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Ontario Geological Survey

Report 224

Geology

of the

Flying Loon Lake Area

District of Kenora

By

N.F. Trowell, J.R. Bartlett, and R.H. Sutcliffe

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FOREWORD

FLYING LOON LAKE AREA

The Flying Loon Lake area was mapped on a reconnaissance scale in conjunction with a regional geological study of the Savant Lake-Crow Lake area, Districts of Thunder Bay and Kenora. The area contains deposits of gold, copper, molybdenum, iron and sand and gravel. The mapping was undertaken in an attempt to correlate lithostratigraphic units between the Sturgeon Lake and Sioux Lookout areas and to provide a geological base to more adequately assess the mineral potential of the Flying Loon Lake area itself. Two geological maps at a scale of 1:50 000 cover the area. Only brief mention is made to the eastern map-sheet where new information warrants. The remainder has been discussed in a report on the Sturgeon Lake area that has been published.

E.G. Pye
Director
Ontario Geological Survey

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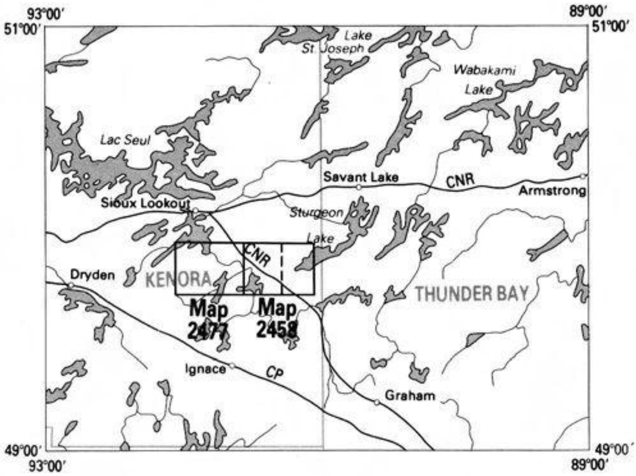

Figure 1–Key map showing location of Flying Loon Lake Area.
Scale 1:3 168 000 (1 inch to 50 miles).

ABSTRACT

This report gives an account of the geology and mineralization of the Flying Loon Lake Area. This area, centred about 30 km southeast of Sioux Lookout, is 900 km^2 in size, and occurs within the Wabigoon Subprovince of the Precambrian Shield.

Bedrock is Early Precambrian (Archean) in age and consists of metavolcanics, metasediments, and igneous intrusive rocks that range from felsic to ultramafic in composition. Much of the area, however, is covered by Pleistocene glacial deposits and Recent swamp deposits.

Metavolcanics are dominantly mafic to intermediate in composition, and consist predominantly of flows with local accumulations of autoclastic and pyroclastic fragmental rocks. Minor intermediate and felsic metavolcanics have a dominantly pyroclastic origin with a local subvolcanic component and occur in the western part of the area. The metavolcanics have been subdivided into several lithostratigraphic groups based upon mode of eruption, areal distribution, and their chemistry. Thin beds of clastic and chemical metasediments occur in interflow positions. A major assemblage of clastic metasediments, the Minnitaki Group, contains a zone of chemical metasediments consisting of intercalated chert, sandstone, and hematite-quartz-magnetite ironstone.

Ultramafic and mafic intrusions intrude the mafic to intermediate metavolcanic sequences.

Granitic batholithic complexes define the northern and southern boundaries of the volcano-sedimentary belt. Plutons and intrusions are interpreted to be subvolcanic to post-tectonic in origin, and vary in composition from trondhjemite to calcic monzonite.

The metavolcanics, metasediments, and mafic and ultramafic intrusions were metamorphosed to the lower to upper greenschist and the lower amphibolite facies rank of metamorphism.

Folding occurred dominantly about east- to northeast-trending fold axes; however, the lack of reliable top determinations precludes accurate determination of the axial plane traces of these folds. Faulting, locally evidenced by the development of mylonite and fault gouge zones, has occurred along east- to northeast-trending and later northeast-trending structures.

Deposits of gold, copper, molybdenum, iron, sand and gravel are present. Gold is associated with quartz veins situated within metavolcanics, and is located along the contact between metavolcanics and the Minnitaki Group metasediments. Disseminated copper and molybdenum mineralization occurs in epizonal, possibly subvolcanic, intrusions. Ferruginous chemical metasediments occur in the Minnitaki Group metasediments.

Geology of the Flying Loon Lake Area, by N.F. Trowell, J.R. Bartlett and R.H. Sutcliffe, Ontario Geological Survey Report 224, 109p. Accompanied by Maps 2458 and 2477, scale 1:50 000 and 1 Chart. Published in 1983. ISBN 7743-7355-5.

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CONVERSION FROM SI TO IMPERIAL			CONVERSION FROM IMPERIAL TO SI		
SI Unit	*Multiplied by*	*Gives*	*Imperial Unit*	*Multiplied by*	*Gives*
			LENGTH		
1 mm	0.039 37	inches	1 inch	**25.4**	mm
1 cm	0.393 70	inches	1 inch	**2.54**	cm
1 m	3.280 84	feet	1 foot	**0.304 8**	m
1 m	0.049 709 7	chains	1 chain	20.116 8	m
1 km	0.621 371	miles (statute)	1 mile (statute)	**1.609 344**	km
			AREA		
1 cm^2	0.155 0	square inches	1 square inch	**6.451 6**	cm^2
1 m^2	10.763 9	square feet	1 square foot	**0.092 903 04**	m^2
1 km^2	0.386 10	square miles	1 square mile	2.589 988	km^2
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm^3	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm^3
1 m^3	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m^3
1 m^3	1.308 0	cubic yards	1 cubic yard	0.764 555	m^3
			CAPACITY		
1 L	1.759 755	pints	1 pint	0.568 261	L
1 L	0.879 877	quarts	1 quart	1.136 522	L
1 L	0.219 969	gallons	1 gallon	**4.546 090**	L
			MASS		
1 g	0.035 273 96	ounces (avdp)	1 ounce (avdp)	28.349 523	g
1 g	0.032 150 75	ounces (troy)	1 ounce (troy)	**31.103 476 8**	g
1 kg	2.204 62	pounds (avdp)	1 pound (avdp)	**0.453 592 37**	kg
1 kg	0.001 102 3	tons (short)	1 ton (short)	**907.184 74**	kg
1 t	1.102 311	tons (short)	1 ton (short)	**0.907 184 74**	t
1 kg	0.000 984 21	tons (long)	1 ton (long)	**1016.046 908 8**	kg
1 t	0.984 206 5	tons (long)	1 ton (long)	**1.016 046 908 8**	t
			CONCENTRATION		
1 g/t	0.029 166 6	ounce (troy)/ ton (short)	1 ounce (troy)/ ton (short)	34.285 714 2	g/t
1 g/t	0.583 333 33	pennyweights/ ton (short)	1 pennyweight/ ton (short)	1.714 285 7	g/t

OTHER USEFUL CONVERSION FACTORS

1 ounce (troy)/ton (short)	20.0	pennyweights/ton (short)
1 pennyweight/ton (short)	0.05	ounce (troy)/ton (short)

NOTE—Conversion factors which are in bold type are exact. The conversion factors have been taken from or have been derived from factors given in the Metric Practice Guide for the Canadian Mining and Metallurgical Industries published by The Mining Association of Canada in co-operation with the Coal Association of Canada.

Geology

of the

Flying Loon Lake Area

District of Kenora

By

N.F. Trowell[1], J.R. Bartlett[2], and R.H. Sutcliffe[3]

INTRODUCTION

The Flying Loon Lake area is bounded by Latitudes 49°45′-50°02′N and Longitudes 91°00′-92°00′W. The area covers about 900 km^2 and is approximately 56 km long and 13 km wide. The centre of the area is about 40 km southeast of Sioux Lookout. The settlement of Umfreville is situated in the central part of the area.

This area was mapped in conjunction with a regional study of the Savant Lake-Crow Lake area, Districts of Kenora and Thunder Bay (Trowell *et al.* 1977, 1978, and 1980).

Acknowledgments

Assistance in the field was provided by R.H. Sutcliffe, Jeff Reid, and Dave Guindon in 1977, and by J.R. Bartlett, M. Hyatt, and R. Sinden in 1978. Messrs. Bartlett and Sutcliffe, as senior geological assistants mapped approximately 55 percent of the area. Both individuals also submitted written geological reports of their respective map-areas. Their findings have been incorpo-

[1]Geologist, Ontario Geological Survey, Precambrian Geology Section, Ministry of Natural Resources, Toronto.

[2]Graduate student, Carleton University, Ottawa.

[3]Geologist, Ontario Geological Survey, Precambrian Geology Section, Ministry of Natural Resources, Toronto.

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rated in the present report. Special thanks are extended to R.O. Page[1] for supplying unpublished geological data for parts of the area not covered by the authors and assistants.

Means of Access

Highway 642 and the Canadian National Railway Sioux Lookout-Thunder Bay line pass through the central part of the area. Lumber roads extending from Highway 642 give access to several of the lakes in the area and facilitate bush traversing. The southwest part of the area is accessible by float-equipped aircraft from Sioux Lookout and by the English River canoe route.

Prospecting and Mining Activity

The area has been prospected, primarily for gold, on an intermittent basis since the turn of the century.

Several base-metal massive sulphide deposits were discovered from 1969 to 1972 in the Sturgeon Lake area, located just east of the current map-area. These discoveries led to the Flying Loon Lake Area being extensively prospected for similar mineralization. Exploration is still continuing at the time of writing, though at a much reduced level.

Other types of mineral occurrences that have been examined within the map-area are:

1. A molybdenum-copper occurrence in the Shanty Lake Pluton, on Shanty Lake, is located just south of Watcomb Lake (Trowell 1970, 1982);
2. Hematite-quartz-magnetite ironstones situated within the Minnitaki Group metasediments in the Twin Bay-Twinflower Lake area, located in the northwestern part of the map-area.

Pleistocene sand and gravel deposits are used for road construction and maintenance.

Field Procedures

Parts of the map-area were mapped by the authors and assistants during the summer months of 1977 and 1978. R.O. Page carried out mapping in the northwestern part of the area in 1978 (Page 1978b).

Mapping was confined to the volcano-sedimentary belt; only the contact relationships with the bounding granitic rocks were examined. The area was not systematically traversed, but rather, traverses were designed to cover areas of maximum exposure and to give stratigraphic sections which are as

[1]Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto.

complete as possible. Parts of the western half of the area were mapped by helicopter reconnaissance in 1978.

Reconnaissance mapping was done at a scale of 1:15 840. The geological field data were plotted on acetate sheets attached to aerial photographs at a scale of 1:15 840. The data were then transferred to base maps, which are at the same scale as the air photographs, that had been prepared by the Cartography Section, Ontario Division of Lands, from maps of the Forest Resources Inventory, Ontario Ministry of Natural Resources.

Information from assessment work files of the Assessment Files Research Office, Toronto, and the Resident Geologist's Office, Sioux Lookout, was also used in the preparation of this report.

Uncoloured preliminary maps P.2350, P.2351, P.2352, P.2353, and P.2354 at a scale of 1:15 840 were published in 1980 (Trowell *et al.* 1980a, 1980b, 1980c, 1980d, and 1980e).

Previous Geological Work

The earliest references to the geology of the map-area are in the reports of R. Bell (1872), A.P. Coleman (1895), W.A. Parks (1898), J.A. Bow (1899, 1900), William McInnes (1901), and E.J. Davidson (1901). W.H. Collins (1909) carried out a reconnaissance survey along the National Transcontinental Railway line in 1906-1907. A.R. Graham (1930) covered the far eastern part of the area in 1929 during his mapping of the Sturgeon Lake area. M.E. Hurst (1932) mapped the Sioux Lookout area. F.J. Pettijohn (1936) mapped the East Bay area of Minnitaki Lake. The Superior Junction-Sturgeon Lake area was mapped in 1937 by H.C. Horwood (Horwood 1938). A report on mining activities in the Sioux Lookout area, including a description of those properties within the western part of the map-area, was written by E.O. Chisholm (1951). R. Skinner (1969) mapped the area at a reconnaissance scale. N.F. Trowell (1970) mapped the Watcomb area. R.G. Walker and F. Pettijohn (1971) carried out detailed mapping in the East Bay area. F.J. Johnston (1972) covered the eastern part of Minnitaki Lake. R.O. Page (1978b) mapped the Zarn Lake area.

The map-area was surveyed aeromagnetically in 1961, and the map sheets at a scale of 1:63 360 which cover this area have been published jointly by the Geological Survey of Canada and the Ontario Geological Survey (Ontario Department of Mines and Geological Survey of Canada 1961a, 1961b, 1961c, and 1961d).

Data Series maps prepared by the Resident Geologist and staff, Ontario Ministry of Natural Resources, Sioux Lookout, provide coverage for most of the area (Palonen and Speed 1975a, 1975b, 1975c; Palonen *et al.* 1978).

Several papers and studies have been written on specific geological topics which involve aspects of the geology of the area (Turner and Walker 1973; Hiscott 1974; Szewcyzk and West 1976; Franklin *et al.* 1977; Page and Clifford 1977).

Physiography

The area occurs in the drainage basin of the English River which discharges into the southeastern corner of Southeast Bay, Minnitaki Lake.

The area is of moderate relief, having elevations that vary between 350 and 420 m above sea-level. The elevation of Sturgeon Lake, situated just east of the area, is 409 m above sea-level, and that of Minnitaki Lake is 358 m above sea-level. The relief mainly reflects the distribution of the Pleistocene and Recent deposits. Areas underlain by granitic rocks and large gabbroic intrusions have slightly higher elevations than the ground underlain by metavolcanics and metasediments.

Most of the area is covered by a thick mantle of glacial material and recent accumulations of organic material.

GENERAL GEOLOGY

The Flying Loon Lake area is part of a regional volcano-sedimentary belt bordered on the north and south respectively by the Lake of Bays and Basket Lake Batholithic Complexes. The belt varies in width from 8 km to 18 km, and was mapped for 53 km of its length along strike.

Table 1 lists the lithological units within the map-area.

Stratigraphic terminology has been applied to the western part of the area by Pettijohn (1936), Walker and Pettijohn (1971), Johnston (1972), Turner and Walker (1973), and Page and Clifford (1977). Volcanic sequences east of the area have been named by Trowell (1983). Table 2 and Figure 2 respectively present the pertinent stratigraphic terminologies and the geographical distribution of lithological sequences in the area.

Turner and Walker (1973) interpreted the Minnitaki Group, and Abram Group [outside the map-area] to comprise two discrete sequences of metasediments (*see* Table 2). These authors believe that the Abram Group unconformably overlies the Northern Volcanic Belt [north of the present map-area]. Though less sure of the relationships, due to the presence of faults between the major lithological sequences, Turner and Walker (1978) interpreted the Central Volcanic Belt (equivalent to the Neepawa Group, Pettijohn 1936; Page and Clifford 1977) and the Minnitaki Group to overlie the Abram Group (Table 2). Turner and Walker (1973) made no statement on the relative stratigraphic position of the Southern Volcanic Belt.

Johnston (1972) considered the metasediments equivalent to the Abram and Minnitaki Groups of Turner and Walker (1973) to be correlative with each other, and that their present distribution in two discrete linear belts is a result of the folding and faulting of a formerly continuous metasedimentary sequence (Table 2).

The authors agree with Turner and Walker (1973) that the two groups of metasediments have a different environment and mode of deposition, but maintains that these groups may be correlative. The authors also interpret the

TABLE 1	LITHOLOGICAL UNITS OF THE FLYING LOON LAKE AREA.

PHANEROZOIC

CENOZOIC

QUATERNARY

RECENT

Swamp, lake, and stream deposits

PLEISTOCENE

Sand, gravel, and clay.

Unconformity

PRECAMBRIAN

EARLY PRECAMBRIAN (ARCHEAN)

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Trondhjemite, granodiorite, quartz monzonite, diorite, quartz diorite, monzonite, aplite, and pegmatite.

ULTRAMAFIC INTRUSIVE ROCKS

Peridotite, pyroxenite, hornblendite.

MAFIC INTRUSIVE ROCKS

Gabbro, diorite.

CHEMICAL METASEDIMENTS

Hematite-magnetite ironstone, chert.

CLASTIC METASEDIMENTS

Wacke, arenite, arkose, mudstone, siltstone, conglomerate.

FELSIC TO INTERMEDIATE METAVOLCANICS

Massive flows, porphyritic flows, tuff, lapilli-tuff, lapillistone, tuff-breccia, porphyry.

MAFIC TO INTERMEDIATE METAVOLCANICS

Massive flows, amygdaloidal and vesicular flows, porphyritic flows, pillowed flows, volcanic breccia, hyaloclastic pillow breccia, autoclastic breccia, tuff, lapilli-tuff, lapillistone, tuff-breccia, calc-alkalic flows, variolitic flows, amphibolitic flows.

Neepawa Group, or at least the upper calc-alkalic part of it, as a post-sedimentary sequence (Table 2). The possibility that the Neepawa Group was tectonically emplaced above the sediments cannot be ruled out.

Stratigraphic relationships in the central and eastern parts of the area are less clear. Here, the predominantly mafic to intermediate metavolcanic bedrock has been subdivided into several sequences based upon structure, texture, and chemistry. The sequences, which have been assigned names by the author of this report, are taken from local geographic features.

TABLE 2 STRATIGRAPHY OF THE FLYING LOON LAKE AREA, IN THE SIOUX LOOKOUT AREA.

Turner and Walker 1971	Johnston, 1972	This Report
Minnitaki Group		
Faulting		
CENTRAL VOLCANIC BELT		
Faulting		Neepawa Group
ABRAM GROUP	ABRAM GROUP	Faulting
		ABRAM AND MINNITAKI GROUPS
Unconformity	Unconformity	
NORTHERN VOLCANIC BELT	MAFIC TO INTERMEDIATE METAVOLCANICS	NORTHERN AND SOUTHERN VOLCANIC BELT

The emplacement of the batholithic complexes is considered by the authors to be contemporaneous with volcanism and sedimentation. Hypabyssal intra-belt offshoots of the batholiths include the porphyries that were exposed and subsequently unroofed to form the basal porphyry-clast conglomerate of the Minnitaki Group. The Shanty Lake Pluton may also represent an early subvolcanic intrusion emplaced at a shallow level as an offshoot of the rising batholith. Unroofing of early batholithic material with attendant erosion and redeposition may account for the upper granitoid-clast conglomerates of both the Minnitaki and Abram (Turner and Walker 1973) Groups. Volcanism probably occurred concomitantly with sedimentation and ended with the outpourings of flows and fragmentals forming the upper part of the Neepawa Group and including the synvolcanic Northeast Bay Pluton.

Deformation began with the sagging of the basal mafic to intermediate metavolcanic platform and the initial upwelling of the batholithic complexes due to gravitational instability. As sagging continued, the lithological discontinuities between the metavolcanics and the "now" deposited sediments could have been the sites of gravity slides. These discontinuities were later to be reactivated as zones of brittle deformation, namely faults, within the then consolidated volcano-sedimentary belt. Post-tectonic intrusions, including the Smock and Wyatt Lakes Plutons and Towers Lake Intrusions, were emplaced after the initial deformation and metamorphism of the metavolcanics had occurred. These intrusions caused the deflection of the foliations, and the superimposi-

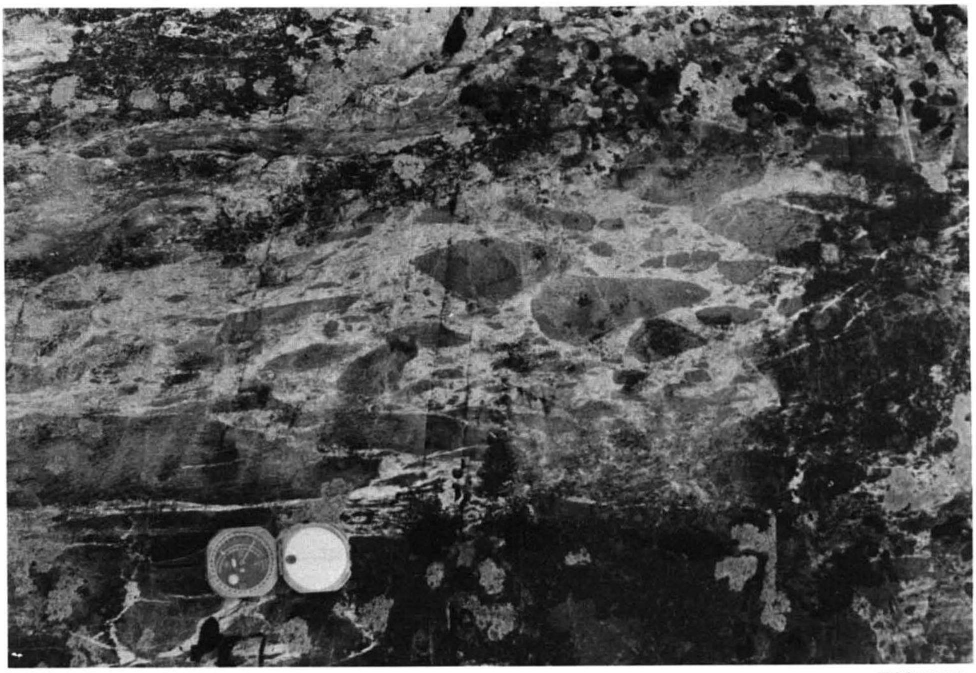

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Photo 1–Autoclastic, possibly broken pillow breccia from mafic metavolcanic flow situated on the north shore of Logger's Lake.

tion of albite-epidote hornfels mineralogies on the regional greenschist mineralogies of the metavolcanics.

Early Precambrian (Archean)

METAVOLCANICS

Mafic to Intermediate Metavolcanics

Mafic to intermediate metavolcanics are the dominant lithology in the surveyed area. For this report, these rocks have been subdivided on the basis of flow features and textures into:

1. massive flows, pillowed flows, amygdaloidal/vesicular flows and plagioclase-phyric flows (one flow with possible variolitic structures is exposed on the shore of Grassy Bay);

2. autoclastic breccias consisting of flow and minor hyaloclastic pillow breccia (Photo 1);
3. pyroclastic rocks.

The metavolcanics in the western part of the area have been previously subdivided into the Neepawa Group (Pettijohn 1936; Page and Clifford 1977) or Central Volcanic Belt (Turner and Walker 1973) and the Southern Volcanic Belt (Turner and Walker 1973). In the eastern part of the area, the metavolcanics appear to correlate with the Central Sturgeon Lake Volcanics, [Central Sturgeon Lake Assemblage of Trowell (1979)], and the South Sturgeon Lake Volcanics [South Sturgeon Lake Assemblage of Trowell (1979)]. Figure 3 illustrates the distribution of these units as well as the newly-defined sequences that will be discussed later in this report. The geology of the upper part of Minnitaki Lake northeast of Southeast Bay is shown in Figure 4. The Neepawa Group occurs predominantly in this area, specifically the calc-alkalic flows. Readers should refer to this figure for any accompanying discussion of the Neepawa Group.

The mafic to intermediate metavolcanics weather various shades of green and grey to locally black. The upper calc-alkalic basalts and andesites of the Neepawa Group have a characteristic grey-green, often slightly blue-grey tinged, weathered surface that allows them to be easily distinguished in the field from the lower tholeiitic basalts. The fresh surfaces of the metavolcanics are similarly coloured, but have generally darker hues. White and brown hues appear to be a consequence of carbonatization. Dark green to black hues reflect the development of hornblende produced during metamorphism to the amphibolite facies rank.

Even though the mineralogy of these rocks is metamorphic, the original pilotaxitic, subophitic to ophitic, and uncommonly, isogranular textures are preserved in the massive to weakly foliated flows. The development of a penetrative foliation or shearing generally destroys these features.

The metavolcanics are variably massive, foliated, and schistose. Banding in metavolcanics marginal to the bounding granitoid areas, and the development of quartzofeldspathic (feldspar + epidote + quartz) pods and lenses adjacent to intrabelt granitoid intrusions are likely caused by the accentuation of primary layering or secondary foliation by metamorphic segregation of mineral components.

Regional metamorphism varies from lower greenschist in the central part of the volcano-sedimentary belt to lower amphibolite facies rank adjacent to the bounding granitoid terrane. Contact metamorphism of the albite-epidote hornfels facies is superimposed on greenschist facies rank mineralogies adjacent to the Smock and Wyatt Lakes Plutons.

Table 3 gives the metamorphic mineral assemblages, observed in thin section, for mafic to intermediate metavolcanics which have been metamorphosed to the greenschist and amphibolite facies rank.

The metavolcanics have been subdivided into several litho-stratigraphic sequences (Figure 3). The bases upon which these divisions were made are structures and textures identified in the field, and subsequent chemical analyses. A discussion of the bedrock chemistry of the metavolcanics, therefore, precedes the description of these sequences.

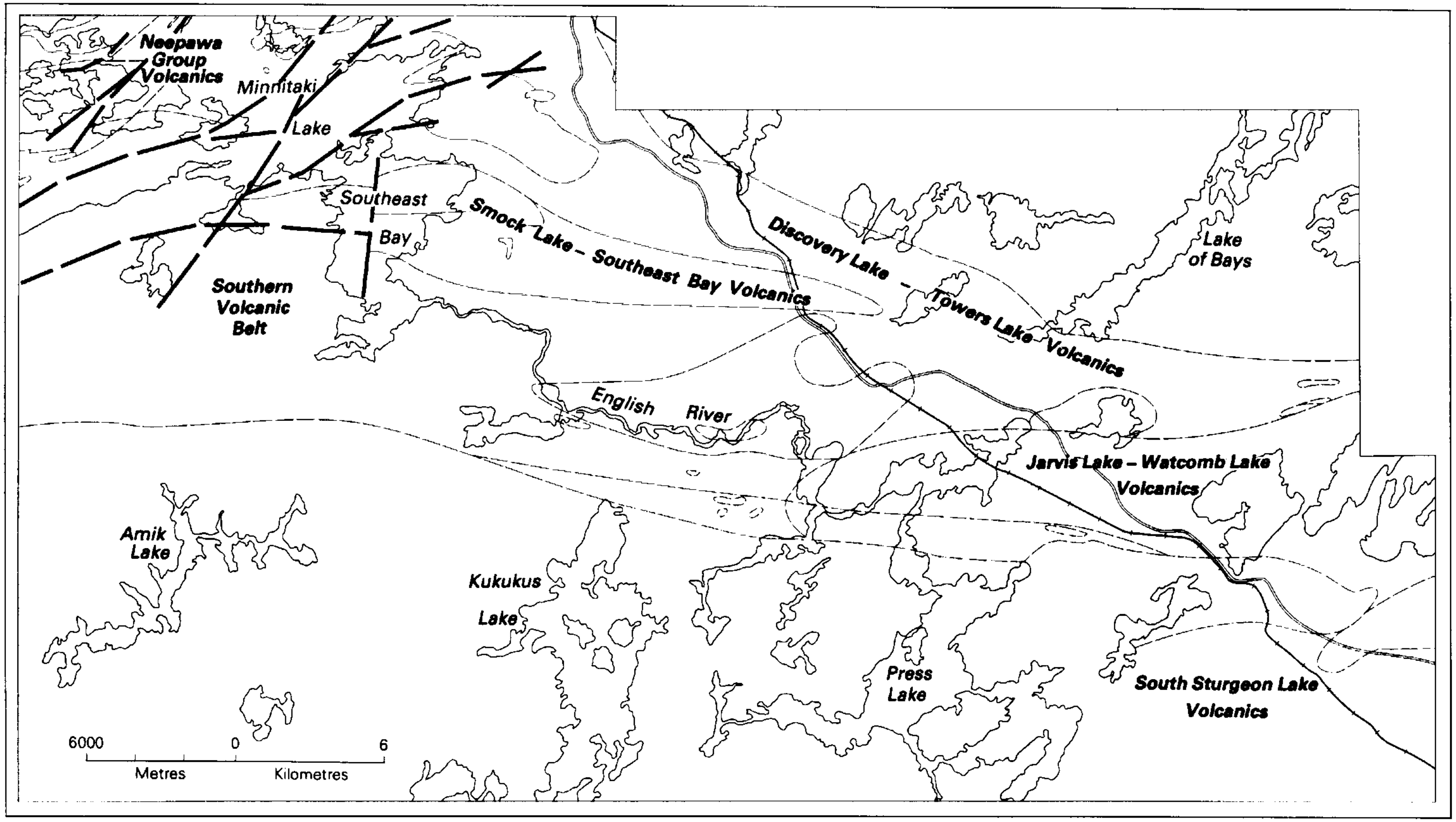

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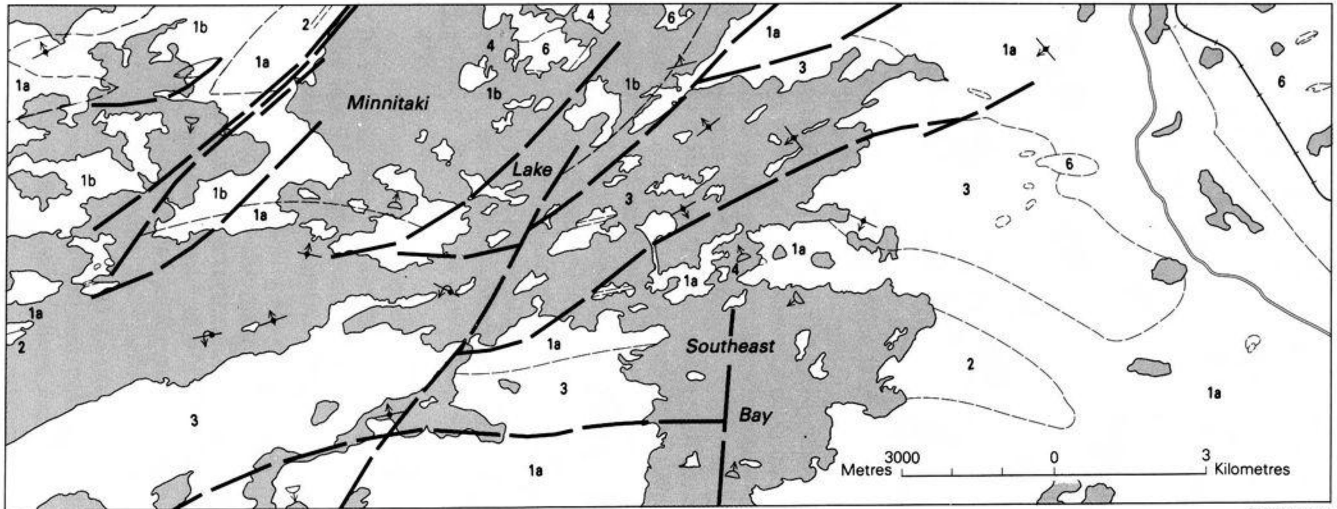
Figure 3–Metavolcanic sequences of the Flying Loon Lake.



LEGEND

6	*Felsic to intermediate intrusive rocks.*
5	*Ultramafic intrusive rocks.*
4	*Mafic intrusive rocks.*
3	*Metasediments.*
2	*Felsic to intermediate volcanic rocks.*
1	*Mafic to intermediate metavolcanics, 1a-calc-alkalic, 1b-tholeiitic.*

Geological boundary.

Fault or lineament.

Lava flow; top (arrow) from pillow shape and packing.

Bedding; top (arrow) from grain graduation; (inclined, vertical, overturned).

Bedding (vertical), top indicated by arrow.

Figure 4–Generalized geology of the Troutfish Bay - East Bay area of Minnitaki Lake.

TABLE 3 | METAMORPHIC MINERAL ASSEMBLAGES OF THE MAFIC TO INTERMEDIATE METAVOLCANICS OF THE FLYING LOON LAKE AREA.

a) Albite* + chlorite + quartz + carbonate + zoisite + epidote ± white mica ± stilipnomelane (one occurrence).

b) Albite + chlorite + tremolite-actinolite ± carbonate ± epidote ± zoisite.

c) Albite + chlorite + tremolite-actinolite + biotite + quartz ± carbonate ± epidote ± zoisite.

d) Albite + chlorite + biotite + quartz + carbonate ± white mica ± zoisite ± carbonate.

e) Albite-oligoclase 3 tremolite-actinolite + biotite + quartz + carbonate + epidote.

f) Albite-oligoclase + hornblende + biotite + quartz + epidote + carbonate ± white mica.

* Albite - An0 to An5.

Amphibolite Facies

a) Oligoclase + hornblende + biotite + quartz + epidote + carbonate ± actinolite-tremolite ± zoisite.

b) Oligoclase + hornblende + quartz + epidote + zoisite ± carbonate ± almandine.

Footnote

i) Accessories for both facies include sphene, hematite, iron-titanium oxide (predominantly in amphibolite facies rocks) and pyrite.

ii) In greenschist facies rocks showing overprint by albite-epidote hornfels facies, the albite is highly altered to epidote or saussurite, epidote is found in fine cross-cutting veinlets and segregation bands, lenses, and pods composed dominantly of albite + epidote + quartz ± carbonate form.

BEDROCK GEOCHEMISTRY OF THE METAVOLCANICS

Samples of the metavolcanic bedrock, collected by the authors and assistants, were analyzed by the Geoscience Laboratories, Ontario Geological Survey, Toronto, for major and minor oxides and specific trace elements. The approximate position of samples collected and analyzed by the authors and by Hiscott (1974) can be found on the map-face of Preliminary Maps P.2350, P.2351, P.2352, P.2353, and P.2354 (Trowell, Bartlett, and Sutcliffe 1980a, 1980b, 1980c, 1980d, and 1980e). The raw chemical data, for each metavolcanic sequence, is presented in Tables 4 to 9. Chemical data for the Neepawa Group are from samples collected outside the present map-area (Trowell *et al.* 1979b). Hiscott's data can be found in his thesis (Hiscott 1974).

Samples were collected along lines more or less perpendicular to the original layering or bedding; and were selected at intervals of 150 to 300 m in apparently homogeneous sequences, and at variable spacings dependent upon apparent lithological changes in the sequences. Samples of fine-grained, massive to weakly foliated metavolcanics were collected wherever possible. In several in-

TABLE 4 | NEEPAWA GROUP VOLCANICS, CHEMISTRY, LITTLE VERMILION LAKE SECTION, AND ABRAM-MANITOU LAKE SECTION, FLYING LOON LAKE AREA.[1]

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	5299	5300	5301	5302	5303	5304	5305
Field Number	78-NT-364	78-NT-365	78-NT-366	78-NT-367	78-NT-368	78-NT-369	78-NT-370
SiO_2	50.1	46.7	46.1	45.9	48.8	44.9	47.9
TiO_2	0.97	1.20	0.92	0.96	1.08	0.91	1.11
Al_2O_3	16.0	15.5	15.8	13.6	15.9	15.7	16.4
Fe_2O_3	11.6	14.5	13.0	11.5	12.7	13.5	13.6
FeO*	—	—	—	—	—	—	—
MnO	0.22	0.19	0.19	0.18	0.21	0.19	0.19
MgO	3.51	7.81	8.73	5.03	4.56	7.83	5.35
CaO	12.4	5.93	9.71	10.0	9.17	10.2	10.1
Na_2O	2.03	2.32	1.84	3.85	4.06	2.66	3.46
K_2O	0.02	0.00	0.02	0.00	0.06	0.00	0.01
P_2O_5	0.09	0.11	0.09	0.10	0.10	0.09	0.11
CO_2	2.06	2.75	0.37	7.28	1.04	1.85	0.15
S	0.19	0.18	0.05	0.02	0.08	0.06	0.03
H_2O+*	—	—	—	—	—	—	—
H_2O-*	—	—	—	—	—	—	—
L.O.I.°	3.90	6.90	3.70	9.70	2.80	4.80	2.10

* Not detected (Total iron as Fe_2O_3)   x Intrusions

° L.O.I. - Loss on ignition

[1] Little Vermilion Lake Section comprises samples 5299 to 5318 inclusive.
Abram-Manitou Lake Section comprises samples 5320 to 5363 inclusive.

Table 4 continued

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	40	40	60	50	60	40	60
Co	52	49	52	38	48	50	55
Cr	172	229	326	225	250	350	258
Cu	144	116	158	132	157	104	167
Li	7	28	24	22	8	16	4
Ni	98	97	140	88	92	108	100
Pb	13	11	10	< 10	< 10	< 10	< 10
Zn	106	104	90	86	104	88	112

SAMPLE NUMBERS	DESCRIPTION
5299	Fine-grained, light grey, massive flow.
5300	Fine-grained, light grey, massive flow.
5301	Medium-grained, light grey, massive flow.
5302	Fine-grained, grey-green massive flow.
5303	Fine-grained, grey, massive flow.
5304	Fine- to medium grained, green, massive flow.
5305	Fine-grained, grey-green, massive flow.

