCTION

The Exploration Services Section of the Mines Branch has been involved in compilation, promotion and exploration services since its inception as the former Geoscience Data Section in April 1979. The Mineral Development Agreement (MDA), signed in April 1984 by the Government of Canada and the Manitoba Government, provided for expansion of these services. Increased staffing and funding under the Agreement resulted in the implementation of a Bibliography of Manitoba geology compilation project (after a hiatus of almost twenty years); reactivation of the Manitoba Mineral Inventory project (essentially dormant since 1979); and significant improvement in the quality of displays and brochures.

COMPILATION

1. BIBLIOGRAPHY OF MANITOBA GEOLOGY

The bibliographic compilation project began in April 1985. During the summer, 630 bibliographic citations were entered onto computer input forms for all geoscientific publications produced by the Department of Energy and Mines and its predecessors. Data entry into a computer-based file will be done this fall and a draft will be available for viewing at the Annual Meeting with Industry in November 1985.

Bibliographic citations for all publications of the Geological Survey of Canada on Manitoba are planned for completion by January 1986. Publication of Open File Report OF86-1 "Bibliography of Manitoba" (from these sources), in alphabetic order by author, is planned for April 1986.

During 1986, data will be added to each citation to permit subject keyword and NTS (National Topographic System) retrievals from the data base. Later, citations from the periodical literature and theses will be added to the computer file. Hardcopy bibliographies cross-referenced by author, subject and NTS will be produced and customer-tailored retrievals should be possible by November 1986.

2. MANITOBA MINERAL INVENTORY

Updating of 63 mineral inventory cards of gold deposits situated in the Rice Lake greenstone belt began in June 1985. At the end of August, the compilation was completed and the cards submitted for word processing. A draft of "Gold Mineral Inventory Update of the Rice Lake Greenstone Belt" will be on display in November at the Annual Meeting with Industry.

By January 1986, the remaining gold inventory cards for the Province should be updated and publication of Open File Report OF86-2 "Manitoba Gold Mineral Inventory Update" is planned for March 1986.

Mineral inventory cards describing base metal deposits will be updated in 1986. The objective will be to produce a published report of these updated cards similar to that for gold.

3. LAND USE

In December 1984, a 1:1 000 000 scale map depicting "Land Use Designations Affecting Mineral Exploration/Development in Manitoba 1984" was compiled. The map, on a simplified topographic base, shows the outlines of Provincial and Federal parks, Provincial forests, wildlife management areas and Indian reservations. It is available to the public.

4. ASSESSMENT REPORT INDEX MAPS

Approximately 600 map mylars showing coverage of all assessment reports, at a scale of 1:31 680, are stored in Exploration Services for overlaying on Mining Recording's claim maps. Five digit accession numbers within former mineral disposition outlines on the maps are cross-referenced in the "Index to Non-confidential Assessment Reports" by NTS Area, Holder and Claim Names. During the summer, 120 of these mylars were updated using information contained in assessment reports recently transferred to non-confidential status.

5. INDEX MAP SERIES

The Section stores and maintains 1:1 000 000 scale mylars portraying several different types of data. Nine mylars show outlines of permits and former exploration reservations and airborne permits, and six outline map areas of geoscientific publications. Map 6 indicates where Mining Claim maps are available. Map 11 locates metallic mines and Map 12 depicts the location of industrial minerals producers. During the summer, most of these mylars were updated and many were redrafted from a scale of 1:1 267 200.

PROMOTION

1. EXPLORATION MONITORING

From January to August 1985, Exploration Services staff undertook 35 field trips to Northern Manitoba. A total of 434 person-days were spent in the field and 154 contacts were made with exploration personnel in on-going liaison and monitoring of exploration activity.

2. DISPLAYS

During the past year, the Section has produced displays depicting exploration activity and mining in the Province and services provided by the Department of Energy and Mines. Two major events were: the Annual Meeting with Industry in Winnipeg last November, and the Prospectors and Developers Convention in Toronto in March. Four other events were: the Winnipeg Careers Symposium in February; Norway House Careers Days in May; Brandon Science Fair in April, and Winnipeg Gem and Mineral Exhibition in July.

3. ARTICLES

Staff wrote several articles describing the activities of exploration companies in the Province. "Gold exploration in Manitoba" was published by The Northern Miner (October 18, 1984). "Mining Exploration in Manitoba 1984" was used by The Northern Miner in its March 7, 1985 "EXPLORATION '85" issue re-titled "Exploration activity in Manitoba shows substantial increase from previous year". Three staff members presented papers to the CIM District 4 convention in Thompson in September.

EXPLORATION SERVICES

1. PUBLICATION DISTRIBUTION

The Section distributes copies of the bilingual booklets "Canada-Manitoba Mineral Development Agreement" and "Manitoba's Precambrian Drill Core Libraries Program". Open File Reports (OF84-1, 84-2, 85-2, 85-3 and 85-6) produced under the previous Canada-Manitoba Interim and the current Mineral Development Agreements were distributed following a notification process. The "Canada-Manitoba Mineral Development Agreement 1984-89, Sector-'A' Geoscientific Activities, Progress Report 1984-85" (Open File Report OF85-9) was released in September 1985. This report reviews activities conducted by Geological Services Branch and Exploration Services Section of the Mines Branch during the 12-month period ending March 31, 1985, and outlines projects scheduled for implementation during 1985-86.

2. BROCHURES

The following brochures were prepared in march 1985 and will be regularly updated to assist the exploration and mining industry:

a. "Mineral and Exploration Services in Manitoba";
b. "Staff and Functions of the Geological Services Branch";
c. "Staff and Duties of the Exploration Services Section";
d. "Mining and Exploration Companies in Manitoba"; and
e. "Selected Contractors and Consultants Serving the Exploration Industry in Manitoba".

AR-1 AGGREGATE RESOURCE INVENTORY OF THE RURAL MUNICIPALITY OF SOUTH NORFOLK

by R.V. Young

INTRODUCTION

An aggregate resource inventory was carried out in the Rural Municipality of South Norfolk with the objective of determining location, quality and reserves of aggregate resources. Aggregate deposits are shown on Preliminary Map 1985-SN at a scale of 1:50 000 accompanying this report.

The study area is located 93 kilometres southwest of Winnipeg between latitudes 49°32' to 49°48' north and longitudes 98°25' to 98°44'. It includes Townships 7 to 9 and Ranges 8 to 9 and a portion of Range 10 west of Principal Meridian.

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 4.0 mm size fraction.

TOPOGRAPHY

The study area is at elevations between 273 to 486 metres above sea level (m a.s.l.), with the lowest elevations in the north along the Assiniboine River. The Manitoba Escarpment rises above the Lake Agassiz plain at elevations of about 343 m a.s.l. Isolated hills associated with the Darlingford Moraine are found along the top of the Escarpment in the southern portion of the study area.

BEDROCK GEOLOGY

The bedrock geology consists of Cretaceous shale and minor sandstone as described by Halstead (1959) and in detail by Bannatyne (1970). The Swan River Formation in the northeastern portion of the study area consists of sandstone, kaolinitic shale and minor lignite. Along the Assiniboine River the bedrock comprises the Ashville Formation which consists of dark grey carbonaceous shale with minor sand, silt and bentonite. The Favel Formation south of the Assiniboine River consists of shale, minor limestone, bentonite and oil shale. The Vermilion River Formation is located within the central portion of the study area. The Pembina Member of this Formation is dark grey or black carbonaceous shale, bentonite and bentonitic shale. The Riding Mountain Formation forms the bedrock along the Escarpment in the southwestern portion of the study area. The Odanah Member consists of a light, hard siliceous shale and outcrops where glacial drift is absent.

