THESE TERMS GOVERN YOUR USE OF THIS DOCUMENT

Your use of this Ontario Geological Survey document (the "Content") is governed by the terms set out on this page ("Terms of Use"). By downloading this Content, you (the "User") have accepted, and have agreed to be bound by, the Terms of Use.

Content: This Content is offered by the Province of Ontario's *Ministry of Northern Development and Mines* (MNDM) as a public service, on an "as-is" basis. Recommendations and statements of opinion expressed in the Content are those of the author or authors and are not to be construed as statement of government policy. You are solely responsible for your use of the Content. You should not rely on the Content for legal advice nor as authoritative in your particular circumstances. Users should verify the accuracy and applicability of any Content before acting on it. MNDM does not guarantee, or make any warranty express or implied, that the Content is current, accurate, complete or reliable. MNDM is not responsible for any damage however caused, which results, directly or indirectly, from your use of the Content. MNDM assumes no legal liability or responsibility for the Content whatsoever.

Links to Other Web Sites: This Content may contain links, to Web sites that are not operated by MNDM. Linked Web sites may not be available in French. MNDM neither endorses nor assumes any responsibility for the safety, accuracy or availability of linked Web sites or the information contained on them. The linked Web sites, their operation and content are the responsibility of the person or entity for which they were created or maintained (the "Owner"). Both your use of a linked Web site, and your right to use or reproduce information or materials from a linked Web site, are subject to the terms of use governing that particular Web site. Any comments or inquiries regarding a linked Web site must be directed to its Owner.

Copyright: Canadian and international intellectual property laws protect the Content. Unless otherwise indicated, copyright is held by the Queen's Printer for Ontario.

It is recommended that reference to the Content be made in the following form: <Author's last name>, <Initials> <year of publication>. <Content title>; Ontario Geological Survey, <Content publication series and number>, <total number of pages>p.

Use and Reproduction of Content: The Content may be used and reproduced only in accordance with applicable intellectual property laws. *Non-commercial* use of unsubstantial excerpts of the Content is permitted provided that appropriate credit is given and Crown copyright is acknowledged. Any substantial reproduction of the Content or any *commercial* use of all or part of the Content is prohibited without the prior written permission of MNDM. Substantial reproduction includes the reproduction of any illustration or figure, such as, but not limited to graphs, charts and maps. Commercial use includes commercial distribution of the Content, the reproduction of multiple copies of the Content for any purpose whether or not commercial, use of the Content in commercial publications, and the creation of value-added products using the Content.

Contact:

FOR FURTHER INFORMATION ON	PLEASE CONTACT:	BY TELEPHONE:	BY E-MAIL:
The Reproduction of Content	MNDM Publication Services	Local: (705) 670-5691 Toll Free: 1-888-415-9845, ext. 5691 (inside Canada, United States)	Pubsales@ndm.gov.on.ca
The Purchase of MNDM Publications	MNDM Publication Sales	Local: (705) 670-5691 Toll Free: 1-888-415-9845, ext. 5691 (inside Canada, United States)	Pubsales@ndm.gov.on.ca
Crown Copyright	Queen's Printer	Local: (416) 326-2678 Toll Free: 1-800-668-9938 (inside Canada, United States)	Copyright@gov.on.ca

LES CONDITIONS CI-DESSOUS RÉGISSENT L'UTILISATION DU PRÉSENT DOCUMENT.

Votre utilisation de ce document de la Commission géologique de l'Ontario (le « contenu ») est régie par les conditions décrites sur cette page (« conditions d'utilisation »). En téléchargeant ce contenu, vous (l'« utilisateur ») signifiez que vous avez accepté d'être lié par les présentes conditions d'utilisation.

Contenu : Ce contenu est offert en l'état comme service public par le *ministère du Développement du Nord et des Mines* (MDNM) de la province de l'Ontario. Les recommandations et les opinions exprimées dans le contenu sont celles de l'auteur ou des auteurs et ne doivent pas être interprétées comme des énoncés officiels de politique gouvernementale. Vous êtes entièrement responsable de l'utilisation que vous en faites. Le contenu ne constitue pas une source fiable de conseils juridiques et ne peut en aucun cas faire autorité dans votre situation particulière. Les utilisateurs sont tenus de vérifier l'exactitude et l'applicabilité de tout contenu avant de l'utiliser. Le MDNM n'offre aucune garantie expresse ou implicite relativement à la mise à jour, à l'exactitude, à l'intégralité ou à la fiabilité du contenu. Le MDNM ne peut être tenu responsable de tout dommage, quelle qu'en soit la cause, résultant directement ou indirectement de l'utilisation du contenu. Le MDNM n'assume aucune responsabilité légale de quelque nature que ce soit en ce qui a trait au contenu.

Liens vers d'autres sites Web : Ce contenu peut comporter des liens vers des sites Web qui ne sont pas exploités par le MDNM. Certains de ces sites pourraient ne pas être offerts en français. Le MDNM se dégage de toute responsabilité quant à la sûreté, à l'exactitude ou à la disponibilité des sites Web ainsi reliés ou à l'information qu'ils contiennent. La responsabilité des sites Web ainsi reliés, de leur exploitation et de leur contenu incombe à la personne ou à l'entité pour lesquelles ils ont été créés ou sont entretenus (le « propriétaire »). Votre utilisation de ces sites Web ainsi que votre droit d'utiliser ou de reproduire leur contenu sont assujettis aux conditions d'utilisation propres à chacun de ces sites. Tout commentaire ou toute question concernant l'un de ces sites doivent être adressés au propriétaire du site.

Droits d'auteur : Le contenu est protégé par les lois canadiennes et internationales sur la propriété intellectuelle. Sauf indication contraire, les droits d'auteurs appartiennent à l'Imprimeur de la Reine pour l'Ontario.
Nous recommandons de faire paraître ainsi toute référence au contenu : nom de famille de l'auteur, initiales, année de publication, titre du document, Commission géologique de l'Ontario, série et numéro de publication, nombre de pages.

Utilisation et reproduction du contenu : Le contenu ne peut être utilisé et reproduit qu'en conformité avec les lois sur la propriété intellectuelle applicables. L'utilisation de courts extraits du contenu à des fins *non commerciales* est autorisé, à condition de faire une mention de source appropriée reconnaissant les droits d'auteurs de la Couronne. Toute reproduction importante du contenu ou toute utilisation, en tout ou en partie, du contenu à des fins *commerciales* est interdite sans l'autorisation écrite préalable du MDNM. Une reproduction jugée importante comprend la reproduction de toute illustration ou figure comme les graphiques, les diagrammes, les cartes, etc. L'utilisation commerciale comprend la distribution du contenu à des fins commerciales, la reproduction de copies multiples du contenu à des fins commerciales ou non, l'utilisation du contenu dans des publications commerciales et la création de produits à valeur ajoutée à l'aide du contenu.

Renseignements :

POUR PLUS DE RENSEIGNEMENTS SUR	VEUILLEZ VOUS ADRESSER À :	PAR TÉLÉPHONE :	PAR COURRIEL :
la reproduction du contenu	Services de publication du MDNM	Local : (705) 670-5691 Numéro sans frais : 1 888 415-9845, poste 5691 (au Canada et aux États-Unis)	Pubsales@ndm.gov.on.ca
l'achat des publications du MDNM	Vente de publications du MDNM	Local : (705) 670-5691 Numéro sans frais : 1 888 415-9845, poste 5691 (au Canada et aux États-Unis)	Pubsales@ndm.gov.on.ca
les droits d'auteurs de la Couronne	Imprimeur de la Reine	Local : 416 326-2678 Numéro sans frais : 1 800 668-9938 (au Canada et aux États-Unis)	Copyright@gov.on.ca

Ontario
Division of Mines

HONOURABLE LEO BERNIER, *Minister of Natural Resources*

Dr. J. K. REYNOLDS, *Deputy Minister of Natural Resources*

G. A. Jewett, Executive Director, Division of Mines *E. G. Pye, Director, Geological Branch*

Geology of the
Lower Manitou–Uphill Lakes Area
District of Kenora

By

C. E. Blackburn

Geoscience Report 142

TORONTO
1976

Publications of the Ontario Division of Mines
and price list
are obtainable through the
Ontario Ministry of Natural Resources, Map Unit, Public Service Centre,
Parliament Buildings, Queen's Park, Toronto, Ontario
and
The Ontario Government Bookstore
880 Bay Street, Toronto, Ontario.

Orders for publications should be accompanied by cheque,
or money order, payable to Treasurer of Ontario.

Parts of this publication may be quoted if credit is given to the Ontario Division of Mines. It is recommended that reference to this report be made in the following form:

Blackburn, C.E.
1976: Geology of the Lower Manitou–Uphill Lakes Area, District of Kenora; Ontario Div. Mines, GR142, 81p. Accompanied by Map 2320, scale 1 inch to ½ mile.

1000-300-76-Car.

CONTENTS

TABLES

FIGURES

PHOTOGRAPHS

GEOLOGICAL MAP

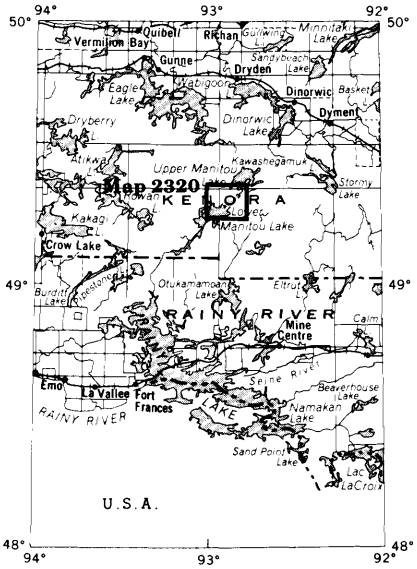
(back pocket)

CHART

(back pocket)

ABSTRACT

The Lower Manitou-Uphill Lakes area lies between Latitudes 49°15′N and 49°22′30″N and Longitudes 92°45′W and 93°00′W, and covers 98 square miles (254km²). Lower Manitou Lake is about 36 miles (58km) south of Dryden.



SMC 13261

Figure 1–Key map showing location of the Lower Manitou-Uphill Lakes area. Scale: 1 inch to 50 miles (1:3,168,000).

Bedrock is predominantly of Early Precambrian (Archean) age, and consists of thick metavolcanic and metasedimentary sequences intruded by mafic sills and lamprophyre dikes, felsic porphyry dikes, the granitic Scattergood Lake and Carleton Lake Stocks, and granitic rocks of the Atikwa Batholith. The Manitou Straits Fault diagonally crosses the area from southwest to northeast along the Manitou Straits and the volcanic-sedimentary successions on either side of the fault differ substantially in detail. The northwestern succession is folded into a regional northeast-trending anticline, and comprises about 12,000 feet (3660m) of pillowed and porphyritic mafic flows, and intermediate, predominantly medium-grained, pyroclastic rocks, the ratio of flows to pyroclastics being about 2:1. The lower part of the sequence is mostly composed of mafic flows, and the upper part of a mixed, mafic flow-intermediate pyroclastic assemblage. The southeastern sequence, which may be as much as 25,000 feet (7600m) thick, is for the most part homoclinal and facing northwest, and is composed of massive and pillowed mafic flows, intermediate, predominantly coarse-grained, pyroclastic rocks, and metasediments in the approximate ratio of 5:2:1. The metasediments occur both as an intravolcanic series of fine-grained clastic and chemical metasediments interbedded with thick, mafic flows of the

lower part of the sequence and as a supravolcanic series of fine- to coarse-grained turbidites overlying an upper, thick, intermediate pyroclastic unit at the top of the volcanic sequence. The latter pyroclastic-epiclastic assemblage constitutes the Manitou "Series" mapped by Thomson in 1932.

Hypabyssal mafic sills composed of hornblende-plagioclase porphyry, and lamprophyre dikes intrude the upper, thick, pyroclastic unit of the southeastern volcanic-sedimentary sequence. Felsic porphyry dikes and stock-like lenses intrude all levels of the volcanic-sedimentary pile, but in particular the lower, mafic part of the northwestern sequence, and the upper, predominantly pyroclastic-sedimentary part of the southeastern sequence.

Syntectonic granodioritic and quartz monozonitic plutonic rocks of the Atikwa Batholith intrude the northwestern volcanic-sedimentary sequence, and are responsible for hybridisation and migmatization of mafic metavolcanics along the contact zone, and for amphibolite facies metamorphism within the metavolcanic rocks up to 3 miles (5km) from the contact. Two post-tectonic stocks, the Carleton Lake Stock and the Scattergood Lake Stock, composed of predominantly porphyritic quartz monzonite and granodiorite intrude the volcanic-sedimentary sequences.

A northwest-trending diabase dike of probable Middle to Late Precambrian (Proterozoic) age intrudes the southeastern, mafic flow series.

During the Pleistocene Epoch, ice from the northeast advanced over and scoured peneplaned Precambrian rocks.

Numerous old gold-prospects and occurrences within the metavolcanic-metasedimentary belt are small and are mostly associated with discontinuous quartz veins which seem to occur preferentially in mafic flows toward the base of the volcanic sequences. Exploration activity in recent years has been in the form of airborne and ground geophysical surveys directed toward the detection and location of electromagnetic conductors characteristic of massive, base-metal sulphide deposits. Molybdenite in quartz and quartzose pegmatite veins occurs within granitic rocks of the Atikwa Batholith close to the contact of the batholith with the metavolcanic-metasedimentary belt.

Geology

of the

Lower Manitou—Uphill Lakes Area

District of Kenora

By

C. E. Blackburn[1]

INTRODUCTION

The Lower Manitou-Uphill Lakes area lies between Latitudes 49°15'N and 49°22' 30"N and Longitudes 92°45'W and 93°00'W, in the District of Kenora. The area covers 98 square miles (254km^2), being 11.3 miles (18.2km) wide by 8.6 miles (13.9km) long. Lower Manitou Lake is about 36 miles (58km) south of Dryden, the nearest town, situated on the Trans-Canada Highway.

Lower Manitou Lake, and Upper Manitou Lake which lies north of the map-area, were the scene of considerable gold prospecting and mining activity during the period 1895 to 1912, and again in the 1930s (Thomson 1933). A number of gold mines were active at the northeast end of Upper Manitou Lake, and gave rise to the town of Gold Rock, now little more than a ghost town. During its heyday, Gold Rock was a thriving centre and the Manitou Lakes (i.e. Manitou Stretch, Lower Manitou Lake, Manitou Straits, and Upper Manitou Lake) were the scene of considerable traffic. A regular steamer service ran the full length of the lakes twice daily. Within the present map-area a half dozen or so prospects were brought close to production, but only one, the Twentieth Century mine, actually produced a significant amount of gold. During the short period of 1902-1903, 8,688 tons of ore were milled at the Twentieth Century mine, to a total value of $43,586 (Ferguson *et al.* 1971, p.168-169); the mine was defunct by 1904.

No further mineral production has been reported from the map-area to date. During the 1960s attention turned to geophysical methods of exploration for base metals, and the Manitou Lakes have received some attention by a few companies in this regard. Prior to the 1972 field season the most up-to-date geological map of the Manitou Lakes was that of Thomson (1933), who surveyed an area of approximately 500 square miles (1300km^2) during the summer of 1932.

---

[1] Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines; manuscript approved for publication by the Chief Geologist, 8 May, 1974.

Present Geological Survey

The present geological survey was carried out by the author and his assistants during the summer of 1972. Preliminary Map P.816 was issued in 1973 (Blackburn 1973a). The field maps were prepared at a scale of 1 inch to ¼ mile (1:15,840), on a base map prepared by the Cartography Section of the Ontario Division of Lands from maps of their Forestry Resources Inventory. Field data were plotted on acetate overlays on vertical air photographs at the same scale as the base map. Outcrops were examined along lake shores and pace-and-compass traverse lines run at approximately right angles to strike of the formations. At a few places geological boundaries were traced directly in the field by walking along them. The traverse interval was of the order of ¼ mile (0.4km) in those parts of the area underlain by metavolcanics and metasediments, but widened to ½ mile (0.8km) where granitic rocks were encountered.

As a result of abundant rock outcrop and the fixed traverse grid, photo-interpretation played an important part in the preparation of the field map and subsequent preliminary map. Large areas of outcrop have been generalized to include areas where rock outcrop is prevalent, and may include many small rock outcrops. Topographic linears and the traces of faults have been interpreted with the aid of air photos at scales of 1 inch to ¼ mile (1:15,840) and 1 inch to 1 mile (1:63,360).

Acknowledgments

The author was ably assisted in the field by senior assistant Wanis Khouri, and junior assistants G.F.L. Newton, R.L. McKellar, and David Brace. Mr. Khouri and Mr. Newton carried out independent mapping throughout the summer and each mapped about one-third of the map-area. Thanks are due to Ted Davis of Camp Beaverhead, and Ed Pilkey of Dryden for many courtesies and hospitality extended to the field party throughout the field season.

Discussions with P.R. Teal, graduate student at McMaster University, Hamilton, who was conducting independent field work in the Manitou Lakes area in preparation for a Ph.D. thesis on the sedimentary rocks of the Manitou "Series", were particularly helpful.

Access

Lower Manitou Lake is part of a 35 mile (55km) chain of interconnected lakes and waterways, including Esox Lake and Manitou Stretch to the southwest, and Manitou Straits and Upper Manitou Lake to the northeast.

No public roads enter the map-area. The Manitou Lakes may, however, be reached at two points from Dryden via a public road and 20 miles (30km) of lumber road. One road, the last ½ mile (0.8km) of which is passable only by four-wheel-drive vehicle, terminates at Jonas Lake, which connects with the north end of Upper Manitou Lake. The second road, the last 2 miles (3km) of which are passable only by four-wheel-drive vehicle, reaches the shore of Upper Manitou Lake near Johnar Lake.

An old 7-mile (11km) road connecting Gold Rock, at the northeast end of Upper

Manitou Lake, with Dinorwic Lake and the settlement of Dinorwic via Minnehaha Lake, is reportedly in very poor condition, and probably impassable except in winter.

From the southwest, Manitou Stretch may be reached from Fort Frances via Rainy Lake and a 12-mile (19km) bush road.

Within the map-area, short portages connect Lower Manitou Lake and Manitou Straits with Upper Manitou Lake, Kaminni Lake, Doyle Lake, Troutlet Lake, Uphill Lake, Cane Lake, and Etta and Knowles Lakes, and Carleton Lake with Upper Manitou Lake. A partly over-grown lumber road, suitable for winter use only, connects Kaminni and Merrill Lakes.

Previous Geological Work

The first notable geological survey of the Manitou Lakes region was undertaken by William McInnes (1896; 1897; 1898) of the Geological Survey of Canada. McInnes' map (1902) shows that considerable work was done within the present map-area.

Geologists and inspectors of the then Ontario Bureau of Mines made short visits to mines and prospects of the Manitou Lakes region during the period from about 1895 to 1912, when an active "gold rush" was in progress. A.P. Coleman (1894) and A.L. Parsons (1911; 1912), in the course of inspections for the Bureau, made pertinent geological observations during this period. E.L. Bruce (1925) reported on mining developments in 1925, and on his own geological field observations in the Manitou Lakes area.

The second geological survey covering the Lower Manitou-Uphill Lakes area was made in 1932 by Thomson (1933). At that time an intensive search for gold deposits was being made in the vicinities of former gold discoveries, and the Manitou Lakes were receiving some new attention. In 1933, Thomson (1934) mapped the Straw-Manitou Lakes area to the southwest of the present map-area, and revised some of the geological interpretations he had made the previous summer.

In 1936, F.J. Pettijohn (1937), in the course of studies on Archean sedimentation, carried out geological mapping within the present map-area at Mosher Bay and Uphill Lake.

During the 1963 and 1964 field seasons, A.M. Goodwin (1965; 1970) carried out stratigraphic studies, allied with systematic sampling of metavolcanic units, over the Lake of the Woods-Manitou Lakes-Wabigoon region.

Topography and Drainage

Topography of the Manitou Lakes area is typical of much of the Canadian Shield. The peneplaned surface is dotted with many lakes joined by short rivers and streams. Rock outcrop is plentiful, there being few swamps or muskegs.

The shape and general pattern of the majority of lakes has been controlled by the bedrock and structure. In areas where bedrock is massive, with little or no schistosity, lakes are irregular in shape (e.g. Kaminni Lake, Ponto Lake). However, jointing is often conspicuous in such massive rocks, and prominent linears associated with jointing have controlled the shapes of some lakes (e.g., Beck Lake and the lake immediately east of it). Prominent shearing of metavolcanics and metasediments in the central parts of the map-area has been largely responsible for the myriad islands, bays, and channels of the Manitou Straits. Many of the islands and shorelines are oriented in northeasterly direction, parallel to regional foliation. Also evident is a more northerly trend to shorelines, associated with a similar joint and fault pattern (e.g., Holcroft Lake and a pronounced valley at the northeast end of Beaverhead Island). This pattern has probably been responsible for northeasterly trending trains of islands, as seen for example between Manitou Island and Shaughnessy Bay.

Other lakes owe their shape to local geologic features. Blanchard Lake, with its comparatively smooth shoreline, is shallow and underlain by glacial sands. Carleton Lake is eroded in a small granitic stock: its shorelines are steep and rocky, suggesting that it is quite deep. Uphill Lake is located over the contact between metavolcanics and a granitic stock.

The main drainage system flows in a southwesterly direction, that is to say, by way of the Manitou Stretch, Esox Lake and the Manitou River into Rainy Lake. Within the map-area all drainage is into this system. All water flowing from Upper Manitou Lake into the system passes through a narrow channel with a consequent swift current on Manitou Straits, in the northeast part of the map-area. A quite spectacular waterfall, Watson's Falls, occurs on Scattergood Creek where Cane Lake flows into Manitou Straits.

GENERAL GEOLOGY

Isotopic ages obtained by various workers in the southern part of the Kenora District, and the adjacent Rainy River District (Goldich *et al.* 1961, p.69-70; Hart and Davis 1969; Wanless 1970) indicate bedrock to be of Early Precambrian age, except for younger northwest-trending diabase dikes (Fahrig and Wanless 1963; Wanless 1970) of Middle to Late Precambrian age. By analogy with isotopic dates from surrounding localities, bedrock within the Lower Manitou-Uphill Lakes area, apart from a diabase dike of younger age, is considered to be of Early Precambrian age.

The map-area lies at the southwest end of the Manitou Lakes-Stormy Lake metavolcanic-metasedimentary belt, an arcuate structure some 12 miles (19km) wide and 50 miles (80km) long, extending from Lower Manitou Lake on the west to Bending Lake on the east, and tapering at either end. To the north, the belt joins with metavolcanics that extend northward toward Dryden, and to the southwest with metavolcanics that extend through Esox and Pipestone Lakes. The Manitou-Stormy Lakes area (Thomson 1933) is characterized by a thick volcanic sequence consisting of mafic to felsic, flow and pyroclastic rocks, and minor volcaniclastic rocks, and a sedimentary sequence, part of the Manitou "Series" of Thomson; both sequences were intruded by mafic and felsic igneous rocks of batholithic, stock- and sill-like form.

Thomson (1933) postulated that the Manitou "Series" lay above the metavolcanics, and thereby implied the presence of a major syncline along the central axis of the belt. Goodwin (1965; 1970), on the basis of a limited number of top determinations, interpolated syncline-anticline couples flanking Thomson's major syncline on both sides. These have been incorporated in the Kenora-Fort Frances Sheet (Davies and Pryslak 1967, Map 2115).

Proof of existence of Thomson's central synclinal axis within the present map-area is complicated by a major fault zone, the Manitou Straits Fault, which crosses the map-area from northeast to southwest. Tops are opposing across the Manitou Straits Fault,

Table 1 TABLE OF LITHOLOGIC UNITS FOR THE LOWER MANITOU-UPHILL LAKES AREA

CENOZOIC
QUATERNARY
PLEISTOCENE AND RECENT
Sand, gravel, boulders

Unconformity

PRECAMBRIAN
MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)
MAFIC INTRUSIVE ROCKS
Diabase dikes

Intrusive Contact

EARLY PRECAMBRIAN (ARCHEAN)
FELSIC INTRUSIVE ROCKS
FELSIC PLUTONIC ROCKS[a]
Equigranular and porphyritic quartz monzonite and granodiorite

FELSIC HYPABYSSAL ROCKS[a]
Quartz porphyry, quartz-feldspar porphyry; felsite; granite; feldspar-biotite porphyry

Intrusive Contact

MAFIC INTRUSIVE ROCKS[a]
Hornblende-plagioclase porphyry, with amygdaloidal phases; lamprophyre

Intrusive Contact

METASEDIMENTS
Volcanic-clast, pebble and boulder conglomerate; polymictic conglomerate with volcanic, granitic, chert, and magnetite clasts; sandstone; siltstone, argillite, slaty argillite; chert; magnetite iron formation; sericite schist

Conformable and Unconformable Contacts

METAVOLCANICS
INTERMEDIATE TO FELSIC METAVOLCANICS
Intermediate lithic-crystal tuff, lapilli-tuff, and monolithologic and heterolithologic tuff-breccia; felsic tuff and (or) dacitic to rhyolitic flows, lapilli-tuff, and tuff-breccia; quartz-feldspar-biotite schist and gneiss; sericite-chlorite schist

MAFIC METAVOLCANICS
Medium- to fine-grained basalt; gabbro; pillowed basalt; porphyritic basalt; pillowed porphyritic basalt; breccia; porphyritic gabbro; amphibolite; amphibolitic migmatite; biotite-amphibolite migmatite; diorite, quartz diorite; chlorite schist.

---

[a] Rocks grouped under these headings are not necessarily all the same age.

but it is not known how much movement has occurred on the fault. Stratigraphic sequences on either side of the fault differ markedly: this may be explained either by facies change from one limb of a fold to the other, or by profound movement along the fault, juxtaposing two very dissimilar sequences that may not have occupied opposing limbs of one fold prior to faulting. On the basis of top determinations north of the map-area, Goodwin (1965) interpreted an anticline to lie beneath Upper Manitou Lake (referred to as the Manitou Anticline in Goodwin 1970, Table 2). This is shown extending southwestward into the present map-area (Figure 2, Chart A, back pocket) on the basis of repetition of stratigraphy on either side of the axial plane trace. The positioning of this axis within the present map-area is further discussed in the sections "Structural Geology" and "Stratigraphic Synthesis of Precambrian Rocks".

Successions on either side of the Manitou Straits Fault differ substantially (see Figure 8), though both show a general evolutionary trend from older, predominantly mafic metavolcanics to younger, predominantly pyroclastic rocks of intermediate to felsic composition. The southeastern sequence is characterized by metasediments appearing at two levels, an earlier one within the mafic metavolcanics, and an upper one above the pyroclastic sequence.

Felsic dikes were probably emplaced prior to major regional deformation. Two granitic stocks intruded the metavolcanic-metasedimentary sequence, possibly later than the emplacement of the granitic rocks and development of migmatites which form part of the Atikwa Batholith (Davies 1973). Deformation of the volcanic-sedimentary pile and metamorphism under greenschist to amphibolite facies (Turner 1968) conditions accompanied these major plutonic events.

Intrusion of a diabase dike postdated major deformation, and is probably related to a northwest-trending dike swarm cross-cutting Early Precambrian rocks throughout the Kenora District (Davies and Pryslak 1967; Fahrig and Wanless 1963).

During the Pleistocene Epoch glacial ice advanced over the peneplaned Precambrian rocks; ground moraine was deposited by the receding glaciers (Zoltai 1961; 1965).

Rock sequences discussed under the headings "Metavolcanics" and "Metasediments" have been assigned names taken from local geographic features, such as lakes, bays and straits. These are not formally defined formations, and equivalents may occur on opposite limbs of the Manitou Anticline (see "Stratigraphic Synthesis of Precambrian Rocks"). Rock-type designations are given according to the dominant lithologies within each sequence. A summary of the areal distribution of these sequences is presented in Figure 2.

Early Precambrian

METAVOLCANICS

The metavolcanic-metasedimentary belt is composed mostly of metavolcanics which exhibit a wide range in chemistry, mineralogy, structure, and texture. Metamorphism and deformation of the metavolcanics vary in grade and intensity within the map-area, in many places obscuring original textures and mineralogy. It is, however, possible to subdivide the metavolcanics into broad categories based on a combination of texture, structure, and mineralogy. Textural and structural criteria were used to assign rocks to either flow or pyroclastic categories, while a combination of such factors as colour of the fresh surface, colour index, hardness, weathering colour, and visible quartz content were used to assign metavolcanics to mafic, intermediate, or felsic categories.

Ideally, a colour index would be used: mafic rocks are defined as melanocratic rocks with more than 35 percent mafic minerals; intermediate rocks as mesocratic rocks with 15 to 35 percent mafic minerals; and felsic rocks as leucocratic rocks with less than 15 percent mafic minerals. In practice it is frequently found difficult to assess mafic mineral content, especially in fine-grained rocks. Colour on the fresh surface is strongly dependent on metamorphic grade, particularly in intermediate and mafic rocks, where development of chlorite, amphibole, and epidote in various proportions can produce all shades of greens and greys in rocks of similar chemical composition. The presence of visible quartz, suggesting intermediate to felsic types, is not always found to be strictly applicable, because grains of quartz are occasionally found in basaltic rocks. For pyroclastic rocks composed of mixed volcanic rock types, and also various matrix compositions, the overall colour index estimated by inspection of clasts and matrix was used to categorise the rock.

During field mapping it became evident that most of the metavolcanics could be classified as either mafic (colour index greater than 35) flow rocks, or intermediate to felsic (colour index less than 35 ranging to less than 15) pyroclastic rocks. Partial and complete chemical analyses (Tables 2, 3, and 4; Figure 3, Chart A, back pocket; Figure 4) of selected metavolcanic rocks from the map-area reveal a range in composition from basalt to dacite or rhyolite, and substantiate the field subdivision of these rocks into two broad categories. Felsic metavolcanics were distinguishable from intermediate metavolcanics in the field, but they constitute a minor portion of the volcanic pile and for mapping purposes they were grouped with the intermediate metavolcanics.

Samples A to G were chosen for whole-rock chemical analysis (Table 2; Figure 4) as being representative of the majority of flow and pyroclastic rocks throughout the map-area. Of these, samples A to E are from mafic flows, while F and G are from intermediate tuffs. According to the classification of Irvine and Baragar (1971), samples A to E are all tholeiitic and "common" with respect to potash content (Figure 4). Sample F, though classified on field and thin-section evidence (see "Beaverhead Island Pyroclastics") as being intermediate, bears affinity with calc-alkaline, "common" basalts, according to Irvine and Baragar's classification. Sample G, also an intermediate rock on field and thin-section evidence, bears affinity with calc-alkaline, "common" andesites. All samples are subalkaline (Figure 4a).

Mafic Metavolcanics

Rocks assigned to this broad class of metavolcanics make up more than half of the volcanic-sedimentary pile (see Figures 2 and 8). Northwest of the Manitou Straits Fault the ratio of mafic to intermediate and felsic metavolcanics is 2:1; southeast of the fault the ratio of mafic metavolcanics to intermediate metavolcanics to metasediments is approximately 5:2:1.