Table 4 — continued on next page

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	5306	5307	5308	5309	5310	5311	5312	5313
Field Number	78-NT-371	78-NT-372	78-NT-373	78-NT-374	78-NT-375	78-NT-376	78-NT-377	78-NT-378
SiO_2	45.0	40.1	45.4	46.7	47.6	47.1	41.7	46.0
TiO_2	1.13	0.71	1.11	0.93	0.97	0.78	0.23	0.38
Al_2O_3	16.2	16.8	15.8	15.8	14.9	15.8	9.53	12.3
Fe_2O_3	15.0	10.1	14.8	13.1	13.4	11.4	8.36	8.37
FeO*	—	—	—	—	—	—	—	—
MnO	0.21	0.15	0.25	0.18	0.20	0.19	0.15	0.14
MgO	7.75	7.21	7.21	7.80	7.93	4.11	13.6	11.4
CaO	8.97	7.75	10.2	10.5	7.66	11.6	8.81	8.85
Na_2O	2.56	2.06	2.22	1.63	4.09	2.40	0.00	1.06
K_2O	0.02	0.56	0.05	0.00	0.11	0.00	0.61	0.00
P_2O_5	0.10	0.08	0.10	0.08	0.09	0.06	0.03	0.05
CO_2	0.22	12.1	1.01	0.61	1.48	4.88	13.8	6.93
S	0.04	0.04	0.02	0.19	0.02	0.07	0.02	< 0.01
H_2O+*	—	—	—	—	—	—	—	—
H_2O-*	—	—	—	—	—	—	—	—
L.O.I.°	3.30	14.4	3.80	3.10	3.80	7.40	16.4	11.5

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	50	220	50	30	80	30	160	40
Co	53	37	50	49	49	48	44	37
Cr	163	172	273	332	250	309	1480	296
Cu	148	116	138	150	134	152	46	9
Li	14	23	14	16	16	19	20	18
Ni	123	138	115	127	118	139	205	102
Pb	< 10	< 10	< 10	164	< 10	< 10	< 10	54
Zn	100	94	109	90	102	90	56	52

SAMPLE NUMBERS	DESCRIPTION
5306	Medium- to fine-grained, green, massive flow.
5307	Fine-grained, grey-green, massive flow.
5308	Fine- to medium-grained grey-green massive flow.
5309	Fine- to medium-grained, green-grey, massive flow.
5310	Medium-grained, grey, massive flow.
5311	Fine- to medium-grained, grey, massive flow.
5312	Fine-grained, grey, massive schistose flow.
5313	Fine- to medium-grained, grey, massive flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	5314	5315	5316	5298	5318	5320	5322	5323
Field Number	78-NT-379	78-NT-380	78-NT-381	78-NT-335	78-NT-401	78-NT-403	78-NT-405	78-NT-406
SiO_2	48.0	44.3	50.7	49.1	43.2	49.1	50.4	46.5
TiO_2	0.57	1.70	1.01	0.39	0.64	1.60	1.80	2.22
Al_2O_3	14.8	14.5	14.1	14.4	13.2	13.0	13.6	13.7
Fe_2O_3	10.4	22.1	12.0	13.6	11.5	17.5	13.5	16.3
FeO*	—	—	—	—	—	—	—	—
MnO	0.19	0.35	0.29	0.18	0.23	0.20	0.18	0.24
MgO	7.31	5.86	3.82	8.48	7.22	5.92	6.32	6.40
CaO	9.21	5.25	9.16	7.86	9.74	8.62	7.03	7.00
Na_2O	3.48	1.83	1.97	1.64	2.71	0.97	3.00	1.70
K_2O	0.02	0.15	0.00	0.08	0.00	0.36	0.31	0.00
P_2O_5	0.07	0.16	0.11	0.10	0.08	0.12	0.19	0.22
CO_2	3.95	1.51	4.15	1.38	6.90	0.60	0.94	1.61
S	< 0.01	< 0.01	< 0.01	< 0.01	0.01	0.16	0.02	0.09
H_2O+*	—	—	—	—	—	—	—	—
H_2O-*	—	—	—	—	—	—	—	—
L.O.I.	6.40	4.90	6.40	4.90	10.7	3.40	3.60	5.00

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	5314	5315	5316	5298	5318	5320	5322	5323
Ba	110	40	—	50	50	90	80	30
Co	36	59	—	44	45	46	42	21
Cr	460	126	—	112	316	89	162	107
Cu	66	< 5	—	48	101	129	62	54
Li	12	13	—	20	24	14	11	15
Ni	104	54	—	49	104	27	65	35
Pb	< 10	< 10	—	16	< 10	< 10	< 10	< 10
Zn	43	67	—	57	98	140	112	119

SAMPLE NUMBERS	DESCRIPTION
5314	Fine-grained, green, massive flow.
5315	Fine-grained, green, massive flow.
5316	Medium-grained, grey, flow/intrusion.
5298	Medium-grained, synvolcanic (?) dioritic intrusion.
5318	Fine-grained, green-grey, massive, foliated flow.
5320	Fine-grained, green-grey, massive, locally pillowed flow.
5322	Fine-grained, green-grey, massive flow/intrusion.
5323	Fine-grained, green-grey, massive flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	5324	5325	5326	5327	5328	5329	5330	5331
Field Number	78-NT-407	78-NT-408	78-NT-409	78-NT-410	78-NT-411	78-NT-412	78-NT-413	78-NT-414
SiO_2	46.8	49.0	54.8	55.2	47.2	46.3	52.1	59.5
TiO_2	2.42	2.06	2.09	2.33	1.60	1.98	1.95	1.49
Al_2O_3	12.5	14.4	15.3	14.0	14.1	14.0	15.2	14.0
Fe_2O_3	17.2	13.5	9.86	11.6	15.3	16.4	10.7	6.85
FeO*	—	—	—	—	—	—	—	—
MnO	0.23	0.16	0.14	0.10	0.21	0.23	0.11	0.49
MgO	4.81	6.76	2.74	3.76	6.10	6.13	3.27	2.65
CaO	6.09	9.21	4.92	5.22	9.60	10.0	7.23	5.69
Na_2O	3.64	2.06	4.94	3.69	2.32	2.37	1.21	4.10
K_2O	0.72	0.00	0.31	0.72	0.04	0.05	1.33	1.01
P_2O_5	0.21	0.28	0.43	0.47	0.16	0.18	0.39	0.32
CO_2	2.34	0.07	3.34	1.56	0.37	0.23	4.71	3.33
S	0.03	0.15	0.01	0.02	0.30	0.22	0.03	0.01
H_2O+*	—	—	—	—	—	—	—	—
H_2O-*	—	—	—	—	—	—	—	—
L.O.I.	5.70	2.80	5.10	3.90	2.80	2.40	7.20	5.20

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	5324	5325	5326	5327	5328	5329	5330	5331
Ba	220	50	90	270	50	50	460	150
Co	41	44	29	30	54	49	24	25
Cr	13	220	25	38	224	172	26	47
Cu	108	103	78	121	81	124	65	76
Li	10	11	16	10	12	10	27	14
Ni	18	103	49	62	107	92	45	58
Pb	$<$ 10	$<$ 10	$<$ 10	$<$ 10	65	$<$ 10	$<$ 10	$<$ 10
Zn	130	135	128	170	110	122	118	93

SAMPLE NUMBERS	DESCRIPTION
5324	Fine-grained, green-grey, massive flow.
5325	Fine-grained, green-grey, massive flow.
5326	Plagioclase-phyric, light grey, pillowed flow.
5327	Plagioclase-phyric, light grey, pillowed flow.
5328	Medium-grained, grey-green, massive flow.
5329	Medium-grained, amphibolite-phyric, massive flow/intrusion.
5330	Fine-grained to plagioclase-phyric, grey, massive to pillowed flow.
5331	Fine-grained, grey-green, amygdaloidal, massive to pillowed flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	5332	5333	5334	5335	5337	5338	5339	5340
Field Number	78-NT-415	78-NT-416	78-NT-417	78-NT-418	78-NT-420	78-NT-421	78-NT-422	78-NT-423
SiO_2	48.3	46.5	56.4	57.3	57.1	43.9	47.9	55.2
TiO_2	1.70	2.02	1.41	1.32	1.29	1.88	1.22	1.72
Al_2O_3	14.5	14.4	14.5	15.2	15.1	13.1	12.5	15.8
Fe_2O_3	16.6	18.7	8.59	7.42	8.51	17.2	8.60	11.5
FeO*	—	—	—	—	—	—	—	—
MnO	0.20	0.25	0.10	0.11	0.08	0.24	0.14	0.14
MgO	4.81	5.65	5.76	5.26	4.59	5.03	4.12	3.24
CaO	8.71	5.30	7.06	5.55	6.12	8.27	10.7	5.23
Na_2O	1.72	3.35	3.51	5.53	5.70	2.67	3.29	3.79
K_2O	0.03	0.00	1.23	1.10	1.16	0.02	0.21	1.31
P_2O_5	0.15	0.20	0.41	0.29	0.29	0.18	0.26	0.54
CO_2	0.63	1.53	0.06	0.07	0.27	5.16	9.34	0.39
S	0.05	0.05	0.01	0.03	0.11	0.24	0.01	0.01
H_2O+*	—	—	—	—	—	—	—	—
H_2O-*	—	—	—	—	—	—	—	—
L.O.I.	3.50	3.60	—	1.80	1.00	8.20	11.1	2.50

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	5332	5333	5334	5335	5337	5338	5339	5340
Ba	40	50	240	160	130	30	60	340
Co	42	47	28	22	25	42	31	27
Cr	174	104	275	215	190	78	144	8
Cu	78	91	42	14	6	82	24	17
Li	10	9	14	12	9	12	28	20
Ni	42	52	152	142	117	42	114	7
Pb	$<$10	$<$ 10	$<$ 10	10	78	11	14	12
Zn	140	150	74	62	44	184	97	112

SAMPLE NUMBERS	DESCRIPTION
5332	Medium-grained, grey-green, massive flow/intrusion.
5333	Medium- to fine-grained, green, massive flow.
5334	Blue-grey plagioclase- and amphibole-phyric massive flow.
5335	Dark grey, autoclastic breccia.
5337	Plagioclase-phyric, grey to buff, massive to locally autoclastic breccia, flow.
5338	Fine- to medium-grained, dark green, massive flow.
5339	Fine-grained, grey-green, amygdaloidal, schistose flows.
5340	Fine-grained to aphanitic, light grey, massive to flow-top breccia, flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	5341	5342	5343	5345	5347	5348	5362	5364
Field Number	78-NT-424	78-NT-425	78-NT-426	78-NT-429	78-NT-430	78-NT-431	78-NT-446	78-NT-447
SiO_2	46.5	51.4	51.6	47.6	47.5	44.7	44.5	46.8
TiO_2	1.60	0.75	1.06	1.96	1.96	1.97	1.81	2.05
Al_2O_3	14.9	11.9	14.1	12.9	12.8	14.3	14.3	13.2
Fe_2O_3	16.0	6.64	8.32	16.5	17.3	16.8	17.7	18.5
FeO*	—	—	—	—	—	—	—	—
MnO	0.20	0.12	0.12	0.23	0.27	0.24	0.24	0.26
MgO	6.00	5.80	4.37	4.26	3.94	5.07	5.89	5.03
CaO	7.32	10.1	8.86	7.81	6.73	7.94	9.26	9.07
Na_2O	2.33	3.34	1.74	3.01	2.50	2.71	1.76	0.56
K_2O	0.00	0.07	1.54	0.01	0.00	0.00	0.01	0.03
P_2O_5	0.16	0.17	0.28	0.14	0.21	0.19	0.16	0.21
CO_2	2.03	7.75	6.62	3.92	4.97	3.93	2.16	1.56
S	0.22	$<$ 0.01	0.05	0.11	0.27	0.10	0.16	$<$ 0.01
H_2O^+*	—	—	—	—	—	—	—	—
H_2O^-*	—	—	—	—	—	—	—	—
L.O.I.	5.40	10.3	9.20	6.10	7.20	6.80	5.00	4.30

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	5341	5342	5343	5345	5347	5348	5362	5364
Ba	40	60	170	60	30	40	40	40
Co	54	28	27	40	44	41	52	47
Cr	149	400	237	76	49	76	183	84
Cu	96	30	19	93	76	84	76	90
Li	12	22	24	20	20	18	19	16
Ni	119	178	134	27	33	38	68	42
Pb	$<$ 10	117	$<$ 10	$<$ 10	$<$ 10	$<$ 10	$<$ 10	$<$ 10
Zn	$<$ 10	66	108	136	166	141	127	134

SAMPLE NUMBERS	DESCRIPTION
5341	Fine- to medium-grained, green-grey, massive, foliated flow.
5342	Fine-grained, grey, amygdaloidal, pillowed flow.
5343	Fine-grained, grey, pillowed, amygdaloidal flow.
5345	Fine-grained, dark green, pillowed flow.
5347	Fine-grained to aphanitic, dark green, massive flow.
5348	Fine-grained, grey-green, massive flow.
5362	Medium-grained, grey-green, massive flow.
5364	Medium-grained, green-grey, massive flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	5365	5317	5319	5321	5336	5344	5346	5363
Field Number	78-107-448	78-107-400	78-107-402	78-107-404	78-107-414	78-107-427	78-107-429A	78-107-476A
SiO_2	46.8	45.5	46.2	46.6	58.7	46.6	61.4	57.6
TiO_2	1.41	0.73	0.70	0.52	0.96	0.63	0.44	1.31
Al_2O_3	13.6	14.9	15.7	10.8	15.6	14.6	16.4	16.2
Fe_2O_3	11.3	11.6	12.7	7.61	7.63	8.27	4.08	8.63
FeO*	—	—	—	—	—	—	—	—
MnO	0.16	0.18	0.19	0.12	0.13	0.14	0.07	0.12
MgO	8.43	7.5	8.94	10.5	3.27	4.62	3.14	4.20
CaO	8.43	13.6	11.1	8.97	5.99	10.4	3.45	3.03
Na_2O	2.32	1.75	1.75	3.40	5.05	3.90	7.69	6.19
K_2O	0.26	0.00	0.04	3.52	1.09	0.45	0.35	0.22
P_2O_5	0.22	0.08	0.06	0.22	0.18	0.30	0.22	0.27
CO_2	5.12	2.43	0.12	7.93	0.24	8.03	2.27	0.74
S	0.16	0.15	0.01	0.01	0.10	0.01	0.22	0.17
H_2O+*	—	—	—	—	—	—	—	—
H_2O-*	—	—	—	—	—	—	—	—
L.O.I.	8.00	6.4	3.10	8.50	0.80	10.6	3.60	2.60

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	5365	5317	5319	5321	5336	5344	5346	5363
Ba	60	40	60	310	350	100	140	90
Co	43	48	49	34	23	29	14	25
Cr	500	59	386	530	62	300	119	85
Cu	68	104	120	54	11	12	18	44
Li	27	12	15	24	8	23	9	14
Ni	230	84	140	210	53	60	40	66
Pb	10	10	12	12	10	10	10	10
Zn	113	63	88	75	98	114	71	96

SAMPLE NUMBERS	DESCRIPTION
5365	Medium- to fine-grained, green-grey, amygdaloidal, massive to pillowed flow.
5317	Medium-grained, dark green, ophitic, synvolcanic intrusion (sill).
5319	Medium-grained, dark green, massive, synvolcanic sill.
5321	Medium-grained, sheared, dioritic intrusions.
5336	Medium-grained, grey, ophitic diorite.
5344	Fine-grained, light grey-green synvolcanic dike (feeder) (cuts 5343).
5346	Quartz-feldspar porphyry trondhjemite dike.
5363	Fine-grained to aphanitic, light grey-green, massive dike (cuts 5362).
X	May be intrusion.

Chemical analyses performed by Geoscience Laboratories, Ontario Geological Survey, Toronto.

TABLE 5 | JARVIS LAKE, WATCOMB LAKE VOLCANICS, CHEMISTRY, FLYING LOON LAKE AREA.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	77-285	77-288	77-289	77-295	77-298
Field Number	68-43-7	68-67-5	68-71-12	68-92-6	68-98-4
SiO_2	52.1	53.5	50.4	49.8	48.3
TiO_2	0.76	0.53	0.98	0.43	0.29
Al_2O_3	18.1	19.8	14.7	19.6	20.4
Fe_2O_3	1.08	1.11	1.90	1.36	1.24
FeO*	7.23	5.07	9.97	4.57	6.07
MnO	0.14	0.10	0.16	0.12	0.13
MgO	5.59	4.70	7.87	7.47	8.24
CaO	10.9	9.28	10.1	9.62	11.4
Na_2O	3.25	3.12	2.60	1.94	1.72
K_2O	0.10	1.04	0.14	1.81	0.32
P_2O_5	0.08	0.03	0.03	0.03	0.0
CO_2	0.18	0.20	0.14	0.16	0.08
S	*	*	*	0.07	*
H_2O+*	*	1.11	0.24	2.18	1.33
H_2O-*	0.26	0.31	0.30	0.41	0.34

* Not Analyzed

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	77-285	77-288	77-289	77-295	77-298
Ba	90	240	70	320	60
Co	51	37	48	28	39
Cr	213	45	329	500	96
Cu	8	14	18	36	56
Ga	—	—	—	—	—
Li	8	15	6	22	12
Ni	183	71	166	157	72
Pb	12	14	10	10	<10
Sc	—	—	—	—	—
Sn	—	—	—	—	—
Sr	—	—	—	—	—
V	—	—	—	—	—
Y	—	—	—	—	—
Zn	64	37	108	58	62
Zr	—	—	—	—	—

SAMPLE NUMBERS	DESCRIPTION
77-285	Fine- to medium-grained, dark grey, feldspar porphyritic flow.
77-288	Medium- to coarse-grained, light grey, massive flow intrusion.
77-289	Fine-grained, medium grey, massive flow.
77-295	Coarse-grained, grey intrusion/flow.
77-298	Medium-grained, green-grey, massive flow/intrusion.

MAJOR COMPONENTS IN WEIGHT PERCENT

Table 5 continued

Laboratory Number	77-299	77-300	77-2658	77-2660	77-2661	77-2662	77-2663
Field Number	68-99-5	68-99-8	76-7(4)-148	76-7(4)-150	76-7(4)-151	76-7(4)-152	76-7(4)-155
SiO_2	59.3	52.9	53.3	48.3	46.7	57.3	53.8
TiO_2	1.54	0.86	1.79	1.48	1.20	0.61	1.03
Al_2O_2	14.4	17.1	13.5	15.2	14.1	16.2	17.1
Fe_2O_3	2.30	1.54	4.97	3.60	3.36	2.90	3.79
FeO*	6.73	7.15	9.66	8.37	8.86	4.27	6.04
MnO	0.16	0.19	0.23	0.17	0.21	0.11	0.15
MgO	3.17	4.53	3.09	7.69	9.75	4.19	4.35
CaO	6.03	7.92	7.05	10.7	8.88	5.94	9.23
Na_2O	3.81	2.97	3.10	1.08	2.74	4.07	2.72
K_2O	0.53	0.98	0.85	0.04	0.03	0.86	0.55
P_2O_5	0.16	0.09	0.38	0.22	0.16	0.11	0.14
CO_2	0.14	0.10	0.16	0.14	0.08	0.42	0.06
S	0.02	*	0.10	0.11	0.02	$<$ 0.01	0.01
H_2O+*	1.08	1.75	1.49	2.17	2.49	1.21	0.52
H_2O-*	0.37	0.37	0.39	0.44	0.49	0.37	0.39

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	77-299	77-300	77-2658	77-2660	77-2661	77-2662	77-2663
Ba	130	160	270	30	30	260	110
Co	30	29	35	45	55	25	35
Cr	40	191	5	330	720	110	75
Cu	270	13	100	95	55	30	10
Ga	—	—	15	15	15	15	10
Li	6	6	7	6	8	8	9
Ni	29	87	8	145	255	80	70
Pb	10	$<$ 10	$<$ 10	60	60	$<$ 10	20
Sc	—	—	35	35	35	20	35
Sn	—	—	$<$ 3	7	8	$<$ 3	$<$ 3
Sr	—	—	150	200	45	350	250
V	—	—	200	200	250	150	250
Y	—	—	50	35	30	20	25
Zn	96	106	150	100	115	70	65
Zr	—	—	200	100	150	150	150

SAMPLE NUMBERS	DESCRIPTION
77-299	Fine- to medium-grained, light grey, massive flow.
77-300	Fine-grained, grey, porphyritic flow.
77-2658	Fine-grained, grey slightly plagioclase-phyric flow.
77-2660	Fine-grained, grey-green, amygdaloidal mafic flow.
77-2661	Fine-grained, grey-green, pillowed flow.
77-2662	Fine-grained, grey-green, plagioclase-phyric flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Table 5 continued

Laboratory Number	77-2665	77-2668	77-2704	77-2705	77-2752	77-2776	77-2777	77-2778	77-2779
Field Number	76-7(4)-158	76-7(4)-162	77-T-251	77-T-393	77-T-250	77-T-578	77-T-581	T580	77-T-583
SiO_2	56.2	52.9	59.1	53.8	59.3	48.9	47.6	49.6	54.4
TiO_2	0.77	1.33	0.73	1.35	0.70	0.81	0.99	0.74	0.87
Al_2O_2	17.2	16.1	16.8	14.7	14.6	13.5	14.8	14.9	15.8
Fe_2O_3	2.48	2.45	1.80	3.10	2.19	2.85	2.84	4.39	2.91
FeO*	5.80	7.16	5.55	9.26	5.72	9.42	10.5	6.04	6.84
MnO	0.13	0.14	0.12	0.19	0.13	0.22	0.22	0.19	0.16
MgO	4.29	3.51	4.28	4.69	4.96	7.29	7.95	4.28	5.36
CaO	6.76	7.00	7.12	6.19	9.15	12.7	10.5	17.3	8.68
Na_2O	3.94	2.52	2.96	2.15	1.68	1.40	1.48	0.01	3.14
K_2O	0.98	1.03	0.48	0.29	0.45	0.09	0.08	0.74	0.72
P_2O_5	0.11	0.27	0.12	0.21	0.11	0.08	0.08	0.09	0.17
CO_2	0.19	1.48	0.06	1.39	0.20	0.97	0.34	1.25	0.03
S	0.01	0.01	0.02	0.02	0.01	0.03	0.14	0.02	0.02
H_2O+*	1.56	3.04	1.30	3.08	0.70	1.33	1.12	0.45	0.58
H_2O-*	0.26	0.27	0.28	0.39	0.32	0.27	0.27	0.21	0.25
TRACE ELEMENTS IN PARTS PER MILLION (PPM)									
Ba	170	380	120	70	70	50	40	40	160
Co	30	30	25	30	30	52	56	41	35
Cr	105	30	110	95	190	278	213	252	110
Cu	65	75	40	9	30	165	142	72	60
Ga	15	20	15	20	15	15	15	15	15
Li	8	15	10	10	8	5	14	<3	21
Ni	100	35	70	50	115	94	138	136	51
Pb	<10	<10	<10	<10	25	23	24	19	22
Sc	25	35	20	30	25	50	40	35	30
Sn	<3	<3	<3	<3	<3	<3	<3	<3	<3
Sr	150	300	250	200	200	80	150	60	300
V	200	300	150	200	150	200	200	200	150
Y	20	40	15	25	20	20	25	20	30
Zn	70	50	75	90	60	90	104	76	84
Zr	100	200	100	200	70	90	100	100	150

SAMPLE NUMBERS	DESCRIPTION
77-2665	Fine-grained, grey-green, plagioclase-phyric flow.
77-2668	Fine-grained, plagioclase-phyric, light grey flow.
77-2704	Fine-grained, light grey-green, plagioclase-phyric flow.
77-2705	Fine-grained, green-grey, massive flow.
77-2752	Fine-grained, dark green, plagioclase-phyric, pillowed, amygdaloidal flow.
77-2776	Fine- to medium-grained, amygdaloidal, grey-green schistose flow.
77-2777	Medium-grained, dark green-grey, amphibolite-phyric, massive flow intrusion.
77-2778	Fine-grained, grey-green, plagioclase-phyric, pillowed flow.
77-2779	Fine-grained, green-grey massive, banded flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Table 5 continued

Laboratory Number	77-2780	77-2781	77-2782	77-2783	77-2784	77-2785
Field Number	77-T-584	77-T-588	77-T-592	77-T-593	77-T-589	77-T-595
SiO_2	49.4	50.7	54.5	53.8	53.9	52.8
TiO_2	0.71	0.73	1.86	0.95	1.66	0.87
Al_2O_3	13.4	15.2	15.6	16.1	14.1	16.7
Fe_2O_3	3.69	2.48	3.02	2.83	1.82	2.98
FeO*	5.07	8.13	9.18	7.00	8.45	6.28
MnO	0.17	0.21	0.15	0.17	0.13	0.15
MgO	8.91	7.25	3.64	5.26	3.11	5.53
CaO	13.5	9.48	6.53	9.08	5.91	8.85
Na_2O	1.45	2.93	3.77	2.96	4.59	3.63
K_2O	1.07	0.13	0.18	0.84	0.01	0.17
P_2O_5	0.80	0.05	0.24	0.09	0.14	0.13
CO_2	0.03	0.53	0.11	0.39	1.42	0.13
S	0.02	0.06	0.04	0.02	0.15	0.02
H_2O+*	0.72	1.58	0.99	0.60	2.44	1.30
H_2O-*	0.38	0.48	0.44	0.40	0.40	0.25

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	1300	90	210	200	40	70
Co	36	46	37	39	35	38
Cr	175	368	133	134	5	163
Cu	27	74	52	52	33	55
Ga	15	15	15	15	15	15
Li	13	9	19	29	6	8
Ni	64	126	90	91	26	114
Pb	26	22	<10	<10	<10	<10
Sc	35	40	40	30	35	30
Sn	<3	<3	<3	<3	<3	<3
Sr	1000	200	60	200	150	150
V	150	200	300	200	250	150
Y	35	20	40	25	40	20
Zn	88	92	92	92	52	89
Zr	200	60	200	150	150	150

SAMPLE NUMBERS	DESCRIPTION
77-2780	Fine-grained, green-grey, banded flow.
77-2781	Fine-grained, green-grey, locally plagioclase-phyric, pillowed and amygdaloidal flow.
77-2782	Medium- to coarse-grained, green-grey flow.
77-2783	Medium-grained, grey-green, locally amygdaloidal flow.
77-2784	Medium- to coarse-grained, green-grey, plagioclase-phyric flow/intrusion.
77-2785	Fine-grained, grey, plagioclase-phyric, amygdaloidal flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	77-2786	77-2787	77-2788	77-2789	77-2790	77-2791
Field Number	77-T-597	77-T-598	77-T-602	T609	77-T-612	77-T-614
SiO_2	60.5	52.3	53.5	62.1	63.4	50.5
TiO_2	0.73	1.18	0.68	0.78	0.78	0.52
Al_2O_3	14.0	13.9	17.8	14.6	15.7	15.8
Fe_2O_3	2.46	3.47	2.96	3.41	2.60	5.39
FeO*	6.04	8.13	5.72	7.65	4.83	7.57
MnO	0.10	0.15	0.13	0.18	0.15	0.17
MgO	4.43	5.42	4.75	1.30	2.33	4.41
CaO	5.05	6.97	7.87	4.84	5.57	8.36
Na_2O	1.96	1.55	4.46	2.78	3.69	2.27
K_2O	0.08	0.57	0.07	1.07	0.55	0.09
P_2O_5	0.22	0.14	0.10	0.28	0.11	0.22
CO_2	1.40	1.35	0.63	0.12	0.09	1.37
S	0.02	0.04	0.03	0.01	0.02	0.02
H_2O+*	2.75	3.35	1.60	0.58	0.78	2.12
H_2O-*	0.28	0.27	0.22	0.23	0.25	0.23

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	50	100	50	440	150	80
Co	38	35	34	12	15	40
Cr	134	37	144	<5	18	148
Cu	52	16	129	8	52	60
Ga	15	15	20	20	15	20
Li	14	20	8	14	7	12
Ni	115	21	127	<5	20	101
Pb	< 10	<10	< 10	<10	< 10	< 10
Sc	20	35	20	20	20	30
Sn	< 3	<3	< 3	<3	< 3	< 3
Sr	150	150	250	250	150	250
V	150	200	150	<10	100	250
Y	20	20	20	60	40	35
Zn	72	107	76	157	88	91
Zr	150	150	150	300	250	200

SAMPLE NUMBERS	DESCRIPTION
77-2786	Fine-grained, grey, coarsely amygdaloidal, pillowed flow.
77-2787	Fine-grained, grey amygdaloidal, locally autoclastic breccia, schistose flow.
77-2788	Fine-grained, grey-green, amygdaloidal, plagioclase-phyric flow.
77-2789	Fine-grained, grey-green, slightly plagioclase-phyric flow.
77-2790	Fine-grained, grey, pillowed, amygdaloidal, locally autoclastic breccia, flow.
77-2791	Fine-grained, grey, massive to autoclastic/pyroclastic breccia, flow.

MAJOR COMPONENTS IN WEIGHT PERCENT

Table 5 continued

Laboratory Number	77-2793	77-796	77-2797
Field Number	77-T-617	77-T-635	77-T-638
SiO_2	52.9	50.2	52.4
TiO_2	1.11	1.03	0.91
Al_2O_3	16.5	14.7	20.5
Fe_2O_3	1.86	2.27	2.10
FeO*	5.88	9.66	4.91
MnO	0.09	0.20	0.12
MgO	5.99	7.47	3.42
CaO	10.2	10.9	10.4
Na_2O	3.76	1.82	2.90
K_2O	0.15	0.19	0.51
P_2O_5	0.19	0.12	0.12
CO_2	0.08	0.12	0.23
S	0.01	0.06	0.14
H_2O+*	0.56	0.25	0.51
H_2O-*	0.28	0.34	0.80

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	70	70	190
Co	30	44	33
Cr	162	323	206
Cu	6	94	69
Ga	15	15	15
Li	6	8	13
Ni	127	81	126
Pb	<10	< 10	< 10
Sc	30	50	30
Sn	<3	< 3	< 3
S	200	200	300
V	150	200	150
Y	30	25	20
Zn	48	98	78
Zr	150	200	100

SAMPLE NUMBERS	DESCRIPTION
2793	Fine-grained, grey-green, massive flow.
2796	Fine- to medium grained, grey-green massive flow.
2797	Fine-grained, grey-green, massive flow.

Chemical analyses performed by Geoscience Laboratories, Ontario Geological Survey, Toronto.

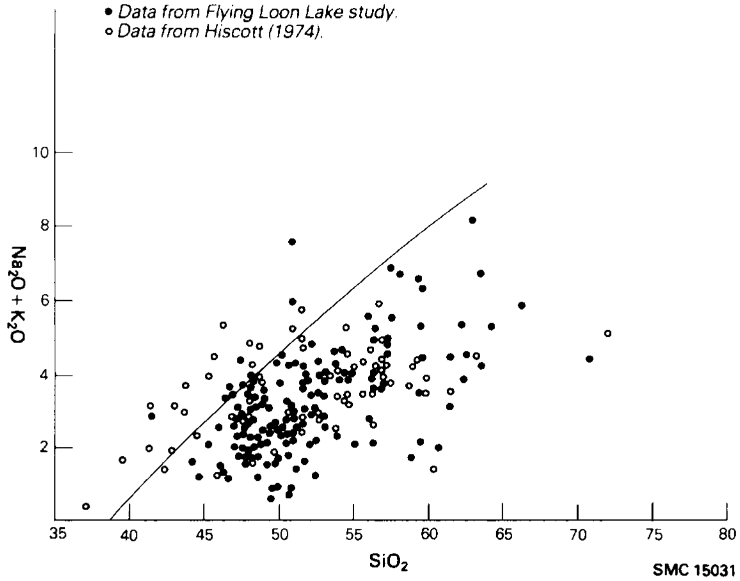


Figure 5–Na_2O + K_2O : SiO_2 composite plot of the metavolcanics.

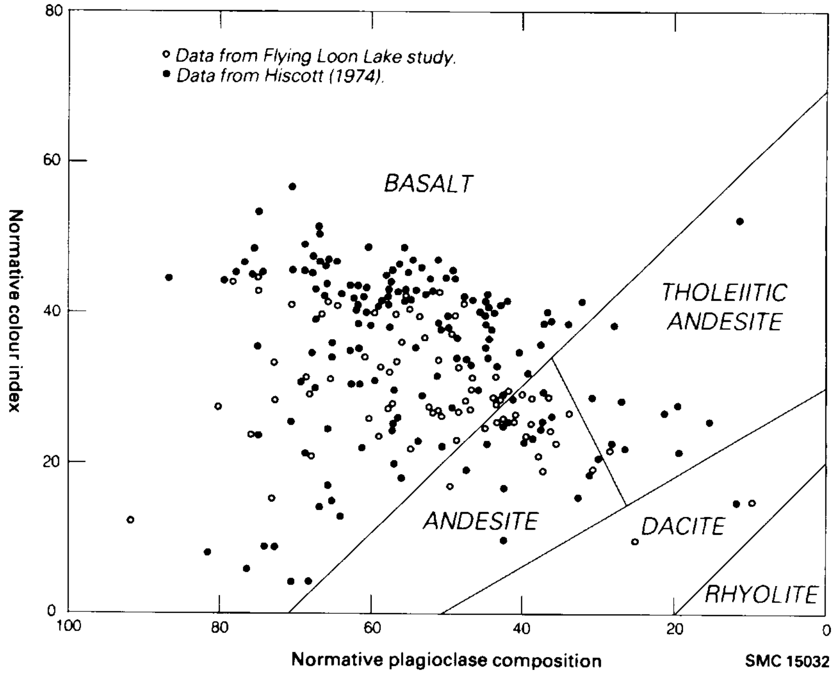


Figure 6–Normative colour index: normative plagioclase composition composite plot of the metavolcanics.

TABLE 6 | SOUTHEAST BAY — SMOCK LAKE VOLCANICS, CHEMISTRY, FLYING LOON LAKE AREA.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	77-2691	77-2750	77-2751	78-5382	78-5383	78-5384
Field Number	77T432	77T276	77T266	78-TJB-80		
SiO_2	52.0	48.3	58.9	61.4	53.7	52.7
TiO_2	1.28	0.84	1.15	1.18	0.65	0.89
Al_2O_3	18.3	16.2	14.6	13.7	16.3	13.9
Fe_2O_3	4.32	2.20	2.84	9.42	8.55	6.64
FeO	6.28	7.65	4.03	*	*	*
MnO	0.29	0.14	0.14	0.13	0.16	0.09
MgO	2.99	4.78	1.70	1.87	6.23	8.60
CaO	9.17	8.58	10.9	5.10	8.05	9.49
Na_2O	2.15	3.21	1.63	4.36	3.87	2.68
K_2O	0.73	0.55	0.14	0.14	0.12	1.67
P_2O_5	0.22	0.09	0.09	0.21	0.12	0.29
CO_2	0.23	4.04	1.41	0.30	0.23	0.10
S	0.17	0.11	0.05	$<$ 0.01	$<$ 0.01	0.02
H_2O+	1.60	3.33	1.48	*	*	*
H_2O-	0.45	0.32	0.35	*	*	*

*Not Analyzed (Total iron expressed as Fe_2O_3)

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	77-2691	77-2750	77-2751	78-5382	78-5383	78-5384
Ba	180	100	60	90	70	1000
Co	36	33	35	24	35	25
Cr	306	166	65	$<$ 5	105	440
Cu	80	84	50	22	58	26
Ga	15	15	15	—	—	—
Li	10	24	10	5	9	10
Ni	141	52	65	30	69	183
Pb	19	18	25	39	13	19
Sc	30	35	30	—	—	—
Sn	$<$3	$<$ 3	$<$3	—	—	—
Sr	450	200	100	—	—	—
V	200	200	200	—	—	—
Y	30	10	25	—	—	—
Zn	110	109	100	90	88	89
Zr	150	80	90	—	—	—

SAMPLE NUMBERS	DESCRIPTION
77-2691	Fine- to medium-grained, light green, massive flow.
77-2750	Fine-grained, light green, massive flow.
77-2751	Fine-grained, light grey-green, massive flow.
78-5382	Fine-grained, light green, plagioclase-phyric flow.
78-5383	Fine-grained, light grey-green massive flow.
78-5384	Fine-grained, light grey-green, massive flow.

Table 6 continued

MAJOR COMPONENTS

Laboratory Number	78-5385	78-5400	78-5402
Field Number	78-TJB-86	78-TJB-188	78-TJB-189
SiO_2	52.6	48.0	49.9
TiO_2	0.56	0.48	0.67
Al_2O_3	19.3	15.8	14.5
Fe_2O_3	7.58	9.93	11.9
FeO	*	*	*
MnO	0.13	0.18	0.22
MgO	4.21	9.05	6.56
CaO	10.8	12.4	9.53
Na_2O	1.99	1.26	2.42
K_2O	0.09	0.30	0.01
P_2O_5	0.08	0.06	0.08
CO_2	0.33	0.20	1.59
S	$<$ 0.01	0.03	0.01
H_2O+	*	*	*
H_2O-	*	*	*

*Not detected

TRACE ELEMENTS IN

Ba	80	110	60
Co	33	45	41
Cr	90	440	340
Cu	50	54	99
Ga	—	—	—
Li	8	12	11
Ni	120	87	56
Pb	$<$ 10	10	10
Sc	—	—	—
Sn	—	—	—
Sr	—	—	—
V	—	—	—
Y	—	—	—
Zn	—	—	—
Zr	74	69	58

IN WEIGHT PERCENT

78-5405	78-5406	78-5407	78-5408
78-TJB-191	78-TJB-192	78-TJB-194	78-TJB-195
54.4	51.0	63.4	50.9
1.04	0.70	0.79	0.88
16.3	14.6	15.3	13.6
8.64	11.4	6.35	13.4
*	*	*	*
0.14	0.18	0.11	0.21
5.20	6.89	2.91	6.86
5.41	10.1	1.40	9.08
3.85	2.11	6.12	2.74
0.15	0.05	0.53	0.17
0.22	0.08	0.15	0.08
1.32	1.13	0.19	0.44
< 0.01	0.03	< 0.01	0.02
*	*	*	*
*	*	*	*

PARTS PER MILLION (PPM)

80	50	190	140
31	44	18	49
117	250	39	19
58	80	10	42
—	—	—	—
20	17	9	10
70	64	16	49
11	11	< 10	(anomalous!)
—	—	—	1050
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
—	—	—	—
110	98	44	62

SAMPLE NUMBERS	DESCRIPTION
78-5385	Fine-grained, grey-green, weakly foliated massive flow.
78-5400	Fine- to medium-grained, grey-green, massive flow/intrusion.
78-5402	Fine- to medium-grained, grey-green massive flow/intrusion.
78-5405	Fine-grained, grey-green, massive flow.
78-5406	Fine-grained, grey-green, massive flow.
78-5407	Fine-grained, plagioclase-phyric, grey-green, flow (possibly cumulate).
78-5408	Medium-grained, grey-green, massive flow/intrusion.

Table 6 continued on next page

Table 6 continued

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	78-5409	78-5410
Field Number	78-TJB-203	78-TJB-205
SiO_2	64.2	44.4
TiO_2	0.47	1.51
Al_2O_3	15.5	13.4
Fe_2O_3	4.68	14.7
FeO	*	*
MnO	0.11	0.19
MgO	1.09	5.97
CaO	5.45	9.16
Na_2O	3.25	1.16
K_2O	2.05	0.00
P_2O_5	0.11	0.09
CO_2	2.05	6.64
S	< 0.01	0.07
H_2O+	*	*
H_2O-	*	*

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	500	30
Co	12	49
Cr	38	193
Cu	46	96
Ga	—	—
Li	13	62
Ni	23	145
Pb	< 10	10
Sc	—	—
Sn	—	—
Sr	—	—
V	—	—
Y	—	—
Zn	—	—
Zr	52	142

SAMPLE NUMBERS	DESCRIPTION
78-5409	Fine-grained, grey-green, massive flow.
78-5410	Fine-grained, grey-green, massive flow.

Chemical analyses performed by Geoscience Laboratories, Ontario Geological Survey, Toronto.

TABLE 7 DISCOVERY LAKE-TOWERS LAKE VOLCANICS, FLYING LOON LAKE AREA
MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	77-2655	77-2656	77-2659	77-2664	77-2666	77-2667	77-2686	77-2687	77-2691
Field Number	76-7 (4) -143	76-7 (4) - 145	76-7 (4) -149	76-7 (4) -157	76-7 (4) -160	76-7 (4) -161	77T434	77T435	77T432
SiO_2	48.5	59.2	47.3	47.9	48.9	51.4	47.8	48.0	52.0
TiO_2	1.77	1.37	1.41	1.93	0.74	2.31	1.92	1.71	1.28
Al_2O_3	14.4	12.7	15.4	14.3	16.9	13.0	15.2	14.7	18.3
Fe_2O_3	3.72	4.76	3.38	3.77	3.05	3.79	2.40	3.90	4.32
FeO	12.4	9.58	11.0	12.0	8.69	12.7	11.5	12.6	6.28
MnO	0.24	0.24	0.22	0.25	0.19	0.24	0.22	0.25	0.29
MgO	5.18	1.55	5.73	6.06	6.81	3.96	4.99	5.93	2.99
CaO	8.93	5.15	9.84	8.98	11.1	6.36	9.53	9.58	9.17
Na_2O	2.08	4.32	2.60	2.56	2.21	3.74	3.44	1.84	2.15
K_2O	0.14	0.27	0.25	0.25	0.16	0.45	0.18	0.37	0.73
P_2O_5	0.16	0.38	0.14	0.19	0.05	0.26	0.23	0.15	0.22
CO_2	0.30	0.14	0.02	0.03	0.11	0.01	0.28	0.04	0.23
S	0.14	$<$0.01	0.02	0.04	0.49	0.21	0.03	0.03	0.17
H_2O	1.91	0.39	0.63	1.08	0.03	1.02	0.78	1.05	1.60
H_2O-	0.34	0.31	0.38	0.31	0.29	0.31	0.29	0.26	0.45
TRACE ELEMENTS IN PARTS PER MILLION (PPM)									
Ba	60	100	70	80	50	140	60	100	180
Co	50	15	45	45	45	35	35	45	35
Cr	100	5	210	165	220	6	145	140	305
Cu	190	25	75	35	90	50	30	95	80
Ga	15	20	15	15	15	10	15	15	15
Li	15	5	10	10	9	10	10	15	10
Ni	65	$<$5	75	65	95	6	60	70	140
Pb	40	20	20	$<$10	40	15	25	15	20
Sc	40	30	40	40	40	40	35	40	30
Sn	4	$<$3	$<$3	$<$3	4	3	$<$3	$<$3	$<$3
Sr	150	150	200	150	150	100	200	250	450
V	350	15	300	450	350	450	250	300	200
Y	50	100	30	45	30	70	45	40	30
Zn	170	150	120	130	95	145	135	135	110
Zr	200	400	150	150	70	250	200	150	150

SAMPLE NUMBER	DESCRIPTION
77-2655	Fine-grained, dark green, massive, amphibolitic flow
77-2656	Fine to medium-grained, dark green, massive amphibolitic flow.
77-2659	Fine-grained, dark green, massive, amphibolitic flow.
77-2664	Fine-grained, dark green, massive, amphibolitic flow
77-2666	Porphyritic medium-grained dark green amphibolitic flow.
77-2667	Fine-grained, dark green, amphibolitic flow.
77-2686	Fine-grained, green-grey, schistose, massive flow.
77-2687	Fine-grained, green-grey, schistose, massive flow.
77-2691	Fine-grained, green-grey, schistose, banded flow.
77-2692	Fine-grained, green-grey, carbonatized flow (carbonatized zone of 77-2687).
77-2694	Fine-grained to aphanitic, green-grey, schistose, plagioclase-phyritic, flow.