SAND AND GRAVEL RESOURCES

Sand and gravel deposits consist of Lake Agassiz beach deposits and glaciofluvial deposits associated with the Darlingford Moraine. Beach deposits trend in a northwest direction following the edge of the Escarpment. The deposits consist of a pebbly sand with well defined beach bedding. The largest beach at an elevation of 373 m a.s.l. is up to one kilometre wide with depths of 14 m. A series of lesser discontinuous beaches are located above and below this elevation. East of Treherne the beaches merge into a series of offshore bars and spits consisting of fine sand. Two pits exposed in sections 33 and 27-7-8 W.P.M. show a lacustrine sequence consisting of silt, clay and minor sand underlain by a sandy flowtill with gravel lenses which is underlain by a well imbricated pebbly gravel. The stratigraphy indicates an esker deposit overlain by lacustrine deposits. The deposit has been mapped as a beach deposit due to nearshore lacustrine deposits overlying glaciofluvial sand and gravel.

Other sources of sand and gravel include outwash and eskers associated with the Darlingford Moraine. The outwash consists primarily of fine sand with minor gravel and large deposits of bedded silt and fine sand. Several roadcuts through these deposits show slump structures and contorted bedding interpreted as outwash deposited onto stagnant ice resulting in subsequent slumping. Only one esker deposit south of Treherne was observed.

REFERENCES

Bannatyne, B.B.,
1970: The Clays and Shales of Manitoba; Mines Branch Publication 67-1.

Halstead, E.C.,
1959: Ground-water Resources of the Brandon Map Area; Geological Survey of Canada Memoir 300.

AR-2 AGGREGATE RESOURCES IN THE RURAL MUNICIPALITY OF SHELLMOUTH

by H.D. Groom

INTRODUCTION

A sand and gravel inventory of the R.M. of Shellmouth 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 (Prelminary Map 1985-SM)

LOCATION AND PHYSIOGRAPHY

The R.M. of Shellmouth covers 560 km² in Twps. 22 to 24, Rges. 28 and 29 W. It lies within the Assiniboine River Plain at the second prairie level.

The land has an overall southwest slope. Elevations fall from 575 m a.s.l. (above sea level) in the northeastern corner of the municipality to 492 m a.s.l. in the southwest. Local relief is subdued on the till plain underlying the northern and central portions of the municipality but commonly exceeds 3 m on the outwash plain that lies east of the town of Shellmouth. Relief exceeds 10 m in the area of a braided esker complex situated south of Shell River (Sec. 31 - Twp. 22 - Rge. 28 W).

The Assiniboine and Shell Rivers are the major drainage channels in the area. Both are underfit streams occupying valleys that are up to 1.5 km wide and from 60 to 75 m deep.

BEDROCK GEOLOGY

The study area is underlain by Upper Cretaceous marine shales of the Riding Mountain Formation. The upper member, the Odanah, is a hard, grey, siliceous shale and underlies the southeastern portion of the study area. The lower member, the Millwood, is a soft, greenish, bentonitic shale which forms the bedrock surface of the remainder of the municipality (Klassen et al., 1970). Depth to bedrock is in excess of 100 m throughout most of the area but rises to near surface in the southeast where it outcrops along Thunder Creek.

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, 1972, 1979). Figure AR-2-1 has been modified from Klassen (1979).

With the exception of the river valleys and the outwash plain east of Shellmouth, the municipality is underlain by a rolling till plain. The till, of the late Wisconsinan Lennard Formation, was deposited by the last glacial ice to advance down the Assiniboine River plain. The outwash plain lying south of the confluence of the Shell and Assiniboine Rivers was deposited during a pause in the retreat of this ice from the area. The position of the ice front at that time is marked by the coarse gravel deposits lying along the northwestern edge of the plain and mapped by Klassen (1979) as a kame moraine. Shell River, carrying meltwater from the stagnating ice on the Duck Mountain uplands, flowed into the Assiniboine Spillway south of the ice front. As the ice retreated from the study area, the northern segment of the Assiniboine Spillway was excavated. The Assiniboine Spillway continued to carry meltwater from the western prairies to Lake Agassiz after the Shell River channel had ceased to function.

AGGREGATE DEPOSITS

Aggregate deposits in the R.M. of Shellmouth are of three types: eskers, outwash plain and terrace deposits along glacial spillways and meltwater channels.

ESKERS

A large braided esker complex is found in Sec. 5-23-28W and Secs. 30 and 31-22-28W. The complex trends north-south. At the northern end, the esker ridges are more than 10 m high and sharp crested. They are formed of a minimum of 4 m of sandy, coarse pebble gravel with cobbles but they fine rapidly southwards to fine pebble gravel. The

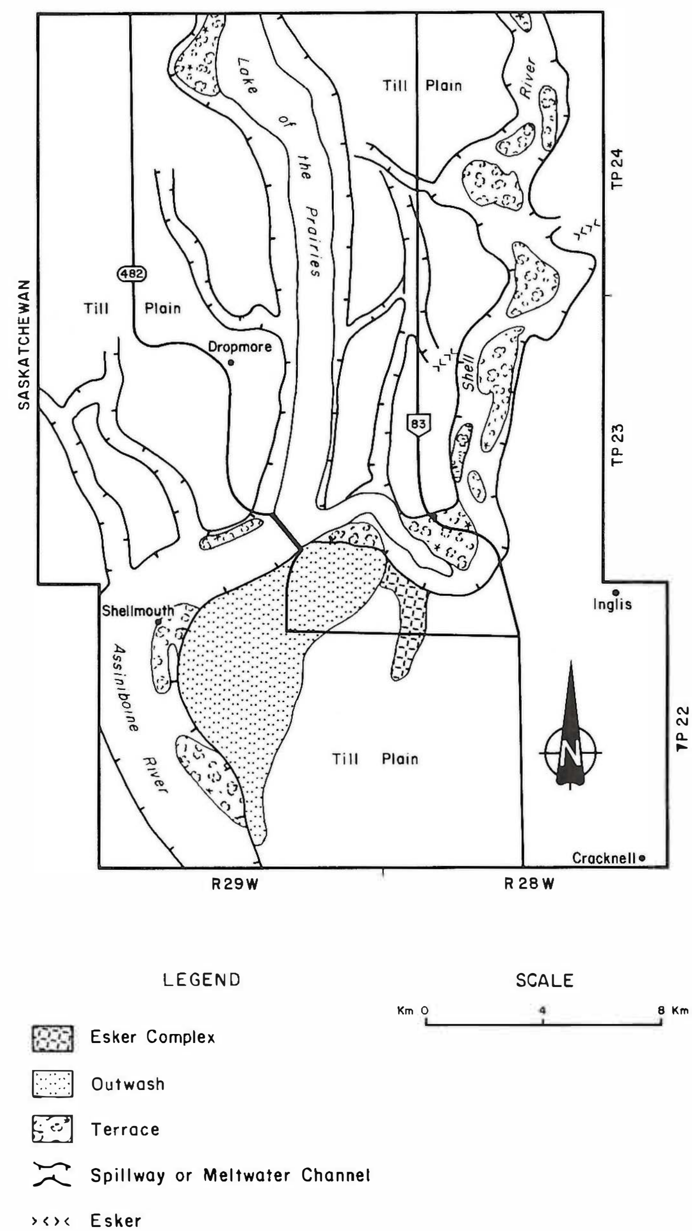


Figure AR-2-1: Surficial geology of the R.M. of Shellmouth; modified from Klassen (1979).

gravel is crossbedded and very well sorted. Backhoe sites in the material flanking the major ridges show fine sand underlying 2 to 3 m of pebble gravel. At the southern end of the complex, the ridges are broad crested and 3 to 4 m high. They comprise sand and pebbly sand. The flanking material is medium-fine sand. The presence of shale in the gravel is unusual as all other deposits in the municipality contain virtually none. One small pit in the deposit (NE 31-22-28W) is used on an intermittent basis.

OUTWASH PLAIN

The outwash plain lying east of Shellmouth covers 26 km^2. The surface of the plain is hummocky in the northern and western portions where it is underlain by gravel and gently rolling to the south where it is underlain by sand.

