ISSN 0704-2582
ISBN 0-7743-6950-7

Ontario Geological Survey
Report 218

Geology of the Heron Bay Area
District of Thunder Bay

by
T.L. Muir

1982

Ministry of
Natural
Resources

Ontario

Ontario Geological Survey
Report 218

Geology of the Heron Bay Area
District of Thunder Bay

by
T.L. Muir

1982

Ontario

Ministry of Natural Resources

Hon. Alan W. Pope
Minister

W.T. Foster
Deputy Minister

ISSN 0704-2582
ISBN 0-7743-6950-7

Publications of the Ontario Ministry of Natural Resources are available from the following sources. Orders for publications should be accompanied by cheque or money order payable to the *Treasurer of Ontario*.

Reports, maps, and price lists (personal shopping or mail order):

Public Service Centre, Ministry of Natural Resources
Room 1640, Whitney Block, Queen's Park
Toronto, Ontario M7A 1E3

Reports only (personal shopping):

Ontario Government Bookstore
Main Floor, 880 Bay Street
Toronto, Ontario

Reports and maps (mail order or telephone orders):

Publications Services Section, Ministry of Government Services
5th Floor, 880 Bay Street
Toronto, Ontario M7A 1N8
Telephone (local calls), 965-6015
Toll-free long distance, 1-800-268-7540
Toll-free from area code 807, 0-ZENITH-67200

Muir, T.L.

1982: Geology of the Heron Bay Area, District of Thunder Bay; Ontario Geological Survey Report 218. 89p. Accompanied by Map 2439, scale 1:31 680.

1000-81-Thorn

CONTENTS

TABLES

FIGURES

PHOTOGRAPHS

GEOLOGICAL MAP
(back pocket)

CHART

Conversion Factors for Measurements in Ontario Geological Survey Publications

If the reader wishes to convert imperial units to SI (metric) units or SI units to imperial units the following multipliers should be used:

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 cm²	0.155 0	square inches	1 square inch	**6.451 6**	cm²
1 m²	10.763 9	square feet	1 square foot	**0.092 903 04**	m²
1 km²	0.386 10	square miles	1 square mile	2.589 988	km²
1 ha	2.471 054	acres	1 acre	0.404 685 6	ha
			VOLUME		
1 cm³	0.061 02	cubic inches	1 cubic inch	**16.387 064**	cm³
1 m³	35.314 7	cubic feet	1 cubic foot	0.028 316 85	m³
1 m³	1.308 0	cubic yards	1 cubic yard	0.764 555	m³
			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 cooperation with the Coal Association of Canada.

ABSTRACT

The Heron Bay area is situated just east of the town of Marathon, Ontario, and covers about 310 km^2 including most of Pic Township.

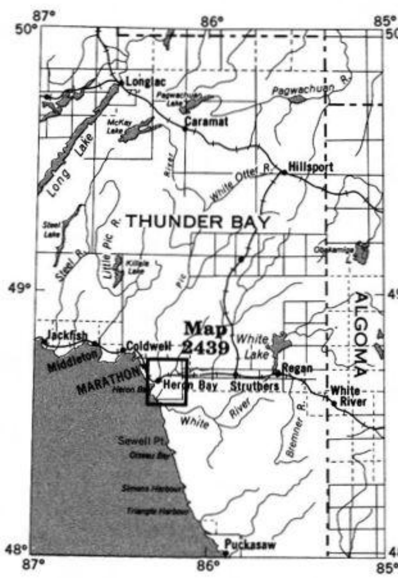
Most of the rocks are of Early Precambrian age. Several Late Precambrian dikes are present and have slightly altered glass stringers and chilled margins.

An east-trending belt consisting mainly of metamorphosed tholeiitic mafic flows with minor intercalated tuffaceous/sedimentary rocks and iron formation lies in the south part of the area between the Pukaskwa Gneissic Complex, which consists of gneissic and foliated trondhjemite and granodiorite, and the Heron Bay Pluton, which consists mainly of massive granodiorite. Many of the volcanic and sedimentary rocks underlying the remainder of the area comprise a calc-alkalic suite of metamorphosed pyroclastic rocks ranging from basalt to rhyolite in chemical composition. A large proportion of these rocks consists of dacitic to rhyolitic pyroclastic breccia. Fragment size generally decreases away from the vicinity of Heron Bay which suggests that a volcanic centre lay within or near Heron Bay. Sedimentary rocks derived mostly from the calc-alkalic volcanic rocks tend to be more abundant away from Heron Bay. The northeast part of the area is underlain by the Gowan Lake Pluton which consists mostly of lineated to massive quartz monzonite. Pyroxenite and minor lherzolite have intruded the tholeiitic volcanic rocks. All of the previously mentioned rocks have been cut by subalkalic diabase dikes which have a predominant northerly trend.

The Port Coldwell Alkalic Complex lies in the northwest part of the area and comprises various types of gabbro and monzonite. Late, mostly alkalic dikes consisting mainly of northerly-trending diabase, lamprophyre, gabbro, and syenite have cut all of the above-mentioned rocks except for the gabbro and monzonite of the complex itself.

Major lineaments, which may represent faults, now form the Pic River valley, several east-trending valleys in the tholeiitic metavolcanic belt, and Heron Bay including an east-northeast-trending extension from the bay. The metavolcanic and metasedimentary supracrustal rocks are generally conformable to the outlines of the granitic plutons, whereas the Port Coldwell Alkalic Complex is a discordant intrusion.

Exploration activity has examined copper mineralization associated with the contact gabbro of the alkalic complex and molybdenum mineralization associated with a quartz vein which intrudes the ultramafic rocks. Interesting gold and silver values have been obtained from some mineralized zones within the intermediate to felsic pyroclastic rocks near Heron Bay.



SMC 14464

Figure 1—*Key map showing location of the Heron Bay area.*

Geology of the Heron Bay Area
District of Thunder Bay

by

T.L. Muir[1]

INTRODUCTION

Location

The Heron Bay area is situated in the District of Thunder Bay, on the north shore of Lake Superior, and is bounded by Longitudes 86°07'30'' and 86°22'30''W, and Latitudes 48°33'N and 48°45'N. The area includes all but the northernmost part of Pic Township and portions of Cotte Township (formerly Township 75), Lecours Township (formerly Township 74), and part of the Mussy Lake Area. The map-area covers about 310 km^2 of land. The small town of Heron Bay is situated in the west-central part of the area and, by highway, is about 340 km east of Thunder Bay and about 420 km northwest of Sault Ste. Marie.

Access

The area can be reached by Highway 17 (Trans-Canada Highway — Lake Superior Route) from the east and the northwest. The highway provides access across the northern third of the area. The Canadian Pacific Railway closely parallels Highway 17 in the eastern part, but branches off to the south, then to the west through the town of Heron Bay and finally swings northwest to the town of Marathon which lies just outside of the map-area near the northwest corner. Highway 627, which roughly parallels the Pic River, connects Highway 17 to Heron Bay, and extends further south, through the Pic River Band Indian Reserve No. 50 to the Pic River estuary. A short gravel road from Highway 17 east of the Black River leads southwest to a waterfall and gorge where a bridge is washed out; a perilous bridge over a creek may hamper travel beyond 1.6 km from Highway 17. A hydro access road beginning outside of the map-area at Highway 17 meanders and passes through the east-central part of the area for about 5 km. Seasonal washouts restrict the use of this road. Some old, minor logging roads are present in the northwest part of the area.

The Pic River is navigable and flows in a southerly direction through the central part of the area. The Black River meanders in an irregular fashion through the eastern and central portions before joining the Pic River. The Black River is navigable except for a set of rapids and a waterfall which may be circumvented by an easily traceable but arduous portage of about 0.8 km in length. The White River flows through part of the south-central portion of the area and is navigable for about 4.0 km from its mouth before reaching the Chigamiwinigum Falls and rapids near the south border of the map-area. Lake Superior provides access to about 70 to 80 km of well-exposed inundated shoreline and islands.

---

[1]Geologist, Precambrian Geology Section, Ontario Geological Survey, Toronto. Manuscript approved for publication by the Chief Geologist, Dec. 22, 1978. This report is published with the permission of E.G. Pye, Director, Ontario Geological Survey.

All the lakes in the area are small, and only a few are suitable for landing fixed-wing aircraft. Helicopter access is useful for sections in the northeast and central-southeast parts of the map-area. During the 1977 field season the nearest helicopter charter facilities were in Thunder Bay.

Physiography

Highways 17 and 627 generally pass through relatively flat areas of glaciolacustrine deposits which belies the fact that much of the map-area's relief away from the highways is in the order of 60 to 90 m. Maximum relief in the area is in the south-central part and is about 160 m above the mean level for Lake Superior which is approximately 184 m above sea level.

Flat-lying areas occur in the Pic and Black River valleys. Elevation changes along the rivers are small, as for example with the Pic River which flows for about 18 km through the area but drops less than 15 m in elevation.

Bedrock exposure is well developed in several places and generally corresponds to areas of high relief. Examples are: the area extending from the south-central border to the central and east-central parts of the map-area; the area around Heron Bay to as far south as Channel Island; and the northeastern part of the area. In granitic terrains, jointing (and faulting) have produced well-defined lineaments which separate higher, multi-level 'blocks' of outcrop. In the Pulpwood-Playter Harbours area and the area to the east there are several east-trending ridges and valleys which form prominent lineaments.

Streams and creeks are numerous in some areas, particularly those overlying well-jointed or glacially-grooved rocks. Drainage north of a line running east from the Pic River estuary (except near the Lake Superior shoreline) is towards the Pic and Black Rivers which flow into Lake Superior. South of this line drainage is mainly to the west as governed by topography.

The shoreline along Lake Superior is rugged in places. Over 95 percent of the shoreline has exposed rock, which varies from smooth, partly rounded, and flat rocks, to steep, rugged cliffs, depending on its orientation with respect to present wave and ice action, glacial action, and rock structure. Scenery along the shoreline and from several vantage points inland is impressive and beautiful under good weather conditions. Evidence along the shore of severe storms is common. Log jams (made of pulpwood logs lost from log booms) are of several ages and were observed at the vegetation line as high as 7 m above water level. Seasonal ice gouges and scrapes in rock and in some lichen/moss cover attest to the action of yearly winter breakups. Lichen and moss are kept to a bare minimum over wide stretches of flat-lying shoreline and much of the other portions of the shoreline. High outcrops with little soil or moss cover are heavily covered with lichen cover near the shoreline and inland. Glacial action has produced poorly developed roche moutonnée structures in some outcrops. In other areas an up and down step-like surface remains where large sections or blocks of rock have been plucked up and transported. Ancient glacial water drainage has left many smooth and occasionally deep, mildly meandering channels on the shoreline and throughout the inland areas.

Previous Work

Previous geological work in the area is limited. Some of the first work was done by R. Bell (1873) for the Geological Survey of Canada in which he reported on the area between Lakes Superior and Winnipeg. Reconnaissance examinations mostly along the Pic River and in the Heron Bay area were carried out by A.P. Coleman (1899, 1900) for several years. The Port Coldwell Alkalic Complex has been the subject of attention for many years. The earliest reference to these rocks is by Sir William E. Logan (1847) and an examination of the nepheline syenites of the complex was reported by H.L. Kerr (1910).

In 1930, J.E. Thompson (1931) mapped much of the present map-area as well as areas to the east and north. His general configuration of granitic and volcanic rocks proved to be useful to the author.

F.P. Puskas (1967a,b) assembled previous work of mapping of the Port Coldwell Complex (done in 1958 and 1959) and added further information from his mapping undertaken in 1960 and 1961.

The area immediately to the north of Pic Township was mapped in detail by V.G. Milne (1967, 1968) and Heron Bay and a large area to the north was mapped at reconnaissance scale by G. Bennett *et al.* (1969).

Present Field Work

The field work for this project was carried out during the summer field season of 1977 as reported in the annual summary of field work (Muir 1977). Vertical aerial photographs at a scale of 1 inch to ¼ mile (1:15 840) were supplied by the Timber Branch, Ontario Ministry of Natural Resources and were used for mapping control. Acetate overlays were used to record data that were collected on traverses which were run by the pace and compass method.

Information from mapping was plotted on Forestry Resources Inventory base maps, numbered 485861, 485862, 486861, and 486862. All outcrops were plotted onto base maps with the aid of a sketchmaster to limit the discrepancies between base map and aerial photograph scales. Recent information with respect to roads, buildings, powerlines, ponds, and shoreline features was added to the base maps. Geology was not tied to surveyed lines.

Traverses were not spaced at regular intervals but were designed to include as many of the major outcrop areas as possible. The granitic plutons did not receive as thorough a coverage as the remainder of the area. Some of the interior sections, extremities, and isolated outcrops of the Port Coldwell intrusion were not examined. Information was compiled from previously issued maps. Considerable time was spent on the shore line of Lake Superior where excellent exposure is present. Heavy lichen cover inland restricted the projection of detailed data from the shoreline. The extreme detail observable on the shoreline could not be represented other than in a general way on the preliminary map (Muir and Barnett 1978a,b) and final map (back pocket).

A 4.87 m deep-hull aluminum boat with a 25 horsepower longshaft motor (and emergency motor, oars, and paddles) were used extensively for mapping on Lake Superior. Caution is extended to others that this should be the minimum of equipment that is used on the lake because weather conditions can change rapidly.

Acknowledgments

The writer was ably assisted in the mapping during the field season by E.S. Barnett as senior assistant who also conducted the fly camps. Capable assistance was provided by C. Dellio, A. Maxwell, and R. Spracklin as junior assistants. Their help during the field season was greatly appreciated.

Thanks are extended to Frank and Mary Lieben of Marathon, and to Marty and Stephanie Peevic of Heron Bay for their hospitality. The author appreciated the assistance of B. Haas, then Ministry of Natural Resources District Manager at Terrace Bay, in obtaining equipment for use on Lake Superior.

GENERAL GEOLOGY

Metamorphosed Early Precambrian (Archean) volcanic, sedimentary, and plutonic rocks constitute most of the bedrock of the Heron Bay map-area. With the possible exception of the Pukaskwa Gneissic Complex (Bennett *et al.* 1969) the oldest rocks are the volcanic and sedimentary units. Field observations and chemical analyses generally support the conclusion that two suites of volcanic rocks are present: a tholeiitic suite consisting generally of iron-rich basalt and minor andesite, which lies in an east-trending belt in the southern part of the area; and a calc-alkalic suite consisting of dacite to rhyolite pyroclastic breccia, tuff-breccia, and lapilli-tuff as well as lesser andesite and basalt. Iron formation and thin, intercalated tuff and sediment units are present in the tholeiitic rocks in the Pulpwood-Playter Harbours area. Siltstone, wacke, and shale units are present within or adjacent to the intermediate to felsic pyroclastic rocks.

Small, discontinuous sill-like bodies of pyroxenite, gabbro, and lherzolite (in decreasing order of abundance) have intruded the tholeiitic rocks at multiple levels within the volcanic pile. The pyroxenite, gabbro, and some overlying pillowed mafic flows may have differentiated from a common magma.

Parts of three large granitic bodies lie within the map area. The largest and probably the oldest is the Pukaskwa Gneissic Complex which underlies the southernmost portion of the area. These rocks are predominantly gneissic trondhjemite and granodiorite and may represent ancient basement rocks. The Gowan Lake Pluton (Milne 1968) which underlies the northeastern portion of the area consists mostly of lineated and massive biotite-hornblende quartz monzonite. The east-central portion of the area is underlain by a large intrusive body which consists mostly of granodiorite and which is referred to in this report as the Heron Bay Pluton. Bedding and (or) foliation in the adjacent metavolcanic and metasedimentary rocks generally parallels the margins of the granitic batholiths.

Numerous diabase dikes have intruded all of the Early Precambrian rocks. Only a few of the dikes have any significant mappable continuity.

The Port Coldwell Alkalic Complex (Kerr 1910; Puskas 1967) underlies the northwestern part of the map-area and is of Late Precambrian age (Fairbairn *et al.* 1959). In this area, the bulk of the complex is composed of various types of alkalic gabbro and monzonite. Later alkalic dikes may be differentiates of the complex. Although the dikes were not observed transecting rocks of the complex, they do intrude all other rock types, and are of approximately the same age as the complex.

Major faults in the area may coincide with the Pic River valley and one or more of the east-trending valleys that parallel Playter Harbour. Neither relative movement nor displacement were determined for these 'faults'. The rocks in and around Heron Bay have been sheared which suggests another possible fault that trends east-northeast from Lake Superior. No major folds in the area were positively delineated although it is certain that large scale deformation around the batholiths has occurred.

Table 1 summarizes the lithological units that were mapped.

TABLE 1. TABLE OF LITHOLOGIC UNITS FOR THE HERON BAY AREA.

CENOZOIC

QUATERNARY

RECENT

Swamp, lake, and stream deposits.

PLEISTOCENE

Glaciolacustrine varved clay, clay, silt, sand, pebble, cobble, and boulder deposits.

Unconformity

LATE PRECAMBRIAN (PROTEROZOIC)

ALKALIC INTRUSIVE ROCKS

ALKALIC AND RELATED DIKES

Gabbro, diabase, porphyritic diabase, lamprophyres, porphyritic gabbro, porphyritic syenite, carbonatite, intrusion breccia (diatreme).

PORT COLDWELL ALKALIC COMPLEX

Biotite gabbro, olivine gabbro, layered gabbro, pyroxene monzonite, hornblende quartz syenite pegmatite, contact breccia, hybrid rocks.

Intrusive Contact

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

MAFIC INTRUSIVE ROCKS

Diabase, porphyritic diabase, olivine diabase, quartz diabase.

Intrusive Contact

EARLY PRECAMBRIAN (ARCHEAN)

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

LATE FELSIC DIKES AND SILLS

Quartz-feldspar porphyry, feldspar porphyry, aplite, pegmatite, trondhjemite.

HERON BAY PLUTON

Porphyritic (microcline) biotite-hornblende granodiorite, hornblende-biotite granodiorite, biotite granodiorite, porphyritic (hornblende) biotite-hornblende granodiorite, porphyritic (plagioclase) biotite-hornblende granodiorite, hybrid rock.

GOWAN LAKE PLUTON

Porphyritic (microcline) biotite-hornblende quartz monzonite; biotite-hornblende quartz monzonite, hybrid rock.

PUKASKWA GNEISSIC COMPLEX

Porphyritic (plagioclase) hornblende-biotite granodiorite gneiss, porphyritic (plagioclase) hornblende-biotite trondhjemite gneiss, biotite granodiorite, biotite quartz monzonite, hybrid rock.

METAMORPHOSED ULTRAMAFIC INTRUSIVE ROCKS

Lherzolite, dunite, pyroxenite.

METAMORPHOSED MAFIC INTRUSIVE ROCKS

Gabbro, diorite, schistose gabbro dikes, schistose diatreme gabbro dike, schistose diorite dike.

Intrusive Contact

METASEDIMENTS

CHEMICAL METASEDIMENTS

Banded magnetite-amphibole-chert iron formation, chert-carbonate-pyrite rocks.

CLASTIC METASEDIMENTS

Shale, siltstone, finely-laminated mudstone and siltstone, sandstone, wacke and arkose.

continued

METAVOLCANICS
INTERMEDIATE TO FELSIC METAVOLCANICS

Light grey or green to white flows, light green pillowed flows, spherulitic flows, quartz-feldspar porphyry (rhyolite), pyroclastic breccia and tuff-breccia, lapilli tuff and tuff, crystal tuff, rhyolite pyroclastic breccia.

MAFIC METAVOLCANICS

Massive, pillowed, variolitic, amygdaloidal, and porphyritic (plagioclase) flows, pillow breccia, pyroclastic breccia and tuff breccia, tuff and lapilli tuff, laminated (epidote layers) flows.

Early Precambrian (Archean)

METAVOLCANICS

Mafic Metavolcanics

The mafic metavolcanics of the Heron Bay area belong to two chemical suites: a tholeiitic sequence which lies mainly in a belt trending east from the Pulpwood-Playter Harbours area, and a calc-alkalic sequence which includes the rocks to the north of the tholeiitic belt. Although one sample taken from the shoreline north of Channel Island indicates a tholeiitic basalt composition, all other analyses conform to the above-mentioned grouping. However, it must be kept in mind that a significantly limited chemical analysis program was undertaken, so that the geographical separation may be oversimplified.

PULPWOOD-PLAYTER HARBOURS SEQUENCE

Mafic metavolcanics of the Pulpwood-Playter Harbours sequence consist of several different types of flows. Chemical analyses are listed in Table 2. Most common are massive flows and flows with pillow-like structures (referred to hereafter as 'pillows' for simplicity). The massive flows are generally less than 2 m thick. The pillows are commonly long and narrow, having maximum and minimum observed dimensions of 3 m by 0.15 m. In some cases, top and bottom pillow surfaces are relatively flat. In others, one or more protrusions may exist on one side of the pillow but similar features may also appear on the other side thereby rendering top determinations difficult or impossible. The rocks are medium to dark green with very-fine-grained dark green selvages that are deeply weathered especially along shoreline areas where water and ice have their greatest effect (Photo 1). These pillow-like structures are interpreted by the author to represent a number of thin, successive flows with numerous lobes or toes.

Variolitic, pillowed, and massive flows are common in the tholeiitic suite and locally are the predominant stratigraphic unit. Mafic dikes, which are possibly feeder-dikes, intrude the pillowed, variolitic flows and the flows with pillow-like structures (Photo 1). Many of the dikes are variolitic. Variolitic flows are similar in structure and colour to the non-variolitic flows except for the presence of varioles. The varioles weather a beige colour and vary from about 1 mm to 15 mm long and <1 mm to 10 mm wide. In fresh surfaces they are very difficult to detect. Varioles have formed quite differently from pillow to pillow; some pillows have discrete varioles throughout, whereas others have centres composed of a mass of coalesced varioles. The varioles tend to be smaller towards the pillow selvages.

Close to the ultramafic and mafic intrusions, the mafic volcanic rocks are very dark green to green-black and superficially resemble the intrusions. The rocks include massive and pillowed flows; no variolites are present.

Minor fine- to medium-grained porphyritic mafic flows containing less than 1 percent stubby, unoriented, plagioclase phenocrysts (1 to 2 mm) are present in this area. Massive,

TABLE 2. CHEMICAL ANALYSES OF MAFIC METAVOLCANICS IN THE HERON BAY AREA.

	1	2	3	4	5	6	7	8
SiO_2	47.9	48.1	46.2	47.9	45.7	55.0	58.2	57.5
Al_2O_3	15.5	13.9	12.7	12.4	14.2	18.4	17.3	16.6
Fe_2O_3			1.90	1.70				
	11.6[1]	16.0[1]			19.1[1]	7.24[1]	6.27[1]	7.33[1]
FeO			13.8	9.20				
MgO	7.6	7.72	6.30	11.3	5.31	4.88	4.08	4.23
CaO	11.9	7.38	9.56	11.0	9.58	7.51	5.03	6.56
Na_2O	2.41	3.04	3.53	2.10	1.85	3.62	5.02	4.94
K_2O	0.18	0.95	0.17	0.18	0.22	0.72	0.82	0.47
TiO_2	0.82	1.19	2.11	0.67	2.49	0.63	0.61	0.58
P_2O_5	0.04	0.08	0.12	0.04	0.18	0.08	0.13	0.11
MnO	0.18	0.22	0.25	0.21	0.26	0.12	0.11	0.12
S	–[2]	–[2]	0.12	0.02	–[2]	–[2]	–[2]	–[2]
H_2O^+			0.94	1.79				
H_2O^-	1.90[3]	2.00[3]	0.26	0.36	0.70[3]	2.40[3]	1.50[3]	1.10[3]
CO_2			1.24	1.50				
TOTAL	100.0	100.6	99.2	100.4	99.6	100.6	99.1	99.5
S.G.	3.07	3.03	3.13	3.06	3.24	2.81	2.71	2.48
N.P.C.[4]	58.86	44.04	36.62	55.88	64.21	49.49	33.06	32.89

SPECIMENS (See Table 16 and Figure 3 for locations.)
1 M483-77 Porphyritic (plagioclase).
2 M637-77 Medium grained
3 M595-77 Pillowed, green-black
4 M630-77 Pillowed variolite.
5 M498-77 Tuff, green-black.
6 M643-77 Pyroclastic breccia (matrix) of pillow breccia sequence
7 M636-77 Tuff.
8 M638-77 Lapilli tuff with mafic fragments.

NOTES
[1] Total iron as Fe_2O_3.
[2] Not determined.
[3] All volatiles as loss on ignition.
[4] Normative plagioclase composition.
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

medium-grained flows are common on the point north-northwest of Campbell Point, and along the north shore of Pulpwood Harbour. They are associated with medium- to coarse-grained mafic rocks which have been classified as gabbro in this report. The two rocks were arbitrarily distinguished in the field on the basis of the lath-like aspect of the amphibole in the 'flows', compared to the equigranular coarse-grained habit in the 'gabbro'. Some of the 'flows' or 'gabbro' contain randomly oriented amphibole needles (up to 15 mm) which may be of metamorphic origin.

Few mafic pyroclastic rocks are present in this belt. Some strongly foliated, dark green, tuffaceous rocks are present along the south shore of Playter Harbour (near the contact with the granodiorite/ quartz monzonite pluton). These are shown in Photo 2 interbedded with intermediate to felsic tuffs. Total unit thickness is less than 5 m.

The narrow section of mafic metavolcanics lying just north of Pitch Rock Harbour is within the contact aureole of the granitic rocks; epidote layers and lenses have developed within the amphibolitized and foliated rocks. This feature disappears inland as the unit widens and the distance from the two contacts increases.

10 355

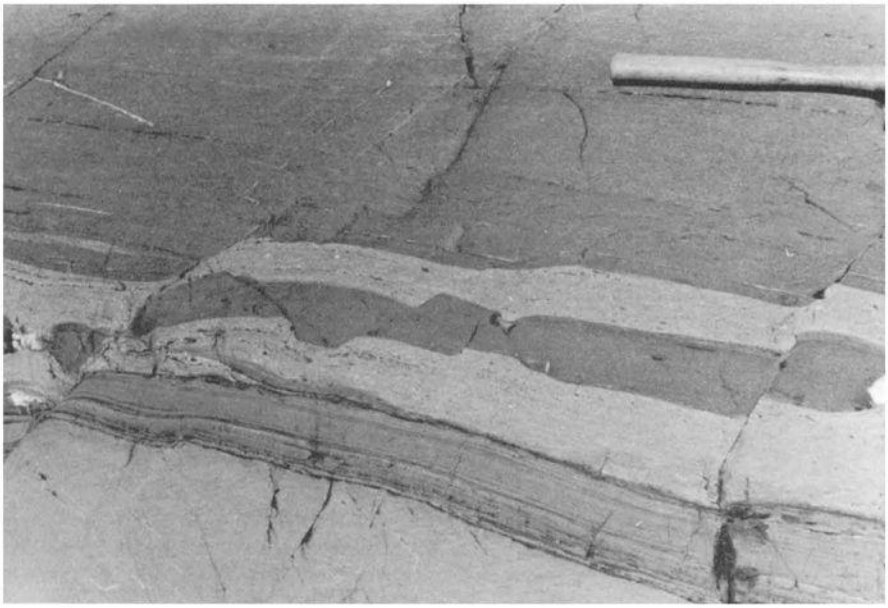
Photo 1—*Variolitic tholeiites as pillow-like structures with later, variolitic, possible feeder dike; Pulpwood Harbour.*

HERON BAY SEQUENCE

The areas of mafic metavolcanics outside of the Pulpwood-Playter Harbours sequence have been grouped together as the Heron Bay sequence for simplicity. Most of the mafic metavolcanics are calc-alkalic in composition and a greater proportion of the rocks are pyroclastic than in the Pulpwood-Playter Harbours sequence.

Massive flows are fine grained and medium green. Pillows, in comparison to the tholeiitic suite, are more elliptical, have thicker selvages, and are lighter in colour. The elliptical shape commonly precluded the determination of top direction. Medium-grained rocks which may be flows or gabbro are locally present.

A pillow-breccia – pyroclastic breccia sequence is present on Randle Point, on Lake Superior. Here, a light to medium green, pillowed unit can be seen in various stages of fragmentation (Photo 3). Hornblende phenocrysts up to 12 mm are common to the pillows, pillow fragments and matrix. Some pillows show only minor disruption (Photo 3) whereas others have been entirely fragmented. Still other exposures show a pyroclastic breccia



10 356

Photo 2—*Mafic tuffs with minor intermediate to felsic tuffs cut by numerous small-displacement faults; boudinaged band at right and left edges of photo; Playter Harbour.*

10 357

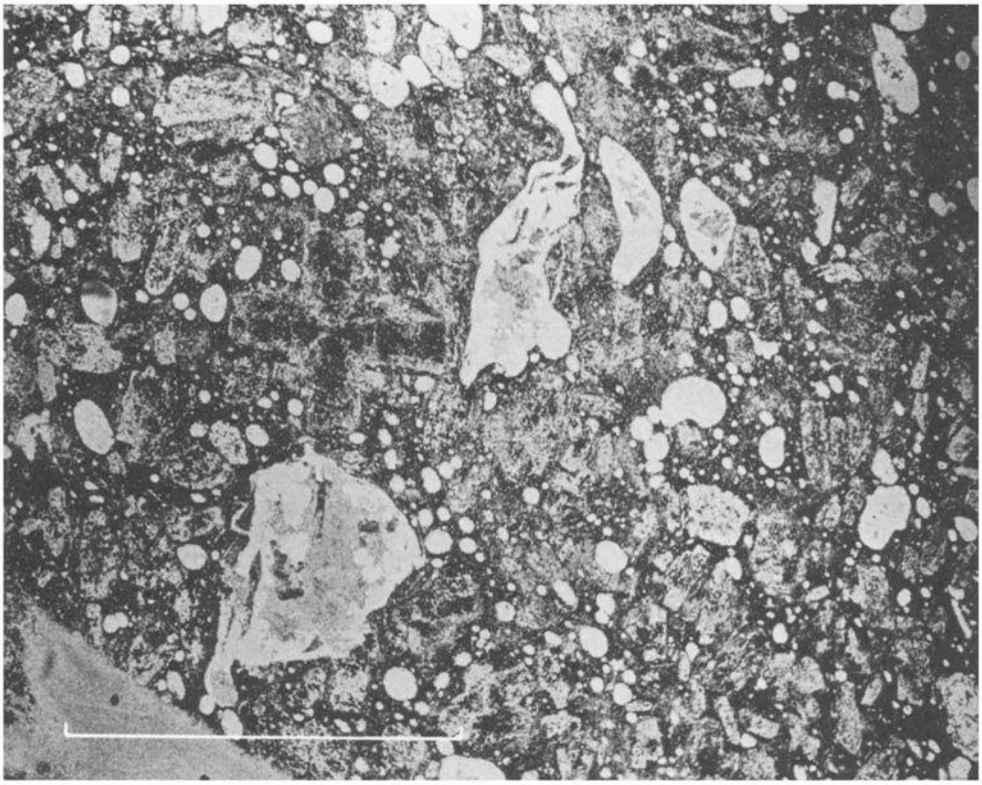
Photo 3—*Broken pillows from pillow breccia sequence in mafic metavolcanics; some fragments have selvage on one side; grey spots are mostly hornblende phenocrysts; Randle Point.*

consisting of light green fragments in a medium green matrix (Photo 4) both of which contain coarse, euhedral, hornblende phenocrysts. A continuous sequence from pillows to pyroclastic breccia was not discerned from the exposure, however, the hornblende crystals suggest a related source. In thin sections the fragments reveal many spherical quartz-carbonate amygdules some of which show minor, primary flattening. Plagioclase phenocrysts are numerous, and some have formed cruciform twins (Photo 5).