Table 7 continued on next page

Table 7 continued

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	77-2692	77-2694	77-2696	77-2697	77-2711	77-2713	77-2716	77-2717	77-2718	77-2720	77-2731	77-2733	77-2734
Field Number	77T435C	77T437	77T399	77T430	77T259	77T310	77T284	77T262	77T277	77T295	77T318	77T288	77T280
SiO_2	48.4	49.9	47.4	48.7	51.4	47.4	52.1	50.0	47.3	51.6	49.7	50.0	48.1
TiO_2	2.22	0.67	1.30	0.93	1.09	2.59	1.86	1.73	1.54	1.88	2.11	2.13	2.04
Al_2O_3	14.1	16.2	15.3	15.4	15.9	13.2	13.4	14.5	17.9	14.3	12.7	13.3	14.3
Fe_2O_3	2.70	2.10	4.00	1.01	3.42	4.80	3.60	3.70	2.80	3.70	3.70	4.10	4.60
FeO	10.1	9.10	11.3	5.31	7.81	13.6	11.0	12.3	9.98	12.1	11.3	12.1	10.8
MnO	0.35	0.21	0.23	0.13	0.19	0.27	0.25	0.22	0.17	0.34	0.22	0.22	0.22
MgO	2.83	6.80	6.75	2.39	6.53	4.56	3.50	6.70	5.40	3.16	4.57	4.95	5.20
CaO	10.6	11.1	9.76	11.9	8.76	8.83	8.51	6.79	6.89	8.60	8.45	7.67	8.45
Na_2O	2.81	2.23	1.81	1.28	2.93	2.11	3.05	2.34	3.90	2.77	2.44	2.30	3.35
K_2O	0.52	0.15	0.19	1.06	0.65	0.25	0.12	0.10	0.36	0.20	0.18	0.15	0.53
P_2O_5	0.19	0.05	0.13	0.93	0.21	0.28	0.20	0.16	0.15	0.15	0.21	0.21	0.21
CO_2	3.74	0.16	0.28	8.30	0.98	0.17	0.03	0.06	0.07	0.34	0.58	0.05	0.36
S	0.10	0.20	0.02	0.20	0.19	0.12	0.14	0.03	0.03	0.02	0.13	0.03	0.11
H_2O+	0.86	0.46	1.47	2.89	0.98	1.80	0.50	1.97	2.59	0.82	1.14	1.71	0.87
H_2O-	0.35	0.39	0.32	0.38	0.22	0.20	0.26	0.34	0.29	0.25	0.19	0.23	0.37

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

200	70	80	80	160	60	130	50	100	70	50	60	80
40	50	45	40	35	35	35	40	30	45	35	40	45
90	440	160	215	225	45	50	120	115	115	55	45	140
65	130	40	80	75	55	75	25	40	70	70	55	80
15	15	15	15	15	20	15	20	20	15	15	20	15
15	9	20	25	15	9	5	20	15	8	10	10	15
45	150	100	135	108	25	35	55	45	60	25	25	70
<10	<10	<10	<10	30	<10	<10	<10	<10	<10	<10	25	<10
40	50	35	35	30	40	35	35	30	35	40	40	40
<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
300	150	150	100	250	60	60	100	200	60	150	150	150
400	250	250	200	200	350	250	300	200	350	300	350	300
50	20	40	15	30	45	45	45	30	35	45	50	45
150	90	125	75	110	140	140	110	105	205	130	140	140
200	80	150	100	150	150	150	150	100	150	200	250	200

SAMPLE NUMBER	DESCRIPTION
77-2692	Fine-grained, green-grey, carbonatized flow (carbonatized zone of 77-2687).
77-2694	Fine-grained to aphanitic, green-grey, schistose, plagioclase-phyritic, flow.
77-2696	Medium-grained, green, amphibole-phyric, flow/intrusion.
77-2697	Fine-grained green-grey, schistose, massive flow.
77-2711	Fine-grained to aphanitic, dark green, amphibolitic, massive flow.
77-2713	Fine to medium-grained, grey-green massive flow.
77-2716	Fine-grained, grey-green, massive flow.
77-2717	Medium-grained, grey-green, massive flow.
77-2718	Fine-grained to aphanitic, grey-green, locally plagioclase-phyric, flow.
77-2720	Fine-to medium-grained, locally plagioclase-phyric, grey-green, pillowed flow.
77-2731	Fine-grained, grey-green, massive flow.
77-2733	Medium-to fine-grained grey-green, locally plagioclase-phyric, flow.
77-2734	Medium-grained dark green-grey, massive, locally pillowed, flow.

Table 7 continued

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	77-2737	77-2738	77-2739	77-2741	77-2753	77-2780	77-2792	77-2801	77-2803	77-2804	78-5411
Field Number	77T307	77T312	77T311	77T283	77T316	77T584	77T615	T582	77T533	77T529-1	77TJB-208
SiO_2	46.7	48.9	46.8	47.4	50.9	49.4	51.3	48.8	49.0	48.9	45.7
TiO_2	2.15	2.23	1.97	1.97	0.88	0.71	1.71	1.97	1.71	2.12	1.79
Al_2O_3	13.6	13.0	16.1	15.0	17.8	13.4	14.7	12.6	14.5	13.8	15.3
Fe_2O_3	4.60	3.90	3.90	4.20	4.67	3.69	3.25	4.15	4.07	3.16	17.0
FeO	12.2	11.8	11.8	12.2	5.88	5.07	10.5	14.0	12.0	11.2	*
MgO	0.25	0.21	0.22	0.25	0.17	0.17	0.24	0.45	0.05	0.004	0.24
CaO	5.21	4.45	3.94	4.93	4.87	8.91	4.48	2.85	5.9	4.06	6.11
Na_2O	8.48	7.75	8.47	9.23	8.97	13.5	9.41	8.91	9.01	9.45	8.60
K_2O	3.17	1.89	3.19	2.65	2.50	1.45	2.21	1.68	2.30	2.85	2.47
P_2O_5	0.20	0.29	0.32	0.21	0.31	1.07	0.32	0.44	0.12	0.38	0.03
CO_2	0.23	0.21	0.26	0.19	0.23	0.80	0.37	0.12	0.16	0.20	0.17
S	0.23	1.44	0.08	0.70	0.09	0.03	0.07	1.87	0.18	1.48	0.26
H_2O+	0.13	0.13	0.08	0.10	0.17	0.02	0.03	0.08	0.05	0.04	0.09
H_2O-	1.38	2.83	1.40	1.10	2.24	0.72	0.49	0.69	0.98	1.00	*
	0.31	0.37	0.46	0.45	0.31	0.38	0.21	0.34	0.36	0.21	*

TRACE ELEMENTS IN PARTS PER MILLION

	70	70	100	60	140	1300	70	200	60	200	60
	45	35	35	45	35	36	35	35	46	45	45
	125	45	80	125	5	175	58	59	121	89	200
	70	100	35	75	45	27	32	54	74	69	65
	20	15	20	20	15	15	15	15	15	15	—
	10	15	10	15	20	13	9	18	26	15	15
	55	20	35	65	30	64	50	30	58	46	75
	<10	10	25	<10	10	26	<10	<10	<10	<10	<10
	40	40	35	40	20	35	40	35	35	45	—
	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	—
	100	60	200	150	600	1000	150	150	200	150	—
	250	300	200	350	150	150	150	300	300	250	
	45	50	45	40	30	35	40	45	45	45	—
	130	140	130	140	105	88	177	119	132	164	135
	200	200	150	150	100	200	200	200	200	200	—

* Not analyzed

SAMPLE NUMBER	DESCRIPTION
77-2737	Medium-grained, dark green, massive flow.
77-2738	Medium-grained, dark green, plagioclase-phyric, flow/intrusion.
77-2739	Medium-grained, grey-green, locally plagioclase-phyric and pillowed, flow.
77-2741	Fine-grained, grey-green, plagioclase-phyric, pillowed flow.
77-2753	Fine-grained, grey-green, slightly plagioclase-phyric flow.
77-2780	Fine-grained, grey-green, banded massive, flow.
77-2792	Fine-grained, grey-green, massive flow.
77-2801	Medium-grained, grey-green, amygdaloidal, schistose flow.
77-2803	Fine-grained, grey-green, massive flow.
77-2804	Fine to medium-grained, grey-green, amygdaloidal flow.
78-5411	Medium-grained, grey-green, plagioclase-phyric flow.

Chemical analyses performed by Geoscience Laboratories, Ontario Geological Survey, Toronto.

TABLE 8 | SOUTHERN VOLCANIC BELT-VOLCANICS, CHEMISTRY, FLYING LOON LAKE AREA MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	78-5377	18-5378	78-5379	78-5380	78-5386	78-5389	78-5390	78-5391	78-5392
Field Number	78-TJB-5	78-TJB-13	78-TJB-48	78-TJB-50	78-TJB-78	78-TJB-143	78-TJB-174	78-TJB-177	78-TJB-178
SiO_2	51.7	48.4	53.7	51.7	48.3	55.8	47.8	49.6	46.1
TiO_2	0.87	1.17	1.82	0.81	2.03	1.50	0.69	1.32	0.77
Al_2O_3	18.7	16.2	12.8	16.3	13.4	15.5	16.9	13.2	16.6
Fe_2O_3	8.71	14.2	18.6	10.4	18.4	12.7	10.4	16.5	12.1
FeO	*	*	*	*	*	*	*	*	*
MnO	0.14	0.21	0.27	0.16	0.26	0.12	0.13	0.23	0.20
MgO	4.12	5.63	2.73	6.16	4.61	3.46	8.84	6.03	7.54
CaO	10.3	10.5	8.71	11.1	8.31	2.04	9.71	10.0	13.6
Na_2O	3.60	3.41	2.04	2.29	2.81	4.97	2.35	2.50	1.30
K_2O	0.14	0.43	0.27	0.27	0.22	0.54	0.25	0.09	0.03
P_2O_5	0.1	0.11	0.18	0.12	0.15	0.27	0.11	0.11	0.08
CO_2	0.43	0.18	0.11	0.16	0.08	0.16	0.06	0.07	0.18
S	0.02	<0.01	0.28	<0.01	0.11	<0.01	<0.01	0.13	0.10
H_2O+	*	*	*	*	*	*	*	*	*
H_2O-	*	*	*	*	*	*	*	*	*

*Not Analyzed For (Total iron expressed as Fe_2O_3)

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

	78-5377	18-5378	78-5379	78-5380	78-5386	78-5389	78-5390	78-5391	78-5392
Ba	100	100	50	90	90	470	90	50	50
Co	30	40	35	40	50	35	45	50	50
Cr	80	140	<5	160	45	6	295	160	355
Cu	50	30	95	50	85	10	15	205	135
Ga	—		—	—	—	—	—	—	—
Li	7	15	4	6	10	10	10	6	6
Ni	85	40	<5	145	20	20	250	45	165
Pb	55	15	10	10	<10	<10	<10	<10	10
Sc	—	—	—	—		—	—		—
Sn	—	—	—	—		—	—		—
Sr	—	—	—	—	—	—	—		—
V	—		—	—	—	—	—		—
Y	—		—	—	—	—	—		—
Zn	90	105	160	90	140	60	65	100	85
Zr	—	—	—	—	—	—	—	—	—

SAMPLE NUMBER	DESCRIPTION
78-5377	Fine-grained, grey-green, plagioclase-phyric flow.
78-5378	Fine-grained, grey-green, plagioclase-phyric flow.
78-5379	Fine grained, grey-green, massive flow
78-5380	Fine-grained, grey-green, plagioclase-and amphibole-phyric, flow.
78-5386	Fine-grained, grey-green, massive flow
78-5389	Fine-grained, green, massive flow/intrusion.
78-5390	Fine-grained, grey-green, amphibole-phyric flow.
78-5391	Fine-grained, grey-green, massive flow.
78-5392	Fine-grained, grey-green, pillowed flow.

Table 8 continued

MAJOR COMPONENTS IN WEIGHT PERCENT

78-5393 78-TJB-181	78-5394 78-TJB-182	78-5395 78-TJB-183	78-5396 78-TJB-184	78-5397 78-TJB-185	78-5398 78-TJB-186	78-5399 78-TJB-187	78-5401 78-TJB-179	78-5403 78-TJB-175	78-5405 78-TJB-191
46.4	45.2	48.9	47.4	46.6	47.9	46.3	46.2	51.7	54.4
1.80	1.25	0.52	1.68	1.23	1.92	1.24	0.80	0.96	1.04
14.3	16.1	13.9	14.5	14.1	14.5	14.4	16.9	15.1	16.3
17.5	14.5	12.4	16.2	16.3	14.6	15.5	12.4	11.2	8.64
*	*	*	*	*	*	*	*	*	*
0.23	0.24	0.22	0.20	0.27	0.28	0.24	0.20	0.22	0.14
5.58	6.57	8.31	3.50	7.34	3.88	6.75	7.78	5.65	5.20
8.99	11.6	10.5	9.79	7.35	7.81	9.02	12.2	10.4	5.41
2.72	1.97	2.34	1.67	3.44	3.36	3.33	1.40	3.04	3.85
0.09	0.04	0.29	0.15	0.12	0.00	0.01	0.02	0.09	0.15
0.17	0.11	0.06	0.17	0.11	0.20	0.10	0.08	0.15	0.22
0.45	0.12	0.53	2.54	0.19	3.93	0.74	0.18	0.45	1.32
0.09	0.03	0.01	0.05	<0.01	<0.01	0.03	0.02	0.03	0.01
*	*	*	*	*	*	*	*	*	*
*	*	*	*	*	*	*	*	*	*

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

50	40	160	100	70	40	40	40	50	80
55	55	50	50	55	45	50	55	40	30
110	330	15	135	215	230	220	370	175	115
140	115	65	90	120	70	170	140	95	60
—	—	—	—	—	—	—	—	—	—
9	8	6	10	10	10	8	7	4	20
60	135	60	65	80	55	55	165	70	70
<10	<10	<10	<10	<10	<10	<10	10	25	10
—		—	—	—	—	—	—	—	—
—	—		—	—	—	—	—	—	—
—		—	—	—	—	—	—	—	—
—		—	—	—	—	—	—	—	—
—		—	—	—	—	—	—	—	—
150	105	55	130	135	140	130	90	100	110
—	—	—	—	—	—	—	—	—	—

SAMPLE NUMBER	DESCRIPTION
78-5393	Fine-grained, grey-green, schistose, massive flow.
78-5394	Fine-grained, grey-green, schistose, massive flow.
78-5395	Fine-grained, grey-green, massive flow.
78-5396	Fine-grained, grey-green, massive flow.
78-5397	Fine-grained, grey-green, massive flow.
78-5398	Fine-grained, grey-green, schistose, massive flow.
78-5399	Fine-grained, grey-green, schistose, massive flow.
78-5401	Fine-grained, grey-green, plagioclase-phyric, pillowed flow
78-5403	Fine-grained, grey-green, massive flow.
78-5405	Fine-grained, grey-green, massive flow.

Chemical analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

TABLE 9 | SOUTH STURGEON LAKE VOLCANICS, CHEMISTRY, FLYING LOON LAKE AREA.

MAJOR COMPONENTS IN WEIGHT PERCENT

Laboratory Number	77-286	77-292	77-296	77-297	77-2818	77-2819	77-2820	77-2821	77-2822	77-2823	77-2824	77-2806
Field Number	66-66-2	68-79-8	68-96-6	68-96-16	R70-1	R68	R67	R66	R61	R64	R66-1	R62
SiO_2	56.4	59.5	46.6	44.1	50.9	51.7	57.2	48.6	61.3	49.7	52.2	62.5
TiO_2	0.73	0.88	0.49	1.36	0.73	1.86	1.41	1.45	1.42	0.32	1.49	0.91
Al_2O_3	17.0	16.7	12.6	17.6	14.3	14.9	16.5	14.6	13.5	17.8	16.2	15.6
Fe_2O_3	1.05	1.52	2.20	4.50	3.75	3.78	2.07	5.12	2.97	1.51	3.91	3.12
FeO	6.07	5.73	9.47	10.1	7.25	9.66	6.20	9.26	7.41	5.72	7.65	4.27
MnO	0.12	0.12	0.18	0.14	0.18	0.19	0.13	0.21	0.17	0.15	0.17	0.09
MgO	4.73	3.53	17.8	6.36	6.81	4.99	3.12	6.98	2.85	9.40	3.95	1.80
CaO	8.33	6.95	7.13	12.2	13.8	8.65	8.59	10.4	7.18	12.4	9.26	5.96
Na_2O	3.23	3.64	1.07	1.48	0.78	2.48	3.27	1.11	2.67	0.67	2.74	3.59
K_2O	0.80	0.77	0.14	0.15	0.09	0.32	0.42	0.65	0.47	0.21	0.63	0.95
P_2O_5	0.15	0.15	0.01	0.0	0.07	0.13	0.27	0.14	0.19	0.05	0.14	0.14
CO_2	0.14	0.08	0.17	0.12	0.08	0.10	0.11	0.32	0.11	0.07	0.37	0.14
S	0.00	0.01	0.00	0.21	0.02	0.02	0.01	0.07	0.10	0.02	0.06	0.02
H_2O+	0.54	0.52	1.86	0.70	0.18	0.21	0.09	0.68	0.21	0.97	0.16	0.41
H_2O-	0.29	0.32	0.37	0.31	0.33	0.34	0.35	0.37	0.29	0.31	0.31	0.21

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	260	200	70	80	50	100	120	200	120	70	150	270
Co	27	24	80	70	43	37	26	51	30	37	36	19
Cr	121	101	420	11	218	131	141	94	26	740	17	< 5
Cu	68	70	14	182	37	19	10	136	10	66	34	22
Ga	—	—	—	—	15	15	15	10	15	9	15	15
Li	14	10	9	6	5	6	8	16	6	8	12	14
Ni	97	61	900	18	72	64	70	155	46	170	< 5	15
Pb	12	< 10	< 10	< 10	< 10	< 10	< 10	< 10	24	< 10	< 10	< 10
Sc	—	—	—	—	50	30	30	35	30	30	35	20
Sn	—	—	—	—	< 3	< 3	< 3	< 3	< 3	< 3	< 3	< 3
Sr	—	—	—	—	150	300	300	250	200	200	300	250
V	—	—	—	—	200	200	150	400	150	90	200	100
Y	—	—	—	—	20	30	40	20	45	10	20	35
Zn	80	88	96	90	76	146	96	157	111	74	125	50
Zr	—	—	—	—	70	150	200	80	200	20	100	200

Table 9 continued

MAJOR COMPONENTS IN WEIGHT PERCENT

Sample Number	77-2825	77-2826	77-2827	77-2828	77-2806
Field Number	R66	R65	R59	R60	R62
SiO_2	53.1	66.5	48.0	52.3	62.5
TiO_2	0.99	0.82	1.01	1.34	0.91
Al_2O_3	16.6	15.0	14.7	16.4	15.6
Fe_2O_3	2.99	2.50	4.12	2.66	3.12
FeO	7.57	4.03	9.98	8.69	4.27
MnO	0.22	0.08	0.23	0.17	0.09
MgO	4.80	0.88	7.64	4.66	1.80
CaO	10.1	3.25	11.3	8.52	5.96
Na_2O	2.27	4.27	1.71	2.42	3.59
K_2O	0.28	1.49	0.08	0.66	0.95
P_2O_5	0.28	0.18	0.07	0.26	0.14
CO_2	0.43	0.68	0.04	0.51	0.14
S	0.01	0.01	0.02	0.08	0.02
H_2O+	0.33	0.32	0.28	0.56	0.41
H_2O-	0.28	0.36	0.26	0.32	0.21

TRACE ELEMENTS IN PARTS PER MILLION (PPM)

Ba	90	560	50	160	270
Co	32	14	46	36	19
Cr	138	19	284	78	5
Cu	22	30	60	58	22
Ga	10	15	15	15	15
Li	9	14	6	12	14
Ni	46	11	57	75	15
Pb	10	<10	<10	<10	10
Sc	25	15	50	25	20
Sn	3	<3	<3	<3	3
Sr	250	300	150	200	250
V	150	60	250	150	100
Y	20	45	30	40	35
Zn	122	88	104	134	50
Zr	150	300	90	200	200

Sample Number	Description
77-286	Medium-grained, light grey, massive intrusion/flow.
77-292	Medium-grained, grey, massive flow.
77-296	Coarse- to medium-grained, dark grey, massive flow (ultramafic?)
77-297	Medium-grained, dark grey, massive flow/intrusion.
77-2818	Fine-grained, grey-green, pillowed flow.
77-2819	Fine- to medium-grained, grey-green, pillowed flow.
77-2820	Fine-grained, grey-green, pillowed, amygdaloidal flow.
77-2821	Fine-grained, grey-green, pillowed flow.
77-2822	Fine-grained, grey-green, massive flow.
77-2823	Medium-grained, grey-green, massive flow/intrusion.
77-2824	Fine-grained, grey-green, pillowed flow.
77-2806	Medium-grained, grey, massive intrusion/flow.
77-2826	Medium-grained, grey-green, massive flow/intrusion.
77-2827	Medium-grained, dark green, plagioclase-phyric flow.
77-2828	Medium-grained, grey-green, pillowed flow.

Chemical analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

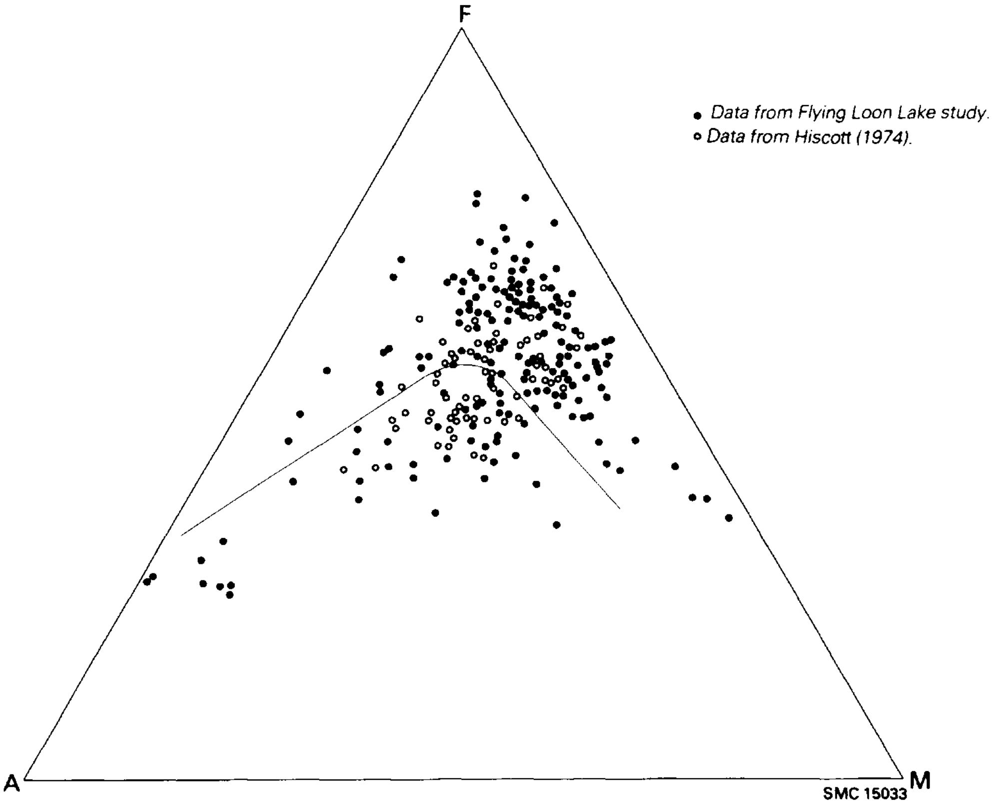


Figure 7–AFM composite plot of the metavolcanics.

stances due to the low outcrop density, this was not possible, so samples, of plagioclase-phyric, amygdaloidal, pillowed, fragmental, and even apparently altered samples were selected for analysis.

Several plots using the chemical data were done to illustrate specific chemical features of the metavolcanics. Figures 5 to 8 are composite plots presenting data from all the samples within the map-area.

The $Na_2O + K_2O$ versus SiO_2 plot (Figure 5, *after* Irvine and Baragar 1971) indicates that the metavolcanics are subalkalic. Samples that plot in the alkalic field contain generally high volatile contents suggesting that they have been highly altered. The normative plagioclase composition versus normative colour index plot (Figure 6, after Irvine and Baragar 1971) indicates that the majority of the metavolcanics are basalts and andesites with minor dacites (Figure 6). AFM (*after* Irvine and Baragar 1971) and cation (Jensen 1976) plots indicate the flows are of both tholeiitic and calc-alkalic affinities (Figures 7, 8).

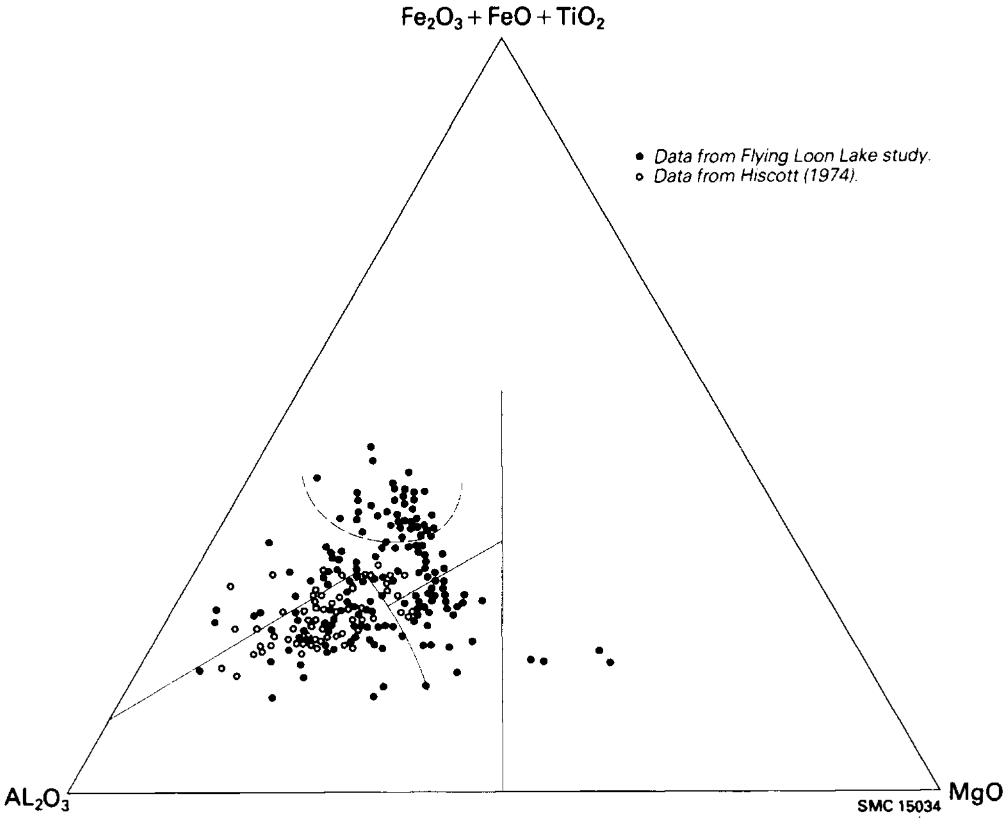


Figure 8–Cation composite plot of the metavolcanics.

Specifically, on the cation plot (Jensen 1976), the tholeiitic basalt units plot into two clusters: (1) a cluster in the high-iron tholeiitic field, and (2) a second cluster straddling the boundary between iron and magnesian (high-magnesian) tholeiites (Figure 8). Similarly on an Al_2O_3 versus FeO (Total)/(FeO (Total) + MgO) plot (Figure 9 *after* Naldrett and Goodwin 1976), there are three groupings of mafic flows which, following their terminology (Naldrett and Goodwin 1976), are respectively high-iron tholeiites, intermediate tholeiites, and calc-alkalic metavolcanics (Figure 9). On a TiO_2 frequency plot, there are two maxima of TiO_2 content (Figure 10). The lower maximum correlates with iron contents characteristic of the calc-alkalic and intermediate tholeiitic metavolcanics, the upper maxima with high-iron tholeiites, but all high-iron tholeiites do not necessarily have high TiO_2 contents. There appears, therefore, to be *four major chemical divisions of metavolcanics* within the map-area:

1. calc-alkalic basalts and andesites

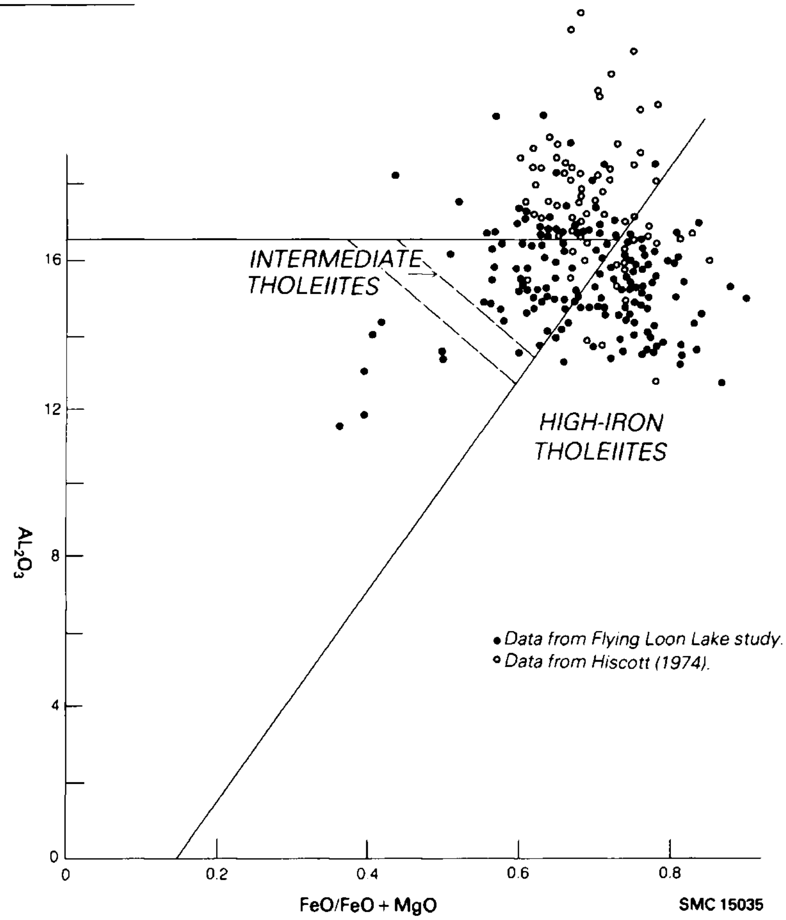


Figure 9–Al_2O_3 : FeO (Total)/(FeO (Total) + MgO) composite plot of the metavolcanics.

2. intermediate tholeiitic basalts and minor andesites
3. high-iron tholeiitic basalts and minor andesites
4. high-iron, high-titanium tholeiitic basalts and minor andesites

The above plots, though useful in a general sense, are hampered by the fact that with the apparent exception of TiO_2 and perhaps Al_2O_3 all the other elements are known to be mobile under various conditions (Garcia 1978). Individual units may therefore be incorrectly classified using these plots, and primary magmatic differences may be obscured by later superimposed alteration. Even though the chemical data in the tables were not pre-screened, an examination of the volatile content (H_2O+ + H_2O- + CO_2 + S) of the samples (*see all tables with chemical data*) gives an approximate idea of the samples that have been greatly altered. The approach of Gelinas *et al.* (1976) was used; those samples having a volatile content or LOI (loss on ignition) of greater than 3.8 weight percent (*see all tables of chemical data*), could be considered suspect in determining petrogenetic affinities.

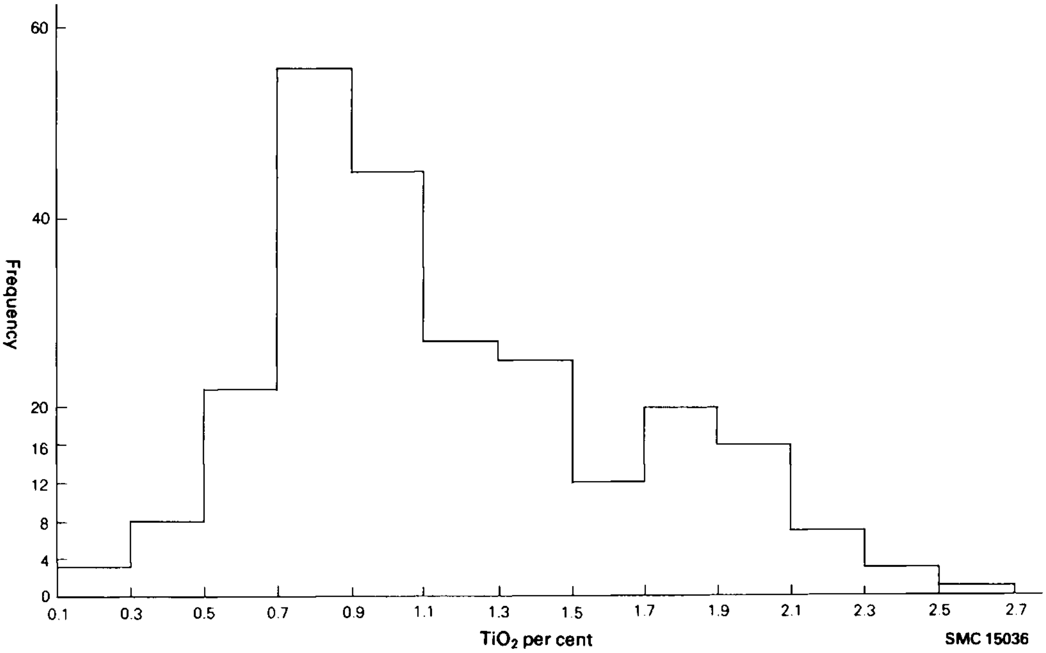


Figure 10–TiO_2 composite frequency plot of the metavolcanics.

Neepawa Group Volcanics

The stratigraphy and chemistry of the Neepawa Group Volcanics has been outlined, respectively by Page and Clifford (1977) and Page (1978a). The authors data, for the Neepawa Group Volcanics from outside the map-area are presented in Table 4. The chemical data may suggest a three-fold division of the Neepawa Group (*see* Section on "Neepawa Group Volcanics - Chemistry"), but only two of these divisions appear to be present within the map-area. These are

1. a lower sequence of tholeiitic basalts and minor andesites
2. an upper sequence of calc-alkalic basalts and andesites.

Page and Clifford (1977) and Page (1978a, 1978b) have presented a more complete and detailed stratigraphy of the Neepawa Group Volcanics, the reader is referred to these studies.

Tholeiitic Basalt Unit

The lower tholeiitic units are dominantly flow rocks and are variably massive, pillowed, amygdaloidal, porphyritic (both plagioclase and amphibole-phyric), and autoclastic fragmental. Pyroclastic fragmental rocks do occur locally: thin units of intermediate tuff are commonly found between the flows. Disseminated sulphide minerals (approximately 1 percent) are ubiquitous.

Calc-Alkalic Basalt-Andesite Unit

The calc-alkalic basalts and andesites consist approximately equally of flows and fragmentals of both autoclastic and pyroclastic origin. These rocks are commonly plagioclase-phyric, locally amphibole-phyric as well. The plagioclase phenocrysts occur as abundant euhedral laths that may reach lengths of 3 to 4 cm in contrast to the more equant, more sparsely distributed plagioclase of the lower tholeiitic units. Pillows are also plagioclase-phyric, amygdaloidal, large (to 2.5 m by 4.5 m), tabular, and have thick selvages, whereas the pillows in the tholeiitic basalts are smaller, have more rounded outlines and have thin selvages. On the south shore of Abram Lake calc-alkalic pillows were found oriented at an angle of approximately 15 degrees to bedding; this orientation is suggestive of deposition on a paleoslope, perhaps that of an original volcanic flank. Autoclastic fragmentals comprise flow breccias and minor pillow breccias. Pyroclastics range from tuff to pyroclastic breccia in size, are locally bedded and graded, and show evidence of redeposition (load marks, scours, ripple-drift cross-lamination; Page and Clifford 1977) that was likely caused by shallow water debris flows. The calc-alkalic volcanic rocks and some of the underlying tholeiitic fragmentals probably represent the build up of an "andesitic" stratovolcano (Johnston 1972; Page and Clifford 1977; Page 1978a, 1978b) in the vicinity of Northeast Bay (*see* Figure 2), overlying a lower platform of tholeiitic basalts.

Neepawa Group Volcanics - Chemistry

The Neepawa Group volcanic rocks are subalkalic, except for highly altered samples (Figure 11), and are composed dominantly of basalts with lesser amounts of andesites (Figure 12). These rocks are of tholeiitic and calc-alkalic affinity (Figures 13 and 14). Apparent komatiitic basalts contain high volatile contents, and are likely to be highly altered (*see* samples 5312, 5313 in Table 4), but the high chromium and nickel values for sample 5312 suggests either a more magnesium-rich composition to begin with, or that chromium and nickel were mobile during the alteration process. Figure 15 shows the breakdown into intermediate tholeiites, high-iron tholeiites, and calc-alkalic volcanics. Because of the high titanium content (Figure 16) of the high-iron flows, the Neepawa Group volcanics have been subdivided into the following three divisions:

1. A lower sequence of intermediate tholeiites that are high in alumina, low in K_2O, P_2O_5, and TiO_2, and are magnesian to slightly ferroan (exposed outside present map-area on Little Vermilion Lake);
2. A middle sequence of high-titanium (and high-iron) tholeiites that are high in TiO_2, FeO (Total), and P_2O_5;

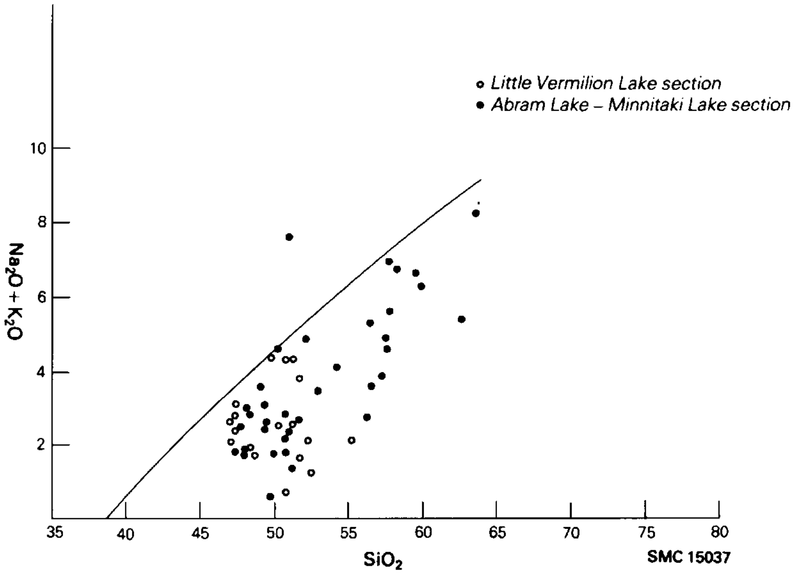


Figure 11–$Na_2O + K_2O:SiO_2$ plot of Neepawa Group Volcanics.