The coarsest gravel is found along the northwestern edge of the plain where there is a minimum of 4 m of sandy, coarse pebble gravel with cobbles. The western and northern ends of the plain are composed of sandy fine to coarse pebble gravel. There are several large pits in Secs. 35 and 36-22-29W where 3 to 4 m of crossbedded fine pebble gravel overlies sand. Backhoe test pits in the central portion of the plain show the same relationship although the thickness of the gravel beds thins to 1 to 2 m. The southern part of the plain is formed of sand that is predominantly massive or plane bedded; crossbedding is rare. Paleoflow direction in the crossbedded sand was to the west and southwest.

The northern portion of the plain has been extensively mined and two very large gravel pits in 36-22-29W were active this summer.

TERRACE DEPOSITS

Terrace deposits occur along the Assiniboine and Shell Rivers as well as along several smaller meltwater channels. All the terraces comprise sand and gravel and, along the Shell and Assiniboine Rivers, the thickness of the deposits always exceeds the reach of the backhoe (4 m).

The terraces along the Shell River occur along the inside of meander bends and are of very large areal extent; several are greater than 2 km^2. The material forming the terraces ranges from cobble gravel to fine sand. The cobble gravel is usually massive and moderately sorted. Pebble gravel is either plane- or crossbedded and usually well sorted. The coarse facies of each deposit is commonly found at the northern end of the terrace and along the river edge. Finer deposits of pebble gravel and sand occur on the downstream end of the terraces. However in at least two locations (NW 23-24-28W and SE 9-23-28 W) 1 to 2 m of massive cobble gravel overlies a minimum of 4 m of crossbedded sandy fine pebble gravel (Fig. AR-2-2). Most of the terraces have small pits that are used on an intermittent basis and four of them have large pits that have been recently active.

Due to the flooding of the Assiniboine valley north of the Shellmouth dam, only three terrace deposits are exposed along the river in the municipality. At the northern end of the terrace at Pyott's Point, an active pit (NW34-24-29W) exposes 5 m of crossbedded sandy, fine to coarse pebble gravel. Much of the southern end of the deposit is covered by sand and silt of alluvial fan origin. The terrace south of the town of Shellmouth lies adjacent to an outwash plain and could be erosional in origin. The active pit in NW30-22-29W shows 10 m of crossbedded gravel that coarsens upwards from fine pebble to coarse pebble gravel with cobbles. The southern end of the deposit shows at least 3 m of coarse sand, similar to the sand facies of the outwash lying immediately adjacent to it above the terrace wall.

Meltwater channels are common in the northwestern portion of the municipality. They are usually from 0.2 to 0.5 km wide, 1-3 m deep and are often sand and gravel floored.

The thickest gravel deposits occur as bars on the inside of meander curves. These deposits are generally 2 to 3 m of sandy fine pebble gravel and sand overlying till. However, the active pit north of Dropmore (NE35-23-29W) is 8 m deep and unusually coarse for this type of deposit.

CONCLUSION

The R.M. of Shellmouth has an abundance of high quality aggregate resources occurring as eskers, outwash plains, river terraces and meltwater channels. All types of deposits have a low shale content, good road access and are used for gravel extraction. However, the major sources of aggregate for the municipality are the river terraces and the outwash plain. The gravel pits in NW30 and N36-22-29W were active this summer and several large pits along Shell River have been active within the last year.

Figure AR-2-2: ***Gravel pit in a Shell River terrace (SE9-23-28W). Pit face is 8 m.***

REFERENCES

Klassen, R.W.

1966: The surficial geology of the Riding Mountain area Manitoba; Ph.D Dissert.; University of Saskatchewan

1972: Wisconsin events and the Assiniboine and Qu'Appelle valleys of Manitoba and Saskatchewan; Canadian Journal of Earth Sciences, v. 9, p. 544-560.

1979: Pleistocene geology and geomorphology of the Riding Mountain and Duck Mountain areas, Manitoba-Saskatchewan; Geological Survey of Canada, Memoir 396.

Klassen, R.W., Wyder, J.C. and Bannatyne, B.B.

1970: Bedrock topography and geology of Southern Manitoba; Geological Survey of Canada, Paper 70-51.

AR-3 AGGREGATE RESOURCES IN THE RURAL MUNICIPALITY OF ROBLIN

by P.R. Berk

INTRODUCTION

A sand and gravel inventory of the R.M. of Roblin was carried out to delineate gravel bearing deposits, to determine gravel quality and quantity and to provide aggregate information for resource management and land use planning. Preliminary map 1985-ROB, at a scale of 1:50,000 delineating aggregate deposits, accompanies this report.

LOCATION AND TOPOGRAPHY

The R.M. of Roblin is located in southwestern Manitoba and covers 432 km^2 between Ranges 13W to 15W and Townships 1, 2 and parts of 3.

The municipality lies within the Boissevain Plain (Klassen, 1979) on the second prairie level west of the Manitoba Escarpment. It is bordered to the north by the Pembina Trench and to the south by the United States border. The two townsites in the area are Cartwright and Mather.

The topography is varied and ranges from flat outwash plains to distinctly rolling corrugated moraine where relief ranges from 6 m to 20 m. The land has a gentle northeast slope with the highest elevation in the southwest at 492 m above sea level (a.s.l.) falling to 440 m a.s.l. in the northeast toward Pembina Trench. Drainage in the area is poor and marshy areas are common. The major drainage channels are Badger Creek, which flows northward through the municipality toward the Pembina River, and Long River and Gimby Creek which flow eastward into Badger Creek.

BEDROCK GEOLOGY

The area is underlain by the Upper Cretaceous marine shales of the Riding Mountain Formation (Bannatyne, 1970). The lower unit, the Millwood Member, a soft bentonitic shale, was not observed in outcrop. The upper unit, the Odanah Member, a hard grey siliceous shale, was observed in outcrop at several locations along Pembina River and Long River. It occurs as both massive blocky beds and as thin fissile beds. Joints are usually iron and manganese stained. In two locations, the Odanah shale was being quarried for use on section roads.

QUATERNARY GEOLOGY

The oldest unit in the area is a till plain which covers most of the southern half of the municipality except where it is overlain by outwash. This unit is of late Wisconsin age and was deposited by an ice advance from the northwest. The till plain is composed of moderately calcareous sandy to clayey sandy till. The surface of this unit is flat to gently rolling with irregular ridges and knolls scattered throughout the area.

In the northern half of the municipality, an expanse of corrugated moraine is present. Subarcuate northeasterly trending till ridges up to 20 m high are aligned transverse to ice flow direction. The orientation of the till ridges indicates that the corrugated moraine was also deposited by a southeasterly ice advance of late Wisconsin age. The ridges are composed of moderately calcareous sandy silty till. Low lying areas between ridges are poorly drained and swampy.

The remnant of a hummocky stagnation moraine is present in the west central portion of the municipality. It extends from the western boundary of the municipality eastward to Cartwright. The moraine has a knob and kettle topography and is composed primarily of silty clayey till with local pockets of silt, sand, and gravel. It is approximately 0.8 km wide and relief ranges from 4 m to 10 m.

Distinct features in the area are the southeasterly trending sinuous glaciofluvial eskers. Relief ranges from 1 m to 10 m. Composition of the eskers ranges from fine sand to stratified sand and gravel. In some cases a till cap greater than 3.5 m was encountered. This till cap infers a subglacial deposition. Sand and gravel is believed to be at depths greater than 3.5 m.

Outwash is deposited adjacent to streams and abandoned channels. The surface of the outwash is flat to gently irregular. Composition of the outwash deposits includes sand, silt and gravel generally less than 3 m deep. The water table is high (2-3 m) and till underlies the outwash.

Terrace deposits occur along Badger Creek. They are distinct low lying flat areas. Composition includes poorly sorted sand silt, and clay.

AGGREGATE RESOURCES

Sand and gravel deposits occur in glaciofluvial eskers and in the outwash.