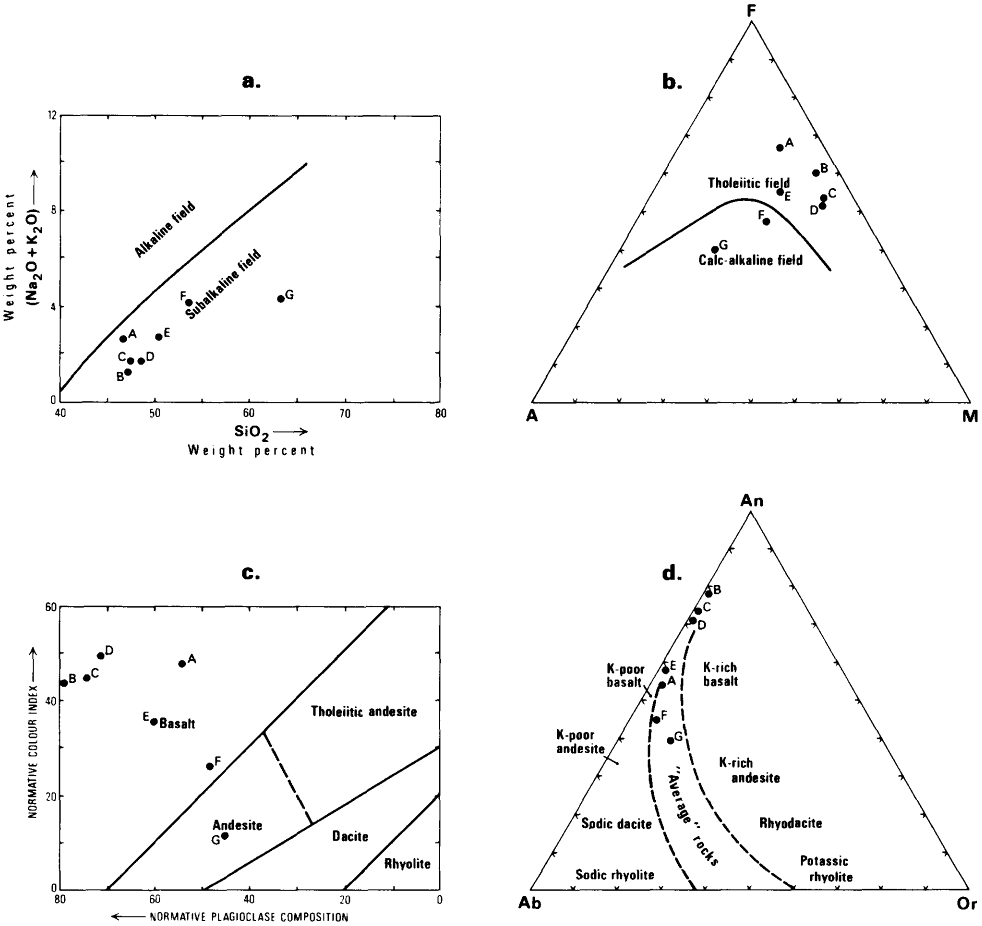
The majority of mafic metavolcanics are flow rocks, though certain breccias may be of flow (autoclastic) or pyroclastic origin. Structure, texture, and mineralogy vary considerably, depending on the amount of deformation, grade of metamorphism, and chemical composition. In general, the metamorphic rank of the metavolcanics varies in relation

Table 2

CHEMICAL ANALYSES AND MOLECULAR (CATION) NORMS OF SELECTED METAVOLCANICS FROM THE LOWER MANITOU-UPHILL LAKES AREA. MAJOR ELEMENTS ARE GIVEN IN WEIGHT PERCENT, TRACE ELEMENTS IN PARTS PER MILLION. THE SAMPLE LOCATIONS ARE SHOWN ON FIGURE 3 AND THE CHEMICAL CLASSIFICATION ON FIGURE 4. ANALYSES BY THE MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

MAJOR ELEMENTS	A	B	C	D	E	F	G
SiO_2	46.80	47.20	47.50	48.30	50.50	53.80	63.20
Al_2O_3	13.60	15.00	15.90	15.10	16.20	15.80	15.80
Fe_2O_3	5.60	3.40	2.88	2.33	2.71	1.69	1.76
FeO	11.60	8.73	8.11	8.70	7.82	6.12	3.05
MgO	6.03	6.80	7.95	8.48	5.20	4.89	2.50
CaO	8.43	10.00	11.10	11.80	10.00	5.90	5.02
Na_2O	2.40	1.10	1.45	1.53	2.48	3.24	3.15
K_2O	0.27	0.05	0.05	0.10	0.18	0.63	1.21
TiO_2	2.31	0.94	0.88	0.68	0.86	0.62	0.66
P_2O_5	0.14	0.08	0.15	0.08	0.07	0.15	0.22
S	0.08	0.03	0.08	0.06	0.19	<.01	<.01
MnO	0.24	0.19	0.18	0.20	0.18	0.11	0.09
CO_2	0.63	1.77	0.13	0.13	0.20	2.96	0.63
H_2O^+	2.63	4.02	2.93	1.82	2.03	3.47	2.01
H_2O^-	0.21	0.23	0.21	0.20	0.14	0.26	0.23
Total	101.00	99.50	99.50	99.50	98.80	99.60	99.50
TRACE ELEMENTS							
Ag	<1	<1	<1	<1	1	<1	<1
As	15	3	<3	6	<3	3	3
Ba	<150	<150	<150	<150	<150	260	320
Be	<3	<3	<3	<3	<3	<3	<3
Co	60	50	50	50	50	30	15
Cr	15	180	400	450	550	230	65
Cu	260	150	130	180	140	10	45
Ga	25	20	20	20	20	20	15
Li	6	6	8	6	10	10	10
Mo	<10	<10	<10	<10	<10	<10	<10
Ni	50	95	150	150	110	85	25
Pb	<10	<10	<10	<10	<10	<10	10
Sb	<1	3	<1	<1	<1	3	<1
Sc	50	40	35	35	40	25	15
Sn	<10	<10	<10	<10	<10	<10	<10
Sr	250	450	300	150	400	250	1000
V	800	320	320	300	400	150	120
Y	40	25	20	20	20	25	<20
Zn	100	95	80	85	80	50	80
Zr	160	80	75	55	70	160	220
MOLECULAR NORMS							
Apatite	0.310	0.183	0.329	0.173	0.154	0.338	0.482
Pyrrhotite	0.294	0.114	0.291	0.215	0.692	0.037	0.036
Ilmenite	3.407	1.431	1.286	0.979	1.256	0.930	0.962
Orthoclase	1.691	0.323	0.310	0.611	1.116	4.013	7.485
Albite	22.814	10.791	13.651	14.202	23.347	31.329	29.578
Anorthite	27.048	39.177	38.525	35.201	34.130	28.772	24.546
Corundum	0.000	0.000	0.000	0.000	0.000	0.000	0.809
Enstatite	14.168	16.987	18.069	17.516	10.832	14.103	7.218
Ferrosilite	12.504	10.899	8.535	8.459	7.051	7.907	2.809
Quartz	0.528	5.698	1.764	0.377	4.805	9.267	24.151
Diopside	6.915	7.052	9.891	13.375	8.442	0.872	0.000
Chromite	0.000	0.032	0.067	0.075	0.093	0.040	0.000
Magnetite	4.218	2.788	2.609	2.356	2.587	1.903	1.924
Hematite	6.103	4.525	4.672	6.460	5.495	0.489	0.000

SAMPLE	ROCK TYPE	LOCATION	ODM SAMPLE NUMBER
A	Basalt	Cane Lake	72-N-203
B	Basalt	Doyle Bay	72-B-101
C	Basalt	Beaverhead Island	72-K-17
D	Basalt	1¼ miles (2km) SE of Beck Lake	72-N-193
E	Basalt	Beck Lake	72-N-162
F	"Mafic" tuff	Manitou Straits	72-B-250
G	Intermediate tuff	Beaverhead Island	72-B-6



SMC 13154

Figure 4–Chemical classification (after Irvine and Baragar 1971) of selected metavolcanics from the Lower Manitou-Uphill Lakes area. Sample numbers refer to Table 2.

a) Alkalies versus silica plot, separating alkaline from subalkaline compositions.

b) AFM plot, separating tholeiitic from calc-alkaline compositions, A = weight percent $Na_2O + K_2O$; F = weight percent $FeO + 0.8998\ Fe_2O_3$; M = weight percent MgO.

c) Classification of subalkaline rocks on plot of normative colour index versus normative plagioclase composition. Colour index = normative diopside + enstatite + ferrosilite + magnetite + hematite + ilmenite; normative plagioclase composition = 100 anorthite/(anorthite + albite).

d) Normative anorthite — albite — orthoclase plot for subalkaline rock suites.

ODM9318

Photo 1–Strongly sheared pillow lavas of amphibolite metamorphic facies grade; southeast shore of Merrill Lake.

to the distance from the Atikwa Batholith in the northwest part of the map-area, and the distance from the granitic rocks of the Entwine Dome (Goodwin 1965) in the southeast. Thus, amphibolitic metavolcanics occur in the outer parts of the metavolcanic-metasedimentary belt, and greenschist facies metavolcanics dominate the interior of the belt. Locally, shearing has produced retrograde metamorphism of the metavolcanics resulting in more chlorite-rich assemblages.

MERRILL LAKE BASALTS

Metamorphism and attendant deformation has obscured structures and textures in many of the mafic metavolcanics, particularly to the northwest of Merrill Lake where rocks of amphibolite facies metamorphic rank predominate, but uniformity of lithologies and textures throughout much of this part of the sequence suggests that flow rocks predominate.

Between Merrill Lake and Early Lake, mafic metavolcanics are closely associated with intermediate pyroclastics. On the shores of Merrill Lake intimately interbanded sequences of mafic flows, occasionally pillowed (Photo 1) or coarsely porphyritic, are interbanded with coarse intermediate pyroclastics (Photo 2) and all of these rocks have been metamorphosed to amphibolite facies rank. On the northwest side of Merrill Lake extensive hybridisation and migmatisation of mafic flow rocks has occurred. Some of the flows are

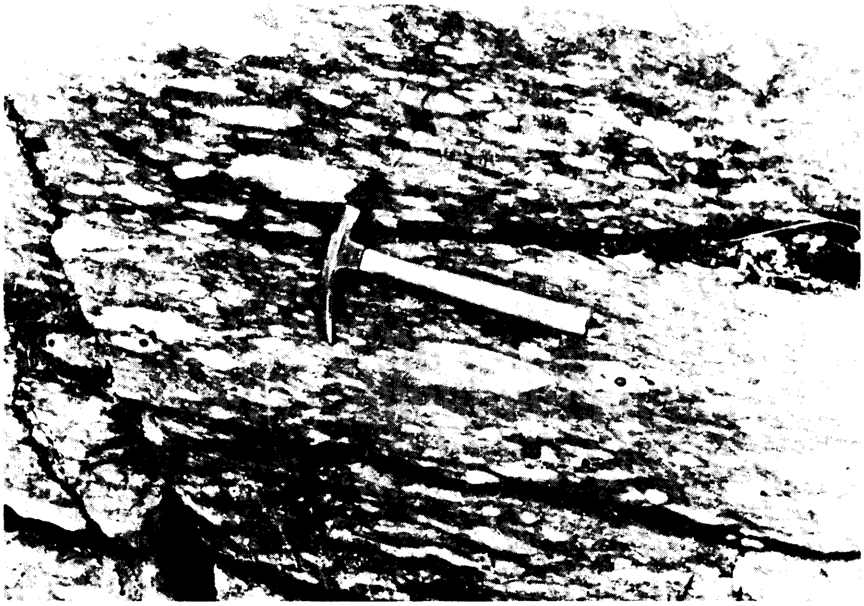


Photo 2–Intermediate tuff-breccia, metamorphosed to amphibolite facies; northeast end of Merrill Lake.

Photo 3–Agmatitic intrusion breccia: porphyritic mafic flow remnants in dioritic to quartz dioritic matrix; northwest shore of Merrill Lake.

coarsely porphyritic (Photo 3), with plagioclase phenocrysts altered to a zoisitic aggregate.

In thin section, amphibolitic rocks in the vicinity of Merrill Lake are seen to contain dark green hornblende as the dominant mafic mineral (40 to 70 percent), usually in prismatic or blade-like habit. Plagioclase is interstitial, untwinned, and recrystallised and either fresh or strongly saussuritized and constitutes about 25 percent of the rock. Where it is recrystallised, an aggregate of epidote and untwinned plagioclase is observed. Foliation, where present, is defined by hornblende and occasional secondary actinolite. Accessory minerals include magnetite and sphene.

BLANCHARD LAKE BASALTS

Blanchard Lake basalts comprise a thick (at least 4,000 feet) (1200m) sequence (see Figure 8), occupying the core of the Manitou Anticline, and are predominantly fine- to medium-grained flow rocks. Flow breccias occur at a number of levels through the sequence, and a 1,000-foot (300m) thick body of coarse-grained mafic rocks, the Doyle Lake sill, occurs on the southeast limb of the Manitou Anticline. Contact relationships between this body and the mafic metavolcanics were not observed in detail. It is interpreted as being a sill on the basis of its continuity along the strike, but may be a thick flow unit. In either case it was contemporaneous with mafic volcanism that produced the Blanchard Lake basalts. Pillow lavas occur scattered throughout the Blanchard Lake sequence. The pillowed units are sparse northwest of the Doyle Lake sill but to the southeast of the Doyle Lake sill they are plentiful, and face southeast.

Mafic metavolcanics on Manitou Island may be part of the Blanchard Lake basaltic sequence. Pillowed flows are ubiquitous, and intermediate pyroclastics constitute a considerable part of the island.

The metamorphic isograd between rocks of amphibolite and greenschist facies rank lies within the Blanchard Lake basalts (see Figure 2). Blanchard Lake basalts metamorphosed to amphibolite facies rank are similar to the amphibolites in the Merrill Lake area. Rocks of the southeastern part of the Blanchard Lake basalt area are metamorphosed to greenschist facies rank. At this grade of metamorphism original textures can be recognized in thin section, though frequently only ghost-like pseudomorphs remain. Primary pyroxene is rarely preserved, but is characteristically psuedomorphed by tremolitic amphibole. Chlorite is usually present, and in the thin sections examined, feldspar is saussuritized, making identification of original composition impossible.

TROUTLET LAKE BASALTS

Troutlet Lake pyroclastics and basalts are an approximately 2,500-foot (760m) sequence of mafic metavolcanics interbedded with intermediate pyroclastics (see Figure 8), lying above Blanchard Lake basalts. Intermediate pyroclastics predominate in this sequence, and no pillow structures were found in the mafic metavolcanics. The mafic metavolcanics vary from medium- to coarse-grained, and are in some places porphyritic. Extensive shearing and possible strike-faulting in this sequence raises the possibility of repetition of units.

BEAVERHEAD ISLAND BASALTS

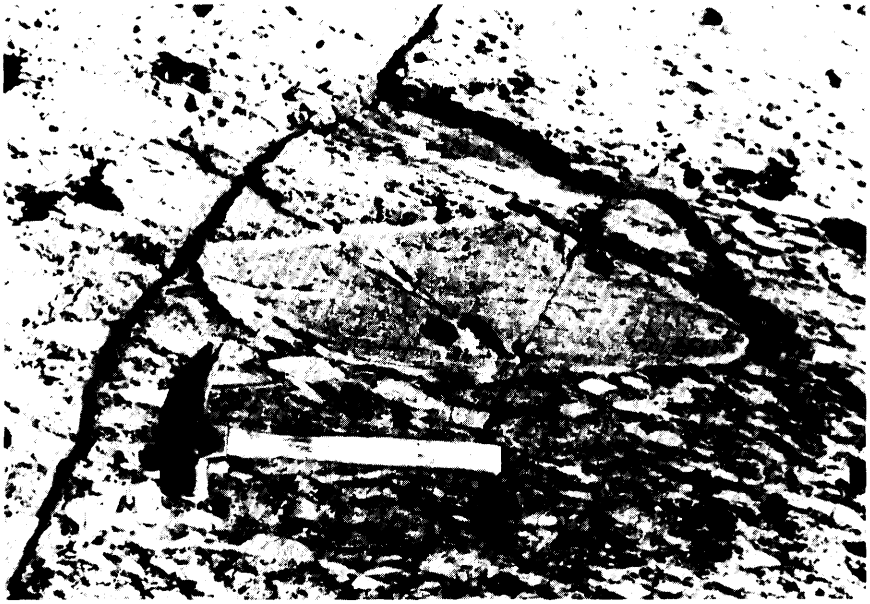
Troutlet Lake pyroclastics and basalts are overlain by Beaverhead Island basalts, an approximately 3,000-foot (900m) sequence of pillowed and porphyritic mafic flows. Within this sequence several discrete units can be mapped, including a breccia unit at its base that may be a pillow breccia (Photo 4). Units that appear to be scoriaceous flow tops may be observed in close association with porphyritic basalt on the numerous islands to the northeast of Beaverhead Island (Photo 5).

BECK LAKE BASALTS

To the southeast of the Manitou Straits Fault, Beck Lake basalts comprise a thick and probably folded mafic metavolcanic sequence (see Figure 8), extending outside of the map-area to the southeast where they are in contact with and probably are intruded by granitic rocks of the Entwine Dome (Goodwin 1965; Davies and Pryslak 1967). In the extreme southeast corner of the map-area and also close to the Scattergood Lake Stock the Beck Lake basalts have been metamorphosed to amphibolite facies rank. Wide variation in colour and grain size is exhibited by these rocks; however, all are considered to be volcanic flow rocks, of predominantly basaltic composition (Table 3, samples 1, 2, 4, 5, 7 to 10).

Except in the areas mentioned above, the Beck Lake basalts have been metamorphosed to greenschist facies rank. Colour in hand specimen varies from dark green, to pale yellowish green to almost grey-green; thin-section observations show colour of hand specimens to be a function of metamorphic mineral content. Darker rocks are usually amphibole-rich, while paler varieties have abundant epidote or plagioclase. Rare, rather glassy, pale-green rocks were found in thin section to consist of plagioclase microlites with quench textures (Gélinas and Brooks 1974) in a matrix of very fine-grained feather-like intergrowths of amphibole and epidote, exhibiting a pilotaxitic texture, and devitrified glass. Partial chemical analysis (Table 3, sample 9) shows them to be basaltic. These pale-coloured rocks were originally considered during field mapping to be andesitic. However, chemical analyses and thin-section study have shown them to be basaltic.

Within the medium- to fine-grained mafic metavolcanics, pillowed lavas are ubiquitous, but are not always easy to recognize because of heavy vegetation cover in this part of the map-area. Pillowed lavas occur sporadically within the coarser mafic flow rocks, which are predominantly situated on the northwest side of the sequence, and probably toward its top (see Figure 8). Because of the presence of pillows the coarser mafic rocks are considered to be flows rather than intrusions. No intrusive contact relations were noted between coarser mafic rocks and pillowed lavas within this sequence. In the vicinity of Holcroft Lake, in the south of the map-area, a variety of coarse-grained, mafic rocks were encountered, interpreted to be part of the flow sequence. Partial chemical analyses of three samples (Table 3, samples 2, 5, and 10) show a considerable variation in SiO_2 content. Thin-section study showed samples 5 and 10 to contain about 60 percent primary hornblende, while in sample 2 extensive alteration of hornblende to a pale green amphibole accounts for the pale colour of the sample in hand specimen. In the field, the samples were termed "leucogabbro" (sample 2), "pyroxenite" (sample 5), and "quartz gabbro" (sample 10); on Map 2320 (back pocket) they are assigned to map-unit 1b,



ODM9321

Photo 4–Possible pillow breccia: a complete pillow lies in a coarse breccia composed of discrete mafic clasts, and possible pillow fragments; small island in Manitou Straits, ½ mile (0.8 km) northeast of Birch Narrows.

ODM9322

Photo 5–Scoriaceous flow top in mafic lavas; island at northeast end of Beaverhead Island.

Table 3

PARTIAL CHEMICAL ANALYSES IN WEIGHT PERCENT OF SELECTED VOLCANIC FLOW ROCKS, LOWER MANITOU-UPHILL LAKES AREA. THE SAMPLE LOCATIONS ARE SHOWN ON FIGURE 3. ANALYSES BY THE MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	1	2	3	4	5	6	7	8	9	10	11
SiO_2	43.1	44.0	45.5	48.8	49.5	49.7	50.2	50.3	52.1	56.6	71.6
Fe_2O_3	13.0	11.2	10.6	11.8	18.4	6.65	11.2	11.1	10.6	16.8	2.08
CaO	8.02	10.2	20.1	10.9	7.42	10.3	8.81	8.50	10.7	5.43	1.48
MgO	11.9	11.3	3.07	6.27	4.40	10.4	14.1	6.70	7.38	1.32	0.45
K_2O	0.34	0.17	0.08	0.16	0.15	1.51	1.98	0.37	0.20	0.26	1.58

SAMPLE	ROCK TYPE	LOCATION	ODM SAMPLE NUMBER
1	Basalt	Cane Lake	72-B-175
2	Coarse-grained basalt	Between Knowles and Holcroft Lakes	72-B-201
3	Basalt pillow centre	Manitou Island	72-B-43
4	Basalt	Ponto Lake	72-B-110
5	Coarse-grained basalt	Between Knowles and Holcroft Lakes	72-B-202
6	Amphibolitic basalt	Olsen Bay	72-B-49
7	Amphibolitic basalt	Scattergood Creek	72-B-159
8	Basalt	Southeast Shore of Lower Manitou Lake	72-B-69
9	Basalt	Beck Lake	72-B-185
10	Coarse-grained basalt	Between Knowles and Holcroft Lakes	72-B-203
11	Rhyolite	Manitou Island	72-B-32

ODM9323

Photo 6—Glomeroporphyritic mafic lava: coarse aggregates of plagioclase feldspar in a dark green matrix; small island in Meridian Bay.

coarse-grained gabbroic basalt. Sample 10 contains abundant granular quartz (10 to 20 percent), and myrmekitic intergrowths of quartz and plagioclase, accounting for its relatively higher SiO_2 content of 56.6 percent.

Mafic breccias, probably of flow type, occur at a number of places within the sequence, particularly at the west end of Beck Lake where there appears to be a transition westwards from fine- and medium-grained flow rocks into coase-grained flow rocks.

ETTA LAKE BASALTS

Mafic metavolcanics are interbedded with predominantly fine grained clastic metasediments and minor pyroclastics in a unit that extends along strike from Meridian Bay in the southwest, through Etta Lake and Glass Bay, to Cane Lake in the northeast. Porphyritic basalts, some very coarse grained (Photo 6), are typical, and no pillowed basalts were found interbedded with the clastic rocks. Total maximum thickness of metavolcanics and metasediments is on the order of 2,000 feet (600m) (see Figure 8).

GLASS BAY BASALTS

Above the Etta Lake metasediments there is a rather abrupt conformable transition into a sequence of pillowed lavas, 4,000 feet (1200m) thick (see Figure 8). This


ODM9324

Photo 7–Mafic aquagene breccia, interbedded with pillow lavas; small island at entrance to Glass Bay.

sequence extends from the southeast shore of Lower Manitou Lake, to the northwest of Glass Bay, and thence to Cane Lake. In the upper 500 feet (150m) of the sequence, brecciated mafic rocks of probable aquagene origin are commonly associated with the pillowed lavas (Photo 7). Some of these breccias may be mafic pyroclastic or flow breccias.

Intermediate and Felsic Metavolcanics

Within the map-area metavolcanics of intermediate to felsic composition are predominantly pyroclastic. Pyroclastic rocks cover a wide range of chemical composition (Tables 2 and 4), from basic (sample F), to intermediate (samples 12 and 20, and sample G) to acidic (samples 21 and 22). Felsic rocks of rhyolitic composition are flows rather than pyroclastics (Table 3, sample 11).

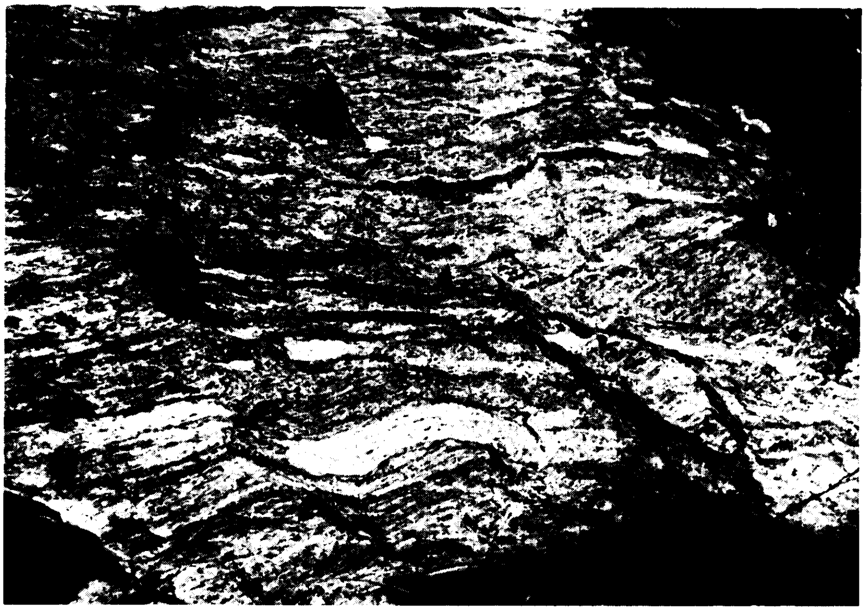
The fragment-size and mixture classification of Fisher (1966) has been used for pyroclastic rocks in this report.

Pyroclastic rocks occupy essentially four distinct parts of the map-area. One is in the northwest, between Olsen Bay, Merrill Lake, and Early Lake, where intermediate, coarse pyroclastics are interbedded with mafic flow rocks. These comprise the Olsen Bay pyroclastics, the Merrill Lake pyroclastics, and the Early Lake pyroclastics. A second area occurs along the north shore of Lower Manitou Lake and the Manitou Straits, extending

Table 4 PARTIAL CHEMICAL ANALYSES IN WEIGHT PERCENT OF SELECTED PYROCLASTIC ROCKS, LOWER MANITOU-UPHILL LAKES AREA. THE SAMPLE LOCATIONS ARE SHOWN ON FIGURE 3. ANALYSES BY THE MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	12	13	14	15	16	17	18	19	20	21	22
SiO_2	55.2	56.2	57.2	57.2	58.7	59.1	64.3	64.8	64.8	65.9	66.5
Fe_2O_3	12.1	8.65	6.32	6.43	6.10	5.55	7.01	5.40	5.91	5.48	3.64
CaO	4.40	5.00	4.10	4.18	2.72	5.21	1.77	2.61	3.60	4.40	3.55
MgO	5.17	5.75	6.58	4.02	4.64	4.10	2.52	4.34	5.22	4.84	3.56
K_2O	0.25	0.12	3.61	0.27	0.35	0.50	0.61	0.93	0.72	1.05	2.73

SAMPLE	ROCK TYPE	LOCATION	ODM SAMPLE NUMBER
12	Intermediate Tuff	Rector Lake	72-K-207
13	Intermediate Tuff	Beaverhead Island	72-B-14
14	Intermediate Tuff	Troutlet Lake	72-B-264
15	Intermediate Tuff	Uphill Lake	72-B-215
16	Intermediate Tuff	Manitou Straits, 1 mile (1.6 km) north of Watson's Narrows	72-N-178
17	Intermediate Tuff	Manitou Straits, ¾ mile (1.2 km) north of Watson's Narrows	72-N-174
18	Intermediate Tuff	Manitou Straits, ½ mile (0.8 km) east of Birch Narrows	72-B-130
19	Matrix of intermediate tuff-breccia	Between Carleton Lake and Reliance Bay	72-N-222
20	Intermediate Tuff	Manitou Straits, east of Troutlet Lake	72-N-144
21	Felsic Tuff	Beaverhead Island, north end	72-K-22
22	Felsic Tuff	Manitou Straits, ¾ mile (1.2 km) south of Watson's Falls	72-B-137



ODM9325

Photo 8—Strongly sheared intermediate tuff-breccia, metamorphosed to amphibolite facies; ½ mile (0.8 km) southwest of Early Lake.

from the northwest corner of Beaverhead Island, through Doyle Bay, the east sides of Troutlet Lake and Carleton Lake, and thence to Upper Manitou Lake. These comprise the Troutlet Lake pyroclastics. Here, medium- to coarse-grained pyroclastics predominate, again interbedded with mafic flow rocks, and also with some distinctly felsic rocks. The third area is again along the Manitou Straits, but on the southeast side, from Beaverhead Island toward the northeast a distance of some 5 miles (8km). This unit, the Beaverhead Island pyroclastics, is composed of intermediate, medium-grained pyroclastics, and is bounded to the southeast by the Manitou Straits Fault. The fourth area, encompassing the Cane Lake pyroclastics, unlike the other three, is to the southeast of the Manitou Straits Fault, and extends from the west end of Glass Bay, through Cane Lake, and thence to Uphill Lake. Coarse pyroclastics predominate in this area, concordantly intruded by mafic sills. The first, second, and fourth of the above-mentioned areas thin to the southwest, disappearing within the map-area, whereas they widen toward the northeast as they extend under Upper Manitou Lake and toward Sunshine Lake.

Pyroclastic rocks also occur within the Etta Lake metasediments, and are discussed with those rocks.

OLSEN BAY, MERRILL LAKE AND EARLY LAKE PYROCLASTICS

Merrill Lake pyroclastics are coarsely clastic intermediate rocks, metamorphosed to amphibolite facies rank (see Photo 2) and in some places strongly deformed (Photo 8).

Clasts in these rocks are highly stretched imparting a strong lineation to these pyroclastics. The most common rock type consists of felsic clasts set in a mafic matrix. On the northwest side of Merrill Lake, migmatisation and hybridisation affecting both mafic metavolcanics and intermediate pyroclastics have obscured the original textures and structures of many of these rocks. Toward the southwest, the Olsen Bay pyroclastics have been so intensely metamorphosed and deformed as to be scarcely recognizable as being of pyroclastic origin. They are quartz-feldspar-biotite (± amphibole) schists and gneisses, and in thin section no trace of their primary pyroclastic texture is visible. In a typical sample from the east side of Olsen Bay, a strong banding is defined by alternating quartz-feldspar-biotite and hornblende-feldspar-quartz-epidote units about ½ inch (1.3cm) wide. Both green biotite and hornblende grains lie parallel to the plane of the foliation.

Rocks of similar metamorphic grade which occur in the headland between Olsen Bay and Lower Manitou Lake are part of the Early Lake pyroclastics, and can be traced along strike toward the northeast, where, in the vicinity of Early Lake and Jackfish Bay of Upper Manitou Lake there is no doubt as to their pyroclastic origin. On the northwest side of Olsen Bay, quartz-feldspar-biotite schists and gneisses occur within the granitic terrain: these are interpreted as being of pyroclastic origin, as opposed to amphibolites on the same shore which are interpreted on the basis of their mineralogy as being derived from mafic flow rocks.