Other mafic pyroclastic rocks consist mainly of lapilli-tuff in which mafic to intermediate fragments of a variety of textures are set in a medium green tuffaceous matrix. Some sections of the shoreline east of Channel Island may contain tuffaceous rocks as indicated by faint suggestions of layering and inhomogeneous textures. These features would most certainly have been hidden with a weathered and lichen-covered surface, and it is possible that more fine-grained pyroclastic tuffs are present in the map-area than were recognized.

10 358

Photo 4—*Pyroclastic breccia associated with pillow breccia sequence in mafic metavolcanics; some grey spots are hornblende phenocrysts; Randle Point.*



10 359

***Photo 5**—Photomicrograph (plane light) of amygdaloidal fragment from pyroclastic breccia in Photo 4. Note spherical and deformed (primary) amygdules, as well as altered plagioclase in cruciform twins. Bar scale represents 1 cm.*

The pyroclastic units appear to be small and are not traceable for any appreciable distance.

Amygdaloidal flows are included in the map legend to account for information for the Port Coldwell Complex compiled from Puskas (1967b). The shoreline of Pen Lake was examined by the author and the 'amygdaloidal' mafic flows have been reinterpreted. Some of the amygdule-like structures consist of up to three recognizable concentric rims of different fine-grained minerals. Others have irregular but complex arrangements of minerals. Some minerals present in some of these structures are hematized feldspar, amphibole, epidote, calcite, bornite, chalcopyrite, and malachite (very small amounts of the latter three minerals were seen.) These structures are only found in the map-area within isolated mafic rocks (roof pendants?) or in contact-metamorphosed rocks. Similar structures are found in intermediate pyroclastic rocks southeast of Three Finger Lake. For the above reasons the structures are considered to be of metamorphic origin.

A peculiar rock that is considered to be pyroclastic is found in the Channel Island area. It contains hornblende phenocrysts in a matrix of plagioclase, hornblende, and quartz. Rock fragments (lapilli) are present in which are found quartz amygdules. This rock may be related to the pillow breccia sequence to the north.

Intermediate to Felsic Metavolcanics

Representative samples of a variety of intermediate to felsic metavolcanics were analyzed; all were found to be of a calc-alkalic composition. The rocks appear to belong to a calc-alkalic differentiation suite (see "Petrochemistry"). Chemical analyses of intermediate to felsic metavolcanic rocks are given in Table 3.

In most of the rocks plagioclase is the predominant mineral and occurs mainly as phenocrysts (1 to 4 mm). Many of the hand specimens were stained in the field for potassium feldspar (using a sodium cobaltinitrite solution). Virtually no potassium feldspar was found in any of the hand specimens except along some late hairline fracture fillings in a few of the specimens.

Flows are interpreted to account for a small proportion of the intermediate to felsic metavolcanics. The flows are massive, aphanitic, grey to light green or beige, siliceous rocks, and are best exposed on the shoreline north of Heron Bay, inland to the north, and at one location on Channel Island. Where sufficient exposure is present the units seem to be less than 1 m thick, and virtually structureless. Microscopically they are seen to consist of a very fine-grained mass of felsic minerals, micaceous minerals, epidote, and some opaque minerals. Recognizeable features are not evident and it is possible that some of these rocks may be siliceous chemical sedimentary rocks. They are dacitic to rhyolitic in chemical composition.

Minor, intermediate, pillowed flows lie just north of the large lake north of Heron Bay. The pillows are light green, elliptical, about 0.3 m long, and rimmed by thick, light-green-weathering selvages. In thin section the pillows are seen to be altered to a mosaic of felsic minerals including carbonate, and minor epidote and opaque minerals.

Spherulitic flows of intermediate composition outcrop along a large portion of shoreline north of Randle Point. They are peculiar rocks and the features they display are difficult to account for by any one mechanism. The 'flows' occur as two varieties: (1) a massive, siliceous, aphanitic, greenish rock with aphanitic, beige, ellipsoidal spherules, and (2) a fine-grained medium-bedded (10 to 25 mm) rock with a greenish-grey matrix, and beige, oval, spherule-like features. In the latter variety both matrix and spherules contain fine-grained plagioclase crystals.

Field observations of the first variety strongly suggest a rock of volcanic origin (Photo 6). In thin section the spherules are undetectable; the rock consists of fine-grained phenocrysts (recrystallized?) of plagioclase and quartz in a groundmass of very fine-grained plagioclase and lesser quartz with minor chlorite, muscovite, and epidote. However, a few small, amygdule-like structures, rimmed and partially filled with dendritic opaques are present, and help to substantiate the interpreted volcanic genesis.

The layered variety is composed of beds as thin as 2 cm which are continuous and straight over distances of up to at least 50 m. The spherule-like structures have coalesced locally to form beige 'beds', separated by grey 'beds', which gives the overall appearance of sedimentary rock or tuff (Photo 7). Deformation has produced elongated spherules with longitudinal axes at an angle of about 25 degrees to the plane of the bed. No sedimentary process known to the author can be invoked to explain these features entirely, nor are these features typical of volcanic rocks. However, the layered variety was classified as volcanic because of its intimate association with the aphanitic massive variety.

North of these rocks are minor, medium to light green, very fine-grained flows with irregularly shaped and distributed patches of poorly defined spherules, and irregularly distributed, fine- to medium-grained, plagioclase phenocrysts. These particular flows overlie the most northern extent of bedded crystal tuffs.

TABLE 3. CHEMICAL ANALYSES OF INTERMEDIATE TO FELSIC METAVOLCANICS IN THE HERON BAY AREA.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SiO_2	74.5	63.8	66.6	68.9	65.1	65.4	64.8	66.6	64.0	67.2	71.9	65.7	71.7	65.1	68.6	70.6
Al_2O_3	13.1	17.0	16.7	16.3	15.8	16.9	15.5	16.1	15.5	16.1	15.3	16.9	11.8	17.7	15.7	16.2
Fe_2O_3	0.53			0.80	1.36				1.20	0.74		1.12	0.16			
		4.53[1]	3.42[1]			3.00[1]	3.69[1]	3.44[1]			2.11			3.14[1]	2.31[1]	1.87[1]
FeO	1.41			0.67	2.08				2.00	2.59		2.45	0.74			
MgO	0.64	1.97	1.49	0.77	1.79	1.73	2.52	1.43	3.69	1.30	0.86	1.77	0.12	2.10	1.08	0.66
CaO	2.28	3.30	3.62	1.51	3.43	3.42	3.09	4.45	2.54	3.26	1.72	5.08	5.02	3.80	2.47	1.12
Na_2O	5.10	6.46	6.45	4.59	4.04	4.17	6.60	4.40	3.77	4.83	4.62	3.95	7.42	5.20	4.52	4.62
K_2O	0.88	0.76	0.47	2.54	2.14	1.99	0.58	1.06	1.83	1.31	1.66	1.51	0.05	1.28	2.66	2.34
TiO_2	0.40	0.54	0.40	0.31	0.49	0.40	0.48	0.39	0.59	0.42	0.22	0.45	0.23	0.49	0.30	0.41
P_2O_5	0.09	0.10	0.08	0.07	0.07	0.10	0.09	0.06	0.05	0.09	0.05	0.08	0.04	0.15	0.04	0.06
MnO	0.05	0.08	0.04	0.02	0.05	0.04	0.05	0.06	0.05	0.05	0.05	0.07	0.05	0.07	0.03	0.02
S	0.08	–[2]	–[2]	0.04	0.09	–[2]	–[2]	–[2]	0.56	0.10	–[2]	0.04	0.14	–[2]	–[2]	–[2]
H_2O^+	0.09			0.62	1.20				1.64	0.37		0.55	0.0			
H_2O^-	0.32	1.70[3]	1.40[3]	0.23	0.28	3.10[3]	3.50[3]	1.00[3]	0.18	0.31	1.60[3]	0.12	0.37	1.10[3]	2.60[3]	2.30[3]
CO_2	0.40			1.66	2.10				2.88	0.56		0.70	3.64			
TOTAL	99.9	100.2	100.7	99.0	100.0	100.2	100.9	99.0	100.5	99.2	100.1	100.5	101.5	100.1	100.3	100.2
S.G.	2.72	2.82	2.74	2.71	2.64	2.80	2.67	2.75	2.49	3.05	2.66	2.92	2.72	2.71	2.69	3.03
N.P.C.[4]	18.30	20.71	20.83	14.58	31.35	30.35	15.61	34.77	26.62	26.44	16.52	40.29	0.0	27.69	22.81	11.07

SPECIMENS (See Table 16 and Figure 3 for locations.)

1 M116-77 Massive, light grey, aphanitic, felsic.
2 M405-77 Massive, greyish, aphanitic, felsic.
3 M118-77 Spherulitic flow, intermediate.
4 M195-77 Quartz-feldspar porphyry.
5 M159-77 Tuff.
6 M303-77 Lapilli tuff.
7 M319-77 Tuff.
8 M128-77 Crystal tuff.

NOTES

[1] Total iron as Fe_2O_3.
[2] Not determined.
[3] All volatiles as loss on ignition.
[4] Normative plagioclase composition.

Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

10 360

***Photo 6**—Spherulitic flow of intermediate composition; spherules deformed and strung out in broad, poorly-defined bands; spherules darker because of local alteration; north of Randle Point.*

Quartz-feldspar porphyry (rhyolite) outcrops on some islands and on restricted shoreline sections in Heron Bay. The rock is pale beige to white and exhibits irregularly spaced and shaped 'schistosity' planes, within an otherwise massive rock. Quartz eyes, (0.5-2 mm) are sparsely distributed throughout the rock. In thin section, numerous highly altered plagioclase phenocrysts can be seen in a very fine-grained (0.1 mm) mosaic of plagioclase and lesser quartz. Minor euhedral to subhedral pyrite crystals are common. It could not be ascertained in the field whether these rocks are flows or subvolcanic intrusions.

Most of the intermediate to felsic rocks are pyroclastic, and the volume of these rocks appears to be significantly greater than in comparably-sized 'greenstone' belts. The area around Heron Bay has the coarsest and most felsic pyroclastic rocks. In general as the distance from Heron Bay increases, the size and proportion of the fragments tends to decrease. Tuffaceous material eventually becomes prominent, and locally, rocks showing good sedimentary features are present or predominant. In terms of mapping, the persistent difficulty of distinguishing tuffs from sedimentary rocks was a plaguing problem. Nevertheless, mapping indicates that the distribution of tuff and sedimentary rocks reflects an overall facies transition rather than a sudden, distinct, lithological change.

Pyroclastic breccia and subordinate tuff-breccia mostly contain felsic fragments although lesser intermediate fragments and minor mafic fragments were found. Fragments vary considerably in size and texture but those of pyroclastic breccia generally range from 64 mm to 256 mm. In some places, isolated blocks of material (generally foreign to the

10 361

Photo 7—*"Bedded" spherulitic flow(?) from location near Photo 6; strung out spherules now form conspicuous bands or "beds"; north of Randle Point.*

composition of most surrounding fragments) are as large as 1.5 m (Photo 8). Most fragments are subangular to subrounded. In many cases the fragments are heterogeneous in texture even though the majority may be of a similar composition. Bedding is rarely visible which prevented significant structural interpretations to be made for much of the area. A rare example of bedding is shown in Photo 9. Where bedding is discernable and where the rocks have been deformed, the strike is generally at an angle of up to 30 degrees to the trace of fragment elongation. Most of the fragments have numerous plagioclase phenocrysts with or without quartz phenocrysts. Blue opaline quartz phenocrysts are common in the area around Heron Bay. The textures of the pyroclastic fragments resemble that of many of the porphyritic sills which cut the crystal tuffs and are similar to unbedded crystal tuffs.

The matrix of the fragmental rocks ranges from intermediate to felsic in composition, and generally consists of small lithic fragments similar in composition to larger lapilli- or breccia-size fragments. Some matrix fragments are so small that fragment outlines cannot be discerned under the microscope. Crystal fragments of plagioclase and quartz may be products of the break-down of porphyritic fragments into smaller and smaller pieces. The matrix in places accounts for as much as 85 percent of the rock and elsewhere as little as 5 percent.

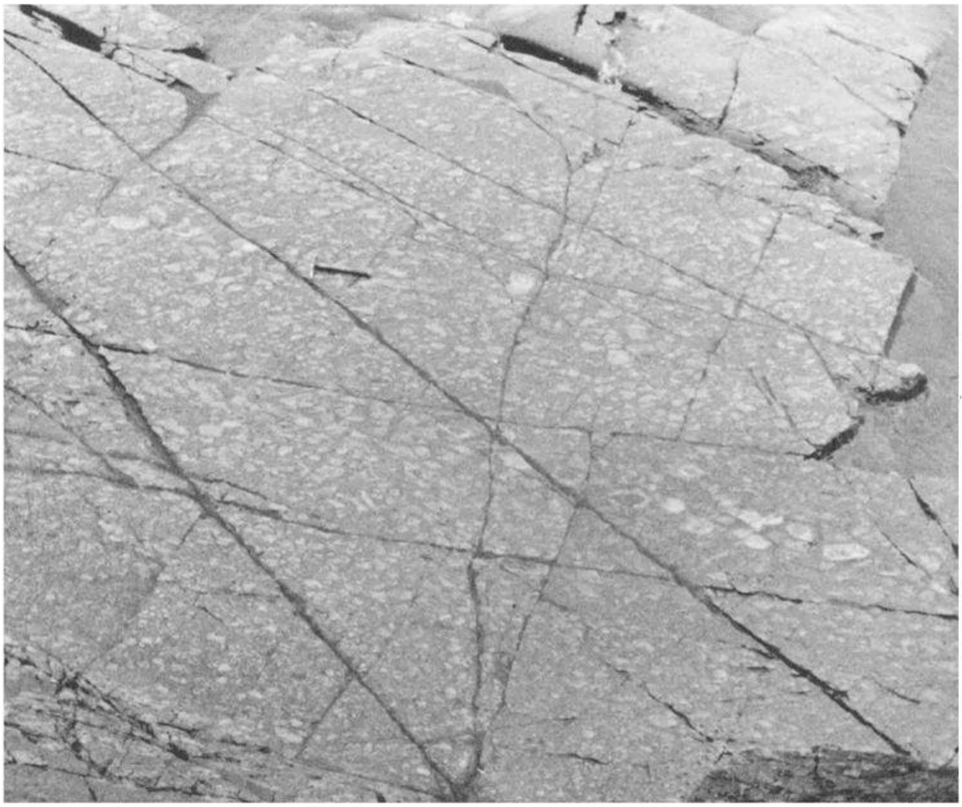
10 362

***Photo 8**—Intermediate to felsic pyroclastic breccia with large mafic volcanic(?) block among smaller sub-rounded, plagioclase-porphyritic fragments; Heron Bay.*

Felsic pyroclastic breccia is present in Heron Bay, particularly along the southern half, and in the large bay that lies between Happy Harbour and Channel Island. The breccia in these two locations are different in makeup and appearance. The breccia in Heron Bay contains up to 95 percent stretched and lineated, very fine-grained, rounded fragments in a felsic matrix. The stretching gives an erroneous bedding appearance, and coupled with the small amount of matrix, locally tends to hide the pyroclastic nature of the rock. Minor (1 percent) pyrite crystals (0.5 to 2 mm) are distributed throughout the rock. In the bay to the south the fragments are not as stretched but form about 70 percent of the rock and are much more variable in size (Photo 10). In both outcrop areas the fragments are essentially monomictic and rhyolitic.

Lapilli-tuff and tuff, which are the predominant type of intermediate to felsic rocks in the map-area, are particularly abundant away from the area around Heron Bay. The lapilli-tuff generally consists of intermediate to felsic lithic fragments which contain crystal fragments of plagioclase; the matrix of the lapilli-tuff is of intermediate composition and contains numerous plagioclase crystals as seen in weathered surfaces. The rocks weather brown, grey, and beige, and are locally rusty, such as east of the Pic River estuary. Visible bedding is more common in lapilli-tuff than in coarser pyroclastic rocks, and beds of fine-grained (0.5 to 1 mm) plagioclase crystals (crystal tuff) are often interbedded with very fine-grained tuff.

Crystal tuff is fairly common in the map-area, particularly north of Heron Bay. Most crystal tuff throughout the area is poorly bedded and contains a significant proportion of plagioclase crystals (an essential component, present in amounts up to 45 percent) and minor quartz crystals (commonly blue and opaline) that range from fine grained (0.5 to

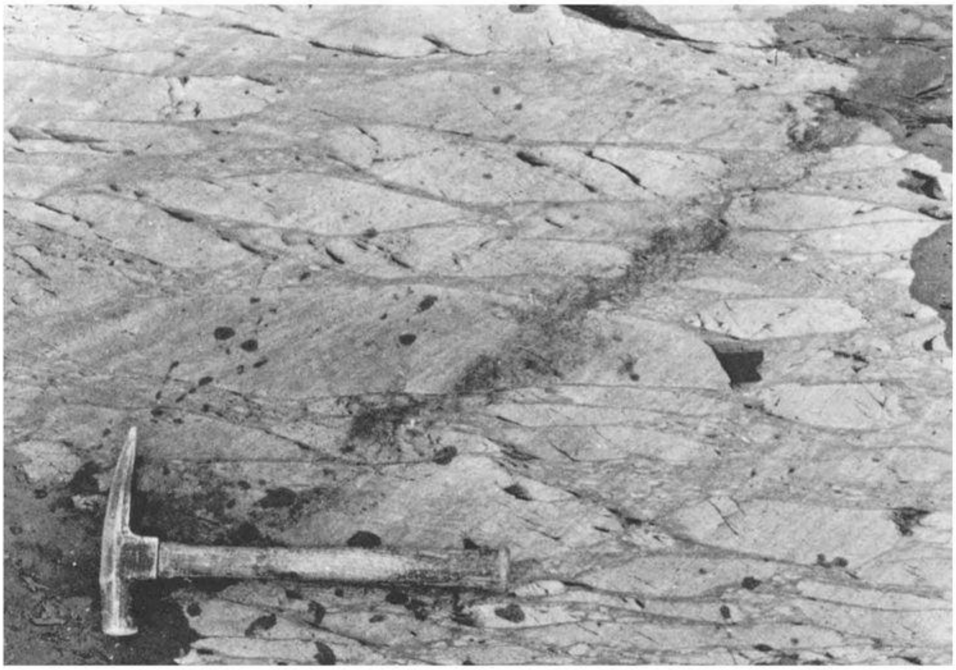


10 363

Photo 9*—Bedded intermediate-composition pyroclastic breccia; bedding evident from changes in fragment size; Randle Point.*

2 mm) to medium grained (4 mm) (uncommon). However, the crystal tuff north of Heron Bay is well bedded. Here, rhythmic bedding, generally less than 3 cm thick, occurs in many of the rocks. The bedding is not evident in fresh surfaces but can be seen in lichen-free, differentially-weathered surfaces, as alternating, medium grey and light grey to beige layers. In some places, isolated lapilli-size fragments can be seen in unbedded and otherwise structureless plagioclase-bearing rocks; if not for the good exposures some of these massive rocks could be mistaken for flows. In some thin sections, small, microcrystalline (0.1 mm) rock fragments are present in the matrix. The matrix is usually a very fine- grained (0.1 to 0.5 mm) non-homogeneous mixture of plagioclase and quartz.

Many of the pyroclastic hand specimens were stained for potassium feldspar. Virtually no potassium feldspar was detected. Some minor hairline fracture fillings became stained but these may have consisted of sericite. The stained rocks included feldspar porphyry (sills) that occurs within the large masses of pyroclastic rocks. Certain foliated felsic porphyries, particularly the narrow units in the mafic volcanic rocks near the granitic intrusions (e.g. Playter Harbour, south shore; north of Pitch Rock Harbour) were not clearly classified in the field as to whether they are crystal tuffs, porphyritic flows, or granitic sills. The staining showed that some of these rocks contain appreciable potassium feldspar. These rocks showed the least similarities to tuff and are not associated with adjacent rocks that would



10 364

Photo 10—*Felsic pyroclastic breccia; stretched fragments in a matrix of lapilli-size fragments; south of Happy Harbour.*

be classified as tuffaceous with any certainty. It is therefore empirically assumed that the potassium-feldspar-bearing porphyries are intrusive and related to the large granite intrusions.

METASEDIMENTS

Clastic Metasediments

Most of the clastic metasediments in the Heron Bay area are siltstone and are commonly in proximity to intermediate to felsic pyroclastic rocks. The largest volume of metasediments in the map-area is a wedge-shaped formation paralleling much of the south border of the Heron Bay Pluton. The maximum interpreted thickness approaches 900 m. The metasediments of this unit consist of grey to brown siltstone with minor dark grey shale and argillite beds. Bed thicknesses generally range from 0.5 cm to 5 cm. Some beds that contain a large proportion of plagioclase crystals (arkose, wacke) are intercalated with the siltstone. In many cases the 'metasediments' are difficult to distinguish from the intermediate to felsic tuff. Metasediments stained for potassium feldspar gave negative results. The presence of plagioclase-rich beds that have phaneritic crystals, the similarity of the tuffs and metasediments (in general), and the lack of potassium feldspar may be evidence that many of the sediments were derived from the intermediate to felsic pyroclastic rocks which commonly have plagioclase phenocrysts.

The metasediments, as seen in thin section, are composed predominantly of very fine-grained felsic minerals, presumably quartz and plagioclase, with 5 to 20 percent preferentially-oriented brown biotite and minor anhedral opaque minerals. Bedding is marked by changes in biotite proportions and (or) very slight changes in grain size.

Minor clastic metasediments are found within tholeiitic mafic metavolcanics in the Pulpwood-Playter Harbours sequence along with intercalated tuff and lapilli-tuff. These thinly bedded metasediments, together with the pyroclastic rocks, form units that are rarely more than 3 m thick. Some very thin (less than 0.5 m) graphitic argillite units which outcrop in Pulpwood Harbour are disrupted by the ultramafic intrusions and contain pyrrhotite, chalcopyrite and possibly pentlandite.

Along the Lake Superior shoreline north of Heron Bay are several small units (less than 5 m thick) of medium to dark grey or black shale and siltstone that are intercalated with crystal tuff and tuff. These units have beds that are from 0.5 to 2.5 cm thick. Some deformation of beds is present solely within the sedimentary unit. Cleavage is present in the shaley beds but is absent in the siltstone beds. The chemical composition of these rocks is given in Table 4 and is somewhat similar to the calc-alkalic basalts.

A relatively large lens of metasediments about 1.2 km north of Randle Point differs from other metasediments in the map-area. The rocks are finely laminated (2 mm) and form a unit about 150 m thick which shows excellent examples of cross-bedding, ripple cross laminations, convolute bedding, and minor slumping. The rocks are medium green to greenish grey, are very fine grained, and in fresh surfaces, no laminations can be seen. The metasediments consist of about 70 percent pale green amphibole and about 30 percent groundmass of very fine-grained felsic material (plagioclase and minor quartz). The rock (Table 4, sample 2) is chemically equivalent to a calc-alkaline basalt and is interpreted to represent distal and (or) shallow water deposits of mafic tuff and mud. It is possible, considering the proximity to rhythmically-banded crystal tuffs (see discussion of crystal tuffs), that these rocks are associated with a turbidite sequence. Further detailed work is needed to confirm this.

TABLE 4. CHEMICAL ANALYSES OF CLASTIC METASEDIMENTS IN THE HERON BAY AREA.

	1	2	3
SiO_2	68.8	54.2	56.7
Al_2O_3	15.7	15.7	15.4
Fe_2O_3[1]	2.32	8.75	7.09
MgO	1.11	6.17	4.38
CaO	2.51	8.82	7.07
Na_2O	4.64	3.22	2.16
K_2O	2.65	0.53	2.78
TiO_2	0.30	0.64	0.60
P_2O_5	0.05	0.12	0.27
MnO	0.03	0.15	0.14
L.O.I.[2]	1.80	2.10	3.00
TOTAL	99.9	100.4	99.6
S.G.	2.72	2.88	2.69

SPECIMENS (See Table 16 and Figure 3 for locations.)
1 M323-77 Siliceous siltstone; grey and light grey beds.
2 M126-77 Laminated mudstone, siltstone; green
3 M133-77 Siltstone, with shale; dark grey.

NOTES
[1] Total iron as Fe_2O_3
[2] Loss on ignition: includes H_2O^+, H_2O^-, CO_2
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Chemical Metasediments

Chemical metasediments constitute a very minor proportion of the sedimentary rocks within the map-area. Of these, banded iron formation containing magnetite, amphibole, and chert is most common. All iron formation units are thin, generally less than 0.3 m, are intercalated with the tholeiitic rocks in the Pulpwood-Playter Harbours sequence, and were only observed to outcrop on shoreline exposures. Iron formation is associated with some of the intercalated metasediment/ tuff units described in the section on clastic metasediments. Banding is poorly developed and discontinuous. Amphibole in places constitutes up to 45 percent of the rock and is associated with magnetite. Chert is rarely pure because it is mixed with fine-grained magnetite. Rare magnetite-rich layers occur locally.

Other minor chemical metasediments are poorly bedded, chert-carbonate-pyrite-bearing units. Only a few such units were found and all are exposed on the lakeshore. These units are also thin and less than 2 m thick. Pyrite is evenly distributed throughout the rock and may amount to about 15 percent of the rock. Very thin mafic (amphibole) bands in places separate chert 'layers'. A poorly banded and contorted cherty unit (less than 1 m thick) with up to 35 percent fine-grained, sugary pyrite is located in a small waterline exposure on Lake Superior on the south shore of Heron Bay. The rock lies within intermediate to felsic pyroclastic breccia and its significance was not determined.

METAMORPHOSED MAFIC INTRUSIVE ROCKS

Gabbro and Diorite

Gabbro occurs mainly as small sills in the tholeiitic flows of the Pulpwood-Playter Harbours sequence. The two rock-types are not always separable. The gabbro is also in contact with pyroxenite although the relationship was not determined because of shearing, weathering, or water cover.

The gabbro is greyish green, equigranular, and medium to coarse grained. Amphibole constitutes about 60 to 70 percent of the rock and in thin section is seen to consist of ragged, anhedral, twinned, actinolite crystals. Highly-altered plagioclase and minor quartz form the bulk of the remainder of the rock. Minor constituents include leucoxene, epidote, biotite, chlorite and opaque minerals.

Leucocratic gabbro outcrops along the east end of the north shore of Pulpwood Harbour and on the north side of the main point located northwest of Campbell Point. In outcrop the rock consists of about 35 percent amphibole (tremolite) as isolated porphyritic crystals within a greyish-white plagioclase matrix. In thin section the minerals are seen to be highly altered to a fine-grained recrystallized aggregate of amphibole with numerous very fine-grained crystals of recrystallized carbonate and saussuritized plagioclase. No relationship was established between the 'normal' gabbro and the leucogabbro. One specimen of each type was analyzed and the results are given in Table 5.

Two, large, xenolith-like bodies of gabbroic rocks are shown on the map within the Gowan Lake Pluton. They may represent blocks of recrystallized mafic volcanic rocks that were caught up in the granitic intrusion during its emplacement.

Diorite, as a field classification term, has been used to classify two small plugs of medium-grained rock that intrude brown to green siliceous sedimentary rocks in roadcuts along Highway 17. The rock is greenish-grey on fresh surfaces and is massive except near contact margins where the rock is highly schistose and friable. Weathered surfaces bleach white. Numerous subangular to angular mafic inclusions of various sizes under 6 cm are irregularly distributed throughout some sections of the diorite body. The rock could not be traced for any appreciable distance.

TABLE 5. CHEMICAL ANALYSES OF MAFIC INTRUSIVE ROCKS IN THE HERON BAY AREA.

	1	2	3	4	5	6
SiO_2	49.9	44.1	47.6	51.9	49.2	57.3
Al_2O_3	15.3	17.7	13.5	12.8	11.5	17.2
Fe_2O_3	2.61		1.50		1.56	
		6.84[1]		8.55[1]		5.53[1]
FeO	8.90		6.96		5.34	
MgO	7.37	6.96	7.25	7.81	9.51	2.81
CaO	8.34	17.6	8.87	9.53	7.85	3.64
Na_2O	3.89	0.36	2.46	3.75	2.66	6.54
K_2O	0.81	0.00	1.57	0.78	3.50	2.07
TiO_2	0.85	0.48	0.69	0.55	0.59	0.77
P_2O_5	0.04	0.01	0.39	0.25	0.31	0.38
MnO	0.20	0.13	0.16	0.15	0.12	0.07
S	0.12	–[2]	0.01	–[2]	0.02	–[2]
H_2O^+	1.56		2.61		1.21	
H_2O^-	0.30	6.50[3]	0.53	4.20[3]	0.28	2.90[3]
CO_2	0.22		5.80		5.32	
TOTAL	100.4	100.7	99.9	100.3	99.0	99.2
S.G.	3.04	2.97	3.23	2.85	2.80	2.75
N.P.C.[4]	38.54	93.53	48.93	38.98	42.43	17.14

SPECIMENS (See Table 16 and Figure 3 for locations.)
1 M453-77 Gabbro, medium grained.
2 M432-77 Leucogabbro, medium grained.
3 M642-77 Schistose gabbro dike.
4 M627-77 Schistose gabbro dike.
5 M358-77 Schistose diatreme gabbro dike.
6 M348-77 Schistose diorite dike.

NOTES
[1] Total iron as Fe_2O_3.
[2] Not determined.
[3] All volatiles as loss on ignition.
[4] Normative plagioclase composition.
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

Schistose Dikes

Numerous, schistose, mafic dikes, easily seen on the Lake Superior shoreline, have intruded the metavolcanics in the map-area. The dikes commonly parallel the strike of the stratigraphy but dip much less steeply (about 45 ± 10 degrees). They locally cut across strike and some display pinch and swell structures. The dike thicknesses are generally less than 2 m and are rarely up to 5 m. The dikes can be grouped into three main types; schistose gabbroic dikes, schistose dioritic dikes, and schistose gabbroic diatreme dikes. None contain appreciable potassium feldspar.

The gabbroic variety consists of approximately 2 to 15 percent chlorite, 1 to 48 percent biotite, 0 to 55 percent amphibole, and 25 to 30 percent plagioclase; a few dikes contain as much as 25 percent anhedral carbonate. Variations in texture (e.g. degree of schistosity) and mineralogy account for most observable differences.

The dioritic varieties are similar in appearance and habit to the gabbroic dikes except they are less mafic and generally contain much more biotite than chlorite. Alteration in some dioritic dikes has given the plagioclase a pinkish orange tinge thus changing the overall hue of the rock.