ESKERS

Northwesterly trending eskers are scattered throughout the municipality. Ridges range from 1-10 m in height and from 0.5-2.5 km long. Composition of the eskers is highly variable ranging from fine sand to stratified sand and gravel. Most of the material has been extracted from the coarser deposits. (Figs. AR3-1 and AR3-2). Lithology of 5/8" to #4 sieve fraction includes carbonate clasts, Precambrian clasts and shale. The shale content ranges from 4% to 84%. Carbonate content is slightly higher than the Precambrian clast content in the samples. Gravel quality ranges from low, due to the high percentage of shale in some deposits, to medium high (60-80% gravel content).

OUTWASH

Outwash gravel occurs adjacent to streams and abandoned channels. It occurs as isolated pockets separated by sand and silt. Thickness of the outwash gravel tested is generally less than 2 m (Fig. AR3-3). Composition is generally sandy fine pebble gravel with varying amounts of shale. In the 5/8" to #4 sieve fraction, shale content ranges from 1% to 50%. Precambrian clasts and carbonates make up the remainder of the samples, with a slightly higher carbonate content. Gravel quality ranges from medium low (20%-40% gravel content) to medium (40-60% gravel content). Outwash gravels tend to be very sandy.

CONCLUSION

Gravel resources are found in eskers and outwash. Due to high percentages of sand and shale in most deposits, gravel quality is low. Where gravel qualities are medium to medium high, the aggregate has been quarried extensively primarily by the municipality for road maintenance.

Figure AR-3-1: Esker near depletion 0.5 km north of Cartwright, facing south.

Figure AR-3-2: Stratified sand and gravel in same esker, facing east. Shovel measures 1 m.

Figure AR-3-3: Outwash gravel less than 2 m deep at NE 28-1-15W, facing west.

REFERENCES

Bannatyne, B.B.
1970: The clays and shales of Manitoba; Manitoba Mines Branch, Publ. 67-1.

Elson, J.A.
1955: Surficial geology of the Tiger Hills Region, Manitoba, Canada; unpublished Ph.D thesis, Yale Univ.

Halstead, E.C.
1959: Ground-water resources of the Brandon Map Area, Manitoba; Geological Survey of Canada, Memoir 300.

Klassen, R.W.
1979: Pleistocene geology and geomorphology of the Riding Mountain and Duck Mountain areas, Manitoba-Saskatchewan; Geological Survey of Canada, Memoir 396.

AR-4 AGGREGATE RESOURCES IN THE LOCAL GOVERNMENT DISTRICT OF REYNOLDS

by G.L.D. Matile

INTRODUCTION

The second year of a three year sand and gravel inventory was carried out in the southern half of the L.G.D. of Reynolds. As the southern half of the L.G.D. was backhoe sampled in the summers of 1983 and 1984 by Materials and Research Branch of the Department of Highways, many potential sand and gravel deposits have already been tested and the data submitted to the Aggregate Resources Section. Several new sites with aggregate potential are scheduled to be tested this fall.

The aggregate study, over the last several years has been progressing southward along the axis of the Milner Ridge-Bedford Hills Moraine. As expected the southern limit of a late advance of the Rainy Lobe was delineated during this summer's mapping.

STRATIGRAPHY

The stratigraphy outlined in Figure AR-4-1 has been described by Matile and Groom (1983) and Matile (1984). Lateral variations within the described units have been observed as mapping proceeded southward.

1) The lowermost unit, the glaciolacustrine sand, becomes more significant in terms of area and elevation. The sand and gravel facies of this unit and the upper glaciofluvial sand and gravel unit have not been observed in the southern half of the L.G.D. of Reynolds. The result is a significant increase in the near surface glaciolacustrine sand to the south.
2) With the discontinuation of the upper glaciofluvial unit, the recessional facies of the silt diamicton becomes a prominent surficial feature. Major glaciofluvial deposits, possibly sublacustrine moraines (deposit 1 west of Windy Lake and deposit 2 at Ste. Rita, Fig. AR-4-2) mark the final retreat of the Red River Lobe. Boulder ridges and boulder fields, originally interpreted to be wave-eroded diamictons, may be ice-rafted material deposited near the retreating icefront. The reason for this reinterpretation is the relative absence of boulder-size material within observed diamicton sections.
3) The southern limit of the upper glaciofluvial sand and gravel unit is delineated by two major sand and gravel deposits (deposit 3 near Seddon's Corner and deposit 4 north of Darwin in the R.M. of Whitemouth, Fig. AR-4-2).
4) The marked increase in near surface glaciolacustrine sand has the effect of decreasing the amount of gravel-sized material within the Lake Agassiz shoreline features, reducing commercial quality gravel in lacustrine units to minor isolated pockets and increasing the amount of sand available for aeolian activities in the area, thereby increasing aeolian sand cover to the south.

REFERENCES

Matile, G. and Groom, H.,
1983: Aggregate Resources in the L.G.D. of Alexander and R.M. of Lac du Bonnet; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1983, p. 155-158.

Matile, G.,
1984: Aggregate Resources in the L.G.D. of Reynolds; **in** Manitoba Mineral Resources Division, Report of Field Activities, 1984, p. 176-178.