TROUTLET LAKE PYROCLASTICS

Troutlet Lake pyroclastics are interbedded with mafic flow rocks. At the base of the pyroclastic sequence, a heterolithologic tuff-breccia or volcaniclastic conglomerate, about 300 feet (90m) thick, extends from Doyle Bay to Troutlet Lake (shown on Map 2320 as map-unit 2c). The tuff-breccia is well exposed on a glaciated island in Doyle Bay and clasts in this basal unit are predominantly of felsic to intermediate metavolcanic composition with some mafic metavolcanics. The clasts range in size from a few inches to over a foot, the average being about 6 inches (15cm). The clasts are well rounded, suggesting water action. At Doyle Bay a 30-foot (9m) argillitic or fine tuffaceous unit occurs immediately above the tuff-breccia unit; most of the pyroclastics above the argillitic unit are fine grained and are classified as lapilli-tuff or tuff. Graded bedding and load casts can be seen in some of these rocks, particularly on a small island just west of the northeast end of Beaverhead Island. Volcaniclastic sandstones and siltstones are also seen on an island at the south end of Shaughnessy Bay, at the base of the pyroclastic sequence. Toward the northeast, as the sequence widens out under Upper Manitou Lake, mafic flows interbanded with the pyroclastics become abundant. Pyroclastics along the southeast shore of Manitou Island appear to be the downstrike equivalents of Troutlet Lake pyroclastics. Intense shearing associated with the Manitou Island Fault has strongly deformed these rocks. At the southwest tip of Manitou Island, felsic pyroclastics and flows have been strongly mylonitized in the shear zone. Rocks at the southwest tip of the island were originally interpreted by Thomson (1933) as being quartz monzonites mostly converted to sericite schist (see "Gaffney Prospect" in "Economic Geology"). No evidence of intrusive nature for these rocks was found during the present survey; on the contrary, at the Gaffney prospect on the pensinsula jutting out from the middle of the southeast side of the island, these rocks were interpreted to be pyroclastic, volcaniclastic or very immature sediments intimately interbedded with mafic flow rocks and intruded by granite dikes. A sample of white, hard, felsic rock, interpreted to be of flow origin, taken from within the mylonite zone of the Manitou Island Fault, was found to be rhyolitic (see Table 3, sample 11). Felsic pyroclastics also occur on the islands to the northwest of the central part of Beaverhead Island. The variety of rock types on these islands, and their complex relationships, suggests that these rocks may represent a volcanic-vent filling. Many of these rocks appear in outcrop to be very heterogeneous, immature sediments, or chaotic pyroclastic deposits, intimately associated with mafic flow rocks.

Comparison of chemical analyses of five tuffaceous samples taken from the Troutlet Lake pyroclastics (see Table 4, samples 14, 16, 17, 20, and 21) demonstrates the broad range and essentially intermediate chemical composition of these rocks.

BEAVERHEAD ISLAND PYROCLASTICS

Beaverhead Island pyroclastics are all dark green in colour, due to extensive development of chlorite. In the field many of these rocks are easily confused with mafic flow rocks, because of their massive character. However, quartz and feldspar are distributed throughout, and careful field investigation reveals pyroclastic fragments, usually of the same composition and texture as the matrix, scattered throughout the rock. In places these deposits have associated volcaniclastic siltstone and argillite interbedded with them, some of which are well graded. Very well bedded tuffs and tuffaceous metasediments of this unit are found on the south side of Beaverhead Island and on nearby islands. Much of this material is crossbedded, and individual beds vary from a few inches to over a foot in thickness (Photo 9). Slump structures and fine cross laminations also occur in these rocks.

Two samples were taken for partial chemical analysis (see Table 4, samples 13 and 18) and one for total analysis (see Table 2, sample F; Figure 4). It is of note that there is a greater than 10 percent silica range in these samples, suggesting a broad range in chemical composition of Beaverhead Island pyroclastics, as in Troutlet Lake pyroclastics. Sample F is in fact basaltic according to the classification of Irvine and Baragar (1971).

Thin-section study of the three samples showed that metamorphism has obliterated the primary pyroclastic textures. Sample 13, from Beaverhead Island, consists of quartz and carbonate grains, less than 1mm in size, the former possessing a recrystallised, mosaic texture, in a very fine grained matrix of chlorite, epidote, and feldspar. Sample 18, from the Manitou Straits, is composed of plagioclase and quartz fragments, in a subordinate fine-grained matrix of chlorite, feldspar and quartz. In sample F, extensive carbonatization, development of chlorite, and alteration of feldspars, evident from the high CO_2 and H_2O+ values obtained on analysis (see Table 2) have obscured original textures and mineralogy. However, in hand specimen its clastic texture is in no doubt: feldspar fragments up to 2mm in diameter predominate, while smaller quartz fragments constitute up to 10 percent of the rock, and are seen in thin section to be highly strained and probably recrystallised. In all three samples a secondary, tectonite fabric is evident.

ODM9326

Photo 9—Bedded intermediate tuffs: bed beneath magnet is scoured and truncated. Youngest beds, as determined from graded metasediments nearby, are to the top of photograph. South shore of Beaverhead Island.

CANE LAKE PYROCLASTICS

On the southeast side of the Manitou Straits Fault, Cane Lake pyroclastics, in places reaching 4,000 feet (1200m) in thickness (see Figure 8), occur as the lower and thickest part of Thomson's (1933) Manitou "Series". Thomson recognized that pyroclastic rocks occurred within the Manitou "Series", but inspection of his map and his Figure 2 shows that he only considered a small proportion of the lower part of the Manitou "Series" to be of such type, notably at Uphill Lake and to the southwest of Cane Lake. However, field work and thin-section study of these coarsely clastic rocks have led the author to conclude that the lower two-thirds of Thomson's Manitou "Series" in the map-area are of pyroclastic origin, though much of the material may have been partially reworked by water action. The pyroclastics are predominantly heterolithologic tuff-breccias, in which rounded to angular, felsic to intermediate, mostly porphyritic fragments varying in size from a few centimetres to tens of centimetres are set in a finer, tuffaceous matrix, usually greenish in colour. Fragments other than volcanic or subvolcanic are rare; granitoid clasts are occasionally encountered, and these increase in frequency toward the top of the sequence. In thin section, a typical felsitic pebble consists of a very fine-grained mosaic of quartz, feldspar, and micaceous minerals, with ghost-like remnants of plagioclase and

ODM9327

Photo 10–Mafic-clast boulder conglomerate or volcaniclastic breccia at the base of Cane Lake pyroclastics: clasts are similar in composition to immediately underlying mafic metavolcanics, which include pillowed basalts. Disconformity is seen at same outcrop. East shore of Cane Lake.

amphibole phenocrysts, no more than 1mm in diameter. At the southwest end of this pyroclastic unit granitic-clast-bearing outcrops are, however, found close to the base of the sequence: in some places their frequency is such that the rock has been called a conglomerate rather than a tuff-breccia, particularly where associated with bedded clastic rocks composed of sand-sized particles. At Uphill Lake a distinct, mappable, argillite and sandstone unit has been traced for at least 2 miles (3km) along strike within the pyroclastic sequence, and extends another mile (2km) to the east (P.R. Teal, graduate student, McMaster University, personal communication, 1972).

The contact between Cane Lake pyroclastics and underlying Glass Bay basalts may be seen close to the shore of Cane Lake, along its southern arm. On a small peninsula at the narrow part of the lake, half way along its length, a basal, coarse, mafic-clast conglomerate or volcanic breccia can be seen, disconformably overlying mafic flow rocks (Photo 10). Elsewhere the contact is less well defined, but is presumably of a disconformable type.

Tuff units occur within the pyroclastic sequence, and at some places, particularly along the east shore of Manitou Straits near Cane Lake, they are gradational into coarser pyroclastics characterised by large fragments of essentially the same material as the tuffaceous matrix. A typical sample of tuff from this locality is medium grained and poorly sorted, with feldspar and amphibole fragments of about 1mm diameter set in a finer, cryptocrystalline matrix. In thin section, the amphibole and feldspar grains are seen to be subhedral to euhedral. The matrix material is a very fine-grained quartz-feldspar aggregate, though intermediate-sized amphibole grains are scattered through it. Feldspars are all highly altered. A partial chemical analysis of another tuffaceous rock (see Table 4, sample 15) from the south shore of Uphill Lake, adjacent to the Scattergood Lake Stock, shows almost 10 percent less silica than the sample from near Cane Lake.

At Uphill Lake, along the northwest shore, a little to the east of the portage to the Manitou Straits, massive, silicic feldspar porphyry forms a cliff-face which is strewn at its base with talus debris. This rock may be a flow within the pyroclastic sequence, or could be a later felsic intrusive.

METASEDIMENTS

Apart from minor clastic metasedimentary bands interbedded with metavolcanic rocks at a number of places in the volcanic pile, metasediments occur at two stratigraphic levels, southeast of the Manitou Straits Fault. The lower metasediments are interbanded with predominantly mafic metavolcanics and minor amounts of pyroclastic rocks, and are intravolcanic, clastic and chemical metasediments. The upper metasediments have no metavolcanics associated with them, and, within the present map-area, overlie the metavolcanic sequence lying southeast of the Manitou Straits Fault. In this report they are referred to as supravolcanic, clastic metasediments, though elsewhere in the Manitou Lakes-Stormy Lake belt metavolcanic rocks may overlie them.

Intravolcanic Clastic and Chemical Metasediments: Etta Lake Metasediments

Fine- and medium-grained clastic metasediments (siltstones, sandstones, minor conglomerates) and minor chemical metasediments (cherts) occur interbedded with mafic flow rocks and minor pyroclastics intermittently over a strike length of 8 miles (13km) from Meridian Bay in the southwest, (via Holcroft Lake, Etta Lake and Glass Bay) to Cane Lake in the northeast. Individual clastic metasedimentary units are mostly discontinuous along strike, and vary both across and along strike from coarse- to fine-grained. The metasediments are well exposed along the shores of a number of small lakes and the shore line of Meridian Bay and Glass Bay.

The pyroclastic rocks in this part of the map-area are distinguished from the epiclastic rocks: by their essentially monolithologic clast population, in contrast with heterolithologic, though dominantly volcaniclastic, metasediments; by the usually ellipsoidal shape of the clasts, in contrast with more or less spheroidal volcanic clasts in epiclastic metasediments; and by the rather vague nature of fragment boundaries in pyroclastics, as opposed to usually sharp clast boundaries in epiclastic metasediments. The criteria are not in all cases definitive and in many places difficulty is met in distinguishing between the pyroclastic and metasedimentary rock types.

The clastic metasediments commonly exhibit massive beds and graded bedding. No crossbedding was seen. Where the metasediments are massive, it is often difficult to find

ODM9328

Photo 11–Graded bedding in volcaniclastic metasediments. The sandstone in the upper part of the picture overlies siltstone, which in turn grades downward to fine-grained sandstone. Entrance to Glass Bay, south shore.

any trace of bedding at all, whereas the well bedded metasediments commonly are graded (Photo 11), or finely laminated (Photo 12).

Pyrite was found within coarse lithic sandstones near the mouth of the Weasel River. In thin section, the sandstone is seen to be very immature, being composed for the most part of volcanic-rock, quartz, feldspar, chert, and porphyry fragments. All fragments are very angular, and of about 1 to 2mm grain size. The porphyry fragments contain quartz, feldspar, and hornblende phenocrysts.

A 50- to 100-foot (15 to 30m) thick chert unit occurs at the top of the clastic sequence, cropping out on the peninsulas of Meridian Bay, and along the northwest side of Holcroft Lake. Similar cherty bands are interbedded with clastic metasediments at the Glass Reef mine, and may be the continuation of the band at Meridian Bay and Holcroft Lake, separated by sinistral displacement along a prominent northeast-trending fault. Cherts were not found further toward the northeast, in the vicinity of Glass Bay.

In the vicinity of Etta Lake, pyroclastic rocks are interbanded with mafic metavolcanics and with the epiclastic metasediments. Rocks of this type are particularly well exposed on the peninsula jutting into the southeast side of Etta Lake, on Glass Bay close to the portage into Etta Lake, and again on Glass Bay to the northeast of Etta Lake. At

ODM9329

Photo 12–Well bedded, finely laminated argillite; west shore, Holcroft Lake.

the first locality, on Etta Lake, are found coarse, essentially monolithologic, intermediate pyroclastics (Photo 13). Most of the fragments are ellipsoidal and stretched, but a few large, irregular blocks occur. One vein-quartz or quartzite pebble was found at this locality.

At the second locality, on Glass Bay, epiclastic, pyroclastic and volcaniclastic rocks are closely associated and merge one into the other. An outcrop (Photo 14) mapped as conglomerate at this locality may be epiclastic or pyroclastic; it is composed of rounded, intermediate volcanic fragments about 3cm in diameter, in a green chloritic matrix. At another outcrop close by, a lithic sandstone contains irregular, bent, and folded pieces of argillite (Photo 15); the rather chaotic form of the argillite fragments suggests that soft-sediment deformation was responsible for these structures.

At the northeast end of Glass Bay, on the peninsula jutting northward into the bay, a peculiar structure occurs in well bedded, graded sandstones and argillites. Spherical to

ODM9330

Photo 13–Intermediate monolithologic tuff-breccia; peninsula on southeast shore of Etta Lake.

oblate bodies, with indistinct margins, about 1cm in diameter, and very fine grained, occur in the finer grained, upper, portion of graded beds. The bodies may be sparsely scattered or close-packed, and some coalesce. In thin section, they are seen to be dominantly composed of a very fine-grained or amorphous mineral, probably a clay mineral. The mineral also occurs dispersed in the siltstone and argillite portion of the bed, but constitutes less than 20 percent of the rock.

The oblate structures bear a superficial resemblance to accretionary lapilli, which Moore and Peck (1961) describe as being ". . . pea-size structures composed entirely of clastic volcanic material, primarily glass or its alteration products. The lapilli exhibit a distinct decrease in grain size from core to rim". The margins of accretionary lapilli are always sharp, and the rims are usually banded. Broken lapilli are frequently present. They occur in poorly stratified tuff, a fact which in itself sets them apart from the Glass Bay structures.

The oblate structures on Glass Bay might also be compared to porphyroblasts, and their presence in the upper, argillitic, portions of graded beds suggests that they might have been retrograded from aluminous metamorphic minerals such as chloritoid or staurolite. However, there is no textural evidence of pre-existing porphyroblasts. Retrograde metamorphism would have produced low-grade metamorphic minerals, such as chlorite, rather than the very fine-grained mineral present, interpreted here as being a clay mineral. The structures must therefore have formed during sedimentation or diagenesis and are interpreted by the author as being of a concretionary or replacement origin.

ODM9331

Photo 14–Volcaniclastic conglomerate, in contact with tuffaceous metasediments; south shore of Glass Bay.

In tracing the Etta Lake metasediments northeastward, from the end of Glass Bay, there is a transition from graded sandstones and siltstones to poorly bedded, usually finer grained metasediments.

At Cane Lake, metasediments crop out at two localities along the east shore of the southern arm of the lake. They may be laterally equivalent, and therefore separated by a north-trending fault. The southerly occurrence is an exposure of a massive pale green, argillitic rock, and arkosic sandstone. The northerly occurrence includes both argillites and coarse, lithic, sandstones. Pyrite was found within the lithic sandstones, giving a rusty appearance on weathered surfaces. Lithic fragments in both rock types are dominantly quartz-feldspar porphyry. Fragments are commonly angular to subrounded, indicating very little transportation. Sorting is virtually absent in the sandstones; the presence of argillites indicates a winnowing of finer material.

Photo 15–Soft-sediment folding of argillite fragments in massive, lithic, sandstone; south shore of Glass Bay.

Eastward from Cane Lake, a unit of coarse pyroclastic rock averaging 1,000 feet (300m) in thickness extends some 2 miles (3km) in an easterly direction. Its position along strike from the sedimentary rocks at Cane Lake suggests that these rocks may have been deposited contemporaneously. However, in lithology the pyroclastic rocks resemble the intermediate heterolithologic Cane Lake pyroclastic rocks(lower part of the Manitou "Series" of Thomson 1933), and are more probably related to an initial phase of explosive volcanism which culminated in the extensive deposition of the Cane Lake pyroclastics.

Supravolcanic Clastic Metasediments: Manitou Straits Metasediments

Within the map-area, metasediments lying at the top of the metavolcanic-metasedimentary succession belong to the Manitou "Series" of Thomson (1933). The Manitou "Series", as defined by Thomson (1933, p.13), ". . . is composed of boulder and pebble conglomerate, arkose, quartzite, slate, and a certain amount of agglomerate and tuff". The "Series" comprised a discontinuous unit of these rocks extending from Beaverhead Island, via Cane Lake, Uphill Lake, and Mosher Bay, in the present map-area, and thence, after a 5 mile (8km) discontinuity attributed by Thomson to the intrusion of a large granitic body, through Washeibemaga Lake and Stormy Lake (Thomson 1933). Subsequent investigations have further extended the unit through Stormy Lake to Bending Lake, at the southeast end of the Manitou Lakes-Stormy Lake metavolcanic-metasedimentary belt (Davies and Pryslak 1967).

Inspection of Thomson's (1933) map and his Figure 2 (Thomson 1933, op. p.18) shows that he considered very little of the Manitou "Series" to be "agglomerate and tuff". Within the present map-area he showed these pyroclastic rocks to occur only at Uphill Lake and southwest of Cane Lake, close to the bottom of the "Series". The lower two-thirds of Thomson's Manitou "Series" is interpreted by the present author as being of dominantly pyroclastic origin (see "Cane Lake Pyroclastics").

At the top of the pyroclastic sequence there is a gradual transition from rocks with dominantly pyroclastic character to those of a dominantly epiclastic character. Within the map-area, the upper 2,000 feet (600m) of Thomson's Manitou "Series" (see Figure 8) is comprised of metasediments. The basal epiclastic rocks are volcanic-clast conglomerates. These are succeeded upwards by an alternating sequence of polymictic conglomerates, sandstones, siltstones and argillites, and minor iron formation.

VOLCANIC-CLAST CONGLOMERATES

These conglomerates are very similar lithologically to the underlying heterolithologic, intermediate tuff-breccias. They differ in that exotic fragments of undoubted nonvolcanic origin are ubiquitous, although they constitute a minor part of the total clast population. The majority of exotic clasts are granitoid in type, mostly whitish in colour, markedly leucocratic, and well rounded, and not unlike those in metasediments occurring within the Cane Lake pyroclastics. Rounded volcanic fragments are another notable feature of these rocks. Conglomeratic rocks of a more polymictic type occur toward the top of this predominantly volcanic-clast conglomerate unit. At some localities substantial amounts of the volcanic-clast conglomerate occur to the northwest of and therefore above polymictic types. This is well documented along the northwest shore of Glass Bay, close to the narrows between Beaverhead Island and the mainland. Here, polymictic conglomerates, interbedded with sandstones and siltstones, occur within the Cane Lake pyroclastic sequence, and again at the base of the Manitou Straits sedimentary sequence. They are succeeded upwards by about 1,000 feet (300m) of volcanic-clast conglomerates with up to 5 percent granitoid pebbles.

POLYMICTIC CONGLOMERATES

These conglomerates (Photo 16) differ substantially from the volcanic-clast conglomerates in that they contain abundant amounts of exotic fragments in comparison with volcanic clasts. Fragments include granitoid, chert, jasper, and magnetite-iron-formation clasts, in addition to porphyritic, dacitic volcanic clasts. A second marked contrast between these rocks and the volcanic-clast conglomerates is that the polymictic conglomerates are very well bedded, coarse beds alternating with finer beds and also alternating with sandstone and siltstone beds. At one outcrop on Manitou Straits, first noted by Thomson (1933, p.13, 14), almost a mile (2km) southwest of Watson's Falls:

> . . . Thirty-four alternating beds of arkose and conglomerate, all over 6 inches [15cm] in width,


ODM9333

Photo 16–Polymictic conglomerate, with alternating sandstone beds. Note alignment of clasts parallel to bedding. The more equant clasts are granitoid, elongate clasts are volcanic. Manitou Straits, 1½ miles (2.4 km) southwest of Watson's Falls.

were counted across a distance of 100 feet [30m] normal to the strike of the beds. There were also innumerable beds of conglomerate one-quarter to one inch [8 to 25mm] in thickness. . . . The maximum thickness of a bed of conglomerate was 5 feet [1.5m]. The boulders lie with their long axes parallel to the strike of the beds, although some of the larger granite boulders are well rounded. Boulders were observed here up to 8 inches [20cm] in diameter, the average being between 1 and 4 inches [2.5 and 10cm].

Within the map-area, these polymictic conglomerates are especially well developed in three discrete areas within the supravolcanic sedimentary sequence: the first is south and southwest of Camp Beaverhead; the second is in an elongate area extending along the Manitou Straits over a distance of approximately 2 miles (3km), to the west of Cane Lake; the third, in the northeast, is to the north of Uphill Lake. This type of conglomerate is scarce or absent between each of these areas. Between the first and the second this is probably caused by attenuation of the sedimentary sequence by the Manitou Straits Fault; between the second and third areas, finer grained sediments predominate, though a paucity of outcrop in the vicinity of location HW 676 leads to uncertainty as to the presence of conglomerates here. On the west shore of that part of Mosher Bay occurring within the map-area, conglomerates of this type constitute only a minor part of the sedimentary sequence; however, considerable amounts of polymictic conglomerate again appear further east, outside the present map-area, south of the main part of Mosher Bay (Thomson 1933; Pettijohn 1937; P.R. Teal, graduate student, McMaster University, personal communication, 1972).

Clasts of granular magnetite derived from magnetite iron formation are rare. It is of special note that they are most abundant in those localities where magnetite iron formation is present as part of the sedimentary sequence. However, top determination in graded bedding at one of these localities show that iron formation overlies the conglomerates. Within the present map-area, clasts of granular magnetite along with jasper clasts are especially prevalent within the conglomerates on the southeastern peninsula of Beaverhead Island. Clasts of granular magnetite are again present, but not in such abundance, in the conglomerates southwest of Watson's Falls, mentioned above and quoted from Thomson (1933, p.13, 14). Thomson counted 188 pebbles over an area of 8 square feet ($0.7m^2$) at this locality, and found only 2 percent of the pebbles to be "banded iron formation" (Thomson 1933, p.14). Clasts of granular magnetite were not observed in the conglomerates interbedded with sandstones, siltstones, and argillites north of Uphill Lake. Clasts of granular magnetite are present in some of the conglomerates north of the main part of Mosher Bay (P.R. Teal, graduate student, McMaster University, personal communication, 1972), and have also been reported in conglomerates of the eastern portion of Thomson's Manitou "Series" (Thomson 1933, p.14).

SANDSTONES, SILTSTONES, AND ARGILLITES

The uppermost portion of the Manitou Straits metasediments is dominantly composed of fine- to medium-grained epiclastic metasediments, i.e. sandstone, siltstone and argillite. They are interbedded with the above-described polymictic conglomerates over most of their strike length. Toward the northeast, along the upper end of the Manitou Straits and at Mosher Bay, they became increasingly voluminous, and constitute the major part of the metasedimentary sequence.

Sandstones predominate at the base of the sequence; and there is transition upwards toward dominantly argillitic metasediments in the vicinity of the Manitou Straits Fault. Along the Manitou Straits Fault zone many of these argillitic rocks have been converted to sericitic schist. In addition, there is a rhythmic layering in many of these rocks, within discrete beds, from sandstone at the base, through siltstone, to argillite at the top (Pettijohn and Potter 1964). This is the graded bedding typical of turbidity-current clastic deposition (e.g. Pettijohn 1957; Bouma 1962). Within these finer grained metasediments, other structures such as ripple cross lamination and slumping (Pettijohn and Potter 1964) are preserved at various points along the Manitou Straits, and particularly at Mosher Bay.

A distinct sandstone-siltstone unit occurs within Cane Lake pyroclastics at Uphill Lake. The unit can be traced over 2 miles (3km) in a northeasterly direction across the bays and peninsulas on the north side of Uphill Lake, and continues for at least another ¾ mile (1km) beyond the map-area (P.R. Teal, graduate student, McMaster University, personal communication, 1972). Within this unit well developed bedding is often absent, and graded beds are rare. However, at its southwest end, on the shore of Uphill Lake, both graded bedding and crossbedding were observed in sandstones and coarse siltstones.

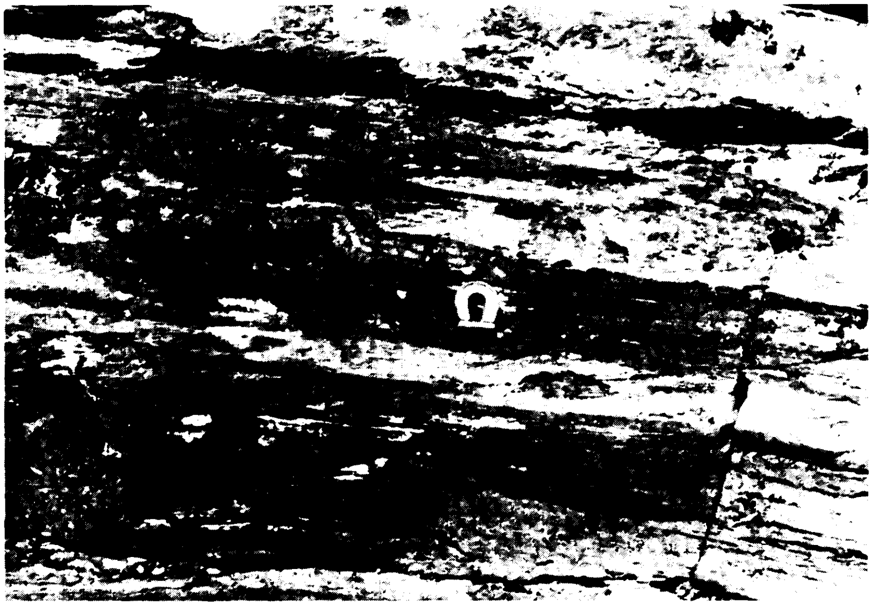
ODM9334

Photo 17–Iron formation: layers of magnetite (darker beds) alternate with layers of argillite and siltstone; southeast peninsula of Beaverhead Island.

Toward the southwest, in the vicinity of Beaverhead Island, sandstones, siltstones and argillites are comparatively poorly represented among the supravolcanic clastic metasediments. Attenuation of the sequence by the Manitou Straits Fault may be responsible for their poor representation.

IRON FORMATION

Magnetite iron formation constitutes a very small part of the preserved supravolcanic metasedimentary sequence. Within the map-area it is only found at two localities, the more important being at the southeast peninsula of Beaverhead Island (Photos 17 and 18), and the other, a far more minor occurrence, being on Manitou



ODM9335

Photo 18–Magnetite iron formation (darker beds) interlayered with argillite and siltstone, showing small lens of dark red jasper (just above magnet) within magnetite band; southeast peninsula of Beaverhead Island.

Straits, about 1½ miles (2.4km) southwest of the portage to Cane Lake. Within the Manitou Lakes-Stormy Lake region, iron formation is present at a number of places within Thomson's Manitou "Series", notably south of Mosher Bay (P.R. Teal, graduate student, McMaster University, personal communication, 1972), and between Stormy and Bending Lakes in the eastern part of Thomson's Manitou "Series" (Davies and Pryslak 1967).

At Beaverhead Island, two banded magnetite iron formation units can be traced a distance of ½ mile (0.8km) along strike across the southeast peninsula of the island, and then southwestward across a small island. The two units (shown on Map 2320 as a single unit) are about 20 feet (6m) and 10 feet (3m) wide respectively, and 20 feet (6m) apart. Layers of apparently almost pure magnetite, varying in thickness between ½ inch (1.2cm) to 1 foot (30cm), alternate with layers of argillite and siltstone, of similar thicknesses (Photo 17). In the thicker unit there are up to 50 such magnetite bands, and 15 bands in the thinner unit to the southeast. Small lenses of red jasper occur in very minor amounts within the magnetite-rich bands (Photo 18). Over most of its strike length the units are undeformed or only slightly folded; on the island to the southwest of the peninsula the iron formation is highly contorted, a feature typical of many Early Precambrian iron formations, and in this case probably caused by movements along the Manitou Straits Fault.

An elongate aeromagnetic high apparent on ODM-GSC Map 1153G (ODM-GSC 1961; Figure 9) suggests that the iron formations continue up to another ½ mile (0.8km) in a southwesterly direction beneath Lower Manitou Lake. During the present geological survey, abandoned drill core (indicated on Map 2320) was found on a small island within the southwest end of the elongate high anomaly. Considerable magnetite iron formation is contained in the core and it may be assumed, from the location of the core, that the hole was drilled from the ice in winter to test the southwesterly continuation of the iron formation beneath Lower Manitou Lake. The abrupt fall-off in the anomaly at either end, coupled with the fact that the iron formation could not be found on the mainland to the northeast of Beaverhead Island, suggests that the iron formation lies within the fault zone, and is attenuated at both ends by fault movements along the Manitou Straits Fault zone.

On Manitou Straits, about 1½ miles (2.4km) southwest of the portage to Cane Lake, two magnetite bands, each about 1 inch (2.5cm) thick, occur in a graded sandstone and argillite sequence. The occurrence is on an island close to the east shore, and adjacent to the Manitou Straits Fault zone. These bands are quite probably at the same stratigraphic level as the iron formation on Beaverhead Island.

MAFIC INTRUSIVE ROCKS

Mafic Sills

Confined within Cane Lake pyroclastic rocks are elongate bodies of mafic rock, showing considerable internal variation in structure and texture, which are considered by the author to be sills. At least two of these sills are traceable over distances measurable in miles. Other less well exposed bodies, typically near the base of the Cane Lake pyroclastics, may be part of one sill, continuous over a distance of at least 2 miles (3km) from the east end of Cane Lake to a point ½ mile (0.8km) west of the south end of Cane Lake.

The two major sills, one near the top of the pyroclastic sequence, the other close to the bottom, are, within the map-area, approximately 3½ and 4 miles (5.6 and 6.4km) long, respectively. The first of these sills has been traced from a small island on Manitou Straits, close to the portage to Cane Lake, northeastward along the shore of Manitou Straits, to Uphill Lake, where it is seen on a number of islands and headlands, passing eastward out of the map-area. Teal (graduate student, McMaster University, personal communication, 1972) has traced this same mafic body another 4 miles (6km) eastward along the north shore of Sunshine Lake, where these rocks were mapped as basic lavas by previous workers (Thomson 1933; Pettijohn 1937). The sill varies in width from about 100 feet (30m) on Manitou Straits to about 1,000 feet (300m) north of Sunshine Lake (Teal, personal communication, 1972).

The second major sill has been traced from Cane Lake, where it occurs on a number of islands and peninsulas, southwestward a distance of some 2 miles (3km), to a point about 1 mile (2km) east of Camp Beaverhead. At its southwest end it has been displaced by two north-trending faults. It varies in thickness from less than 100 feet (30m) at Cane Lake to over 1,000 feet (300m) near its southwest end.

Although the rocks composing the sill are not homogeneous, they are characteristically a brownish colour on the weathered surface, and a dark, blackish green on the

Table 5 PARTIAL CHEMICAL ANALYSES IN WEIGHT PERCENT OF SELECTED SAMPLES FROM MAFIC SILLS, LOWER MANITOU-UPHILL LAKES AREA. THE SAMPLE LOCATIONS ARE SHOWN ON FIGURE 3. ANALYSES BY THE MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	23	24	25	26	27
SiO_2	53.7	54.2	57.5	59.8	68.4
Fe_2O_3	8.98	8.91	7.57	6.00	5.63
CaO	6.15	5.70	4.57	5.81	2.63
MgO	9.03	7.86	4.33	5.67	3.01
K_2O	3.39	2.41	2.75	3.85	2.01

SAMPLE	ROCK TYPE	LOCATION	ODM SAMPLE NUMBER
23	Amygdaloidal, diabasic, mafic intrusive rock or coarse-grained basalt	Manitou Straits 1 mile (1.6km) south of Watson's Narrows	72-B-240
24	Diabasic, porphyritic, mafic intrusive rock	Cane Lake	72-B-166
25	Diabasic, mafic intrusive rock	Cane Lake	72-B-156
26	Diabasic, porphyritic, mafic intrusive rock	¾ mile (1.2km) west of south end of Cane Lake	72-B-238
27	Porphyritic dacite	Uphill Lake	72-B-220

fresh surface. In texture they vary from coarse, equigranular to diabasic to porphyritic, and amygdaloidal varieties of the diabasic and porphyritic types are common. Vesicularity is often a feature of volcanic flow rocks; however, vesicular texture is also found in shallow intrusions, so that presence of vesicles or amygdules does not show that this mafic rock is not intrusive.