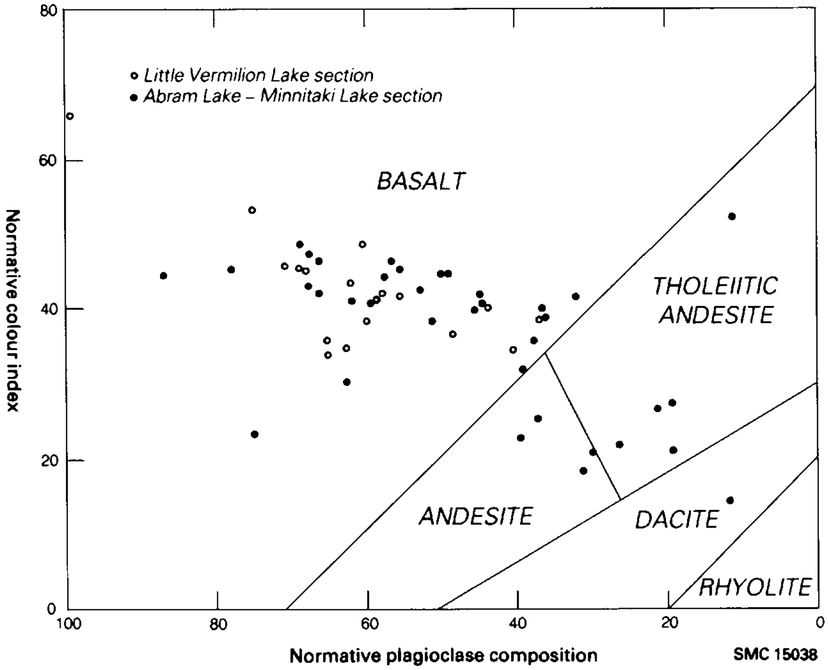


Figure 12–Normative colour index: normative plagioclase composition plot of Neepawa Group Volcanics.

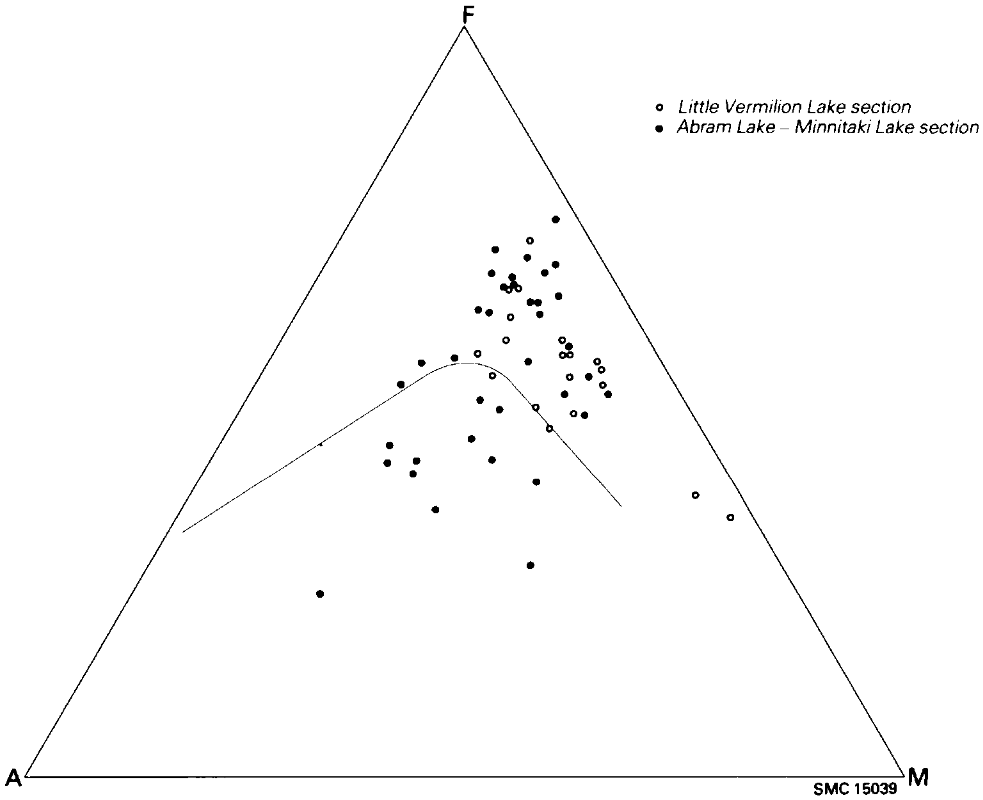


Figure 13–AFM plot of the Neepawa Group Volcanics.

3. An upper calc-alkalic sequence. Figure 16 indicates that these divisions can be discriminated on the basis of their Ti content.

Some of these samples are from apparent synvolcanic intrusions (*see* Table 4). Sample 5336 is from a gabbro body similar in appearance to and is interpreted to be comagmatic with the gabbro-diorite phase of the Northeast Bay Pluton (*see* section on "Northeast Bay Pluton"). It plots in the field of calc-alkalic rocks (*see* Figures 13, 14) and lends support to the Northeast Bay Pluton being comagmatic and subvolcanic to the upper calc-alkalic units (Page and Clifford 1977). Other samples of intrusions plot in the same field as the metavolcanics. This suggests that these intrusions are synvolcanic and comagmatic to the metavolcanics.

Jarvis Lake - Watcomb Lake Volcanics

The volcanics herein defined as the Jarvis Lake-Watcomb Lake Volcanics, have similar flow and fragmental features and similar chemistry (*see* section on "Jarvis Lake-Watcomb Lake Volcanics-Chemistry") to the upper calc-al-

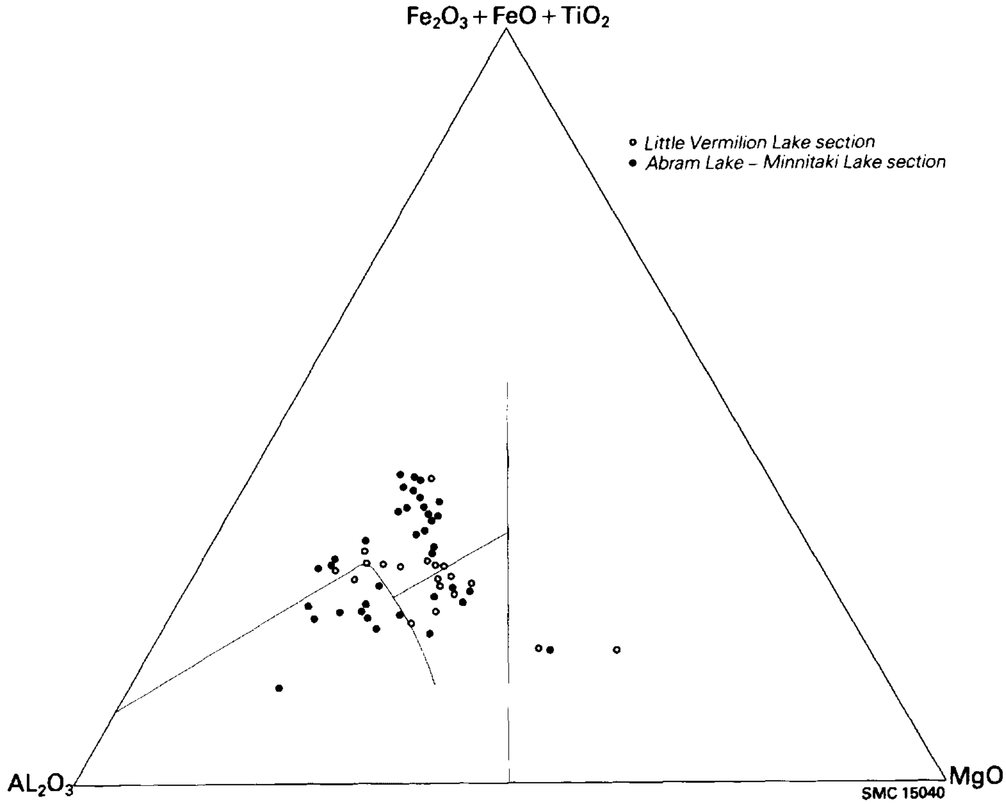


Figure 14–Cation plot of the Neepawa Group Volcanics.

kalic units of the Neepawa Group Volcanics. In addition, there are high-iron, relatively high-titanium tholeiitic basalts underlying this sequence. These basalts, however, are neither as iron- nor as titanium-rich as those of the Neepawa Group, and since their areal extent has not been exactly determined, they are tentatively included within the Jarvis Lake- Watcomb Lake Volcanics.

Along the southeast margin of the belt, massive, generally non-pillowed, and non-amygdaloidal, plagioclase-phyric flows of calc-alkalic affinity overlie high-iron tholeiitic flows (*see* section on, "Jarvis Lake-Watcomb Lake Volcanics - Chemistry"). These calc-alkalic flows may represent a deep water facies of the upper more vesicular and fragmental units or conversely, subaerial volcanism could explain the paucity of pillowed flows.

These lower flows are overlain by a sequence of pillowed, coarsely amygdaloidal flows, autoclastic flow breccias, minor broken pillow breccia, and by pyroclastic fragmentals towards the top of this sequence. The flows, including the pillowed units, are commonly feldspar-phyric. On Jarvis Lake, large elongated pillows contain quartz- and carbonate-filled amygdules that attain diameters of 10 cm indicative of shallow water formation. Autoclastic fragments are lo-

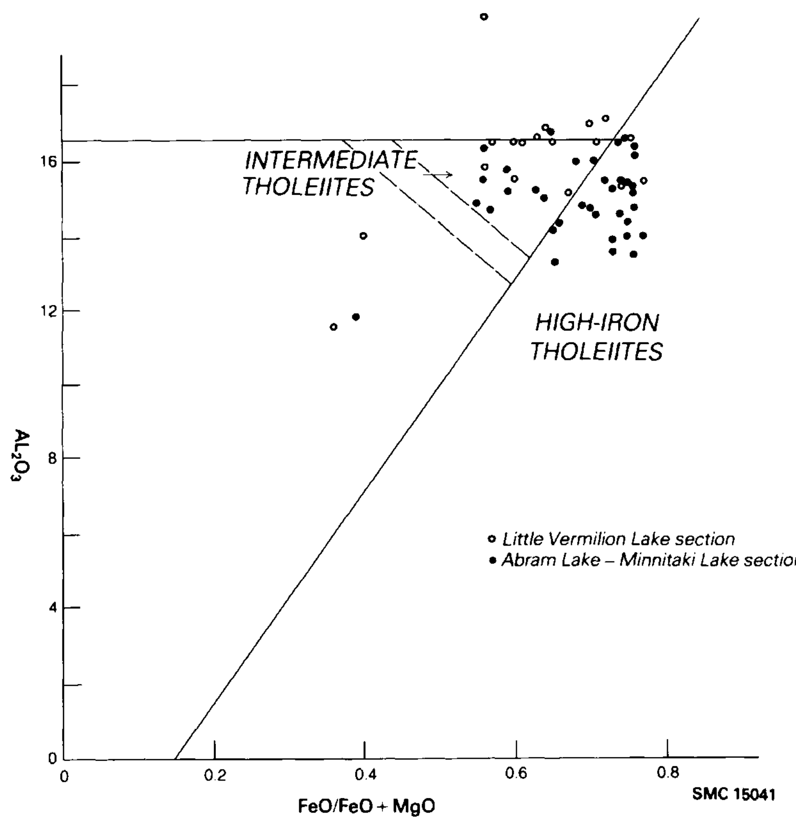


Figure 15–Al_2O_3:FeO (Total)/(FeO(Total) + MgO) plot of the Neepawa Group Volcanics.

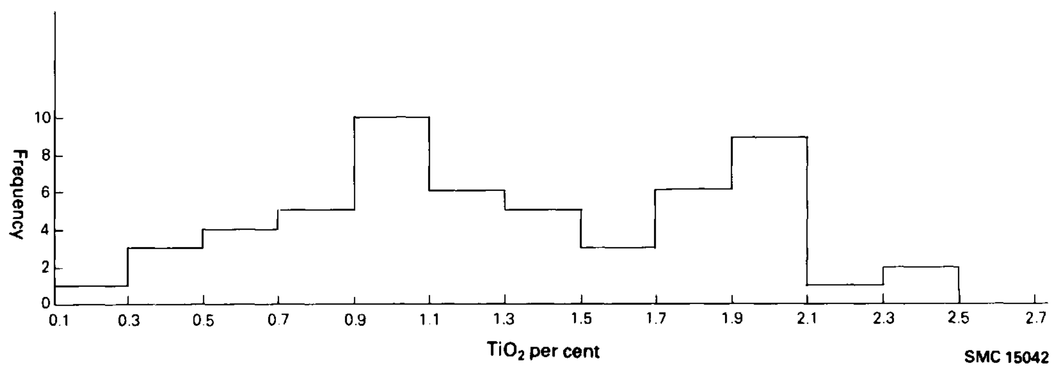


Figure 16–TiO_2 frequency plot of the Neepawa Group Volcanics.

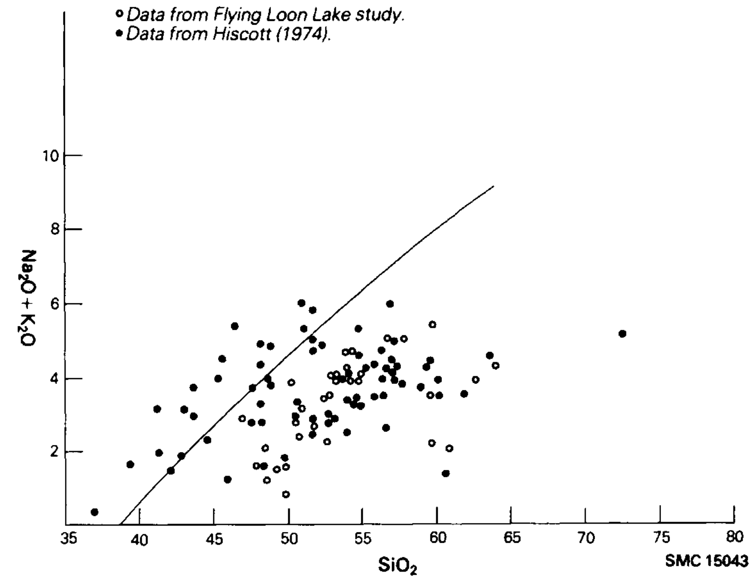


Figure 17–Na_2O + K_2O:SiO_2 plot of the Jarvis Lake-Watcomb Lake Volcanics.

cally highly vesicular to almost pumiceous. Some may be bombs produced by local explosive volcanism subsequently incorporated in the flows. An isolated outcrop of heterolithic breccia occurs on the narrow inlet joining Jarvis and Flying Loon Lake. This volcanic sequence appears to thin and pinch out on the western shore of Flying Loon Lake.

A few scattered outcrops of massive and pillowed flows with minor autoclastic breccia mark the eastwards extent of this upper flow-fragmental sequence until more abundant outcrop is found on and east of Watcomb Lake. Intermediate to felsic tuff, uncommonly tuff-breccia, forms a major part of the upper part of this sequence. The tuffs are bedded, locally graded, and are uncommonly crossbedded. Pillow breccia, and coarsely amygdaloidal plagioclase-phyric, thick-selvaged pillowed and massive flows also occur in these rocks.

Jarvis Lake-Watcomb Lake Volcanics-Chemistry

Table 5 gives the chemical data for the Jarvis Lake-Watcomb Lake Volcanics. Figures 17 to 22 present the data on various selected plots; data from Hiscott (Hiscott 1974) are plotted as solid circles.

The metavolcanics are dominantly sub-alkalic (Figure 17) and composed of basalts and andesites (Figure 18) of both tholeiitic and calc-alkalic affinity (Figures 19 and 20). Figure 21 indicates that high-iron tholeiites, intermediate tholeiites, and calc-alkalic metavolcanics are present. In contrast to the Nee-

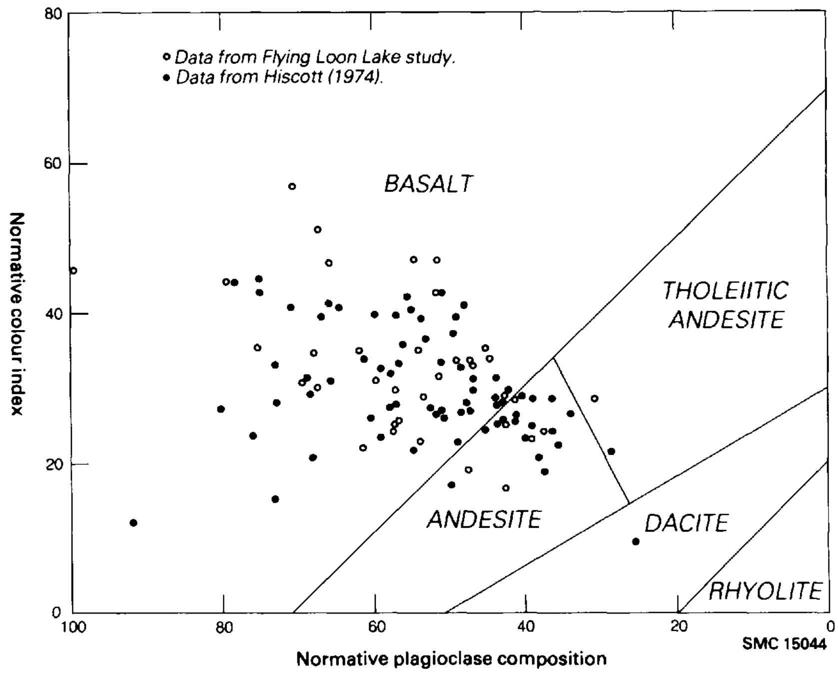


Figure 18–Normative colour index: normative plagioclase composition plot of Jarvis Lake-Watcomb Lake Volcanics.

pawa Group to which they may be correlatable, no high-iron, high-titanium metavolcanics are present (Figure 22).

Southeast Bay-Smock Lake Volcanics

The volcanics, herein named the Southeast Bay-Smock Lake Volcanics, comprise a lower mafic to intermediate metavolcanic flow sequence and an upper felsic to intermediate fragmental sequence (*see* section on "Southeast Bay Pyroclastics") that extend from Southeast Bay to the vicinity of Yonde Lake (*see* Figure 3). Towards the top of the mafic metavolcanic flow sequence, interflow felsic to intermediate tuff observed in outcrop and reported in diamond-drill hole logs (*see* Map 2477 and 2458, back pocket) likely are precursors of the main episode of explosive felsic to intermediate volcanism.

The mafic metavolcanic flows weather brown to green-grey and are variably massive, plagioclase- and/or amphibole-phyric, pillowed, and amygdaloidal. Coarse-grained flows or synvolcanic sills and uncommon autoclastic breccia zones are also present.

In the Smock Lake area, the lower boundary of this sequence is apparently marked by a zone of intermediate metasediments and high-iron tholeiitic flows.

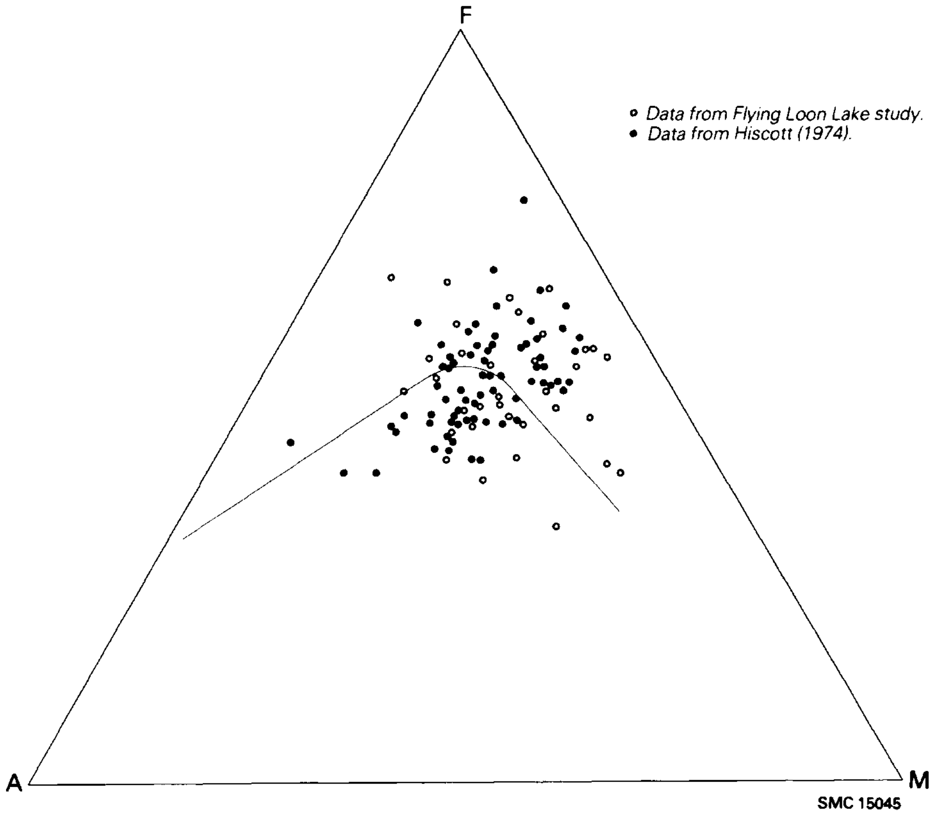


Figure 19–AFM plot of the Jarvis Lake-Watcomb Lake Volcanics.

Coarse-grained, ophitic-textured gabbro intrudes this metavolcanic sequence northeast of Smock Lake.

Southeast Bay - Smock Lake Volcanics-Chemistry

These metavolcanics are revealed to be subalkalic (Figure 23) basalts, andesites, and one dacite (Figure 24). They are apparently of both tholeiitic and calc-alkalic affinity (Figures 25 and 26), the tholeiites being both intermediate and high-iron (Figure 27). A bimodal TiO_2 content is suggested, though sufficient data is lacking (Figure 28).

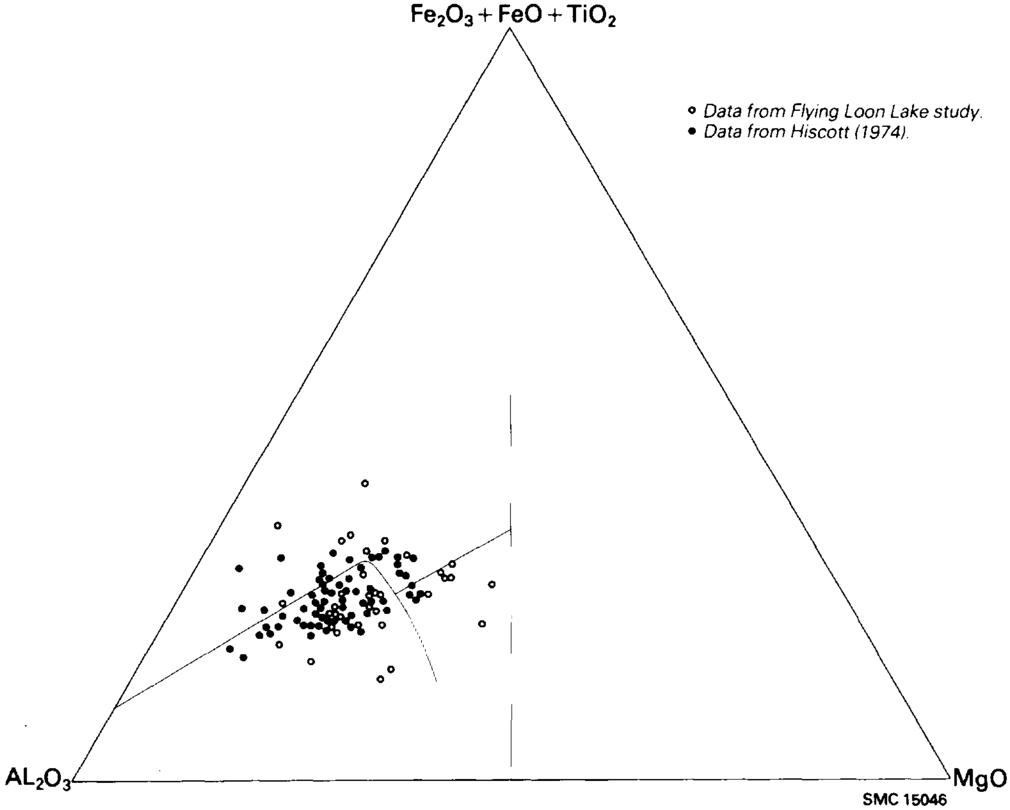


Figure 20–Cation plot of the Jarvis Lake-Watcomb Lake Volcanics.

Discovery Lake-Towers Lake Volcanics

The volcanic rocks, herein named the Discovery Lake-Towers Lake Volcanics, occupy the north half of the volcano-sedimentary belt. To the east, these rocks correlate with flows of the Central Sturgeon Lake Volcanics (Central Sturgeon Lake Assemblage; Trowell 1982). Even though sufficient structural data is lacking, these rocks may also be correlative to the high-iron tholeiitic flows that lie adjacent to the north margin of the Shanty Lake Pluton. If so, the Discovery Lake-Towers Lake Volcanics lie stratigraphically below the Jarvis Lake-Watcomb Lake Volcanics. To the west, the Discovery Lake-Towers Lake Volcanics appear to be correlative with lower units, specifically the high-titanium, high-iron tholeiitic flows of the Neepawa Group (*see* section on "Neepawa Group"). Contact relationships with the Minnitaki Group in the area east of East Bay were not observable in outcrop, though rare pillow tops in the meta-

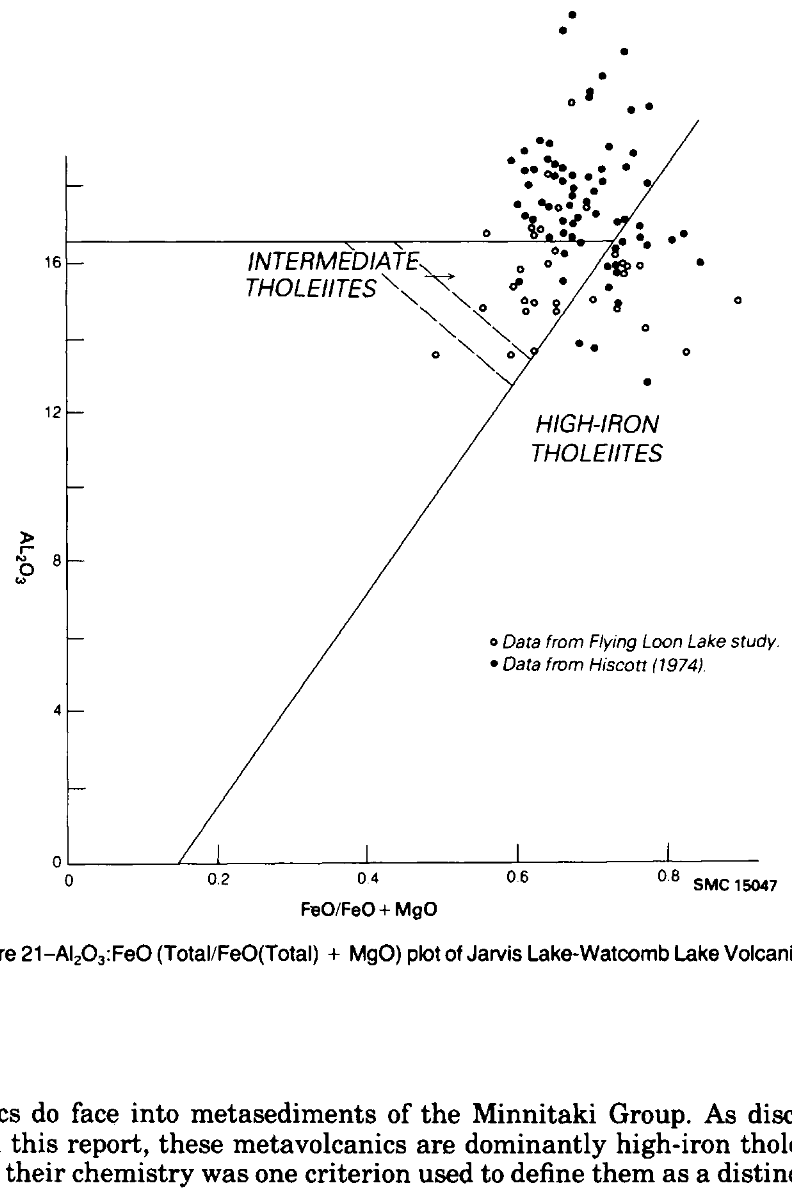


Figure 21–Al_2O_3:FeO (Total/FeO(Total) + MgO) plot of Jarvis Lake-Watcomb Lake Volcanics.

volcanics do face into metasediments of the Minnitaki Group. As discussed later in this report, these metavolcanics are dominantly high-iron tholeiites. Indeed, their chemistry was one criterion used to define them as a distinct volcanic sequence.

The metavolcanics of the Discovery Lake-Towers Lake Volcanics are composed of dark grey-green, green to black, massive, feldspar-phyric, and locally pillowed flows. Autoclastic fragmentation of the flows was not commonly observed. These rocks are generally non-vesicular, and pyroclastic interflow material is not abundant. Synvolcanic intrusive sills similar in appearance and chemistry to the flows are common. Thin wacke-siltstone beds locally occur between the flows. The flows have been metamorphosed to the upper greenschist

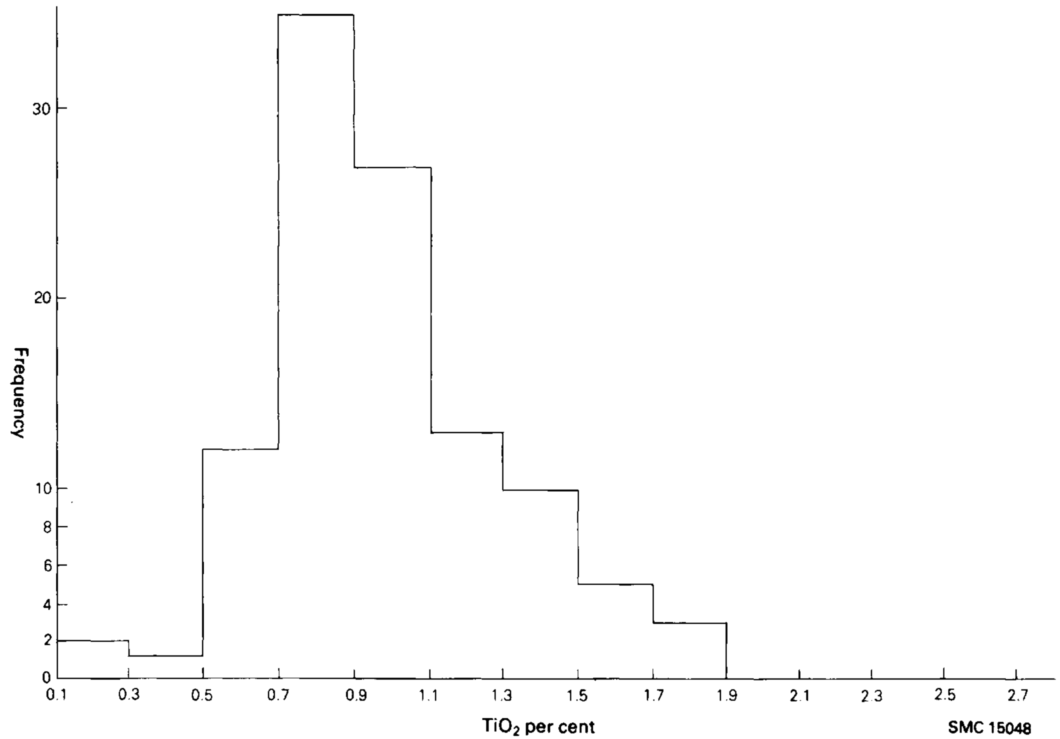


Figure 22–TiO_2 frequency plot of Jarvis Lake-Watcomb Lake Volcanics.

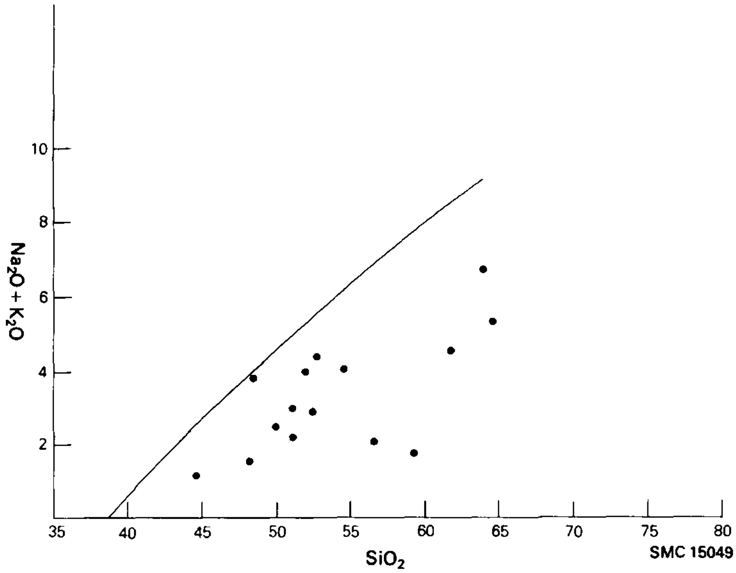


Figure 23–Na_2O + K_2O:SiO_2 plot of Southeast Bay-Smock Lake Volcanics.

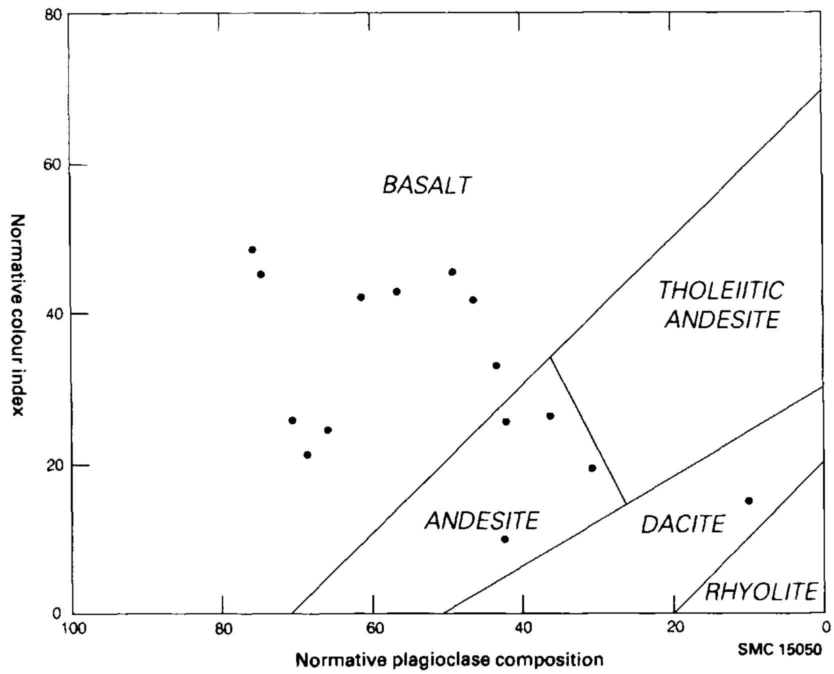


Figure 24–Normative colour index: normative plagioclase composition plot of Southeast Bay-Smock Lake Volcanics.

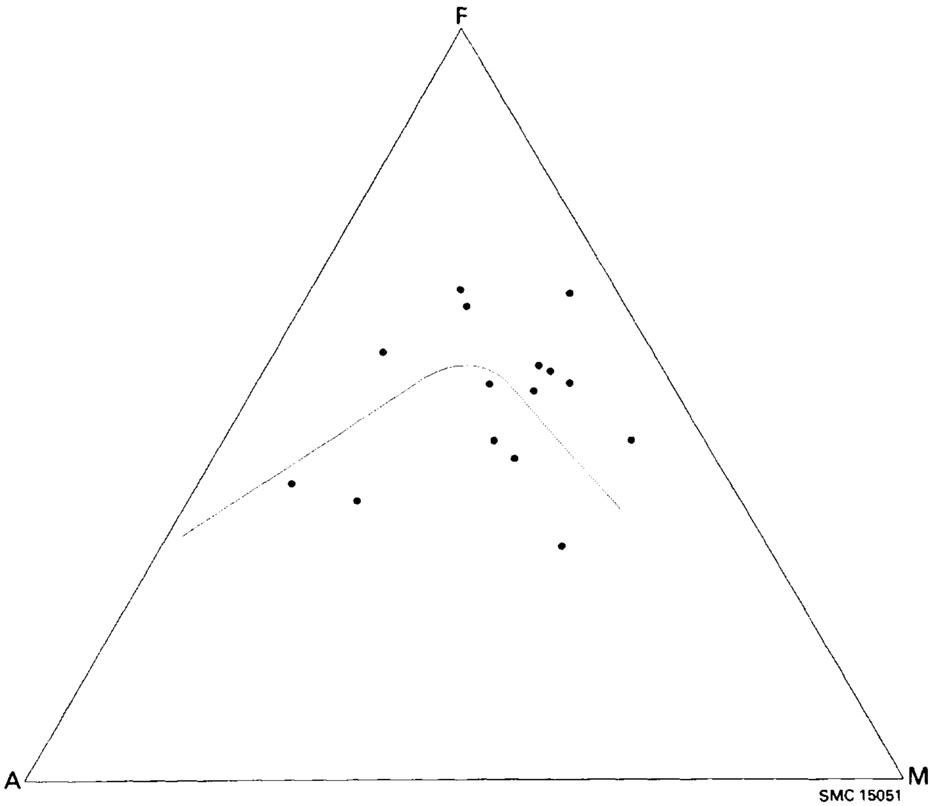


Figure 25–AFM plot of Southeast Bay-Smock Lake Volcanics.

to lower amphibolite facies rank dependent upon their distance from the Lake of Bays Batholith. Characteristically, the flows have a knobby weathering surface due to the crystallization of medium-grained amphibole studs. Quartzofeldspathic segregations were most likely produced by contact metamorphic effects due to the intrusion of the Smock and Wyatt Lakes Plutons. In the western part of the area, these flows are characteristically highly deformed on the outcrop scale. Tight isoclinal and chevron-style folds were observed. As well, minor faulting occurred along conjugate shear planes. Pillows and even plagioclase phenocrysts show extension in the east to southeast plane of 10 to 1 to 30 to 1. These flows commonly contain minor sulphide minerals, principally pyrite with trace amounts of chalcopyrite. This is similar to the apparent correlative flows of the Neepawa Group.

Discovery Lake-Towers Lake Volcanics-Chemistry

Chemical data for the Discovery Lake-Towers Lake Volcanics are presented in Table 7.