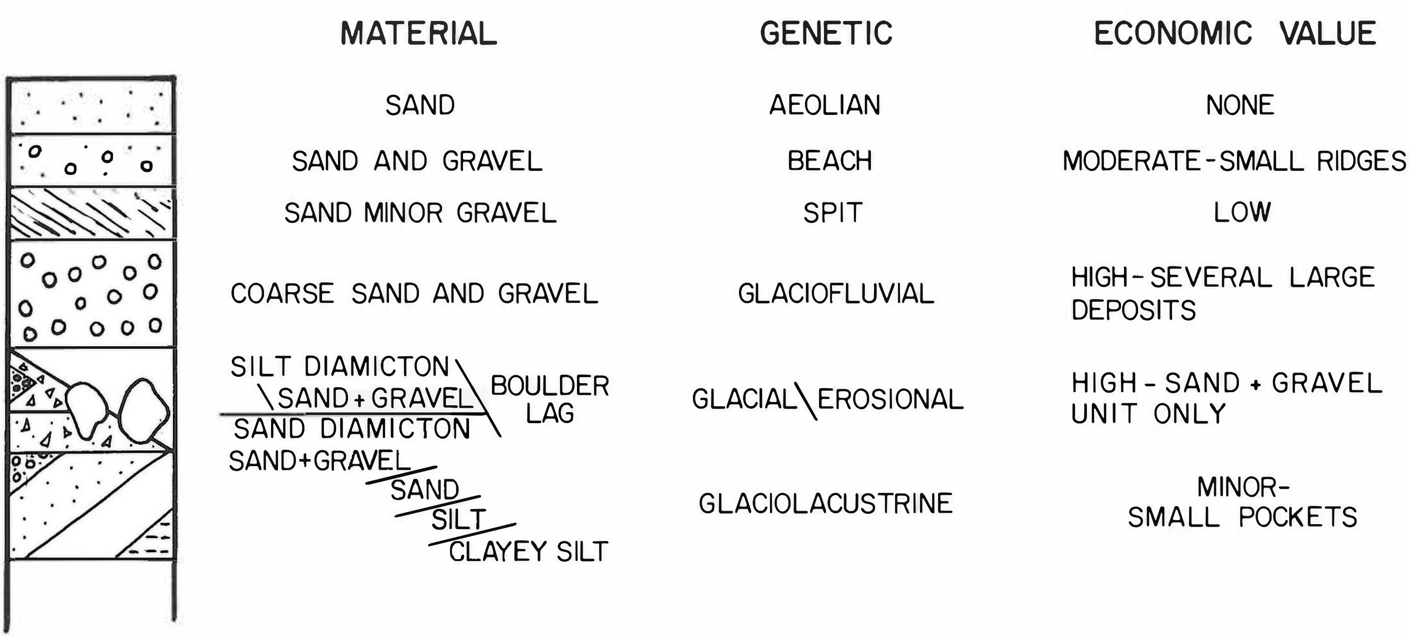
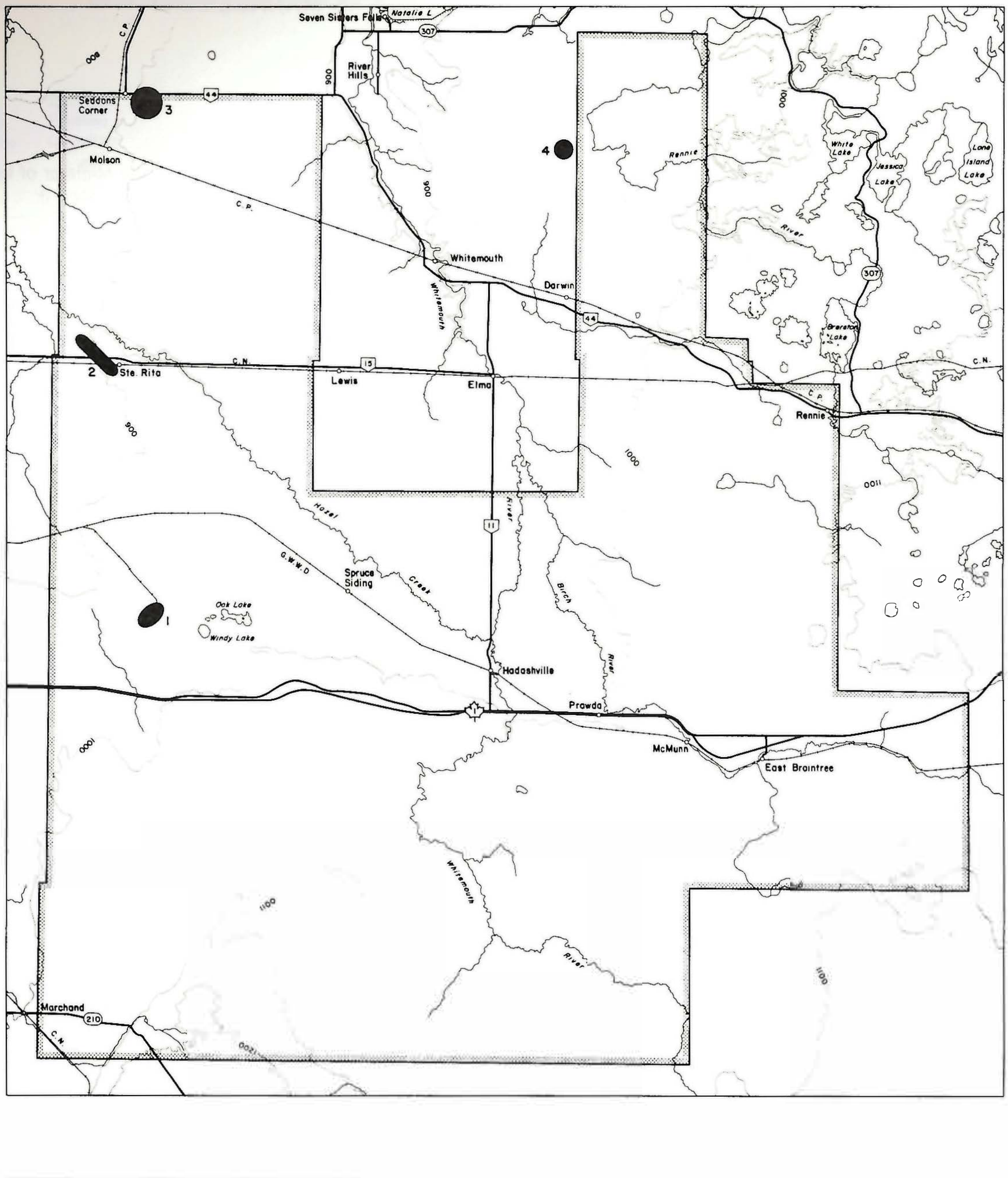
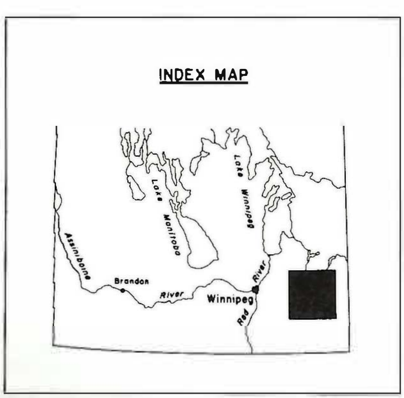


Figure AR-4-1: Generalized stratigraphy of the Milner Ridge-Bedford Hills Moraine, after Matile and Groom (1983).





LOCAL GOVERNMENT DISTRICT OF REYNOLDS

Figure AR-4-2: Index map and major glaciofluvial deposits marking icefront positions.

AR-5 AGGREGATE RESOURCES MANAGEMENT IN MANITOBA

by C.W. Jones

INTRODUCTION

Aggregate resources are an essential commodity required to support present and future construction-related activities in Manitoba. This non-renewable resource, under present engineering technology, has no suitable substitute for most end uses (Table AR-5-1). Aggregate is characterized by a low intrinsic value, high bulk, and a delivered price that is highly sensitive to transportation costs. Because of limited regional supplies, competing surface land uses restricting mineral development, and upgrading of technical requirements for the resource, there is a demonstrated need to manage and conserve Manitoba's aggregate resources.

RESOURCE MANAGEMENT ACTIVITIES

The aggregate resource management program has been designed to facilitate aggregate resource conservation as well as to resolve land-use conflicts and other resource-related issues as they arise. The program based upon Provincial Land Use Policy #13, Manitoba Regulation 217/80 of The Planning Act, is separated into four broad resource management activities: 1) the subdivision review process; 2) background studies, promoting the management of mineral resources, for rural municipal councils and local district planning boards; 3) review of Crown Land Transfers and resource-related issues; and 4) review of District Development Plans, zoning by-laws and amendments to ensure policies do not sterilize valuable, non-renewable aggregate resources. The objectives of mineral resources management are achieved through the legal instruments of land use planning and control of development.

DEVELOPMENT PLANS - ZONING BY-LAWS

A development plan, in general terms, is a planning document which states land use development policies mutually agreed upon by the municipality and the Province in order to resolve land use issues as they arise. Specifically, it contains statements of findings, objectives, and policies with respect to land use matters, proposals for implementation of plans, maps showing permitted land use, and a 5 year capital works program. It is important to emphasize that a development plan is not a static document, as it can be modified to accomodate changing conditions and social values.

Manitoba Energy and Mines provides technical input into this planning process by providing background studies promoting mineral resources management (Fig. AR-5-1). These studies include an economic evaluation of regional supply and demand for aggregate, information concerning land disposition and tenure and, most importantly, resource planning recommendations based upon Provincial Land Use Policy #13. Each study is used by the Rural Municipal Council or the Local District Planning Board as a guide in developing mineral resources management policies, reflected in subsequent zoning by-laws. Under Section 34(2) of The Planning Act, the council must proceed to adopt a zoning by-law to carry out the intent of the development plan. The by-law establishes various land use zones or districts, determines both permitted and conditional uses, and details appropriate development standards and requirements applicable in each land use district.

SUBDIVISION REVIEW PROCESS

A subdivision of land occurs when an existing parcel is divided into 2 or more parts or when an interest in the land is acquired, such as a lease. According to Section 62(1) of The Planning Act, a subdivision of land shall be approved only by resolution given by the council of the municipality. A subdivision must also be approved by the approving authority, which is presently the Minister of Municipal Affairs. A subdivision proposal will only be approved if:

(1) it complies with the objectives and policies contained in the development plan; and

(2) it meets the requirements of all municipal by-laws, regulations outlined in The Planning Act, and other appropriate laws.