The gabbroic diatreme dikes are the most interesting and variable of these types of dikes. They contain up to 50 percent green biotite and 35 percent plagioclase; the remainder is carbonate and quartz (7 percent). The dikes have not been classified as lamprophyres although some contain biotite phenocrysts. Their most striking characteristic is the variety of fragments which they contain. These include: (1) subangular to rounded mafic (chloritized) and ultramafic (tremolitized) inclusions which form the sole fragment type; (2) subrounded to well-rounded 'pebbles', 'cobbles', and 'boulders' of granitic and pyroclastic rocks; and (3) tabular fragments of felsic to intermediate tuff. The size, abundance, and type of fragment may vary considerably along strike as well as from dike to dike. Photo 11 shows an example of one of the dikes that is deficient in felsic fragments. Dike compositions are given in Table 5.

METAMORPHOSED ULTRAMAFIC INTRUSIVE ROCKS

Metamorphosed intrusive ultramafic rocks occur in two general locations within the map-area; in the Pulpwood-Playter Harbours sequence where most are situated, and on the shore that is north of the east half of Channel Island. The latter consists of two exposures. One exposure (northeast of the east end of the island) is about 45 m long. It consists of severely altered, fine- to medium-grained rock that now consists of carbonate (magnesite?), talc, chlorite, and minor magnetite (octahedrons) and pyrite (cubes). The rock is cut by numerous carbonate veins (less than 2.5 cm thick) and shows evidence of plastic deformation during alteration. Adjacent rocks which may be the contact margins consist of chlorite, talc, pyrite, and magnetite. About 600 m west-northwest of this location is a poorly-exposed outcrop of a fine-grained chlorite-talc-carbonate rock. Nearby rocks consist mainly of chlorite and lesser pyrite (cubes) with minor magnetite.

10 365

Photo 11*—Schistose diatreme gabbro dike; numerous sub-rounded to sub-angular mafic and ultramafic inclusions as well as one isolated felsic fragment; Lake Superior shoreline.*

Numerous lenses ('sills') of intrusive ultramafic rocks occur within the tholeiitic mafic metavolcanics of the Pulpwood-Playter Harbours sequence. The best exposures of these rocks occur in Pulpwood Harbour. The contact relationship between lherzolite, pyroxenite[1], chlorite-rich rock, and mafic metavolcanics (country rock) is complex and not fully understood. The ultramafic rocks appear to have intruded along many planes of weakness. These lenses are commonly discordant. The best example is on one of the islands in Pulpwood Harbour where mafic metavolcanics and intercalated metasediments and pyroclastic rocks are truncated by pyroxenite on the eastern half of the island. The majority of the ultramafic rocks are quite magnetic.

Pyroxenite is the predominant ultramafic rock type, and on shoreline is intermittently mixed with lherzolite, tremolite-rich rock, or chlorite-rich rock. No layering, zoning, or indications of differentiation could be interpreted because the rock types appear to be sporadically distributed. Some chemical compositions are given in Table 6.

The pyroxenite is very dark green to green-black and varies from medium- to very coarse-grained (up to 25 mm); coarse-grained textures are the most common. Hornblende crystals in massive rocks are generally prismatic in habit. In some outcrops hornblende occurs as needles up to 4 cm long although some needles consist of a few shorter en echelon needles thereby imparting a lineated fabric to the rock. Commonly the trend of the needles is subparallel to the contact with the enclosing mafic metavolcanics. In thin section, some of the needles are subparallel whereas others occur in poorly-developed rosettes. The matrix consists of fine- to medium-grained, randomly-oriented hornblende needles. Minor (4 percent) opaque minerals occur throughout and tend to be randomly dispersed, however, some form a series of disconnected anhedral grains that parallel the needles. Fine-grained

[1] The 'pyroxenite' consists mostly or entirely of hornblende but subsequent work in the Hemlo area (Muir 1980) revealed that remnant pyroxene was present. The rocks are considered to have been amphibolized; 'pyroxenite' is used as an interpreted term for the original rock.

TABLE 6. CHEMICAL ANALYSES OF ULTRAMAFIC INTRUSIVE ROCKS IN THE HERON BAY AREA.

	1	2
SiO_2	36.9	39.9
Al_2O_3	2.86	7.58
Fe_2O_3	11.0	2.30
FeO	8.16	17.5
MgO	26.8	8.07
CaO	3.62	13.6
Na_2O	0.0	1.34
K_2O	0.0	0.47
TiO_2	0.98	3.29
P_2O_5	0.04	0.10
MnO	0.26	0.24
S	0.05	0.07
H_2O^+	5.21	0.49
H_2O^-	0.58	0.48
CO_2	2.04	2.76
TOTAL	98.5	98.2
S.G.	3.00	3.27

SPECIMENS (See Table 16 and Figure 3 for locations.)
1 M620-77 Lherzolite; fine to medium grained.
2 M601-77 Pyroxenite; coarse grained, green-black
NOTE
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

carbonate porphyroblasts form 4 percent of the rock and very minor amounts of plagioclase were identified. In the massive pyroxenite, the hornblende forms anhedral to subhedral interlocking crystals. Opaque minerals (magnetite) form up to 4 percent of the rock. Some narrow, 5 cm thick veinlets, which consist of asymmetrical amphibole crystals and minor plagioclase oriented perpendicular to the veinlets, were found to intrude some of the pyroxenite. They may represent later rapidly cooled injected material. Isolated sections along the shoreline show that locally the rock has slightly more than 10 percent irregularly-distributed plagioclase and can be called melanogabbro.

Serpentinized lherzolite and lesser dunite are present in minor amounts. In thin section, serpentine (antigorite) is seen to pseudomorph olivine grains which are outlined by numerous fine-grained magnetite crystals. Clumps of the olivine grains are separated by fine-grained actinolite-tremolite which may be replacing pyroxene. Talc, carbonate, and chlorite are common secondary minerals. Clean, weathered surfaces show the pseudomorphed olivine grains.

Numerous tremolitic and chloritic rocks outcrop along the shoreline. The chlorite rocks seem to form in pods and (or) shear zones within the ultramafic rocks. These may be similar to sections of chlorite-rich rocks which are commonly found within some serpentinized ultramafic rocks as seen in drill core from the Timmins area (Muir 1975). Tremolitic rocks are commonly near contacts with mafic metavolcanics and may represent contact metamorphosed mafic volcanic rocks or marginal rocks of the ultramafic intrusions.

The pyroxenite and lherzolite were not always recognized in the field. Considerable reinterpretation of field data has been used to indicate the locations of coarse-grained 'mafic' rocks. A few hand specimens helped in verifying the locations. This has resulted in the interpretation of numerous small lenses of ultramafic rocks east of the shoreline exposures. It is the author's opinion that the ultramafic rocks were intruded as discrete sill-like bodies as shown on the map although more detailed mapping of the belt would probably delineate more lenses. Judging from the offshore islands of ultramafic rocks in Lake Superior, it is possible that the bulk of ultramafic rocks lies underwater to the west.

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

Three main granitic complexes are partially contained within the Heron Bay map-area. Each is distinctly different in certain features: the Gowan Lake Pluton within the map-area contains flow-aligned hornblende, and has a high hornblende to biotite ratio; the Heron Bay Pluton is massive and has a variable hornblende to biotite ratio that is generally close to 1; the Pukaskwa Gneissic Complex is weakly to moderately gneissic and (or) foliated, and generally has a hornblende to biotite ratio significantly less than 1. All have porphyritic and non-porphyritic phases although the phenocrysts are not necessarily of the same mineral. Relative ages between the granitic masses were not ascertained. It is conjecture that the Pukaskwa Gneissic Complex is the oldest 'batholith' and that the massive Heron Bay Pluton is the youngest one.

Contact relationships between the granitic bodies and country rock are variable. In some cases, the nearby country rock is more altered, there may be some granitic stringers, and the contact with granitic rocks is fairly sharp. In other cases, the proportion of granitic rocks (as sills and dikes) increases gradually until the rock is predominantly granitic with slabs and xenoliths of country rock (e.g. metavolcanics). This transition usually takes place over a distance of 30 m to 100 m although isolated granitic sills or xenoliths of country rock may occur further from the contact. The above conditions apply generally to the Pic and Heron Bay Plutons. At the contacts of the Pukaskwa Gneissic Complex, not only are the sills of granitic material or slabs of volcanic material present, but the volcanic rocks are somewhat migmatized and contorted into small tight folds. This effect may be present up to at least 0.4 km from the contact. Pegmatitic and aplitic material is common within 50 m of the contact.

Pukaskwa Gneissic Complex

The southernmost section of the map-area is underlain by the Pukaskwa Gneissic Complex. The complex is part of a large granitic and gneissic terrain which extends tens of kilometres to the south (Bennett *et al.* 1969). High relief and good bedrock exposure occur in the section near Lake Superior. Further inland the relief lessens and the exposure is almost nil in some parts due to extensive sand cover.

Most of the rocks of the complex are distinctively foliated and weakly gneissic, in contrast with the granitic rocks of the other plutons. The term 'gneiss', as used here, denotes banding that is probably due to remnant slabs and fragments of ancient rocks that have been recrystallized and partly remobilized. These remnants were probably granitic in composition originally since the banding is not sharply defined in most cases, and most sections now have a granitic texture and appearance.

Not all the rocks are banded; some are weakly foliated whereas others are heterogeneous in composition. Banding varies from 0.1 m to 2 m thick, and where present, is irregularly spaced and discontinuous, with most bands pinching out. Some slabs of rock could be identified as inclusions of tuff or sedimentary rocks that have been recrystallized and have undergone resorption, but most could not be identified as to their origin. In many cases the gneissosity and (or) foliation is weak and easily obscured by dense lichen cover. Within the map-area, the eastern portion of the complex is less gneissic and less foliated than the western portion.

Two types of granitic rock form the bulk of the complex within the map-area. The types represent differences in composition as observed on an outcrop scale in the form of banding or non-homogeneous mineralogy. Rocks of trondhjemitic composition dominate over granodiorite but, based on stained sample distribution, there does not seem to be any recognizable pattern in the distribution of either rock type.

Under the microscope the porphyritic (plagioclase) hornblende-biotite granodiorite is seen to have two populations of plagioclase: medium-grained, subhedral, zoned and twinned phenocrysts; and fine- to medium-grained, anhedral to subhedral crystals with no zoning or twinning. Quartz has formed clumps of medium- to fine-grained, anhedral crystals. Biotite is partially altered to chlorite, and with epidote, forms thin, weakly-defined bands. The thin bands represent foliation planes and are deformed around larger crystals, particularly the plagioclase phenocrysts. Myrmekitic texture was seen in one specimen. Although hornblende was observed in some outcrops, and is locally abundant depending on the proximity to mafic inclusions, there is none present in the two thin sections that were examined.

The porphyritic (plagioclase) hornblende-biotite trondhjemite is the more abundant rock type in the complex. The one thin section that was examined came from a fairly well-defined band that was more mafic than the surrounding rock. Plagioclase is present as fine- to medium-grained, anhedral, zoned and twinned crystals, and as very fine-grained to fine-grained vaguely zoned crystals; similar habits are found in the granodiorite specimens. Quartz occurs in megacryst-like groups of crystals indicating possible recrystallization. Very fine-grained quartz and feldspar crystals occur in irregularly distributed patches among the larger (fine-grained) quartz and feldspar crystals. These patches are ill-defined but they may be the result of recrystallization from high temperatures and (or) partial melting. This may also explain the two apparent types and size populations of the plagioclase in both the granodiorite and the trondhjemite. Potassium feldspar in both the granodiorite and the trondhjemite is untwinned and it was not determined whether it is microcline or orthoclase. Visual mode estimates for two granodiorite samples and one trondhjemite sample are given in Table 7.

A small pluton that occurs on the shoreline south of Playter Harbour has been included in the Pukaskwa Gneissic Complex. The pluton largely consists of massive, medium-grained, biotite granodiorite that contains approximately 30 to 35 percent quartz, 35 to 40 percent zoned plagioclase, and 15 to 20 percent microcline. Dark green biotite (up to 5 percent) is partially altered to chlorite. Accessory minerals include epidote (2 percent), apatite, sphene, and carbonate. Minor myrmekitic texture is present (less than 1 percent). Lesser amounts of medium- to coarse-grained biotite quartz monzonite form part of the pluton. Quartz (36 percent), plagioclase (33 percent) and microcline (22 percent) constitute the bulk of the rock; accessory minerals are the same as in the biotite granodiorite. No myrmekite is present. Table 7 shows visual modal estimations for rocks of this pluton.

TABLE 7 CHEMICAL ANALYSES AND VISUAL MODAL ESTIMATES OF SAMPLES FROM THE PUKASKWA GNEISSIC COMPLEX IN THE HERON BAY AREA.

Chemical Analyses	**1**	**5**
SiO_2	69.0	63.8
Al_2O_3	15.5	16.5
Fe_2O_3	1.28	1.58
FeO	1.93	4.24
MgO	0.91	0.78
CaO	3.43	3.19
Na_2O	4.77	5.21
K_2O	1.23	2.01
TiO_2	0.41	0.51
P_2O_5	0.08	0.15
MnO	0.05	0.13
S	0.02	0.06
H_2O^+	0.27	0.67
H_2O^-	0.24	0.29
CO_2	0.20	0.54
TOTAL	99.3	99.7
S.G.	2.70	2.73

Modal Analyses	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Plagioclase (and alteration products)	56	45	43	42	49	33	47
Potassic feldspar	1	2	<1	2	5	22	15
Quartz	37	45	44	43	36	36	30
Biotite	5	6	8	9	10		4
Chlorite	<<1		<<1		<<1	5	1
Muscovite		1	<<1		<1	1	
Epidote	1	1	5	3	<<1	2	2
Apatite	<<1	<<1	<<1	<<1	<<1	<<1	<<1
Sphene			<<1	<<1		<1	<1
Tourmaline			<<1				
Carbonate					<<1	<<1	<<1
Myrmekite				<<1			<1
Opaque minerals		<<1	<<1		<<1	<<1	

SPECIMENS (See Table 16 and Figure 3 for locations of chemical analyses.)
1 M562-77 Porphyritic (plagioclase) hornblende-biotite trondhjemite gneiss
2 M564-77 Porphyritic (plagioclase) hornblende-biotite trondhjemite gneiss.
3 M566-77 Porphyritic (plagioclase) hornblende-biotite granodiorite gneiss.
4 M572-77 Porphyritic (plagioclase) hornblende-biotite granodiorite gneiss.
5 M510-77 Biotite granodiorite (hybrid); near contact with mafic metavolcanics.
6 M519-77 Biotite quartz monzonite.
7 M538-77 Biotite granodiorite.

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

Gowan Lake Pluton

The Gowan Lake Pluton lies east of the Pic River and extends into the northeastern part of the map-area and beyond into the Black River area (Milne 1968). In the map-area a porphyritic and an equigranular phase are distinguished.

Porphyritic (microcline) biotite-hornblende quartz monzonite is the prevalent phase. Subhedral to euhedral microcline phenocrysts are 5 to 12 mm in size and display well-developed, polysynthetic and Carlsbad twinning; minor fine-grained microcline occurs throughout the matrix. Hornblende is the dominant mafic mineral, forms columnar grains 1 to 5 mm in length, and is commonly lineated[1]. The aligned hornblende crystals vary considerably in orientation on an outcrop scale. In places they give a swirled appearance and in others the orientation varies slightly. Plagioclase crystals are strongly sericitized and show remnant zoning. Myrmekitic texture is present in some feldspar crystals. Minor, pleochroic, light to dark brown biotite forms discrete primary grains. Accessory minerals include zircon, sphene, apatite, carbonate, and opaques.

The composition of these rocks is near the borderline between quartz monzonite and granodiorite with respect to the potassium feldspar to total feldspar ratio. However, the majority of stained samples are visually estimated to have a potassium feldspar to total feldspar ratio of ⅓ to ⅔. Table 8 gives visually estimated modes for two porphyritic samples.

Equigranular, biotite-hornblende quartz monzonite, is slightly finer grained than the porphyritic quartz monzonite, and hornblende crystals in the equigranular variety are stubbier and are generally not preferentially oriented. Plagioclase occurs as anhedral to subhedral normally zoned crystals some of which contain microcline inclusions. In all thin sections examined with the exception of one from the centre of the complex, the plagioclase is highly saussuritized. Microcline forms anhedral crystals of similar size (1.5 to 3 mm) to the

[1]The term 'lineated' is used here for aligned hornblende, in contrast to foliation which is a planar feature. It is not to be confused with the product of stretching and shearing during deformation. The lineation may be a primary flow feature.

TABLE 8. VISUAL MODAL ESTIMATES OF SAMPLES FROM THE GOWAN LAKE PLUTON, HERON BAY AREA.

	1	2	3	4
Plagioclase (and alteration products)	29	52	34	38
Microcline	25	18	17	30
Quartz	23	20	28	15
Hornblende	13	12	11	10
Biotite	2	<1	<1	5
Chlorite	5	6	6	<1
Epidote	3	1	3	1
Apatite	<<1	<<1	<<1	<<1
Sphene	<<1	<<1	<<1	<<1
Zircon				<<1
Carbonate			<<1	
Myrmekite	<1	<<1	<<1	<<1
Opaque minerals	<1	<1	<1	<1

SPECIMENS
1 B216-77 Porphyritic (microcline) biotite-hornblende quartz monzonite
2 B466-77 Porphyritic (microcline) biotite-hornblende quartz monzonite
3 B219-77 Biotite-hornblende quartz monzonite.
4 B470-77 Biotite-hornblende quartz monzonite.

plagioclase. Myrmekitic texture is present in small patches. Alteration and accessory minerals are similar to the porphyritic phase. Table 8 gives visually estimated modes for two non-porphyritic samples. Again, some specimens are granodioritic, based on stained hand specimens, but the majority of specimens have slightly greater than ⅓ feldspar as potassium feldspar.

As with the Heron Bay Pluton, the term 'phase' is used loosely since no actual contact relationship was seen. It is possible that the two rock types are continuous 'phases' and that they record the inhomogeneity of the magma at the time of solidification. More detailed mapping might establish the actual relationship. In general the central part of the pluton within the map-area seems to be dominated by the equigranular quartz monzonite, whereas the western and eastern portions seem to be dominated by the porphyritic quartz monzonite.

Some areas within the Gowan Lake Pluton are underlain by more mafic quartz monzonite that contains numerous fragments and large blocks of partially assimilated mafic volcanic (?) rocks. These areas are relatively small and were not outlined as to their extent. They have been indicated on Map 2439 (back pocket).

Heron Bay Pluton

The Heron Bay Pluton underlies a large portion of the east-central map-area, east of the Pic River. It is not entirely contained within the map-area. Two main phases constitute most of the Heron Bay Pluton. These are a porphyritic (microcline) biotite-hornblende granodiorite phase and a non-porphyritic, hornblende-biotite granodiorite phase. The term 'phase' is loosely used (as with the Gowan Lake Pluton) because no contact, and therefore no relationship was established between the two rock types. It is possible that gradational changes may take place between the two types, and they may merely represent the non-homogeneity throughout the pluton. The non-porphyritic phase is much more prevalent, with large 'pockets' of the porphyritic phase occurring in three general areas, based on limited field observations (see Map 2439, back pocket).

The porphyritic phase of the granodiorite generally has slightly more hornblende than biotite, but the ratio is variable. Hornblende and biotite in most cases are slightly finer grained than the feldspar and quartz (0.5 to 2 mm). The microcline phenocrysts are generally incompletely developed, contain small inclusions of hornblende, quartz, and plagioclase (visible in hand specimen), and appear to have formed in the latter stages of crystallization. Visual modes for one specimen are given in Table 9.

The equigranular hornblende-biotite phase is medium grained although microcline and hornblende are somewhat finer grained than in the porphyritic phase. Hornblende forms fine-grained, stubby prisms, noteably different from the Gowan Lake Pluton rocks. Biotite occurs as anhedral flakes, some of which are partly chloritized. Again, the hornblende-biotite ratio is variable, and in some places hornblende predominates. Locally plagioclase approaches a porphyritic character with crystals up to 4 mm. Microscopically the plagioclase is well zoned (oscillatory) and a saussuritic type of alteration has commonly taken place, usually along one or more specific composition zones. Quartz may occur as clumps of anhedral grains which appear to be megacrysts at first glance. They may originally have been individual crystals which have been strongly strained and recrystallized. Numerous minute fluid inclusions with crystals or gas bubbles (displaying Brownian motion) are present in the quartz grains. Visual mineralogical modes of several non-porphyritic specimens are given in Table 9.

Some large mafic inclusions occur in the main part of the pluton and there is noticeable contamination of the granodiorite in the form of increased mafic content (up to 25 percent) in proximity to the inclusions. The contaminated zones are up to a few tens of metres wide and have been classified as hybrid rock. In some areas, large blocks of intermediate pyroclastic rocks have been caught up in the intrusion; they are commonly deformed but not strongly recrystallized.

TABLE 9. VISUAL MODAL ESTIMATES OF SAMPLES FROM THE HERON BAY PLUTON, HERON BAY AREA.

	1	2	3	4	5	6
Plagioclase (and alteration products)	27	42	42	43	49	29
Microcline	14	22	12	17	8	4
Quartz	28	25	31	34	31	35
Hornblende	7	6	5	5	4	18
Biotite	5	3	7	5	6	12
Chlorite	<1	<<1		4		
Epidote	1	1	2	1	1	3
Apatite	<<1	<<1	<<1	<<1	<<1	<<1
Sphene		<<1	<<1	<<1	<<1	
Opaque minerals	<<1	<<1	<1	<<1	<<1	<<1

SPECIMENS
1 B47-77 Porphyritic (microcline) biotite-hornblende granodiorite.
2 M57-77 Hornblende-biotite granodiorite.
3 M688-77 Hornblende-biotite granodiorite.
4 B44-77 Hornblende-biotite granodiorite.
5 B533-77 Hornblende-biotite granodiorite.
6 B260-77 Porphyritic (plagioclase) biotite-hornblende granodiorite.

The island of granodiorite off Ogilvy Point has two phases: porphyritic (hornblende) biotite-hornblende granodiorite, and biotite granodiorite. Unequivocal evidence for age relationships was not found. Biotite is partly chloritized, particularly in the biotite granodiorite. Mafic xenoliths are found along both the east and west shorelines of the island. Although no physical evidence was noted that linked this island with the main Heron Bay Pluton, it was included under this section because of some similarities in mineralogy and texture. It is the author's opinion that the island is part of a large granitic body that extends beneath the lake.

The only pluton contained wholly within the map-area lies between the Heron Bay and the Gowan Lake Plutons just north of the Black River. It consists of a texturally and mineralogically variable, porphyritic (plagioclase) biotite-hornblende granodiorite. Plagioclase is medium to coarse grained and in a weathered hand specimen, its well-zoned nature can be detected. Hornblende is generally in excess of biotite but locally the latter predominates. The rock is more mafic than either of the nearby plutons and may reflect a marginal contaminated phase.

LATE FELSIC DIKES AND SILLS

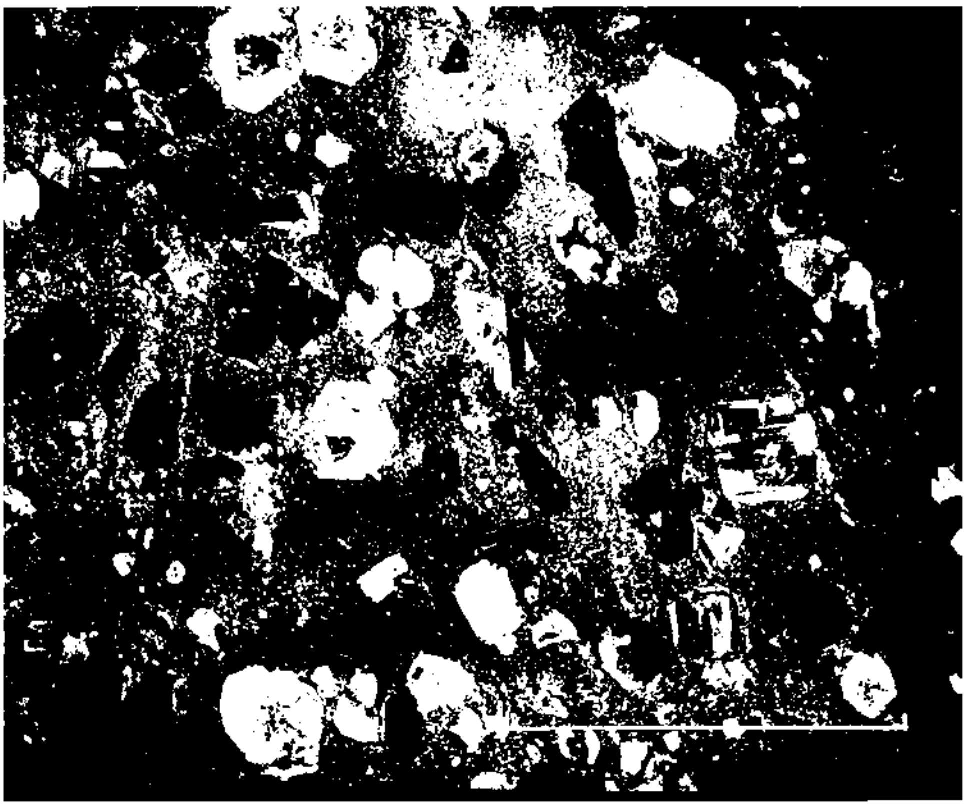
Porphyritic Dikes

Several types of felsic dikes were recorded in the field. Both porphyritic and massive varieties occur and for each there are several distinguishable subvarieties. It is not known how many separate ages of felsic dike intrusions took place, nor has it been established in many cases, whether a given dike is related to any particular granitic pluton.

Some of the porphyries are probably related to the volcanism. Many sills of quartz-feldspar porphyry occur in the intermediate to felsic crystal tuffs, particularly those north of Heron Bay. Commonly they closely resemble the crystal tuffs but their homogeneity with respect to quartz and feldspar distribution, and their overall homogeneous texture favour an intrusive origin. No cross-cutting relationships were established. Some of the porphyries are composed of more than 35 percent phenocrysts by volume, with a significantly greater proportion of plagioclase phenocrysts to quartz phenocrysts (Photo 12). Several feldspar porphyry dikes containing up to 40 percent equant (4 mm), subhedral, continuously-zoned plagioclase phenocrysts are present south of the Pic River estuary. In a few dikes euhedral pyrite is a common accessory. Locally the porphyries are moderately to well foliated, whereby the micaceous minerals (usually muscovite and chlorite) are deformed around the phenocrysts. Quartz phenocrysts are oval-shaped, 2 to 3 mm in size and now consist of an interlocking mosaic of many smaller quartz crystals. In most of the above-mentioned porphyritic dikes, the matrix is very fine grained to aphanitic, and consists mostly of quartz, plagioclase, and micaceous minerals (biotite, chlorite, muscovite) although hornblende may also be present. Very little or no potassium feldspar is present. Table 10 gives the chemical analysis results.

There are many other felsic sills and sub-conformable dikes that are porphyritic or sub-porphyritic with respect to plagioclase. These rocks commonly have an overall pinkish colour with a fine-grained matrix. They also commonly contain numerous, small (less than 3 mm) subangular to angular xenoliths of fine-grained chloritized mafic volcanic (?) rocks. These dikes commonly intrude the intermediate to felsic pyroclastic rocks and superficially resemble some of them. They may also be related (essentially synchronous) to the volcanic rocks; potassium feldspar is absent.

In contrast to the above-mentioned porphyritic dikes there are locally many other plagioclase porphyritic dikes generally within 400 m of the main granitic contacts. Most of the dikes are less than 5 m thick. These dikes are presumed to be related to the granitic plu-



10 366

***Photo 12**—Photomicrograph (crossed nicols) of quartz-feldspar porphyry dike; equant euhedral plagioclase, sub-rounded recrystallized quartz; Lake Superior shoreline. Bar scale represents 1 cm.*

TABLE 10. CHEMICAL ANALYSES OF LATE FELSIC DIKES IN THE HERON BAY AREA.

	1	2
SiO_2	61.3	66.5
Al_2O_3	16.9	15.7
Fe_2O_3	1.30	3.01[1]
FeO	2.67	
MgO	1.53	1.66
CaO	3.57	3.30
Na_2O	8.81	5.25
K_2O	0.46	1.76
TiO_2	0.49	0.35
P_2O_5	0.19	0.07
MnO	0.08	0.04
S	0.13	-[2]
H_2O^+	0.81	
H_2O^-	0.44	2.90[3]
CO_2	1.54	
TOTAL	100.2	100.5
S.G.	2.71	2.68

SPECIMENS (See Table 16 and Figure 3 for locations.)
1 M402-77 Feldspar porphyry.
2 M311-77 Trondhjemite; banded dike.

NOTES
[1] Total iron as Fe_2O_3.
[2] Not determined.
[3] All volatiles as loss on ignition.
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

tons, and in general are different from the subvolcanic porphyritic dikes. The groundmass is generally fine grained and mafic minerals are usually large enough to be identified by the unaided eye. Texturally the phenocrysts are commonly neither as large in size and volume in proportion to the groundmass, nor as euhedral as in the subvolcanic porphyries. The rocks are weakly porphyritic in some cases. Mineralogically there is often greater than 5 percent potassium feldspar in the groundmass. Some varieties are also found within the granitic plutons within about 400 m of the main contact.

The largest, late, felsic porphyritic body is a 110 m thick 'sill' near the contact of the Heron Bay Pluton about 2 km west of Onpaco Lake. The rocks range from foliated to non-foliated, and become subporphyritic towards the pluton itself. Plagioclase phenocrysts present in these rocks are well-zoned.

Non-Porphyritic Dikes

Non-porphyritic felsic dikes fall under three main types; trondhjemite, aplite, and pegmatite. None are volumetrically significant even within the plutonic complexes. Aplite is generally pinkish, fine to medium grained, and equigranular. The dikes are irregular in shape and attitude, and are short and discontinuous. Pegmatitic dikes are mostly composed of feldspar and quartz with biotite as the mafic constituent. These dikes are similar to the aplite dikes in habit and the two types are commonly found together.

The trondhjemite dikes are most prevalent on the shoreline between Ogilvy Point and Prospect Cove, but are also found in Pulpwood Harbour. They are irregular in habit but are peculiar in that they exhibit features which resemble bedding, clasts, and other sedimentary structures. These features are best evident when the rock is wet, but they are almost undetectable on a hand specimen scale. The bands are subparallel to the dike contacts, and may be numerous; individual bands are 3 to 15 mm thick and may extend for over 3 m. The centres of some dikes contain contorted, tabular fragments. The author interprets the features to be related to the intrusion of a plastic, partially solidified magma which underwent differential flowage.

Middle to Late Precambrian

MAFIC INTRUSIVE ROCKS

Numerous, relatively small, diabase dikes are present throughout the Heron Bay map-area. These dikes are particularly well exposed and it is quite possible that the dike density may be similar throughout larger parts of the map-area. As a result of the exposure, a number of interesting features were noted. There are emplacement features of diabase dikes which can easily lead to misinterpretation of the extent and number of diabase dikes. This latter feature is discussed at the end of this section.

There are two, and quite possibly more, ages of subalkaline diabase dikes. In addition, there are younger alkalic diabase dikes (see "Alkalic and Related Dikes") which appear very similar to the subalkaline (or 'common') type of diabase. An empirical set of criteria for distinguishing the two types was formulated. The few chemical analyses done on these rocks support this division. The criteria are not always conclusive (especially in the narrower, completely-chilled dikes) and in many cases the dikes were mapped as subalkaline diabase for lack of better information. Table 11 outlines the major similarities and differences between the two types of diabase.