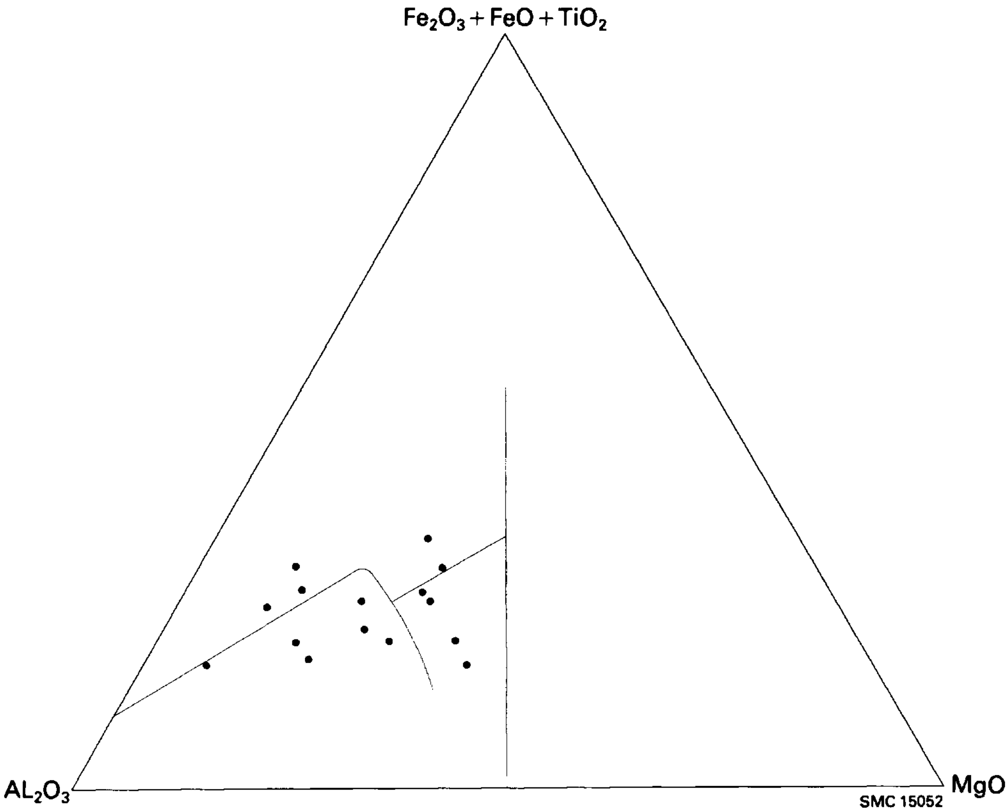


Figure 26–Cation plot of Southeast Bay-Smock Lake Volcanics.

These metavolcanics are dominantly subalkalic (Figure 29) and are mainly basalts with minor andesites (Figure 30). These rocks are predominantly tholeiitic in composition (Figures 31 and 32) and have high-iron characteristics (Figure 33). These rocks show a bimodal distribution of TiO_2 (Figure 34); the higher TiO_2 bearing units are similar to the high-iron, high-titanium tholeiites of the Neepawa Group to which they may be correlative.

Southern Volcanic Belt Volcanics

The volcanic rocks, herein named the Southern Volcanic Belt Volcanics, extend from the west margin of the map-area to east of Loggers Lake (*see* Figure 3). Their relationship to the Jarvis Lake-Watcomb Lake Volcanics is not known.

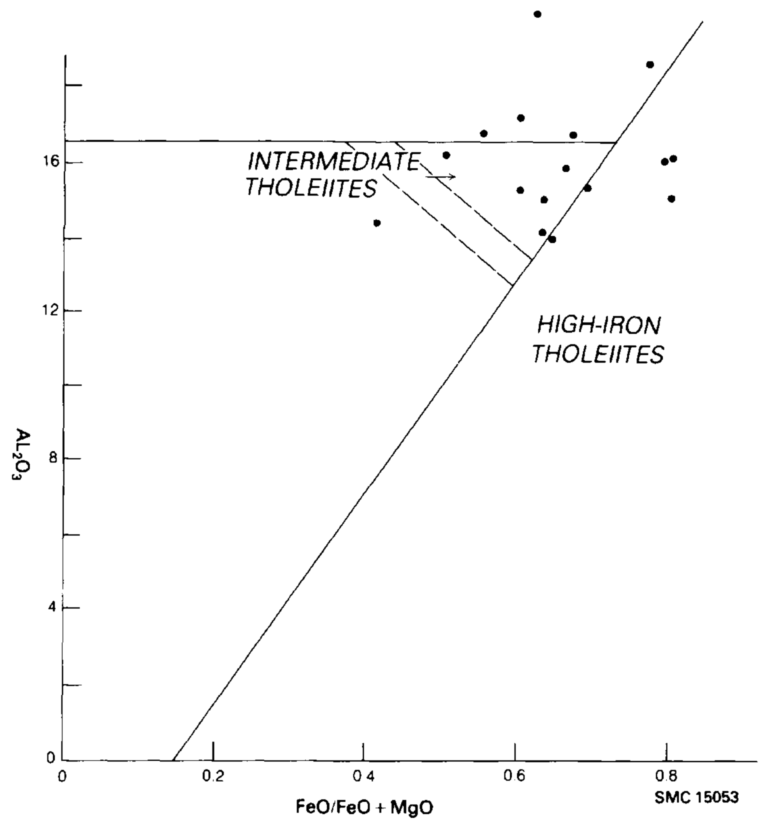


Figure 27–Al_2O_3:FeO (Total)/FeO (Total) + MgO) plot of Southeast Bay-Smock Lake Volcanics.

In the Loggers Lake area, this sequence comprises massive; pillowed; amygdaloidal; and plagioclase-phyric, uncommonly amphibole-phyric flows with interflow beds of metasediments, and intermediate but uncommon felsic tuffs. The flows weather green-grey to dark green and become increasingly darker hued to the east where flows metamorphosed to greenschist facies rank are transitional to flows metamorphosed to the amphibolite facies rank of metamorphism.

Pillows within the pillowed flows have amoeboid shapes, but they are apparently stretched in the east-west plane. The pillows have high-weathering, 2 cm thick selvages, are plagioclase-phyric, and contain carbonate-filled amygdules.

Porphyritic flows contain plagioclase phenocrysts that compose 50 to 70 percent of the flow and are up to 5 cm long.

Minor autoclastic, perhaps broken pillow breccia, is locally present.

Flows vary in thickness from 3 and 4 cm to 15 m.

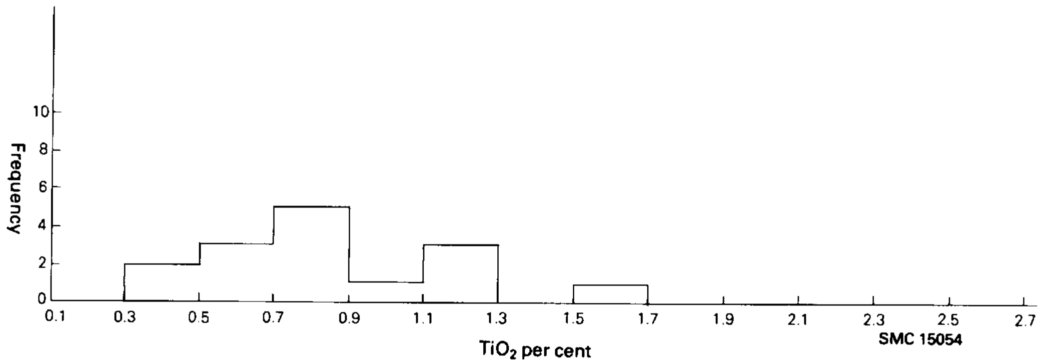


Figure 28–TiO_2 frequency plot of Southeast Bay-Smock Lake Volcanics.

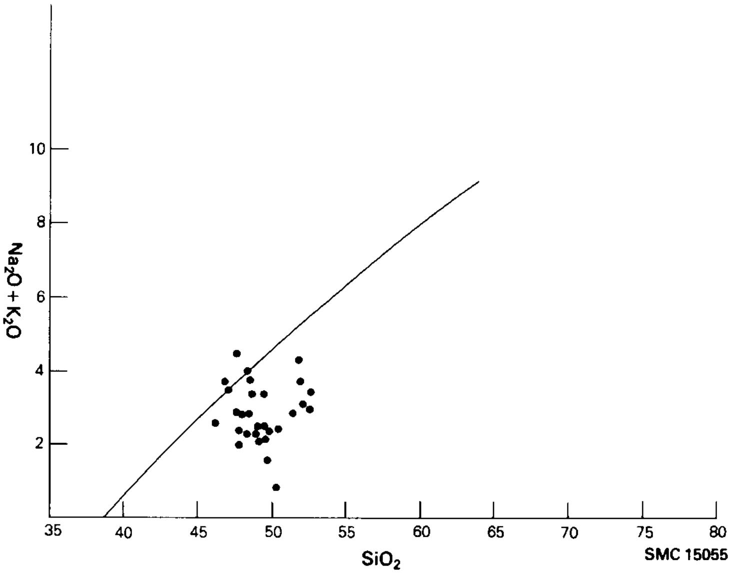


Figure 29–Na_2O + K_2O:SiO_2 plot of Discovery Lake-Towers Lake Volcanics.

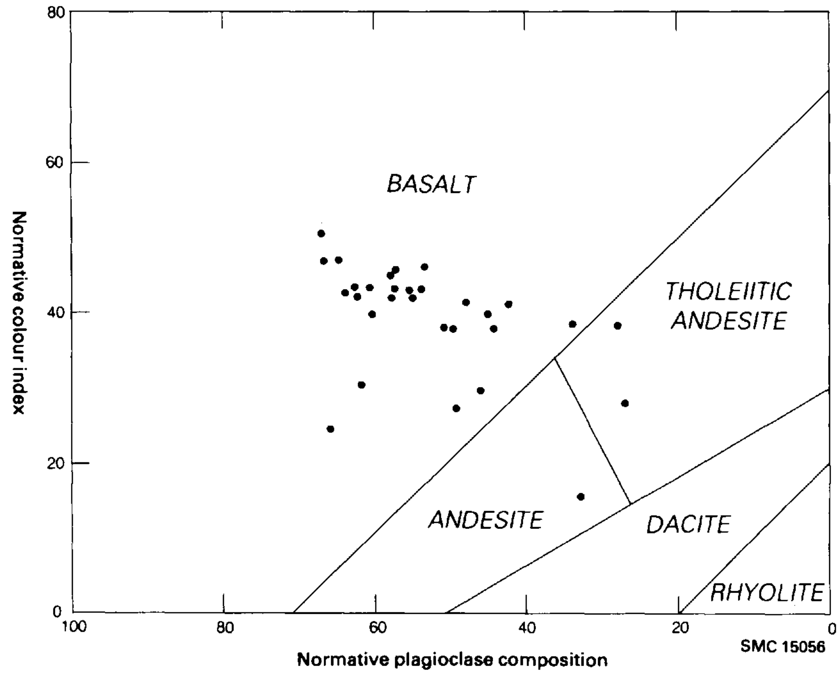


Figure 30–Normative colour index: normative plagioclase composition plot of Discovery Lake-Towers Lake Volanics.

To the west in Southeast Bay, a similar variety of flow types are present, but intercalated tuffs and metasediments were not observed. The porphyritic flows are more noticeably amphibole- (5 to 7 mm phenocrysts) as well as plagioclase-phyric. Massive and pillowed flows are noticeably vesicular with the average amygdule size increasing from north to south. At the bottom of Southeast Bay, amygdules, with quartz cores and epidote rims, are up to 5 cm in diameter. Pillows are as much as 3 to 5 m long; one pillowed flow at the south end of Southeast Bay contains apparent varioles as well as amygdules. The east-trending shears in these flows are noticeable.

To the west, in the Twinflower Lake area, intermediate autoclastic, "apparent" pillow breccia, was observed on Twinflower Lake. As well, intermediate fine- to coarse-grained pyroclastics occur between the flows.

Southern Volcanic Belt Volcanics-Chemistry

The Southern Volcanic Belt Volcanics are dominantly subalkalic (Figure 35) and predominantly basalts with minor andesites (Figure 36) of predominantly tholeiitic affinity (Figures 37 and 38). Figures 39 and 40 show a scatter of data likely due to incomplete sampling of this volcanic sequence.

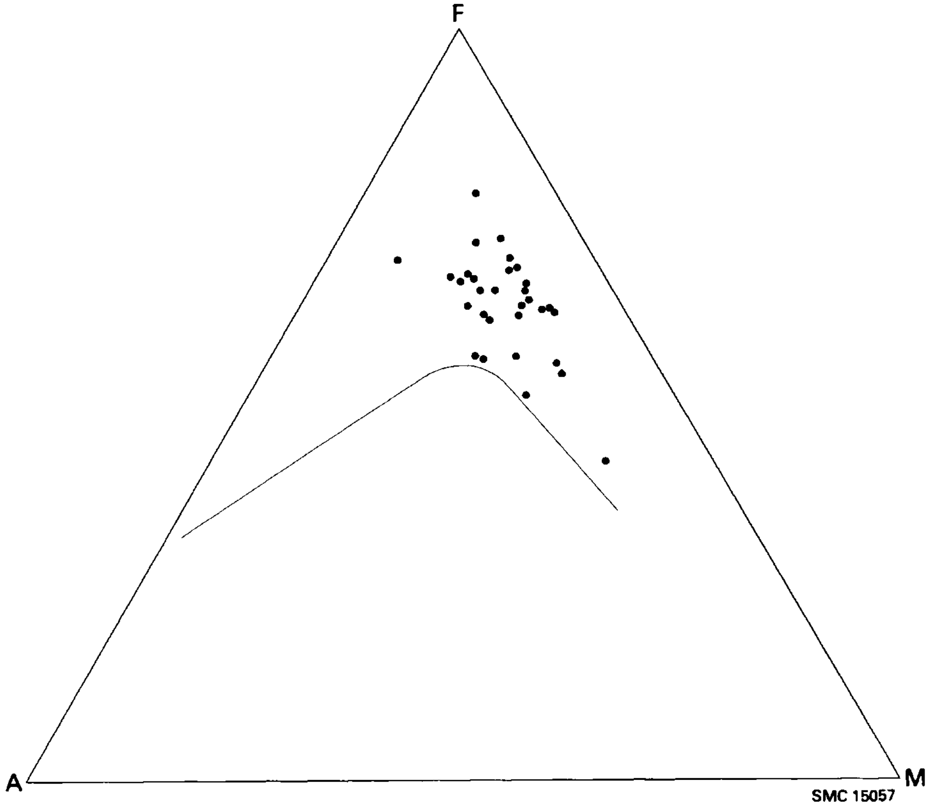


Figure 31–AFM plot of Discovery Lake-Towers Lake Volcanics.

South Sturgeon Lake Volcanics

The structure, texture, and stratigraphic position of this sequence of volcanics exposed south of the Shanty Lake Pluton have been previously described (Trowell 1970, 1982). In these reports, these rocks were interpreted to compose part of the lower South Sturgeon Lake Assemblage (*see* section on "South Sturgeon Lake Volcanics"). Details on their texture, structure, and petrography can be found in Trowell (1970).

South Sturgeon Lake Volcanics - Chemistry

This metavolcanic sequence is subalkalic (Figure 41), dominantly basaltic with minor andesite (Figure 42) and of both tholeiitic (lower part) and calc-al-

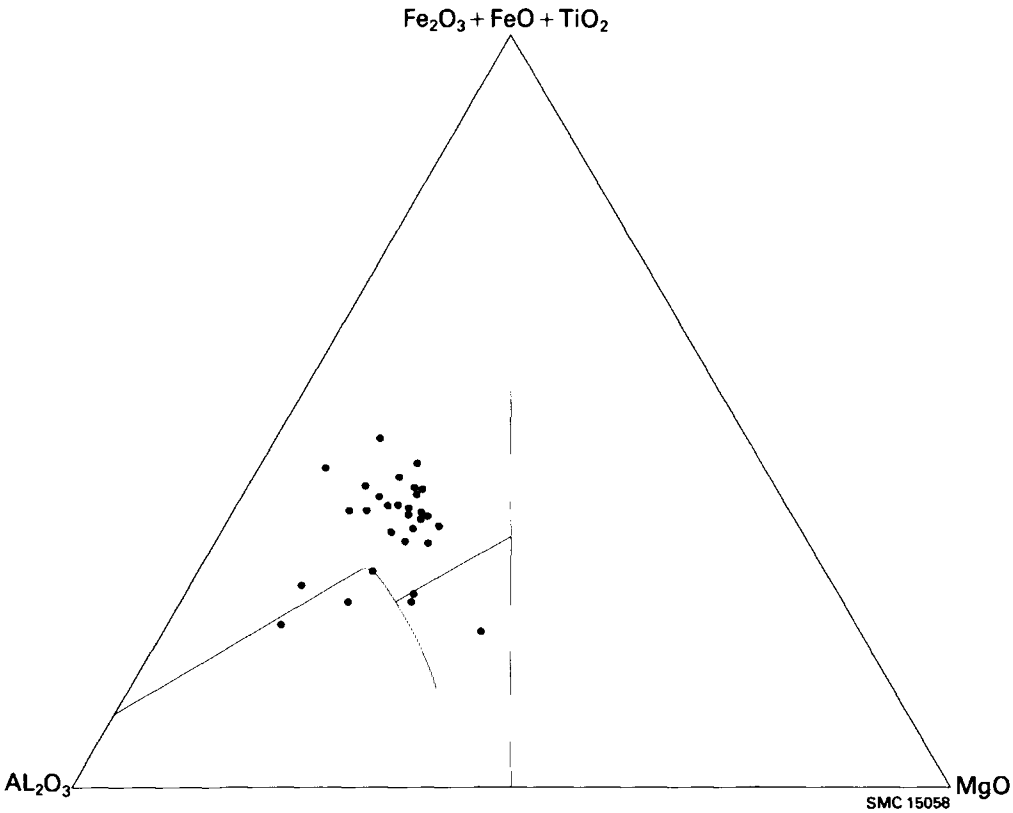


Figure 32–Cation plot of Discovery Lake-Towers Lake Volcanics.

kalic affinity (upper part; *see* Figures 43 and 44). Other figures, (Figures 45 and 46) show a wide scatter of data.

Felsic to Intermediate Metavolcanics

Felsic to intermediate metavolcanics occur in small amounts in the northeast part of Southeast Bay, and in the Loggers Lake area.

Southeast Bay Pyroclastics

A few outcrops of felsic to intermediate metavolcanics in the northeast area of Southeast Bay were previously mapped by F.J. Johnston as metasediments (Johnston 1969, 1972). The authors feel, however, that the presence of such fea-

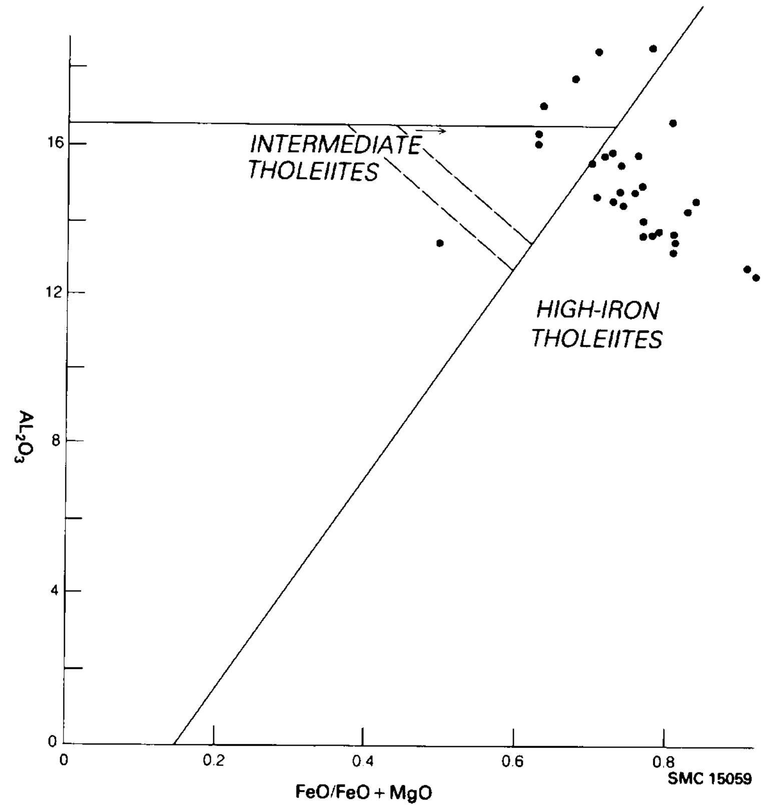


Figure 33–Al_2O_3:FeO (Total)/FeO(Total) + MgO) plot of Discovery Lake-Towers Lake Volcanics.

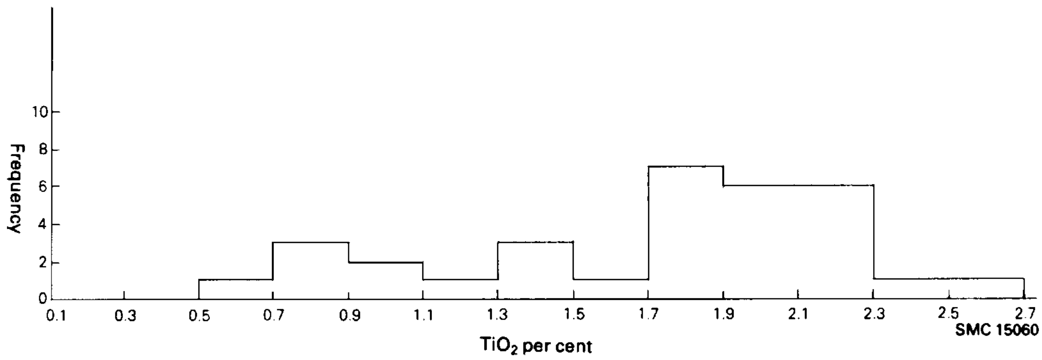


Figure 34–TiO_2 frequency plot of Discovery Lake-Towers Lake Volcanics.

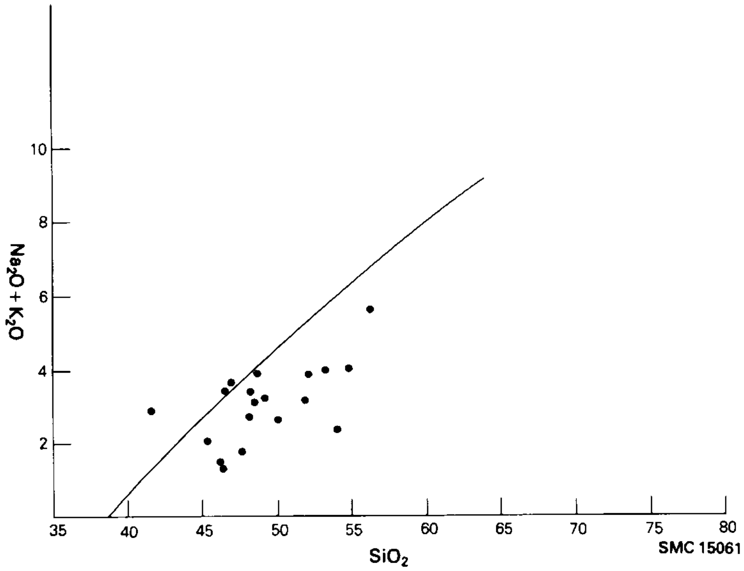


Figure 35–Na_2O + K_2O:SiO_2 plot of Southern Volcanic Belt Volcanics.

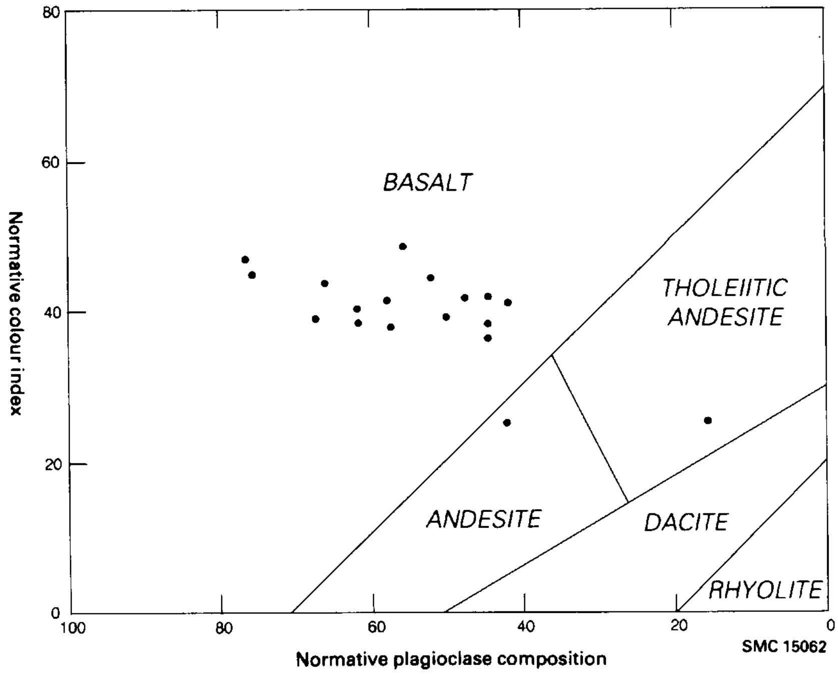


Figure 36–Normative colour index: normative plagioclase composition plot of Southern Volcanic Belt Volcanics.

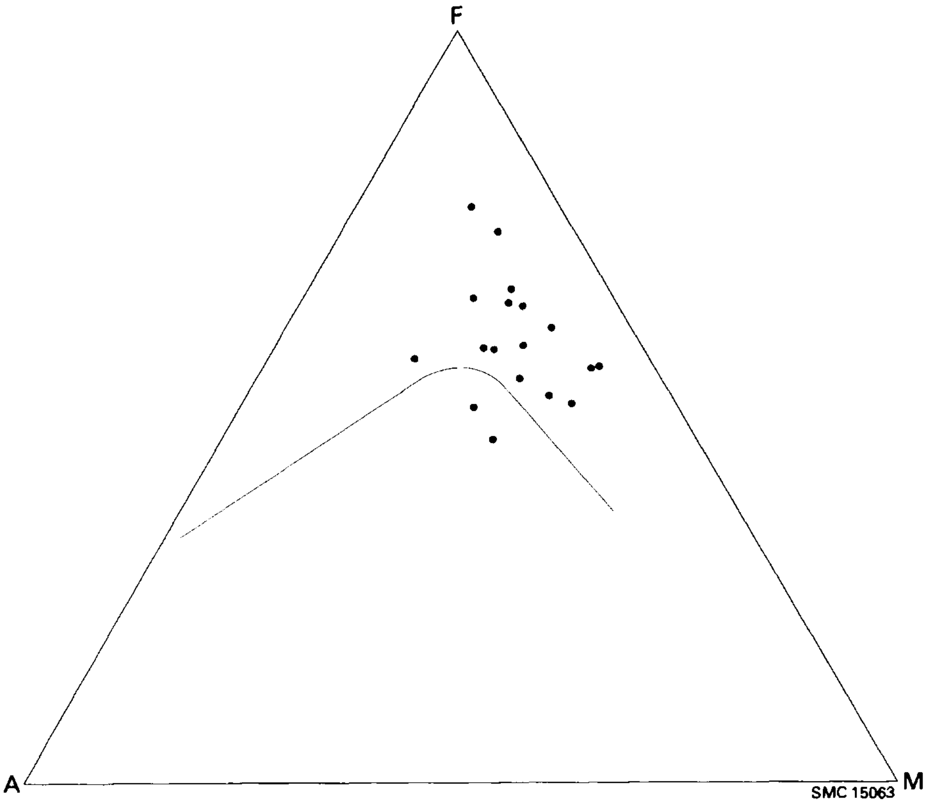


Figure 37–AFM plot of Southern Volcanic Belt Volcanics.

tures as volcanic clasts and matrix, and the lack of rounding and bedding indicates that a volcanic origin, possibly involving redeposition by debris flows, is more tenable.

The Southeast Bay Pyroclastics are interpreted to be the upper felsic component of the Southeast Bay-Smock Lake Volcanics (*see* section on "Southeast Bay-Smock Lake Volcanics").

The felsic to intermediate metavolcanics are dominantly fragmental, though some uncommon massive to vesicular flows, or vesiculated tuffs, of calc-alkalic affinity (*see* Table 6, and section on "Chemistry of the Southeast Bay-Smock Lake Volcanics") are present. Two major size fractions, within the fragmentals, can be recognized: (1) lithic ash and lapilli-tuff; and (2) tuff-breccia to pyroclastic breccia. The ash and lapilli-tuff are intermediate to felsic in composition and contain angular to subangular, generally monominerallic 3 mm average-sized clasts in an intermediate fine-grained ash matrix. The tuff-breccia and pyroclastic breccia are heterolithic and contain angular to subangular, un-

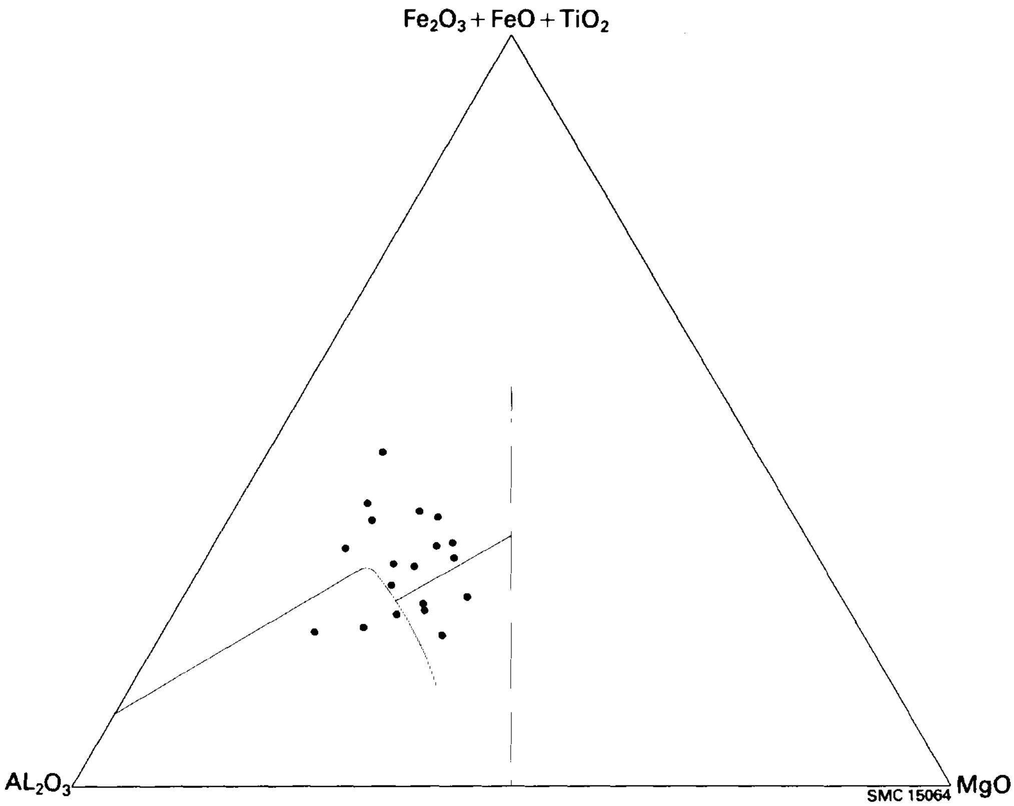


Figure 38–Cation plot of Southern Volcanic Belt Volcanics.

commonly subrounded, clasts that vary from 5 to 150 cm in size and have both an intermediate and a felsic composition. These clasts are set in an intermediate ash tuff matrix. Intermediate and felsic crystal tuffs are present in the southern extension of this sequence and as interflow beds within the underlying mafic metavolcanics.

No bedding was discernible, nor was size gradation of the clasts observed. These rocks are sheared and lineated, but not penetratively foliated. Thin crystal tuffaceous units occur between mafic metavolcanic flows south and east of this sequence, and most likely represent precursors of the main explosive volcanic event.

Intermediate and felsic pyroclastics intercalated with pelitic and graphitic mudstones and sulphide horizons are also reported in diamond-drill hole logs from drill holes put down east and south of the major area of exposure of this sequence (*see* Maps 2477, and 2458 and List of Properties on Figure 48, Chart A, back pocket).

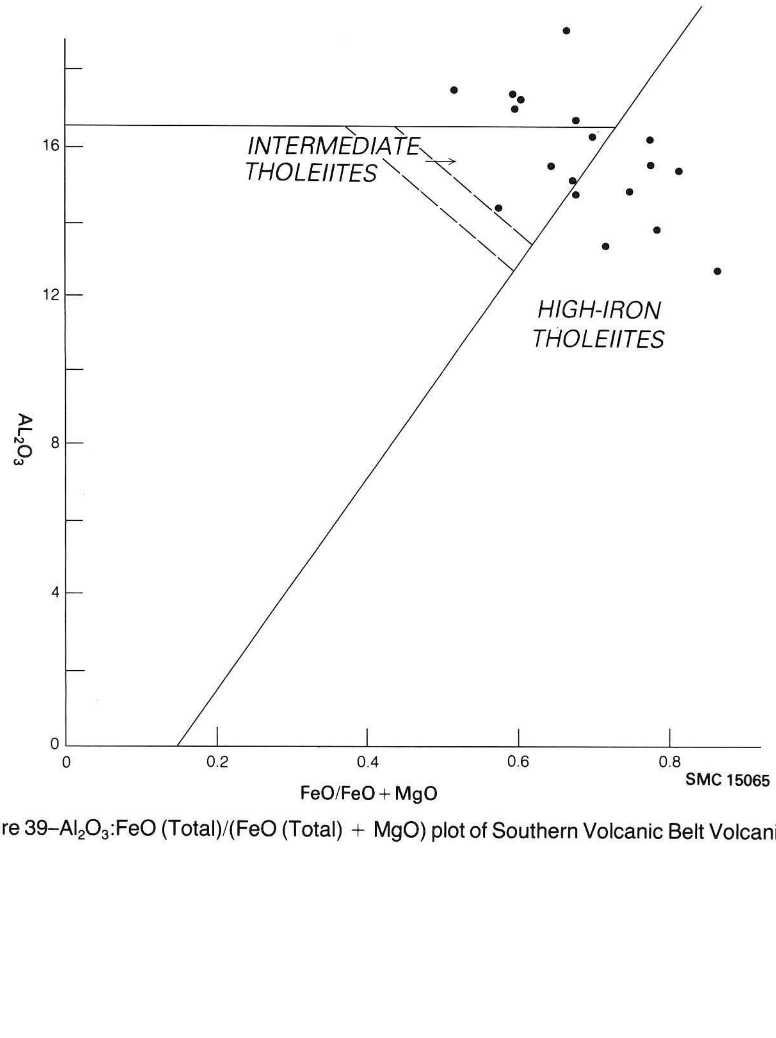


Figure 39–Al_2O_3:FeO (Total)/(FeO (Total) + MgO) plot of Southern Volcanic Belt Volcanics.

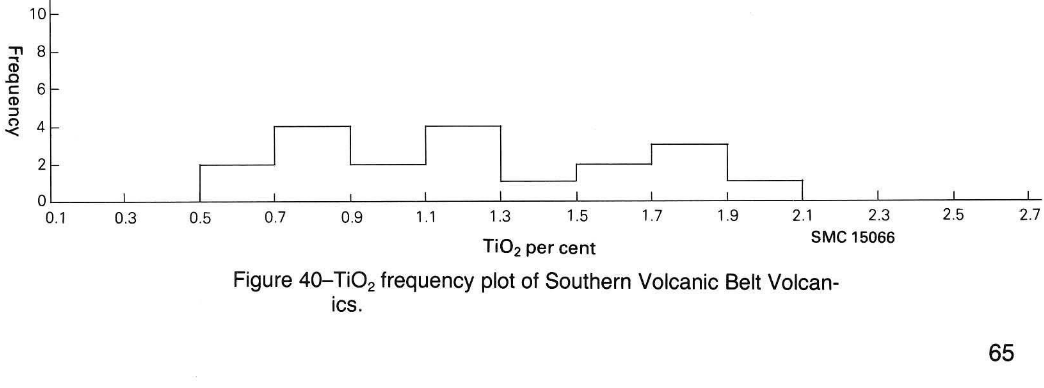


Figure 40–TiO_2 frequency plot of Southern Volcanic Belt Volcanics.

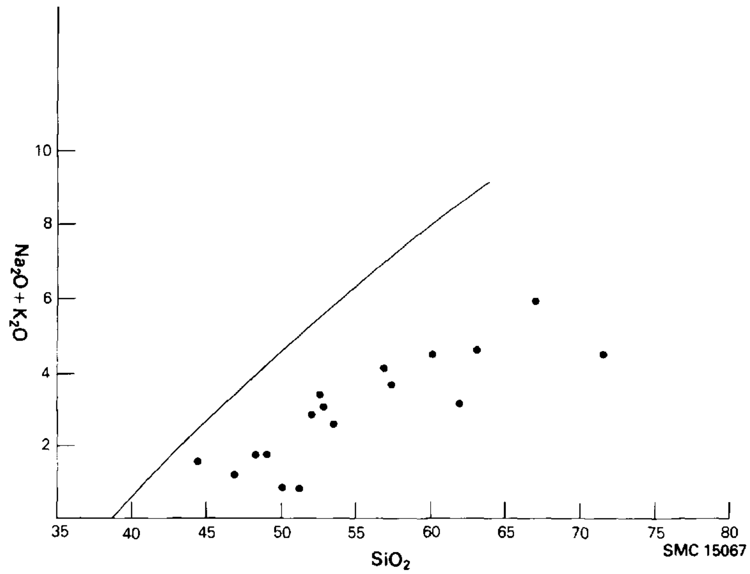


Figure 41–Na_2O + K_2O:SiO_2 plot of South Sturgeon Lake Volcanics.

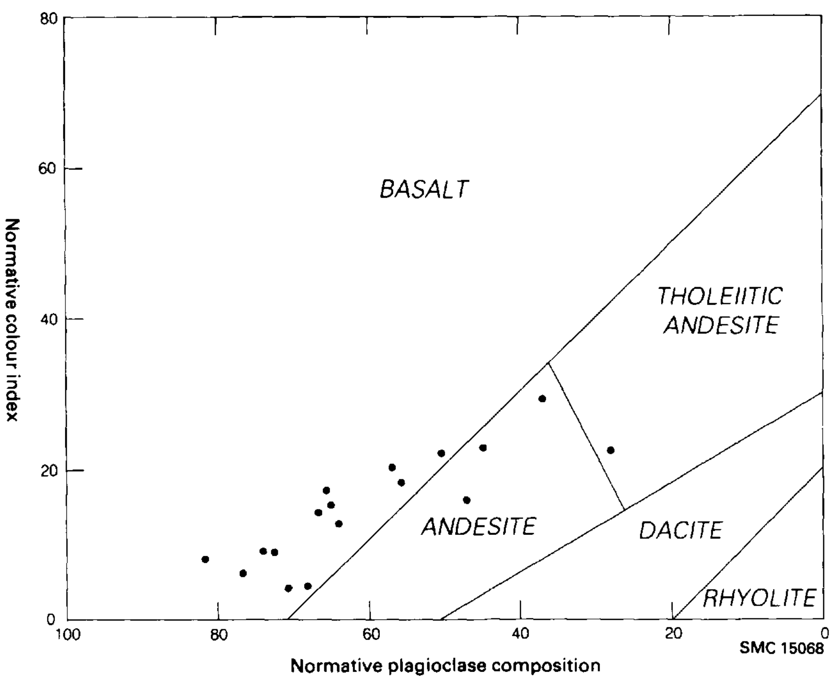


Figure 42–Normative colour index: normative plagioclase composition plot of South Sturgeon Lake Volcanics.