In thin section, an amygdaloidal sample was seen to be composed of altered feldspar phenocrysts, granular aggregates of amphibole, probably derived from phenocrysts of the same mineral, and volcanic rock fragments, all in a fine-grained matrix composed of feldspar, amphibole, epidote, and carbonate. The amygdules are composed of carbonate and quartz intergrowths. Phenocrysts are no larger than 2mm, while amygdules are usually about 1 to 3mm, but may be as large as 10mm. The fine-grained basaltic inclusions are difficult to explain, but could represent volcanic material incorporated in the magma during passage upward through the volcanic pile. A coarser grained phase of the sill is seen in hand specimen to contain subhedral feldspar laths, and darker, amphibole phenocrysts, in a fine, dark matrix. Thin-section examination shows the rock to have an intergranular to subophitic texture, and indicates that the feldspar is andesine plagioclase exhibiting albite twinning. The amphiboles have been partly altered to a fine-grained aggregate of chlorite and epidote. Partial chemical analyses of the amygdaloidal and coarser grained samples (Table 5, samples 23 and 26 respectively) show them to have a basaltic to andesitic affinity though both magnesia and potash contents are high. A more felsic sample, interpreted in the field to be a differentiated portion of one of the sills, and collected at Uphill Lake (Table 5, sample 27) is more dacitic (68.4 percent SiO_2). This sample is distinctly pinkish on the weathered surface; dark green phenocrysts of amphibole are distinctly seen against the pink matrix. However, the fresh surface is uniformly dark green, obscuring this porphyritic texture. In thin section, altered plagioclase crystals, of the same size as the amphibole phenocrysts are also visible. No quartz phenocrysts are present: the fine-grained matrix is however, composed of feldspar, quartz, and very fine-grained amphibole laths.

Lamprophyre Dikes

Lamprophyre dikes, all on the order of 1 foot (30cm) wide, and traceable in outcrop over a distance of tens of feet at the most, were found at five widely separated localities in the map-area: one on the north shore of Uphill Lake, close to the entrance to Rush Bay; two on the Manitou Straits, one a ¼ mile (0.4km) south of Watson's Falls, and the second a ½ mile (0.8km) further down the shore; one east of the Manitou Straits, about 1¼ miles (2km) northeast of Camp Beaverhead; and one on a small, rocky, island northwest of the western peninsula of Beaverhead Island.

Their relative ages are not known, or their ages in relation to felsic dikes and plutons, and other mafic intrusions. However, they bear a certain similarity to the hornblende-plagioclase porphyry phase of the mafic sills occurring within Cane Lake pyroclastics (see "Mafic Sills"). The lamprophyres are all dull, greenish black weathering rocks, while on fresh surfaces the typical fine-grained black matrix with myriad biotite phenocrysts is evident. Biotite phenocrysts vary from less than 1mm to 1cm in diameter, but on the average are about 2mm. A thin section of a weakly magnetic sample taken from the dike south of Watson's Falls shows the rock to be composed essentially of biotite phenocrysts, constituting about 50 percent of the rock, in a plagioclase matrix. Plagioclase grains are optically continuous across and around biotite phenocrysts in many cases, indicating that the ground mass is not as fine grained as would appear in hand specimen. The plagioclase is poorly twinned on the albite law, each twin appearing to be spindle-shaped and rather vaguely defined. Low extinction angles suggest it is a sodic plagioclase, but it is too strained to make precise determinations. Feldspars are moderately sericitised, and biotites are in some cases rimmed by chlorite or a granular, very fine-grained amphibole. Granular amphibole also occurs scattered through the matrix. Secondary carbonate and an unidentified opaque mineral occur as accessories.

Apart from the dike near Beaverhead Island, the lamprophyre dikes all occur close to the mafic sills in the Cane Lake pyroclastics. Their texture is not very dissimilar to that of the hornblende-plagioclase mafic porphyries constituting these sills, and it is possible that they are offshoots of these sills. For this reason they have been grouped with them on Map 2320 (back pocket).

FELSIC INTRUSIVE ROCKS

Felsic Hypabyssal Rocks

Felsic hypabyssal rocks of various types are for the most part confined to two distinct zones within the map-area, one each on either side of the Manitou Straits Fault (Figure 5, Chart A, back pocket). Northwest of the fault they are predominantly found within Blanchard Lake basalts, from Manitou Island in the southwest, to Carleton Lake in the northeast. Southeast of the Manitou Straits Fault they are found predominantly within Cane Lake pyroclastics, Glass Bay basalts, Etta Lake metasediments and basalts, and a few are found within the Manitou Straits metasediments.

The rocks occupy bodies that are mostly transgressive and therefore referred to here as dikes. However some are sill-like in that they lie parallel or almost parallel to stratigraphic contacts. Dimensions of the bodies vary from narrow, discontinuous dikes a few feet wide, to broad, elongate dikes, in excess of 20 feet (6m) wide, continuous for distances of over a mile (2km) (such as the dike on Manitou Island, and the dikes parallel to the southeast shore of Lower Manitou Lake), to massive, thick, lensoid bodies of almost stock-like dimensions. Texturally they vary from felsitic to porphyritic to granitic, but are all petrographically similar in that felsic minerals predominate. They are not all necessarily of the same age, but their petrographic similarity suggests a chemical similarity and therefore common source. At no locality were cross cutting relationships between dikes observed, though dikes are sufficiently separated geographically that such evidence cannot be used to state categorically that they are all of similar age.

In hand specimen these rocks vary in colour on the weathered surface from brownish grey to pinkish white, and on fresh surfaces from grey to pink. The porphyries and felsites are usually grey, whereas more granitic varieties are frequently pink, on fresh surfaces. The dikes and lenses have undergone various degrees of shearing and alteration or recrystallisation. Some samples display in thin section almost perfectly preserved igneous textures, while others have been strongly sheared and recrystallised. Typical fresh samples of porphyry contain phenocrysts of sodic plagioclase and quartz in a fine-grained quartzo-feldspathic matrix. The plagioclase phenocrysts are euhedral, frequently zoned, and frequently twinned on the albite law; the quartz phenocrysts are embayed, resorbed, clear, and unstrained. Phenocrysts are rare or absent in felsite; they make up to 75 percent or more of the well developed porphyritic rocks. The porphyritic rocks grade transitionally into coarse-grained rocks with a granitic texture. Phenocrysts vary in size from less than 1mm to a maximum of about 1cm. Ferromagnesian minerals are usually present in amounts of less than 5 percent, and are commonly absent. They include biotite, amphibole, chlorite, and epidote. In many of the sheared porphyries, the quartz phenocrysts have been rounded and the feldspar phenocrysts completely altered to a sericite-epidote-quartz aggregate, while the quartzo-feldspathic groundmass has been recrystallised into a mosaic with a distinct tectonite fabric, in places with a foliation defined by platy minerals.

Felsic dikes are especially well developed on Manitou Island (see Figure 5). The majority of the dikes trend in a northeast direction, parallel to regional foliation. Numerous dikes of this type can be seen along the northwest shore of the southern end of the island, where they are all on the order of 2 to 10 feet (0.6 to 3m) wide, and strike approximately east-northeast. On the islands to the north of the middle of Manitou Island numerous dikes and lenses cut across the regional foliation and are not themselves foliated. One lens occupies almost the whole of an island: this, and the fact that numerous porphyry dikes occur in the vicinity, suggests that the lens may be part of a larger body of porphyry lying beneath the waters of Lower Manitou Lake. On the southeast side of the island numerous coarser, more granitic dikes occur within and adjacent to a prominent schist and mylonite zone interpreted to be a fault, in this report named the Manitou Island Fault. Some of these dikes, particularly those at the extreme southern tip of Manitou Island, cut across the fault zone and are not themselves affected by the shearing. The age of this shearing is not known, but has been interpreted (see "Faults" in "Structural Geology") to have been approximately contemporaneous with that along the Manitou Straits Fault. If this is the case, at least some of the felsic dikes in the map-area were emplaced later than one of the main tectonic events.

Granitic dikes, emplaced across regional foliation on the peninsula of Manitou Island covered by claims K3594 and K3595 (part of property 2 on Map 2320) appear to bear some relation to metallogenic processes which localized the pyrite-chalcopyrite-gold mineralization at this locality (see "Gaffney Prospect" in "Economic Geology").

Southeast of the Manitou Straits Fault, a number of larger quartz-feldspar porphyry dikes occur in the vicinity of Glass Bay, from Meridian Bay in the southwest, through to Cane Lake in the northeast. The largest of these is a stock-like, elongate and bifurcating body, about 1½ miles (2.4km) long by ¼ mile (0.4km) wide, west of Cane Lake. The intrusive nature of this body is suggested by its contact relationships with surrounding coarse pyroclastics: remnants of country rock locally occur as xenoliths within the porphyry close to its margins. An outcrop showing this relationship is located on the eastern shore of the small lake which cuts across the margin of the porphyry body.

Two dikes on the order of 100 feet (30m) wide, outcrop on the north shore of Glass Bay, and one of them extends to an island a few hundred feet offshore. They can be traced northeastward, inland, for about 1 mile (2km), where they coalesce. The probable continuation of one of these dikes may be seen some 2 miles (3km) to the southwest, where it crosses two headlands and an intervening bay, to terminate north of Meridian Bay. These dikes, traceable for at least 4 miles (6km) along strike, cross the contact between Glass Bay basalts and Cane Lake pyroclastics.

The age relationship of porphyry dikes to granitic stocks is difficult to demonstrate, since nowhere have dikes been followed into either the Scattergood Lake or Carleton Lake Stock. Southwest of Carleton Lake a rather wide porphyry dike occurs adjacent to the Carleton Stock. Lack of outcrop prevents observation of its relationship to the stock, but it seems likely that the dike could be an offshoot of the stock. Similarly, around the Scattergood Lake Stock, various satellitic granitic bodies, seen on the northern shores of Uphill Lake, are almost certainly offshoots of the stock (see "Scattergood Lake Stock"). Numerous porphyry dikes, of somewhat smaller dimensions than the granitic satellites, may also be offshoots of the main granitic stock. Close to the Scattergood Lake Stock a number of dikes are more ferromagnesian-rich (biotite-feldspar porphyry, see Figure 5) than most of the porphyry dikes in the map-area. In particular, a dike occurring on the east shore of Manitou Straits, about ¼ mile (0.4km) south of the portage to Cane Lake shows this feature.

From the frequency and distribution of dikes of porphyritic and granitic type at Manitou Island, it might be suggested, if indeed stocks and dikes are genetically related, that felsic plutonic rocks, of stock-like dimensions, lie at shallow depth beneath the island.

Felsic Plutonic Rocks

Felsic plutonic rocks occupy three areas. In the west, in the vicinity of Kaminni Lake, granitic and migmatitic rocks of an extensive batholithic body, variously referred to as the Atikwa-Niven Dome or the Atikwa Batholith (Goodwin 1965; Davies 1973), extend well beyond the map-area. In the east, south of Uphill Lake, a homogeneous granitic intrusion, extends southeastward out of the map-area, and is here named the Scattergood Lake Stock (see "Scattergood Lake Stock"). A small, homogeneous, granitic body, the Carleton Lake Stock, occurs in the north central part of the map-area.

All these bodies are well separated from each other. Their relative age relations are therefore conjectural. It is probable that the Scattergood Lake Stock and the Carleton Lake Stock are of the same age and both younger than the batholithic rocks in the west, because there is evidence that the emplacement of the batholithic rocks was syntectonic, and that the stocks were emplaced late in the tectonic cycle.

The age relations between these felsic plutonic rocks and the felsic hypabyssal rocks are also problematical. In no case has a dike been traced directly into the plutonic rocks. However, felsic dikes are scarce close to the rocks of the Atikwa Batholith, whereas they are abundant close to both the Scattergood Lake and Carleton Lake Stocks (see Figure 5). This suggests a genetic relationship between dikes and stocks, but not between dikes and batholith.

KAMINNI LAKE LOBE OF THE ATIKWA BATHOLITH

The granitic rocks of the Kaminni Lake lobe of the Atikwa Batholith are predominantly coarse-grained, porphyritic, pink, quartz monzonite and granodiorite. Close to the contact with mafic metavolcanics, which are now amphibolite, xenoliths are abundant and foliation pronounced. Mappable bands of amphibolitic migmatite, biotite-amphibolite migmatite, and migmatites containing quartz-feldspar-biotite gneiss and schist, are found well within the batholithic area, but appears to diminish in frequency toward the west, or the interior part of the batholith. These migmatites were in all probability derived by *lit-par-lit* injection of granitic magma into metavolcanics and intermediate pyroclastic rocks. Good evidence for this conclusion is seen at Olsen Bay, where a variety of migmatite types occur on the west shore of the bay, within the batholithic area; whereas similar mafic and intermediate metavolcanics, but not migmatitic types, occur on the east shore.

The contact between the granitic rocks of the Atikwa Batholith and the basal mafic metavolcanics (Merrill Lake basalts), as shown on the accompanying geological map (Map 2320, back pocket), passes through Little Merrill Lake, and not, as shown on earlier maps (Thomson 1933; Goodwin 1965; Davies and Pryslak 1967), through Merrill Lake, 2 miles (3.2km) further east. In his reconnaissance mapping Thomson (1933) included much of the amphibolites in his plutonic, Algoman phase. However, from the present, more detailed survey, it has been observed that there is a gradational transition across strike from clearly recognizable basaltic flow rocks into massive amphibolites, and therefore the amphibolites have been shown as metavolcanics on Map 2320. By analogy with Merrill Lake basalts, mappable amphibolitic and migmatitic units within the Atikwa Batholith have been grouped as part of the volcanic sequence.

SCATTERGOOD LAKE STOCK

The Scattergood Lake Stock, in plan view, is an elongate body, about 6 miles (10km) long, 2½ miles (4km) wide at its northwest end, and 1 mile (2km) wide at the southeast end, the long axis being oriented northwest. According to previous mapping (Thompson 1933), it is wholly contained within the metavolcanic-metasedimentary belt. A brief reconnaissance at the southeast end of Scattergood Lake by members of the present field party confirmed that mafic metavolcanics occupy that end of the lake, and that the granitic body is therefore probably a discrete intrusion and not continuous with batholithic rocks at Meggisi Lake. The stock is here named the Scattergood Lake Stock because Scattergood Lake is the only named lake that lies mostly within the confines of the stock.

Approximately half of the stock lies within the present map-area. Field observations suggest that it is petrographically homogeneous within the map-area. Contacts with surrounding mafic metavolcanics and Cane Lake pyroclastic rocks are sharp, and little or no xenolithic material occurs within the stock. Small mafic clots, rarely larger than 2 or 3cm in diameter, and predominantly composed of amphibole, occur very widely scattered through the stock. They may represent remnants of xenolithic, basaltic material incorporated in the magma.

On fresh surfaces, the rock is usually a pale pink colour, whereas weathered surfaces are more whitish because of weathering of feldspars. Grain size is of the order of 3 to 5mm and tabular feldspar phenocrysts, about 1cm in length occur very sparsely scattered through the rock, but may not be found at any one outcrop. The dominant mafic mineral everywhere seems to be hornblende. In thin section, the feldspars were found to be plagioclase of oligoclase composition, and subordinate microcline. The phenocrysts are all microcline. Quartz constitutes 10 to 30 percent of the rock. The ratio of potassium feldspar to total feldspar is between two-thirds and one-eighth: the rocks are thus classified as quartz monzonite and granodiorite, according to the classification of Ayres (1972).

A number of felsic and granitic dikes occur within pyroclastic and mafic flow rocks adjacent to the stock (see Figure 5). Three such dikes are well exposed on the north shore of Cane Lake. These dikes may be offshoots from the stock. At Uphill Lake, a number of small granitic bodies occur within pyroclastics on the north shore of the lake. These are probably all apophyses of the stock, since in hand specimen they are identical to equigranular phases of the stock.

CARLETON LAKE STOCK

The Carleton Lake Stock, in the north-central part of the map-area, is 1½ miles (2.4km) long by ½ mile (0.8km) wide in plan view. The long axis is oriented northeast, that is to say at right angles to that of the Scattergood Lake Stock, and parallel to regional trend of enclosing metavolcanic rock-units. The rocks of the stock occupy the shoreline of most of Carleton Lake, the form of which appears to have been controlled by the dimensions of the stock. More than 75 percent of the area of the stock is beneath the lake. Precipitous granitic cliffs occur on the northwest, southwest, and southeast shores.

Field mapping suggests that this stock, like the Scattergood Lake Stock, is essentially petrographically homogeneous. Contacts with mafic metavolcanics and pyroclastic rocks are sharp, and no xenoliths were found within the stock.

Superficially, rocks of the Carleton Lake Stock are identical to those of the Scattergood Lake Stock. The fresh colour is a flesh pink, weathering to a whitish pink. Colour index (mafic mineral content) is a little higher than in the Scattergood Lake Stock. Grain size is medium to coarse, and porphyritic phases are common. However, phenocrysts are not usually much larger than the matrix. Biotite appears to be the dominant mafic mineral in these rocks, as distinct from the hornblende in the rocks of the Scattergood Lake Stock. Examination of one thin section showed feldspars to be normally zoned plagioclase of oligoclase composition, and subordinate microcline. As in the Scattergood Lake Stock, phenocrysts are microcline. Quartz constitutes 10 to 30 percent of the rock. The ratio of potassium feldspar to total feldspar is between two-thirds and one-eighth, as in the rocks of the Scattergood Lake Stock, and they are thus classified as quartz monzonites and granodiorites, according to the classification of Ayres (1972).

A number of felsic dikes occur close to the stock, and may be offshoots of it. In particular, a dike oriented in a northeasterly direction near the southwest end of the stock may be an extension of the tongue-shaped outcrop defining this end of the stock. However, since confirmation of this was not found in outcrop, the dike has not been shown to join with, or be intersected by the stock on the geological map.

Chemical analyses of one sample from each of the Scattergood Lake and Carleton Lake Stocks (Table 6, sample H and I) show the essential chemical similarity of the two bodies. A chemical analysis of a sample from the Scattergood Lake Stock, taken from Thomson (1933, p.12) is shown for comparison.

Relationship between Felsic Stocks and Felsic Hypabyssal Rocks

As noted previously (see "Felsic Hypabyssal Rocks"), felsic dikes and similar bodies appear to occupy two distinct zones on either side of the Manitou Straits Fault zone (see Figure 5). It is also of note that the Scattergood Lake Stock within the map-area and the Carleton Lake Stock each intrude one of these zones. It has been suggested (see "Felsic Hypabyssal Rocks", "Scattergood Lake Stock", and "Carleton Lake Stock") that felsic dikes close to the stocks may be offshoots from these stocks. The possibility also arises that most or all of these dikes and lenticular intrusive bodies are of the same age and consanguineous with the stocks. If this is the case the large number of dikes in the vicinity of Manitou Island and Shaughnessy Bay might indicate that a stock-like body is present in this area at shallow depth.

Some of the dikes, particularly those that transgress stratigraphy at high angles, may be the hypabyssal manifestations of felsic volcanism represented by coarse pyroclastics and thus somewhat older than the stocks.

However, very few of the dikes transgress stratigraphy at high angles, but appear to have been intruded parallel or almost parallel to regional structural trends. This suggests that, like the stocks, they were emplaced after the volcanic-sedimentary pile had been folded into its present, vertical configuration. Many of the narrower dikes are sheared parallel to regional shear trends, whereas no shearing is evident in granitic rocks of the stocks. An explanation might be that the more massive stocks acted as buttresses during continuing regional deformation and fractured, while the dikes, being mechanically weaker, sheared.

Table 6

CHEMICAL ANALYSES AND MOLECULAR (CATION) NORMS OF SELECTED GRANITIC ROCKS FROM THE LOWER MANITOU-UPHILL LAKES AREA. MAJOR ELEMENTS ARE IN WEIGHT PERCENT, TRACE ELEMENTS IN PARTS PER MILLION. THE SAMPLE LOCATIONS ARE SHOWN ON FIGURE 3. ANALYSES BY THE MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	H	I	"GRANITE"
Major Elements			
SiO_2	67.50	67.50	66.95
Al_2O_3	15.60	16.00	16.53
Fe_2O_3	1.96	1.54	1.60
FeO	1.25	1.03	1.17
MgO	1.68	0.78	1.36
CaO	2.49	2.37	2.83
Na_2O	5.13	5.02	5.12
K_2O	3.78	3.66	2.95
TiO_2	0.30	0.28	0.39
P_2O_5	0.15	0.14	0.10
S	<0.01	<0.01	0.01
MnO	0.05	0.06	0.08
CO_2	0.10	0.18	0.33
H_2O^+	0.30	0.30	0.48
H_2O^-	0.25	0.29	
Total	100.50	99.20	99.90
Trace Elements			
Ag	<1	17	
As	<3	<3	
Ba	1300	1800	
Be	7	4	
Co	8	<5	
Cr	170	25	
Cu	10	10	
Ga	20	20	
Li	25	10	
Mo	<10	<10	
Ni	35	10	
Pb	35	35	
Sb	<1	<1	
Sc	<10	<10	
Sn	<10	<10	
Sr	1000	1000	
V	55	35	
Y	<20	<20	
Zn	50	55	
Zr	160	140	
Molecular Norms			
Apatite	0.312	0.296	
Pyrrhotite	0.034	0.035	
Ilmenite	0.415	0.394	
Orthoclase	22.189	21.866	
Albite	45.711	45.526	
Anorthite	8.306	10.414	
Magnetite	2.034	1.626	
Enstatite	3.455	1.977	
Ferrosilite	0.133	0.176	
Quartz	15.000	17.258	
Diopside	2.297	0.396	
Hematite	0.088	0.035	
Chromite	0.027	0.000	

SAMPLE	ROCK TYPE	LOCATION	ODM SAMPLE NUMBER
H	Granodiorite	2 miles (3.2km) south of Uphill Lake	72-B-231
I	Granodiorite	Carleton Lake	72-B-269
"granite"	"pink hornblende granite" from Scattergood Lake Stock (Thomson 1933, p.12)		

A further possibility is that the more comformable dikes are sheets, intruded into the volcanic pile prior to regional deformation, and therefore not related to the later felsic stocks.

The author is inclined toward the view that stocks and dikes were contemporaneous, at least within the map-area.

Middle or Late Precambrian

MAFIC INTRUSIVE ROCKS

Two discontinuous diabase dikes were mapped, one each on the north and south side of a small lake ½ mile (0.8 km) south of the east end of Cane Lake. They both strike southeast and are vertical. Their distribution suggests they are one and the same dike, displaced by a northeast-trending fault. However, the dike on the north side of the lake is probably in excess of 50 feet (15 m) wide, while that on the south side of the lake is no more than 6 feet (2 m) wide. The dike on the north side of the lake outcrops at the top of a steep-sided hill. Its contacts with surrounding coarse-grained mafic flow rocks were not found because of overburden. Both contacts of the dike on the south side of the lake were found, and noted to be sharp, against coarse-grained mafic flow rocks.

The dikes weather a typical orange-brown colour in most exposures, but the rocks in a few outcrops are mottled pale green and black: the pale green mineral is plagioclase occurring as laths, and the black mineral is pyroxene. The rock has a fresh, unaltered appearance on unweathered surfaces, and is almost black in colour, with a typical diabasic texture. Chilled facies were occasionally found within the dikes, and pyrite appears to be ubiquitously distributed, constituting between 1 and 10 percent of the rock.

Cenozoic

PLEISTOCENE AND RECENT

The present topography and drainage pattern in the Lower Manitou-Uphill Lakes area is a result of the scouring action of glacial ice of the Pleistocene Epoch. Very little sedimentary material can be attributed to glacial action, and the very minor amounts of material in swamps and muskegs is attributable to Recent geological activity.

According to Zoltai (1961, p.63), in northwestern Ontario "Evidences thus far observed indicate the movements of the latest, or Wisconsin glacier only". Ice movements were from two prominent directions during the Winconsin glaciation: Keewatin ice moved from a northwesterly to westerly direction; Patrician ice came from the northeast (Zoltai 1961). In the present map-area little evidence was found for Keewatin ice activity since striae, which are abundant on all exposed rocky surfaces, are predominantly oriented northeasterly, parallel to larger scale, glacially moulded bedrock structures, and were presumably produced by movement of Patrician ice. At a number of localities low-angle cross cutting relationships of these striae were observed, suggesting the possibility of more than one advance of Patrician ice. Evidence for at least some influx of Keewatin ice was observed at the southwest end of Manitou Island, where sets of striae were observed at two localities, with a N80E and a S70E orientation respectively. At both places these striae were interpreted on cross cutting evidence to be later than the dominant northeasterly striae. Because these striae are poorly developed, little opportunity was found to determine the direction of flow of the ice that produced them: it must be borne in mind that it may be possible for ice to be deflected by irregularities in topography, and that these striae could therefore have been produced by Patrician rather than Keewatin ice.

Only limited areas of Pleistocene sand deposits, for example at Blanchard Lake and in the vicinity of location HW676 on Manitou Straits, were found during the present survey. No extensive moraine deposits, and no glaciolacustrine clays, such as are well developed elsewhere in northern Ontario (Zoltai 1961; 1965) were found.

Of interest are two occurrences of potholes. Both occurrences are on shore lines, one on the east shore of Doyle Bay, and the other about ¼ mile (0.4 km) southwest of Camp Beaverhead on the shore opposite Beaverhead Island. The former, or Doyle Bay pothole, is found right at the shoreline, and measures only a few feet in diameter. The latter, or Beaverhead potholes, are more spectacular. Three partially preserved potholes, two of which are at the shore, and a third which is 30 feet (9 m) behind the shore, occur in a row, possibly delineating an ancient stream channel. Two of the holes were of large diameter, possibly, judging from their curvature, in excess of 10 feet (3 m). The third between the other two, is some 12 to 15 feet (3.6 to 4.6 m) deep and 4 to 5 feet (1.2 to 1.5 m) in diameter. It is probable that the holes were scoured by glacial melt water run off during Pleistocene times.

STRUCTURAL GEOLOGY

MAJOR STRUCTURE

The structure of "greenstone" belts of the Canadian Shield has classically been considered to be that of synclinorial supracrustal keels imbedded in surrounding crustal granitic rocks and this model has mostly been substantiated by recent work (Clifford 1972). Thomson's (1933) work implied an essentially synclinorial disposition of the Manitou-Stormy Lakes supracrustal metavolcanics and metasediments, in that he considered the Timiskaming-type sedimentary rocks of the Manitou "Series" to lie above the Keewatin-type volcanic sequence, and therefore at the centre of the synclinorium. This conclusion was further strengthened by his analysis of the structure within his Manitou "Series" at Mosher Bay, where he (Thomson 1933, p.17 and Figure 2) concluded that "...the sediments appear to occur in a closely folded syncline, the axis of which strikes about N 70° E and pitches to the southwest." Pettijohn (1937, p.168 and Plate 2), on the basis of detailed mapping of Mosher Bay, found no repetition of individual members of the metasedimentary sequence, and that grain-size gradations in individual beds in most cases indicated tops to be to the north. He also found pillows with tops facing north in mafic metavolcanics lying directly above and to the north of the metasediments. On this basis, apparently, the major synclinorial axis has been placed, on later maps (Goodwin 1965; Davies and Pryslak 1967), to the north of Thomson's Manitou "Series" within mafic metavolcanics.

However, within the present map-area, rocks of Thomson's Manitou "Series" are at the top of the volcanic-sedimentary sequence southeast of the Manitou Straits Fault, by which they are attenuated. Thomson considered (1933, p.11) that the volcanic sequence "...west of the fault is on the western limb of a syncline, the axis of which trends roughly northeast-southwest". The volcanic and sedimentary sequence east of the fault is on the eastern limb of a syncline, which may or may not be the same syncline. Until further work has been done in the Manitou Lakes-Stormy Lake region the relationship between the two sequences facing each other across the Manitou Straits Fault cannot be stated with any certainty.

Thomson (1933, p.11) considered that "...the pillow lavas are not sufficiently well developed or widespread in occurrence to furnish a key to the major structural features". He (1933, p.11) considered it possible that narrow bands of clastic sediments within the mafic volcanics ". . . are remnants of the main body of the Manitou series that have been so deeply infolded as to escape erosion". According to Thomson, "This seems the more logical assumption in the case of the isolated area of sediments east of Cane Lake, which is much larger than the others and which contains conglomerate similar to that of the Manitou series". However, these clastic deposits, pyroclastic rather than epiclastic, are here interpreted to be part of a discrete unit within the mafic metavolcanics, and to herald the great accumulation of pyroclastic material constituting the lower part of Thomson's Manitou "Series" (see "Etta Lake Metasediments").

During the present survey, abundant reliable top determinations were obtained within mafic flow rocks from pillow lavas, while fewer and less reliable determinations were made on porphyritic mafic flows, using criteria previously outlined by the author (Blackburn 1973c). These determinations were made particularly in those parts of the northwestern and the southeastern sequences outcropping along the Manitou Straits and on Lower Manitou Lake. In the volcanic sequences to the northwest of the Manitou Straits Fault there are no reversals in top determinations. However, to the northwest of a line between Blanchard Lake and Rector Lake no reliable top determinations were made. Although pillows are fairly abundant throughout this part of the sequence, deformation and migmatisation has made them unreliable for top determinations. Goodwin (1965), on the basis of top determinations from Upper Manitou Lake, interpreted an anticlinal fold axis to lie in a northeasterly direction, almost coincidental with the centre line of the lake, passing through Swede Boys Island and the community of Gold Rock. He later referred (Goodwin 1970, Table 2) to this as the Manitou Anticline. The extension of the Manitou Anticline to the southwest is shown to pass approximately equidistant between two gold occurrences (Goodwin 1965), referred to in this report as the Hampe property ("Swede Boy" location) and the Reliance prospect (see the section "Economic Geology"), and shown as 8 and 11 respectively on Map 2320 (back pocket). No direct evidence was found during mapping to substantiate or negate the presence of this fold axis. In the absence of evidence to the contrary, the Manitou Anticline axis has been interpreted to extend in a southwesterly direction into the present map-area, so that all southeasterly pillow facings occur to the southeast of the axial plane trace of the fold.

Southeast of the Manitou Straits Fault, abundant top determinations from pillow lavas, mostly at the top of the mafic metavolcanic sequence, and also from grain gradation in metasediments, indicate a generally consistent picture of a homoclinal sequence facing essentially northwest. A few discrepancies occur in pillow and porphyritic flow facings at Glass Bay. South of a line extending a little south of east from the narrows about half way along Glass Bay, there is a very pronounced change in pillow facings. Only at four localities were pillows well enough preserved to provide reliable facings: in all four localities the pillows were found to face southeastward, that is, in the opposite sense to pillows elsewhere in the southeastern volcanic sequence. One porphyritic flow-top facing was obtained from the extreme southeast corner of the map-area, and indicated a southwesterly facing. Porphyritic basalts also seem to define an arcuate structure in this southeast corner, the nose of the arc facing westward: whether this is a true fold structure is difficult to ascertain. There is, then, evidence that in the southeast, structural complications have disturbed the otherwise essentially homoclinal nature of the southeastern metavolcanic-metasedimentary sequence.