Among the subalkaline diabase dikes, there is a fairly wide variety in textures. The amount, size, and distribution of plagioclase phenocrysts varies from dike to dike as do grain size and degree of intergranular, equigranular, and isogranular development.

In a few cases, two ages of subalkaline diabase dikes were noted in a cross-cutting relationship. The two best examples are located about 1.3 km north of Randle Point and 0.9 km north-northwest of Campbell Point. In the first example two diabase dikes are almost virtually identical in colour, texture, and grain size except for a chilled margin and a partially rotated wall fragment (which clarified the age relationship). In the second case, textures and grain size are quite different. The older diabase is quartz-bearing, 90 m wide and is cut by an olivine-bearing diabase. Many cross-cutting relationships of other dikes were noted but generally it could not be determined whether the younger dike has an alkalic affinity. The author was unable to ascertain the absolute ages of the different subalkaline diabase. The lack of mappable, continuous dikes in the area precluded the establishment of dike trends for different ages. In a few locations olivine was observed in fresh-looking chilled dikes which indicated that these dikes may have been of the alkalic type.

A thin section of a porphyritic (plagioclase) diabase dike was visually estimated to contain 55 percent plagioclase (groundmass plagioclase mostly saussuritized, phenocrysts sericitized) and 44 percent subhedral clinopyroxene with minor amounts of amphibole, chlorite, and opaque minerals (magnetite). Ophitic texture was not seen in any of the thin sections. Isogranular and minor intergranular textures are common. Samples of the quartz- and olivine-bearing dikes north of Campbell Point were analysed and the results are given in Table 12. The chemical composition of the two dikes is fairly similar. The main differences appear to be somewhat higher Fe (total) and TiO_2, and lower CaO and MgO in the older, quartz-bearing dike.

Diabase Dike Emplacement

As is common in many sections of the Precambrian crust, substantial numbers of diabase dikes are found in the Heron Bay area. As the map shows, only a few of these dikes could

TABLE 11. COMPARISON OF SUBALKALIC AND ALKALIC DIABASE DIKES IN THE HERON BAY AREA.

Feature	Subalkalic (Common) Diabase	Alkalic Diabase
Colour	• quite variable depending on grain size and alteration of plagioclase • medium grained: dark green • fine grained to aphanitic: grey to black • saussuritized plagioclase yields lighter green colour	• as with subalkalic diabase only less commonly medium grained • plagioclase commonly altered to reddish brown
Texture	• isogranular, intergranular, diabasic, porphyritic • phenocrysts (plagioclase) are isolated, greenish white, and equidimensional to lath-like	• as with subalkalic diabase • phenocrysts (plagioclase) reddish brown to beige • may have pyroxene, magnetite phenocrysts, sulphide blebs
Mineralogy (potassium feldspar stain)	• essentially no potassium feldspar	• up to 0.5% stain: either potassium feldspar or other potassium mineral
Chilled margins	• dark grey to black, aphanitic dull lustre • may have been glass originally	• very dark grey to black and aphanitic • may presently be bluish black glass or be glassy
Alteration	• generally only saussuritized (or sericitized) plagioclase noticeable in hand-specimens	• reddish brown plagioclase, hairline reddish brown stringers along fractures; some peculiar reddish circular features in planes of fracture
Fracturing	• many types; parallel and perpendicular jointing (to strike), cylindrical jointing • some dikes may weather out in dike centre along parallel joints (subalkaline nature not established)	• parallel and perpendicular jointing (to strike) • centre area of dike may fracture and weather out as ball-like fragments; crumbles • may weather out in dike centre (parallel to strike) along joints
Cutting relationships	• may cut other diabase of subalkalic type	• cuts subalkalic type, other alkalic dikes (indicating multiple ages), and lamprophyres

TABLE 12. CHEMICAL ANALYSES OF SUBALKALIC DIABASE DIKES IN THE HERON BAY AREA.

	1	2
SiO_2	48.9	47.9
Al_2O_3	15.2	15.4
Fe_2O_3[1]	14.9	13.1
MgO	3.45	5.65
CaO	7.31	10.8
Na_2O	3.26	2.59
K_2O	1.70	1.20
TiO_2	2.43	1.17
P_2O_5	0.53	0.53
MnO	0.20	0.22
L.O.I.[2]	1.70	1.70
TOTAL	99.6	100.3
S.G.	2.95	2.92
N.P.C.[3]	42.71	53.59

SPECIMENS (See Table 16 and Figure 3 for locations.)
1 M457-77 Quartz diabase; intergranular texture, cut by M456-77.
2 M456-77 Olivine diabase; isogranular texture, cuts M457-77.

NOTES
[1] Total iron as Fe_2O_3
[2] Loss on ignition; includes H_2O^+ H_2O^- CO_2.
[3] Normative plagioclase composition
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

be traced any distance. Even on the shoreline where exposure is very good, there are numerous diabase dikes up to 3 to 9 m in width which could not be traced, for example, across an island or a point of land that is as little as 170 m across. Figure 2 shows five features characteristic of brittle-fracture infilling that were observed on a small scale (a metre or two) in the map-area. Most of the features were also observed on a somewhat larger scale (in the order of several metres), and the assumption is made that all of them have operated on a large scale (tens of metres or more) and have influenced the interpreted dike distribution shown on the accompanying map.

In Figure 2a the termination of a diabase dike is illustrated as a simple wedge. Since any propogated fracture is finite in extent, all dikes must end at some point. Diabase stringers (offshoots from larger dikes) are the most common examples of this type of termination. It was commonly observed that dikes with similar contact attitudes close to each other, in fact had different divergent strike trends. Figures 2b,c, and e illustrate three situations in which the same dike may appear to be two different dikes (or three in the case of Figure 2c). A fourth possibility is that two separate dikes do, in fact, exist. The spacing between the en echelon dikes in Figure 2b is variable but the ends of both segments always overlap. The author generally observed that the total thickness of diabase dike (both segments) across any section (ie. AA', BB'), perpendicular to strike was roughly the same for any given dike. This indicates that locally, crustal separation was equivalent along a given fracture 'zone' but not necessarily continuous along the 'zone'.

The figures show how information from limited exposure could be misinterpreted as two dikes, or offset dikes, when in fact the same dike may be involved. Figure 2e depicts how one dike which changes strike by following brittle fractures, would appear as two dikes having different strikes. A similar, small-scale example of Figure 2e is actually shown in Photo 13. It should also be pointed out that many of the late alkalic dikes also exhibit the features shown in Figure 2.

For the above reasons and the absence of geophysical or other supporting data it was usually not possible to interpret the extension of diabase dikes for long distances.

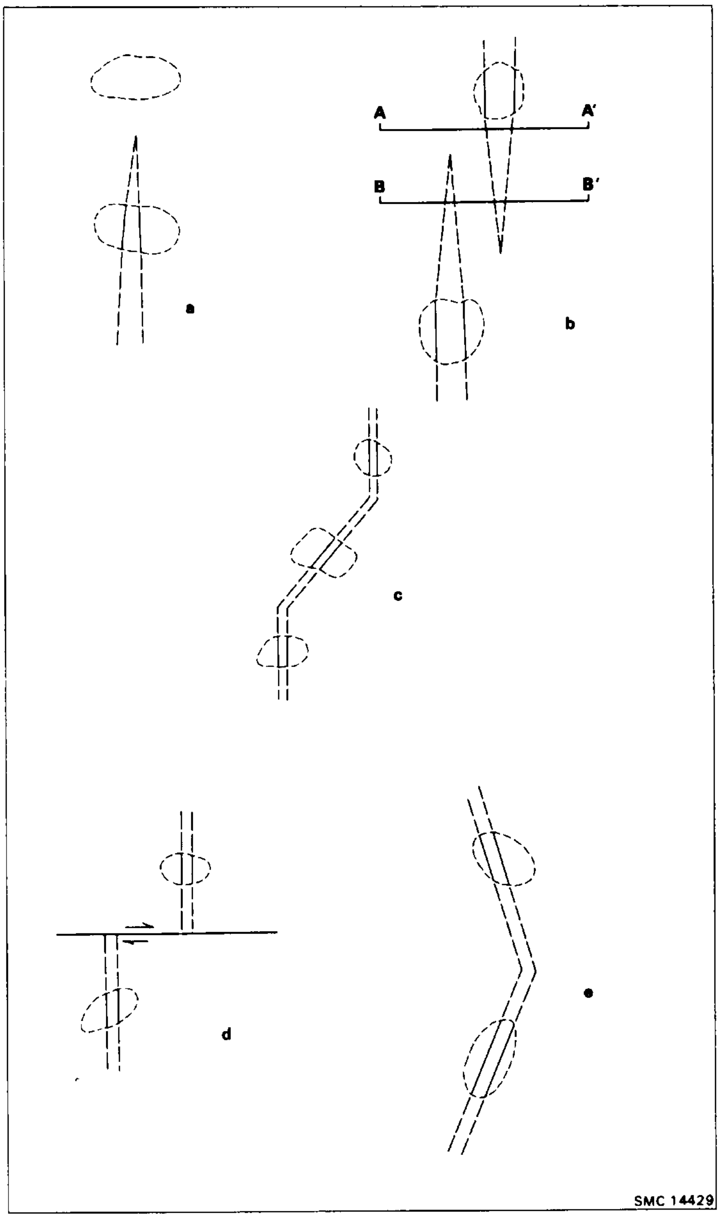
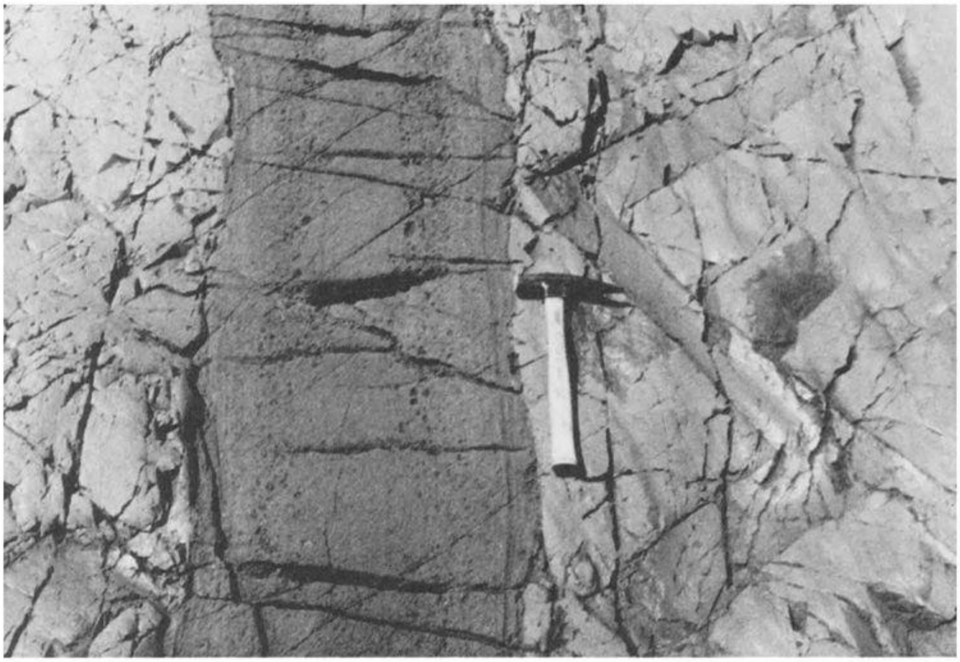


***Figure 2**—Hypothetical dike configurations to demonstrate difficulty in interpreting observed outcrops.*



10 367

Photo 13—*Zoned lamprophyre dike which cuts (not evident in photo) a zig-zag diabase stringer; diabase controlled by predominant fracturing in the rock; Lake Superior shoreline.*

Late Precambrian (Proterozoic)

ALKALIC INTRUSIVE ROCKS

Port Coldwell Alkalic Complex

The Port Coldwell Alkalic Complex is a large, partly circular, intrusion; the southeastern part underlies the northwest corner of the Heron Bay map-area. The magnetic expression of the complex is very pronounced and its general shape is easily discerned. The complex has been known for about 100 years (Kerr 1910) and has a very complicated petrological character; very little of the intrusion has been studied in great detail. The general age of the intrusion has been estimated from limited K/Ar dating of syenites as 1,050 m.y. (Fairbairn *et al.* 1959), although multiple ages are suspected. It is not within the scope of this report to treat the complex in detail, and the author refers the reader to works by other geologists such as Currie (1976), Lum (1973), Milne (1967), and Puskas (1967) for more detailed information.

Two main rock types constitute most of the complex within the map-area: monzonite (to syenite) and gabbro. In the map-area the gabbro lies at the margin of the complex in contact with the country rock. The petrography of these rocks is discussed below. Towards the margin of the complex, the gabbro exhibits a highly variable nature, and hybrid rocks are common. The hybrid rocks are generally fine to medium grained, and although feldspar phenocrysts may have developed locally, it becomes virtually impossible in the field in places to distinguish between fine-grained, chilled gabbro, and metamorphosed volcanic and sedimentary rocks. This is undoubtedly due to the high degree of assimilation, anatexis, and rheomorphic intrusion that has taken place as a result of the high temperature of intrusion which is estimated to have been 900 degrees C (Currie 1976). Hybrid rocks also vary considerably in texture and appearance and thus are difficult to generalize in terms of description. This particular ill-defined 'zone' of hybrid rocks may be up to 100 m in apparent thickness. Some areas well within the intrusion show mixtures of rock whose origin is uncertain. In part, these may represent remnant stoped blocks, roof pendants, or unusual phases of gabbro or monzonite.

The country rocks themselves, outside of the hybrid 'zone', show signs of rheomorphism and metamorphism in addition to recrystallization. Exposures on Highway 17 show contacts with intermediate to felsic lapilli tuff, pyroclastic breccia, and possibly sedimentary rocks. The difference in behaviour of some beds and of some fragments in response to the heat and subsequent deformation is remarkable; rock competency played an important part in the degree of rheomorphism. Intrusion breccias of more than one age can be seen. Some (earlier) have a gabbroic matrix (e.g. on Pen Lake, and on Highway 17), and some (later) have a granitic matrix (with quartz) (e.g. near Highway 17 and the powerline).

Diabase dikes do not cut the Port Coldwell rocks within the map-area and they have not been unequivocally shown to cut any of the rocks of the complex elsewhere.

GABBRO

There are several varieties of gabbro within the complex; these largely reflect different grain sizes and (or) different proportions of olivine, pyroxene, biotite, and magnetite. Grain size differences are locally mappable but mineralogical variations are usually detectable only by microscope examination.

Three types of gabbro are shown on the map: biotite gabbro, layered gabbro, and olivine gabbro. Biotite gabbro is the predominant gabbro and is medium to coarse grained, and dark green-black. Biotite flakes are 2 to 8 mm in size and on fresh surfaces cleavage planes impart a copper-brown colour. Olivine (partially altered to iddingsite) and augite are

TABLE 13. CHEMICAL ANALYSES OF SAMPLES[1] FROM THE PORT COLDWELL COMPLEX.

	1	2	3
SiO_2	48.91	48.79	57.17
Al_2O_3	14.47	14.44	15.24
Fe_2O_3	4.43	3.70	2.66
FeO	9.25	9.70	7.23
MgO	4.48	4.72	0.36
CaO	7.81	8.51	3.33
Na_2O	3.92	3.39	5.13
K_2O	2.28	2.07	5.22
TiO_2	2.04	1.87	0.96
P_2O_5	0.61	0.62	0.14
MnO	0.22	0.24	0.26
H_2O	1.02	1.03	1.02
CO_2	0.00	0.35	0.19
TOTAL	99.44	99.43	99.22

SPECIMENS
1 Fine-grained gabbro.
2 Average of 5 gabbro analyses (including specimen 1).
3 Coarse-grained, massive, brown monzonite (syenite).

[1] Data from Currie (1980); specimens 1, 2 from Table 10, p. 15 and specimen 3 from Table 12, p. 17.

common mafic accessory minerals; locally they form the dominant mafic constituents. Euhedral apatite and subhedral to anhedral magnetite are ubiquitous and significant accessories (1 to 2 percent) in most of the specimens that were examined. Biotite and magnetite commonly exhibit a 'symbiotic' habit. All of the gabbro contains sufficient magnetite to attract a hand magnet, and in some cases a compass as well. Plagioclase occurs as well-twinned (albitic) laths which are reported to have a composition of An_{35} to An_{60} (Lum 1973).

Layered gabbro displays faint to conspicuous primary mineralogical banding in alternating light and dark layers. The colour variation is due to alternating proportions of mafic and felsic minerals. Biotite is not a major mafic constituent in this rock type. Compositions averaging $An_{55\pm5}$ are recorded for the plagioclase (Lum 1973). The layering is generally not continuous for distances greater than 30 m; it either fades and disappears or is truncated against finer grained phases. At the roadcut on Highway 17, the attitude of layering strikes S05E and dips 50 degrees to the west which is somewhat steeper than the generally reported values of 30 degrees to 35 degrees (Puskas 1967a).

Chilled, or fine-grained gabbro, is reported to be present along or near the contact zone with the country rocks (Lum 1973). Lum gives average plagioclase compositions of $An_{57\pm5}$ and states that aside from the obvious aspect of layering, the layered and chilled gabbro are very similar except for mineral segregations.

Olivine gabbro (olivine >10 percent) was not found in great abundance in the map-area. It was distinguished in hand specimen by numerous fine- to medium-grained, equigranular, yellowish green olivine crystals and a strong magnetic character. The rock is greenish-black on fresh surfaces due to both olivine and magnetite. Its relationship with the biotite gabbro is not clear.

Compositions of some gabbros are given in Table 13.

MONZONITE

The predominant rock-types of the Port Coldwell complex underlying the map-area have been given several names since their original reporting. Terms such as black granite (a commercial term), augite syenite (Thompson 1931), and laurvikite (Puskas 1967a) have been variously applied by different workers. The rock in the map-area appears to be largely of a monzonite composition as deduced from thin sections obtained by the author and by R. Sage[1]. The monzonite is medium to coarse grained and varies in colour from reddish brown to greenish grey dependent on the colour of the feldspar. Reddish varieties are due mostly to hematite staining, and they commonly contain an alkalic amphibole (Puskas 1967). Greenish grey feldspar imparts a darker colour to the rock, which may then be confused with a leucogabbro. The two types grade imperceptably and, locally, repeatedly into one another.

The feldspar is predominantly coarse-grained perthite with well- developed exsolution patterns. The ratio of microcline to albite is somewhat variable and some examples approach a syenite composition. Olivine (fayalite), augite (ferro variety) (Puskas 1967), biotite, and magnetite constitute the mafic minerals in various proportions (generally less than 3 percent). They are heterogeneously distributed throughout the rock. Biotite commonly mantles magnetite grains and in places occurs in a fan-like arrangement. Euhedral apatite is virtually ubiquitous. Rare, brown amphibole is present as are amphiboles of the ferro-edenite-hastingsite series (Mitchell and Platt 1977).

Layering imparted by leucocratic and melanocratic compositions is common in the monzonite. Good exposures are present in the lakeshore outcrop at the western boundary of the map area. Here individual layers are traceable for over 30 m, dip to the northwest at 35 to 40 degrees and strike parallel to the interpreted contact with the country rock. Cross-bedding, slump structures, and diffuse turbulent layering are reportedly present in the area

[1]Geologist, Ontario Geological Survey, personal communication 1978.

(Mitchell and Platt 1977) but they were not seen by the author. Syenite reportedly intrudes the gabbro of the complex outside of the map-area (Currie 1980). The chemical composition of a monzonite (syenite) is given in Table 13.

HORNBLENDE QUARTZ SYENITE PEGMATITE

Numerous pegmatitic dikes cut gabbro and hybrid rocks. In the Heron Bay map-area, they are best exposed in the rock cut along Highway 17. Two varieties are prevalent although other phases are present. The most common is a very coarse-grained (10 to 40 mm), green feldspar-rich syenite with minor, irregularly distributed quartz and amphibole. Euhedral feldspar, commonly altered and fractured, constitutes up to 95 percent of the rock. Locally a graphic texture is evident. Some medium-grained varieties of this pegmatite are also present. Dike attitudes and thicknesses are usually irregular.

The second most common type consists largely of pink feldspar and lesser quartz and amphibole in medium- to coarse-grained habits. The amphibole is black, commonly euhedral, and occurs both in crossed and rosette (poorly developed) form. Quartz is interstitial to the subhedral feldspar and is minor and variable in abundance. These dikes have irregular attitudes and thicknesses.

Alkalic and Related Dikes

Numerous types of alkalic and related dikes are found in the Heron Bay map-area with the exception of the Port Coldwell Complex itself where no alkalic dikes were observed. Reports of alkalic dikes cutting the rocks of the complex, as described by Puskas (1967a), and Mitchell and Platt (1977), are restricted to areas outside of this map-area. The dikes were rarely observed inland due to differential weathering and Cenozoic cover, although numerous debris-filled 'trenches' were recorded. Nevertheless the shoreline exposed an incredible variety and number of dikes. In general these dikes are more numerous in the north and gradually diminish in abundance so that in the south part of the shoreline they are sparse. The dikes may actually be more abundant along the margins of the Lake Superior basin. Only one or two dikes were observed to have cut the Heron Bay Pluton and the Pukaskwa Gneissic Complex where exposure is good; none were observed to cut the Gowan Lake Pluton.

The variety of the dikes is impressive. Strike, dip, and thickness commonly change within the same dike. In some, colour, texture, and mineralogy change considerably along strike such that different names could be given to the same dike depending upon where it is examined. Other dike types are very consistent in their features. Most dikes intruded vertically or near vertically but some intruded at shallow dips (less than 45 degrees). Most dikes have undergone a high degree of alteration on a microscopic scale despite their relatively young age. Much of this alteration may be deuteric.

Peculiar textures are common in these dikes (which in part helped to identify them from common rock types): circular and fossil-like features on chilled dike walls; golf-ball-size mineral 'aggregations' which weathered out as solid spheres; multiple zoning and (or) layering parallel to dike contacts (see Photo 13); lumpy, fractured and easily-weathered dike centres (Photo 14); and ocelli are only some of the features. Composite dikes may be present in which later dikes, with no appreciable chill margin, look older than the earlier dike.

It is estimated by the author that more detailed mapping would lead to the recognition and grouping of 10 to 15 types of dikes and that another 20 or so uncommon varieties exist. For this report the dikes are described under six headings. At least several general ages of dikes are present; lamprophyres are cut by alkalic diabase, which are cut by other lamprophyres, which are in turn cut by syenitic dikes. The great number of varieties and their uneven distribution by type, along the shoreline, precluded for this project a more exact relative age relationship between the major dike types.

The relative age of many of the dikes in the map-area (alkalic and non-alkalic) was generally established between no more than two or three types at any given location. In a few cases, three dikes almost intersected at a triple junction. However, in order to make the data fit appropriately to the scale of the map, many of the dikes had to be omitted throughout the length of the shoreline. In one noteable case, the relationships between eight types of dikes (along a 275 m length of shoreline south of Prospect Cove) were established with reasonable certainty. These are shown in Table 14.

The following sub-sections describe the broadly generalized major types of alkalic and related dikes.

10 368

Photo 14—*Alkalic diabase dike with common weathered-out dike centre (along joints); note change in dike attitude, and trapped, rounded boulders; Playter Harbour.*

TABLE 14. CROSS-CUTTING RELATIONSHIPS BETWEEN EIGHT DIKES ON LAKE SUPERIOR SHORELINE, HERON BAY AREA.

Early to Middle Precambrian	Pink dioritic dike with aphanitic matrix and flow-aligned, coarse-grained plagioclase laths;
	cut by
	Pinkish grey dioritic dike with fine-grained matrix and numerous angular fragments of mafic metavolcanics (?)
	cut by
	Schistose diatreme gabbro dike with biotite phenocrysts (see section on Schistose Dikes)
	cut by
	Internally deformed and banded trondhjemite dike (see section on Late Felsic Dikes and Sills)
	cut by
Middle to Late Precambrian	Fine-grained subalkalic diabase dike (see section on Mafic Intrusive Rocks)
	cut by
Late Precambrian	Fine- to medium-grained alkalic diabase dike (see section on Alkalic and Related Dikes)
	cut by
	Plagioclase-porphyritic alkalic diabase dike (see section on Alkalic and Related Dikes)
	cut by
	Gabbroic lamprophyre dike (olivine? phenocrysts) (see section on Alkalic and Related Dikes)

GABBRO, DIABASE

One of the most interesting features of the gabbroic and diabasic dikes is the presence of glass stringers and chilled margins in at least three widely-separated localities: north of Randle Point, east of Boulton Reef, and near Channel Island. The glass stringers (up to 3 cm wide) are fractured, locally crumbly, and possess sharp cutting edges. In each case, the stringers are offshoots of a diabasic dike. The composition of one sample is given in Table 15. Although this sample is chemically classified as subalkalic tholeiitic basalt it is grouped under Alkalic and Related Dikes because of its late age[1]. The glass varies from uniformly black to a grey-blue-black with bright or dull blue, green, and red lenses of 'impurities'. In thin section no sign of devitrification is detectable except that the glass is anisotropic and exhibits undulating extinction. It is highly fractured and the anisotropy may be due to strain effects. The chilled margins of other dikes are commonly grey-black and develop a steel-blue-grey weathered surface. They are present as margins on some of the various types of alkalic diabase-gabbro dikes. The presence of undevitrified glass suggests a young age (radiometric ages are given in the Appendix).

A carbonatitic dike on Patterson Island (in the Slate Islands group) to the west of the map-area has been dated at 300 m.y[2]. It in turn is cut by a diatreme which itself has undergone later igneous activity. It is therefore not unrealistic to anticipate dikes younger than 300 m.y. in this area. The prospect of late Paleozoic igneous activity in this part of the Canadian Shield is interesting.

The section on Mafic Intrusive Rocks (diabase) has discussed the similarities and dissimilarities of common subalkalic diabase dikes and late alkalic diabase dikes. The major problem is that many of the dikes were not classified with certainty. Limited chemical analy-

[1]See Appendix for comments on chemical composition and age of dike.
[2]D.H. Watkinson, Carleton University, personal communication, 1977.

ses (two) confirm the empirically-derived field classification, but the analysed samples are some of the best examples of alkalic diabases. Lack of information on the extent of variation in appearance and mineralogy of common diabase dikes hindered the classification.

Some dikes are characterized by peculiar sulphide blebs with felsic acicular crystals and medium- to coarse-grained mafic phenocrysts, possibly both pyroxene and olivine, which are observable in hand specimen. A red colouration of certain minerals and fracture fillings may be associated with some dikes. Specific fracturing features (see Photo 14) and fresh looking (glassy and non-glassy) chilled margins, are other features used in grouping certain dikes as 'alkalic'. Common thicknesses for these dikes range from 0.1 m to 5 m. A type of dike present over a large part of the shoreline has been designated porphyritic diabase or gabbro by the author depending on whether diabase texture was observed. These dikes have up to 15 percent coarse-grained, twinned and zoned, plagioclase phenocrysts (Photo 15) that are commonly weakly to strongly flow-aligned, parallel to the dike contacts. Locally these dikes are glomeroporphyritic. These dikes cut common diabase and some alkalic diabase, and are in turn cut by more than one age of aphanitic, gabbro- or diabase-like dikes with or without plagioclase or olivine phenocrysts. In one case, a porphyritic alkalic diabase cut an earlier similar dike that contains numerous, well-zoned, augite phenocrysts (Photo 16). Both of these dikes cut a large subalkalic diabase dike.

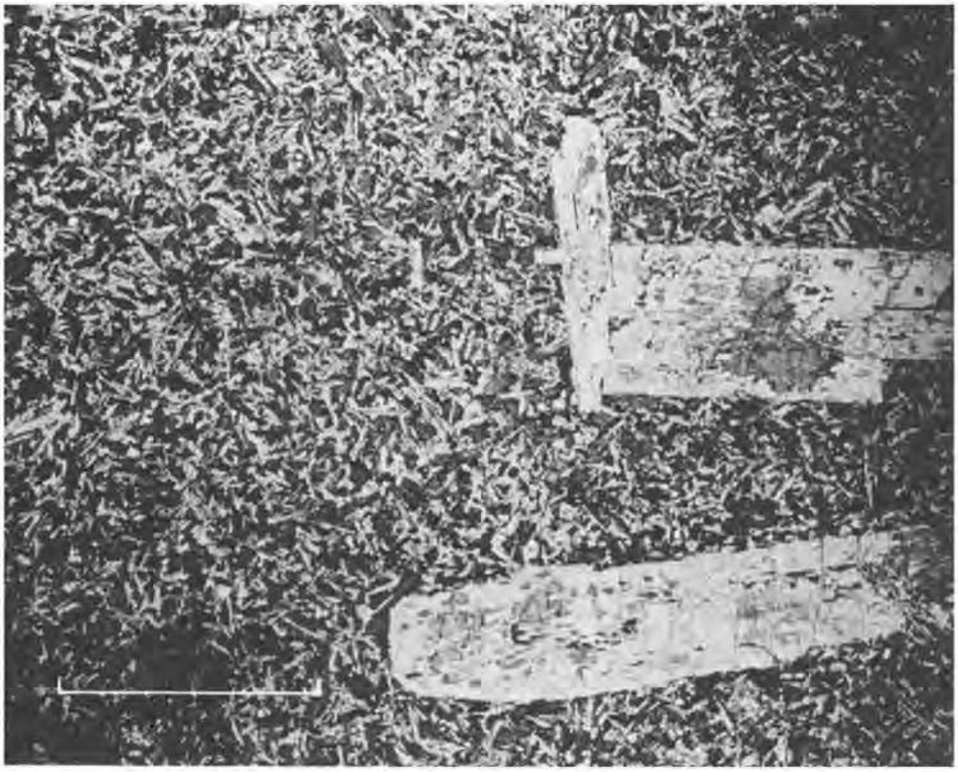
Chemical compositions of some alkalic dikes are given in Table 15.

TABLE 15. CHEMICAL ANALYSES OF ALKALIC AND RELATED DIKES IN THE HERON BAY AREA.

	1	2	3	4	5	6	7	8	9
SiO_2	44.6	46.5	45.9	27.1	43.9	32.2	44.7	43.4	56.4
Al_2O_3	12.9	14.0	15.5	2.96	9.26	3.11	8.84	14.1	15.0
Fe_2O_3	14.9[1]	4.11	15.1[1]	15.2[1]	13.3[1]	7.06	11.2[1]	13.5[1]	3.03
FeO		8.90				5.80			6.90
MgO	4.94	4.34	4.80	16.2	13.1	15.3	21.0	6.99	1.11
CaO	8.22	8.86	9.66	17.2	11.4	19.0	8.71	10.5	3.04
Na_2O	1.13	3.91	3.29	0.03	1.44	0.43	0.75	2.89	5.96
K_2O	1.49	1.90	1.78	1.28	0.26	0.40	0.21	1.28	4.65
TiO_2	1.67	1.21	2.06	3.13	1.65	2.92	0.62	1.91	1.22
P_2O_5	0.74	1.10	0.76	0.72	0.38	1.30	0.11	1.30	0.30
MnO	0.26	0.26	0.23	0.24	0.31	0.28	0.19	0.30	0.29
S	–[2]	0.13	–[2]	–[2]	–[2]	0.10	–[2]	–[2]	0.07
H_2O^+		0.61				3.71			0.32
H_2O^-	8.90[3]	0.26	0.90[3]	16.1[3]	5.10[3]	1.50	4.30[3]	3.70[3]	0.68
CO_2		3.16				7.48			0.84
TOTAL	99.7	99.6	100.0	100.2	100.1	100.6	100.6	99.9	99.8
S.G.	2.62	3.00	3.22	2.77	3.13	3.49	2.96	2.96	2.66

SPECIMENS (See Table 16 and Figure 3 for locations.)
1 M125-77 Basaltic glass from stringer off diabasic dike.
2 M282-77 Alkalic diabase.
3 M309-77 Porphyritic (plagioclase) alkalic diabase.
4 M139-77 Gabbroic lamprophyre.
5 M176-77 Gabbroic lamprophyre.
6 M403-77 Ultramafic lamprophyre.
7 M600-77 Ultramafic lamprophyre.
8 M393-77 Porphyritic gabbro dike.
9 M653-77 Porphyritic syenite dike.