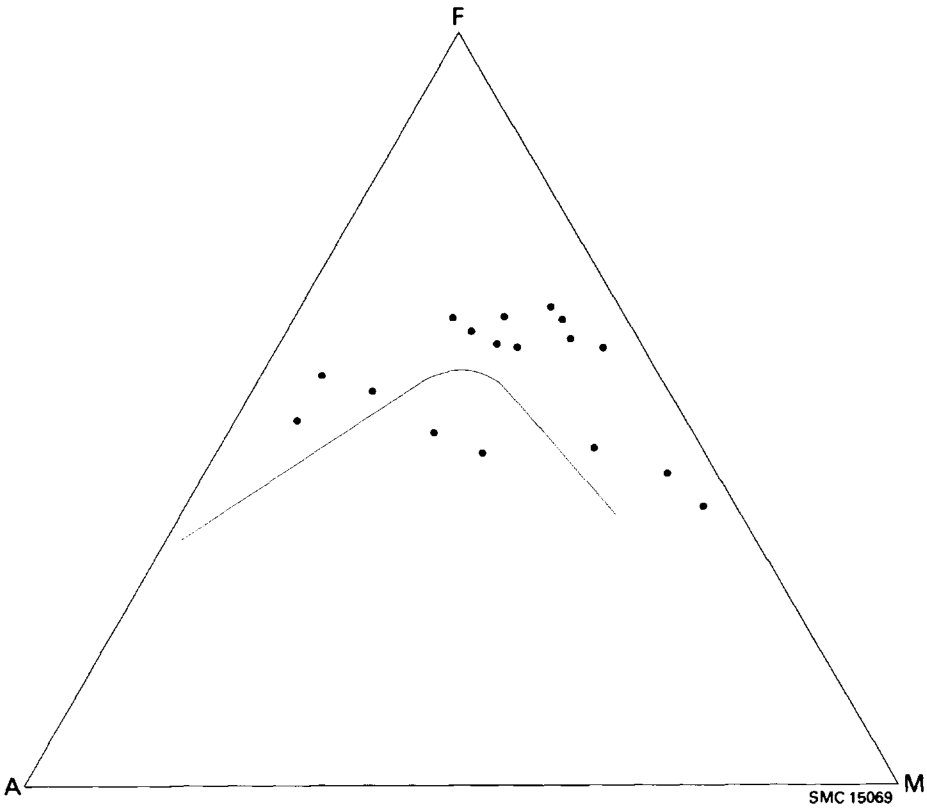


Figure 43–AFM plot of South Sturgeon Lake Volcanics.

The coarse clast size and the general lack of rounding of the clasts suggest that this major pyroclastic sequence was likely a proximal, near-vent deposit.

Several interflow pyroclastic beds are present in the Loggers Lake area. These beds are dominantly intermediate and are not commonly felsic in composition; they are composed of crystal ash to lapilli-tuff. The beds vary from 10 cm to 1 m in thickness, are sometimes graded, and locally infill interpillow interstices of underlying mafic flows indicating subaqueous deposition likely occurred. The total extent of these pyroclastics, and their source, is unknown because little outcrop is present either east or west of Loggers Lake.

Thin beds of intermediate tuff occur between tholeiitic flows of the lower section of the Neepawa Group. These beds appear to make their appearance near the change over from lower intermediate tholeiitic flows to upper high-iron high-titanium tholeiitic flows (*see* section on "Neepawa Group Volcanics-Chemistry"). Though their source is unknown, these rocks were deposited subaqueously as is indicated by their turbidite-like bedding features, grading, scouring, and ripple drift cross-lamination.

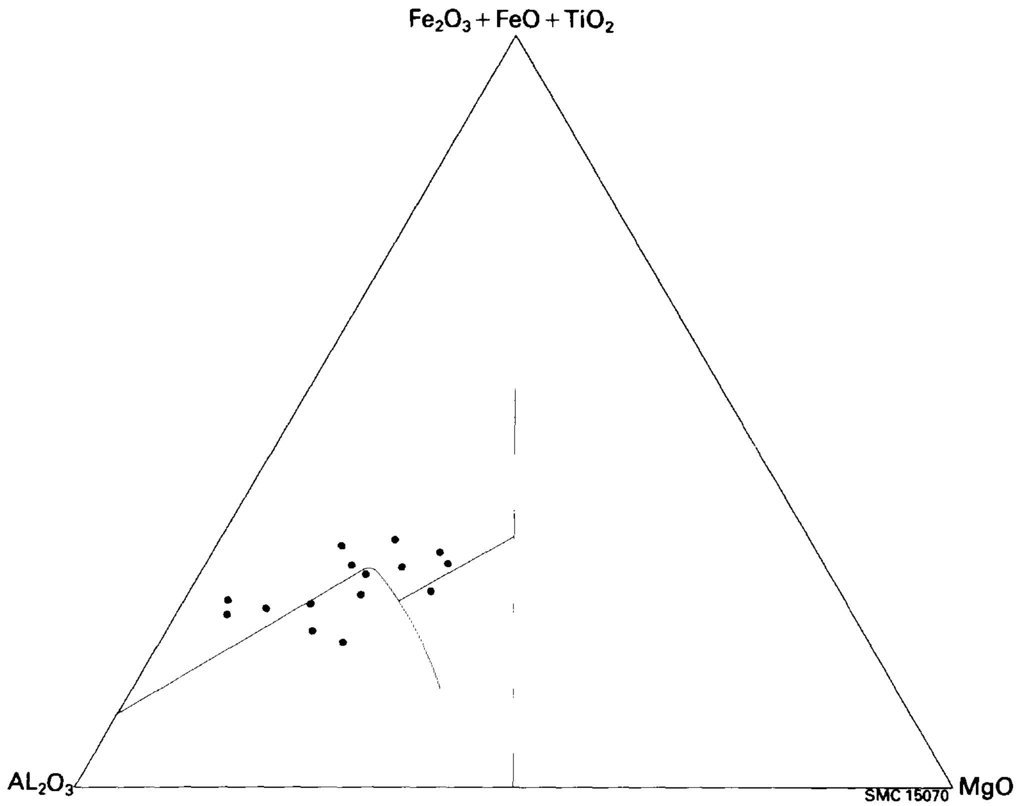


Figure 44–Cation plot of South Sturgeon Lake Volcanics.

An intrusive component, which is probably of subvolcanic origin, of the felsic to intermediate metavolcanics, consists of quartz and quartz-feldspar porphyry. Two bodies of this composition are exposed on Burnthut Island. These bodies were not examined during the present survey. These bodies apparently are concordant to the mafic metavolcanics in this area. These bodies locally have a fragmental autobreccia to crystal tuff appearance (Ian Sutherland, formerly geologist with Ontario Geological Survey, Toronto, personal communication, 1979).

The arkose and arkosic conglomerate facies of the Minnitaki Group, East Bay area, are similar texturally and compositionally to porphyry bodies in this area. These porphyry bodies likely represent the provenance area for these metasediments.

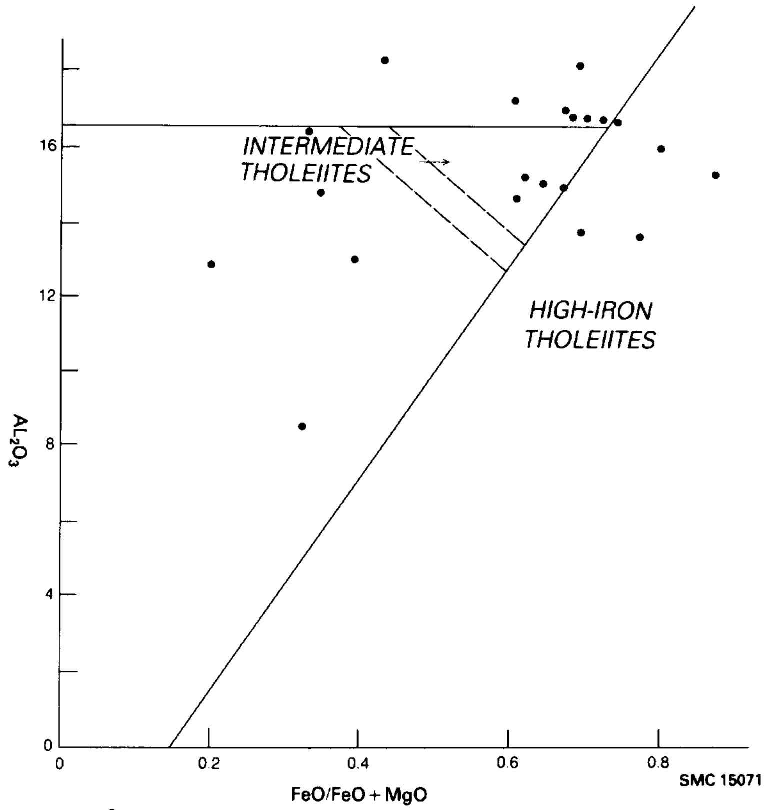


Figure 45–Al_2O_3:FeO (Total)/(FeO(Total) + MgO) plot of South Sturgeon Lake Volcanics.

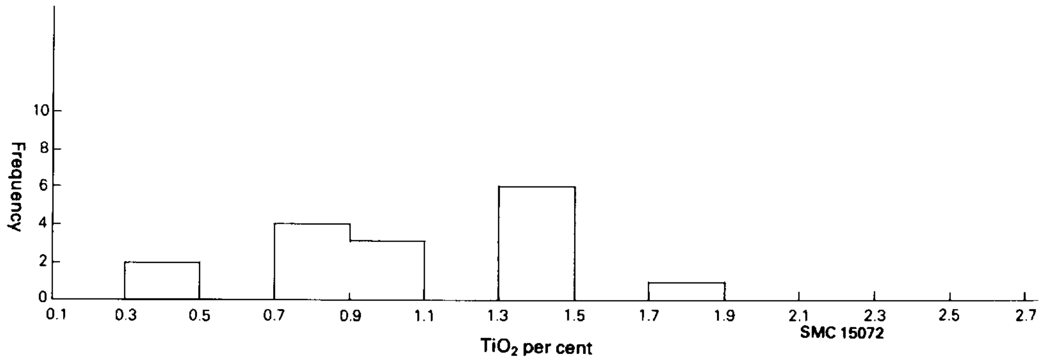


Figure 46–TiO_2 frequency plot of South Sturgeon Lake Volcanics.

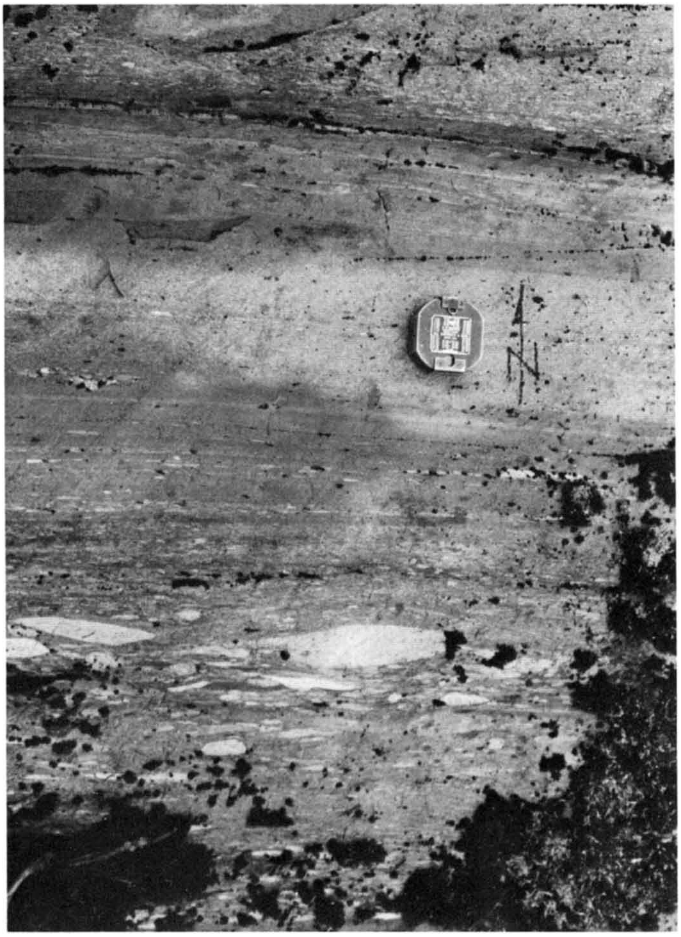


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Photo 2–Graded bed from Minnitaki Group situated on western shore of Southeast Bay showing gradation from conglomerate to sandstone.

METASEDIMENTS

Clastic Metasediments

Clastic metasediments in the map-area consist of: sandstones, including wackes, arkoses, and minor arenites; siltstones and mudstones; and conglomerates (Photo 2) containing quartz porphyry, granitic, volcanic, and sedimentary clasts.

Thin interflow beds of wacke-siltstone were observed throughout the area. Significant metasedimentary sequences occur, however, at the following localities: (1) on and south of Minnitaki Lake (Minnitaki Group *see* Walker and Pettijohn (1971)), (2) at Loggers Lake, (3) at Towers Lake, and (4) north of Smock Lake.

Minnitaki Group Metasediments

Metasediments on and south of Minnitaki Lake were first extensively mapped by Hurst (1932), Pettijohn (1936), and Horwood (1938). Johnston (1969, 1972) equated these metasediments, as had Pettijohn (1936) with the Abram Metasediments (Abram Group) situated north of the present map-area (Johnston 1972). Walker and Pettijohn (1971) carried out detailed mapping in the East Bay area to determine relationships, provenance, environment, and mode of deposition of these metasediments. These authors were the first investigators to assign these metasediments a group name, specifically the Minnitaki Group, on the basis of the geographic location of these rocks. Turner and Walker (1973) stated that the Abram and Minnitaki Groups were not correlative sequences.

Detailed descriptions of the various lithologies within the map-area can be obtained from these reports.

Walker and Pettijohn (1971) interpreted the metasediments of East Bay to have been deposited by turbidity currents; proximal in the case of the arkoses and conglomerates of East Bay, and more distal for the wackes exposed westward along Minnitaki Lake. Pelitic metasediments (mudstones) were interpreted to represent background basin sediment.

Walker and Pettijohn (1971) recognized two conglomerate facies in the East Bay area. The first is a basal quartz-porphyry clast conglomerate facies, which, as well as the interbedded arkose, are interpreted to have formed by the erosion of subjacent quartz porphyry intrusions situated east of East Bay. Horwood (1937) and Page (1979a, 1979b) mapped quartz porphyry in this area. Even though no contacts were seen, the distribution of small irregular masses of porphyry surrounded by conglomerate is compatible with *in-situ* erosion of the porphyry and deposition of the quartz porphyry detritus upon these masses possibly as regoliths. Redeposition of this detritus produced the interbedded arkoses and quartz-porphyry conglomerates situated to the west.

The second conglomerate facies, apparently situated at a higher stratigraphic level than the first facies is characterized by a decrease in the amounts of quartz porphyry clasts and an increase in the number of granitoid and volcanic clasts (Walker and Pettijohn 1971).

The presence of the granitoid clasts and the substantial quartz content of the more distal wackes, led Walker and Pettijohn (1971) to interpret the existence of a granitic provenance for these units. Likewise, Turner and Walker (1973) subsequently suggested a granitic provenance for the Abram Group which is exposed north of the map-area.

The provenance for clastic metasediments within volcano-sedimentary belts has been a major point of debate for a long time. Walker and Pettijohn

(1971) have pointed out that their concept of a granitic provenance for the clastic metasediments of the Minnitaki Group is the opposite of a strictly volcanic (and subvolcanic) provenance proposed for other areas by such authors as Bass (1961) and Ayres (1969), but is similar to the concept of Donaldson and Jackson (1965).

These opinions are a reflection of contrasting regional tectonics rather than varying provenances. If the provenance was strictly volcanic, the sediments could have been derived by simple degradation of a volcanic pile. The invoking of a granitic provenance implies that emplacement of granitic rock, its elevation and unroofing to form subjacent highlands, predated erosion and deposition of the sediments.

There are data which support both views.

Relatively new geochronologic data (Davis *et al.* 1980) suggest that granite emplacement was partly synchronous with volcanism in adjacent volcano-sedimentary belts. The granites would still have had to have been uplifted and unroofed, however, to act as a source area for the metasediments.

Walker and Pettijohn (1971) pointed out that the upper conglomerate facies contains granitoid, specifically leucotrondhjemite clasts. Subvolcanic intrusions should not be excluded as the source of these clasts, because all subvolcanic intrusions are not porphyries, but rather, show a wide variation in composition and texture. No adjacent granitoid plutons having a similar composition and texture as the clasts are known. This situation is also evident for the Abram Group which is situated north of the report-area. There, coarse-grained porphyritic (potassic feldspar) granodiorite clasts are found in the conglomerates (Johnston 1972; Turner and Walker 1973; Trowell *et al.*1977). This implies that these clasts were redeposited from an unknown source.

The problem relating to the so-called quartz fraction needs resolution. Felsic and intermediate metavolcanics contain appreciable quartz. The quartz is commonly finer than the size fraction of the quartz in the wackes. Subvolcanic porphyries do contain appreciable medium-grained to coarse-grained quartz grains. These are generally small, isolated masses but because such masses have been partly eroded to provide clasts and quartz grains for the quartz porphyry-clast conglomerate and arkose respectively, they were larger than presently observed.

The chemical metasediments, specifically the ironstones and chert (*see* section on "Chemical Metasediments") present a problem if a strictly granitic provenance is to be considered. Shegelski (1978) described similar chemical metasediments in the Savant Lake area, and interpreted the ironstone to represent background sedimentation where it often forms in place, or above, the upper pelitic interval of a turbidite unit. Shegelski (1978), however, ascribed both the ironstones and clastic sandstones to a volcanic provenance.

The author would suggest that volcanism, sedimentation, and granitic emplacement occurred concomitantly; the sediments drew on all available sources of provenance.

The clastic metasediments of Loggers Lake are dominantly wacke-siltstones with minor mudstones. These rocks are thin-bedded and occur in thicknesses ranging from a few cm up to 20 m between mafic, generally pillowed, flows.

A thin sequence of highly fractured and sheared, buff-weathering wacke-siltstones is exposed on the northern shore of Towers Lake.

On the highway north of and in the area east of Smock Lake, thinly bedded to finely laminated siltstones with minor thin wacke beds occur between mafic metavolcanic flows. The rocks that are situated within the Smock Lake-English River Brittle Deformation Zone (*see* section on "Structural Geology") are highly deformed and mylonitized.

Other thin beds of wacke-siltstone and mudstone are reported in diamond-drill hole logs (*see* Maps 2458 and 2477). These units are generally sulphidic and locally also contain graphite and uncommonly magnetite.

Chemical Metasediments

A major zone of clastic metasediments containing intercalated chert and hematite-quartz-magnetite ironstone extends from the western boundary of the map-area eastward through Twinflower Lake and Twin Bay to the western shore of Southeast Bay. Johnston (1969) has described the western extension of this zone beyond the map-area.

This ferruginous zone is located near to or in the far western part of the map-area. Apparently, this zone is at the southern contact of the Minnitaki Group with the Southern Volcanic Belt. The best exposures of this zone are on the islands and shorelines of Twinflower Lake and Southeast Bay. To the west, its extent is interpreted from geophysical (ground magnetic) and diamond-drill hole data (*see* account on "Minnitaki Iron Range Limited" *in* section on "List of Properties").

The ironstone units comprise about 10 to 20 percent of the several zones observed. The remainder of the zones predominantly consist of wacke, mudstone, chert, and rarely conglomerate. Tight folding is evident, and it is possible only one or two horizons exist that have been repeated and locally thickened by the folding.

As mentioned previously, Turner and Walker (1973) stated that the ironstone often appears to take the place of the upper pelitic interval of a wacke turbidite unit. This is similar to the deposition process envisaged by Shegelski (1978) in the Savant Lake area, where iron complexes represent the background sedimentation. The source of the iron has been interpreted as volcanic (Shegelski 1978).

The iron minerals are predominantly magnetite and minor amounts of hematite are present. Pyrite occurs in amounts ranging from 1 to about 10 percent. An apparent oolitic ironstone unit (personal communication, Ian Sutherland, formerly geologist with Ontario Geological Survey, 1979) occurs near the quartz porphyry body at the entrance to Pickerel Arm (west of the map-area). This represents the first reported occurrence of a shallow water sedimentary facies in the area, but it may be associated with the volcanism, rather than with the Minnitaki Group.

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Photo 3–High-weathering knobby amphibole crystals (pseudomorphic after pyroxene) from Pen Creek Intrusion situated on the English River.

ULTRAMAFIC AND MAFIC INTRUSIVE ROCKS

Ultramafic Intrusive Rocks

Pen Creek Intrusion

An outcrop of ultramafic rock forms one set of rapids on the English River east of its junction with Pen Creek. A pronounced aeromagnetic "high" on the Yonde sheet (Ontario Department of Mines-Geological Survey of Canada 1961b), includes within its boundaries, this outcrop. This "high" is interpreted to be due to a covered ultramafic intrusion, herein called the Pen Creek Intrusion.

The outcrop itself consists of a knobby weathering metapyroxenite containing one observed gabbroic xenolith. It is cut by leucocratic quartz monzonite dikes.

High-weathering hornblende, composing 15 to 20 percent of the outcrop, occurs in 1 cm to 5 cm equant grains which impart the characteristic knobby appearance (Photo 3).

Examination of thin sections reveals that the hornblende is pseudomorphic after pyroxene as indicated by its habit and relict cores of augite. Augite forms anhedral to subhedral, equant to elongate grains, as much as 1 mm long, and comprises 50 to 55 percent of the groundmass. Biotite forms 1 mm long subhedral grains, and occurs both in 1 cm bladed aggregates pseudomorphic after individual hornblende grains and in individual grains set in the augite-rich groundmass. Chlorite occurs as a marginal alteration/replacement of the biotite. Accessories include 5 to 10 percent rounded epidote grains, 2 percent isolated plagioclase grains overgrown by augite, and epidote, minor magnetite, and trace amounts of talc. The lack of appreciable magnetite indicates that the covered parts of this intrusion are of different composition, or contain concentrations of magnetic minerals to account for the aeromagnetic response.

A chemical analysis of a sample from this outcrop (Table 10, sample 78-5433) indicates high MgO and Cr, and low TiO_2 contents. This lends support to this outcrop having an ultramafic affinity.

Normatively, this sample is characterized by about 25 percent undersaturated minerals. High K_2O and Ba contents, uncharacteristic for ultramafic rocks, are probably incorporated in the biotite.

As discussed under the heading "Smock Lake Pluton" (*see* section on "Felsic to Intermediate Intrusions, and Plutons") the Pen Creek Intrusion could be a large xenolith or a cumulate ultramafic phase. The undersaturated normative mineralogy, the presence of substantial biotite, some of which appears to be a primary crystallizing phase, and the relatively high SiO_2 and Al_2O_3 contents lends some credence to the second hypothesis.

Way Lake Intrusion

Serpentinized peridotite has intruded mafic metavolcanics; this is visible in an outcrop west of Way Lake. Aeromagnetic data on Map 1137G (Ontario Department of Mines-Geological Survey of Canada 1961b) indicate the presence of a small, predominantly covered, intrusion of high magnetic relief, herein called the Way Lake Intrusion. This intrusion is likely to be similar in composition to the exposed outcrop, but perhaps also includes some gabbro.

Recorded in diamond-drill hole logs from this area (*see* Map 2477, back pocket) is the presence of serpentinized peridotite containing visible olivine, talc, and magnetite.

A thin section from a hand specimen collected from this outcrop is composed of; approximately 60 to 65 percent antigorite after olivine, 20 to 25 percent clinoenstatite in ragged eguidimensional grains with marginal alteration to antigorite, 3 to 5 percent enstatite, 3 to 5 percent tremolite pseudomorphic after pyroxene, and 1 to 3 percent magnetite and minor talc.

A chemical analysis of a sample from this outcrop is given in Table 10, Laboratory sample number 78-5434. The high MgO, Cr, and Ni contents, and the low TiO_2 contents confirm an ultramafic composition for the outcrop.

TABLE 10 | CHEMICAL ANALYSES OF MAFIC AND ULTRAMAFIC ROCKS, FLYING LOON LAKE AREA.

Sample Number (Laboratory)	78-5433	78-5434	77-2708
Sample Number (Field)	78-TJB-35	78-TJB-157	77T229
MAJOR OXIDES IN WEIGHT PERCENT			
SiO_2	44.4	39.3	50.3
Al_2O_3	10.9	5.65	17.9
Fe_2O_3	9.18	15.0	2.75
FeO	N.D.	N.D.	7.25
MgO	15.8	27.1	6.16
CaO	12.3	4.35	9.43
Na_2O	0.72	0.00	1.97
K_2O	4.15	0.01	0.21
TiO_2	0.96	0.24	0.70
P_2O_5	0.28	0.04	0.11
S	$<$0.01	0.01	0.10
MnO	0.13	0.22	0.16
CO_2	0.14	0.49	0.12
H_2O+	N.A.	N.A.	2.04
H_2O-	N.A.	N.A.	0.34
TRACE ELEMENTS IN PARTS PER MILLION (PPM)			
Ba	1500	50	80
Co	55	100	40
Cr	850	2090	230
Cu	35	20	100
Li	20	4	10
Ni	270	810	120
Pb	40	15	20
Zn	80	75	75

ND — Not determined (Total iron expressed as Fe_2O_3).
NA — Not analyzed for.
Chemical analyses performed by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Mafic Intrusive Rocks

Pike Lake Intrusion

The Pike Lake Intrusion (Trowell 1982) is a sub-elliptical body having an interpreted extent from Moss Lake to the southwest end of Sturgeon Lake (*see* Map 2458). The construction of Highway 642 exposed new outcrops of this body, and allows a reinterpretation to be made of the areal extent and petrogenesis of this intrusion.

The Pike Lake Pluton Intrusion is composed of several phases that are noticeably texturally distinct, but that also exhibit compositional differences. Thirteen textural/compositional phases, including intrusion breccias, were tentatively identified along Highway 642. Although cross-cutting relationships between several of the phases were observed, the inter-relationships of all phases were not resolved. Several phases are likely to be textural variations of each other, rather than representative of discrete pulses of intrusion. The distribution of phases, as observed by the authors on Highway 642, is illustrated in Figure 47.

The study of hand specimens and thin sections reveals that the composition varies from an ultramafic (hornblende pyroxenite) phase of cumulate origin, to the dominant gabbro phase, and is variable locally to quartz diorite and minor granophyric pegmatite representative of a late felsic differentiate phase.

Petrographically, the phases are composed predominantly of amphibole (variety hornblende) and plagioclase. Hornblende grains having a pyroxene habit are uncommon, but in general, the hornblende appears to have formed by re-crystallization during regional greenschist metamorphism. No relict pyroxene cores were observed in thin section.

In the equigranular phases, the hornblende occurs in a subophitic to ophitic relationship with plagioclase. In the plagioclase-phyric phases, the texture is intergranular, and in the granophyric pegmatite phase, hornblende occurs as large, up to 15 by 10 cm in length, euhedral laths. Locally, the melanocratic gabbro phases are amphibole- or amphibole- and plagioclase-phyric.

Chlorite in subhedral felted patches locally replaces hornblende.

Plagioclase is invariably altered to clinozoisite, but relict cores do give compositions as high as An_{60}. Normal to oscillatory zoning can still be observed in thin sections, despite the alteration.

Less than 5 percent quartz occurs as intercrystal granular aggregates within the melanocratic gabbros and gabbros. In the leucocratic gabbros and quartz diorite, quartz occurs as subhedral grains commonly having a characteristic blue hue.

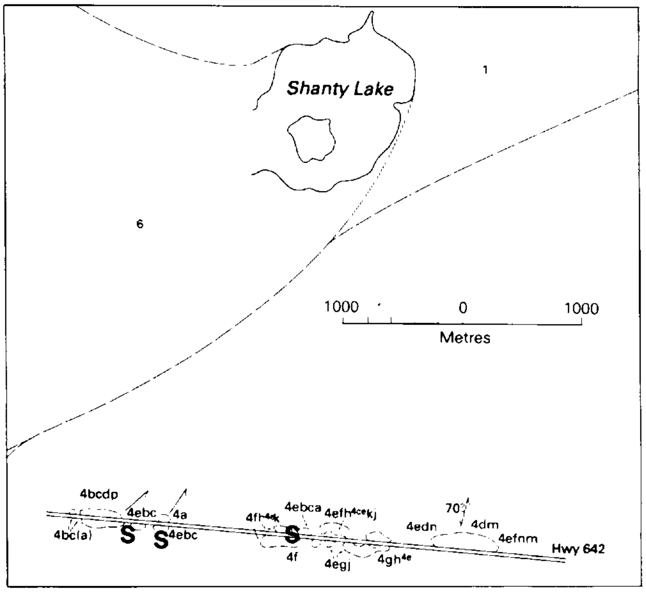
Biotite appears to be confined to the leucocratic gabbro and quartz diorite phases. It is present in amounts up to 5 percent.

Accessory and/or alteration minerals include sphene, epidote, clinozoisite, minor sericite, and uncommon carbonate.

Subhedral, fine- to coarse-grained titaniferous magnetite averages 2 to 4 percent of the rock, but locally constitutes up to 8 percent of the rock. Sulphide minerals present locally include pyrite, minor pyrrhotite, trace chalcopyrite, and uncommon sphalerite.

Pale green diopside crystals up to 15 cm in length were found in a boulder near an outcrop of gabbro along Highway 642. These crystals are in a quartz-carbonate vein cutting leucocratic gabbro similar to the nearby outcrops. Even though the crystals are many faceted, they are not likely to be of gem quality, but could be of local collecting interest if more exist and their source could be found.

The rocks of this pluton are massive and are rarely foliated. Compositional banding reflects the development of cumulate layering. This banding com-



6	6	Granite rocks; unsubdivided.
4	4	Gabbro; unsubdivided.
	4a	Layered gabbro.
	4b	Clotty gabbro.
	4c	Melanocratic gabbro.
	4d	Knobby-weathering gabbro.
	4e	Medium-grained equigranular gabbro.
	4f	Leucocratic gabbro.
	4g	Quartz gabbro, quartz diorite.
	4h4	Xenolithic gabbro (superscript denotes xenolithic phase).
	4j	Intrusion breccia–metasedimentary xenoliths.
	4k	Intrusion breccia–mafic metavolcanic xenoliths.
	4m	Feldspar porphyritic gabbro dikes.
	4n	Granophyric gabbro, pegmatite.
	4p	Fine-grained basaltic dikes.
1	1	Mafic metavolcanics; unsubdivided.
		Geological boundary.
		Cumulate layering.
		Plagioclase alignment.
S		Sulphide mineralization.

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Figure 47–Detailed geology of part of Pike Lake Pluton.

prises alternating mafic-rich (100 percent hornblende; after pyroxene?) and feldspar-rich (70 percent plagioclase, 30 percent hornblende) layers. Layers range from 5 to 10 cm in thickness, but some are 0.3 to 1.0 m thick. Two zones exhibiting straight, parallel, regular banding were observed. Elsewhere, discontinuous banding and mafic streaking may also represent incompletely formed and disrupted cumulate layering. The disruption occurred before lithification in a "crystal-mush" state. A systematic joint pattern is a characteristic feature of this pluton. Extensive quartz veining occurs along narrow shear zones that cut the intrusion.

As mentioned previously, it was not possible to decipher the timing of the various textural and compositional phases in more than a general way. This pluton does, however, appear to span two periods of mafic volcanism. It intrudes pre-existing mafic metavolcanics and metasediments as is indicated by local zones of intrusion breccia consisting of xenoliths of these lithologies set in a matrix of gabbro. It is also cut by fine-grained mafic metavolcanic "basaltic" dikes that may be intrusive equivalents of, or feeders to the mafic metavolcanics situated north of this pluton.

A change is observed along Highway 642 (Figure 47), from west to east. To the west, predominantly, knobby-weathering and equigranular, locally clotty and phase layered, gabbro and melanocratic gabbro change eastward to predominantly medium- to coarse-grained gabbro with zones of coarse-grained leucocratic gabbro, feldspar-phyric gabbro, and minor quartz diorite and granophyric pegmatite. The change is not transitional, but rather reflects, dominance of particular phases, and may only be a reflection of available outcroppings.

The melanocratic clotty gabbro and banded gabbro phases appear to be cut by the medium- to coarse-grained knobby and equigranular gabbros. Later phases include leucocratic gabbro locally containing melanocratic gabbro inclusions, quartz gabbro, and diorite, and pegmatite. Gabbroic dikes that cut these phases are of more than one age. The matrix of the intrusion breccias is medium-grained equigranular gabbro variable to quartz gabbro-diorite. The latest intrusions are the aforementioned fine-grained "basaltic" mafic volcanic dikes.

One sample from this body, a medium-grained equigranular gabbro phase, was analyzed (Table 10, Sample 77-2708). Though not representative of the body as a whole, this sample has a calc-alkalic affinity. Most of the overlying mafic flow and intermediate and fragmental sequence in this area (*see* section on "Jarvis Lake-Watcomb Lake Volcanics") also have a calc-alkalic affinity.

The author has interpreted the Pike Lake Pluton to be a subvolcanic intrusion emplaced within, but near the top of a lower series of dominantly tholeiitic mafic metavolcanics. The intrusion represents a source for, and perhaps mimicks the fractionation trends of the overlying mixed tholeiitic to calc-alkalic sequence of volcanics (Trowell 1983).

Diamond-drill hole data (*see* Map 2458, back pocket) suggest that north of Pike Lake there may be some included septa of mafic metavolcanics and intermediate tuffs within this body.

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

Batholithic Complexes

Basket Lake Batholith and Adjacent Granitic Rocks

Only a few scattered outcrops of the granitic mass to the south were examined during the present survey. Parts of it situated west and south of the map-area were mapped by Hurst (1932), Johnston (1969), and Sage *et al.* (1974). Szewcyzk and West (1976) conducted a gravity survey over a large area including the southern part of the map-area. The granitic outcrops in the western part of the map-area would be included in their Basket Lake Batholith, but the outcrops as far east as Press Lake would fall in the "migmatite and gneiss" grouping of Szewcyzk and West (1976).

In the area west of Loggers Lake, the predominant phase is a medium- to coarse-grained, equigranular to slightly porphyritic (potassic feldspar) biotite granodiorite. The granodiorite is weakly to strongly foliated. It contains xenoliths of mafic metavolcanic amphibolite along its margin with the volcano-sedimentary belt. Fine-grained leucocratic quartz monzonite dikes cut the granodiorite. These rocks are included within the Basket Lake Batholith (*see* Figure 2) after Szewcyzk and West (1976).

South and east of Loggers Lake, the outcrops mapped indicate the presence of a hybrid zone developed between the volcano-sedimentary belt proper and the bounding granitic rocks (Figure 2). The contact is gradational rather than sharp, and has been interpreted to lie between this hybrid zone to the north and a clotty hornblende quartz diorite-granodiorite phase to the south.

Within the volcano-sedimentary belt, irregular pods of gabbro, diorite, and leucocratic diorite variable to quartz diorite, discordantly intrude the amphibolite-rank mafic metavolcanics. The leucocratic diorite and quartz diorite phases are the latest intrusive phases. The gabbro and diorite could be; synvolcanic intrusions in the metavolcanic sequence, recrystallized amphibolitic mafic metavolcanic flows, or phases of the later granitic intrusive event.

The gabbro and diorite contain up to 75 and 50 percent, 2 to 4 mm amphibole grains respectively; the remainder consists of plagioclase, quartz, and minor accessories. These rocks are generally medium grained, equigranular, and massive. The leucocratic diorites are equigranular hypidiomorphic, and contain approximately; 20 percent amphibole, 70 percent plagioclase, and 5 to 10 percent quartz plus accessory minerals including magnetite, sphene, apatite and uncommonly, sulphide minerals. As the quartz content increases, diorite becomes quartz diorite. Two amphiboles were observed in some of these units: dark green tremolite-actinolite, and a black hornblende.

Agmatite consisting of biotite-hornblende (quartz) diorite-granodiorite containing amphibolite xenoliths marks the boundary of the granitic terrain.

The presence of irregular dioritic patches locally observed within amphibolitic mafic metavolcanics suggests these patches might have developed by a possible *in-situ* anatexis process. The larger intrusive masses of gabbro and diorite possibly formed by a similar process, but at a deeper level than is presently exposed. Partial anatexis may also have generated the biotite-hornblende (quartz) diorite-granodiorite phase.

The hybrid zone appears to pinch out against the Basket Lake Batholith west of Loggers Lake.

Lake of Bays Batholith

Only a few marginal outcrops of the Lake of Bays Batholith (Szewcyzk and West 1976) were mapped during the present survey. Page (1978b) mapped a biotite granodiorite and quartz monzonite phase in the area south of Zarn Lake and assigned them to the Zarn Lake Pluton.

The predominant phase mapped, during the present survey, is pink to white, slightly leucocratic, weakly foliated biotite trondhjemite; other phases are present.

Several phases were recognized along the railway line west from and in the area south of Zarn Lake and east to Discovery Lake. The predominant phase is white to grey, locally slightly pink, medium- to slightly coarse-grained, equigranular to porphyritic (potassic feldspar) trondhjemite-granodiorite. The percentage of mafic minerals varies from 10 to 20 percent, and mafic minerals comprise mainly biotite and biotite + epidote + locally minor hornblende. Aplitic and pink granodiorite dikes cut the predominant phase. Locally, the predominant phase contains quartz diorite and mafic metavolcanic xenoliths. This phase is foliated, lineated, and locally sheared.

In the Bawden Lake area (see Map 2477), occur equigranular to slightly porphyritic (hornblende and potassic feldspar) hornblende granodiorite and biotite trondhjemite-granodiorite. An aphanitic biotite trondhjemite phase at the contact with the mafic metavolcanic amphibolites may be a chilled border phase of the batholith.

South of Upper Pepperbell Lake, (*see* Map 2458, back pocket) a coarse-grained biotite-hornblende granodiorite phase, containing mafic clots, is cut by feldspathic and pegmatoid veins and leucotrondhjemite dikes. It has been deformed by plastic flow folding.

On Prospect Lake, a biotite quartz-feldspar porphyritic trondhjemite and an altered diorite phase occur in a narrow zone between the country rocks and the biotite trondhjemite phase of the batholith.

On the southern shore of Lake of Bays, pink, leucocratic, quartz monzonite phases intrude the major trondhjemite phase.

In the eastern part of the area, foliated locally porphyritic biotite trondhjemite to granodiorite is the marginal batholithic phase.

Felsic to Intermediate Plutons and Intrusions

Smock Lake Pluton

The Smock Lake Pluton has been interpreted to cover a wide area between Smock and Snag Lake to the north, to just south of the English River to the south. As can be seen on the map-face; (*see* Map 2477, back pocket) this coverage is highly speculative due to a thick cover of extensive glacial drift. Several compositional and textural phases were recognized, despite the paucity of outcrop. As well, some evidence exists to suggest that this intrusion is zoned from a mafic (perhaps even ultramafic) margin to the south and west, to a leucocratic interior to the north.

The major observed phase consists of a pink medium-grained locally porphyritic (potassic feldspar), massive biotite granodiorite which varies with increasing potassic feldspar content to quartz monzonite. The potassic feldspar phenocrysts are subhedral to euhedral grains that vary in size from 5 mm to 1.5 cm. Biotite comprises 5 to 10 percent of the rock. North of Smock Lake and south of the English River, this phase contains mafic volcanic xenoliths along the margin of this intrusion.

As discussed previously, the Pen Creek Intrusion could be a large ultramafic xenolith or an ultramafic cumulate phase of the Smock Lake Pluton. The second hypothesis is somewhat supported by the one chemical analysis from the Pen Creek Intrusion and by similarities between the Smock Lake Pluton and Bell Lake Pluton as is mentioned in the following account.

On the shore of and east of the lake west of Smock Lake, the progression of rock types lends credence to the possibility of a compositional zonation of the Smock Lake Pluton.

A gabbro outcrop on the shore of this lake consists of 4 mm to 2 cm equant amphibole phenocrysts pseudomorphic after pyroxene. Texturally similar to the ultramafic outcrop on the English River (Pen Creek Intrusion), the gabbro could represent a mafic border phase of the Smock Lake Pluton. It could also be just a discrete intravolcanic gabbroic intrusion. The gabbro contains 1 to 2 percent magnetite, minor pyrite, and trace chalcopyrite.