FAULTS

Faulting within the present map-area is of two distinct types, probably genetically distinct. Age relationships between the two types are difficult to ascertain in that cross cutting relationships between the two types are only seen at a few places. The first type is associated with intense shearing, producing broad schistose and mylonitic bands along which fault movements have occurred. This type is exemplified by the Manitou Straits Fault zone. The second type is of more brittle nature, and has no associated schist zones: fault surfaces are discrete movement planes. This type is characterized by the northeast- to north-trending faults running obliquely across Glass Bay.

Manitou Straits Fault and Related Schist Zones

Thomson (1933, p.4) recognized that:

> A fault of considerable magnitude extends through the Manitou straits and northward to Kabagukski lake. It may possibly continue southward along the eastern shore of Lower Manitou lake. A zone of soft fissile schists was developed along the fault.

The width of this zone, according to Thomson (1933, p.17) is about 200 feet (60m). During the present survey, it was found that the fault zone is considerably wider at some localities, and that parallel fissile zones, separated by less sheared rocks, are present. There is in fact not one fault, but a distinct zone of shearing which in total defines the Manitou Straits Fault. On the geological map (Map 2320, back pocket) the zone has been outlined by fault symbols: between the boundaries shearing is present, and movement has taken place along a multitude of discrete shear surfaces.

The iron formation unit on Beaverhead Island is enclosed within the fault zone. Strong shearing is found in argillite, siltstone, sandstone, and conglomerate on either side of the iron formation. For much of the distance along the fault zone the contact between southeast-facing pyroclastics and mafic metavolcanics and northwest-facing metasediments lies within the fault zone. On the geological map the contact has been drawn on an arbitrary basis in most places, since chloritic to sericitic schists derived from volcanic rocks on the northwest side of the fault zone could not be distinguished from sericitic to chloritic schists derived from sedimentary rocks on the southeast side of the fault zone. Only where distinct sedimentary structures and textures have been preserved within the fault zone can such schistose rocks be definitively classified.

Along parts of the fault zone there is a low angular discordance between bedding and schistosity within and outside, but close to the fault zone. In the field, the discordance is in most places difficult to ascertain, but it can be seen distinctly at the northeast end of the fault zone, where bedding, in general, strikes more east of north than the schistosity. In this respect Thomson (1933, p.18) noted that:

> . . . Near the contact the sedimentary beds are truncated by this sheared zone at an angle of about 15 degrees in Mosher bay and 25 degrees on Beaverhead island. In Mosher bay there is concrete evidence of great disturbance in the sedimentary beds near the faulted contact. Drag folds are developed in the arkosic and slaty beds, and small minor faults may be observed in several places . . .

The Mosher Bay locality is outside and to the northeast of the present map-area, but serves to add further evidence for the interpretation of the shear zone as one along which faulting has occurred. The angular discordance noted by Thomson on Beaverhead Island is more apparent than real, most probably attributable to dragging of sediments and pyroclastics along the fault zone, since individual rock units do not show this discordance.

That the fault has attenuated the sedimentary sequence on the southeast side of the shear zone is suggested by the complete absence of sandstones, siltstones, argillites, and polymictic conglomerates from the top of the sequence over a distance of at least 1 mile (2km) to the northeast of Camp Beaverhead. The thick sequence (at least 1,000 feet) (300m) of these well bedded sedimentary rocks which is especially well exposed along the southeastern shore of Manitou Straits and a small lake about 1 mile (2km) west of Cane Lake, diminishes to zero thickness over a distance of less than ½ mile (0.8km). A somewhat attenuated, and more conglomeratic, sequence reappears in the vicinity of Beaverhead Island. The continuity of this predominantly turbidite-like sequence (see "Manitou Straits Metasediments") along strike from Mosher Bay in the east (P.R. Teal, graduate student, McMaster University, personal communication, 1972), down Manitou Straits, for a distance of some 10 miles (16km), makes it highly unlikely that the termination is due to sedimentary facies change, because the same facies occur again at Beaverhead Island. These facies were not traced southwest of the island, and it is likely that they were again truncated by the fault in a southwest direction. Aeromagnetic data (ODM-GSC 1961) suggest that the iron formation continues another ½ mile (0.8km) southwest of Beaverhead Island, and possibly to the northwest side of the fault zone. However, the Manitou Straits Fault zone may be sufficiently wide at this point to include this extension of the iron formation within its boundaries.

Cane Lake pyroclastics also terminate beneath Glass Bay, near to Beaverhead Island. This may be attributable to attenuation against the Manitou Straits Fault, or alternatively may mark the edge of the pyroclastic depositional basin.

It was noted at the beginning of this section that Thomson considered the possibility of the fault zone continuing southward along the southeastern shore of Lower Manitou Lake. Mafic metavolcanics, predominantly pillow lavas, are strongly sheared along this shore, and chlorite schists are present on a number of headlands, close and parallel to the shore. The author considers this to provide ample evidence of the continuity of the fault, which extends out of the map-area at its southwest corner.

The schist zone associated with the Manitou Straits Fault is not the only one in the area. Other, less continuous, schist zones occur to the northwest of the Manitou Straits Fault. In all of these schist zones the shearing is northeasterly and parallel to that in the Manitou Straits. Sericitic and chloritic schists are present along the southeast shore of Manitou Island, on the western peninsula of Beaverhead Island and the adjacent islands to the north, and over a distance of some 3 miles (5km) along the northwest side of the Manitou Straits northeast of Doyle Bay. Other schist zones occur at various places along the Manitou Straits, but are in general narrow and discontinuous. The author considers that the schist zones, like those defining the Manitou Straits Fault, are associated with faulting caused by shearing along numerous planes. Along the Manitou Straits there may be a number of such fault zones. For example, the largest island in the straits, close to Birch Narrows in the centre of the map-area, may be fault-defined on its northwest and southeast sides. On the southeast side a zone of chloritic schists can be traced within pillowed flows, while on the northwest side an airborne electromagnetic survey (see "Freeport Canadian Exploration Company [1970]" in the section "Economic Geology") and a ground electromagnetic survey (see "Kerr Addison Mines Limited [1967]" in "Economic Geology") has delineated a marked line of anomalies, here interpreted to define a schist zone and associated faulting.

On Manitou Island intense shearing has produced sericitic and chloritic schists from a variety of rock types at three localities along the southeast shore. In the southwest, felsic volcanic rocks of probable flow origin have been converted to whitish mylonites. Toward the northwest at this same locality the mylonites become more green in colour, and are interpreted to have been intermediate pyroclastic rocks. At the peninsula projecting out into Lower Manitou Lake about half way along the shore of Manitou Island, the rocks within the schist zone are intermediate pyroclastic rocks. A schist zone also occurs along the shore at the tip of the peninsula adjacent to the Gaffney prospect (see "Economic Geology"). This schist zone has been intersected by a number of diamond drill holes, and sedimentary rocks were logged in core from two drill holes on the southeast side of the schist zone below lake level (diamond drill holes S20 and S21, Figure 10). At the northeast end of the island, chlorite schists derived from mafic flow rocks define the schist zone.

Schists of the Manitou Island Fault zone may continue northeastward to be seen next on the western peninsula of Beaverhead Island and the adjacent islands to the north. At the tip of the western peninsula, mafic metavolcanics form a conspicuous cliff, facing northwestward toward the channel between Beaverhead Island and the adjacent island. At the foot of the cliff, highly contorted schistose rocks are exposed close to lake level, and similar schists occur on the adjacent islands. Schist zones occur in outcrop at intervals along the southern shore of Beaverhead Island, and its very irregular configuration must be attributable in part to these softer, fissile zones which weather out comparatively easily compared with more massive, mafic flow rocks.

The Manitou Island schist zone could not be traced in outcrop beyond these islands, but another schist zone, approximately along strike with it, begins near the mouth of Doyle Bay, on its north shore, and extends some 3 miles (5 km) along the northwest side of the Manitou Straits. This schist zone is almost entirely in intermediate pyroclastic rocks, but widens at its northeast end where it includes chloritic schists near Watson's Narrows on Manitou Straits. At this point the schist zone appears to join with the Manitou Straits schist zone.

Cross Faults, Lineaments, and Joints

Considerable evidence exists to postulate that the schist zones discussed above were developed prior to later sets of cross faults. The cross faults offset shear zones where they intersect them, though often the amount of offset is small, probably because stress is taken up in the vicinity of the shear zones by a component of strain along the shear zones. On Manitou Straits, near Beaverhead Island and Doyle Bay, at least three of these cross faults, oriented east of north, intersect schist zones of the Manitou Straits Fault and the postulated Manitou Island Fault.

When prominent lineaments (mostly interpreted from study of air photographs) are combined with known faults (Figure 6) a pattern of two prominent sets of cross faults emerges. The dominant set of cross faults (set A on Figure 6) trends about N20E, while a weaker, but consistent set of cross faults trends approximately east. The N20E set is part of a regional fracture pattern characteristic of the area between the Manitou Lakes on the north and Rainy Lake on the south (Parkinson 1962, Figure 6; Davies and Pryslak 1967; Blackburn 1973b). These prominent fractures are spaced on the order of 1 to 2 miles (2 to 3km) apart.

The second set of cross faults (set B on Figure 6) is only weakly developed. Fractures of this set appear to be less continuous, and are frequently bounded at their ends by cross faults belonging to the N20E set. As part of a regional photogeologic survey, Parkinson (1962, Figures 2 and 6) shows a prominent fault zone which he calls the Kenora Fault Zone, extending from the Ontario-Manitoba border, near Kenora, in the west, to Ignace in the east. This second set of cross faults, with a predominantly easterly trend, may be considered to be part of Parkinson's set. There is no evidence within the map-area that any major displacement has occurred along these cross faults.

During field work several hundred joint determinations were made throughout the map-area. Only prominent joint directions were measured, and usually in parts of the map-area where other structural data was of limited occurrence. Most of the data were collected in three parts of the area: in the plutonic rocks around Kaminni Lake; in the massive mafic metavolcanics in the southeast (Beck Lake-Ponto Lake); and in the Scattergood Lake Stock. Bimodal distributions were found in the Kaminni Lake sub-area, and in the Beck Lake-Ponto Lake sub-area (Figure 7). Gneisses and migmatites of the area around Kaminni Lake are marginal facies of the Atikwa Batholith. A strong joint pattern appears to be developed striking about N75E, with a weaker set about N10E. The stronger joint set may be associated with the regional east-trending fracture pattern (Kenora Fault Zone of Parkinson, 1962), while the weaker joint set may be associated with the regional N20E fracture set. In the area around Beck Lake and Ponto Lake the strongest joint set strikes about S30E and a weaker set strikes about N50E, almost at right angles to it. Neither set has a regional fracture pattern analogue. However, the weaker set, oriented northeast, can perhaps be correlated with the rather weak maximum found in the Scattergood Lake Stock, also oriented northeast. Regional fracture patterns in the stock tend to be aligned in a northeasterly direction, suggesting their association with the northeast jointing.

MINOR STRUCTURES

Within the map-area, minor structures include various types of foliations and lineations, and, within highly sheared rocks associated with the schist zones, well developed kink bands. Minor folds were only found within iron formation at Beaverhead Island.

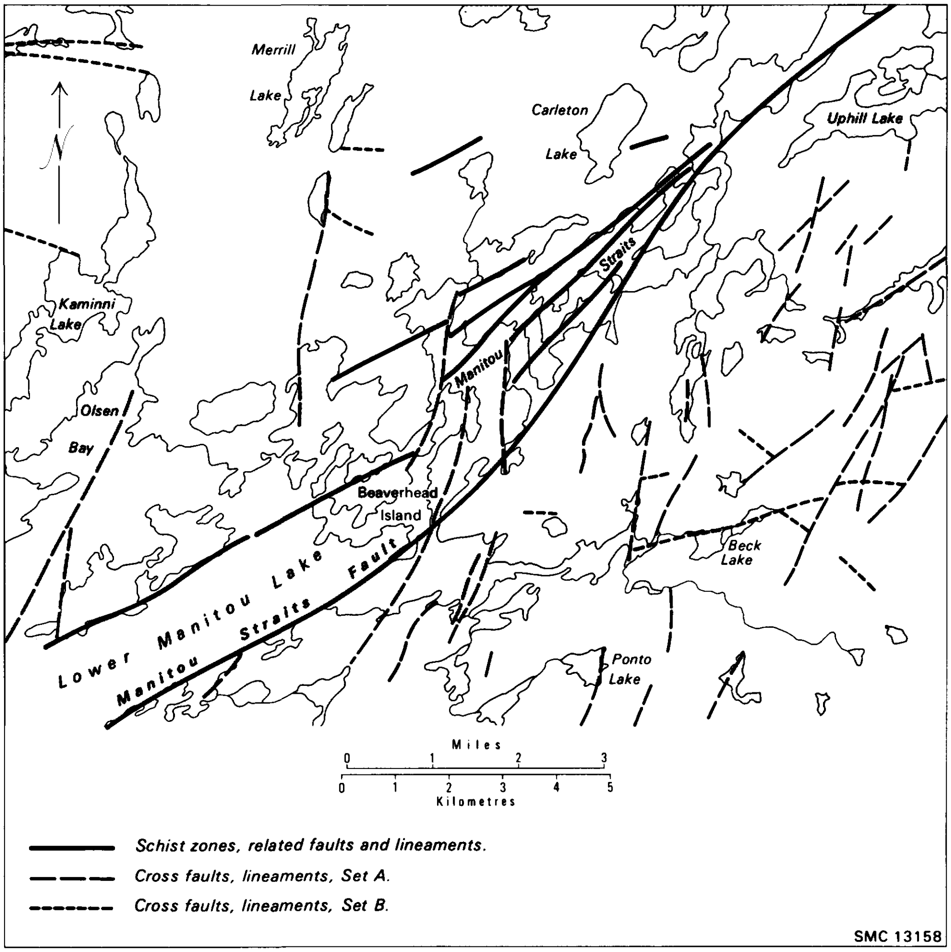


Figure 6–Major fracture patterns in the Lower Manitou-Uphill Lakes area.

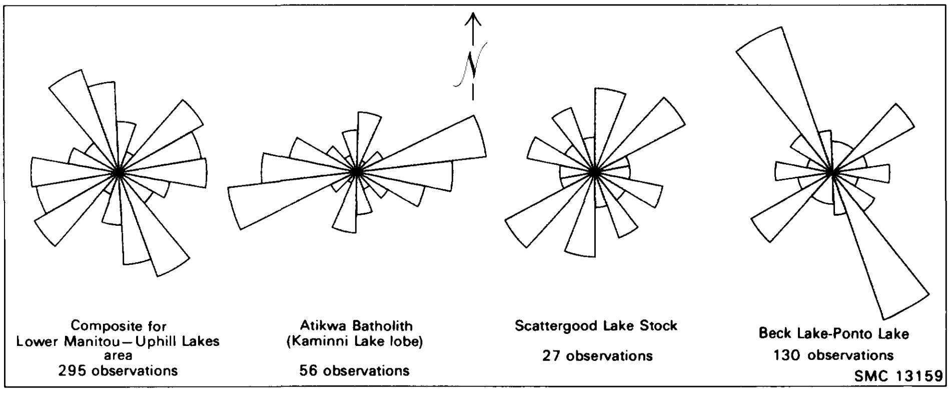


Figure 7–Rose diagrams of strikes of joints in the Lower Manitou-Uphill Lakes area.

Foliation

The term *foliation* is used here to encompass any mesoscopic planar structure of tectonic origin. Thus schistosity, slatey cleavage, and gneissosity, all of which are found in the map-area, are all foliations. On the map face (Map 2320, back pocket) three symbols have been employed to designate these foliate structures; a specific symbol for gneissosity, a specific symbol for schistosity, and a general symbol for foliate structures other than those found in gneisses and schists. Rocks with gneissic structure are all found in the west of the map-area, in and adjacent to the Atikwa Batholith, in rocks of amphibolite facies. The gneissosity is a mineral banding. The term *schist* is here used to include any tectonites in which the planar anisotropy is defined by platey minerals along which the rock cleaves easily. In practice the schistosity symbol has been used for foliation found within the schist zones, and includes phyllitic and mylonitic rocks. Rocks with slatey cleavage, usually of argillitic origin, where they occur outside the schist zones, have been designated with the foliation rather than the schistosity symbol.

The more general foliation symbol has been used for rocks that possess a distinct planar anisotropy which is neither defined by platey minerals nor by mineral banding. The anisotropy is frequently defined by tabular or prismatic minerals, or lensoid aggregates of equant minerals. This is the more frequent case apart from schist zones and migmatite terrains. In felsic plutonic rocks, feldspars, amphiboles, and micas are frequently aligned consistently in any one outcrop, and this constitutes a foliation. In many places in the vicinity of Kaminni Lake it is only possible to see the trend of the foliation on one subhorizontal surface in outcrop, so that the dip angle has been omitted, or the dip direction omitted.

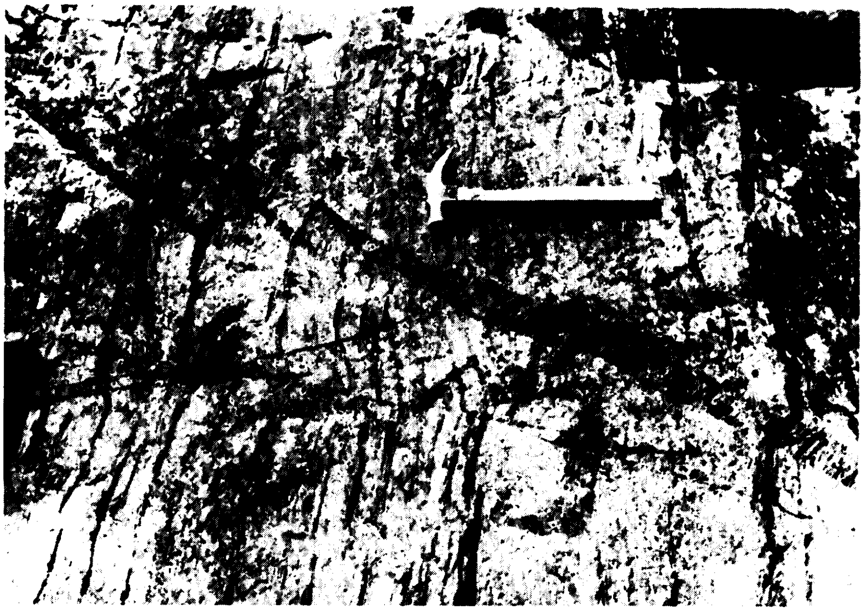
The dominant foliation trend in the map-area is northeast, in general parallel to formational trend, and it is frequently found that foliation is parallel to bedding in metasediments and pyroclastic rocks and to flow units in mafic metavolcanics. In fact, it may therefore often be assumed, where primary depositional lamination is absent, that foliation gives an approximation to that surface. Thus, although primary structures are uncommon north of the Manitou Anticline, it may be assumed that the shallow dips in foliation found close to the edge of the metavolcanic-metasedimentary belt reflect a similar shallow dip in the formational contacts and in bedding. It is on this assumption that estimates of stratigraphic thicknesses north of the Manitou Anticline have been made.

Foliation of any kind is difficult to find in the massive mafic flow rocks in the southeast of the map-area. Where observed, it appears to have a more easterly trend than the prominent northeastward direction along the Manitou Straits.

Foliation was not found in the granitic rocks of the Scattergood Lake and Carleton Lake Stocks, suggesting that the stocks were not emplaced during regional deformation, and that they have not been later involved in any major tectonic episode.

Lineation

All lineations mapped are mineral lineations, defined by elongate amphiboles, micas, feldspars, and quartz rodding, and are found to lie in the plane of regional foliations. At only a few localities, notably within amphibolitic and migmatitic rocks at Olsen Bay and Kaminni Lake, were lineations found in the absence of a planar anisotropy. Throughout



ODM 9336

Photo 19–Kink bands in finely bedded slatey, argillite. Note dominance of one set, and *en echelon* arrangement of bands. Manitou Straits, ¾ mile (1.2 km) northeast of Watson's Narrows.

the area the predominant trend of lineations is to the south-southeast, and there is a consistent increase in plunge angle from northwest to southeast across the area. Along the Manitou Straits the plunge of lineations is steep, usually on the order of 65 to 80 degrees, plunging down the dip of the steeply dipping foliation. Southeast of the Manitou Straits Fault, lineation is only weakly developed and especially so within Manitou Straits metasediments and Cane Lake pyroclastics.

Kink Bands

At a number of localities along the Manitou Straits mesoscopic structures indicative of late strain along the Manitou Straits Fault and related schist zones were encountered. These commonly take the form of kink bands (Photo 19), the geometry and genesis of which have been amply discussed in the literature (e.g. Anderson 1964; Paterson and Weiss 1966; Ramsay 1967; Kleist 1972). The kink bands are developed in schistose and phyllitic rocks adjacent to and within the Manitou Straits Fault, and the Manitou Island Fault, but have also been found at one locality almost 1 mile (2km) distant from the Manitou Straits Fault, on Cane Lake. The form of the kink bands varies with the rock type in which they occur but at any one outcrop the trend of the kink bands is usually consistent.

The kink bands commonly occur in conjugate sets, so that there are two consistent orientations, each crossing the local schistosity so that it approximately bisects the angle they make with each other. The bisected angle is the obtuse angle of the set, a characteristic of conjugate kink band sets (Anderson 1964; Paterson and Weiss 1966; Ramsay 1967; Kleist 1972).

The sense of rotation on kink bands is always such that strain has been in the form of shortening along the direction parallel to regional schistosity. Similar types of structures in which this type of strain is implied, but where kinking is not in bands, are designated conjugate or box folds. Folds of this type are found within the Manitou Straits Fault zone at the end of the southeast peninsula of Beaverhead Island.

Experimental work (e.g. Paterson and Weiss 1966) suggests that kink bands only form in rocks with a distinct planar anisotropy, and only when such a rock is subjected to compression within certain angular limits to the plane of anisotropy; thus little or no kinking may be expected if the angle between the foliation and compression direction exceeds about 25 degrees.

The development of kink bands, box folds and conjugate folds in schistose rocks associated with the Manitou Straits Fault and other fault zones is a late-stage phenomenon. However, the relationship between these structures and regional fracture and joint patterns is not clear. In the vicinity of Beaverhead Island, joints appear to be developed parallel to kink band orientations, so that some jointing may have been produced under the same stress system as that which produced the kink bands. In fact, at many outcrops, one of the conjugate directions of kink banding is expressed by jointing rather than kinking.

Cross faults close to the Manitou Straits Fault (e.g. the one immediately east of Beaverhead Island, see Figure 6, cross fault set A) closely parallel the south-southeast orientation of one of the conjugate kink band orientations. Since the amount of displacement along the length of a kink band is limited by the width of the kink band, most of which are no more than 1 or 2 inches (2.5 to 5cm), then this might explain why there has been so little displacement of the Manitou Straits Fault zone along these regional fracture zones (Figure 6).

STRATIGRAPHIC SYNTHESIS OF PRECAMBRIAN ROCKS

Analysis of the Early Precambrian stratigraphy in the Lower Manitou-Uphill Lakes area is complicated by folding and faulting. Three stratigraphic columns have been erected (Figure 8), one each flanking the Manitou Anticline, northwest of the Manitou Straits Fault (columns A and B) and one to the southeast of the Manitou Straits Fault (column C). Tentative correlations between columns A and B have been made on the basis of earlier mapping (Thomson 1933; Goodwin 1965), which clearly shows a continuity of pyroclastic rocks around the nose of the Manitou Anticline (see also Davies and Pryslak 1967), and also on the basis of the positioning of the Manitou Anticline within the present map-area (see "Structural Geology"). Correlation of columns A and B with column C, across the Manitou Straits Fault, is not here attempted, as sequences differ substantially.

Sections measured across strike, and which make allowances for change in dip of formations (see "Foliation" for further discussion of primary strike and dip interpretation), indicate that the southeast sequence is at least 25,000 feet (7600m) thick whereas

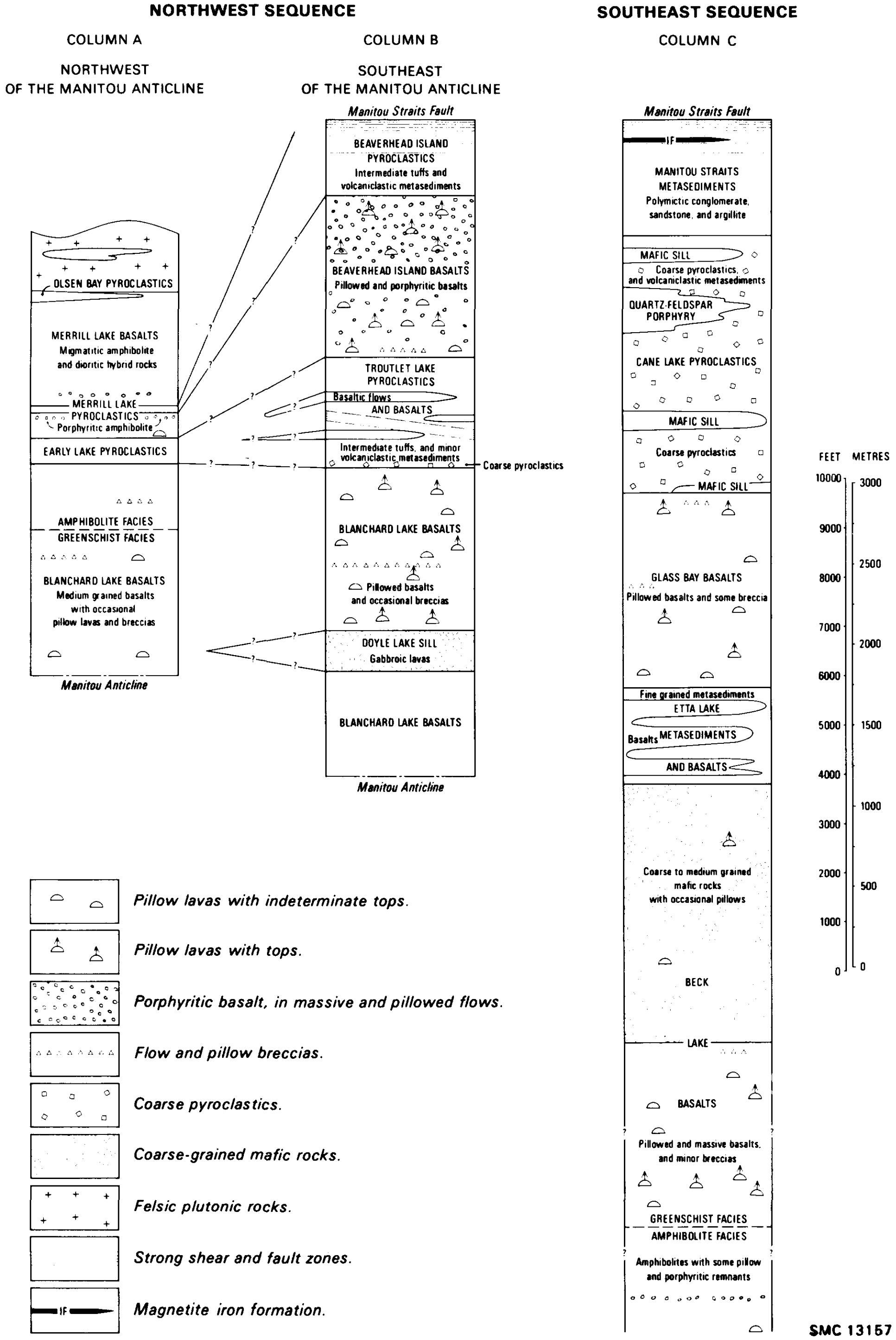


Figure 8—Stratigraphic columns showing thicknesses and possible correlations in the Lower Manitou-Uphill Lakes area. The thicknesses were estimated along a line approximately crossing the map-area from northwest to southeast.

the northwest sequence is about 12,000 feet (3650m) thick, as exposed. The northwest sequence is composed of mafic flows and intermediate pyroclastic rocks in the approximate ratio of 2:1, while the southeastern sequence is composed of mafic flows, intermediate pyroclastic rocks, and metasediments in the approximate ratio of 5:2:1. Thus in each sequence mafic flow rocks constitute about two-thirds of the volcanic-sedimentary pile.

NORTHWEST SEQUENCE

The lowest exposed part of the northwest sequence is in the axis of the Manitou Anticline. The Doyle Lake sill occurs on the southeast limb of the fold only, and must thin and pinch out across the axial plane. The Blanchard Lake basalts are at least 4,000 feet (1200m) thick, including the subvolcanic Doyle Lake sill. Correlation of Troutlet Lake pyroclastics and basalts with Early Lake pyroclastics is made both on the basis of their position in stratigraphic sequences on either side of the Manitou Anticline, and on their continuity around the nose of the anticline, beneath Upper Manitou Lake, as shown by earlier mapping (Thomson 1933; Goodwin 1965). Correlation of Beaverhead Island basalts with those Merrill Lake basalts stratigraphically below Merrill Lake pyroclastics, and correlation of Beaverhead Island pyroclastics with Merrill Lake pyroclastics, is only tentative because continuity of these units around the nose of the Manitou Anticline has not been demonstrated by mapping. According to the present tentative correlation, Merrill Lake basalts above Merrill Lake pyroclastics have no stratigraphic equivalents on the southeast limb of the fold. In addition, Beaverhead Island pyroclastics have been attenuated against the Manitou Straits Fault. It is therefore possible but not necessary that at least a further 2,000 to 3,000 feet (600 to 900m) of volcanic rocks have been removed from above Beaverhead Island pyroclastics by faulting. Merrill Lake basalts may be well in excess of 2,000 feet (600m) in thickness: their width in outcrop increases to the north, where they continue beyond the map-area. The thickening may only be apparent, due to folding.

SOUTHEAST SEQUENCE

Pillow top observations in the southeast corner of the map-area show that Beck Lake basalts are almost certainly folded. Any estimate of their thickness can be only tentative, because insufficient numbers of top determinations have been made to define fold axes but a 10,000-foot (3050 m) thickness is a conservative estimate. This includes the coarser grained basaltic rocks at the top of the Beck Lake sequence. The Etta Lake metasediments and basalts are a 2,000-foot (600 m) sequence of interdigitating, fine-grained metasediments and basaltic flows, and indicate an influx of erosional debris into the volcanic basin. Pillowed lavas are rare in this sequence, but immediately above the Etta Lake metasediments and basalts, Glass Bay basalts are predominantly pillowed, and total about 4,000 feet (1200m). Thus far, the southeast sequence bears some resemblance to the northwest sequence, in that mafic flow rocks dominate the volcanic pile. However, pyroclastics seem to be generally absent from the southeast sequence below the Cane Lake pyroclastics, except for minor occurrences within the Glass Bay basalts-Etta

Lake metasediments and basalts section. But above Glass Bay basalts, clastic rocks predominate: the Cane Lake pyroclastics and Manitou Straits metasediments reach a thickness of about 7,000 feet (2100 m) in the map-area. Within the map-area there is no sequence on the northwest side of the Manitou Straits Fault to compare in thickness with this clastic sequence.

DISCUSSION OF AEROMAGNETIC DATA

Comparison of the accompanying geological map (Map 2320, back pocket) with the Upper Manitou Lake aeromagnetic map (ODM-GSC 1961) shows a number of pertinent correlations between magnetic intensity and geology. These are summarised in Figure 9 (Chart A, back pocket).

The most conspicuous magnetic feature in the area is the pronounced high value (approximately 62,200 gammas) south of Beaverhead Island. This anomaly is directly correlated with iron formation outcropping on Beaverhead Island and interpreted to continue beneath Lower Manitou Lake toward the southwest (see "Iron Formation" in "Metasediments", and "Iron" in "Economic Geology").