NOTES
[1] Total iron as Fe_2O_3.
[2] Not determined
[3] All volatiles as loss on ignition
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto



10 369

Photo 15—*Photomicrograph (plane light) of porphyritic (plagioclase laths) alkalic diabase dike; fine-grained matrix, very coarse-grained phenocrysts; near Channel Island; cuts rock in Photo 16. Bar scale represents 5 mm.*

LAMPROPHYRES

The term lamprophyre, as used in this report, has been restricted to rocks containing mafic phenocrysts only. Other dikes that contain mafic and felsic phenocrysts have been classified as porphyritic gabbro or porphyritic syenite dikes.

The gabbroic lamprophyres are of several varieties. Some are mafic lamprophyres with almost 25 percent fine- to medium-grained pyroxene and (or) olivine phenocrysts (see Photo 17) and minor sulphide blebs in a very fine-grained mafic matrix. Others contain fine- to medium-grained mafic phenocrysts and similar or larger, subhedral and euhedral phenocrysts of magnetite. Some varieties have phenocrysts with alteration rims that show in weathered specimens. Rock fragments, commonly not of the immediate adjacent wall-rock, are abundant in other varieties. Biotite and (or) olivine phenocrysts are identifiable in others. Combinations of the above features also occur. Zoning is common in some types of lamprophyre (see Photo 13), and is especially evident on weathered surfaces as a result of different proportions of phenocrysts, slight changes in grain size, or multiple magma influxes.

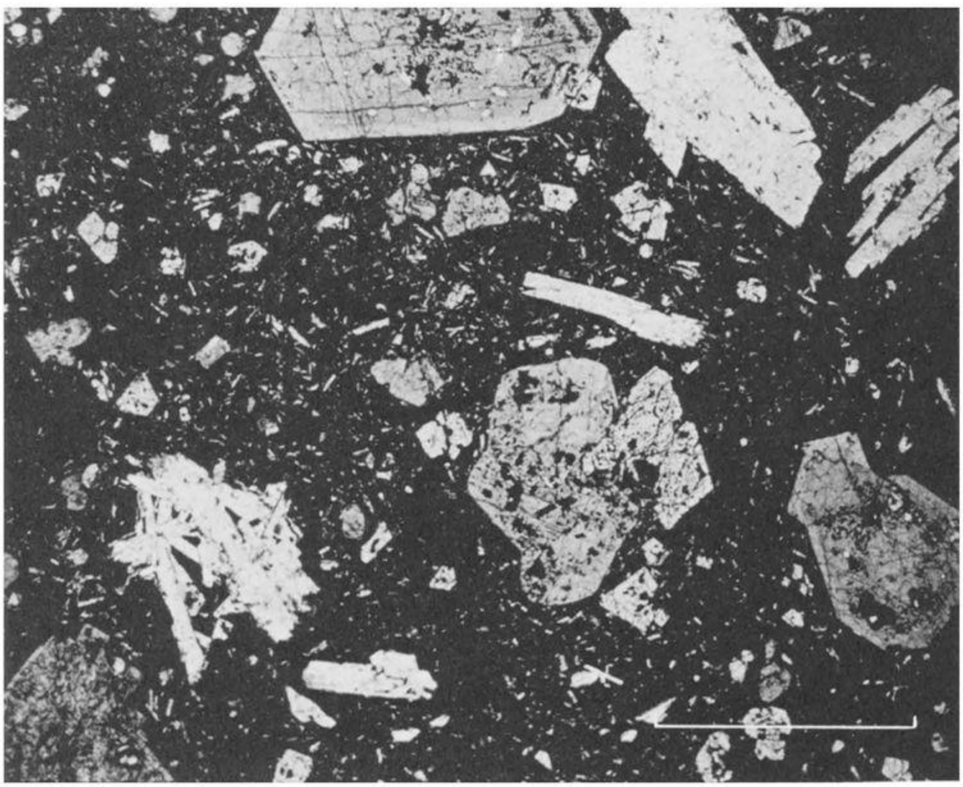
The dikes commonly range from 2 cm to 40 cm thick and repeatedly bifurcate, change thickness, or terminate by wedging out. It is not uncommon to have later lamprophyre dikes cut earlier ones. Colours and textures in weathered and fresh surfaces are so variable within dikes, and from dike to dike, as to defy description. Not all of the lamprophyres are chemically alkalic but no evidence was observed to indicate that any of these dikes are older than the subalkalic diabase dikes. Therefore these dikes have been grouped by the author with the alkalic rocks. Analyses of several lamprophyres are given in Table 15.

Ultramafic lamprophyres were not commonly observed. One example consists of a dark, altered dike that shows numerous olivine (partly altered) phenocrysts in a fine-grained groundmass. The dike is located at Pulpwood Harbour, and may be related to the nearby ultramafic intrusions. However, the dike is alkalic (see sample M600-77, Table 15).

Chemically, the analysed lamprophyres, if not ultrabasic, are commonly borderline between ultrabasic and basic. They are moderate to high in MgO content. Normative colour indices may not be reliable because they are based on peculiar compositions, but the general range is from 44 to 89.

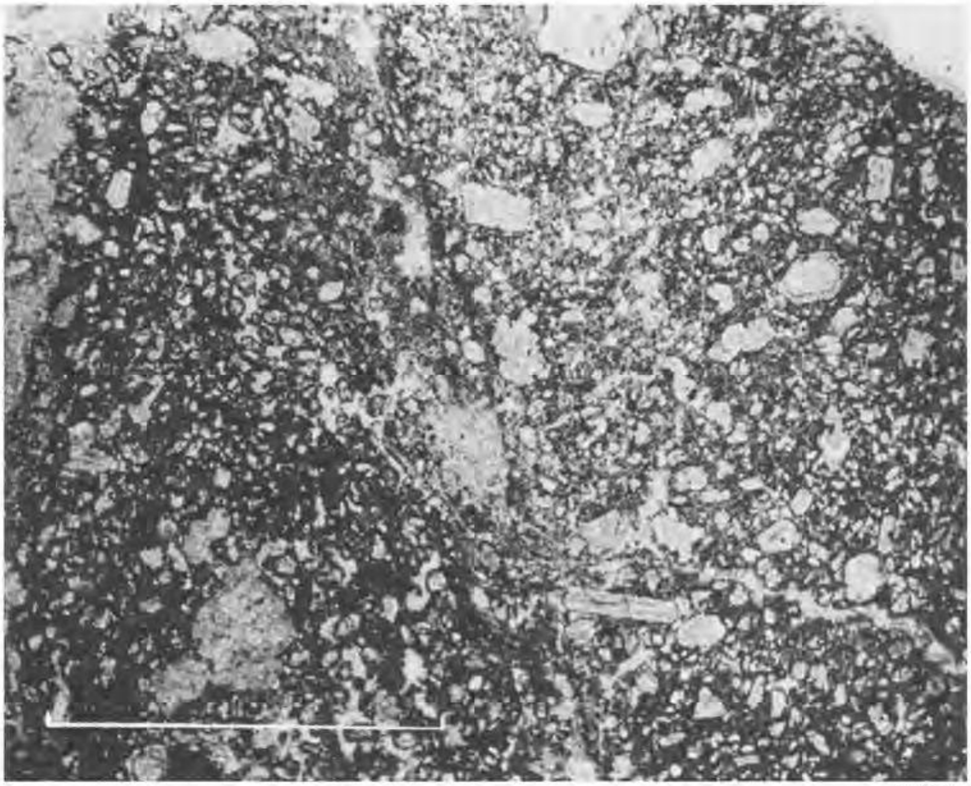
PORPHYRITIC GABBRO

Dikes similar to some of the lamprophyres except for the presence of felsic phenocrysts are numerous and are of such great variety as to require almost individual description. One



10 370

Photo 16—*Photomicrograph (plane light) of porphyritic (augite, plagioclase) alkalic diabase dike; augite well zoned; synneusis-like texture with plagioclase laths; cut by rock in Photo 15; near Channel Island. Bar scale represents 5 mm.*



10 371

Photo 17—*Photomicrograph (plane light) of gabbroic lamprophyre dike; numerous totally altered olivine and pyroxene phenocrysts, now serpentine, chlorite, and talc; Lake Superior shoreline. Bar scale represents 5 mm.*

or more of the following phenocrysts are common to the dikes: biotite, pyroxene, feldspar, quartz, and calcite. Some phenocrysts have a red colouration possibly due to hematization. Ocelli are present in some of the dikes and most of the general properties of alkalic dikes as described at the beginning of this section are exhibited in the porphyritic gabbro dikes. One chemical analysis is given in Table 15.

PORPHYRITIC SYENITE

Several varieties of syenitic dikes outcrop along the shoreline; one dike was observed within the Heron Bay Pluton. The most common phenocrysts are feldspar which range from 3 to 20 mm in size and from 1 to 5 percent by volume of the dikes. Other phenocrysts include amphibole (1 to 5 percent) up to 10 mm in length. The matrices are aphanitic and commonly pinkish brown to reddish brown. Some dikes have numerous phenocrysts, in which case the felsic phenocrysts may be up to 20 mm long, and others have sparse phenocrysts which are generally less than 5 mm long. Amphibole phenocrysts are generally not larger than 5 mm.

The best exposed porphyritic syenite dike outcrops intermittently on the Lake Superior shoreline extending from Randle Point northward for about 2.2 km. The dike is glomeroporphyritic (anorthoclase), brick red to reddish brown on fresh and weathered surfaces, about 1.3 to 2 m thick and vertically dipping. This particular dike and others in the area have been described by Coleman (1900), and Mitchell and Platt (1977). The latter describe the dike as an analcite tinguaite with phenocrysts of ferroaugite, hastingsite (acmite rims) and anorthoclase, in a very fine-grained groundmass of hematized feldspar, pyroxene, apatite, analcite, and fluorite. An analysis of this dike is given in Table 15.

CARBONATITE DIKES

Carbonatite dikes are not common in the map-area, but nonetheless are present in a variety of forms. They commonly form part of or are associated with intrusion breccias. Several show altered (fenitized) reddish fragments (subrounded to angular) of wall-rock in a rusty-brown-weathering, granular, carbonate matrix. In some dikes the fragments are concentrated in zones adjacent to the dike walls. These dikes are exceptionally irregular in attitude and thickness, as compared to other dikes in the map-area. A reddish colouration (hematite) commonly extends up to 0.1 m into the adjacent wall rocks.

Some dikes consist almost wholly of carbonate in mixtures of widely varying grain sizes (medium to very coarse) and fine- to medium-grained fluorite; others contain a reddish orange translucent silica mineraloid that superficially resembles jasper. Some dikes show autobrecciation features. Combinations of the above-mentioned features can be present in any one dike.

INTRUSION BRECCIA

Most intrusion breccias have been grouped with the carbonatite and other alkalic dikes. However, some are diatreme-like and as such have been classified separately. The best example of a diatreme-like dike occurs on the southwest 'corner' of the shoreline in Happy Harbour. This dike changes considerably in appearance along strike but can be traced across the point to Lake Superior and onto a nearby island. Where best developed, the dike is 1 m wide and consists of rounded to subangular fragments, possibly of intermediate to felsic pyroclastic rocks, in a very fine-grained, dark purplish brown matrix, with rimmed calcite and possibly quartz amygdules and vugs. Fragments constitute up to 70 percent of the rock. The megascopic texture resembles that of a conglomerate in places.

Another example occurs about 0.8 km north of Randle Point. Here a conformable, 1 m thick diatreme contains angular to sub-rounded fragments of mafic and intermediate to felsic metavolcanics, siltstone and argillite. The matrix is very fine grained and most fragments are less than 5 cm in diameter. The dike resembles a sedimentary breccia.

Cenozoic

QUATERNARY

Pleistocene and Recent

The glaciolacustrine deposits are now restricted mostly to the Pic and Black River valleys, and consist of fine sand, silt, clay and varved clay. These deposits give the Black River and particularly the Pic River (underfit rivers) a constant muddy appearance. Both rivers (particularly the Black) meander through this flat-lying sedimentary cover. In the north part of Pic Township, deposits along the banks of the Pic River are upwards of 20 m thick. Extensive glacial outwash of sand and minor clay overlies the southeastern part of the area. The east-central part of the area is filled with relatively thick sand and gravel deposits. Little

Black River, Onpaco Creek, Mussy Creek, Jordon Creek, and other tributaries have dissected the deposits and have developed a dendritic drainage pattern.

Large sections of the northwestern part of the area are covered by thick glacial deposits. The deposits represent an ice-contact delta with some reworked gravels and eolian sands (Cowan 1976). Included in the area are deposits of coarse sand and gravel as well as deposits of well rounded and well sorted pebbles, cobbles, and boulders. Steep-sided kettles are present in part of the glacial cover. Several nearby short beaches on Lake Superior consist of these well-sorted deposits. Several discontinuous, ancient shorelines are evident on aerial photographs. One large continuous shoreline extends for about 6.5 km. The Canadian Pacific Railway parallels the foot of another long shoreline for about 4 km. Both can be readily seen from specific ground viewpoints. A few ancient shorelines are present near the mouth of the Pic River.

The map-area is relatively free of swamps due to its high relief and good drainage. Most of the swamps occur at the ends of lakes or in linear valleys between high ridges of rock.

Glacial striae can be found on many outcrops. The best examples are those on Lake Superior where glacial scouring is particularly evident. The prevailing direction of ice movement was towards the Lake Superior basin but was controlled locally by surface morphology. This is evident in several areas where widely varying readings from locality to locality are always parallel or subparallel to major bedrock features. Glacial striae in the area near Heron Bay give a sense of movement of about S55-65W. Readings approach S75W in the Pulpwood-Playter Harbour area where there are several west-trending valleys. One small island near Channel Island showed that at least two distinct directions of ice movement have occurred; one at S42W and another at S72W. Chronological relationships could not be determined.

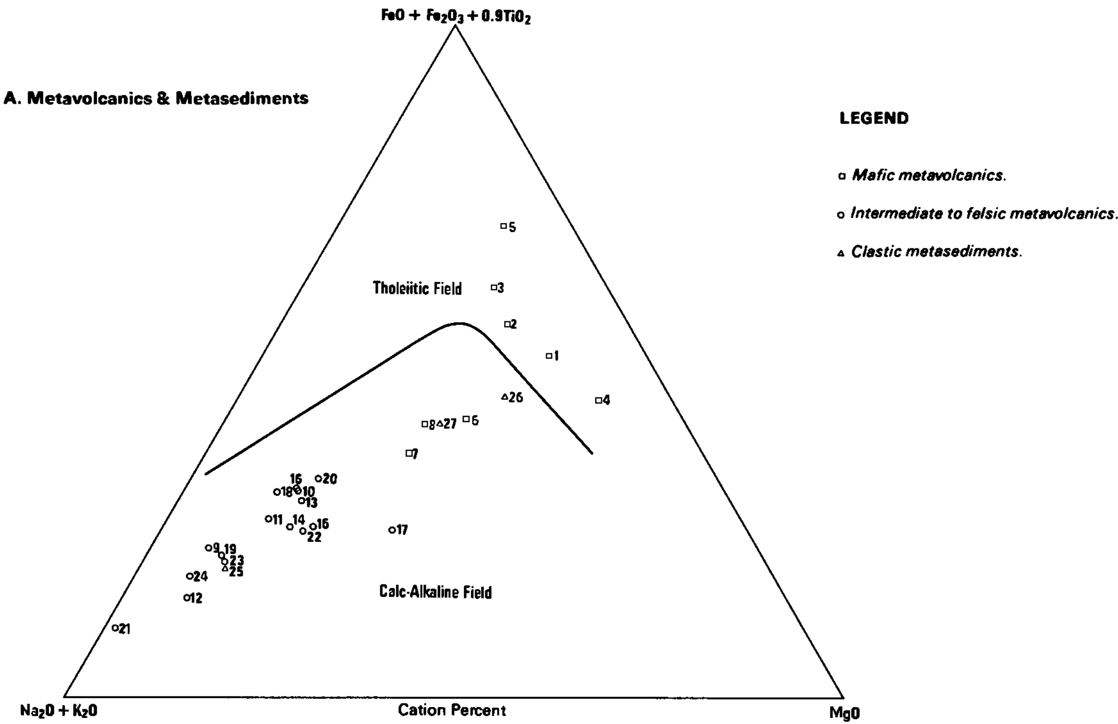
Petrochemistry

The section on petrochemistry has been included so that a synopsis of relative compositions of most of the rock types (both intrusive and extrusive) can be made. The triangular diagrams that are used (Figures 4, 5 and 6) to compare the compositions are: an AFM plot and a Ne-Ol-Q plot (after Irvine and Baragar 1971), and an Al–Fe + Ti–Mg 'cation' plot (after Jensen 1976). An alkalies-silica plot (Figure 7 after Irvine and Barager 1971) is also included. Although the Jensen classification does not apply to alkalic rocks, it is instructive to examine their relative position with respect to the subalkaline rocks. In some cases, slight alkali metasomatism may place a rock into an 'alkalic' classification (compare sample no. 3, Figures 6a and 7a) even though its position in Figures 4a and 5a is representative of the field name for the rock (see sample no. 3, Figures 4a and 5a). Results of normative and triangular plot classifications are given in Table 16.

With respect to the extrusive rocks, the differentiation of the calc-alkalic suite of rocks is most apparent. Groups of samples in Figure 4a and 5a are similar but the relative position of samples within those groups varies. This suite of rocks represents a large portion of the volcanic rocks in the map-area. The tholeiitic suite is poorly defined, perhaps because of a small sample population. These rocks might be considered to be calc-alkalic basalts and andesites[1] except for their pronounced high iron content and close association with ultramafic rocks that have some similar properties. There is also a marked separation in some triangular diagrams between the tholeiitic rocks from the Pulpwood-Playter Harbours sequence and the pyroclastic rocks from the Channel Island area. The author proposes that the presence of some tholeiitic mafic rocks and ultramafic rocks in the Channel Island area indicates there may have been displacement of these rocks to the north with respect

[1]The classifications cannot accurately distinguish between rocks of different suites that have similar compositions (e.g. tholeiitic basalt vs. calc-alkalic basalt).

A. Metavolcanics & Metasediments



SMC 14430

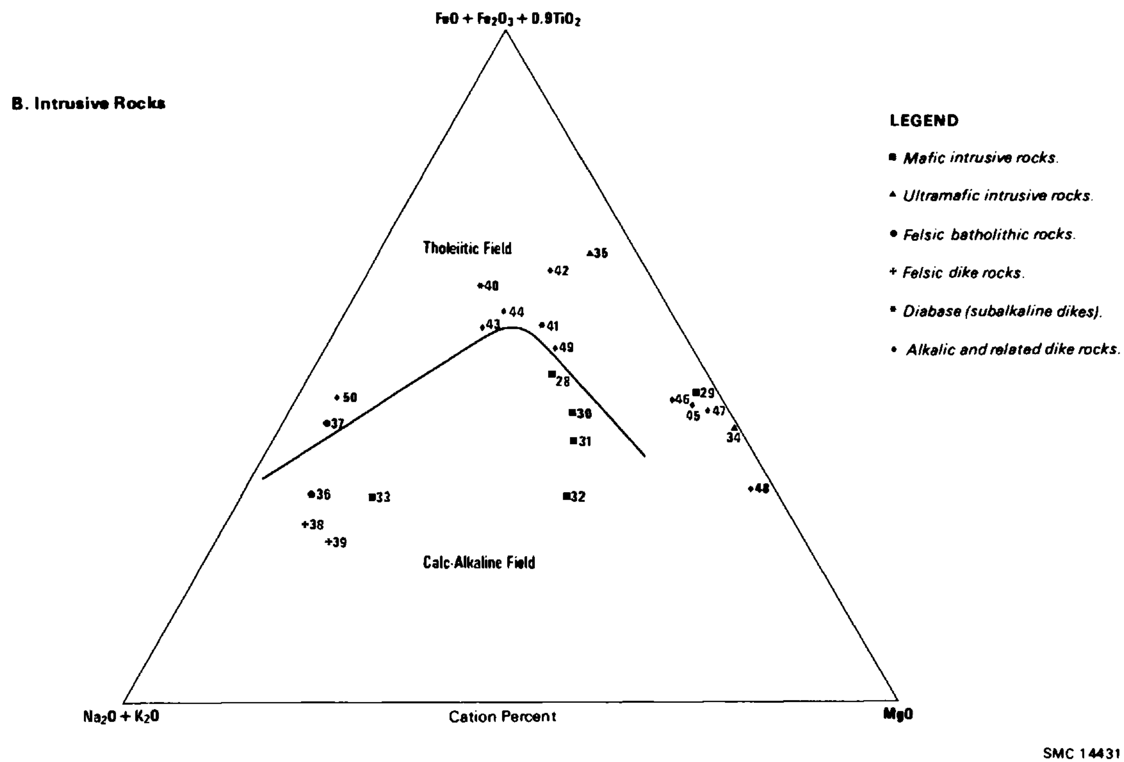
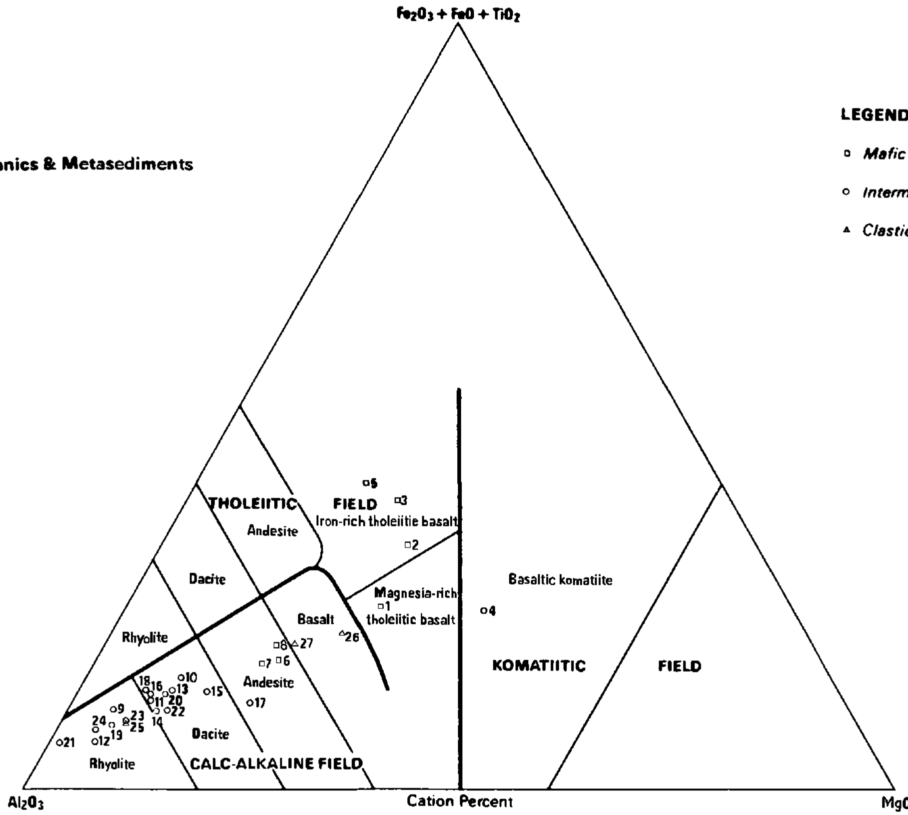


Figure 4—*AFM plot (after Irvine and Baragar 1971) of chemically analysed samples from the Heron Bay area. Sample numbers and locations are given in Table 16 and Figure 3.*

A. Metavolcanics & Metasediments



LEGEND

- ▫ *Mafic metavolcanics.*
- ○ *Intermediate to felsic metavolcanics.*
- ▲ *Clastic metasediments.*

SMC 14432

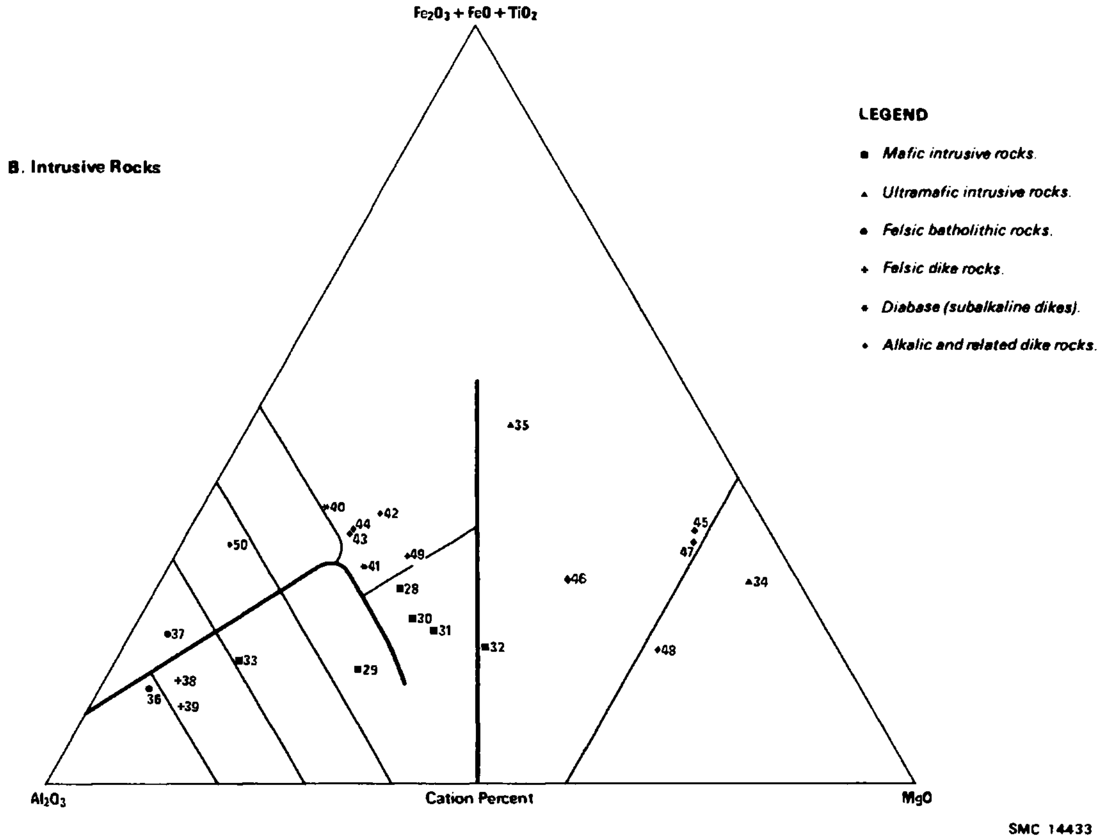
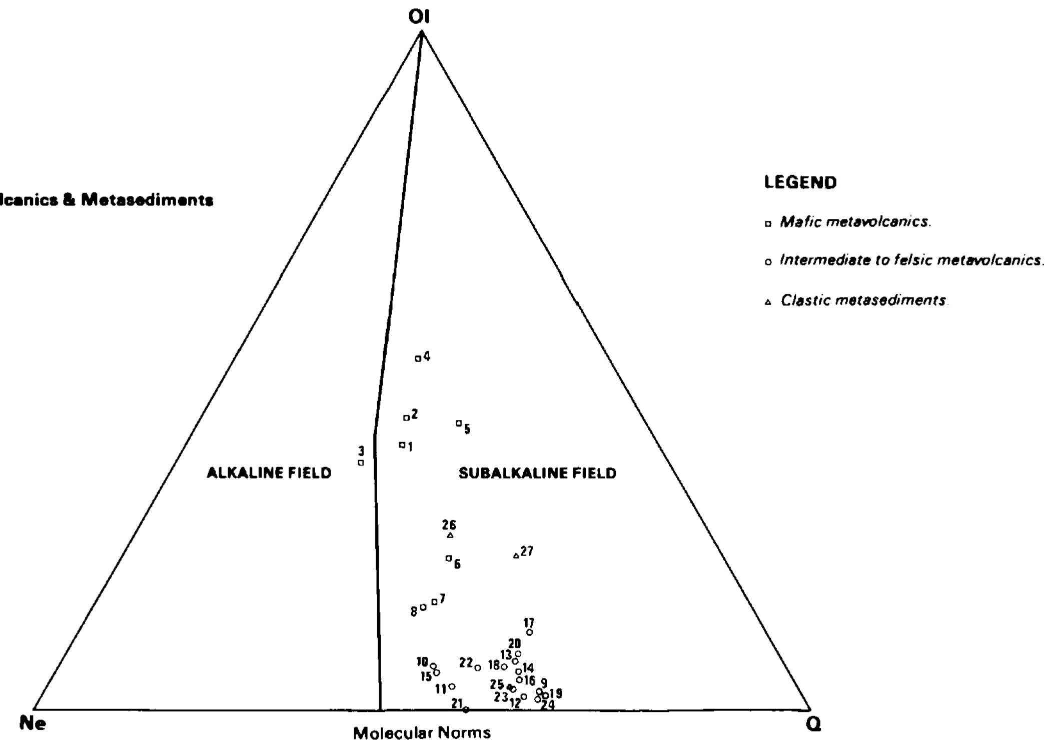


Figure 5—*Cation plot (after Jensen 1976) of chemically analysed samples from the Heron Bay area. Sample numbers and locations are given in Table 16 and Figure 3.*

A. Metavolcanics & Metasediments



SMC 14434

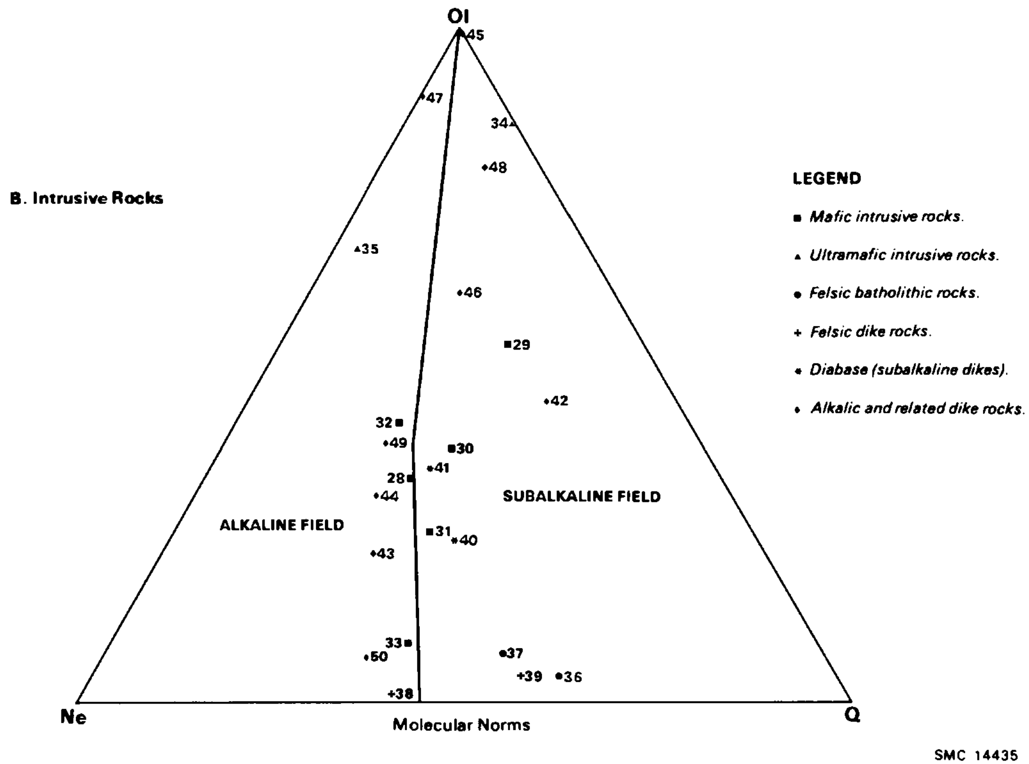
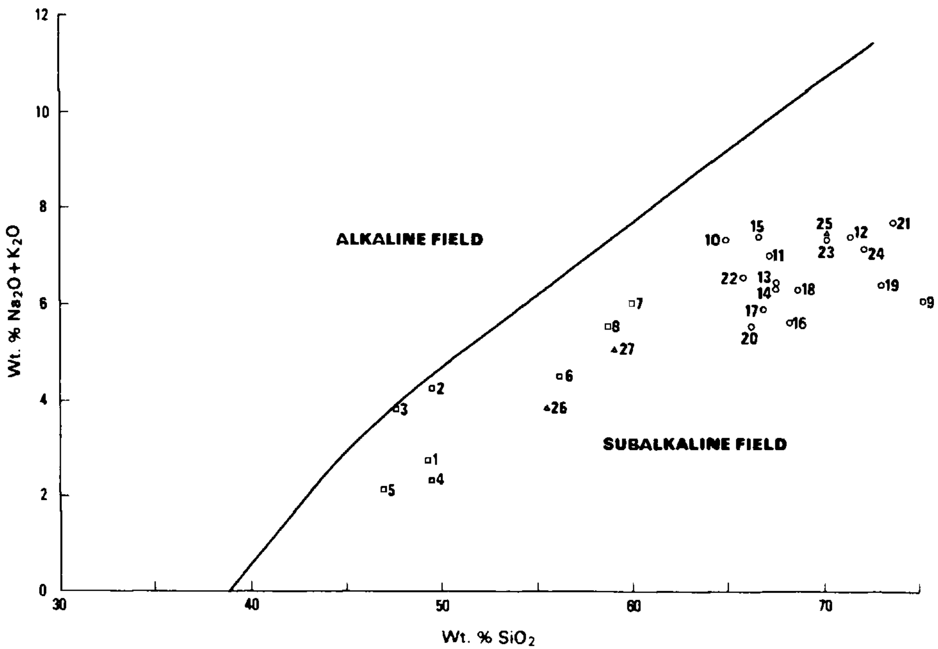


Figure 6—Ne-Ol-Q plot (after Irvine and Baragar 1971) of chemically analysed samples from the Heron Bay area. Sample numbers and locations are given in Table 16 and Figure 3.