To the east, an outcrop of augite-hornblende monzonite contains 50 percent calcic (An_{60}) plagioclase, 35 percent microcline, 10 percent augite, and less than 5 percent quartz. Accessories include sphene, ilmenite, and rutile. Texturally, the monzonite is medium grained, and hypidiomorphic granular. It is weakly foliated. Further to the east, is an outcrop of hornblende-biotite quartz monzonite. It consists of 40 to 50 percent plagioclase (An_{15}-An_{25}), 30 to 35 percent microcline, 10 percent quartz, and 10 percent total mafics. The texture is medium-grained, hypidiomorphic granular, and the rock is massive. Quartz increases in abundance and the texture becomes porphyritic to the east. Further to the east and north, the porphyritic biotite granodiorite phase is found. These phases comprise individual outcrops and a transition was not directly observed, but rather is inferred.

South and west of Snag Lake and just south of the Canadian National railway line, the dominant porphyritic biotite granodiorite phase appears to cut foliated biotite trondhjemite (chilled border phase). Both these rocks are cut by an equigranular leucocratic granodiorite to quartz monzonite dike.

Granodiorite dikes, similar in composition to the main phase of the Smock Lake Pluton, intrude mafic metavolcanics marginal to its interpreted border.

Although little direct evidence exists to confirm that the Smock Lake Pluton is compositionally zoned, the spatial distribution of compositional phases is similar to those of the Bell Lake Pluton (Hoad 1970; Trowell 1974), a zoned intrusion situated east of the current report-area. The similar distribution of phases in both bodies includes an incomplete ultramafic marginal phase, or for the marginal phase of the Smock Lake Pluton, an outer incomplete zone of mesotype (augite, hornblende, biotite) monzonite and an inner zone of leucocratic (quartz) monzonite, which is quite small in areal extent in the case of the Bell Lake Pluton (Trowell 1974).

Wyatt Lake Pluton

The pluton, herein named, the Wyatt Lake Pluton, is a sub-elliptical stock that intrudes mafic metavolcanics on and west of Wyatt Lake.

The rocks of this pluton weather grey to buff to slightly pink, and are generally grey to slightly pink on the fresh surface. These rocks are medium to coarse grained, equigranular to slightly quartz and potassic feldspar porphyritic, and are massive to weakly foliated. The mineralogical composition of this pluton, as determined in stained hand specimens and in thin sections consists of feldspar (60 percent) + quartz (10 to 20 percent) + biotite (5 to 15 percent) + sphene (5 percent) + epidote (5 to 10 percent) ± hornblende (10 percent) ± chlorite (5 percent) + opaques (1 to 3 percent). In the eastern part of the pluton, the mafic minerals have a clotty appearance. Here, also, occur minor pegmatoid patches.

Contact relationships with the mafic metavolcanics were observed on Highway 642. Here, the contact is transitional. The contact passes from mafic metavolcanics through an agmatite zone consisting of mafic metavolcanic xenoliths set in a trondhjemite-granodiorite matrix to massive hornblende-biotite trondhjemite-granodiorite containing minor scattered mafic metavolcanic xenoliths. Near the contact, a banding within the granitoid phase appears to be of cataclastic origin developed subsequently to emplacement of the pluton.

Trondhjemite-granodiorite sills and dikes intrude the mafic metavolcanics in a 700 m wide zone around this intrusion. On the north side of this pluton, feldspar and quartz + epidote + feldspar pods, likely developed due to a segregation process, have formed within this zone of mafic metavolcanics. The pods present within mafic metavolcanics that extend west of this zone, may not have formed as a direct result of emplacement of this pluton. The westward extension of this zone could, however, have formed due to the combined effects of the Wyatt Lake and Smock Lake Plutons.

Also, within this 700 m wide zone, the mafic metavolcanics have been metamorphosed to the albite-epidote hornfels facies rank which is superimposed on the regional greenschist facies rank.

This body is marked by a low magnetic response with respect to the surrounding mafic metavolcanics.

Northeast Bay Pluton

A pluton, which is composed of a core of biotite trondhjemite and an outer segmented rim of diorite-gabbro, occurs in the central part of Northeast Bay. Johnston (1972) has previously described this pluton. The reader is referred to his report for a complete description. This pluton is possibly of subvolcanic to late synvolcanic origin having been emplaced within its own volcanic pile (the Neepawa Group Volcanics) and marking an ancient volcanic centre (Johnston 1972; Page, Geologist with Ontario Geological Survey, personal communication, 1978).

Shanty Lake Pluton

The Shanty Lake Pluton has been described previously (Trowell 1970, 1982). Except for mapping new outcrops of biotite trondhjemite along Highway 642, no further study of this pluton was carried out. The author is still not sure about the intrusive relationships of this body. While it appears to intrude lower mafic metavolcanics, it also could have been a subvolcanic feeder for upper calc-alkalic flows and fragmental sequences such as the Jarvis Lake-Watcomb Lake Volcanics. Or it could be a later intrusion emplaced as an offshoot of the bounding granitic rocks.

Towers Lake Intrusions

Two small lensoid bodies or sills of trondhjemite are exposed along the northern shores of Towers Lake and an unnamed lake 1200 m northeast of Towers Lake.

The intrusion on Towers Lake consists of medium- to slightly coarse-grained, grey, locally pink to red, highly fractured trondhjemite.

The intrusion on the unnamed lake consists of white to grey trondhjemite that varies from leucocratic trondhjemite at its western exposure to trondhjemite containing 10 to 15 percent biotite and hornblende at its eastern exposure. It locally contains mafic metavolcanic xenoliths. The adjacent mafic metavolcanics are cut by trondhjemite dikes and contain feldspathic patches.

Both these intrusions are similar compositionally and texturally to the border trondhjemite phase of the Lake of Bays Batholith. These intrusions might be connected at depth to this batholith.

Cenozoic

QUATERNARY

Pleistocene

The map-area is covered by glacial, glaciofluvial, and glaciolacustrine deposits. Pleistocene and Recent features are not shown on the maps. Glacial deposits consist of till that covers almost the entire area. Estimates of the till's thickness can be ascertained from the overburden thickness recorded in the diamond-drill hole data (*see* Map 2477, back pocket). A major moraine, the Sioux Lookout Moraine (Zoltai 1965a) trends southeast through the central part of the report-area. It is closely followed by the road-bed of the Sioux Lookout - Thunder Bay Canadian National Railway line. Minor washboard moraines that developed perpendicular to the ice flow occur east of Southeast Bay, Minnitaki Lake (Zoltai 1965a, 1965b).

Glaciofluvial deposits include features such as southeast-trending eskers and drumlinoid ridges.

Glaciolacustrine deposits include clay and varved clay as seen for example on Neepawa Island and kames with well-developed terraces that are situated south of Minnitaki Lake (Zoltai 1965b) and on the east shore of Jarvis Lake.

During the Pleistocene Epoch, the map-area was covered by several ice sheets (Prest 1970). The last ice sheet, the Patricia ice mass (Zoltai 1965a), retreated at the end of the Wisconsinan stage. The pre-Pleistocene topography was modified by these ice sheets and glacial Lake Azassiz (Zoltai 1967).

Glacial striae, drumlinoid ridges, and eskers trend relatively consistently southwest to south-southwest.

Prest (1978) has recently examined the western part of the area for potential road aggregate materials.

Recent

Recent organic swamp and muskeg deposits are common, but of limited extent. Sand beaches are uncommon, and appear to have formed due to the lacustrine reworking of Pleistocene deposits.

Elson (1961) gave a brief description of the soil types of the former Lake Agassiz region.

STRUCTURAL GEOLOGY

Figure 2 illustrates the major structures of the Flying Loon Lake area. Previous structural interpretations dealing with the East Bay and the northern Southeast Bay areas include those of Pettijohn (1936), Pettijohn and Walker (1971), Johnston (1972), and Page and Clifford (1977). Structural information from Page (geologist with Geological Survey of Canada, formerly with Ontario Geological Survey, Toronto, personal communication, 1978) and the current survey led to:

1. modifications in these previous interpretations, specifically the placement of previously interpreted major fault structures
2. the interpretation of additional major fault structures
3. to additional data on the major fold pattern

It should be stressed, however, that the structural data now available is still insufficient to, either unravel the structural history of this area, or to accurately define the pre-deformation distribution and stratigraphy of the major lithological groups.

Major Structures

FAULTS

A comparison of Figure 2 with Figure 2 of Johnston (Johnston 1972, p.14) indicates the changes in the placement of major faults and the addition of newly interpreted faults in the western part of the area.

The contacts between the major lithological groups, the Minnitaki Group, and the Neepawa Group in the Southern Volcanic Belt, are controlled by east to northeast-trending faults. Apparently, a series of younger north- to northeast-trending faults cut across both these earlier faults and the major east-west trending folds.

Three newly interpreted major fault structures are the Twin Bay Fault, the Southeast Bay Fault, and the English River-Smock Lake Brittle Deformation Zone.

Twin Bay Fault

The contact between the Minnitaki Group and the Southern Volcanic Belt, even though not exposed in outcrop, forms a topographic feature marked by low-lying swamp and is locally followed by meandering streams. Rocks near this feature are highly sheared and contain numerous carbonate veinlets locally carrying minor pyrite. The authors interpret this contact to be a fault structure that follows an original angular unconformity between the Southern Volcanic Belt and the overlying Minnitaki Group. Bedding structures in both the metasediments and metavolcanics adjacent to this fault dip from 65 to 85 degrees south. The metasediments face north away from the fault. Pillows in the metavolcanics, on the shore of Southeast Bay, face north into the fault, whereas those on Twinflower Lake face south away from the fault. To the southwest of the map-area, metasediments and metavolcanics face each other along this same contact (Pettijohn 1935; Johnston 1969). This fault mainly follows the metasedimentary-metavolcanic contact, but may locally splay and transect lithological boundaries. Likewise, if the folding of the metavolcanics occurred before the metasediments were deposited, the truncation of the fold structures in the metavolcanics could be explained. Tight isoclinal folding of the metavolcanics against the more rigid block of metavolcanics, followed by a possible thrust component of movement along this fault, could explain the opposing and inward facings observed between the two lithological groups along their contact.

Southeast Bay Fault

The fault, herein named the Southeast Bay Fault, is interpreted to trend north through the central part of Southeast Bay. Lithologies, specifically the metasediments of the Minnitaki Group to the west and the intermediate to felsic fragmentals to the east, end abruptly in central Southeast Bay. A similar truncation is observed on the aeromagnetic map of this area (*see* section on "Correlation of Geology with Geophysical Data"). As well, the axial plane traces of east-trending folds appear to be similarly offset. If simple strike-slip movement occurred and if the author's correlation of lithologies on either side is correct, then the apparent movement along this fault is inconsistent. Displacement of the metasediment-metavolcanic contact is on the order of 4 km, while movement of the metavolcanics at the bottom of Southeast Bay appears negligible. Vertical and rotational components of movement along this fault might possibly explain these inconsistencies.

Smock Lake-English River Brittle Deformation Zone

An east-west trending zone in which the bedrock lithologies exhibit intense brittle deformation structures such as fault gouge and mylonite is situated north of Smock Lake. It may extend west to the mouth of the English River, but not all the outcrops within this zone are intensely deformed. To the east, it can be traced as far as the southern end of Yonde Lake where lack of outcrop precludes tracing it further. North of Smock Lake, along Highway 642, an undeformed outcrop of pillow breccia lies immediately north of this zone. Similarly to the south, the bedrock shows a weak to moderate foliation.

Four different lithologies were sampled and examined in thin section to determine the nature and extent of the deformation (Table 11). The thin sections confirm the deformation as being brittle. Cataclasis involves both the development of fault gouge in the mafic metavolcanics and mylonite in the more quartzofeldspathic rocks. A sample of the Smock Lake Pluton that lies within this zone exhibits (in thin section) highly strained and stretched quartz grains and 15 percent strongly aligned biotite. The extent of the deformation is not, however, as intense as in the adjacent lithologies. This suggests this zone is an early structure that was crosscut by the Smock Lake Pluton, and that some late activation of this zone was responsible for the deformation within the pluton. Another interpretation is that the deformation was mainly confined to the contact between the two contrasting lithologies.

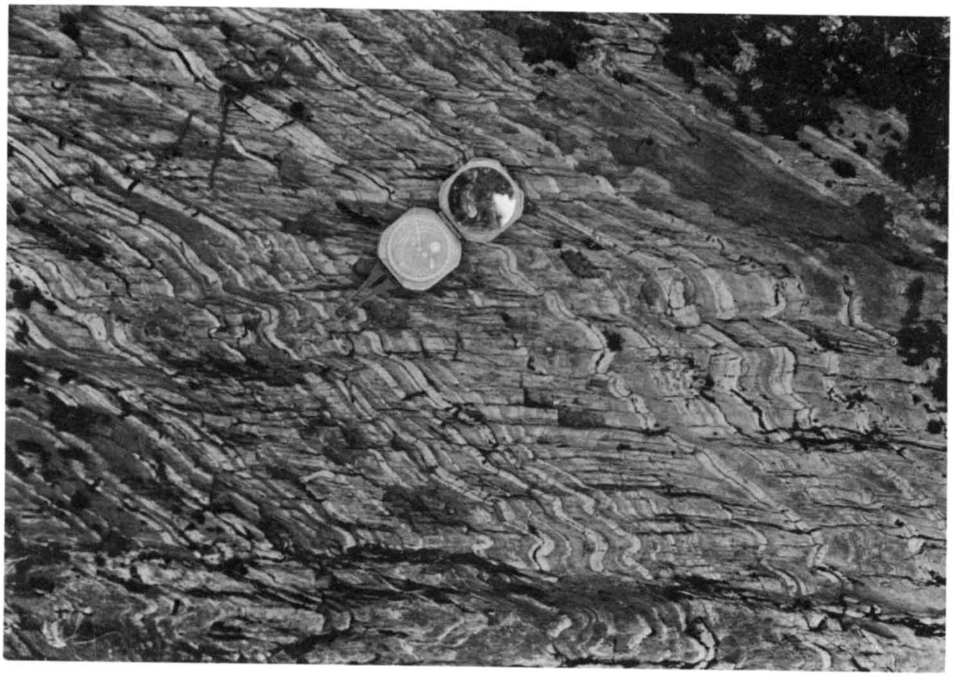
FOLDS

In the central and eastern parts of the area, scattered facing observations indicate that the sequences have been folded. The paucity of such observations does not permit an accurate placement of the axial plane traces of the major fold structures. In the eastern part of the area, more detailed information on facing indicates that the tight isoclinal folding observed within the metasediments also developed in the metavolcanics, but with larger amplitude folds. The general trend of the folds, however, is east-west for both lithologies (Figure 2).

TABLE 11 | THIN SECTION AND OUTCROP DESCRIPTION OF LITHOLOGIES FROM SMOCK LAKE-ENGLISH RIVER BRITTLE DEFORMATION ZONE FLYING LOON LAKE AREA.

LITHOLOGY	MINERAL	TEXTURE	STRUCTURE	HAND SPECIMEN/ OUTCROP STRUCTURE	NAME
Fine-grained mafic meta-volcanic flow	Chlorite — 60*	0.4 mm platy aggregates	Aligned in layers	Irregular shearing	Fault Gouge
	Sphene — 15	0.1 mm anhedral crystals			
	Epidote — 10	0.2 mm euhedral grains			
	Quartz — 5-10	0.2 mm anhedral-subhedral grains	Lenticules		
	Muscovite — 5	0.2 m anhedral flakes			
Porphyritic mafic meta-volcanic flow	Plagio-clase — 40-45	0.2 mm equidimensional grains		Strongly foliated;	Mylonite
	Quartz — 25-30	bimodal grain size: .2 mm grains in matrix, 1 mm		crudely banded; biotite-epidote-rich and quartz-plagioclase rich bands	
	Biotite — 15	0.5 mm laths	Aligned:define foliation wrap-around micro-cline augens		
	Micro-cline — 5-10	3 mm elongate grains	Augens (porphy-roclasts?)		
	Epidote — 5	0.1 mm subhedral-anhedral grains			
	Sericite — 1	alteration of microcline			
Intermediate (crystal) tuff	Plagio-clase — 35	0.1 mm anhedral grains	Crushed	Well foliated, banded (fluxion structure); interbanded with mylo-nites derived from dif-ferent lithologies	Mylonite
	Quartz — 25-30	0.1 mm anhedral grains	Crushed		
	Micro-cline —15-20	1 mm to 4 mm blebs; zoned	Augens		
	Biotite —10	0.5 mm bladed cyrstals	Aligned		
	Epidote — 3-5	0.5 mm subhedral grains			
	Calcite — 1	alteration of feldspars			
	Sericite — 1	fine-grains and feldspar alteration			
	Opaques — 1				
	Zircon — trace				
Siltstone	Chlorite — 35	0.1 mm blades	Aligned	Strongly foliated, banding of chlorite + quartz and chlorite + quartz + sericite; cross-cut by quartz and quartz + epidote veinlets	Mylonite
	Sericite — 20	fine anhedral grains			
	Epidote — 1				
	Quartz+Plagioclase-45	0.05 mm grains	Locally form lenticules in lenticules		
	Sillimanite - Trace	fibrolite needles			

* Modal Analyses



OGS 10 494

Photo 4–Drag folding in thinly bedded mudstone-siltstone metasediments on southern shore of Minnitaki Lake. Cleavage trends parallel to bottom edge of photograph.

Minor Structures

Foliations, Lineations

Foliations in the map-area include: general foliations that define anisotropic planar structures; and schistosity that defines planar structures showing alignment of platy minerals.

Lineations include mineral lineations, fold axes of minor folds, and intersections of bedding and cleavage.

Minor Folds

Minor folds are folds that can be seen on the outcrop or on the scale of a hand specimen. In the map-area these include tight isoclinal similar folds; chevron or buckle folds with associated shear faults; dominant Z-shaped, locally S-shaped, folds associated with right-hand slip along the major east to northeast-trending faults (Photo 4); and fine crenulation folds associated with late northeast- to north-trending faults.

Photo 5–Refolded fold from Smock Lake-English River Brittle Deformation Zone situated at mouth to English River.

Minor folds were seen mainly in the metasediments of the Minnitaki Group and in the mafic metavolcanic units in the Discovery Lake area. Refolding of previously developed folds were seen in metavolcanics within the English River-Smock Lake Brittle Deformation Zone at the mouth of the English River (Photo 5).

Folding in the metavolcanics in the Discovery Lake area was accompanied by extensive north-south compression of the units. Here, individual pillows were observed with length to width ratios of 30 to 1, the width being of the order of 2 to 8 cm.

CORRELATION OF GEOLOGY WITH GEOPHYSICAL DATA

The map-area was surveyed aeromagnetically in 1961 and the map sheets at a scale of 1:63 360 were jointly released by the Geological Survey of Canada and the Ontario Department of Mines (Yonde Sheet, Map 1137G; Sioux Lookout Sheet, Map 1138G; Watcomb Sheet, Map 1127G, Ycliff Sheet, Map 1128G; Ontario Department of Mines-Geological Survey of Canada 1961a, 1961b, 1961c, and 1961d).

The major magnetic features in the map-area are;

1. the contrast in magnetic pattern and response between the volcano-sedimentary belt and the surrounding granitic areas
2. the indicated presence of magnetite-bearing zones in the metasediments

In general, there is a tighter spacing of contours, a greater variation of magnetic response, and a linear alignment of contours over the volcano-sedimentary belt in contrast to the aeromagnetic pattern over the granitic rocks.

A major zone of intercalated clastic metasediments and quartz-hematite-magnetite ironstones mapped on Twin Bay and the west shore of Southeast Bay and intersected in diamond-drill holes near the western margin of the map-area (*see* Minnitaki Iron Range Limited in "List of Properties") is reflected by a tightly contoured linear zone of high magnetic response.

Two zones having magnetic responses about 500 and 600 gammas above background, approximately 60420 gammas for the map-area, are located near the junction of Pen Creek with the English River and west of Way Lake respectively. Ultramafic outcrops were found in both areas, and the areal extent of covered ultramafic intrusions was interpreted in part from the aeromagnetic data (*see* section on "Ultramafic Intrusions").

The Wyatt Lake and Smock Lake Plutons exhibit discrete contour patterns on the aeromagnetic maps that allow a rough estimate of their areal extent to be made. The Smock Lake Pluton, is depicted by closely spaced contours and includes within its aeromagnetic boundaries, the Pen Creek Intrusion. This suggests a possible genetic(?) relationship (*see* section on "Smock Lake Pluton"this report) between these two bodies.

Indications that the Southeast Bay Fault exists, are reflected in the closure/truncation of east-west trending magnetic patterns, specifically those due to the ironstone units.

Gamma-ray spectrometry survey data (Ontario Department of Mines-Geological Survey of Canada 1976a, 1976b: Sioux Lookout Sheet, Map P.1115; Ignace Sheet, Map P.1150) indicate that there are no likely concentrations of radioactive minerals within the map-area. Due to the wide line spacing of the survey, the data is also not sufficiently detailed to distinguish the lithologies.

A gravity survey (Barlow 1975) covers the eastern part of the map-area. The data roughly defines the boundary between the volcano-sedimentary belt and the bordering granitic areas. A gravity low over Wyatt Lake gave the first indication of the existence of a possible felsic to intermediate intrusion which was subsequently confirmed by mapping during the present survey.

ECONOMIC GEOLOGY

Gold, copper, molybdenum, and iron mineralization have been reported from the map-area. No past or presently producing mines are located within the map-area. The various types of mineralization are discussed below. Reference is made to individual properties (*see* "List of Properties", Figure 48) to describe type examples.

TABLE 12 | LIST OF PROPERTIES, FLYING LOON LAKE AREA

NAME	Number on Figures	M-2233 Township of Drayton	M-2150 Parnes Lake	M-2222 Zarn Lake	M-3196 Smock Lake	M-3198 Flying Loon Lake	M-3197 Wyatt Lake	M-1947 Press Lake	M-2052 Valora Lake	Geophysical Work	Geological Work	Toronto File Numbers	Date of Work	Remarks	Additional References
Alkenore-Buffalo Gold Mines Limited	1			X									1937	Property allowed to lapse (Work done outside of map-area)	Page (1978, 1979), Horwood (1937)
Asarco Exploration Company of Canada	2-1		X								6	63A-399	1961	Work done on A.L. Guest Syndicate (1960) claims; properties allowed to lapse	
	2-2		X								6	63A-399	1961		
	2-3A		X								6	63A-399	1961		
	2-3B		X								7 (4-53.4m)		1961		
Boylen, F.A.	3							X			8		1971	Overburden trenching, property allowed to lapse	
Central Manitoba Option (Central Manitoba Mines Limited)	4		X								7 (24-1293m)		1950-1951	See Macdonald claims (This Report)	See J.L. Macdonald in Johnston (1972) See Central Manitoba Mines Limited in Chisholm (1951)
Chimo Gold Mines Limited	5								X	3,4		63.2801	1970	Property allowed to lapse	
Colleen Copper Mines Limited	6	X								11			1965	Property allowed to lapse	
Coltrin-Dale Claims	7		X								7 (4-105m)		1934	Property allowed to lapse	
Combined Metal Limited	8-1				X					3		63.3019	1972	Properties allowed to lapse	
	8-2A				X						7 (1-166.3m)		1973		
	8-2B				X							63.3019	1972		
	8-3A				X					3		63.3019	1972		
	8-3B				X						7 (2-205.1m)		1973		
	8-3C				X					11		63.3407	1972	Prospectus Filed	
	8-4A				X							63.3019	1972		
	8-5A				X							63.3019	1972		
Conecho Mines Limited	9-1	X									6	63A-129	1951	Properties allowed to lapse	
	9-2A	X	X								6	63A-129	1951		
	9-2B	X	X							3		63.264	1951		
	9-3	X	X							3		63.264	1951		
Congress Mining Corporation Limited (J. Tokarsky)	10A				X					3,4		2.582	1971	Property allowed to lapse	
	10B				X						7 (1-167)		1971		

Table 12 continued

Consolidated Dolson Mines Limited	11-1						X		3,4		2.430	1971	Properties allowed to lapse	
	11-2						X		3,4		2.430	1971		
Courier Explorations Limited	12	X							3,4		2.408	1971	Property allowed to lapse	
Dave Lake Mines Limited (J. Tokarsky)	13A				X				3,4		2.599	1971	Property allowed to lapse	
	13B				X					7 (1-165.m)		1971		
Delnite Mines Limited	14		X							7 (8-944.2m)		1963	See Macdonald Claims and Central Manitoba option (This report) Property held under Leased claims	See J.L. Macdonald in Johnston (1972)
Denison Mines Limited	15		X						3,4		2.911	1972	Property allowed to lapse	
Denison Mines Limited-Goldray Mines Limited	16		X							7 (7-759.5m)		1973	Property allowed to lapse	
Dome Exploration (Canada) Limited	17		X						1		2.902	1972	Property allowed to lapse	
East Bay Gold Mines Limited	18						X		4		2.457	1971	Property allowed to lapse	
Falcon Lake Mining Corporation Limited	19A			X					3		2.360	1971	Property allowed to lapse	
	19B		X							7 (1-168.9)		1971		
Gaspe Québec Mines Limited	20						X	X	3,4		2.429	1971	Property allowed to lapse	
Geophysical Engineering Limited	21-1		X							7 (3-305.1m)		1977	Porperties Held	
	21-2		X							7 (1-98.4m), 9		1977		
	21-3				X					7 (1-132.1m)		1977		
Goldray Mines Limited	22-1		X						1,2			1969	Properties allowed to lapse	
	22-2		X						1,2		2.76	1969		
	22-3A				X				1,2		2.76	1969		
	22-3B				X					7 (6-687m)		1978		
	22-4A				X				1,2		2.76	1969		
	22-4B				X					7 (1-116.1m)		1970		
	22-5A				X				1,2		2.76	1969		
	22-5B				X					7 (1-126m)		1970		
	22-6				X				1,2		2.76	1969		
	22-7				X				1,2		2.76	1969		
	22-8A				X				1,2		2.76	1969		
	22-8B				X	X				7 (3-320.5m)		1970		
	22-9						X			1,2	2.76	1969		
	22-10						X		1,2		2.76	1969		
	22-11A						X		1,2		2.76	1969		
	22-11B						X			7 (2-227.7m)		1970		
	22-12A						X		1,2		2.76	1969		
	22-12B						X			7 (1-130.6m)		1970		
	22-13				X	X			1,2		2.76	1969		
	22-14								1,2		2.76	1969		
	22-15				X				1,2		2.76	1969		

Table 12 continued on next page

Table 12 continued

Hanson Mines Limited (Hanson Mining Company Limited)	23-1A				X	X	4		2.420	1971	Airborne magnetic and electromagnetic surveys (not filed) done in 1970, Properties allowed to lapse	
	23-1B				X	X	4		2.827	1972		
	23-2					X	4		2.284	1970		
Hartland Mines Limited (T. Sokoloff)	24A						3,4			1971	Also see Mid-Patapedia Mines Limited (This Report)	
	24B							7 (3-347.5m)		1972		
Imperial Oil Enterprises Limited	25	X	X				4		2.98	1970	Property allowed to lapse	
John Sykes Mining and Milling Company Limited	26-1		X					10		1900	Property comprises one patented claim	See 'John Sykes Mining and Milling Company' in Hurst (1932)
	26-2							10		1900		
	26-3							9		1900		
	26-4							9		1900		
Keevil Mining Group Limited	27					X	3,4		63.1746	1965	Property allowed to lapse	See 'Keevil Mining Group Limited' in Trowell (1970).
Kelore Mines Limited (New Kelore Mines Limited)	28-1		X					6		1951	Portion of property 28-1 comprises two patented claims; Property 28-2A, B Allowed to lapse	See 'Kelore Mines Limited' in *Johnston* (1972).
	28-2A		X					6		1951		
	28-2B		X				3		63.270	1951		
	28-3		X				3	6	63.270	1951		
Kostiuk, M.	29				X			8		1971	Property allowed to lapse	
Levesque, R. and Carre, J.	30					X	3,4		2.292	1970	Property allowed to lapse	
Macdonald Claims	31		X					8		1958-1962	See Delnite Mines Limited	See 'J.L. Macdonald' in Johnston (1972).
Massval Mines Limited	32				X		3,4		2.31	1970	Property allowed to lapse	
Mattagami Lake Exploration	33-1			X			3,4		2.2348	1976-	Property held	
	33-2A			X			3,4		2.2348	1976-1977	Property allowed to lapse	
	33-2B			X				7 (1-146.6m)		1977		
	33-3			X			3,4		2.2351	1976-1977		
	33-4A			X			3,4		2.2351	1976-1977		
	33-4B			X				7 (1-117.1m)		1977		
	33-5A			X			3,4		2.2352	1976-1977		
	33-5B			X				7 (1-171.6m)				
	33-6A			X			3,4		2.2352	1976-1977		

Table 12 continued

NAME	Number on Figures	M-2233 Township of Drayton	M-2150 Parnes Lake	M-2222 Zarn Lake	M-3196 Smock Lake	M-3198 Flying Loon Lake	M-3197 Wyatt Lake	M-1947 Press Lake	M-2052 Valora Lake	Geophysical Work	Geological Work	Toronto File Numbers	Date of Work	Remarks	Additional References
	33-6B				X						7 (1-130.2m)				
	33-7				X					3,4		2.2440	1977		
	33-8A				X					3,4		2.2655	1977		
	33-8B				X						7 (1-130.2m)		1978		
	33-9A					X				3,4		2.2347	1977		
	33-9B					X					7 (1-140.1m)		1977		
	33-9C					X				5		2.2538	1977		
	33-9D					X					7 (1-139.8m)		1978		
	33-10A					X				3,4		2.2347	1977		
	33-10B					X					7 (1-136.5m)		1977		
	33-10C					X				5		2.2538	1977		
	33-11					X				5		2.2538	1977		
	33-12					X				5		2.2538	1977		
	33-13						X			3,4		2.2349	1977		
	33-14						X			3,4		2.2349	1977		
	33-15						X			3,4		2.2346	1977		
	33-16A						X			3,4		2.2346	1977		
	33-16B						X				7 (3-337.6m)		1977		
	33-16C						X			5		2.2556	1978		
	33-17						X					2.2346	1977		
	33-18						X			3,4		2.2349	1977		
	33-19							X		3,4		2.2350	1977	Property held (2 claims; 2 allowed to lapse	
McComb McCombe Group (Wright-Hargreaves Mines Limited)	34A	X									8,7		1948		See 'Wright-Hargreaves Mines Limited in Johnston (1972)
	34B	X									6,9	63A-124	1951	Property optioned to Wright-Hargreaves Mines Limited in 1951, Property allowed to lapse	
McCombe Mining and Exploration Limited	35	X								4		63-950	1957-1958	Property optioned to and work done by Noranda Mines Limited in 1957-1958; also see Rio Tinto Canadian Exploration Limited (this report); Property allowed to lapse	See 'McCombe Occurrence' in Johnston (1972).

Table 12 continued on next page

Table 12 continued

Mid-North Engineering Services Limited-Amalgamated Rare Earth Mines Limited	36-1						X	1		63.2698	1969	Properties allowed to lapse	
	36-2						X	1,2		63.2698	1970		
Mid-Patapedia Mines Limited	37			X				11				Filed Prospectus Property Allowed to lapse	
Minnitaki Iron Range Limited	38-1		X					3		63-1537	1964-1965	Properties held under lease	See 'Iron' in Hurst (1932); see Minnitaki Iron Range Limited in Johnston (1969).
	38-2A		X					3		63-1537	1964/65		
	38-2B		X						7 (6-745.4m)		1965		
Neepawa Island Gold Mines Limited	39	X	X						7 (18-218.2m)		1950	Property allowed to lapse	See 'Neepawa Island Gold Mines Limited' in Johnston (1972), see Neepawa Island Gold Mines Limited 'in Chisholm (1951).
New Calumet Mines Limited	40-1				X			1,2		2.27	1970	Property allowed to lapse	
	40-2				X		X	1,2		2.27	1970		
New Calumet Mines Limited-Zenmac Metals Mines Limited	41-1						X		7 (3-371.8m)		1970/71	Properties allowed to lapse	
	41-2						X		7 (2-235.9m)		1970/71		
New Hugh Malartic Gold Mines Limited	42		X						7 (5-719.2m)		1951		
Noranda Exploration Company Limited	43-1			X				3,4		2.285	1970	Properties allowed to lapse	
	43-2			X				3,4		2.695			
	43-3			X				3,4		2.195	1970		
	43-4A			X					7 (5-599.5m)		1970		
	43-4B			X					7 (5-599.5m)				
	43-5			X					7 (3-413.6m)		1970		
	43-6A			X				3,4		2.288	1970		
	43-6B			X					7 (2-241.5m)		1970		
	43-7			X				3,4		2.300	1970		
	43-8A			X				3,4		2.554	1970		
	43-8B			X					7 (2-170.6m)		1971		
	43-9			X				3,4		2.289	1970		
	43-10			X				3,4		2.280	1970		
	43-11			X				6	6	2.695	1971		
	43-12			X				3,4		2.223	1970		
	43-13A				X			3,4		2.275	1970		
	43-13B				X				7 (1-136m)		1970		
	43-14A				X			3,4		2.223	1970		
	43-14B				X				7 (1-101.4m)		1970		
	43-15A				X			3,4		2.281	1970		
	43-15B				X				7 (1-133 m)		1970		
	43-16				X				7 (1-136.1m)		1970		
	43-17				X			3,4		2.275	1970		
	43-18					X		3,4		2.178	1970		
	43-19					X	X	3,4		2.182	1970		
Ourgold Mining Company Limited	44A	X							7 (1649.6m)		1947	Property allowed to lapse	See 'Ourgold Mining Company Limited' in Johnston (1972).
	44B	X						3	7 (18-759.6m)		1961/62		

Table 12 continued

Paymaster-Gillies Property	45	X						6,9	63A-121	1951	Companies that held property: Paymaster Consolidated Mines Limited, Gillies Lake Porcupine Gold Mines Limited, Empire Gold Mines Limited, Property allowed to lapse	
Reeta Exploration Limited	46				X			3,4		1971	Property allowed to lapse; prospectus filed	
Rio Tinto Canadian Exploration Limited	47		X						7 (5-544.3m)		1961	See McCombe Mining and Exploration Option (this report); property allowed to lapse	See 'Mccombe Occurrence' in Johnston (1972)
Scurry-Rainbow Oil Limited	48-1						X	4		63.1022	1972	Properties allowed to lapse	
	48-2A					X	X	3,4		2.224	1969/70		
	48-2B					X	X		7 (11-1534.7')		1970		
	48-2C						X		7 (10-259.5')		1971		
	48-2D						X		7 (4-534.3')		1973		
	48-3					X	X	3,4	3,4	2.166	1970		
	48-4						X	3,4	3,4	63.2748	1969/70		
Selco Exploration Company Limited	49-1	X		X					7 (5-501.6m)		1971	Properties allowed to lapse	
	49-2		X					3		2.438	1971		
	49-3		X						7 (1-92.9m)		1971		
	49-4		X						7 (2-170.9m)		1971		
Shilo Mines	50A		X							63.2944		Property allowed	
	50B		X					3,4		2.1182	1972	to lapse	See 'Harvey Syndicate' in Hurst (1932).
Silver-Miller Mines Limited-New Davies Petroleum Limited	51					X		1,2		2.56	1972	Property allowed to lapse	
Steep Rock Iron Mines Limited	52					X	X	3	6,8	63.2408	1966	Property allowed to lapse	See 'Steep Rock Iron Mines Limited in Trowell (1970).
Sturgeon King Mining Corporation Limited	53A				X			3,4		2.361	1970/71	Property allowed	
	53B				X				7 (2-337.9m)		1971	to lapse	
Whalen Deposit	54		X						7		1916/17	Property allowed to lapse	See 'Whalen Occurrence' in Johnston (1972).

CODE FOR ASSESSMENT WORK

1) Airborne magnetometer survey
2) Airborne electromagnetic survey
3) Ground magnetometer survey
4) Ground electromagnetic survey
5) Induced polarization survey
6) Geological Survey
7) Diamond drilling (number of holes - total length in metres)
8) Trenching
9) Shaft
10) Underground development
11) Prospectus filed

BASE-METAL SULPHIDE MINERALS

Several conductive horizons have been drilled and the diamond-drill hole data have been turned in for assessment credits (*see* "List of Properties" and Maps 2477 and 2458). The conductive horizons consist of pyrite and pyrrhotite-bearing tuffs or metasediments and sulphidic ironstones. These are commonly situated between mafic metavolcanic flows where they are intercalated with wackes and mudstones, often graphitic, or with intermediate tuffs. Trace amounts of chalcopyrite and sphalerite are reported to accompany the pyrite and pyrrhotite.

The mineralization appears to be stratigraphically controlled and most likely formed during periods of quiescence between major outpourings of mafic lava.

COPPER, MOLYBDENUM

Disseminated copper and molybdenum mineralization is found in the Northeast Bay Pluton (Johnston 1972) and the Shanty Lake Pluton (Trowell 1970, 1982). Both plutons may be synvolcanic and subvolcanic plutons; the mineralization occurring in them was formed similarly to that of more recent "porphyry copper" analogues.

IRON

Chemical metasediments comprising intercalated chert, and locally sulphidic, hematite-quartz-magnetite ironstone, form a major ferruginous zone within the southern part of the Minnitaki Group (*see* "Minnitaki Iron Range Limited" in Table 12, "List of Properties"). This zone extends to the west of the report area (Johnston 1969). Significant amounts of iron have been reported (Johnston 1969), but the iron in many cases was apparently deposited in place of the upper pelitic interval of individual turbidite units and would make extraction difficult. Specific horizons where the iron accumulated in substantial thicknesses, or areas where folding has resulted in thickening of the sequence, might have potential economic significance.

Substantial pyrite accompanied by graphite occurs in metasediments on the southern shore of East Bay (*see* "Whalen Occurrence" *in* Table 12, "List of Properties").

GOLD

All the known gold occurrences are in the western part of the report-area. Details can be found in the reports of Chisholm (1951) and Johnston (1972).

The majority of the gold occurrences are found in pyrite-quartz stringers in sheared and carbonatized mafic metavolcanics that are often situated near the contact with metasediments of the Minnitaki Group. Some of the reported gold mineralization on Burnthut Island (*see* "Ourgold Mining Company Limited", *in* Table 12, "List of Properties") occurs at the contact between mafic metavolcanics and apparently intrusive quartz porphyry. Small amounts of galena and chalcopyrite are also present.

Description of Properties

This report and maps evolved as a supplement to a much more extensive project intended to investigate the regional stratigraphy and structure of the Western Wabigoon subprovince between Crow Lake in the west and Savant Lake in the east. Detailed property examinations and reviews of assessment work over this large area were not feasible within the time allotted. As a result of the geological reconnaissance, however, sufficient new information, involving a significant proportion of the exposure in this poorly exposed area, was obtained to warrant publication in map form. The standard property descriptions normally contained in this type of report, however, were not possible.

Table 12 lists assessment information that has been submitted for the Flying Loon Lake area to the end of August 1978. The table gives the file name, claim map location, type of information, file number in the Assessment Files Research Office, Toronto, diamond-drill hole data, and date of work. Remarks giving the status of the property references follow each entry. The property locations are shown on Figure 12.

Considerations in Future Exploration

The newly-defined intermediate fragmental sequence in Southeast Bay is a likely target for exploration for base-metal sulphide mineralization. Its eastern extent is not known due to lack of outcrop, but conductive horizons that have been drilled east of Southeast Bay (*see* Map 2477, back pocket) are locally composed of sulphidic intermediate tuffs and intercalated mudstones.

The ultramafic intrusions warrant an examination for nickel, copper, and platinoid-group mineralization. The Pike Lake Pluton should be examined for similar mineralization plus the possibility of gold in late leucocratic differentiates.

So-called quartz porphyry bodies on Vermilion Lake (Trowell *et al.* 1978) north of the map-area and on Pickerel Arm (Ian Sutherland, personal communication, 1979) west of the map-area, have associated felsic pyroclastic phases. These bodies are similar to the porphyry body on Burnthut Island which contains galena and chalcopyrite indicating that it should be examined for possible base-metal sulphide mineralization.