Isomagnetic lines, at 100 gamma intervals, show that there is a correlation between magnetic susceptibility and certain stratigraphic units, in that they tend to have similar trends, and commonly follow contacts. For example, along the Manitou Straits the 60,500 gamma line follows the contact between Beaverhead Island basalts and pyroclastic rocks for a distance of at least 2 miles (3 km). Another example is the close correlation between isomagnetic lines and the boundary of the Scattergood Lake Stock.

Disregarding anomalies caused by point concentrations of magnetic minerals, it seems that, depending on metamorphic grade, mafic metavolcanics show a marked difference in magnetic field background when compared with intermediate pyroclastics and metasediments. Over areas of greenschist facies metamorphism, mafic metavolcanics possess a higher magnetic susceptibility than pyroclastics and metasediments. For example, Manitou Strait metasediments, and Beaverhead Island and Cane Lake pyroclastics show a distinctly lower magnetic field value than flanking mafic metavolcanics (Beaverhead Island basalts and Glass Bay basalts). The same contrast is seen between Beaverhead Island basalts and underlying Troutlet Lake pyroclastics and basalts. However, no contrast is seen between Troutlet Lake pyroclastics and basalts and underlying Blanchard Lake basalts.

At higher metamorphic grade (amphibolite facies) magnetic-field intensities over basalts and pyroclastics seem to be similar. This is evident when intensities over Merrill Lake basalts and Merrill Lake pyroclastics are compared. In the southeast corner of the map-area an anomalous situation occurs: basalts of amphibolite facies have a low magnetic expression, compared with coarser grained mafic flow or intrusive rocks at the top of the Beck Lake basaltic sequence. Within this same sequence there is a strong correlation between the 60,500 gamma isomagnetic line and the transition from basaltic, pillowed metavolcanics into gabbroic-textured mafic rocks.

Magnetic intensities over felsic plutonic rocks are not consistent in the map-area. The Scattergood Lake Stock has a distinct magnetic expression. Referring to the Upper Manitou Lake aeromagnetic sheet (ODM-GSC 1961), the stock, as outlined by Thomson's mapping (Thomson 1933), is contained by the 60,500 gamma isomagnetic contour. Magnetic values over the stock level off at about 60,600 gammas, and nowhere exceed 60,800 gammas. The rocks can be considered magnetically homogeneous, complementing their petrologic homogeneity (see "Scattergood Lake Stock" in "Felsic Plutonic Rocks").

The Carleton Lake Stock has a much lower overall magnetic intensity than the Scattergood Lake Stock, being between 60,500 gammas and 60,440 gammas.

Low magnetic values are recorded over the Olsen Bay portion of plutonic rocks of the Atikwa Batholith. However, the intensity increases northward, but not abruptly, indicating a gradual change across the area. Isomagnetic lines between the 60,500 and 60,600 gamma contours near Little Merrill Lake (ODM-GSC 1961) trend parallel to the metavolcanic-batholith contact.

The relationship of mineral occurrences and showings to magnetic intensities is not, in general, pronounced. Apart from the magnetite iron formation at Beaverhead Island, the only other direct correlations are found at the Gaffney prospect on Manitou Island and at the Glass Reef mine south of Beaverhead Island (see "Glass Reef Mine" in "Economic Geology"). At both of these localities the high magnetic values are attributable to disseminated magnetite associated with pyrite. About 1 mile (2 km) southeast of the Glass Reef mine (6 on Map 2320, back pocket), a magnetic high is centred over the east shore of Knowles Lake. A little to the north of the high, pyrite mineralization and associated fuchsite have been found in a shear zone in mafic metavolcanics. A north-trending linear passing through the C.R. Wright and D.C. Wright property (14 on Map 2320) is closely paralleled by the 60,500 gamma contour line.

The sill-like body of gabbroic-textured mafic metavolcanics (Doyle Lake sill) within Blanchard Lake basalts appears to have little magnetic expression. It in fact occurs within an area of distinct magnetic lows. In this respect the sill differs markedly from coarse, gabbroic-textured mafic rocks at the top of the Beck Lake basalts, which have a high magnetic relief.

It should be noted that the marked low magnetic values (below 60,400 gammas) associated with the Cane Lake pyroclastics between Cane Lake and Camp Beaverhead occur where these rocks form high hills, and where outcrop is almost continuous, except for vegetation cover.

ECONOMIC GEOLOGY

Gold was undoubtedly the first economic mineral to be actively sought by modern man in the Manitou Lake region. Little work had been done up to the end of the nineteenth century, though gold had been found, for Coleman (1894, p.66) could write:

> Up to the present Manitou lake has yielded only specimens, some of them exceedingly fine however. There is no mine and no stamp mill on its shores and the deepest exploration at the time of our examination . . . did not go down more than 25 feet . . .

During the period 1895 to 1912 the area experienced a "gold rush", with the opening of a number of mines, of which the Laurentian, Big Master and Elora at the northeast end of Upper Manitou Lake, and the Twentieth Century mine in the present map-area, were the only appreciable producers. During the 1930s further interest in gold was centered on the Manitou Lakes, and a number of new locations were opened up, and old locations re-examined. Activity at the turn of the century and in the 1930s has been chronicled by Thomson (1933; 1934).

Exploration for base metals is a more recent development, commencing in the 1960s, and conducted with the aid of geophysical equipment, both airborne and ground-based. Up to December 1972 no significant deposits had been discovered.

Mineral deposits found within the map-area to December 1972 include gold possibly associated with quartz veins, porphyry intrusions, and sulphide replacements, iron in magnetite iron formation, and molybdenum in quartz and quartzose pegmatite veins.

Description of Properties, Mineral Deposits, and Exploration

Information on older properties, all gold prospects, within the Lower Manitou-Uphill Lakes area is contained within reports by Carter (1902; 1904; 1905), and Thomson (1933; 1934). Further information on some of these older properties, and on all the more recent exploration has been extracted from the Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora, and from the Assessment Files Research Office, Ontario Division of Mines, Toronto.

Properties are titled in this report according to ownership as of December 1972. Names in parentheses, following titles, refer to previous owners or names by which the property is otherwise known, e.g., H.R. Churchill and E.J. Stone (Gaffney Prospect).

Mineral deposits open to staking as of December 1972 are titled as mines, prospects, or occurrences according to the amount of work previously done on them, i.e., a *mine* is a former producer of any amount of the commodity, a *prospect* is a deposit on which underground development or more than 2,000 feet (610 m) of diamond drilling was carried out, and an *occurrence* a deposit on which less than 2,000 feet (610 m) of diamond drilling was carried out; e.g., Queen Alexandra mine, Reliance prospect, and Watson occurrence.

Areas of exploration are titled according to the company that performed the work. Dates in square brackets following titles indicate date of last major work on parcels of lands open to staking as of December 1972, on which no mineral deposit has been discovered, e.g., Kerr Addison Mines Limited [1967].

Numbers in parentheses following titles of properties and areas of exploration correspond to those on the map face (Map 2320).

Canadian Nickel Company Limited [1971] (1)

In February of 1971, the Canadian Nickel Company Limited drilled a 572-foot (174.3 m) hole (Assessment Files Research Office, Ontario Division of Mines, Toronto) on claim number K44694 on the southeastern shore of Lower Manitou Lake. The hole was drilled off the ice and the dip of the hole at the collar was 60 degrees due north. Following is a summary of rock-types logged by D.R. Wadge, geologist for Canadian Nickel Company Limited: 120 to 324 feet (36.8 to 98.8 m), andesite; 324 to 419 feet (98.8 to 127.7 m), schist; 419 to 572 feet (127.7 to 174.3 m), porphyry. Scattered pyrite mineralization was found between 120 and 419 feet (36.6 and 127.7 m), and for the first 5 feet (1.5 m) in the porphyry. The hole was probably put down on a conductive zone that is parallel to, or an extension of the one located by Kerr Addison Mines Limited. The schist may be associated with shearing parallel to the Manitou Straits Fault. The claim lapsed in 1972.

Lower Manitou — Uphill Lakes Area

H.R. Churchill and E.J. Stone (2)

Thomson (1933, p.27) gave an account of development on Manitou Island:

> The whole of Manitou island, excepting the southwest end, was held at one time by the Anglo-Canadian Explorers, Limited. They did a considerable amount of surface stripping and trenching, uncovering several quartz veins and a zone of sulphides. However, their interest was cancelled in March, 1928, and the claims were restaked for the Manitou Island Syndicate of Kenora. They were again cancelled in November, 1931, and the northeastern portion of the island has since been restaked by Frank Gaffney, of Kenora, and his associates. The latest stakings include 10 claims (K. 3,594-99 and 3,795-97), one of which covers the old Bee-hive mine.

BEE-HIVE MINE

The Bee-hive mine is located at the northeast end of Manitou Island on patented claim K3599, which is part of property 2 on Map 2320.

The following account of the Bee-hive mine is taken from Thomson (1933, p.31):

> An old shaft is located on a quartz vein near the north end of Manitou island. This is the location of the Bee-hive mine, which was worked in 1897. The vein may be traced east for 140 feet [43 m] from the edge of a swamp. The dip is almost vertical. It averages about 3 feet [0.9 m] in width, but at the western extremity it splits into two parts and becomes considerably wider. The vein material consists of well-fractured white quartz containing a considerable amount of crystallized pyrite and chalcopyrite in places. Tourmaline occurs in the vein and also veinlets of carbonate. Immediately west of the shaft, the writer found some fine specimens of native gold in the quartz. A few feet west of this spot, a chip sample was taken across 10 feet [3 m] of well mineralized quartz. When assayed, this was found to contain no gold values. An attempt has been recently made to dewater and retimber the old shaft.
>
> North of the shaft there is another vein which may be traced 180 feet [54 m] and averages about 3 feet [0.9 m] in width. It consists of white quartz with a series of fractures running parallel to the walls. No mineralization was noticed.

From 1933 to 1936 it was held by Frank Gaffney and his associates, and then passed into the hands of Gaffney Mines Limited. About 1943 it was optioned to Sylvanite Gold Mines Limited, along with the Gaffney prospect. Little work was done on the property by any of these parties: Sylvanite Gold Mines Limited assayed samples from one trench, and reportedly (Assessment Files Research Office, Ontario Division of Mines, Toronto) obtained high gold values of a very local nature. There is no record of further work having been done on the property since 1943. As of December 1972, the property was held under patent (claim number K3599).

The author visited the property in 1972 and found only pyrite and minor chalcopyrite mineralization in the quartz veins.

GAFFNEY PROSPECT

The Gaffney prospect is located on a peninsula jutting out from the southeast side of Manitou Island. The prospect, part of property 2 on Map 2320, is presently covered by patented claims K3594 and K3595 owned by H.R. Churchill and E.J. Stone.

In 1933, Frank Gaffney and his associates staked the zone of sulphides uncovered by previous work. This has come to be known as the Gaffney location or prospect (Figure 10).

According to Thomson (1933, p.29, 31):

> . . . The country rock in this vicinity consists of greenstone on the north, which merges into acidic rock toward the south. Immediately east of No. 1 pit this rock is medium-grained and dark-green in colour, and contains prominent "eyes" of quartz. Microscopic examination shows that it is a quartz monzonite. This same type of rock occurs throughout the western end of the workings, but it is often altered to a sericite schist. It is probably an intrusive and resembles the Laurentian rocks. The greenstones, quartz monzonite, and sericite schist are all intersected by dikes of quartz porphyry, which sometimes carry a considerable amount of pyrite.
>
> A zone of sulphides, irregular in shape, is revealed in the quartz monzonite by a group of test pits along the side of a ridge near the south shore of the island. The sulphides are pyrite and, to a much lesser extent, chalcopyrite. They are most heavily concentrated near the contact of quartz porphyry dikes. The writer took a chip sample across 12 feet [4m] of sulphide material along the northeast face of pit No. 1. This assayed $42.80[1] per ton in gold. A grab sample of the massive quartz porphyry, which contained a fair percentage of pyrite and some secondary quartz, was also assayed and found to contain $3.30[1] per ton in gold.
>
> North of the sulphide zone a quartz vein has been uncovered. It is composed of somewhat fractured white quartz, the fractures being filled with carbonate and fine-grained pyrite. The wall rock is carbonated quartz monzonite and is somewhat schistose. The principal vein is about 2 feet [0.6m] wide, but several smaller veins about 6 inches [15cm] in width run parallel to it. At No. 2 pit the vein system is 6 feet [2m] wide. A chip sample across it near this point assayed $1.40[1] per ton in gold.
>
> Near the central part of the island, west of the above-mentioned workings, there are two parallel quartz veins striking N. 65° E. and dipping 60° to 70° S.E. They may be traced 260 feet [80m] and 400 feet [120m] respectively, and vary from a few inches to 4 feet [1.2m] in width. The shorter vein is somewhat fractured and contains a trace of sulphides. A sample taken across its widest part assayed 40 cents[1] in gold.

Later in 1933, a Dr. James submitted 69 samples from the Gaffney property for assay to the Haileybury Assay Office. The highest value of gold obtained was 0.54 ounce per ton (Assessment Files Research Office, Ontario Division of Mines, Toronto).

Six drill holes (see Figure 10, G holes) were put down on the property during January and February, 1934. All holes were started at 45 degree dip, and were between 200 and 300 feet (61.0 and 91.4m) long. Total footage amounted to 1,506 feet (459.0m). Pyrite mineralization was found in all holes, and according to J.A.H. Paterson, who logged the core, this was associated with silicification and feldspathization of granodiorite and "greenstone" country rock. A gold assay of 0.29 ounce per ton was obtained from a 4-foot (1.2m) section of core from hole No. 1 (see Figure 10, G1) by the Haileybury Assay Office (Assessment Files Research Office, Ontario Division of Mines, Toronto). Minor chalcopyrite, associated with pyrite, was found in one drill hole only, while magnetite was found in several holes, usually in granodiorite, and with no attendant sulphide mineralization.

In 1936, Gaffney Mines Limited was formed, and held a total of 15 claims on Manitou Island, including the Gaffney prospect and the Bee-hive mine. Existing trenches were sampled for gold assay. The highest assay, $22.60[2] per ton, was obtained from the main pit (Assessment Files Research Office, Ontario Division of Mines, Toronto). Hamlin B.

---

[1] In 1933 the price of gold was $28.60 per ounce.

[2] In 1936 the price of gold was $35.03 per ounce.

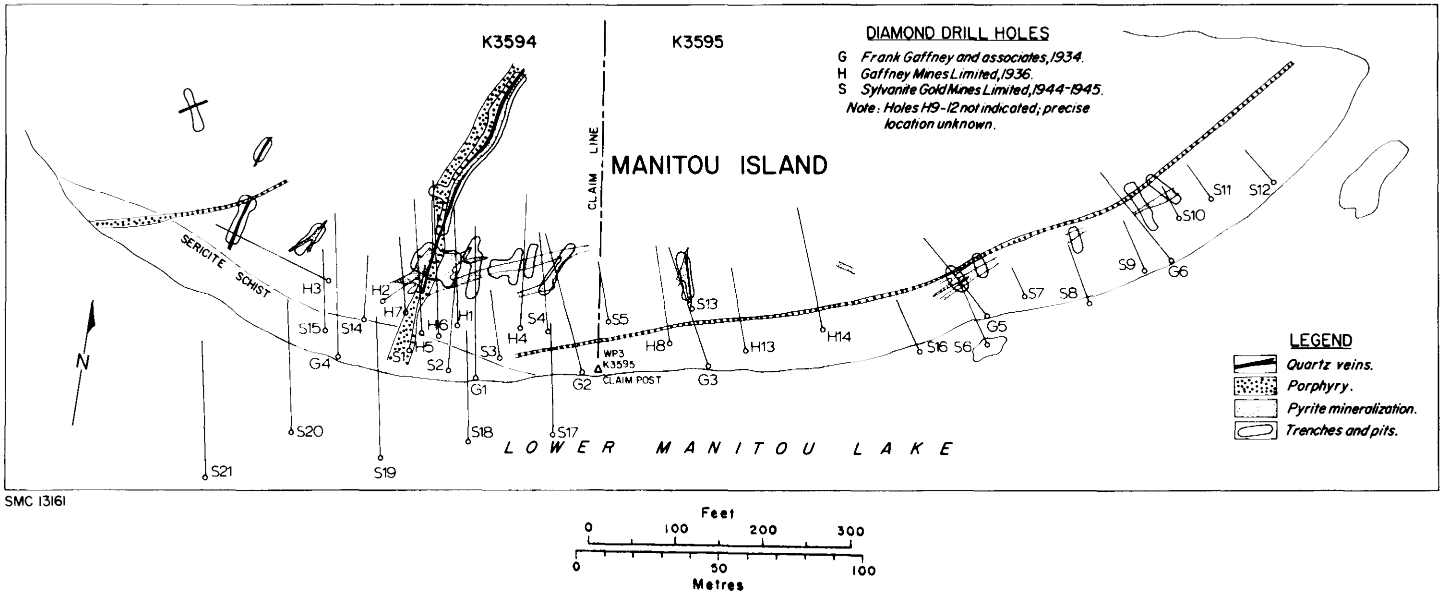


Figure 10–Diamond drill hole plan of H.R. Churchill and E.J. Stone property (Gaffney prospect), adapted from plans of former property owners.

Hatch, geologist in charge, claimed "commercial gold values" for a length of 300 feet (91.4m) across 24 feet (7.3m) in the vicinity of the main pit. In October 1936, 14 diamond drill holes were put down on the property (see Figure 10, H holes; holes 9 to 12 not shown). Total footage was reportedly 1,752 feet (534.0m). All were drilled at an initial dip of 45 degrees, and gold values were reported in every hole. The best gold assays reported by Hatch were: $10.50[1] per ton across 5 feet (1.5m) in hole 5; $14.00[1] per ton across 6 feet (1.8m) in hole 6; and $17.75[1] per ton across 11 feet (3.4m) in hole 12 (Assessment Files Research Office, Ontario Division of Mines, Toronto). All three holes intersected the sulphide zone beneath the main pit (the position of hole 12 is uncertain and not shown in Figure 10). Hatch recognized the discontinuous, lensoid, nature of the mineralized zone. There is no record of further work being done on the property by Gaffney Mines Limited, and in 1943 the claims reverted to Frank Gaffney.

Sylvanite Gold Mines Limited obtained the claims under option from Frank Gaffney in 1943. During the winters of 1943-1944 and 1944-1945, 21 diamond-drill holes were put down on the property, under the direction of G.L. Holbrooke (Assessment Files Research Office, Ontario Division of Mines, Toronto). There is no record of further work being done on the property. The property was held by Sylvanite Gold Mines Limited until at least 1961.

The author visited the property during the summer of 1972. The property lies close to or in the Manitou Island Fault zone. No evidence could be found that the "quartz monzonite" shown on Thomson's map (1933, Map 42c) is intrusive. In thin section the clastic, felsic nature of this rock can be seen. Quartz and plagioclase feldspar fragments, all very angular, lie in a fine-grained, sericitic, altered matrix. It is probably of pyroclastic origin.

Daering Explorers Corporation Limited [1967] (3)

In March of 1967, an airborne magnetometer survey over 54 contiguous unsurveyed claims (K39239 to K39274; K39347 to K39364) was carried out by Dominion Exploration Syndicate of Winnipeg for Daering Explorers Corporation Limited (Assessment Files Research Office, Ontario Division of Mines, Toronto). A vertical flux-gate magnetometer was mounted in a Cessna 180 airplane. Twenty-eight flight lines were run at 660-foot (200m) intervals at a height of 500 feet (150m) above lake level. The claim group was located between Glass Bay and Beaverhead Island, predominantly over Manitou Straits metasediments, and on its northwest side overlapped the Manitou Straits Fault.

The instrument was previously balanced at 1,000 gammas, so that all areas over 1,500 gammas were considered to be anomalies of interest. Two anomalies defined on the Upper Manitou Lake aeromagnetic map, (ODM-GSC 1961), one centered over the southern end of Beaverhead Island and shown during the present geological survey to be caused by iron formation (see "Iron Formation" in "Metasediments"), and one over the old Glass Reef mine, were also identified by this magnetic survey. A number of smaller anomalies, one about 1 mile (2km) east of Camp Beaverhead, one at the northeast end of Beaverhead Island, and three others in a line along Glass Bay, were located (Assessment Files Research Office, Ontario Division of Mines, Toronto).

---

[1] In 1936 the price of gold was $35.03 per ounce.

On the basis of Thomson's (1933) report, A.S. Dawson, engineer in charge of the project, concluded that the magnetic high located along the Manitou Straits Fault was more likely to be due to sulphides than magnetite iron formation. No further work was carried out as a result of the magnetometer survey (L.F. Labow, President of Consolidated Daering Enterprises and Mining Incorporated, formerly Daering Explorers Corporation Limited, personal communication, 1972).

Present mapping has shown a distinct and mappable band of iron formation trending northeast within the fault zone, on the southeast side of Beaverhead Island, directly beneath the elongate anomaly.

As of December 1972 all claims had lapsed.

Elora Gold Mines Limited (Twentieth Century Mine) (4)

The Twentieth Century mine is located ¼ mile (0.4km) east of the southern end of Rector Lake, in the north-central part of the map-area.

The mine was developed during the period 1900 to 1904. W.E.M. Carter made a number of visits to the mine (Carter 1902, p.248-250; 1904, p.67; 1905, p.51) and the following description is modified and condensed from his observations.

Lenticular quartz veins and stringers, up to 25 feet (7.6m) in width, lie parallel to regional foliation in the mafic metavolcanics. According to Carter, the trend of foliation at the mine is east-west. Gold occurred in the quartz veins, with minor amounts of pyrite, chalcopyrite, and occasional sphalerite. The shaft was apparently sunk to trace the quartz veins to depth. The shaft was sunk to 389 feet (118.6m), and levels established at 80 feet (24.4m), 160 feet (48.8m), 250 feet (76.2m), and 320 feet (97.5m). Approximately 470 feet (145m) of drifting and 440 feet (135m) of crosscutting were carried out. A 20-stamp mill was installed, but moved to another property in 1903, and shortly afterwards operations at the mine ceased. During the period 1902-1903, 8,688 tons of ore were milled, to a total value of $43,586 (Statistical Files, Ontario Division of Mines).

The author visited the property in 1972. Rock types in the mine dump were found to be dominantly mafic metavolcanics and a granitic dike rock, with lesser amounts of vein quartz. Very minor amounts of the following minerals were found upon examination of numerous quartz fragments: pyrite, chalcopyrite, tourmaline, fuchsite, calcite, and possible hematite and garnet.

As of December 1972, contiguous mining locations HW45, HP399, and HW46 were held under patent. The mine is located on HP399.

Freeport Canadian Exploration Company [1970] (5)

During April and May 1970, a combined airborne electromagnetic survey and magnetic survey was flown by Questor Surveys Limited for Freeport Canadian Exploration Company over Straw Lake, Eagle Lake, and the Manitou Lakes, as a joint venture with Beth-Canada Mining Company (Assessment Files Research Office, Ontario Division of Mines, Toronto).

A Super Canso aircraft was equipped with a Mark V INPUT airborne electromagnetic system and a Barringer AM-101 proton precession magnetometer. Flight lines were run 660 feet (200m) apart, at right angles to regional structural trends.

In the Manitou Lakes area, electromagnetic conductors with magnetic correlations were reported (Assessment Files Research Office, Ontario Division of Mines, Toronto) at three places within the present map-area (5 on Map 2320, back pocket). The first of these was located beneath Lower Manitou Lake, about ½ mile (0.8km) southeast of Manitou Island. The conductor was located on one flight-line only. An elongate conductive zone identified on five adjacent flight-lines was located about ¾ mile (1km) east of the north end of Merrill Lake, trending northeast, parallel to regional foliation in the underlying pyroclastic rocks. The third, and most extensive conductive zone, picked up on eleven adjacent flight-lines, was located in the Manitou Straits, east of Troutlet Lake. The conductive zone lies adjacent and parallel to a prominent schist zone within pyroclastic rocks, and may be associated with a shear or fault zone within pillowed mafic metavolcanics. Both of these more elongate conductive zones appear to correspond or lie close to conductive zones identified by Kerr Addison Mines Limited by ground electromagnetic survey (see "Kerr Addison Mines Limited [1967]").

There is no record of a follow-up program carried out on these anomalies. The claims lapsed in 1972.

Glass Reef Mine (6)

According to Carter (1901, p.99):

> Location HW391 and 594 are situated on the east shore of Lower Manitou Lake, south of Beaverhead Island. . . . The mine had been worked for over a year . . . but on December 22, 1900, after about two months' mill testing of the rock from the mine workings, everything was closed down and no work has since been done.

During the period of operation, a shaft was sunk 200 feet (60m) and a considerable amount of drifting and crosscutting was completed (Thomson 1933, p.25); 22 ounces of gold were produced (Statistical Files, Ontario Division of Mines).

Carter (1901) described the deposit and underground developments:

> The nature of the deposit was described in a former report, it being a faulted and schistose area in a massive dark green trap dike, the schist carrying lenses of quartz. The shaft was started down on one of these and though it pinched out at about 20 feet [6m] depth, sinking continued in the schist, and, . . . the dike of trap explored thoroughly both by drifts and crosscuts, but with unsatisfactory results, for throughout all the drifts nothing but scattered lenses and stringers of quartz were found, seldom over a foot and a half [0.5m] wide, short and with no apparent continuity, and in the crosscuts nothing but trap.

Thomson (1933) quoted the above description; during his own visit to the property he found:

> . . . no surface exposure of the above-mentioned zone, and the timbers cover the rock in the shaft. However, from the nature of the broken rock on the dump it appears that the "dike of trap" is a sheared quartz porphyry containing a considerable amount of quartz in the form of a stockwork of small veinlets. The quartz contains a little tourmaline and carbonate with a trace of pyrite. Near the shaft the country rock is massive greenstone, but a large quartz porphyry dike is exposed to the northeast and the strike would carry it very close to the shaft. A grab sample of quartz and schist selected from the material on the dump was assayed but contained no gold values.

The author visited the mine in 1972, and substantiated most of Thomson's observations. However, the large porphyry dike was not found. A quartz porphyry dike occurring to the northeast on the shore of Glass Bay had been offset by a north-northeast-trending fault, and passes to the north of the shaft.

Following closure of the mine in 1900, no further work appears to have been done at this property. As of December 1972, the deposit was open to staking.

L. Hampe (Charles Merrill Estate, Royal Sovereign Mine) (7)

The following is taken from Thomson (1933, p.26):

> This property is located on the northwest shore of Lower Manitou lake immediately north of Manitou island. Development was commenced in 1897. In 1902, 23 tons of ore were treated in the stamp mill of the Glass Reef mine across the lake. Apparently no work has been done at the property since that time. On the edge of a ridge near the lake shore a shaft was sunk on a quartz vein, and a little drifting was done along the vein. A short tunnel was driven from the base of the ridge to intersect the drift near the shaft.
>
> At the lake shore 6 distinct quartz veins with well-defined walls occur in chlorite schist across a width of about 50 feet [15m]. The three larger veins are each about a foot [0.3m] in width. The veins are roughly parallel and strike about N. 70° E.; the dip is from 75° to 80° S.E. The strike would carry them to the shaft on the hill about 50 feet [15m] away. The veins on the shore contain white vitreous quartz with a little tourmaline. At the shaft the vein is covered by the dump, but it may be observed in the tunnel. Here, a branching and irregular stockwork of quartz veins up to one foot [0.3m] in width forms a lenticular body about 6 feet [2m] in width near the shaft but lensing out almost entirely 20 feet [6m] to the northeast. The ore consists of white quartz and tourmaline, considerably fractured and containing numerous ankerite veinlets. A trace of pyrite occurs, chiefly in the chlorite schist. A sample, chipped across a width of 6 feet [2m] of the vein in the tunnel near the shaft, assayed 20 cents[1] per ton in gold. A second sample of similar vein material taken from the dump assayed 20 cents[1] per ton in gold.
>
> About 80 feet [25m] southwest of the above-mentioned shaft, a second shaft is located. The timbers obscure any sign of a vein, but the ore on the dump is similar to that from the other shaft.

The author visited the property in 1972. Country rock in the vicinity of the mine is coarse-grained, mafic flows, some of which are pillowed. An intermediate tuffaceous unit occurs at the mine itself, and the quartz veins referred to by Thomson are closely associated with this unit.

As of December 1972, the property on claim K1190 (mining location HW54), was held under patent.

L. Hampe (Charles Merrill Estate, "Swede Boy" Location) (8)

The following account is taken from Thomson (1933, p. 35-36):

> The property was originally staked by three Swedes in 1895. It was claimed that gold occurred in paying quantities in the mud of the swamp near the vein, and a crude attempt was made to establish placer mining, but only a few dollars worth of gold was recovered. The source was probably a milky quartz vein 2½ feet [0.8m] wide, which strikes N. 53° E. and

---

[1] In 1933 the price of gold was $28.60 per ounce.

> dips 47° S.E. It may be traced about 15 feet [4.5m] along the strike. A shallow test pit has been sunk on the vein. A sample chipped across 4 feet [1.2m] of quartz and schist in the pit gave no gold values.
>
> About 850 feet [260m] to the southwest a second quartz vein occurs. It has a strike of N. 55° E. and dips 70° S.E. It may be traced roughly 250 feet [76m] and has a width of almost 7 feet [2m] in a pit located at the northern limit of its exposure. The vein quartz contains a trace of tourmaline and some green schist in which pyrite and a little chalcopyrite are found. A sample taken across the width of the vein in the pit on assay gave no gold. Native gold is reported to occur in the vein.
>
> The vein occurs along the side of a ridge of massive gabbro. To the east the rock is gabbro and basalt occasionally intersected by small dikes of feldspar porphyry or granite.

During the summer of 1932 Jonas Wetelainen restaked the location, in conjunction with Charles Merrill of Wabigoon. Thomson returned to the property in the summer of 1933, and reported (Thomson 1934, p.26-27) that:

> During the summer of 1933 Charles Merrill and associates did a considerable amount of development work. . . . In the group there are 9 claims, including the old Swede Boy location. . . . A new vein was uncovered in 1932 about 300 feet [90m] east of the Swede Boy vein.
>
> The newly located vein follows a well-defined sheared zone in massive gabbroic greenstone. The sheared zone strikes N. 30°-35° E. and dips at an angle of 65° to the southeast. At the time of the writer's visit (September), vein material had been picked up at intervals in trenches for a distance of 1,065 feet [325m] along the strike.
>
> At the northeast end of the original discovery the main vein is 18 inches [45cm] wide, but there are quartz stringers in the highly sheared chlorite schist on either wall. The quartz is white and sugary with seams of chlorite running through it. Native gold is found in considerable amount in the quartz, especially in the vicinity of fractures containing chlorite. To the southwest the vein runs into a swamp but is picked up about 600 feet [180m] along the strike. A trench 90 feet [30m] in length at this point reveals quartz and silicified schist across a width of about 10 feet [3m] in the sheared zone. This material is impregnated with fine-grained sulphides, principally pyrite with traces of chalcopyrite. Gold can be panned from all parts of the vein at this place, and native gold has been observed. A chip sample taken by the writer across 3 feet [0.9m] of vein material assayed 0.16 ounces per ton in gold.
>
> About 150 feet [45m] farther along the strike, quartz was uncovered across a width of 6 to 18 inches [15 to 45cm] at the time of the writer's visit. A considerable amount of chalcopyrite is present at this place. A grab sample of their vein material assayed 4.64 ounces per ton in gold.
>
> In December, 1933, the Merrill claims were optioned by Arnold Hughes and associates. Surface trenching and test-pitting was carried on during the summer of 1934.