A. Metavolcanics & Metasediments

LEGEND

- *Mafic metavolcanics.*
- *Intermediate to felsic metavolcanics.*
- *Clastic metasediments.*



SMC 14436

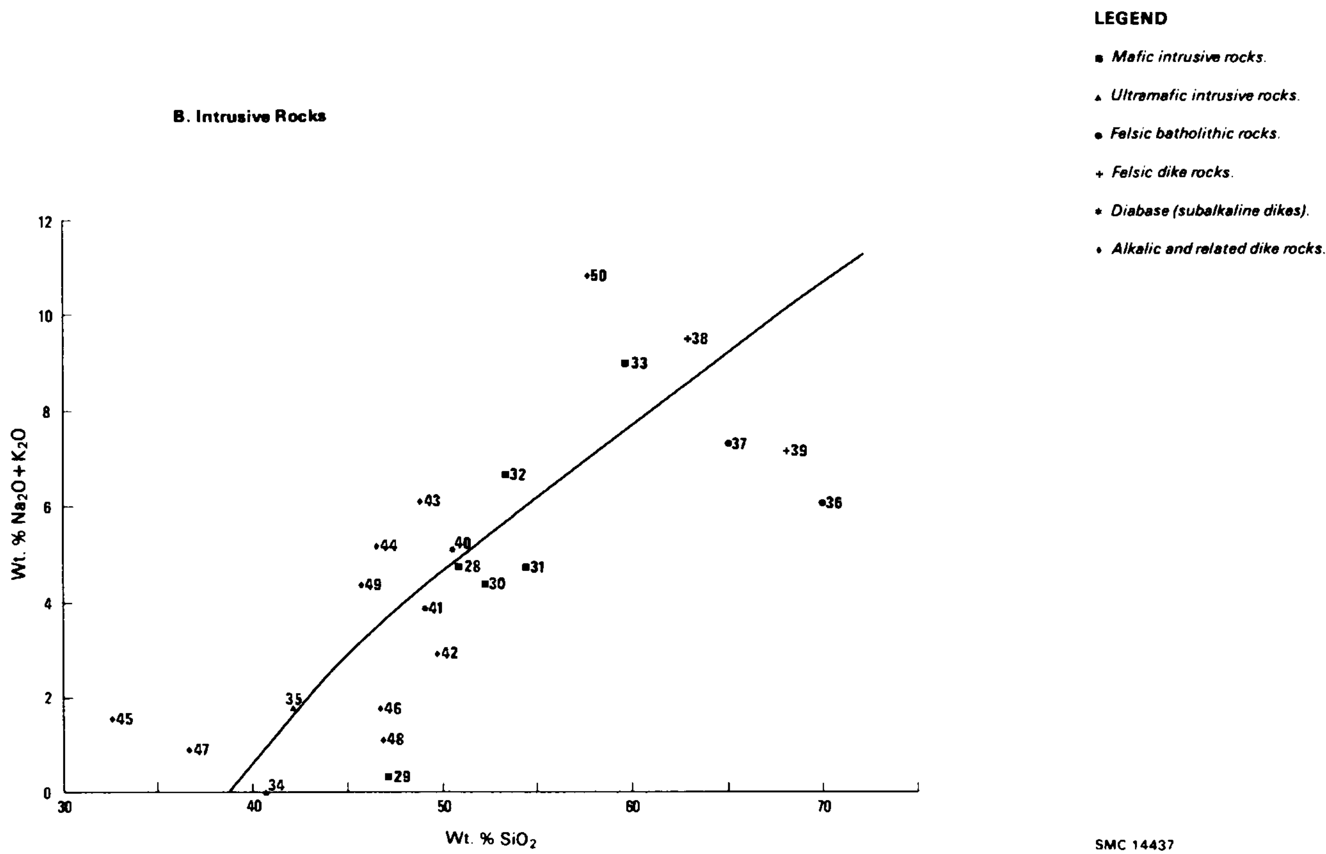


Figure 7—Alkalies vs. silica plot (after Irvine and Baragar 1971) of chemically analysed samples from the Heron Bay area. Sample numbers and locations are given in Table 16 and Figure 3.

TABLE 16. CLASSIFICATION OF CHEMICALLY ANALYSED SPECIMENS FROM THE HERON BAY AREA.

Code No.[1]	Sample No.	Field Name	Irvine and Barager (1971) Classification	Jensen (1976) Classification
1	M483-77	mafic flow, plagioclase-porphyritic	tholeiitic basalt	tholeiitic basalt, high-Mg
2	M637-77	mafic flow, medium grained	tholeiitic basalt	tholeiitic basalt; high-Fe
3	M595-77	mafic pillowed flow, green black	alkali basalt; Na series	tholeiitic basalt; high-Fe
4	M630-77	mafic, pillowed, variolitic flow	tholeiitic basalt	komatiitic basalt
5	M498-77	mafic tuff, green-black	tholeiitic basalt	tholeiitic basalt; high-Fe
6	M643-77	mafic pyroclastic/pillow breccia	calc-alkalic basalt; high-Al	calc-alkalic andesite
7	M636-77	mafic tuff	calc-alkalic basalt; high-Al	calc-alkalic andesite
8	M638-77	mafic lapilli-tuff	calc-alkalic andesite; high-Al	calc-alkalic andesite
9	M116-77	felsic flow	calc-alkalic dacite	calc-alkalic rhyolite
10	M405-77	felsic flow	calc-alkalic dacite; high-Al	calc-alkalic dacite
11	M118-77	intermediate spherulitic flow	calc-alkalic dacite; high-Al	calc-alkalic dacite
12	M195-77	felsic quartz-feldspar porphyry	calc-alkalic rhyolite; high-Al	calc-alkalic rhyolite
13	M159-77	intermediate tuff	calc-alkalic dacite; high-Al	calc-alkalic dacite
14	M303-77	intermediate tuff	calc-alkalic dacite; high-Al	calc-alkalic dacite
15	M319-77	intermediate tuff	calc-alkalic dacite	calc-alkalic dacite
16	M128-77	intermediate crystal tuff	calc-alkalic dacite	calc-alkalic dacite
17	M144-77	intermediate to felsic crystal tuff	calc-alkalic dacite; high-Al	calc-alkalic andesite
18	M419-77	intermediate tuff	calc-alkalic dacite; high-Al	calc-alkalic dacite
19	M505-77	intermediate crystal tuff	calc-alkalic dacite	calc-alkalic rhyolite
20	M654-77	intermediate crystal tuff	calc-alkalic andesite; high-Al	calc-alkalic dacite
21	M628-77	felsic tuff	peralkaline	calc-alkalic rhyolite
22	M631-77	intermediate to felsic tuff	calc-alkalic dacite; high-Al	calc-alkalic dacite
23	M347-77	felsic tuff-breccia	calc-alkalic dacite; high-Al	calc-alkalic rhyolite
24	M190-77	felsic pyroclastic breccia	calc-alkalic rhyolite; high-Al	calc-alkalic rhyolite
25	M323-77	silicified siltstone	—	calc-alkalic rhyolite
26	M126-77	mafic to intermediate tuff/sediment	—	calc-alkalic basalt
27	M133-77	argillaceous siltstone	—	calc-alkalic basalt
28	M453-77	gabbro	hawaiite; Na alkali basalt series	tholeiitic basalt, high-Mg
29	M432-77	leucogabbro	tholeiitic basalt	calc-alkalic basalt
30	M642-77	schistose gabbroic dike	tholeiitic basalt	tholeiitic basalt, high-Mg
31	M627-77	schistose gabbro/diorite dike	calc-alkalic basalt	tholeiitic basalt; high-Mg
32	M358-77	schistose diatreme-like mafic dike	alkali basalt; K series	*komatiitic basalt
33	M348-77	schistose dioritic dike	mugearite; Na alkali basalt series	*calc-alkalic andesite
34	M620-77	lherzolite/dunite	ultramafic	komatiitic peridotite
35	M601-77	hornblendite/pyroxenite	ankaramite; Na alkali basalt series	*komatiitic basalt
36	M562-77	granodiorite	trondhjemite	+calc-alkalic rhyolite
37	M510-77	granodiorite hybrid	trondhjemite	+tholeiitic rhyolite
38	M402-77	feldspar porphyry (dike)	Na trachyte; Na alkali basalt series	+calc-alkalic dacite
39	M311-77	quartz diorite (dike)	trondhjemite	+calc-alkalic dacite

40	M457-77	diabase (quartz)	tholeiitic basalt	tholeiitic basalt; high-Fe
41	M456-77	diabase (olivine)	tholeiitic basalt	tholeiitic basalt; high-Fe
42	M125-77	glass, intrusive; basalt (alkalic)[2]	tholeiitic basalt	tholeiitic basalt; high-Fe
43	M282-77	alkalic diabase dike	hawaiite; Na alkali basalt series	*tholeiitic basalt; high-Fe
44	M309-77	porphyritic (plagioclase) alkalic diabase dike	alkali basalt; K series	*tholeiitic basalt; high-Fe
45	M139-77	gabbroic lamprophyre (alkalic)	alkalic picrite basalt; Na series	*komaiitic basalt
46	M176-77	gabbroic lamprophyre (alkalic)	tholeiitic basalt	komatiitic basalt
47	M403-77	ultramafic lamprophyre (alkalic)	ankaramite; Na alkali basalt series	*komatiitic basalt
48	M600-77	ultramafic lamprophyre (alkalic)	tholeiitic picrite basalt	komatiitic peridotite
49	M393-77	porphyritic gabbro dike (alkalic)	alkali basalt; Na series	*tholeiitic basalt; high-Fe
50	M653-77	glomeroporphyritic syenite dike (alkalic)	trachyte; K alkali basalt series	*tholeiitic dacite; high-Fe

* Alkaline rock; classification does not apply.
+ Classification not designed for plutonic terminology.
[1] Corresponds with numbers used in Figures 3, 4, 5, 6, and 7.
[2] See Appendix.

to the Pulpwood-Playter Harbours sequence. The samples of sedimentary rocks (classified as chemically equivalent to calc-alkalic basalt) show a transition in position from the calc-alkalic mafic volcanic rocks toward the tholeiitic mafic volcanic rocks. The source rock may be considered to have been mafic but the genetic relationship to chemical suites is uncertain.

The intrusive rocks show a much more scattered distribution, which reflects to some extent their different genesis, and the inclusion of the late alkalic rocks for which there are no extrusive analogues in this area. The leucogabbro (sample no. 29) and gabbro (samples no. 28, 30 and 31) show an interesting relationship. In the 'cation' plot of Figure 5b the leucogabbro (sample no. 29) (the field relationship to the gabbro was not established) plots towards the Al apex as it might under differentiation, whereas in the AFM plot (Figure 4b) its lack of alkalies causes a reverse in its expected position under normal differentiation (see Table 16). This suggests that the leucogabbro has been metasomatically altered.

According to the Irvine and Barager (1971) norm classification, the pyroxenite samples, the gabbro sample (in contact with pyroxenite 1.5 km to the east) and a dark green, pillowed, mafic flow (in contact with pyroxenite near the location of the analysed pyroxenite) are alkaline, belonging to the sodic alkali basalt series (Figure 6a, b). This fact, unless caused by metasomatism (see trace element results), suggests that the rocks may have differentiated from the same magma. If such is the case, the pyroxenite may have been subvolcanic (certain textures suggest this may be true, see "Ultramafic Intrusive Rocks"). The pyroxenite sample (no. 35) position is somewhat isolated in all three diagrams. It is intermediate in composition between the average alkali pyroxenite and the average hornblendite of Nockolds (1954).

The positions of the subalkaline diabase with respect to the alkalic diabase are relatively similar (Figure 4b, 5b). The lack of a significant difference, particularly for one specimen, in the AFM plot is interesting. However, Figure 6b illustrates the difference when plotting normative mineral ratios. Note that the alkalies-silica plot (Figure 7b) classifies one of the subalkalic diabase samples as alkalic. All of the lamprophyre dikes plot in the komatiitic side of Jensen's cation plot, which reflects their high magnesium content. All of the alkalic

TABLE 17. TRACE ELEMENT ANALYSES OF WHOLE ROCK SAMPLES FROM THE HERON BAY AREA.

Rock-Type	Sample	Ba	Be	Cr	Co	Cu	Li	Ni	Pb	Sc	Sr	V	Y	Zn	Zr
Mafic Metavolcanics	M595-77	120	<1	840	85	150	10	373	21	40	200	400	30	138	150
	M630-77	70	<1	1020	60	100	14	322	25	35	100	200	30	86	50
Felsic to Intermediate Metavolcanics	M116-77	230	<1	22	10	50	8	22	19	6	300	35	10	62	100
	M195-77	590	<1	15	8	7	8	<5	15	<5	300	25	<10	36	60
	M159-77	210	<1	36	9	33	12	18	13	7	350	50	<10	66	70
	M144-77	260	<1	55	8	8	16	33	11	7	200	40	<10	38	60
	M419-77	240	<1	28	12	19	14	15	40	6	900	45	<10	19	100
	M654-77	200	<1	31	12	24	12	18	26	9	600	50	<10	67	90
	M628-77	250	<1	16	9	13	5	27	40	<5	300	15	<10	39	35
Mafic Intrusive Rocks	M453-77	170	<1	51	47	154	24	66	18	45	300	300	15	92	60
	M642-77	160	<1	312	36	90	60	50	13	25	300	200	25	98	150
	M358-77	680	4	660	33	38	31	161	62	20	800	100	15	90	100
Ultramafic Intrusive Rocks	M620-77	30	<1	2340	152	118	6	2080	78	15	50	150	10	73	90
	M601-77	90	<1	8	91	620	10	187	43	<5	300	15	<10	132	35
Felsic Intrusive Rocks	M562-77	170	<1	13	10	12	19	7	12	6	400	30	<10	67	200
	M510-77	480	<1	9	8	9	20	<5	14	6	600	<10	25	122	300
	M402-77	220	3	14	<5	18	8	<5	72	5	1500	45	15	27	100
Alkalic Dike Rocks	M282-77	1400	4	17	34	96	14	31	23	20	700	200	45	140	200
	M403-77	510	5	720	68	102	14	427	21	20	1500	150	30	108	400
	M653-77	900	10	7	13	40	12	<5	29	15	400	<10	70	198	600

NOTES
All values in parts per million.
Ag, Mo, Sn gave values below the detection limit (spectrophotometer).
Ga gave values between 15 and 25 ppm.
Ba, Cr, Co, Cu, Li, Ni, Pb, Zn determined by atomic absorption.
Be, Sc, Sr, V, Y, Zr determined by emission spectrophotometer.
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

and related dikes plot on the Fe-rich side of the line in the AFM plot. All but one of the gabbroic rocks plot on the Fe-poor side of the same line.

Some trace element results for 20 total rock analyses (emission spectrograph) are given in Table 17. Eighteen elements were analysed; all elements gave significant differences between rock types, except for Be and Y which gave mentionable differences, and Ag, Ga, Mo, and Sn which gave no significant differences (of the four elements all but Ga gave results below detection limits). The data are not statistically significant but serve to illustrate a few interesting features:

Ba: highest values with alkalic diabase and syenite dike.
Be: late syenite dike has the highest value.
Cr: highest values with lherzolite and variolitic pillowed flow.
Co: highest values in lherzolite, pyroxenite and pillowed tholeiitic basalt.
Cu: highest values with pyroxenite, gabbro, and pillowed tholeiitic basalt.
Li: highest value in schistose gabbro.
Ni: highest values in the lherzolite.
Pb: highest values in the lherzolite, feldspar porphyry, and diatreme-like dike.
Sc: highest values contained in gabbro, and pillowed tholeiitic basalts of Pulpwood Harbour.
Sr: highest values from three different rock types but within a small area (south of the Pic River estuary).
V: highest values contained in gabbro, and pillowed tholeiitic basalt of Pulpwood Harbour.
Y: highest values in late syenite dike and (late) alkalic diabase dike.
Zn: highest value in the syenite.
Zr: highest values in late syenite dike and lamprophyre.

For simplicity, only the more obvious features are listed above but the following points should be noted as well. The lamprophyre, alkalic diabase, schistose gabbro dike and schistose diatreme gabbro dike commonly place within the top ½ to ⅓ of the highest values for many of the elements that were analysed. This may merely indicate similarities between various mafic magmas. However, all but the schistose gabbro are classified as alkaline. Therefore there may be some genetic relationship between the dike rocks even though they are of different ages.

Metamorphism

Chemical analyses and thin sections were primarily obtained for the purpose of conflrming lithological and textural classifications. Many of the rocks are fine to very fine grained (i.e. less than 0.5 mm). No X-ray diffraction analyses were made. The sample distribution is such that only a general statement can be made with respect to metamorphism in the map-area. Regional metamorphism has affected all rock units except the late alkalic rocks and possibly the diabase dikes. Combined with this are the effects of contact metamorphism from the ultramafic sills and the granitic plutons. The late intrusion of the Port Coldwell Complex has imprinted a contact aureole on the surrounding volcanic and sedimentary rocks.

In the centre of the map-area, about 2 km northeast of the town of Heron Bay, a variolitic mafic volcanic rock consists of the mineral assemblage chlorite + actinolite + plagioclase + quartz + epidote + carbonate. This location is one of the few areas with mafic rocks that are significantly distant from any large intrusion. It appears that the regional(?) metamorphism is of low-grade, low-temperature greenschist rank (as defined by Winkler 1976, 1967). Ultramafic intrusions have caused contact metamorphism of the volcanic rocks within the Pulpwood-Playter Harbours area. The mafic volcanic rocks consist of actinolite (or possibly hornblende in some samples) + plagioclase + quartz + biotite + chlorite + carbonate. This would correspond to lower to middle greenschist grade (Winkler 1976, 1967). One specimen may contain anthophyllite but its unverified presence prevents a positive identification of low-grade amphibolite rank. Garnet has developed locally in some schistose mafic tuffs in Pulpwood Harbour that are close to the contact with the ultramafic rocks. This also suggests the possibility of low-grade amphibolite rank. Garnet is also present in some intermediate to felsic tuff located about 0.8 km south of the Pic River estuary.

A sample of metamorphosed siltstone from between the Gowan Lake and Heron Bay Plutons consists of the assemblage plagioclase + quartz + biotite + chlorite which does not provide a very specific definition of metamorphic grade.

Mafic rocks in contact with the granitic plutons are darker green, harder in some cases, and may be more foliated than those further from the contacts. They commonly show signs of minor folding or recrystallization, particularly those in contact with the Pukaskwa Gneissic Complex. These features suggest a higher grade of metamorphism than the general area has undergone. A sample of intermediate-composition crystal tuff has hornblende(?) and chlorite as mafic minerals but beyond these observations there were no other samples taken for examination.

The contact aureole of the Port Coldwell Complex is perhaps as wide as 2 km. Puskas (1970) has placed a pyroxene-hornfels isograd (or potassium feldspar-cordierite hornfels isograd, Winkler 1967) at about 230 m from the gabbro contact in a reference line measured along the powerline near Highway 17. Metamorphic effects (porphyroblasts, well-developed cleavage) and deformation effects (minor folds) can be seen at least up to 1.75 km from the contact. Siltstone about 1.5 km from the contact (northeast of Three Finger Lake) consists of quartz + plagioclase + biotite + chlorite + garnet. The finely laminated siltstone/mudstone unit on the Lake Superior shoreline north of Randle Point consists of plagioclase + quartz + actinolite + biotite + epidote + carbonate which suggests that the contact metamorphic effects of the alkalic complex do not extend this far (2.4 km).

STRUCTURAL GEOLOGY

Exposure on the shoreline of Lake Superior is excellent but surprisingly little indication of major structures was discovered. Large exposures of poorly bedded to unbedded pyroclastic rocks exposed along the shoreline provided sparse structural data. Where bedding was detected, top directions were rarely determinable. Most information (graded bedding, cross-bedding) came from the tuffs, crystal tuffs, and sedimentary rocks along the north part of the shore. In the tholeiitic rocks to the south, schistosity, where present, trends east and tends to obliterate primary features. Top determinations could not be obtained from many of the pillows observed. Several, thin, intercalated sedimentary beds within the mafic volcanic rocks are disrupted by the ultramafic rocks and could not be traced with any certainty.

In general the volcanic and sedimentary rocks have been regionally deformed to conform to the outlines of the main granitic intrusive bodies. The rocks that lie between the Port Coldwell and Gowan Lake intrusions are highly metamorphosed and somewhat contorted. Nevertheless limited data suggests that whereas the rocks conform somewhat to the Gowan Lake Pluton contact, they are truncated by the Port Coldwell Complex signifying a major difference in intrusive mechanisms. The granitic plutons in the map-area are probably syntectonic to late tectonic whereas the Port Coldwell Complex is probably post-tectonic.

Lineaments

Numerous lineaments throughout the map-area, clearly apparent on aerial photographs, are shown on Map 2439 (back pocket). The lineaments shown on the map were not extended beyond their extent observed on the air photographs. Lineaments were not interpreted to be faults where there was no field evidence for such a feature; it is, however, considered probable that many of the lineaments are faults.

Where granitic terrain is best exposed, lineaments are numerous as in the Gowan Lake Pluton and the southwest part of the Pukaskwa Gneissic Complex. Several parallel to subparallel lineaments are present in the Pulpwood-Playter Harbours sequence (see below).

Faults

No major faults were positively identified in the area. However, a few are postulated from the available data. For several reasons, the Pic River valley is considered to be a fault zone. It forms a long, north-trending lineament (best observed on ERTS photographs) that seems to extend beyond a point where the Pic River changes course, for at least 24 km north of Pic Township. The lack of granitic exposure of the Gowan Lake and Heron Bay Plutons on the west side of the valley is a conspicuous feature. In addition, the westernmost outcrops of the Heron Bay Pluton are pinkish red and contain epidote and chlorite. However, the distribution of volcanic and sedimentary rocks does not indicate any particular offset unless the Channel Island area is comparable to the Pulpwood-Playter Harbours sequence (see "Petrochemistry"). It is highly possible that the granitic intrusions are at least in part post-Pic-Valley faulting. No evidence of faulting was observed by Milne (1967) along the Pic River to the north of the map-area.

The Heron Bay Pluton is interpreted to be sinistrally faulted about 4 km east of the Pic River. General outcrop configuration, lineaments, and country rock bedding were used in the interpretation.

Weakly to strongly lineated and schistose rocks, in part carbonatized, are found in the vicinity of Heron Bay. A well-defined lineament extends east-northeast from Heron Bay for about 3 km; further east it is poorly defined and appears to join another lineament that roughly parallels the north contact of the Heron Bay Pluton. The Heron Bay lineament may represent a fault.

Several lineaments in the Pulpwood-Playter Harbours sequence are associated with local shearing and well-developed schistosity. The schistose zones have weathered out leaving a series of parallel, east-trending valleys and ridges; some of valleys may delineate faults. If some of these lineaments represent faults they may be analagous to the zone of thrusting between sialic crust and the overlying volcanic rocks as proposed for greenstone belts in general by Gorman *et al.* (1978).

Numerous, minor, northerly trending faults occur in the Playter Harbour area, as evidenced by local concentrations of hundreds of thin, epidote-filled fractures and gash fractures. Displacements appear to be very small.

Folds

Although no major folds were outlined, evidence suggests that some folds may exist. Since it is common that volcanic and sedimentary rocks are fairly conformable to the outlines of granitic plutons, it might be expected that, on a broad scale the rocks would be folded around the Heron Bay and Gowan Lake Plutons. In the Gowan Lake Pluton area, exposure is poor and interference from the Port Coldwell Complex obscures relationships. However, in the vicinity of the Heron Bay Pluton, bedding attitudes to the north and south of the west end of the pluton indicate conformity to the contacts. To the southeast of the town of Heron Bay on the west side of the Pic River, schistosity is also conformable except on the south side of an east-southeast trending lineament. Lineations to the west (on the lakeshore), trend and plunge away from the pluton suggesting a west plunging anticline around the batholith. From aerial photographs (scale 1 inch to 1 mile), the outlines of a small fold are suggested in the area about 2.4 km southeast of the town of Heron Bay. This fold may be a smaller-scale fold in the nose of the larger-scale anticline discussed above. However, more data are needed to substantiate this.

Between the Gowan Lake and Heron Bay Plutons there is a poorly exposed, east-trending sequence of metavolcanics and metasediments. Here, limited data on the bedding indicate dips in the order of 60 degrees away from the granitic plutons. No definite conclusion regarding structure can be made but it is suggested that a synform (syncline?) may exist between the plutons.

The rocks lying between the Heron Bay Pluton and the Pukaskwa Gneissic Complex appear to dip consistently to the north. This is contrary to common observations regarding major 'granite-greenstone' contacts. Even more interesting is the shallowness of some of the dips (i.e. 45 degrees) towards the Heron Bay Pluton as close as 90 m to the contact. It is not known if the units are upright or overturned, however, a significant degree of overturning would be required to account for the shallow dips. An upright configuration might be more plausible given that the Pukaskwa Gneissic Complex may represent early sialic crust (whether partly remobilized or not).

Pillow facings suggest a small scale fold in Pulpwood Harbour. These data are considered to be inadequate for major structural interpretations. Another small-scale fold occurs 2 km north of Randle Point. Here, one of the limbs of a west-plunging, combined anticline-syncline is slightly overturned. The relation of these small folds to any major structures is not known.

The mafic metavolcanics and veins and stringers of granitic material within 0.5 km (0.3 miles) of the Pukaskwa Gneissic Complex contact display small-scale folding. Some of the fold axes trend at N62W and plunge at 35 degrees.

ECONOMIC GEOLOGY

Mineral exploration within the Heron Bay area has been sporadic. Most of the early work was done in the late 1920s to early 1930s. The majority of the work was undertaken in the mid 1950s with some later work occurring in the mid 1960s. During the field season of 1977, some staking was done in the vicinity of Heron Bay and north-northeast of Heron Bay.

Initial activity in the area was undertaken in search of gold and silver. The Heron Bay occurrence, situated near the Heron Bay station, was explored in 1872 when reportedly three pits were dug in sheared, intermediate to felsic pyroclastic rocks; assay results (Bell 1873) gave 0.06 ounces gold per ton and 7.03 ounces silver per ton. Thompson (1931) reported traces of pyrite and chalcopyrite, however, the occurrence had been abandoned long before 1930 and has not been relocated.

The majority of the exploration work in the Heron Bay area has been related to copper mineralization, in particular the contact zone around the Port Coldwell Alkalic Complex, and to molybdenum mineralization, in particular the deposit situated east-northeast of the east end of Playter Harbour. Both developments are discussed briefly under the respective commodity headings. Sulphide mineralization related to the ultramafic rocks was not observed.

Many of the rocks of the Port Coldwell Complex in the Heron Bay area (especially the gabbro) are noticeably magnetic. However, no sizeable magnetic occurrences were seen or have been reported even though some small occurrences occur in syenite to the northwest of the map-area. Some of the syenite, also to the northwest of the area, was quarried as early as 1880 for construction purposes, and later in the 1920s as a decorative building stone because of its iridescent feldspar. Only small amounts of this type of syenite were seen in the map-area during the field season.

Quaternary deposits of clay, silt, sand, pebbles, and cobbles in various mixtures are extensive in some parts of the Heron Bay area. Some sand and gravel deposits along Highway 17 have been used in highway and road construction; a few are still maintained. The ancient shoreline which the Canadian Pacific Railway parallels northwest of Heron Bay is composed mostly of well-rounded to spherical pebble- and cobble-size granitic and volcanic rocks. In 1930 these were considered for use in ball mills but no shipments were ever made. Some sections east of Marathon may be considered as principal areas of good aggregate (Cowan 1976).