Upon receipt of a subdivision application the Manitoba Department of Municipal Affairs solicits comments from concerned government agencies, one of which is Manitoba Energy and Mines (Fig. AR-5-2). Relevant comments are summarized by Manitoba Municipal Affairs and included in a report to both council and the local district planning board where a decision concerning approval or rejection is made. Should it be defeated by council there is no appeal; however, if the concerns expressed by a provincial agency have not been resolved, a forum for resolution is provided through the Provincial Planning Branch.

TABLE AR-5-1: SAND AND GRAVEL END USES IN MANITOBA

Construction Type	End Use
Road Construction	subbase base traffic (surface) gravel shoulders culvert fill maintenance (pit run) ice control
Concrete Aggregate	road surface dams foundations building ready-mix sidewalks pre-cast blocks, tiles mortar grout
Asphalt Aggregate	road surfacing parking lots
Railway Construction	subbase ballast
Fill	sewer and water pipe bedding septic field construction rip-rap dam construction

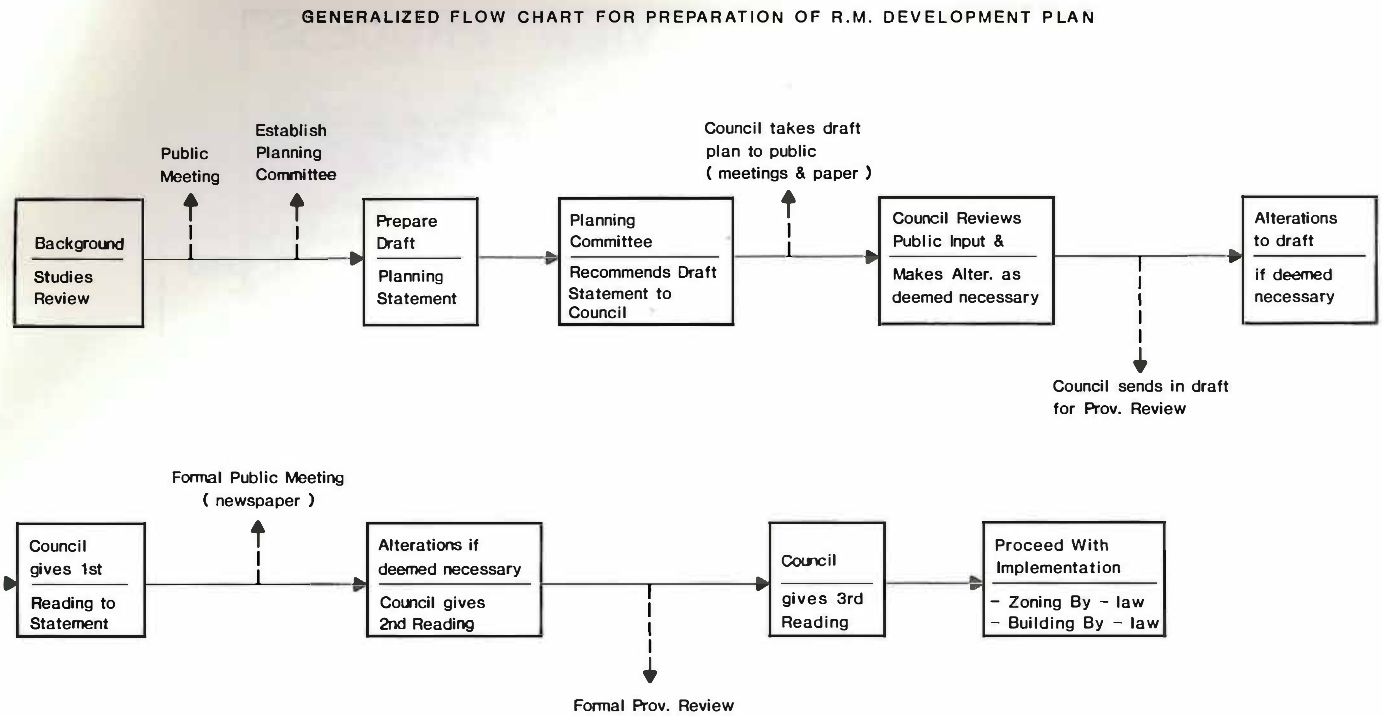


Figure AR-5-1: *Generalized flow chart for preparation of a development plan.*

CROWN LAND ISSUES

The management and administration of Crown land rests with the Departments of Agriculture and of Natural Resources. The principal responsibility for management lies with the Department of Natural Resources, which administers The Crown Lands Act and also oversees the Crown Land Classification Committee (C.L.C.C.). The C.L.C.C. is an interdepartmental group that reports to and receives its direction from the Provincial Land Use Committee of Cabinet. Its responsibilities include planning of Crown land use and review of resource-related issues. The Agriculture Crown Lands Branch has the administrative responsibilities of issuing agricultural leases and permits of occupation, and of designating multiple land uses subject to the specific conditions and covenants required by other resource users.

The aggregate resource management program is actively involved in monitoring Crown surface use clearances and Crown resource related issues in order to 1) minimize conflicts of surface use and 2) protect Crown mineral rights in order to ensure that the resource will be developed (Fig. AR-5-3). Conservation objectives of the resource management program are achieved through this planning process for use of Crown land.

HIGHLIGHTS OF THE YEAR

- Background studies for aggregate resource management were prepared for R.M. of Wallace, R.M. of Miniota, R.M. of Roblin (in prep.), R.M. of Shell River (in prep.), R.M. of Russell (in prep.), Town of Birtle (in prep.).
- Surficial geological mapping and aggregate inventories were initiated for the R.M. of Shell River, R.M. of Roblin, R.M. of Shellmouth, R.M. of South Norfolk, and L.G.D. of Reynolds.
- Approximately 1500 subdivision applications were reviewed in order 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 and resource planning recommendations.
- Review of approximately 2000 Crown Surface Transfers in order to protect Crown Mineral Rights.
- Presentations of background studies including aggregate resource management policies to rural municipal councils and local district planning boards.
- Representation on Local Land Use Committees 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 policies 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.
- Legislative Review for the revision of Quarry Minerals Regulation 226/76.
- Policy Analyses for the recommendations contained within the Weir Report (assessment reform)
- Response to several requests for technical assistance from government agencies, industry, and the public.