Work continued on the property, and the claims were brought to patent in 1939 by Charles Merrill, and James Walmsley of Dryden. As of December 1972, the property was held under patented claims, numbers K3820, K3821, K3693, K3694 (aliquot parts of mining location HP304), K3931 (mining location HP305), and K3932 (mining location HP365).

The author briefly visited the property in 1972, and found native gold in the chlorite-bearing quartz vein in claim K3693 (southwest quadrant of mining location HP304).

Kerr Addison Mines Limited [1967] (9)

During the summer of 1967 and the following winter, Kerr Addison Mines Limited (9 on Map 2320, back pocket) carried out ground electromagnetic surveys on seven groups of claims, designated A to G, in the Manitou Lakes area (Assessment Files Research Office, Ontario Division of Mines, Toronto). Claim groups C to F lay wholly within the map-area, whereas the southern end of claim-group B lay within the map-area. Group A lay some 6 miles (10km) northeast of the northeast corner, and group G lay 1 mile (2km) north of the north boundary of the map-area. The surveys were carried out with the Crone Junior Electromagnetic unit, along picket lines spaced at 200-foot (60m) intervals and cut at right angles to regional structure.

Conductive zones were located on groups, B, C, E, and F within the present map-area. No conductive zones were located on group D, a parcel of 12 claims (K40321 to K40332) covering the southern end of Cane Lake.

Group B comprised a parcel of 42 claims strung out in a northeasterly direction from Merrill Lake in the southwest and thence along the northwestern shore of Upper Manitou Lake. Nine of the claims (K40249 to K40251; K40279 to K40284), at the southwest end of the group, and bordering on Merrill Lake, lay within the map-area. An elongate intermittent conductive zone was located over a distance of 5 miles (8km) along the full length of the claim group, that is in a northeast direction. Drill holes were put down at a number of points along the conductive zone. Within the present map-area, two holes were drilled toward the northwest at angles of 45 degrees on claims K40281 and K40283 (see Map 2320, back pocket). Both holes were collared in mafic metavolcanics, and both intersected a number of pyrite and pyrrhotite zones on the order of 1 foot (30cm) core-length at shallow depth. The southwest hole on claim K40283, was drilled to 150 feet (45.7m) and the northeast hole on claim K40281, to 47 feet (14.3m). A 2-foot (0.6m) width in the latter hole assayed 0.07 percent copper (Assessment Files Research Office, Ontario Division of Mines, Toronto).

Group C comprised a parcel of 25 claims (K40295 to K40299; K40339 to K40356; K42348 and K42349) strung out along Manitou Straits, from Doyle Bay in the southwest, for 3 miles (5km) in a northeasterly direction. The claim group lay predominantly to the northwest of the Manitou Straits Fault, over metavolcanics. Two linear anomalies were outlined in this group, one to the northwest and one to the southeast of the large island in the middle of the claim group (Assessment Files Research Office, Ontario Division of Mines, Toronto). Other weak anomalous readings were attributed to topographical effects. Drill holes were put down to test these two anomalies. The 200-foot (61m) hole to the southeast of the island was collared adjacent to the Manitou Straits Fault, on a northwesterly bearing at an angle of 45 degrees. Very minor pyrrhotite and pyrite, in graphitic tuffs, were intersected over a core length of 5 feet (1.5m). The hole predominantly intersected sheared mafic metavolcanics, and was terminated at 200 feet (61m). No records are available for the hole on the northwest side of the island.

Group E comprised a parcel of 19 claims (K40303 to K40320; K40294) immediately north of Glass Bay, located over mafic metavolcanics. Two anomalous zones were outlined, one a long zone of weak, intermittent, conductors oriented in a northeast direction, and a short, stronger, more easterly trending zone closer to the shore of Glass Bay (Assessment Files Research Office, Ontario Division of Mines, Toronto). Three drill holes were put down on this claim group. Two holes were drilled on the long, weak zone, one each near either end, and a single hole was put down on the short zone. Log records are not available for these holes.

Group F comprised a parcel of nine claims (K40285 to K40293) on the southeast shore of Lower Manitou Lake, north of Meridian Bay and Holcroft Lake. The eastern boundary of the group lay about ½ mile (0.8km) west of the old Glass Reef mine. One significant anomaly was located on this group (Assessment Files Research Office, Ontario Division of Mines, Toronto), approximately over the wide porphyry dike trending east-northeast. No further work was reported on this group.

All claims on groups B to F had lapsed prior to the 1972 field season.

Queen Alexandra Mine (10)

The following account is taken from Thomson (1933, p.27):

> In 1904 a shaft was sunk 85 feet [25m] on a quartz vein located on claim H.W. 270 on the eastern shore of Carleton lake . . . 18 tons of ore were treated in a small stamp mill erected on the property, and this produced $16.00[1] per ton in gold.
>
> Very little can be seen now at the shaft. There is no vein exposed. The rock dump consists of chlorite schist with small lenses of quartz, both of which carry a little pyrite. A grab sample of this material assayed $1.80[2] per ton in gold. The country rock is schisted andesite cut by granitic dikes.

According to Carter (1905, p.51) the property was owned by an "English syndicate" in 1904. There is no record of further work done on the property following that described by Carter.

The author visited the property in 1972, and could find only a small, barren pit. The pit is located within granitic rocks of the Carleton Lake Stock, close to the contact with mafic metavolcanics.

As of December 1972, the property was open to staking.

Reliance Prospect (11)

The following is taken from Thomson (1933, p.33-35):

> This has been formerly known both as the Westerfield mine and the Independence mine. It is located west of Carleton lake on claim K.3,412 . . .
>
> As early as 1899, three shafts were sunk to shallow depths on the vein. During 1900, the main or No. 3 shaft had reached a depth of 85 feet [25m]. In 1904, No. 2 shaft was down 97 feet [30m], having been sunk that distance on the vein. A drift was also run to the north along the vein. Apparently no work has been done since that time . . .
>
> A quartz vein, which is not well exposed at the surface, has been traced along a sheared zone by shafts and test pits for a distance of about 800 feet [240m]. The sheared zone strikes N.15°E. and dips 60° to 75°S.E. The vein material consists of fractured quartz containing a little tourmaline and schist. The included schist carries pyrite and sometimes traces of pyrrhotite, chalcopyrite, and sphalerite. The wall rock is a carbonated chlorite schist. The width of the vein cannot be ascertained at the two shafts, but in one of the pits there is mineralized quartz and schist across 6½ feet [2.0m], the quartz vein being about 2 feet [0.6m] wide. A chip sample, taken across the full mineralized width, did not contain any gold values. A grab sample of the best-looking vein material on the dump at No. 2 shaft also gave a blank, but a similar sample from No. 1 shaft assayed $4.00[2] per ton in gold.
>
> The claim is largely covered by massive andesite, which is intruded by an occasional aplite dike. A small stock of granite occurs near by on Carleton lake.

The author did not visit the prospect. Wanis Khouri, senior assistant, reported visible mineralization in the quartz veins to be predominantly pyrite, with minor hematite.

As a December 1972, the prospect was open to staking.

---

[1] In 1904 the price of gold was approximately $17 per ounce.

[2] In 1933 the price of gold was $28.60 per ounce.

Watson Occurrence (12)

The following is taken from Thomson (1933, p.36):

> This claim (S.V. 343) is located east of Beck lake. A quartz vein occurs immediately south of a small creek. It strikes N.30°E., dips 75°S.E., and is 5 feet [1.5m] wide. The vein outcrops again about 100 feet [30m] southwest of the creek. Here the quartz is 4 feet [1.2m] wide but is white and vitreous. A trace of sulphide, chiefly pyrite, occurs in the schistose wall rock. A sample chipped across 5 feet [1.5m] of quartz and schist contained no gold values. It is reported and evidently quite true that a pocket containing spectacularly rich native gold was found in the quartz vein at the creek. This must have been localized within a small area, as no sign of gold could be seen in the quartz surrounding the small pit from which the high-grade ore was supposed to have been taken. The vein occurs in massive andesite.

The pit and quartz vein could not be found during the present survey.

As of December 1972, the occurrence was open to staking.

Wetelainen Occurrence (13)

The following is taken from Thomson (1933, p.36):

> Jonas Wetelainen, of Goldrock, owns claims K.2,956, K.2,955, and K.2,954, all of which adjoin the Watson vein. Several small veins and lenses of quartz occur in massive andesite. The largest of these is found near the southeastern corner of K.2,955, where there is a vein about 60 feet [20m] in length and 1 foot [0.3m] wide. Mr. Wetelainen reported an assay of $3.60[1] in gold from this location. About the centre of claim K.2,954 a small pocket of very rich native gold was found in a vein of quartz and mineralized schist. A sample taken by the writer across 6 feet [2m] of vein material at the spot from which the gold-bearing samples had been removed assayed $1.40[1] per ton in gold.

The unsurveyed claims were held by Jonas Wetelainen until 1935, and were then restaked by Charles Merrill and Frank Gaffney, who held them until 1938.

As of December 1972, the occurrence was open to staking.

The veins could not be found during the present survey.

D.C. Wright and C.R. Wright (Dryden-Red Lake Prospecting Partnership) (14)

The following account under the heading "Dryden-Red Lake Prospecting Partnership", is taken from Thomson (1933, p.31):

> Four claims (K.2,205-2,208, inclusive), located north of Lower Manitou lake, are held by this group, for which C.J. Wright, of Dryden, is agent. The main showing on the property is a sheared zone containing quartz veins and chlorite schist. It strikes N.10°E. to N.15°E. and dips 45° to 55°E. The sheared zone lies in massive andesite and has a maximum width of 20 feet [6m] averaging 10 to 12 feet [3 to 3.6m]. On claim K.2,205 two prominent quartz veins up to 1 foot [0.3m] in width occur in the sheared zone. Both quartz and schist contain a little pyrite and carbonate. The sheared zone is largely covered by drift, but it has been traced about 300 feet [90m] along the strike on claim K.2,205 and then disappears to the north under overburden. A sample chipped across 8 feet [2.5m] of quartz and schist by the writer in pit No. 2 assayed $1.00[1] per ton in gold; another sample from pit No. 1, across 4 feet [1.2m] of vein material, assayed $12.80[1] per ton in gold.

---

[1] In 1933 the price of gold was $28.60 per ounce.

Several lenticular masses of milky-white quartz adjoin the sheared zone. These have an *en échelon* arrangement and probably occupy fractures that were formed as the result of tension stresses at the same time as the main sheared zone. These quartz masses are devoid of mineralization and do not hold much promise of gold values.

The author visited the property in 1972 and found one of the larger pits, probably the "main showing", and a number of small, overgrown pits. No mineralization was noted in the larger pit, and very narrow quartz stringers are all that remain in the schist. The shear zone lies within and parallel to a prominent lineament (see Figure 6).

There is no record of further work having been done on this property. As of December 1972, claims K2205 to K2208 inclusive (shown on Map 2320 as mining locations HP303, HP308, HW363, and HP306 respectively) were held under patent.

Considerations for Future Exploration

Gold

A comprehensive report of the gold deposits between Lake of the Woods and the Manitou Lakes was made by Thomson (1936), based on his field work throughout that country. He came to the conclusion that there was a strong genetic relationship between intrusive granitic and porphyritic rocks and the gold, and suggested that (1936, p.693) "...most of the gold deposits occur near the contacts of...greenstones and schists with invading granite batholiths of considerable surface dimension".

Thomson classified the gold deposits under four general types. The first type, gold quartz veins, he exemplified, among others, in the Hampe ("Swede Boy" location), Reliance, and the Wright and Wright properties (8, 11, and 14 on Map 2320). These he called lode or composite types, in that they "consist of parallel or nearly parallel veins, irregularly connected, with schistose country rock intervening in places. They generally occur along well-defined sheared zones in the greenstones." Gold quartz fissure veins, occupying a single fissure with well defined walls, he stated to be more typically developed in granite and granodiorite than in greenstones, though he suggested that some veins in the Manitou Lakes area could be of this type.

Sulphide replacements, his second type, he stated to be represented by occurrences at Manitou Island. The sulphides, according to Thomson, replace highly altered volcanic rocks, generally adjacent to acidic intrusive dikes. The main showing at the Gaffney prospect might be assigned to this type.

Thomson cited the Glass Reef mine as being typical of his third type, stockworks in porphyry intrusions, though the present author did not find evidence to support the idea of the Glass Reef mine being associated with a porphyry intrusion (see "Glass Reef Mine" in "Economic Geology"). In this type, "Dykes and irregularly shaped masses of intrusive porphyry . . . contain a network of quartz stringers and are mineralized with sulphides". According to Thomson "This type of deposit deserves some attention owing to the fact that it presents the possibility of large tonnages of low-grade ore."

The fourth type, siliceous-carbonate replacements, were not quoted from the Manitou Lakes area by Thomson. Zones characterized by a rusty weathering surface, containing large amounts of silica and carbonates, according to Thomson, have replaced country rock and often carry disseminated sulphides. However, he stated that these zones had not been found to contain significant gold values.

In discussing the mineralization of the gold deposits, Thomson (1936, p.697) was careful to point out that "Every variation in mineralization from pure-white quartz veins to almost solid sulphide masses is found, and there is no 'rule of thumb' method of spotting gold ore by the type of mineralization or the appearance of the quartz. Generally speaking, spectacularly rich native gold occurs in quartz containing little sulphides, whereas a more uniform grade of ore occurs with uniform sulphide mineralization." According to Thomson, pyrite and gold in quartz veins may be associated with carbonates and tourmaline, and such sulphides as chalcopyrite, pyrrhotite, galena, sphalerite, and molybdenite.

Thomson (1936, p.699) emphasized that:

> The localization of the gold deposits is nearly always a function of the local structure, because there must be either faults, fractures, sheared zones, or replaceable rocks up which the ore solutions may travel . . . . The two features essential to all the deposits seem to be: (1) granite or porphyry intrusives to act as the source of the mineralizing solutions, although the source rock may not always appear on the surface near the showing; and (2) a means of access to these solutions.

In a discussion at the end of Thomson's paper, E.L. Bruce (Thomson 1936, p. 701) pointed out that:

> The assumption of genetic relationship between the veins and the granitic rocks so widely exposed in the [Manitou Lakes to Lake of the Woods] region is open to question. Proximity to such rocks is a doubtful criterion, since, in a region so riddled by intrusive bodies, it would be difficult to find any locality very far removed from some such occurrence.

It is of note that in the present map-area the gold prospects, showings and old mines seem to be preferentially located within the lower, more mafic, part of the volcanic pile, and in particular within Blanchard Lake, Glass Bay and Beck Lake basalts. Some stratigraphic control is thus indicated, and a volcanogenic origin must be considered for at least some of these gold occurrences (see "Base Metals").

Base Metals

In the Manitou Lakes area in general the most promising type of base metal deposit to seek would seem to be the strata-bound volcanogenic massive sulphide type. In a review of such Precambrian types, Sangster (1972, p.3) noted that "The most common host rocks in the immediate vicinity of most ore bodies are the acidic, usually clastic, phases of volcanism." Thus the presence of a silicic volcanic phase in voluminous quantities would appear to be advantageous if not a prerequisite for the siting of such deposits. The presence of voluminous pyroclastics of dacitic to andesitic composition, and minor amounts of rhyolitic flow rocks is therefore encouraging.

The airborne electromagnetic and magnetic survey of Freeport Canadian Exploration Company and the ground electromagnetic survey of Kerr Addison Mines Limited have delineated a number of conductive zones notably along the Manitou Straits, near Merrill Lake, and in the vicinity of Meridian and Glass Bays, and a small anomaly beneath Lower Manitou Lake southeast of Manitou Island. Conductive zones at Manitou Straits, Merrill Lake, and possibly that beneath Lower Manitou Lake, occur within pyroclastic or mixed flow-pyroclastic sequences. The conductive zones between Meridian and Glass Bays are situated in mafic metavolcanics, but close to the Etta Lake metasediments. Some pyroclastic units occur with Etta Lake epiclastic rocks, and the Etta Lake sequence as a whole represents a volcanic paleoenvironment, mostly of explosive type. It is thus evident that electromagnetic surveys have picked up conductive zones within or close to dacitic-andesitic, predominantly pyroclastic, sequences. Despite the fact that drilling of these conductors to date has indicated only minor amounts of sulphides of economic potential, the apparent continuity of the conductors along strike warrants further airborne and ground electromagnetic surveys, to locate possible weaker conductive zones that may prove to be good diamond-drill targets.

Among the old gold mines and prospects, those not specifically associated with quartz veins may be of interest as base-metal prospects. Massive sulphide is present at the Gaffney prospect, and though predominantly pyritic contains minor amounts of chalcopyrite and sphalerite. The country rock at this locality is pyroclastic, so that there is a possibility of a volcanogenic origin of these sulphide minerals. Little information is available concerning the host rocks of the gold at the Glass Reef mine. The presence of this deposit within the mixed volcanic-sedimentary Etta Lake sequence is of particular interest. Pyroclastic rocks, which possibly include porphyry are present at the Royal Sovereign mine. Although not strictly within the pyroclastic sequence the mine lies close to the top of Blanchard Lake basalts, near the transition into Troutlet Lake pyroclastics. Other gold deposits in the area seem to be predominantly associated with quartz veining. Pyrite occurs at most of these deposits, though in minor amounts, and only within or close to quartz veins.

Pyrite occurs within Etta Lake metasediments, specifically at the portage along the Weasel River in the extreme southwest of the map-area, again suggesting a close connection between volcanism and sedimentation. The pyrite within the metasediments may be of exhalative or detrital origin, but whichever is the case it was probably derived ultimately from a volcanic source, since these metasediments are intravolcanic and volcaniclastic. Many of the metasediments in this area are cherty, further suggesting that chemical precipitation or exhalative activity took place at times during deposition of sediments.

Iron

The magnetite iron formation at the southeast peninsula of Beaverhead Island is the only significant iron occurrence in the area. In view of its narrow width, short strike length, and the abundant interbedded argillitic metasediments, coupled with its location in an inaccessible area, it is not considered to be of present economic interest.

Molybdenum

Disseminated molybdenite and associated fluorite occurs in quartz and quartzose pegmatite veins and immediately adjacent country rocks within granitic rocks of the Atikwa Batholith at a locality between Kaminni Lake and Olsen Bay, close to the contact with amphibolites at the base of the metavolcanic sequence. Molybdenite has been found in a similar position and association north of the map-area, near Harper Lake (Davies and Pryslak 1967), along the same contact zone, and at other places scattered along the metavolcanic-granite contact zone around the eastern end of the Atikwa Batholith.

These occurrences though not in themselves of exploitable dimensions could hypothetically be indicators of possible low grade, large tonnage molybdenum deposits within plutonic rocks of the batholith. If such were the case, it might be expected that plutonic rocks near the molybdenum occurrences in quartz veins would contain at least low amount of molybdenum. As a test of this hypothesis, samples of granitic country rock from near the Kaminni Lake-Olsen Bay occurrence were submitted for qualitative spectrographic analysis to the Mineral Research Branch, Ontario Division of Mines, but yielded no trace of molybdenum.

REFERENCES

Anderson, T.B.
1964: Kink-bands and Related Geological Structures; Nature, Vol.202, p.272-274.

Ayres, L.D.
1972: Guide to Granitic Rock Nomenclature used in Reports of the Ontario Division of Mines; Ontario Div. Mines, MP52, 14p.

Blackburn, C.E.
1973a: Lower Manitou-Uphill Lakes Area, District of Kenora; Ontario Div. Mines, Prelim. Map P.816, Geol. Ser., scale 1 inch to ¼ mile. Geology 1972.
1973b: Geology of the Otukamamoan Lake Area. Districts of Rainy River and Kenora; Ontario Div. Mines GR 109, 42p. Accompanied by Map 2266, scale 1 inch to 1 mile.
1973c: Geology of the Off Lake-Burditt Lake Area, District of Rainy River; Ontario Div. Mines, OFR5088, 124p.

Bouma, A.H.
1962: Sedimentology of Some Flysch Deposits; Elsevier Publishing Company, Amsterdam, London, New York, 168p.

Bruce, E.L.
1925: Gold Deposits of Kenora and Rainy River Districts; Ontario Dept. Mines, Vol.34, pt.6, p.1-42.

Carter, W.E.H.
1901: Mines of Northwest Ontario: Part II; p.90-112 *in* Ontario Bur. Mines, Vol.10, 236p.
1902: The Mines of Ontario; p.231-298 *in* Ontario Bur. Mines, Vol.11, 309p.
1904: Mines of Western Ontario; p.58-87 *in* Ontario Bur. Mines, Vol.13, 255p.
1905: Mines of Western Ontario; Ontario Bur. Mines, Vol.14, pt.1, p.43-75.

Clifford, P.M.
1972: The Superior Province: Geological Structure; p.540-553 *in* Variations in Tectonic Styles in Canada, edited by R.A. Price and R.J.W. Douglas, Geol. Assoc. Canada, Spec. Paper No. 11, 688p.

Coleman, A.P.
1894: Gold in Ontario: Its Associated Rocks and Minerals; Ontario Bur. Mines, Vol.4, sec.2, p.35-100 (published 1895).

Davies, J.C.
1973: Geology of the Atikwa Lake Area, District of Kenora; Ontario Div. Mines, GR111, 58p. Accompanied by Map 2273, scale 1 inch to ½ mile.

Davies, J.C., and Pryslak, A.P.
1967: Kenora-Fort Francis Sheet, Kenora, Rainy River Districts; Ontario Div. Mines, Geol. Comp. Series, Map 2115, scale 1 inch to 4 miles. Compilation 1963-65.

Fahrig, W.F., and Wanless, R.K.
1963: Age and Significance of Diabase Dyke Swarms of the Canadian Shield; Nature, Vol.200, p.934-937.

Ferguson, S.A., Groen, H.A., and Haynes, R.
1971: Gold Deposits of Ontario, Part 1, Districts of Algoma, Cochrane, Kenora, Rainy River, and Thunder Bay; Ontario Dept. Mines and Northern Affairs, MRC13, 315p.

Fisher, R.V.
1966: Rocks Composed of Volcanic Fragments and their Classification; Earth-Science Reviews, Vol.1, No.4, p.287-298.

Gélinas, L., and Brooks, C.

1974: Archean Quench-Texture Tholeiites; Canadian J. Earth Sci., Vol.11, No.2, p.324-340.

Goldich, S.S., Nier, A.O., Baadsgaard, H., Hoffman, J.H., and Krueger, H.W.

1961: The Precambrian Geology and Geochronology of Minnesota; University of Minnesota, Minnesota Geol. Surv., Bull.41, 193p. Accompanied by five maps.

Goodwin, A.M.

1965: Preliminary Report on Volcanism and Mineralization in the Lake of the Woods-Manitou Lake-Wabigoon Region of Northwestern Ontario; Ontario Dept. Mines, Prelim. Rept. 1965-2, 63p. Accompanied by one map, scale 1 inch to 4 miles.

1970: Archean Volcanic Studies in the Lake of the Woods-Manitou Lake-Wabigoon Region of Western Ontario; Ontario Dept. Mines, OFR 5042, 47p. Accompanied by eleven tables and one map, scale 1 inch to 4 miles.

Hart, S.R., and Davis, G.L.

1969: Zircon U-Pb and Whole-Rock Rb-Sr Ages and Early Crustal Development near Rainy Lake, Ontario; Geol. Soc. America Bull., Vol.80, No.4, p.595-616.

Irvine, T.N., and Baragar, W.R.A.

1971: A Guide to the Chemical Classification of the Common Volcanic Rocks; Canadian J. Earth Sci., Vol.8, p.523-548.

Kleist, J.R.

1972: Kink Bands along the Denali Fault, Alaska; Geol. Soc. America Bull., Vol.83, No.11, p.3487-3490.

McInnes, William

1896: *Untitled report of fieldwork for 1895*; p.45A-49A *in* Summary Report on the Operations of the Geological Survey for the Year 1895, by G.M. Dawson. Geol. Surv. Canada, Vol.8, Part A, 154p.

1897: *Untitled report of fieldwork for 1896*; p.35A-43A *in* Summary Report on the Operations of the Geological Survey for the Year 1896, by G.M. Dawson. Geol. Surv. Canada, Vol.9, Part A, 144p.

1898: *Untitled report of fieldwork for 1897*; p.38A-43A *in* Summary Report on the Operations of the Geological Survey for the Year 1897, by G.M. Dawson. Geol. Surv. Canada, Vol.10, Part A, 156p.

1902: District of Rainy River (Manitou Lake Sheet); Geol. Surv. Canada, Map No.720, scale 1 inch to 4 miles.

Moore, J.G., and Peck, D.L.

1962: Accretionary Lapilli in Volcanic Rocks of the Western Continental United States; J. Geol., Vol.70, p.182-193.

ODM-GSC

1961: Upper Manitou Lake, Kenora District, Ontario; Ontario Dept. Mines-Geol. Surv. Canada, Aeromagnetic Map 1153G, scale 1 inch to 1 mile. Survey May to October 1961.

Parkinson, R.N.

1962: Operation Overthrust; p.90-101 *in* The Tectonics of the Canadian Shield, edited by J.S. Stevenson, Roy. Soc. Canada, Spec. Publ. No.4.

Parsons, A.L.

1911: Gold Fields of Lake of the Woods, Manitou and Dryden; Ontario Bur. Mines, Vol.20, pt.1, p.158-198.

1912: Gold Fields of Lake of the Woods, Manitou and Dryden; Ontario Bur. Mines, Vol.21, pt.1, p.169-204.

Paterson, M.S., and Weiss, L.E.

1966: Experimental Deformation and Folding in Phyllite; Geol. Soc. America Bull., Vol.77, No.4, p.343-374.

Pettijohn, F.J.
1937: Early Pre-Cambrian Geology and Correlational Problems of the Northern Subprovince of the Lake Superior Region; Geol. Soc. America Bull., Vol.48, No.2, p.153-202.
1957: Sedimentary Rocks; Harper and Brothers, New York, 2nd Edition, 718p.

Pettijohn, F.J., and Potter, P.E.
1964: Atlas and Glossary of Primary Sedimentary Structures; Springer-Verlag, 370p., 117 plates.

Ramsay, J.G.
1967: Folding and Fracturing of Rocks; McGraw-Hill Book Company, New York, 568p.

Sangster, D.F.
1972: Precambrian Volcanogenic Massive Sulphide Deposits in Canada: A Review; Geol. Surv. Canada, Paper 72-22, 44p.

Thomson, J.E.
1933: Geology of the Manitou-Stormy Lakes Area; Ontario Dept. Mines, Vol.42, pt.4, p.1-40 (published 1934). Accompanied by Map 42c, scale 1 inch to 1 mile.
1934: Geology of the Straw-Manitou Lakes Area; Ontario Dept. Mines, Vol.43, pt.4, 32p (published 1935). Accompanied by Map 43a, scale 1 inch to 1 mile.
1936: Gold Deposits of the Belt Extending from Manitou Lake to Lake of the Woods, Ontario; CIMM Trans., p.686-701.

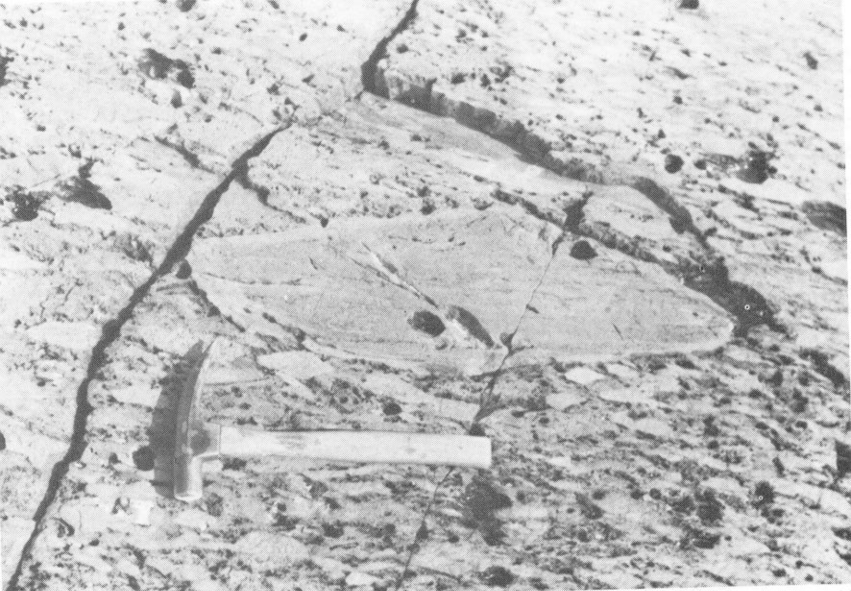
Turner, F.J.
1968: Metamorphic Petrology: Mineralogical and Field Aspects; McGraw-Hill Book Company, New York, 403p.

Wanless, R.K.
1970: Isotopic Age Map of Canada; Geol. Surv. Canada, Map 1256A, scale 1:5,000,000. Compilation 1969.

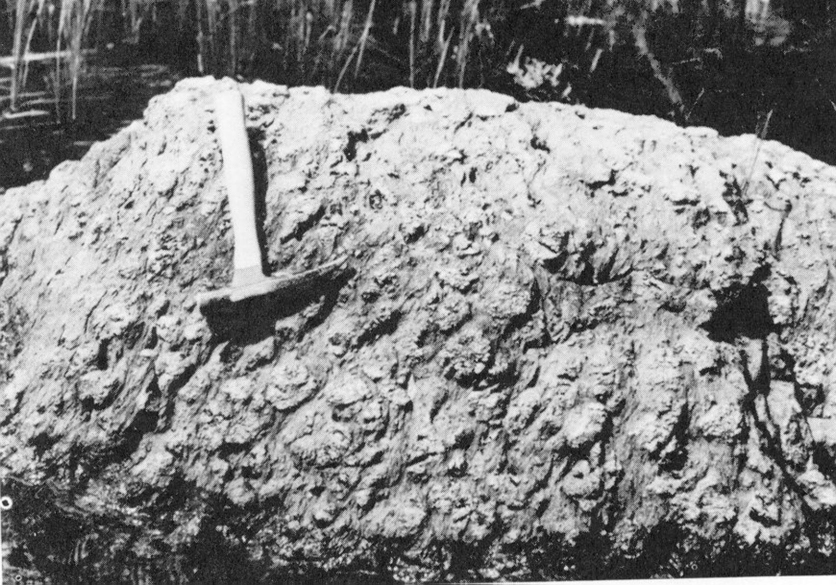
Zoltai, S.C.
1961: Glacial History of Part of Northwestern Ontario; Proc. Geol. Assoc. Canada, Vol.13, Dec.1961, p. 61-83 (published July 1962).
1965: Kenora-Rainy River, Surficial Geology; Ontario Dept. Land and Forests, Map S165, scale 1 inch to 8 miles. Geology 1958 to 1960.