Gold, Silver

In the late 1920s a small number of quartz veins and rusty zones were assayed and(or) trenched for gold and silver. Later, Thompson (1931) reported that a quartz vein on claim SSM 6302, about 1.8 km east of Playter Harbour (not found by the author), was stripped for about 43 m. Its maximum width is 11.5 m. Channel samples gave negative results.

An island of fine-grained amphibolite in Pulpwood Harbour is reported to have a thin quartz vein with traces of pyrite, galena, and chalcopyrite (Thompson 1931). This particular dike was not identified by the author, however, a quartz vein with pyrite and arsenopyrite(?) on a nearby island (of pyroxenite and gabbro), was sampled and gave 0.02 percent Cu and 0.02 percent Mo with traces of gold and silver (Geoscience Laboratories, Ontario Geological Survey, Toronto).

Sheared intermediate to felsic pyroclastic rocks have been blasted for a length of about 20 m along a cliff face 0.8 km west-southwest of the town of Heron Bay. No work is on file in the assessment office, and judging by the overgrowth, the work is probably 30 years old or more. A selected grab sample taken by the author showing pyrite and rusty minerals assayed 0.15 ounces gold per ton and 2.45 ounces silver per ton, as well as 0.20 percent Zn, 0.13 percent Pb, and 0.08 percent Cu (Geoscience Laboratories).

Most other assay samples taken from the map-area during the field season gave only trace amounts of gold and silver. However, a sample containing sugary crystalline pyrite from a 1 m thick, banded (bedded?), pyrite-chert rock in intermediate to felsic pyroclastic breccia on the south shore of Heron Bay assayed 0.03 ounces gold per ton (Geoscience Laboratories); base metal values were negligible. The rock is exposed at the waterline for about 2 m. It was not determined whether the pyrite is primary or secondary.

Copper

Copper mineralization occurs at several places throughout the map-area, particularly along the gabbro-volcanic contact of the Port Coldwell Alkalic Complex in the vicinity of Highway 17. Disseminated and massive chalcopyrite, pyrite, and pyrrhotite are associated with the gabbro, contact breccia, and adjacent pyroclastic-sedimentary rocks. The nature of the mineralization is such that: 1) massive sulphides occur as small, localized lenses within the gabbro and the nearby, highly altered country rock; 2) disseminated varieties occur in the gabbro and are usually very low grade and of irregular extent. However, mineralization within this general contact zone can be significant as evidenced by the disseminated copper showing of Anaconda American Brass Limited which occurs in gabbro bordering the Port Coldwell Complex several miles north of the map-area (Puskas 1967).

Very small amounts of bornite, chalcopyrite, malachite, and pyrite were found by the author in locally developed, amygdule-like structures in highly altered mafic volcanic rocks within the Port Coldwell Complex on the shore of Pen Lake (near Marathon). The writer interprets these structures as being of metamorphic derivation (see "Mafic Metavolcanics").

Several narrow, pyroclastic/sedimentary units in the Pulpwood Harbour area contain visible sulphide minerals such as pyrite, pyrrhotite, and chalcopyrite. They were sampled by the author and assayed for copper, zinc, nickel, cobalt, and lead. The results are given in Table 18 (see Figure 8 for locations). The cobalt and lead values are negligible and are not given. Several of the units consist of graphitic argillite or argillaceous siltstone which have been disrupted and metamorphosed by the ultramafic rocks. The graphitic units are generally less than 1 m thick. It is interesting to note detectable nickel associated with the graphitic samples, and the similarity of the element contents in the graphitic rocks and in a zinc-copper-nickel occurrence about 7.6 km to the east of Pulpwood Harbour. This occurrence is described as graphitic tuff with pyrite, pyrrhotite, and minor chalcopyrite (Assessment Files Research Office, Ontario Geological Survey, Toronto). Assays from this occurrence gave 0.95 percent Zn, 0.06 percent Cu, and 0.05 percent Ni (Assessment Files Research Office). Unverified reports from the assessment files suggest the thickness is possibly up to 18 m. It is possible that the original environment of this unit and the one(s) in Pulpwood Harbour were similar. Although Pulpwood Harbour and some of the surrounding area have been withdrawn from staking for purposes of a national park (see Figure 9), the occurrence to the east, to the author's knowledge, is open and may be of interest.

TABLE 18. ASSAYS[1] OF SAMPLES OF INTERCALATED SEDIMENTARY ROCKS AND TUFFS FROM THE PULPWOOD HARBOUR AREA OF THE HERON BAY MAP-AREA.

Sample[2]	Description	% Cu	% Ni	% Zn
M430-77	intermediate tuff, schistose; pyrite, chalcopyrite	0.07	–[3]	0.47
M470-77	poorly banded iron formation; pyrite	0.03	–[3]	0.17
M474-77	banded iron formation; pyrite, magnetite, chalcopyrite	0.07	–[3]	0.05
M586-77	felsic to intermediate tuff, schistose, rusty	0.01	–[3]	0.01
M587-77	as above; pyrite, magnetite; 0.02 oz Au/ton	0.19	–[3]	0.06
M596-77	graphitic (fissile) with tremolite alteration and mafic rock	0.05	0.06	0.53
M599-77	chlorite-rich sedimentary rock or tuff; pyrite	0.07	0.05	0.30
M604-77	graphitic with tremolite alteration, fissile; pyrite	0.03	0.02	0.02
M605-77	as above; pyrite, chalcopyrite	0.06	0.02	0.12
M622-77	graphitic, fissile rusty	0.20	0.06	0.18
M623-77	less graphitic than M622	0.07	0.05	0.10
M552-77	siltstone or tuff (with iron formation); pyrite	0.07	–[3]	0.11

[1] Assays by Geoscience Laboratories, Ontario Geological Survey, Toronto.
[2] See Figure 8 for location of samples.
[3] Not determined.

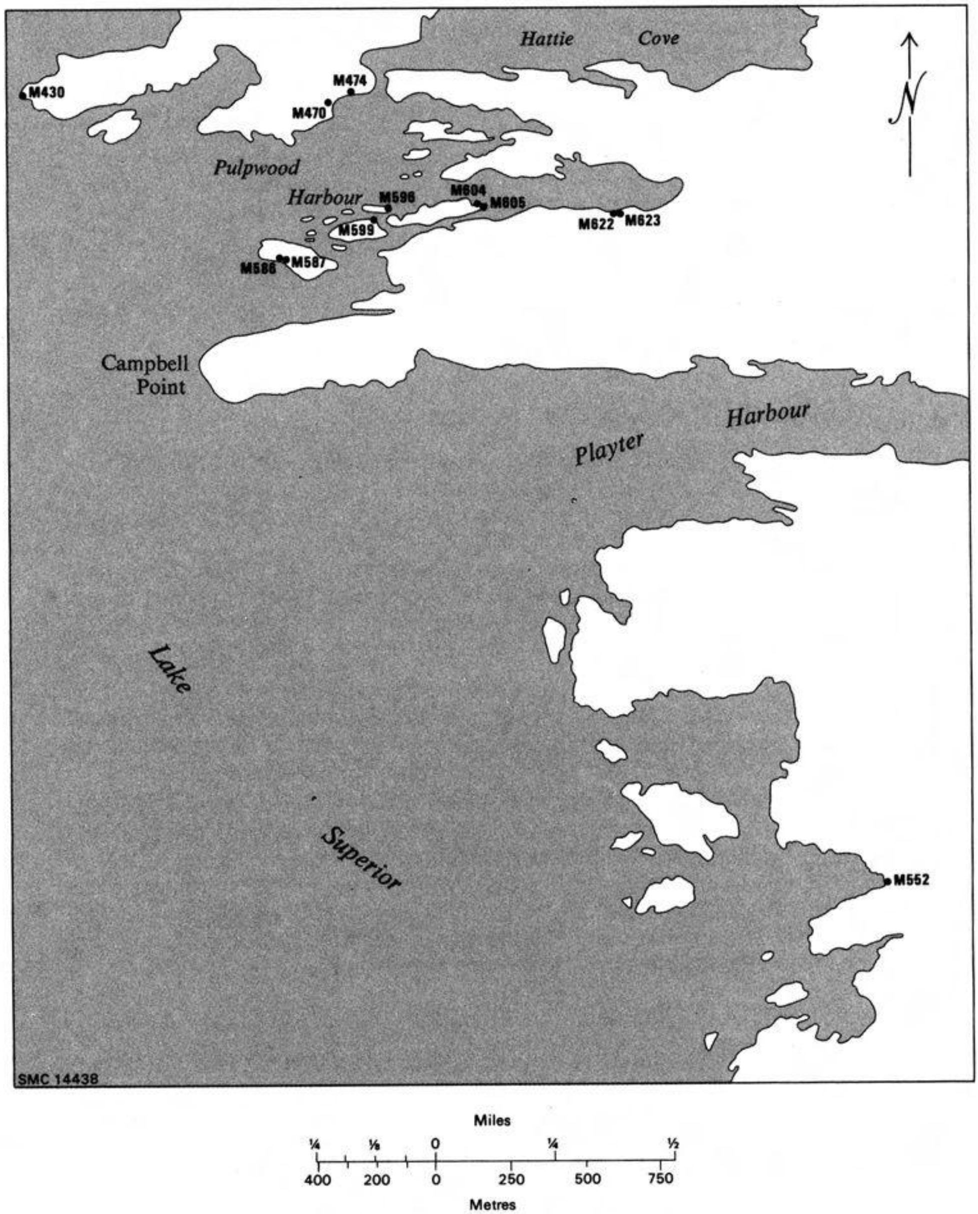


Figure 8—Locations of samples taken for assay from the Pulpwood Harbour area.

Molybdenum

Significant work has been done on a molybdenite prospect east of Playter Harbour since the early 1930s. The initial showing consisted of a quartz vein with fine-grained molybdenite along fractures in the quartz. The immediate wall rocks are highly sheared and schistose. Most of the country rock is pyroxenite and lherzolite with lesser mafic metavolcanics and intermediate to felsic tuffs or sedimentary rocks. This molybdenite-bearing quartz vein appears to be the only known occurrence of this type in the area and does not appear to be of high enough grade or tonnage to warrant economic development.

Minor molybdenite was seen by the author in a rusty gabbro gossan on Highway 17.

Description of Properties and Deposits

The following section consists of a description of the properties, deposits, and unclaimed parcels of land for which assessment work is available. Table 19 is provided to give the reader basic information about exploration work that has taken place. A sketch map is also provided (Figure 9) to indicate the approximate locations of claim groups.

ANACONDA AMERICAN BRASS LIMITED [1968] (1)

In 1968, Anaconda American Brass Limited held several claim groups in the Port Coldwell Complex; three of these groups were in the Heron Bay map-area and were located in the northwest part of the map-area. No work on these claims has been filed subsequent to some diamond drill logs that were submitted in 1965.

In all, thirteen holes were recorded for an aggregate length of 2445 m. Biotite-bearing gabbro was the most common rock type found, along with monzonite and syenite pegmatite. Minor amounts of metasediment and amygdaloidal(?) metabasalt were recorded. Sulphide minerals (chalcopyrite and pyrite) were either rare or absent throughout the holes. The claims have been dropped.

ANACONDA SULPHIDE OCCURRENCE (2)

In 1965, Anaconda American Brass Limited completed some drilling on a large block of claims near Three Finger Lake. On one of the claims a 111 m hole is reported to have intersected biotite gabbro, with disseminated chalcopyrite and pyrrhotite for 37 m. Conspicuously layered gabbro was also obtained from parts of the core length. No further work was filed for assessment. The location lies about 1.6 km north-northeast of the gossan on Highway 17 and is about the same distance in from the main interpreted gabbro-volcanic contact as is the gossan. The claims have been allowed to lapse.

J.T. COSGROVE [1957] (3)

J. T. Cosgrove formerly held a property in the northwest part of the map-area about 2.4 km southeast of Pen Lake. The property is underlain mainly by gabbro although small outcrops of diabase and andesite were recorded (Assessment Files Research Office). In 1956 and 1957, Cosgrove conducted a dip-needle survey to test for the continuation of the copper sulphide-bearing gabbro that Kinasco Exploration and Mining Limited had staked nearby (gossan on Highway 17). The map submitted for assessment suggests, on the basis of geophysics, that gabbro does underlie the property. Some of the drilling by Anaconda American Brass Limited was done later nearby and confirms the geophysical interpretation. However, no further work was undertaken and the claims lapsed.

C.S. DOWNEY (4)

C.S. Downey currently holds one claim (TB109470) which lies north-northeast of Marathon at the northern border of the map-area. In 1965 he completed minor trenching and sank three diamond drill holes totalling 27 m. The drilling was entirely within coarse-grained monzonite, possibly with iridescent feldspar.

W.B. DUNLOP (5)

W.B. Dunlop holds five surveyed claims numbered TB104118 to TB104122 inclusive. The claims straddle Highway 17 and are underlain by gabbro and contact-metamorphosed pyroclastic rocks. Interest in the area originated in the early to middle 1950s with the blasting of a rock cut for Highway 17 (Trans-Canada Highway) which revealed gabbro mineralized with chalcopyrite and pyrite extending over an area about 61 m by 15 m (Assessment Files Research Office, Ontario Geological Survey, Toronto).

Kinasco Exploration and Mining Limited originally held the ground and in 1955 a preliminary self-potential survey was undertaken along with five exploratory X-ray diamond drill holes. The self potential survey outlined an anomaly 610 m by 38 m (Assessment Files Research Office). Diamond drilling (amount unreported) intersected massive pyrite and chalcopyrite in four out of five holes. One intersection assayed 3.5 percent copper over 3 m, and another assayed 1.2 percent copper over 10 m. (Assessment Files Research Office). Ten diamond drill holes totalling 1928 m were subsequently drilled in 1956. Most of the holes intersected medium- to fine-grained gabbro, highly metamorphosed sedimentary rocks, and minor monzonite. Massive and disseminated sulphides consisting mostly of pyrrhotite, pyrite, and minor chalcopyrite, were intersected in all of the holes (Assessment Files Research Office).

In 1961, International Nickel Company of Canada Limited restaked the lapsed claims and completed a gravimetric survey over the main showing (Assessment Files Research Office). The claims subsequently lapsed. In 1962, Conwest Exploration Company Limited made a preliminary investigation of the property, and in 1964 sank two diamond drill holes totalling 306 m. The best assays from this core gave nil values for gold, 0.03 ounces silver per ton, and 0.59 percent copper over 3 m, averaging 0.31 percent copper throughout (data on file at the Assessment Files Research Office, Ontario Geological Survey, Toronto). The claims are currently registered under W.B. Dunlop.

The gossan zone in the roadcut has undergone considerable weathering since 1956. Flat-lying contact breccia forms the host for the mineralization. Although some mineralized zones reportedly ran 2 percent copper over widths of up to 1.5 m (Assessment Files Research Office, Ontario Geological Survey, Toronto), a grab sample selected by the writer, containing chalcopyrite and pyrite, assayed 0.85 percent copper and negligible lead, zinc, and nickel. A few traces of molybdenite were seen during the field examination.

GALEX MINES LIMITED [1972] (CITADEL MINES LIMITED [1969]) (6)

In 1969, Citadel Mines Limited held a block of 80 contiguous claims situated at the east end of Playter Harbour. Most of the exploration work by Citadel Mines Limited was done on the molybdenite prospect located on the property now held by R.A. Schiralli (No. 16) and is described under that section.

In 1965 a sulphide occurrence was discovered on claim SSM103322 about 2.4 km east of the molybdenite prospect. Two trenches exposed a highly-sheared graphitic tuff with minor pyrite, pyrrhotite, and traces of chalcopyrite. Channel sampling across a 5 m long trench returned values of 0.95 percent zinc, 0.06 percent copper, and 0.05 percent nickel (Assessment Files Research Office, Ontario Geological Survey, Toronto).

Galex Mines Limited purchased in 1972, a claim block of 79 contiguous claims corre-

TABLE 19. LIST OF PROPERTIES AND DEPOSITS IN THE HERON BAY AREA.

Property Name	Number on Map	Year Work Done	Geological Mapping	Geophysics Mag	Geophysics EM	Geophysics IP	Geophysics SP	Geophysics ER	Number of Holes	Diamond Drilling Total Length m/ft	Recorded Number of Claims	Remarks
Anaconda American Brass Ltd.	1	1965							13	2445/8022	10	Claims held at least until 1968
Anaconda Sulphide Occurrence	2	1965							1	111/364	1	Part of a group of claims of No. 1
Citadel Mines Ltd.		1968 1969	*	*	*				14	1410/4625	80	Filed under E.J. Rivers, work described under No. 7, 16
Conwest Explor. Co. Ltd.		1964							2	306/1007	5	Work described under No. 5
Cosgrove, J.T.	3	1957									8	Dip needle survey
Downey, C.S.	4	1965							3	27/85	1	Leased claim
Dunlop, W.B.	5	1977									5	Leased claims; description includes work of Kinasco, Conwest
Galex Mines Ltd.	6	1972							6	945/3100	79	
Great Basin Metal Mines Ltd.	7	1965 1966	*	*	*	*	*				16	Also 2 geochemical (soil) surveys with maps
Keevil Mining Group Ltd.	8	1965		*	*						29	Airborne geophysical surveys
Kinasco Explor. and Mining Ltd.	9	1955 1956					*		10	1928/6325	18	Work described under No. 5
McCuaig, K.T.	10	1977									12	Staked during the field season; no work filed
Mentor Explor. and Development Co. Ltd.	11	1956		*				*	2	315/1037	9	
Michano, D.	12	1977									2	Staked during the

Property Name	Number on Map	Year Work Done	Geological Mapping	Mag	Geophysics EM	IP	SP	ER	Number of Holes	Diamond Drilling Total Length m/ft	Recorded Number of Claims	Remarks
Norgold Mines Ltd.	13	1955 1956		*			*	*	12	1467/4814	15	
Provincial Mining and Development Co. Ltd.	14	1965	*	*	*						20	Filed under H. Cravit; some drilling mentioned but not filed
Rockwin Mines Ltd.	15	1956		*	*			*			18	
Schiralli, R.A.	16	1977									6	Description includes work of Citadel, Galex
Shell Canada Resources Ltd.		1974		*	*						—	Airborne surveys; mentioned under No. 15
Smith, R.J.	17	1977									6	Staked during the field season; no work filed
Stenlund, E.	18	1977									3	Staked during the field season; no work filed
Stenlund, L.	19	1977									6	Staked during the field season; no work filed
Stenlund, R.E.	20	1977									6	Staked during the field season; no work filed
Stenlund, V.	21	1977									10	Staked during the field season, no work filed
Zulapa Mining Corp. Ltd.	22	1956		*				*	3	515/1690	5	

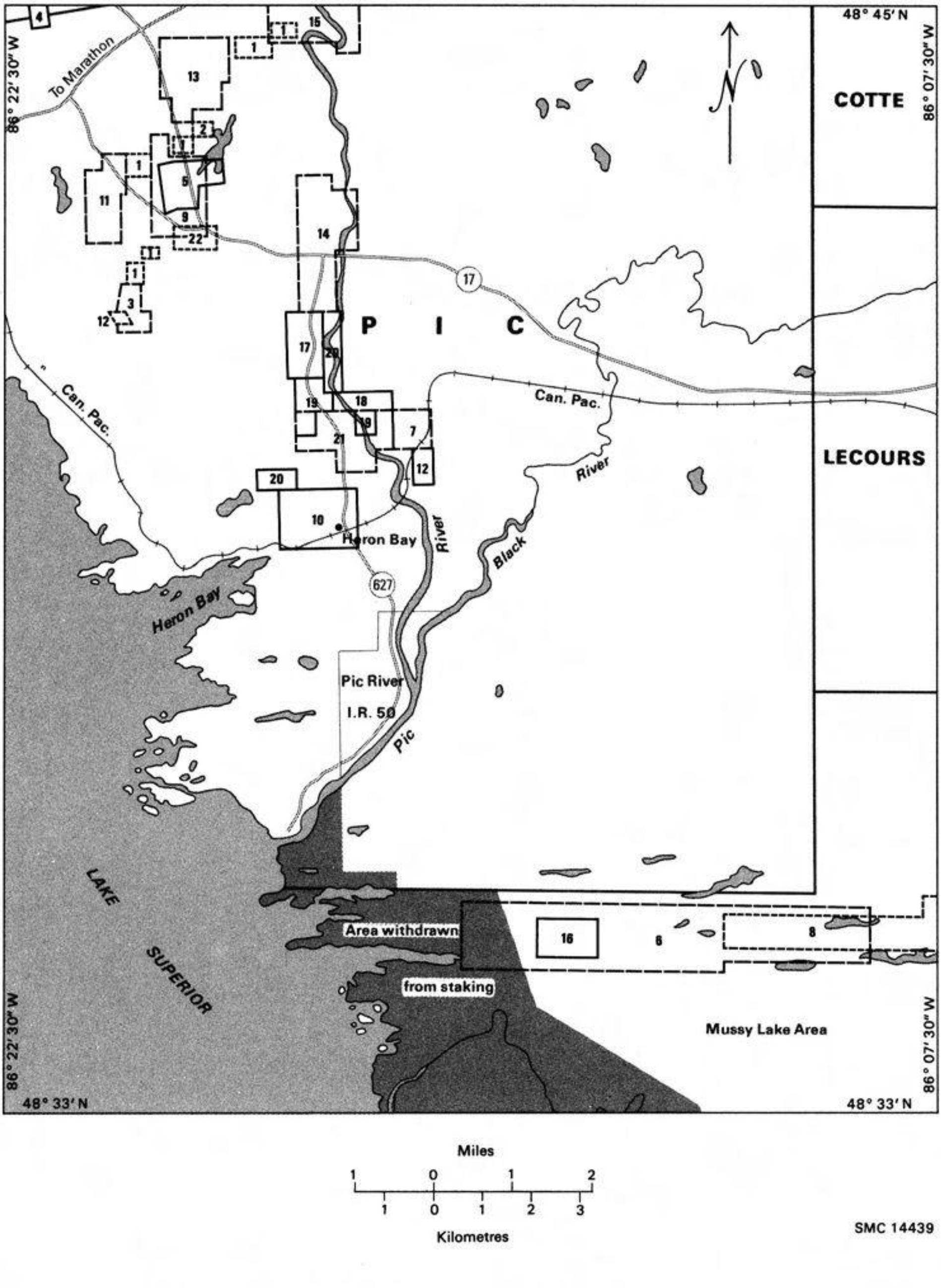


Figure 9—*Sketch map showing exploration activity in the Heron Bay area. Solid lines outline properties in good standing (1977); broken lines show properties not presently held.*

sponding to the Citadel Mines Limited claims with the exception of one claim (for an undisclosed reason). Diamond drilling was done on what is now the Schiralli property (16) and is thus described under that property.

GREAT BASIN METAL MINES LIMITED [1966] (7)

Sixteen claims, bisected by the Pic River and centred about 1.6 km north-northeast of Heron Bay, were held by Great Basin Metal Mines Limited in 1965 and 1966. Outcrops occur only on three of the most westerly claims. They consist mostly of mafic metavolcanics with minor granitic rocks (Assessment Files Research Office). In 1965, geological and geophysical surveys (electromagnetic, magnetic, induced polarization, and self potential) were contracted by the company (Assessment Files Research Office); none of the surveys gave encouraging results.

Two soil geochemical surveys were conducted in 1966. Total heavy metals were analysed and a small anomaly about 0.4 km square was outlined. No further work was undertaken and the claims were dropped.

KEEVIL MINING GROUP LIMITED (BARRETT OPTION) [1965] (8)

In April of 1965, Keevil Mining Group Limited completed combined electromagnetic and magnetometer airborne surveys over 29 contiguous claims in the Mussy Lake area about 8 km east of Playter Harbour. The area is underlain mainly by mafic metavolcanics with lesser pyroxenite/dunite sills and numerous small bodies of feldspar porphyritic rocks. Several showings of disseminated pyrite and chalcopyrite are reportedly on the property (Assessment Files Research Office, Ontario Geological Survey, Toronto) including one which has given low copper, zinc, and gold values; more specific information is not available.

The survey was flown using both north-south and east-west flight lines. No electromagnetic anomalies were detected. The property is on an east-west linear magnetic anomaly but no further exploratory work was undertaken and the claims lapsed.

KINASCO EXPLORATION AND MINING LIMITED [1956] (9)

In 1956, Kinasco Exploration and Mining Limited, held 18 claims at the contact zone of gabbro of the Port Coldwell Complex and highly-altered sedimentary and pyroclastic rocks. Part of this property formed the claim group currently held by Dunlop (5). A self-potential geophysical survey (Assessment Files Research Office) was undertaken on the claims particularly over the contact zone. Further work on the property is discussed under W.B. Dunlop (5).

K.T. MCCUAIG (10)

In 1977, K.T. McCuaig held 12 claims numbered TB464284 to TB464295 inclusive, in the area of the town of Heron Bay. The claims are underlain by stretched, lineated, and schistose intermediate to felsic pyroclastic breccia and tuff-breccia.

The first 69 m of core from one diamond drill hole (drilled during the summer of 1977) was examined by the author. Minor disseminated pyrite and traces of chalcopyrite were present. Blue opaline quartz was present in some of the core. The pyroclastic rocks (and a late red syenite dike) encountered in the drilling revealed the similarily between rocks in this area and those found along the shore of Heron Bay 2.4 km (1.5 miles) to the southwest. The core that was retrieved sparked the staking for this property, and of several of the other properties almost immediately to the north. No work has been filed for assessment.

MENTOR EXPLORATION AND DEVELOPMENT COMPANY LIMITED [1956] (11)

In 1956, Mentor Exploration and Development Company Limited held an option (Lun-Echo) on nine claims centred about 1 km east of Pen Lake. The claims are largely sand covered and only a few outcrops of monzonite are present.

Interest in the property originated with the nearby sulphide discoveries of Kinasco Exploration and Mining Limited (W.B. Dunlop property). In 1956, electrical resistivity and magnetometer surveys of the claims were made and an anomalous zone was outlined in the northeast part of the claim block. In the same year, two diamond drill holes were sunk totalling 315 m (Assessment Files Research Office). Only traces of sulphide minerals in coarse-grained gabbro and monzonite were encountered. No further work was done and the claims were allowed to lapse.

D. MICHANO (12)

This property staked in 1977, consists of two claims numbered TB455056 and TB455057 and is situated less than 2.4 km northeast of the town of Heron Bay. Several outcrops occur on the claims and consist mainly of mafic pyroclastic breccia and tuff-breccia that contain fragments more felsic than the matrix. Towards the north boundary of the claims there is a large outcrop of variolitic and pillowed mafic metavolcanics. Several quartz-feldspar porphyry sills and a diabase dike have intruded the volcanic rocks. No work has been filed for assessment.

NORGOLD MINES LIMITED [1956] (13)

Nineteen claims were held by Norgold Mines Limited in 1955 and 1956. Highway 17 runs through the western portion of the claim group.

The property straddles the contact between syenite and gabbro of the Port Coldwell Complex and intermediate and mafic volcanic rocks. Outcrops are sparse and are covered by dense vegetation. Data from the geophysical surveys were used to interpret the syenite-gabbro contact from which the diamond drilling program was proposed.

In 1956 Norgold drilled 12 diamond drill holes totalling 1467 m. The drilling mainly encountered gabbro, monzonite and pegmatitic syenite. Only minor disseminated pyrrhotite, pyrite, chalcopyrite and magnetite were encountered and the claims were subsequently dropped.

PROVINCIAL MINING AND DEVELOPMENT COMPANY LIMITED [1965] (14)

In 1965, Provincial Mining and Development Company Limited conducted an electromagnetic and magnetic survey over 20 claims in the vicinity of the intersection of Highway 17 and the Pic River. The claim group is mainly underlain by intermediate pyroclastic breccia and tuff-breccia.

The geophysical surveys outlined several anomalies and eight diamond drill holes, from 91 m to 152 m in length, were completed; only traces of chalcopyrite were encountered (Assessment Files Research Office). The claims lapsed.

ROCKWIN MINES LIMITED [1956] (15)

In 1956, Rockwin Mines Limited held 18 claims in north Pic Township. The claims are underlain by biotite gabbro and lesser intermediate lapilli tuff and sedimentary rocks.

An electrical resistivity survey, magnetometer survey, and an electromagnetic survey were conducted on the property in 1956. One anomalous zone was indicated. A five-hole drilling program entailing 670 m of drilling was proposed (Assessment Files Research Office) but there is no record that this work was done. The claims were dropped.

In 1974, a large scale airborne magnetic and electromagnetic survey was flown for Shell Canada Resources Limited in Cotte Township. A minor overlap into Pic Township mostly coincided with the former ground of Rockwin Mines Limited as well as an area to the east of the Pic River. No claims were staked in Pic Township.

R.A. SCHIRALLI (16)

R.A. Schiralli currently holds six claims which are centred approximately 2.4 km east of Playter Harbour. The claim numbers are TB424782 and TB438515 to TB438519, inclusive. The property is just outside of the area withdrawn from staking.

History

Prior to 1930, H.J. Johnson staked 28 claims east of Playter Harbour. The claims included a large vein of quartz, maximum width 11 m, containing minor pyrite (Thompson 1931), galena, and chalcopyrite. Although gold and silver were reported (Thompson 1931), samples taken by Thompson gave negative results. In the late 1930s, Consolidated Mining and Smelting Company Limited acquired the property, and trenched and bulk sampled the quartz vein. The results of this work are not available. In 1968 Kennco Explorations (Canada) Limited sampled some of the rock trenches. The same year W.G. Wahl Limited also sampled a number of trenches (Assessment Files Research Office).

Citadel Mines Limited acquired an option in 1968 on 80 contiguous claims which covered an 8.8 km length of area from Playter Harbour to about the east border of the map-area. In 1969, 14 diamond drill holes were sunk in the molybdenite deposit area totalling 1410 m. Many of the holes were spaced at about 30 m intervals along strike. In conjunction with the drilling, an electromagnetic survey was carried out over a strike length of 1830 m. A magnetometer survey was carried out over the drilled portion of the mineralized zone but the noticeably magnetic pyroxenite and lherzolite masked any possible results that might have been obtained. Prospecting and geological mapping were also carried out.

In 1971, Galex Mines Limited acquired the above property and in 1972, sunk six more diamond drill holes totalling 945 m to test for continuity in the molybdenite mineralization. No further work on the property has been recorded.

General Geology

The narrow valley in which the prospect is situated is flanked to the north and south by pyroxenite and minor serpentinized lherzolite, which had been interpreted as intermediate to basic lava and schist in the geological reports, and as magnetite-bearing andesite and hornblende-biotite schist in the diamond drill logs. Further to the north and south massive mafic metavolcanics outcrop.

The author made a cursory examination of the remaining core at the prospect site. Most of the core consists of pyroxenite, lherzolite, gabbro, lesser mafic metavolcanics, and minor intermediate to felsic tuff. Most of the rock types are strongly altered (schistose, cut by carbonate stringers). All of the rock types, with the possible exception of the tuffs, were well represented by shoreline exposure in Pulpwood and Playter Harbours.

In this area, there are several east-trending ridges with narrow valleys that are virtually free of exposure. The few rocks that are exposed are strongly schistose. This suggests faulting may be the cause of the strong lineaments which have been accentuated by erosion.