Gold mineralization, as it is now found, appears to be primarily structurally controlled along east- to northeast-trending fracture systems. Spatially, many of the gold occurrences lie near the contact between mafic metavolcanics and the Minnitaki Group; they are also often situated close to cross-cutting faults. The contacts may be fault-masked unconformities. The gold may have been localized as detrital deposits in the metasediments that were subsequently remobilized by the later fracturing events and redeposited in favourable structural sites in the mafic metavolcanics.

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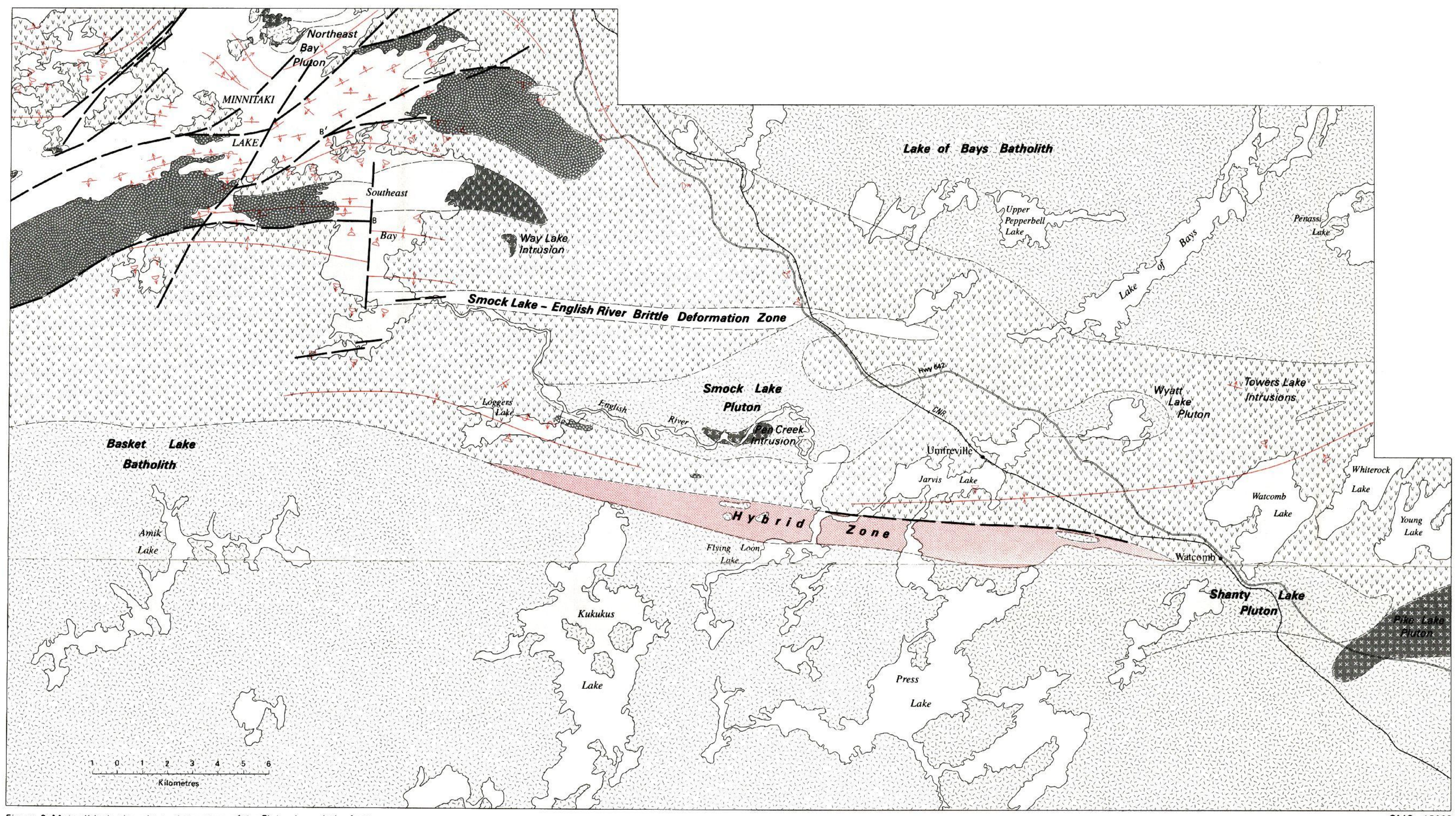
INDEX



LEGEND

- Felsic to intermediate intrusive rocks
- Mafic and ultramafic intrusive rocks
- Metasediments
- Felsic to intermediate volcanic rocks
- Mafic to intermediate volcanic rocks
- Geological boundary
- Fold axis (trace of axial plane)
- Fault or lineament
- Pillow facings
- Bedding with facing

Figure 2. Major lithologic units and structure of the Flying Loon Lake Area.

SMC 15028

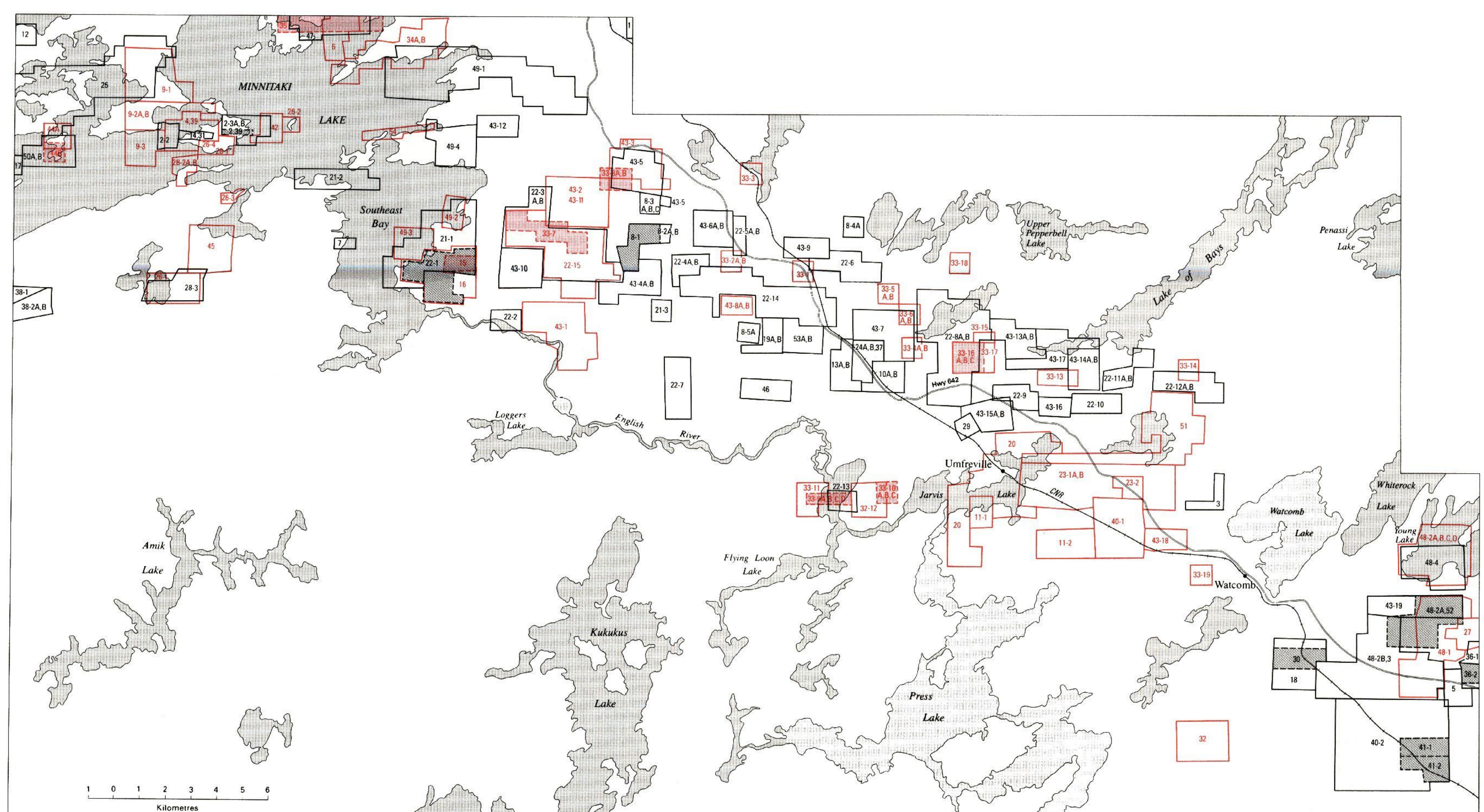


Figure 48. Map of properties in the Flying Loon Lake Area.

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LIST OF PROPERTIES

1. Alkenore-Buffalo Gold Mines Ltd
2. Asarco Exploration Company of Canada Ltd.
3. Boylen, F.A
4. Central Manitoba option
5. Chimo Gold Mines Ltd
6. Colleen Copper Mines Ltd
7. Coltrin-Dale claims
8. Combined Metal Mines Ltd.
9. Conecho Mines Ltd
10. Congress Mining Corp. Ltd.
11. Consolidated Dolsan Mines Ltd.
12. Courier Explorations Ltd.
13. Dave Lake Mines Ltd.
14. Delnite Mines Ltd.
15. Denison Mines Ltd
16. Denison Mines Ltd.–Goldray Mines Ltd.
17. Dome Exploration (Canada) Ltd.
18. East Bay Gold Mines Ltd.
19. Falcon Lake Mining Corp. Ltd
20. Gaspé Quebec Mines Ltd.
21. Geophysical Engineering Ltd
22. Goldray Mines Ltd
23. Hanson Mines Ltd.
24. Hartland Mines Ltd.
25. Imperial Oil Enterprises Ltd.
26. John Sykes Mining and Milling Co. Ltd.
27. Keevil Mining Group Ltd
28. Kelore Mines Ltd.
29. Kostiuk, M.
30. Levesque, R., Carré, J.
31. Macdonald claims.
32. Massval Mines Ltd
33. Mattagami Lake Mines Ltd.
34. McCombe group.
35. McCombe Mining and Exploration Ltd.
36. Mid-North Engineering Services Ltd.–
Amalgamated Rare Earth Mines Ltd.
37. Mid-Patapedia Mines Ltd
38. Minnitaki Iron Range Ltd.
39. Neepawa Island Gold Mines Ltd.
40. New Calumet Mines Ltd
41. New Calumet Mines Ltd.–Zenmac Metal
Mines Ltd.
42. New Hugh Malartic Gold Mines Ltd.
43. Noranda Exploration Ltd.
44. Ourgold Mining Co. Ltd.
45. Paymaster-Gillies property.
46. Reeta Explorations Ltd.
47. Rio Tinto Canadian Exploration Ltd.
48. Scurry-Rainbow Oils Ltd
49. Selco Exploration Co. Ltd.
50. Shilo Mines Ltd.
51. Silver-Miller Mines Ltd.–New Davies
Petroleums Ltd
52. Steep Rock Iron Mines Ltd.
53. Sturgeon King Mining Corp. Ltd.
54. Whalen deposit.

For further information refer to Table 12.

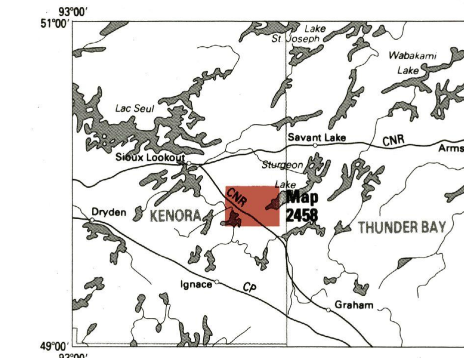
Ministry of Natural Resources
Ontario

Ontario Geological Survey

Map 2458

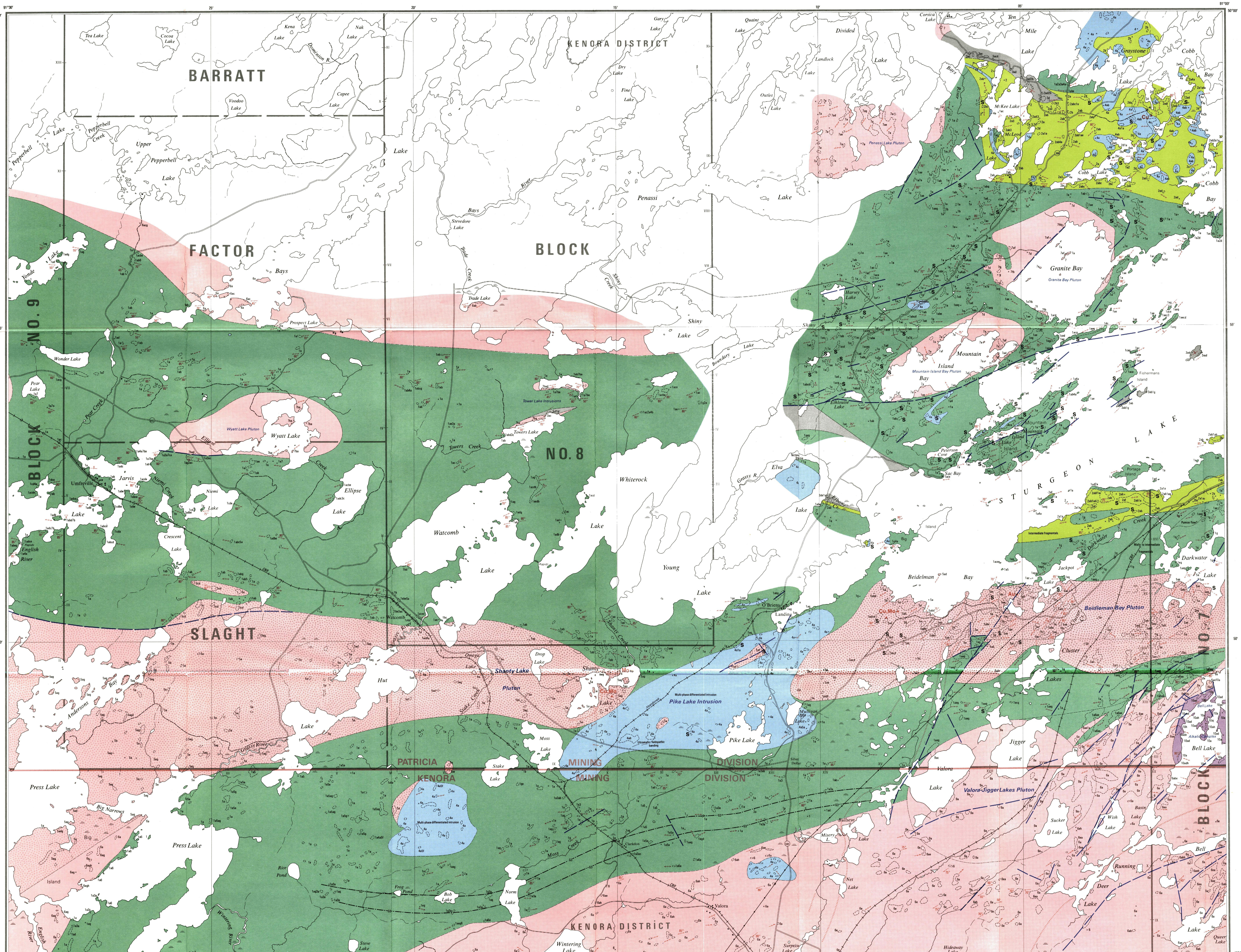
WHITEROCK LAKE

PRECAMBRIAN GEOLOGY
Scale 1:50 000



Aeromagnetic reference 1127G
NTS reference 52G/14

Published 1981



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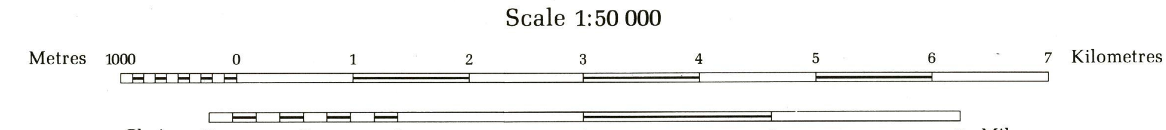

International, provincial boundary, approximate position only.
Regional municipality, territorial district, boundary approximate position only.
Geographic township boundary, base or meridian line, with milepost; approximate position only.
Surveyed line, approximate position only.
Mining Division, boundary approximate position only.
Indian Reserve, Provincial Park, boundary approximate position only.
Swamp, inundated land.
Motor road, with Provincial Highway number if applicable. (642)
Minor road, surface condition variable.
Trail, winter road or portage.
Railway.
Electric power transmission line.
Building, built-up area.
Elevation in feet. 1144
Pit (sand, gravel).
Esker.

SYMBOLS

- 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).
- Lava flow; top (arrow) from pillows shape and packing.
- Schistosity; (horizontal, inclined, vertical).
- Foliation; (horizontal, inclined, vertical).
- Banding; (horizontal, inclined, vertical).
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Geological boundary, deduced from geophysics.
- Lineament or fault.
- Jointing; (horizontal, inclined, vertical).
- Drag folds with plunge.
- Producing mine.
- Past producing mine.
- Mineral occurrence.

METAL AND MINERAL REFERENCE

Au ..... Gold.
Cu ..... Copper.
Mo ..... Molybdenum.

SOURCES OF INFORMATION

Geology from published maps of the Ontario Geological Survey, Ministry of Natural Resources and the Geological Survey of Canada, unpublished maps and reports of mining companies, unpublished theses, published papers; supplementary mapping by N. F. Trowell and assistants 1975-6.
Geology is not tied to surveyed lines.

Assessment files, Ministry of Natural Resources, Sioux Lookout and Toronto offices.

Cartography by P. A. Wisbey and assistants, Surveys and Mapping Branch, 1980.

Topography derived from Forest Resources Inventory maps, Surveys and Mapping Branch, with additional information by N. F. Trowell.

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MINERAL PRODUCTION AND RESOURCES

Gold, zinc, copper, silver, molybdenum, iron, fluorine, and radioactive mineralization have been reported in the area. Gold and silver, valued at $2,157,823 and $7,469 respectively, were produced from the St. Anthony Mine from 1901 to 1941. Other minor gold occurrences are known in the area generally associated with quartz veins in mafic metavolcanics or epizonal felsic intrusions (Darkwater Mine). Other associations for gold in addition to quartz veins are sulphide ironstone and trondhjemite dikes. Associated pyrite, pyrrhotite, minor chalcopyrite, and locally galena and sphalerite, in quartz veins are common.

Zinc, copper, silver, and lead are presently being produced at Mattabi Mines Limited (mining commenced in 1972) and Sturgeon Lake Mines Limited (mining commenced in 1974). Production is from two massive base-metal sulphide deposits situated within intermediate to felsic volcanic breccias. Two similar deposits, the 'Creek' and 'Lyon Lake', both owned by Mattagami Lake Mines Limited await development. Other copper occurrences are within epizontal felsic plutons (porphyry copper affinity).

Molybdenite is found in epizonal felsic intrusions (porphyry molybdenum) affinity.

Iron occurs in sulphidic, locally graphitic and quartz magnetite ironstones situated within respectively, metavolcanics and clastic metasediments.

Fluorite is found disseminated throughout the Sturgeon Narrows Alkalic Intrusive Complex.

Radioactive mineralization is present in the breccia zone along Sturgeon Narrows and reportedly on Coveney Island in a coarse-grained alkalic syenite.

LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Glacial deposits, lake, swamp, and stream deposits.

UNCONFORMITY

PRECAMBRIAN

EARLY PRECAMBRIAN (ARCHEAN)

FELSIC, INTERMEDIATE, AND ALKALIC INTRUSIVE ROCKS

SQUAW LAKE ALKALIC COMPLEX†

12 Unsubdivided.
12a Syenite (medium to coarse-grained, alkali feldspar, minor mafics and foids, locally trachytoidal).
12b Syenite (fine to coarse-grained, foid–(nepheline, cancrinite, sodalite) and/or zeolite (natrolite, stilbite)–bearing, 5 to 15 percent mafics).
12c Hybrid zones (internal cataclastic-metasomatic zones).
12d Inclusion syenite (syenite, monzonite inclusions in alkali syenite).
12e Inclusion syenite (mafic volcanic/intrusive inclusions).
12f Monzonite, monzosyenite.
12g Pegmatoid syenite (perthite pegmatite, biotite-perthite, biotite-magnetite-perthite pegmatite).
12h Syenite dikes, sills.

STURGEON NARROWS ALKALIC COMPLEX†

11 Unsubdivided.
11a Syenite (coarse-grained, equigranular, massive, biotite- amphibole or amphibole-pyroxene, local nepheline or altered nepheline, locally trachytoidal).
11b Syenite (medium-grained, equigranular, massive, nepheline with biotite-amphibole or amphibole-biotite, locally trachytoidal).
11c Syenite (fine to medium-grained, massive, commonly leucocratic, garnet-nepheline or nepheline-garnet).
11d Syenite (medium to coarse-grained, massive, locally pegmatitic, leucocratic with nepheline).
11e Syenite (muscovite leucosyenite).
11f Lamprophyre dikes.
11g Perthite porphyry; pegmatitic, feldspathic, and aplitic dikes.
11h Xenolithic syenite.
11j Syenodiorite, syenogabbro.
11k Xenolithic syenodiorite, syenogabbro.
11m Carbonate breccia (clasts of alkalic complex and enclosing rocks in carbonate matrix).
11n Porphyroblastic syenite, syenodiorite (nepheline, biotite, porphyroblasts).
11p Banded syenite (weak diffuse mafic bands, feldspar phenocrysts).

BELL LAKE ALKALIC COMPLEX

10a Biotite-hornblende-augite monzonite, syenite.
10b Porphyritic biotite-hornblende-augite monzonite, syenite.†
10c Porphyritic perthite monzonite, syenite.†
10d Monzonite, syenite (metapyroxenite inclusions).
10e Monzonite syenite (granitic and amphibolite inclusions).
10f Biotite pyroxenite.†
10g Lamprophyre (dikes).†
10h Aplite, syenite pegmatite (dikes and irregular masses).
10j Gabbro (dikes).

QUARTZ MONZONITE INTRUSIVE ROCKS

9 Unsubdivided.†
9a Quartz monzonite, granodiorite (variable locally to granodiorite-trondhjemite).
9b Granodiorite, quartz monzonite dikes.†
9c Xenolithic, hybrid quartz monzonite, granodiorite.

MONZONITE-SYENITE-GRANODIORITE INTRUSIVE ROCKS†

8 Unsubdivided.
8a Amphibole, biotite-amphibole granodiorite, monzonite, syenite (variable to quartz monzonite, syenodiorite (quartz) syenite).
8b Porphyritic amphibole, biotite-amphibole granodiorite, monzonite, syenite (variable to quartz monzonite, syenodiorite, quartz syenite).
8c Xenolithic, hybrid granodiorite, monzonite, syenodiorite.
8d Pegmatite.
8e Leucocratic massive granodiorite, (quartz) monzonite.

TRONDHJEMITE-GRANODIORITE INTRUSIVE ROCKS

7 Unsubdivided.
7a Foliated granodiorite, trondhjemite.
7b Massive trondhjemite, porphyritic trondhjemite, granodiorite.
7c Muscovite granodiorite, trondhjemite.†
7d Xenolithic granodiorite, trondhjemite.
7e Foliated granodiorite, quartz monzonite.
7f Hybrid hornblende syenite.
7g Granodiorite, trondhjemite, aplite dikes.

BATHOLITHIC GRANITIC COMPLEXES

6 Unsubdivided.
6a Biotite-hornblende, hornblende-biotite foliated granodiorite, trondhjemite (variable locally to quartz diorite, quartz monzonite and syenodiorite).
6b Porphyritic foliated granodiorite, trondhjemite.
6c Foliated granodiorite, quartz monzonite.
6d Foliated quartz monzonite, porphyritic quartz monzonite, granodiorite.†
6e Massive trondhjemite, porphyritic trondhjemite, granodiorite.
6f Quartz-lenticule gneissic granodiorite, trondhjemite.†
6g Xenolithic, hybrid granodiorite, trondhjemite, quartz monzonite.
6h Pegmatite, aplite, feldspathic mobilizates.

EPIZONAL (SUBVOLCANIC) INTRUSIONS

5 Unsubdivided.
5a Trondhjemite, granodiorite.
5b Porphyritic trondhjemite, granodiorite, feldspar porphyry, quartz-feldspar porphyry.
5c Quartz diorite.
5d Xenolithic, trondhjemite, granodiorite (mafic metavolcanic inclusions).
5e Quartz-tourmaline-ankerite and quartz veins.
5f Xenolithic trondhjemite granodiorite (felsic intrusive xenoliths.
5g Aplite, diorite dikes.

INTRUSIVE CONTACT

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS

4 Unsubdivided.
4a Gabbro, diorite.[a]
4b Porphyritic gabbro, diorite.[a]
4c Anorthositic gabbro, diorite.[a]
4d Serpentinized peridotite.†

INTRUSIVE CONTACT

METASEDIMENTS

3 Unsubdivided.
3a Wacke.
3b Arenite, arkose.
3c Siltstone, argillite.
3d Conglomerate.
3e Debris flow, conglomerate.
3f Quartz-magnetite ironstone.
3g Sulphide (pyrite-pyrrhotite) ± graphitic ironstone.†

METAVOLCANICS

FELSIC TO INTERMEDIATE METAVOLCANICS

2 Unsubdivided.
2a Tuff, lapilli-tuff (variable to volcanogenic siltstone).
2b Lapilli-tuff, lapillistone tuff.
2c Lapillistone tuff, tuff-breccia, pyroclastic breccia (in part reworked).[b]
2d Quartz, feldspar, quartz-feldspar porphyry intrusions (includes possible flows, tuffs).
2e Felsite.[c] †
2f Derived schists, phyllites.

MAFIC METAVOLCANICS

1 Unsubdivided.
1a Massive flows.
1b Porphyritic flows.[d]
1c Pillowed flows.
1d Amygdaloidal, vesicular flows.
1e Autoclastic breccias (includes hyaloclastic breccia).
1g Pyroclastics (variable to redeposited fragmentals).

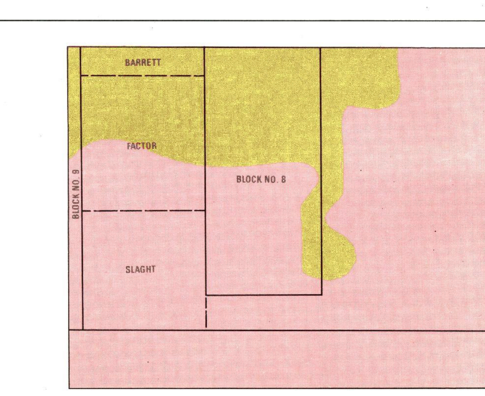
S Sulphide mineralization

Where in places a formation is too narrow to show in colour and must be represented in black, a short black bar appears in the appropriate block.

[a] May include some mafic metavolcanic flows.
[b] May include some volcanogenic conglomerate.
[c] May include some tuffs and flows.
[d] May include some mafic intrusive rocks.

The letter "G" preceding a rock unit number, for example "G3" indicates interpretation from geo-physical data in drift covered areas.

† Does not occur on this sheet.



GEOLOGICAL MAP COVERAGE

Detailed mapping: scales 1" to ¼ mile, 1" to ½ mile.
Reconnaissance mapping: scale 1" to 2 miles.

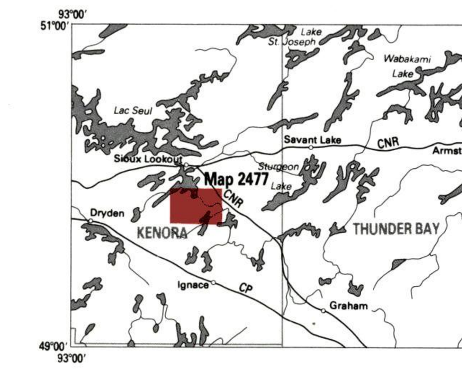
Ministry of Natural Resources
Ontario

Ontario Geological Survey

Map 2477

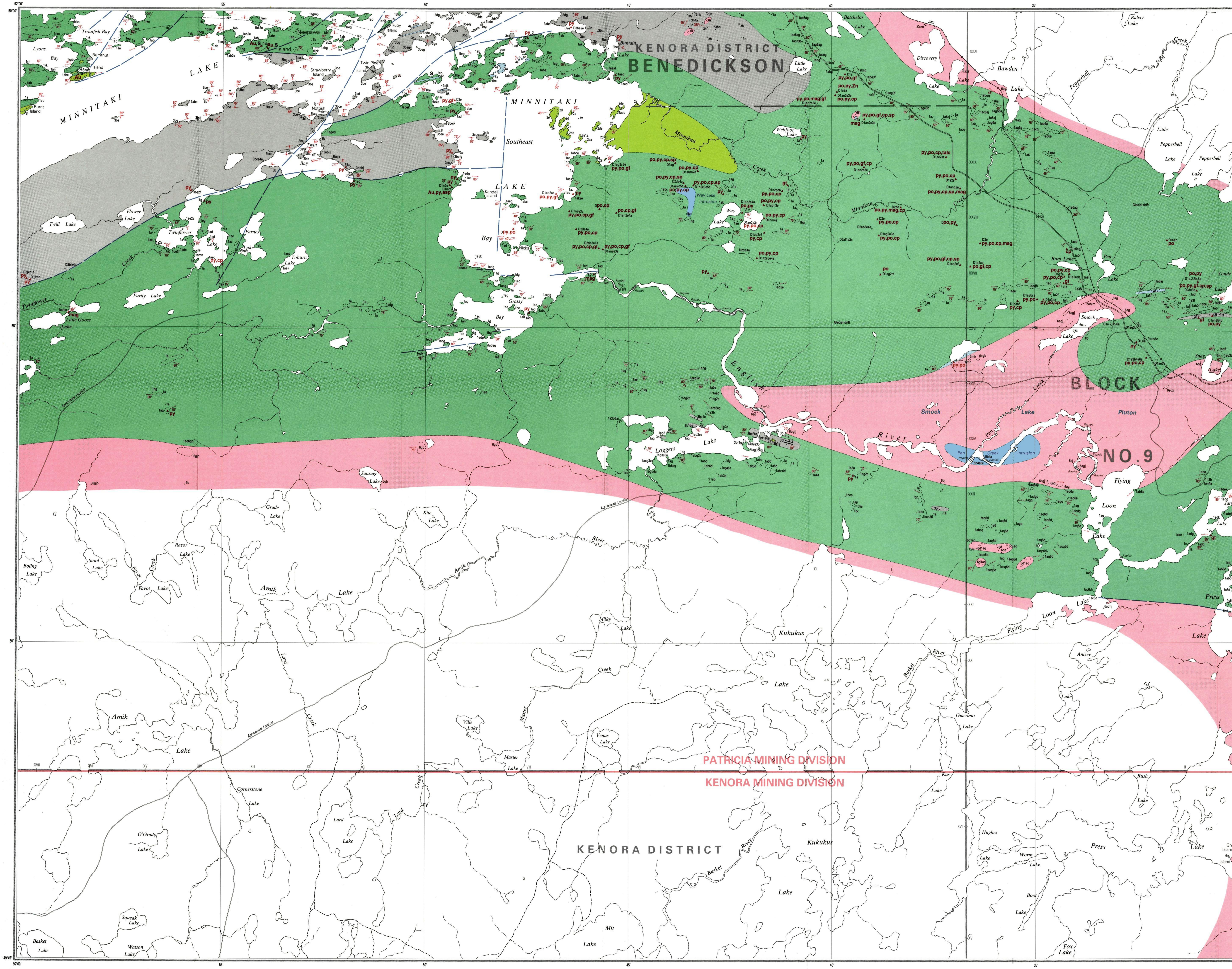
LOGGERS LAKE

PRECAMBRIAN GEOLOGY
SCALE 1:50 000



Aeromagnetic reference 1137G
NTS reference 52G/13

Published 1982



Scale 1:50 000

Metres 1000 0 1 2 3 4 5 6 7 Kilometres

Chains 80 40 0 1 2 3 Miles

LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Glacial drift, sand and gravel, swamp deposits.

UNCONFORMITY

PRECAMBRIAN

EARLY PRECAMBRIAN (ARCHEAN)

FELSIC TO INTERMEDIATE INTRUSIVE ROCKS

- 6 *Unsubdivided.*
- 6a *Massive to weakly foliated trondhjemite, granodiorite.*[a]
- 6b *Foliated granodiorite, trondhjemite.*[a]
- 6c *Quartz monzonite.*
- 6d *Diorite, quartz diorite.*[b]
- 6e *Aplite.*
- 6f *Xenolithic granitic rocks.*
- 6g *Biotite, hornblende-biotite granitic rocks.*
- 6h *Hornblende, biotite-hornblende granitic rocks.*
- 6j *Feldspar porphyritic granitic rocks.*
- 6k *Quartz, feldspar-quartz porphyritic (subvolcanic) granitic rocks.*
- 6m *Monzonite.*

INTRUSIVE CONTACT

ULTRAMAFIC INTRUSIVE ROCKS

- 5a *Peridotite, serpentinized peridotite.*
- 5b *Pyroxenite, hornblendite.*

INTRUSIVE CONTACT

MAFIC INTRUSIVE ROCKS[c]

- 4a *Gabbro, diorite.*
- 4b *Porphyritic (feldspar) gabbro, diorite.*

INTRUSIVE CONTACT

METASEDIMENTS

- 3 *Unsubdivided.*
- 3a *Sandstone.*
- 3b *Wacke.*
- 3c *Arenite.*
- 3d *Arkose.*
- 3e *Mudstone.*[d]
- 3f *Siltstone.*
- 3g *Granitoid-clast conglomerate.*
- 3h *Volcanic-clast conglomerate.*
- 3j *Hematite-magnetite ironstone.*
- 3k *Chert.*

METAVOLCANICS

FELSIC TO INTERMEDIATE METAVOLCANICS

- 2 *Unsubdivided.*
- 2a *Massive fine- to medium-grained flows.*
- 2b *Amygdaloidal, vesicular flows.*
- 2c *Quartz porphyritic, quartz-feldspar porphyritic flows, tuffs.*
- 2d *Tuff-breccia.*
- 2e *Tuff, lapilli tuff.*
- 2f *Quartz porphyry, quartz feldspar porphyry (subvolcanic) intrusions.*

MAFIC TO INTERMEDIATE METAVOLCANICS

- 1 *Unsubdivided.*
- 1a *Massive fine- to medium-grained flows.*
- 1b *Massive medium- to coarse-grained flows.*
- 1c *Medium- to coarse-grained synvolcanic sills (flows).*
- 1d *Amygdaloidal, vesicular flows.*
- 1e *Pillowed flows.*
- 1g *Porphyritic (feldspar/amphibole) flows.*
- 1h *Volcanic breccia.*[e]
- 1j *Hyaloclastic breccia (pillow breccia).*
- 1k *Autoclastic (flow, crumble) breccia.*
- 1m *Tuff breccia.*
- 1n *Tuff, lapilli tuff.*
- 1p *Variolitic flows.*
- 1q *Amphibolitized flows.*
- 1r *Calc-alkaline (basalt, andesite) flows.*[f]

S *Sulphide mineralization*

Where in places a formation is too narrow to show in colour and must be represented in black, a short black bar appears in the appropriate block.

[a]*May include subvolcanic intrusions.*

[b]*May include some mafic intrusive rocks.*

[c]*May include some medium- to coarse-grained mafic metavolcanic rocks.*

[d]*Includes argillite, slate, shale.*

[e]*Occurs only on Map 2458 as unit 1e.*

[f]*Coded to show distribution of mafic to intermediate metavolcanic rocks predominantly of calc-alkaline affinity; other mafic to intermediate metavolcanic rocks are predominantly of basaltic tholeiite affinity.*

The letter "D" preceding a rock unit number, for example "D4a" indicates identification from diamond drill cores.

Motor road, with Provincial Highway number if applicable. 642
Minor road, surface condition variable.
Trail, winter road or portage.
Railway.
Electric power transmission line.
Building, built-up area.
Elevation in feet. 1092'
Pit (sand, gravel).
Esker.

International, provincial boundary, approximate position only.
Regional municipality, territorial district, boundary approximate position only.
Geographic township boundary, base or meridian line, with milepost; approximate position only.
Surveyed line, approximate position only.
Mining Division, boundary approximate position only.
Indian Reserve, Provincial Park, boundary approximate position only.
Swamp, inundated land.

SYMBOLS

Small bedrock outcrop.

Area of bedrock outcrop.

75° *Bedding, top unknown; (inclined, vertical).*

70° *Bedding, top indicated by arrow; (inclined, vertical, overturned).*

70° *Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).*

Bedding, top (arrow) from relationship of cleavage and bedding; (inclined, overturned).

Lava flow; top (arrow) from pillows shape and packing.

80° *Schistosity; (horizontal, inclined, vertical).*

80° *Foliation; (horizontal, inclined, vertical).*

35° *Lineation with plunge.*

Geological boundary, position interpreted.

Geological boundary, deduced from geophysics.

Lineament or fault.

80° 80° *Drag folds with plunge.*

Mineral occurrence.

Drill hole.

METAL AND MINERAL REFERENCE

asp	*Arsenopyrite.*	**po**	*Pyrrhotite.*
Au	*Gold.*	**py**	*Pyrite.*
cp	*Chalcopyrite.*	**sp**	*Sphalerite.*
gf	*Graphite.*	**talc**	*Talc.*
gt	*Garnet.*	**Zn**	*Zinc.*
mag	*Magnetite.*		

MINERAL PRODUCTION AND RESOURCES

Gold, molybdenum, copper and iron mineralization have been reported in the area. While several old shafts and workings are present on former gold properties there is no mention in the literature of any actual production. Neither are there any mines presently in operation.
Gold is found in quartz veins that cut the mafic metavolcanic sequences, specifically those near the contact with the Minnitaki Group metasediments.
Disseminated molybdenum and copper mineralization occurs in epizonal, possibly subvolcanic, intrusions.
Ferruginous chemical metasediments are situated within the Minnitaki Group metasediments.
Pleistocene sand and gravel deposits are used for road construction and maintenance.

SOURCES OF INFORMATION

Geology from published maps of the Ontario Geological Survey, Ministry of Natural Resources and the Geological Survey of Canada, unpublished maps, files and plans of mining companies, published papers, supplementary mapping by N.F. Trowell, J.R. Bartlett and R.H. Sutcliffe, 1977–8. Geology is not tied to surveyed lines.

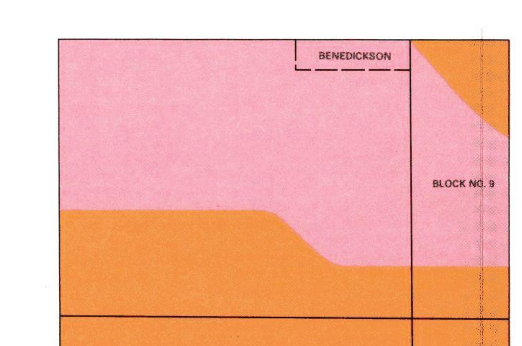
Assessment files, Ministry of Natural Resources, Sioux Lookout and Toronto offices.

Cartography by P.A. Wisbey and assistants, Surveys and Mapping Branch, 1982.

Topography derived from Forest Resources Inventory maps, Surveys and Mapping Branch, with additional information by N.F. Trowell.

Magnetic declination in the area was approximately 3° East, 1978.

Trowell, N.F., Bartlett, J.R. and Sutcliffe, R.H. 1982: Loggers Lake; Ontario Geological Survey, Map 2477, Precambrian Geology Series, scale 1:50 000, geology 1977–8.



GEOLOGICAL MAP COVERAGE

Detailed mapping: scale 1" to 1/4 mile, 1" to 1/2 mile.

Reconnaissance mapping: scale 1" to 2 miles.