SUBDIVISION REVIEW PROCESS

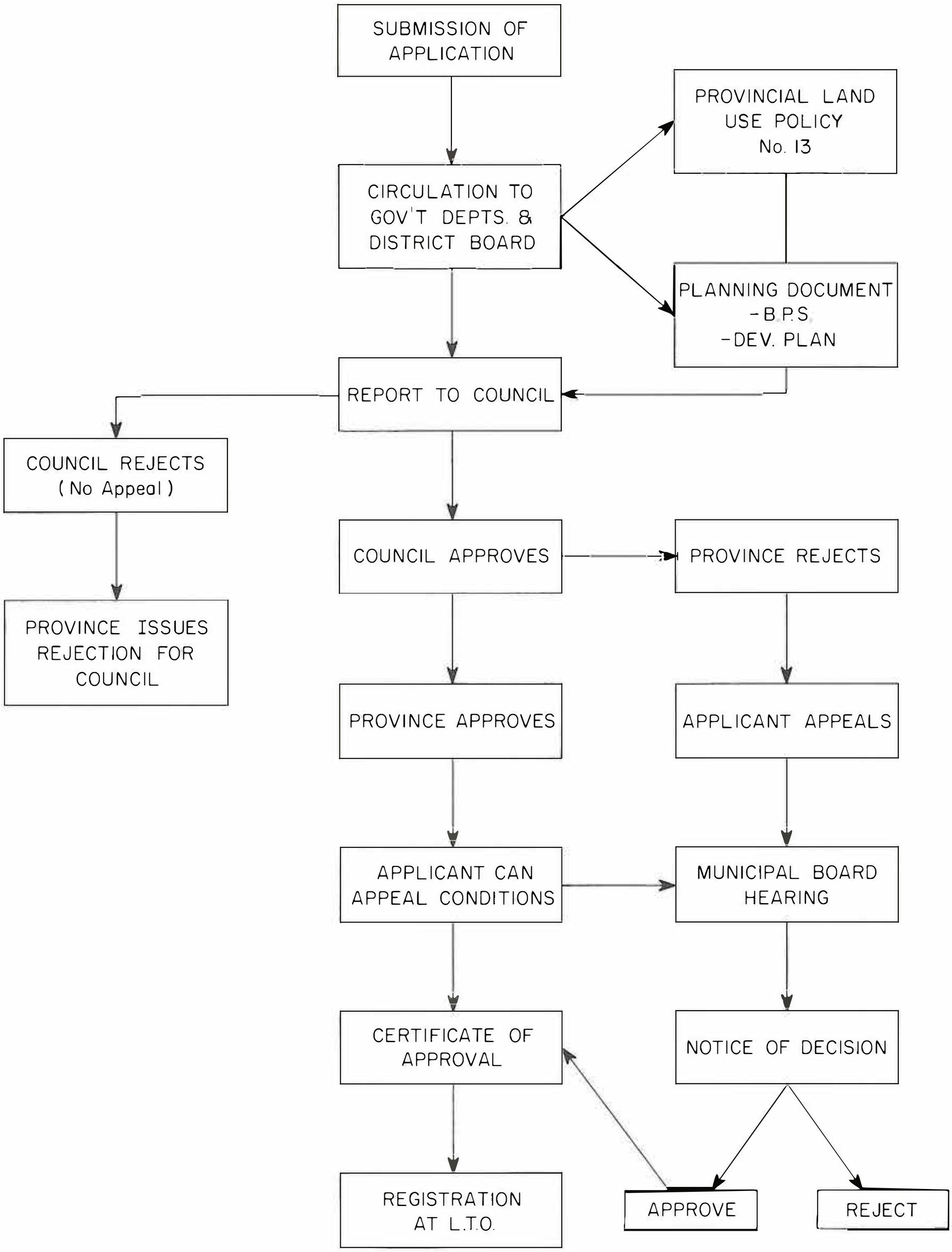


Figure AR-5-2: *Subdivision review process in Manitoba.*

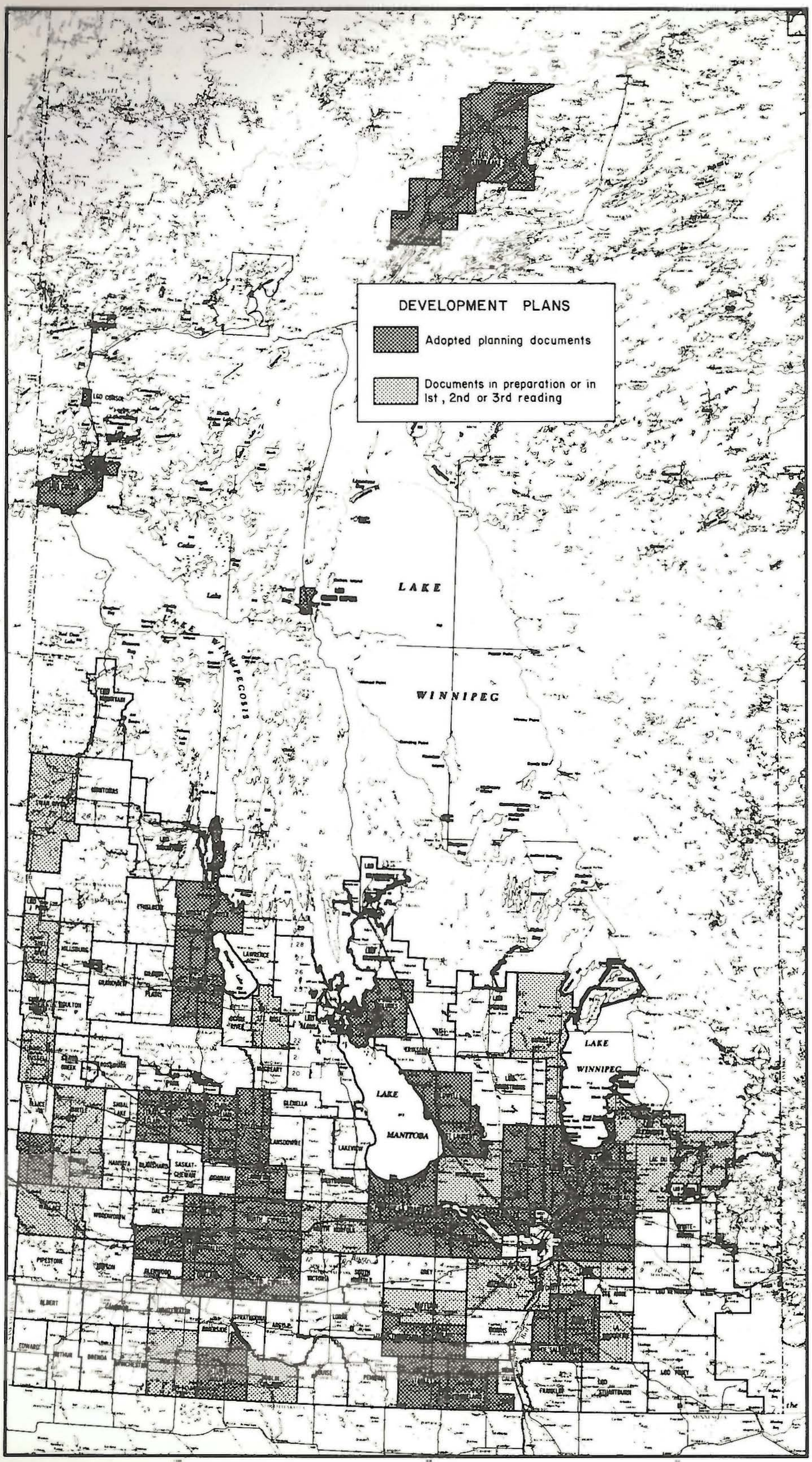


Figure AR-5-3: Aggregate resources management activity in southern Manitoba.

LIST OF PUBLICATIONS RELEASED (November 1984 - November 1985)

NOVEMBER 15, 1984		Price*
Report of Field Activities	Report of Field Activities, 1984; 183 pages; 124 figures and 17 tables - staff, Mineral Resources Division	$ 5.00
Geological Report GR80-3	Quaternary Geology and Gravel Resources of the Island Lake-Red Sucker Lake Area; 24 pages, 10 figures, 3 tables, 13 plates - E. Nielsen	$15.00
Geological Report GR82-2	Systematics and Paleoecology of Upper Ordovician Trilobites from the Selkirk Member of the Red River Formation, Southern Manitoba; 51 pages, 4 figures, 2 tables and 1 plate - S.R. Westrop and R. Ludvigsen, Department of Geology, University of Toronto	$ 5.00
Open File Report OF84-1	Preliminary Results of Biogeochemical Studies in the Lynn Lake Area; 104 pages, 24 figures, 1 table and 5 appendices - M.A.F. Fedikow	$7.00
Open File Report OF84-2	Interpretation of Airborne Magnetic Gradiometer Surveys of the Area South of the Flin Flon-Snow Lake Belt; 26 pages, 2 figures, 1 table and 1 map - I.T. Hosain	$5.00
December, 1984 Aggregate Report AR84-4	Surficial Geology and Aggregate Resource Inventory of the Rural Municipality of Victoria - Underwood McLellan Ltd.	$10.00
JUNE 3, 1985		
Annual Report 1983-84	Annual Report of the Mineral Resources Division of Manitoba Energy and Mines for the Fiscal Year Ending March 31, 1984; 44 pages, 6 figures and 11 tables	NO CHARGE
Geological Report GR83-1A	Geology of the Oxford Lake-Carrot River Area; 73 pages, 69 figures, 8 tables and 4 maps - J.J.M.W. Hubregtse	$20.00
Geological Report GR83-2	Geology of the Saw Lake Area; 47 pages, 27 figures, 9 tables and 1 map - Alan H. Bailes	$25.00
Geological Paper GP84-1	Ultramafic Rocks of the Island Lake Area; 29 pages, 17 figures, 15 plates and 6 tables - P. Theyer	$10.00
Open File Report OF85-1	Radiometric Survey of Southeastern Manitoba; 7 pages and 5 figures - D.M. Watson	$ 5.00
Open File Report OF85-2	Silica Potential of the Libau-Beausejour Area; 10 pages and 2 figures - D.M. Watson	$ 5.00