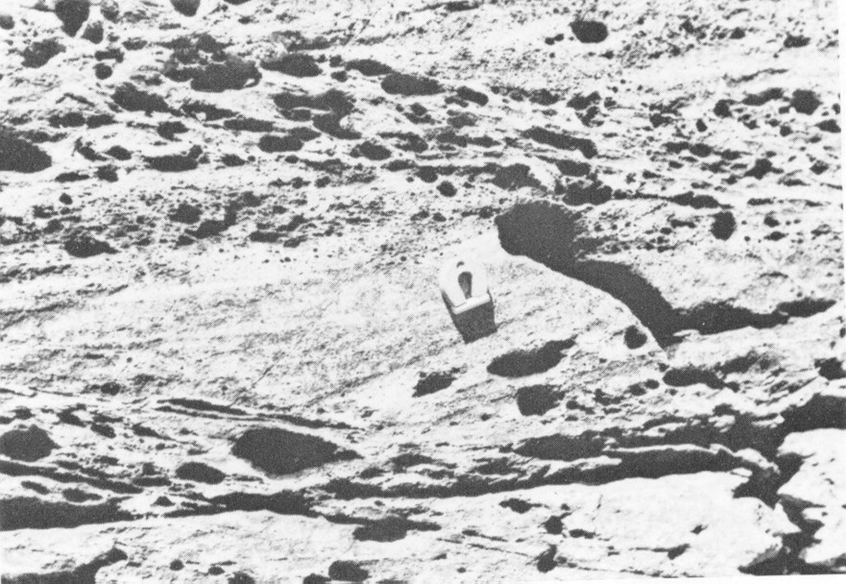
INDEX

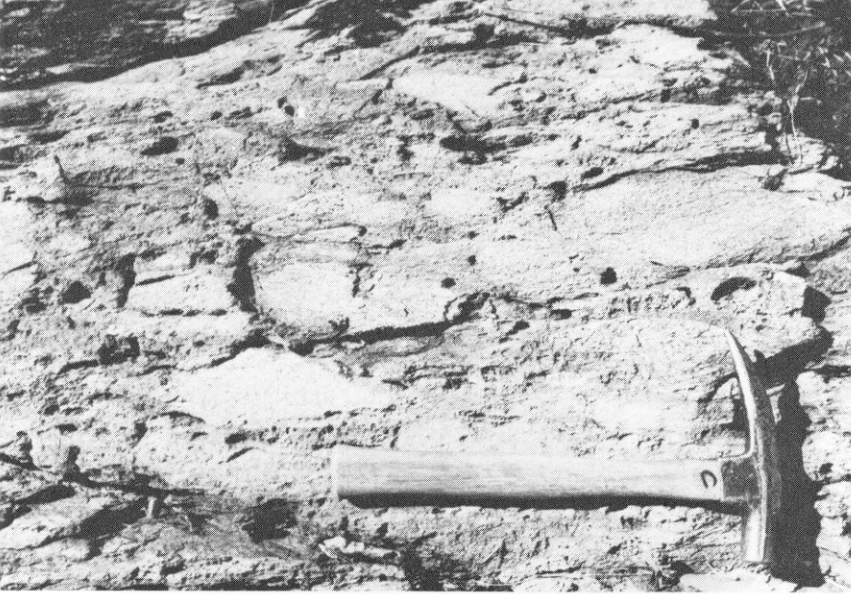
ODM9330

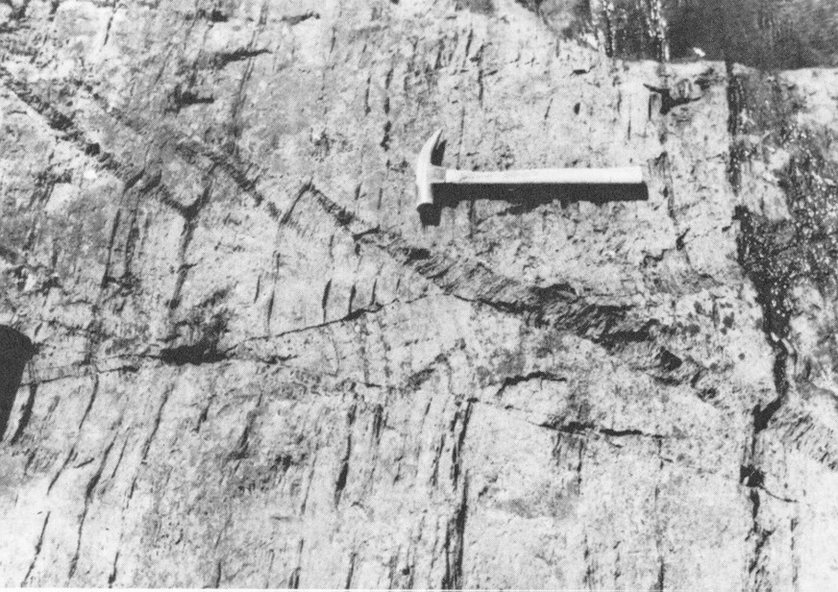


ODM93

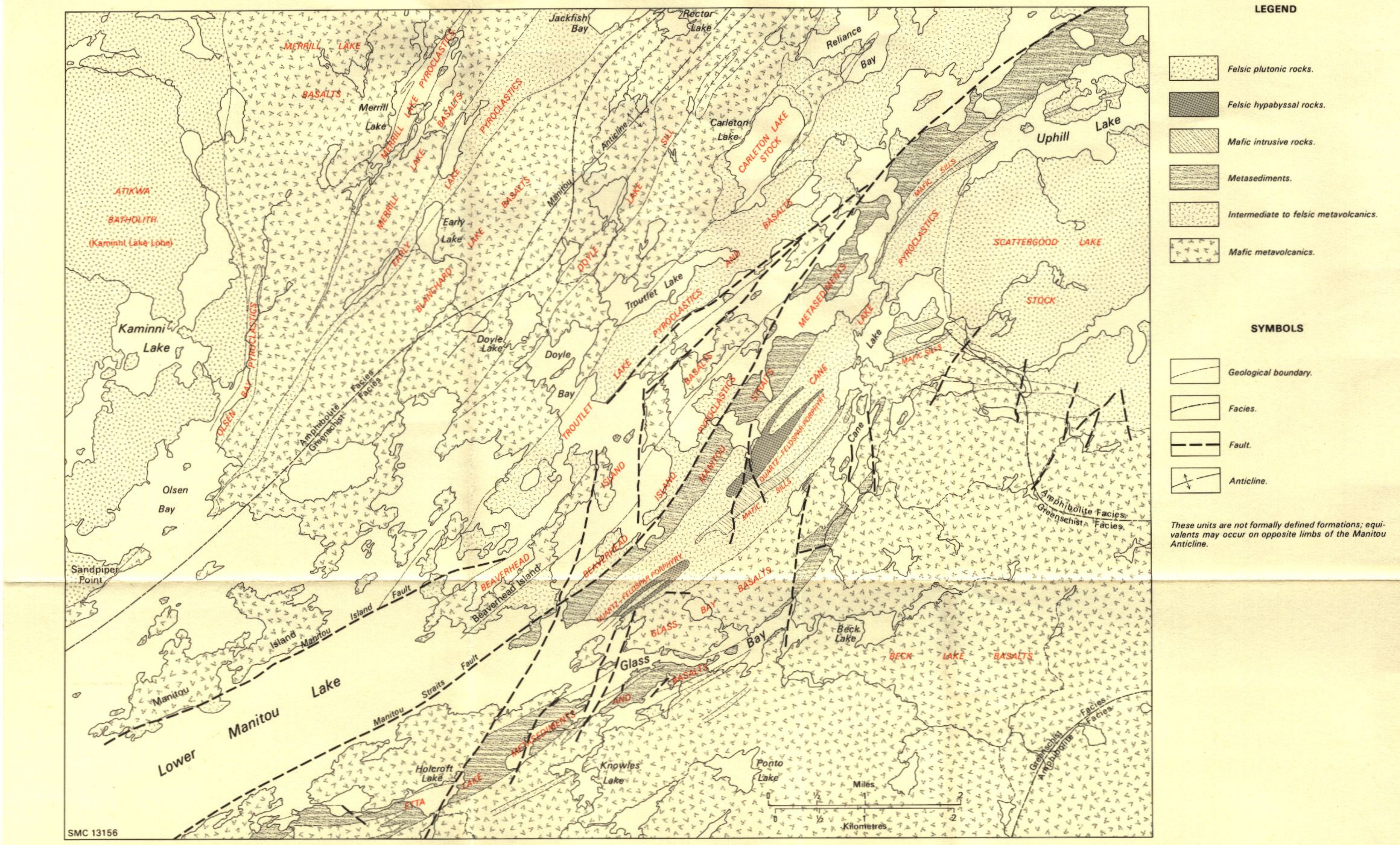






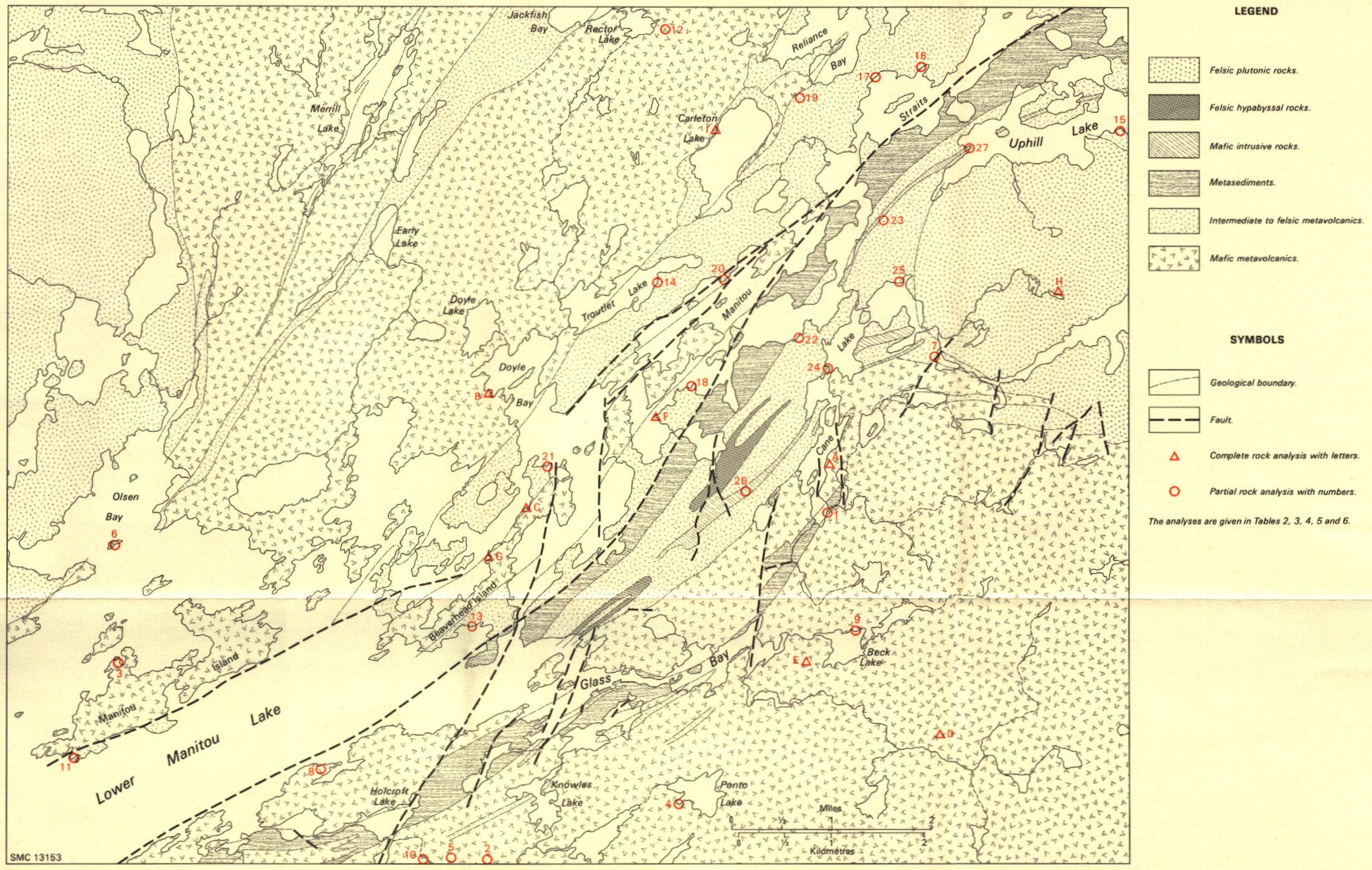


Lower Manitou—Uphill Lakes Area Report
Chart A
Figures 2, 3, 5 and 9



These units are not formally defined formations; equivalents may occur on opposite limbs of the Manitou Anticline.

Figure 2—Areal distribution of major geologic units.



The analyses are given in Tables 2, 3, 4, 5 and 6.

Figure 3—Location of samples taken for chemical analysis.

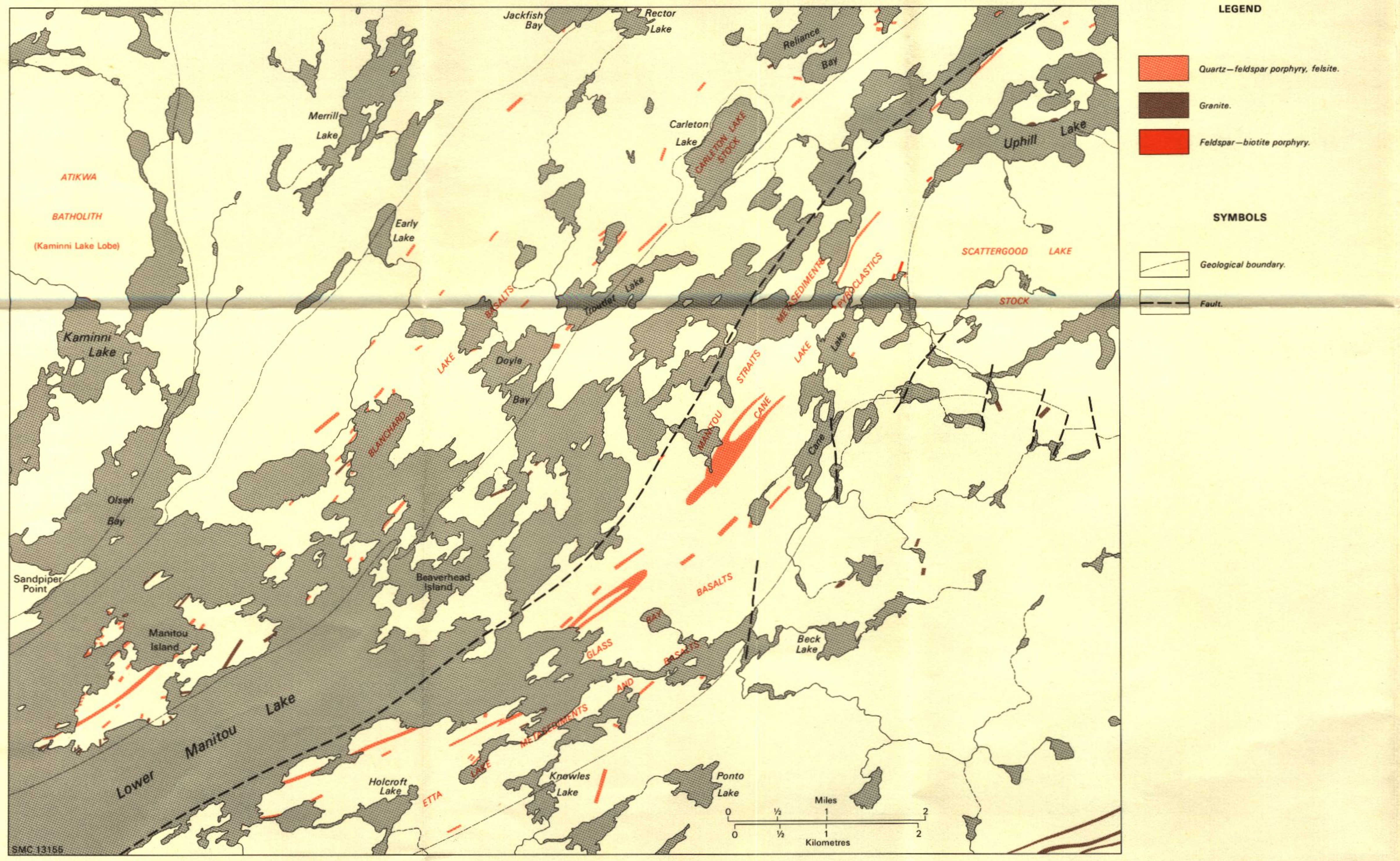
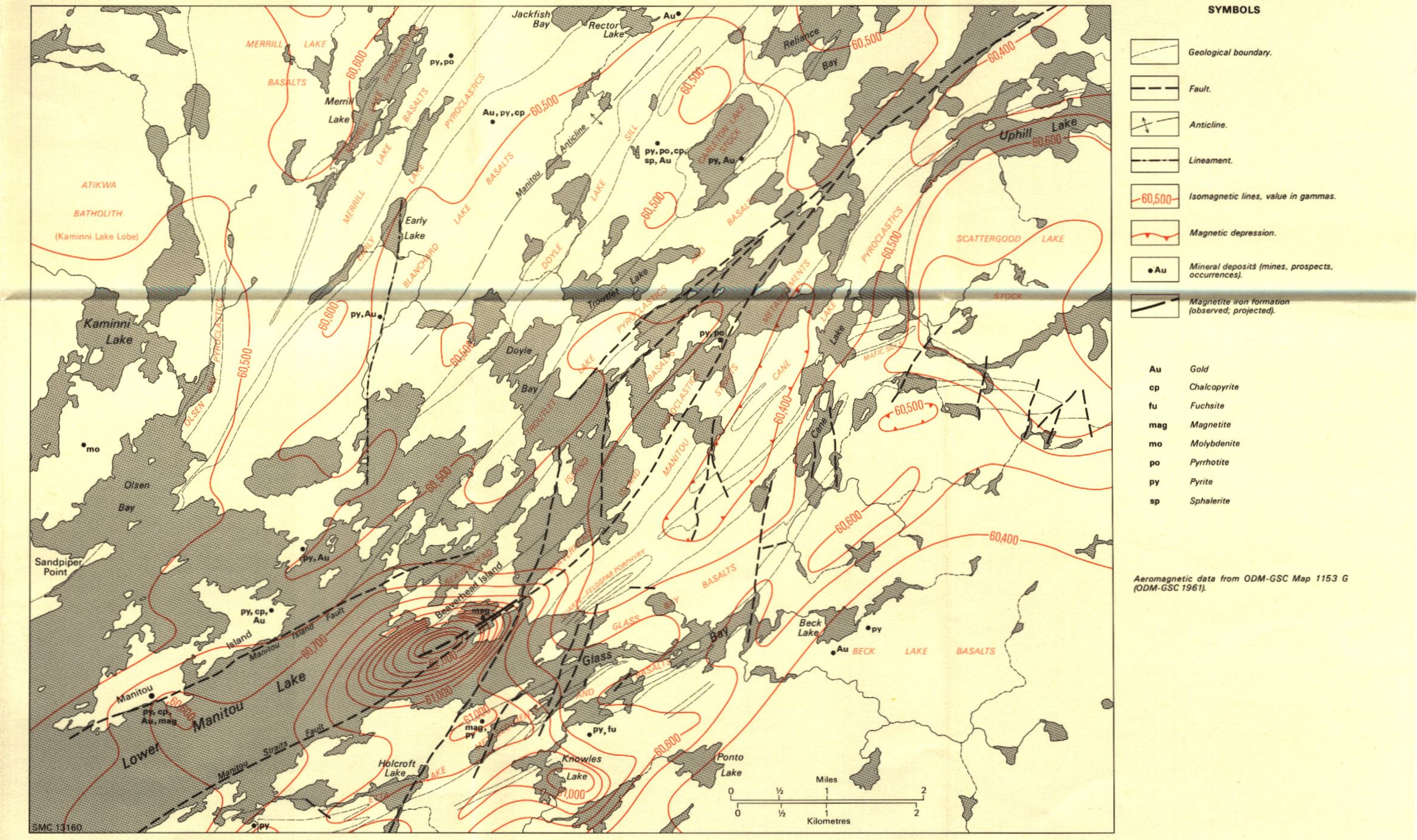


Figure 5—Distribution of felsic hypabyssal rocks.



Aeromagnetic data from ODM-GSC Map 1153 G (ODM-GSC 1961).

Figure 9—Relationship of aeromagnetic expression to geology.

ONTARIO
DIVISION OF MINES
HONOURABLE LEO BERNIER, *Minister of Natural Resources*
DR. J. K. REYNOLDS, *Deputy Minister of Natural Resources*
G. A. Jewett, *Executive Director, Division of Mines* E. G. Pye, *Director, Geological Branch*

Map 2320
Lower Manitou Lake-Uphill Lake

SYMBOLS

- *Glacial striae.*
- *Small bedrock outcrop.*
- *Area of bedrock outcrop.*
- *Bedding, top unknown; (inclined, vertical).*
- *Bedding, top indicated by arrow; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).*
- *Lava flow; top (arrow) from pillows shape and packing.*
- *Lava flow; top in direction of arrow.*
- *Schistosity; (horizontal, inclined, vertical).*
- *Gneissosity, (horizontal, inclined, vertical).*
- *Foliation; (horizontal, inclined, vertical).*
- *Kink folding; showing sense, and orientation of subvertical kink bands.*
- *Lineation with plunge.*
- *Geological boundary, observed.*
- *Geological boundary, position interpreted.*
- *Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.*
- *Lineament.*
- *Jointing; (horizontal, inclined, vertical).*
- *Anticline, syncline, with plunge.*
- DH *Drill hole; (vertical, inclined).*
- MA *Magnetic attraction.*
- *Swamp.*
- *Trail, portage, winter road.*
- *Building.*
- *Township boundary, meridian or base line, with milepost, approximate position only.*
- 2 *Mining property; surveyed.*
- 5 *Mineral deposit; mining property, unsurveyed.*
- *Surveyed line, approximate position only.*

PROPERTIES, MINERAL DEPOSITS

1. *Canadian Nickel Co. Ltd. [1971].*
2. *Churchill, H. R., Stone, E. J. (Bee-hive mine, Gaffney prospect).*
3. *Daering Explorers Corp. Ltd. [1967].*
4. *Elora Gold Mines Ltd. (Twentieth Century mine).*
5. *Freeport Canadian Exploration Co. [1970].*
6. *Glass Reef mine.*
7. *Hampe, L., Charles Merrill Estate, (Royal Sovereign mine).*
8. *Hampe, L., Charles Merrill Estate, ("Swede Boy" location).*
9. *Kerr Addison Mines Ltd. [1967].*
10. *Queen Alexandra mine.*
11. *Reliance prospect.*
12. *Watson occurrence.*
13. *Wetelainen occurrence.*
14. *Wright, C. R., Wright, D.C. (Dryden-Red Lake Prospecting Partnership).*

Information current to 31 December, 1972. Only former properties on ground now open for staking are shown where exploration information is available—a date in square brackets indicates last year of exploration activity. For further information see report.

SOURCES OF INFORMATION

Geology by C. E. Blackburn and assistants, Geological Branch, 1972.
Geology is not tied to surveyed lines.

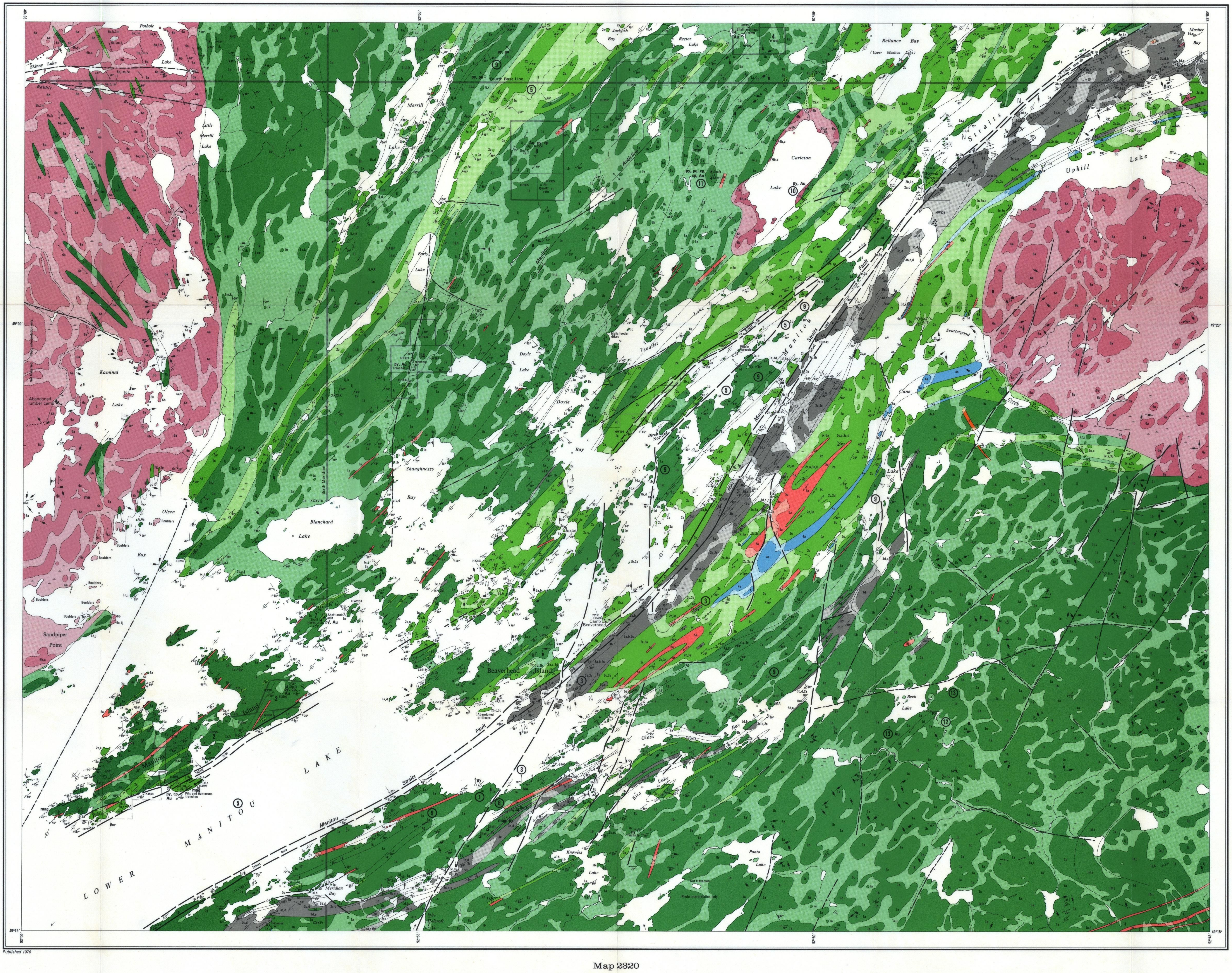
Aeromagnetic map 1153G, ODM-GSC.

Ministry of Natural Resources (ODM):
Map 42c, Manitou-Stormy Lakes Area, scale 1 inch to 1 mile, issued 1933.
Preliminary map P.816, Lower Manitou-Uphill Lakes Area, scale 1 inch to ¼ mile, issued 1973.

Cartography by D. W. Robeson and assistants, Surveys and Mapping Branch, 1974.

Base map derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch with additional information by C. E. Blackburn.

Magnetic declination in the area was approximately 5°E, 1972.



Published 1976

LEGEND

CENOZOIC[a]
QUATERNARY
PLEISTOCENE AND RECENT
Sand, gravel, boulders.

UNCONFORMITY

PRECAMBRIAN[b]
MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)
MAFIC INTRUSIVE ROCKS

7 *Diabase.*

INTRUSIVE CONTACT

EARLY PRECAMBRIAN (ARCHEAN)
FELSIC INTRUSIVE ROCKS
FELSIC PLUTONIC ROCKS[c]

6 *Unsubdivided*
6a *Porphyritic quartz monzonite, granodiorite.*
6b *Quartz monzonite, granodiorite.*

FELSIC HYPABYSSAL ROCKS[c]

5 *Unsubdivided.*
5a *Quartz porphyry, quartz-feldspar porphyry.*
5b *Felsite.*
5c *Granite.*
5d *Feldspar-biotite porphyry.*

INTRUSIVE CONTACT

MAFIC INTRUSIVE ROCKS[c]

4 *Unsubdivided.*
4a *Hornblende-plagioclase porphyry, amygdaloidal hornblende-plagioclase porphyry.*
4b *Lamprophyre.*

INTRUSIVE CONTACT

METASEDIMENTS[d]

3 *Unsubdivided.*
3a *Volcanic-clast, pebble conglomerate and boulder conglomerate.*
3b *Polymictic conglomerate with volcanic, granitic, chert, and magnetite clasts.*
3c *Sandstone.*
3d *Siltstone, argillite, slatey argillite.*
3e *Chert.*
3f *Magnetite iron formation.*
3g *Sericite schist.*[e]

CONFORMABLE AND UNCONFORMABLE CONTACTS

METAVOLCANICS[f]
INTERMEDIATE TO FELSIC METAVOLCANICS

2 *Unsubdivided.*
2a *Intermediate lithic-crystal tuff.*
2b *Intermediate lapilli-tuff.*
2c *Intermediate tuff-breccia.*
2d *Felsic tuff and (or) dacitic to rhyolitic flows.*
2e *Felsic lapilli-tuff.*
2f *Felsic tuff-breccia.*
2g *Quartz-feldspar-biotite schist and gneiss.*
2h *Sericite-chlorite schist.*[e]

MAFIC METAVOLCANICS

1 *Unsubdivided.*
1a *Medium- to fine-grained basalt.*
1b *Coarse-grained basalt (gabbroic).*
1c *Pillowed basalt.*
1d *Porphyritic basalt.*
1e *Pillowed porphyritic basalt.*
1g *Breccia.*
1h *Porphyritic gabbroic basalt.*
1j *Amphibolite.*
1k *Amphibolitic migmatite.*
1m *Biotite-amphibolite migmatite.*
1n *Diorite, quartz diorite.*
1p *Chlorite schist.*[e]

Au	*Gold.*
cp	*Chalcopyrite.*
mag	*Magnetite.*
mo	*Molybdenite.*
po	*Pyrrhotite.*
py	*Pyrite.*
S	*Sulphide mineralization.*
sp	*Sphalerite.*

---

[a] *Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts of the map.*

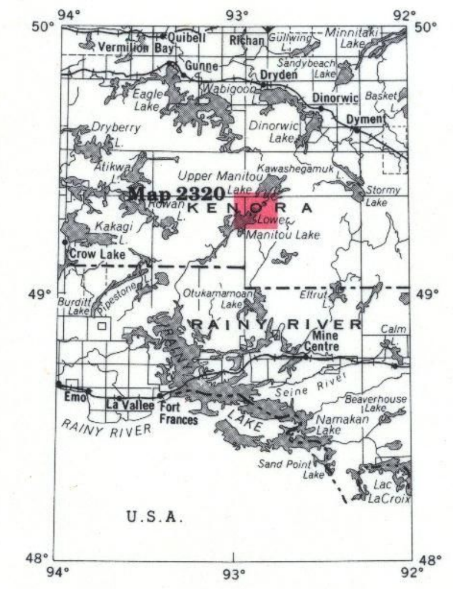
[b] *Bedrock geology. Outcrops and inferred extensions of each rock map unit are shown respectively in deep and light tones of the same colour. Where in places a formation is too narrow to show colour and must be represented in black, a short black bar appears in the appropriate block.*

[c] *Rocks grouped under these headings are not necessarily all the same age.*

[d] *Rocks grouped here belong in part to the "Manitou Series" (Thomson 1933), and are in part intravolcanic.*

[e] *Derived by dynamic metamorphism along fault and shear zones.*

[f] *Numerical order does not imply age relationships between metavolcanics.*



Scale, 1 inch to 50 miles

N.T.S. reference 52F/7

Map 2320

LOWER MANITOU LAKE-UPHILL LAKE

KENORA DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1 2 Miles
Metres 1000 0 1 2 3 Kilometres
Feet 1000 0 5,000 10,000 Feet