Aggregate Report AR84-1	Surficial Geology and Aggregate Resource Inventory of the Rural Municipality of Whitemouth - R.V. Young	$ 5.00

SEPTEMBER 20, 1985

Geological Report GR84-1	Geochemistry of Metavolcanic Rocks in the Lynn Lake Belt - E.C. Syme	$12.00
Economic Geology Report ER84-1	Industrial Minerals in Rare-element Pegmatites of Manitoba - B.B. Bannatyne	$12.00
Economic Geology Report ER84-2	Silica in Manitoba - D.M. Watson	$ 5.00
Aggregate Report AR84-2	Surficial Geology and Aggregate Resources of the Fisher Branch Area; Local Government District of Fisher and Rural Municipality of Bifrost - H.D. Groom	$14.00
Map AR84-3	Quaternary Geology of the Gypsumville Area - E. Nielsen and G. Matile	$ 5.00
Map AR84-5	Quaternary Geology Map of the Birds Hill Area - G. Matile	$ .00

SEPTEMBER 20, 1985 - Cont'd.

		Price
Aggregate Report AR85-1	Aggregate Resources in the Rural Municipality of Wallace - P.R. Berk	$10.00
Open File Report OF85-3	Preliminary Results of Till Petrographical and Till Geochemical Studies at Farley Lake - E. Nielsen and D.C. Graham	$ 5.00
Open File Report OF85-6	The Vegetation Geochemical Signature of the Agassiz Stratabound Au-Ag Deposit, Lynn Lake, Manitoba - M.A.F. Fedikow	$ 5.00
Open File Report OF85-9	Canada-Manitoba Mineral Development Agreement 1984-89 Sector 'A' Geoscientific Activities, Progress Report 1984-85	$ 5.00

NOVEMBER 20, 1985

Geological Report GR83-1B	Geology of the Knee Lake-Gods Lake Area - H.P. Gilbert	$20.00
Aggregate Report AR85-4	Surficial Geology and Aggregate Resource Inventory of the Rural Municipality of Shell River - Underwood McLellan Ltd.	$13.00
Open File Report OF85-4	Platinum-Palladium Distribution of Ultra-mafic Rocks in the Bird River Complex, Southeastern Manitoba - P. Theyer	$ 5.00
Open File Report OF85-8	Chromite Reserves of the Bird River Sill - D.M. Watson	$ 5.00

Orders for the above publications may be made to Manitoba Energy and Mines, Geoscience Publications, 555-330 Graham Avenue, Winnipeg, Manitoba R3C 4E3. Orders should be accompanied by cheque or money order made payable to the Minister of Finance of Manitoba.

* Manitoba residents please add 6% Provincial Sales Tax.

LIST OF PRELIMINARY MAPS-1985

Geological Survey

		SCALE
1985B-1	Knight Lake-Wass Lake (53E/11 NW) by K.L. Neale	1:20 000
1985C-1	Cat Creek (part of 52L/12) by J.J. Macek	1:10 000
1985I-1	Wakun Lake (53E/13 NE) by H.P. Gilbert	1:20 000
1985I-2	Ogit Lake (53E/13 NW) by H.P. Gilbert	1:20 000
1985I-3	Loonfoot Island (53E/16 SE) by H.P. Gilbert (Supersedes 1984 I-1)	1:20 000
1985I-4	Meegeesiwaseeson Island (53E/16 SW) by H.P. Gilbert	1:20 000
1985I-5	Wagner Island (63H/16 NE) by H.P. Gilbert	1:20 000
1985K-1	Kisseynew Lake West: Weasel Bay area (63K/13NW) by W.D. McRitchie	1:20 000
1985K-2	Big Island-Yakushavich Island, Kississing Lake (63N/3) by D.C.P. Schledewitz	1:20 000
1985N-1	Northeast Cross Lake (parts of 63-I/11, 14) by J.J. Macek, G. Finnson and G. Liebrecht (Supersedes 1984N-1)	1:50 000
1985N-2	Pipestone Lake (parts of 63-I/5 and 63-I/12) by M.T. Corkery AND H.D.M. Cameron	1:20 000
1985N-3	Detailed map of part of the south shore of Pipestone Lake (part of 63-I/12 SE) by H.D.M. Cameron	1:100
1985R-1	Stormy Lake (part of 52L/14 SW) by and D.J. Owens and D.M. Seneshen	1:10 000
1985T-1	Phillips Lake (parts of 63-0/1, 8) by J.J. Macek	1:20 000

Mineral Investigations

1985-MI-1	Geology of the Tartan Lake area (part of 63K/13) by S. Peloquin	1:5 000
1985-MI-2	Geology of the Evans Lake (Kay Lake) area (part of 63N/2) by S. Peloquin and D. Hayden-Luck	1:5 000

Aggregate Resources

1985-SN	Aggregate resources in The Rural Municipality of South Norfolk (62G/9, 10, 15, 16) by R.V. Young	1:50 000
1985-ROB	Aggregate resources in The Rural Municipality of Roblin (62G/3; part of 62G/6) by P.R. Berk	1:50 000
1985-SM	Aggregate resources in The Rural Municipality of Shellmouth (parts of 62N/3, 4 and 62K/13, 14) by H.D. Groom	1:50 000

LIST OF GEOLOGICAL STAFF AND AREAS OF CURRENT INVOLVEMENT

GEOLOGICAL SERVICES

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-Snow Lake-Reed Lake
	H.D.M. Cameron	Cross Lake and Lynn Lake regions
	M.T. Corkery	Cross Lake-Northern Superior Province, Nelson and Churchill River
	H.P. Gilbert	Island-Stevenson Lakes and Barrington Lake
	P.G. Lenton	Cross Lake-Northern Superior Province - granite and pegmatite
	Dr. J.J. Macek	NE Cross Lake-Phillips Lake; Cat Creek
	D.C.P. Schledewitz	North of 58°; Kississing Lake
	E.C. Syme	Flin Flon, Athapapuskow Lake, Lynn Lake
	Dr. H.V. Zwanzig	Churchill Province/Kisseynew Lynn Lake
Mineralogist	C.R. McGregor	Sub-Paleozoic Precambrian basement
Geological Compiler (Atlas)	J.S.D. 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	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
	D. Parbery	Mineral Deposit Geological Assistant
	P. Stewart	Mineral Deposit Geological Assistant
Industrial Minerals Geologists	W.R. Gunter	Northern Manitoba
	D.M. Watson	Southern Manitoba
	P.H. 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 R.M. of South Norfolk
Quaternary Geologist	G.L.D. Matile	Aggregate inventory L.G.D. of Reynolds
	H.D. Groom	Aggregate inventory R.M. of Shellmouth
	P.R. Berk	Aggregate inventory R.M. of Roblin
Resource Management Geologist	C.W. Jones	Aggregate resources management
Exploration Services:		
Section Head	W.D. Fogwill	Exploration activity in Manitoba
Assessment Geologist	B. Esposito	Assessment files
Special Projects Geologist	P.J. Doyle	Exploration activity, drill core program
Drill Core Geologist	J.K. Filo	Drill core collection/storage
Staff Geophysicist	I.T. Hosain	Regional compilation of assessment data
Information Geologist	J.D. Bamburak	Publications, information
Compilation Geologist	P.D. Leskiw	Indices to Manitoba geoscience data
Mineral Inventory Geologist	D.J. Richardson	Mineral deposit data