Main Prospect

The prospect oonsists of a 7 m thick, east-striking, steep-southerly-dipping quartz vein partially exposed over a length of 40 m; the wall rock is highly sheared. Small outcrops of quartz (not located by the field party) also occur 760 m to the east, and 460 m to the west (Assessment Files Research Office). A granodiorite porphyry is reported to outcrop 430 m west of the main surface showing (Assessment Files Research Office) but this was not located by the field party.

The molybdenite is disseminated along the surface of fractures in the quartz vein and in amount appears to be directly proportional to the degree of fracturing in the quartz vein. Some mineralized veinlets are reported to have been 8 mm thick (Assessment Files Research Office) but most fracture fillings are very thin (hairline) and have very fine-grained molybdenite along them. All of the mineralized drill core had previously been removed from the property.

Representative grab samples taken by Kennco Explorations (Canada) Limited from the main trench gave an average of 0.21 percent MoS_2 over 12 m and 0.56 percent MoS_2 over 10 m respectively. Averages of bulk and chip samples (weighted for length) for W.G. Wahl Limited gave 0.12 percent and 0.21 percent MoS_2, respectively.

The drilling results of Citadel Mines Limited indicated the mineralized quartz vein has a maximum thickness of 9 m and a total strike length of 460 m. It was tested to depths ranging from 35 m to 88 m. The wall rocks are sheared from 3 m to 6 m on both sides. Pyrite-carbonate-quartz veining is common in the sheared zones. Maximum and minimum grade/-width values of MoS_2 (percent) for the drilled holes are given as follows (Assessment Files Research Office).

MoS_2 (percent)		Horizontal width (m)
0.47	max	1.6
0.33		5.2 max
0.08	min	3.1
0.09		0.4 min

A plan view of the drilling program and surface geology is shown in Figure 10 along with the summary of assay results from each diamond drill hole.

Most assaying of the Galex Mines Limited core returned values of trace or less than 0.01 percent MoS_2. Further work has not been filed for assessment since the 1972 drilling.

R.J. SMITH (17)

In 1977, R.J. Smith held six claims numbered TB464353 to TB464358 inclusive. These claims straddle Highway 627 and are centred about 2.4 km south of Highway 17. Only a few outcrops occur on the property. Most of the rocks are mafic metavolcanics but some intermediate pyroclastic rocks and argillite do occur. An outcrop of pillowed mafic flows occurs on Highway 627; it also shows some medium- to coarse-grained rock that may be gabbro. No work has been submitted for assessment.

E. STENLUND (18)

In 1977, E. Stenlund held three adjacent claims (numbered TB464371 to TB464373 inclusive). They lie eastward from the Pic River and are about 2.4 km north of Heron Bay. The

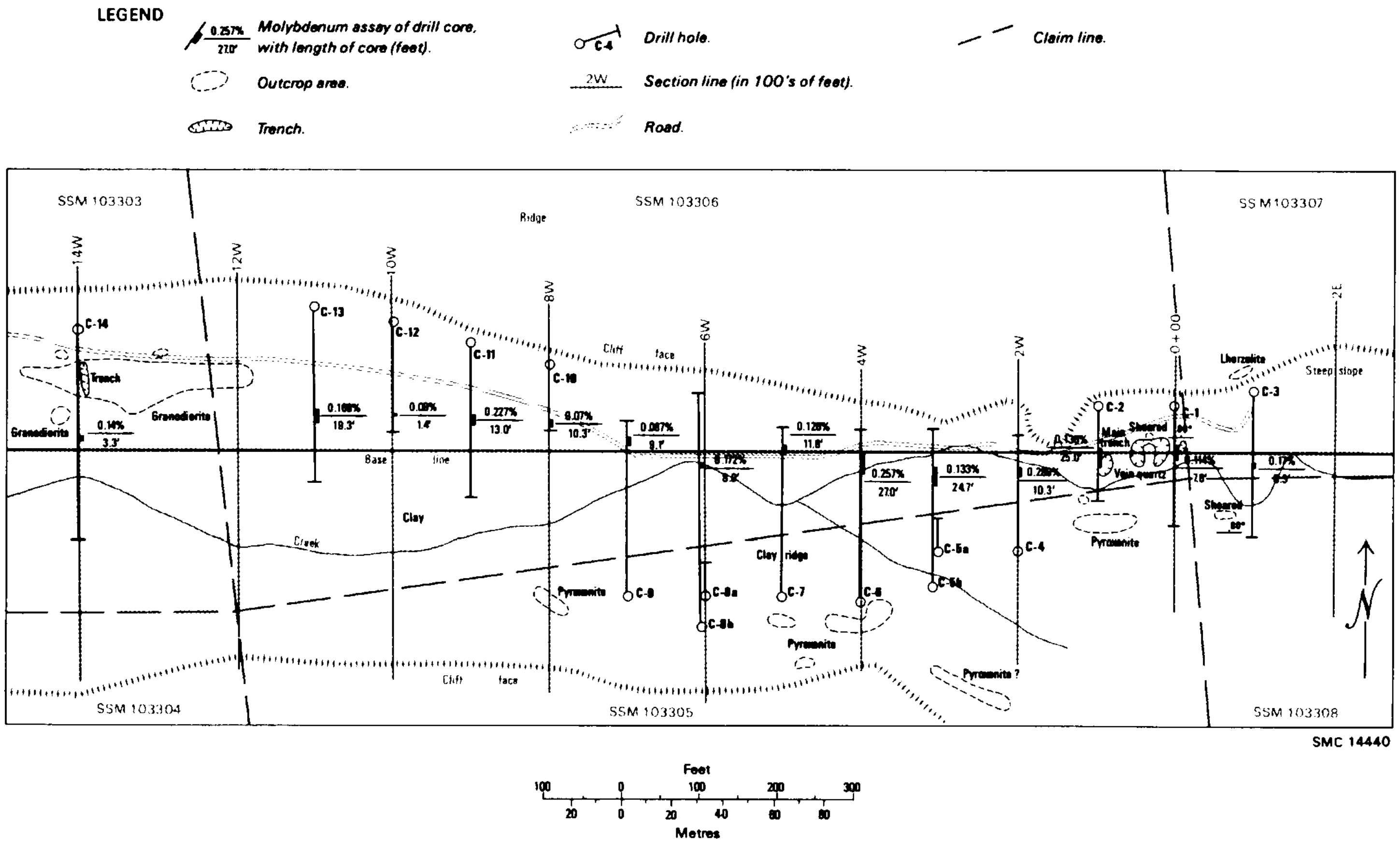


Figure 10—Plan of diamond drilling and geology on the Schiralli property (No. 16 on map). Modified after assessment work filed by Citadel Mines Limited (Assessment Files Research Office, Ontario Geological Survey, Toronto).

property lies entirely within the Pic River valley and no outcrops are present on the property. No work has been submitted for assessment.

L. STENLUND (19)

In 1977, L. Stenlund held five contiguous claims (numbered TB464247, TB464248, and TB464251 to TB464253 inclusive) which straddle Highway 627 about 2.4 km north-northwest of the town of Heron Bay, and one separate claim (TB464250) lying nearby and bisected by the Pic River.

A few outcrops of intermediate tuff and lapilli-tuff occur on the property. Mafic volcanic rocks may underlie portions of the property as well. There are no outcrops on the lone claim and no assessment work has been filed for any of the claims.

R.E. STENLUND (20)

In 1977, R.E. Stenlund held six claims (one group of four numbered TB464526 to TB464529 inclusive, and one group of two numbered TB464530 and TB464531). The first group is aligned north-south and lies along the east side of the claims held by R.J. Smith. The second group is adjacent to the northwest corner of the claims held by K.T. McCuaig. The Pic River meanders through the middle of the first group. The claims lie on the clay-silt valley floor and no outcrops are present. No work has been filed.

V. STENLUND (21)

In 1977, the property of V. Stenlund consisted of 10 claims numbered TB464348 to TB464352, and TB464122 to TB464126 inclusive. The claims are centred approximately 1.6 km north of the town of Heron Bay and are intersected by Highway 627 and the Pic River. Outcrops are present only on the western half of the property and consist of intermediate to felsic flows and lapilli-tuffs, and mafic metavolcanics. The claims were staked during the field season of 1977 and have had no assessment work filed on them.

ZULAPA MINING CORPORATION LIMITED [1956] (22)

In 1956, Zulapa Mining Corporation Limited held five claims; Highway 17 passed through the claims in a northwest direction. Few outcrops occur on the claim group. Highly altered sedimentary rocks and/or tuffs with epidote and carbonate are present in a small roadcut on Highway 17. Rocks of the Port Coldwell Complex may underlie portions of the claim group.

Three anomalies were outlined by an electrical resistivity survey whereas a magnetometer survey showed fairly high magnetic readings everywhere (Assessment Files Research Office). Three follow-up diamond drill holes were sunk totalling 515 m. The holes intersected mafic volcanic rocks, argillite, and minor syenite (monzonite). The argillite commonly contains seams and blebs of pyrite. No further work was recorded and the claims lapsed.

Recommendations for Future Mineral Exploration

The intermediate to felsic pyroclastic rocks in the vicinity of Heron Bay are located near one of the first mineral occurrences (gold, silver) to be found in the area. A sample from a nearby pit, taken during the field season, returned interesting silver and gold levels. Little work for this area is on file and it is suggested that these rocks should be examined for precious metals. The major lineament that extends eastward from Heron Bay, and the lineated and/or schistose rocks are two factors that are encouraging to further work here.

The present geological mapping has outlined significantly more intermediate to felsic (pyroclastic) rocks in the Heron Bay area than were previously reported. The bulk of these rocks are dacitic in composition although some rhyolites are present. The presence of pyrite as a ubiquitous mineral in the vicinity of Heron Bay may be an important factor in that it indicates the presence of sulphur. Important also is the generalization that the fragment size in the pyroclastic rocks decreases away from the area around Heron Bay. This suggests that the major source for the pyroclastic rocks may have been in the vicinity of Heron Bay or to the west of the map-area under what is now Lake Superior. It is suggested that the potential for base metal mineralization is probably highest in this portion of the area.

The ultramafic rocks have not been fully explored or mapped. Although there were no indications of nickel sulphide minerals, chromite, or asbestos located during the field season, further mapping would improve the delineation of the ultramafic rocks. It should be kept in mind that the large volume of low MgO-bearing pyroxenite and the small volume of moderately-high MgO-bearing lherzolite are generally not promising factors when considering exploration for sulphide mineralization and asbestos development.

Much of the gabbro of the Port Coldwell Alkalic Complex within the map-area has been tested with numerous geophysical systems and a number of diamond drill holes. However, these rocks are mantled by thick overburden in several places. It should be pointed out that Anaconda American Brass Limited holds a promising copper prospect to the north of the map-area.

Outside of the map-area, some late dikes within the alkalic complex have given indications of uraniferous minerals (K.G. Fenwick, Regional Geologist, Ontario Ministry of Natural Resources, Thunder Bay, personal communication, 1977). Some of the dikes within the map-area were tested with a scintillometer for radioactivity and a few indicated radiation levels two to three times background level. In the light of uraniferous dikes found outside of the area, further work along this line may be warranted.

APPENDIX
GLASSY DIKES AND RADIOMETRIC DATES

This section is based on additional field work that was completed in 1978, after the report was written. A fine-grained alkali basaltic dike with aphanitic and locally glassy chilled margins was found during the 1977 field season. Country rock consists of bedded calc-alkalic tuff and lapilli tuff (probably water deposited) of dacitic composition. The contact of the Port Coldwell Alkalic Complex lies 2.2 km to the northwest. Numerous dikes have intruded the country rock in the immediate sample vicinity. Intrusive relationships indicate the following order, from oldest to youngest: a schistose (chlorite) mafic dike, a plagioclase-porphyritic diorite dike, a subalkalic diabase dike, a bifurcating hematite-rich alkalic dike, and the alkali basalt dike (0.3 m thick).

Glassy material is present mainly in narrow apophyses (up to 2.5 cm) and generally constitutes the entire apophysis. Thin (2 mm) glassy contacts are present on the chilled margin of the main dike. The glassy apophyses are black, and locally contain small (4 mm by 1 mm) red and green lenses oriented along numerous fractures that are parallel to the contacts. The small lenses are probably related to devitrification. The glassy dike margins are generally a murky bluish black to bluish grey, and break with conchoidal fractures. In thin section the glassy material is weakly devitrified; X-ray diffraction patterns show a few weak peaks. The crystalline portion of the dike is composed of fine-grained plagioclase laths and subhedral pyroxene crystals with very fine-grained, interstitial plagioclase, pyroxene, devitrified glass, and cruciform and dendritic opaque minerals. Chilled margins contain quenched plagioclase microlites in lieu of the laths.

The results of seven chemical analyses (three crystalline, four glassy samples) are given in Table 20. The most significant difference between the two types is in the reduced Na_2O content of the glassy samples. This difference is reflected in the classification of the samples as shown in Figure 11 and Table 21 where it can be seen that the crystalline samples are classified as alkalic and the glassy specimens are classified as subalkalic. This may be explained by the partial loss in sodium through weak devitrification. The proportions of some other elements have also been altered in the glassy specimens, either through weak devitrification, or by chemical exchange or contamination by being in contact with the country rock. These changes are reflected in the normative calculations and can be seen by comparing the scatter of glassy samples (Figure 11) to the closely grouped crystalline analyses. Chemical analyses of glassy specimens are therefore suspect when one is considering original chemical composition.

Three radiometric ages are given as follows[1].

M293A-78—Whole rock, K-Ar age 1074 ± 39 m.y. K = 1.51%, radiogenic Ar = 96.9%.

Concentrate: crushed whole-rock; fine-grained dike centre. See M293C-78 for sample location, description, and interpretation.

M293B-78—Whole rock, K-Ar age 1116 ± 41 m.y. K = 1.45%, radiogenic Ar = 95.5%.

Concentrate: crushed whole-rock; fine-grained dike centre. See M293C-78 for sample location, description, and interpretation.

[1] Radiometric ages were determined by Geochronology Section, Geological Survey of Canada, Ottawa.

M293C-78—Whole-rock, K-Ar age 986 ± 43 m.y. K = 1.11%, radiogenic Ar = 99.1%.

Concentrate: crushed whole-rock; aphanitic chilled margin. From alkali basalt dike, potassic series (as defined by Irvine and Barager 1971), on Lake Superior shoreline, 5.63 km west of junction of Highway 627 and C.P.R. tracks (at town of Heron Bay, Ontario); 48°39′48″N, 86°21′27″W (map reference, Muir and Barnett 1978a).

TABLE 20. CHEMICAL ANALYSES OF GLASS-BEARING DIKES[1] IN THE HERON BAY AREA.

	1	2	3	4	5	6	7[2]
SiO_2	47.2	46.6	46.4	44.5	45.6	47.6	44.6
Al_2O_3	15.0	14.5	15.5	13.6	17.8	14.3	12.9
Fe_2O_3	5.86	4.50	4.40	4.90	2.90	3.60	14.9*
FeO	8.68	10.3	10.1	9.60	11.0	9.45	
MgO	4.66	4.63	4.20	4.91	4.47	4.13	4.94
CaO	9.51	9.45	8.91	7.98	8.85	8.30	8.22
Na_2O	3.29	3.29	3.35	1.78	0.85	1.55	1.13
K_2O	1.83	1.78	1.97	1.33	3.33	1.28	1.49
TiO_2	1.72	1.70	1.72	1.66	1.61	1.55	1.67
P_2O_5	0.77	0.76	0.77	0.74	0.76	0.66	0.74
MnO	0.26	0.25	0.25	0.30	0.24	0.22	0.26
S	0.06	0.03	0.06	0.04	0.03	0.04	N.D.
H_2O^+	1.11	0.71	1.22	6.01	1.94	6.11	
H_2O^-	0.98	0.47	0.58	3.70	1.03	0.92	8.90‡
CO_2	0.16	1.38	1.00	0.26	0.52	0.87	
TOTAL	101.1	100.3	100.4	101.3	100.9	100.6	99.7
S.G.	2.93	3.00	2.99	2.63	3.00	2.68	2.62
R.I.	N.D.	N.D.	N.D.	1.56	1.62	1.58	N.D.
Ba	1000	1000	1200	1000	1200	1000	
Co	45	75	45	45	50	45	
Cr	65	65	70	65	65	60	
Cu	280	280	280	240	260	230	
Li	15	20	15	15	15	7	
Ni	45	45	45	45	45	40	
Pb	30	25	55	20	45	40	
Rb	50	60	60	50	120	50	
Sr	520	640	690	1950	710	810	
Y	50	50	50	40	50	50	
Zn	170	160	175	160	160	145	
Zr	340	320	320	290	310	290	

SPECIMENS
1 M290-78 Aphanitic to fine-grained dikelet (intruding subalkalic diabase dike).
2 M293A-78 Main alkali basaltic dike; fine grained.
3 M296-78 Chilled (aphanitic) dikelet.
4 M283-78 Black glass stringer (intruding subalkalic diabase dike).
5 M292-78 Dark grey glass stringer (intruding felsic to intermediate pyroclastic).
6 M294-78 Black glass stringer (intruding felsic to intermediate pyroclastic).
7 M125-77 Black glass stringer with coloured lenses (intruding subalkalic diabase dike).

NOTES
* Total iron as Fe_2O_3.
‡ All volatiles as loss on ignition.
[1] Major oxides in weight percent; trace elements in ppm.
[2] Also shown in Table 15 and in Figures 3, 4, 5, 6, and 7 as code no. 42.
N.D. Not determined.
Analyses by Geoscience Laboratories, Ontario Geological Survey, Toronto.

The first two ages listed are similar, within error limits, and were determined from the same specimen. The third is somewhat lower which may be the result of argon loss due to a significant proportion of initial interstitial glass. The youngest activity in the vicinity of the Port Coldwell Complex is about 300 m.y. (R.P. Sage, Geologist, Ontario Geological Survey, personal communication) and this dike was dated to test for possible younger activity. The age of the dike, however, if taken as 1095 ± 62 m.y. (combination of the first two ages) corresponds to Late Keweenawan and is similar to the age of the Port Coldwell Alkalic Complex which is most recently given as 1085 ± 15 m.y. (Rb/Sr) by Bell *et al.* (1979). The presence of glass of Keweenawan age indicates that devitrification can be a fairly lengthy process under certain conditions.

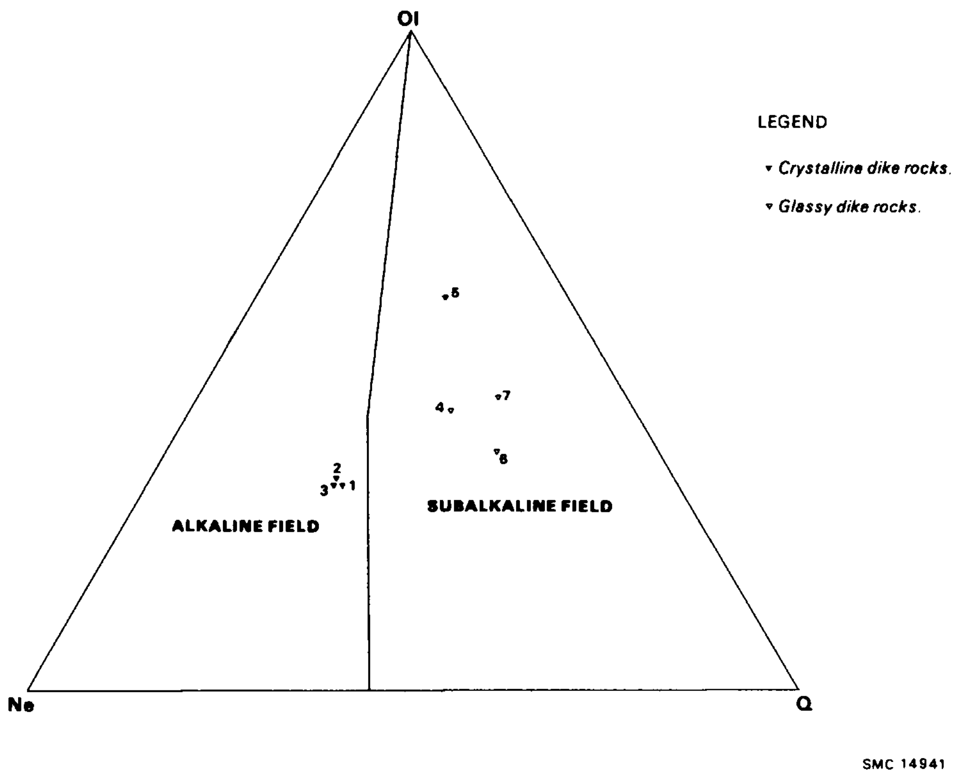


Figure 11—*Ne-Ol-Q plot (after Irvine and Baragar 1971) of chemically analysed samples of glassy dikes from the Heron Bay area.*

TABLE 21. CLASSIFICATION OF GLASS-BEARING DIKES IN THE HERON BAY AREA.

Code No.[1]	Sample No.	Field Name	Irvine and Barager (1971) Classification	Jensen (1976) Classification
1	M290-78	crystalline, alkalic basaltic dike	alkali basalt; potassic series	*tholeiitic basalt; high FeO
2	M293A-78	crystalline, alkalic basaltic dike	alkali basalt; potassic series	*tholeiitic basalt; high FeO
3	M296-78	crystalline, alkalic basaltic dike	alkali basalt; potassic series	*tholeiitic basalt; high FeO
4	M283-78	glass, alkalic basaltic dike	tholeiitic basalt	tholeiitic basalt; high FeO
5	M292-78	glass, alkalic basaltic dike	tholeiitic basalt; high Al	tholeiitic andesite; high FeO
6	M294-78	glass, alkalic basaltic dike	tholeiitic basalt	tholeiitic basalt; high FeO
7‡	M125-77	glass, alkalic basaltic dike	tholeiitic basalt	tholeiitic basalt; high FeO

[1] Corresponds with numbers used in Figure 11.
* Alkalic rock; classification does not apply.
‡ Also shown in Figures 3, 4, 5, 6 and 7 as code no. 42.

REFERENCES

Bell, K., Blenkinsop, J., and Watkinson, D.H.
1979: Rb/Sr Geochronology of Alkalic Complexes, Ontario; *in* Geoscience Research Grant, Summary of Research, 1978-1979, edited by E.G. Pye, Ontario Geological Survey, MP87, p. 69-78.

Bell, R.
1873: Report on the Country between Lake Superior and Lake Winnipeg; Geological Survey Canada, Rept. Progress 1872-73, p.87-111.

Bennett, G., Thurston, P.C., and Giguere, J.F.
1969: Operation Pukaskwa, Pukaskwa River Sheet, Districts of Thunder Bay and Algoma; Ontario Department of Mines Preliminary Map P. 507, Scale 1 inch to 1 mile.

Coleman, A.P.
1899: Dyke Rocks Near Heron Bay; Ontario Bureau Mines, Vol.8, pt.2, p.172-174.

1900: Heronite or Analcite Tinguaite; Ontario Bureau Mines, Vol.9, p.186-191.

Cowan, W.R.
1976: Evaluation of Selected Aggregate Deposits, North Shores of Lakes Huron and Superior; p.137-138 in Summary of Field Work, 1976, by the Geological Branch, edited by V.G. Milne, W.R. Cowan, K.D. Card, and J.A. Robertson, Ontario Division Mines, MP67, 183p.

Currie, K.L.
1980: A Contribution to the Petrology of the Coldwell Alkaline Complex, Northern Ontario; Geological Survey Canada, Bull. 287, 42 p.

Fairbairn, H.W., Bullwinkel, H.J., Pinson, W.H., and Hurley, P.M.
1959: Age Investigations of Syenite from Port Coldwell, Ontario; Geological Assoc. of Canada Proc., Vol.11, p.141-144.

Gorman, B.E., Pearce, T.H., and Birkett, T.C.
1978: On the Structure of Archean Greenstone Belts; Precambrian Research, Vol.6, p.23-42.

Irvine, T.N. and Barager, W.R.A.
1971: A Guide to the Chemical Classification of the Common Volcanic Rocks; Canadian Journal of Earth Sciences, Vol. 8, p.523-548.

Jensen, L.S.
1976: A New Cation Plot for Classifying Subalkalic Volcanic Rocks; Ontario Division Mines, MP66, 22p.

Kerr, H.L.
1910: Nepheline Syenites of Port Coldwell, Ontario Bureau Mines, Vol.19, pt.1, p.194-232.

Logan, Sir William E.
1847: Report of Progress 1846-47, Geological Survey of Canada, p. 29 to 31.

Lum, H.K.
1973: Petrology of the Eastern Gabbro and Associated Sulphide Mineralization of the Coldwell Alkalic Complex; Ontario; unpubl. B.Sc. Thesis, Carleton University, Ottawa, Ontario, 69p.

Milne, V.G.
1967: Geology of the Cirrus Lake-Bamoos Lake Area; Ontario Div. Mines, Geol. Rept. 43, 61p. Accompanied by Map 2099, scale 1 inch to ½ mile.

1968: Manitouwadge Sheet, Districts of Thunder Bay and Algoma; Ontario Department of Mines, Geological Compilation Series, Preliminary Geological Map P. 494, Scale 1 inch to 2 miles.

Mitchell, R.H. and Platt, R.G.
1977: Field Guide to Aspects of the Geology of the Coldwell Alkaline Complex; 23rd Annual Meeting, Institute on Lake Superior Geology, p.1-34.

Muir, T.L.
1975: A Petrological Study of the Ultramafic and Related Rocks of the Shaw Dome, Southeast of Timmins, Ontario; unpubl. M.Sc. Thesis, Queen's University, Kingston, Ontario, 271p.

1977: Heron Bay Area, District of Thunder Bay; p.80-3 *in* Summary of Field Work, 1977, by the Geological Branch, edited by V.G. Milne, O.L. White, R.B. Barlow, and J.A. Robertson, Ontario Geological Survey Miscellaneous Paper 75, 208p.

1980: Geology of the Hemlo Area, District of Thunder Bay; Ontario Geological Survey Open File Report 5280, 78 p. 4 maps.

Muir, T.L. and Barnett, E.S.
1978a: Heron Bay Area, Northern Part, District of Thunder Bay, (42 D/9); Ontario Geological Survey Prelim. Map P.1981, Geol. Ser., scale 1:15840. Geology 1977.
1978b: Heron Bay Area, Southern Part, District of Thunder Bay (42 D/9); Ontario Geological Survey, Prelim. Map P.1982, Geol. Ser., scale 1:15 840. Geology 1977.

Nockolds, S.R.
1954: Average Chemical Compositions of Some Igneous Rocks; Geol. Soc. America Bull., Vol.65, p.1007-1032.

Puskas, F.P.
1967a: Geology of the Port Coldwell Area; Ontario Dept. Mines, Open File Report 5014.
1967b: Port Coldwell Area, District of Thunder Bay; Ontario Dept. Mines Prelim. Map P.114, Geol. Ser., scale 1 inch to ½ mile.
1970: The Port Coldwell Alkalic Complex; in Institute of Lake Superior Geology, 16th Annual Meeting, p.85-100.

Thompson, J.E.
1931: Geology of the Heron Bay Area, District of Thunder Bay; Ontario Dept. Mines, Vol.40, pt.2, 43p. Accompanied by Map 40d, scale 1 inch to 1½ miles.

Winkler, H.G.F.
1967: Petrogenesis of Metamorphic Rocks; Revised Second Edition, Springer-Verlag, New York Inc., 237p.
1976: Petrogenesis of Metamorphic Rocks; Fourth Edition, Springer Verlag, New York Inc., 334p.

INDEX

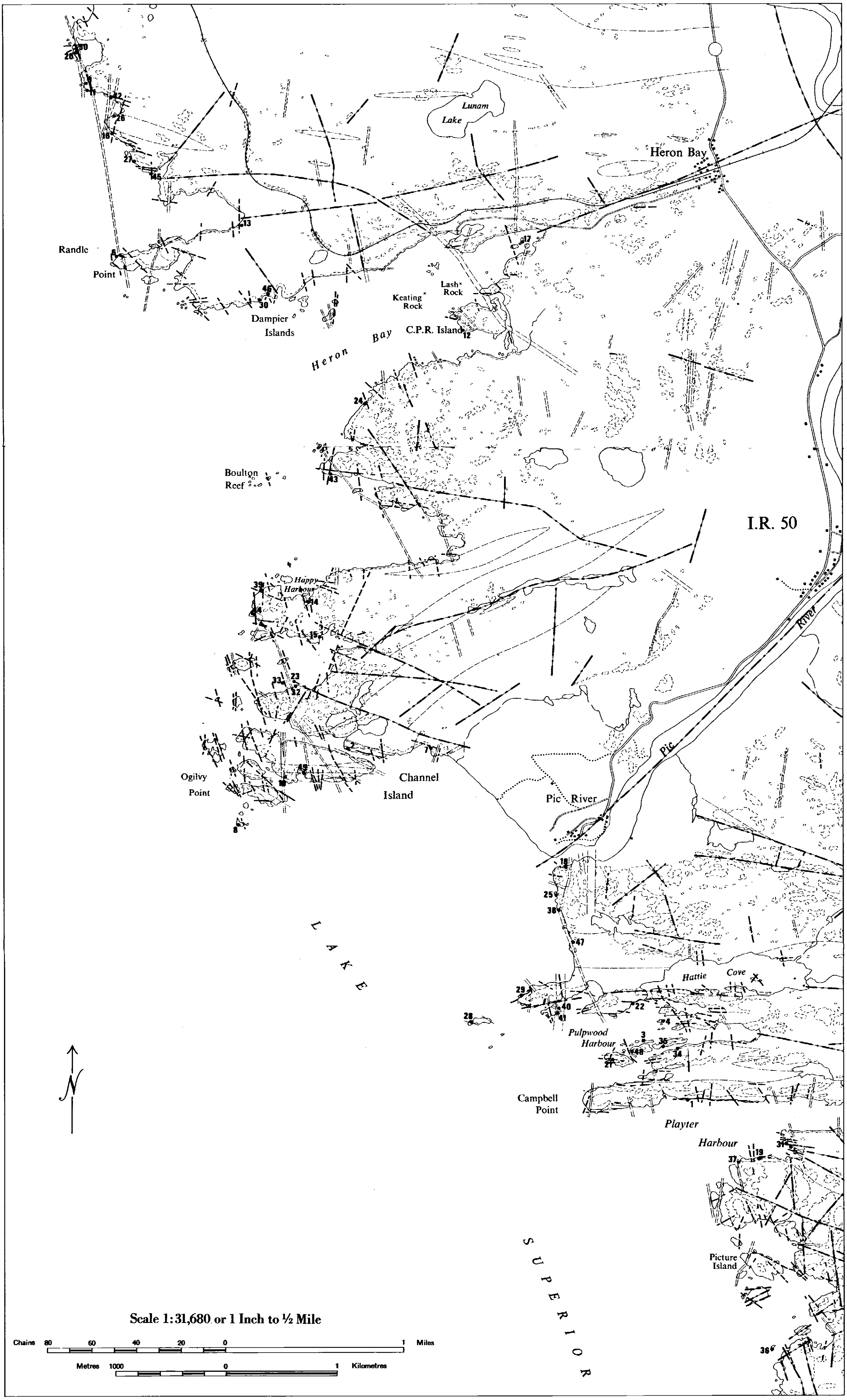
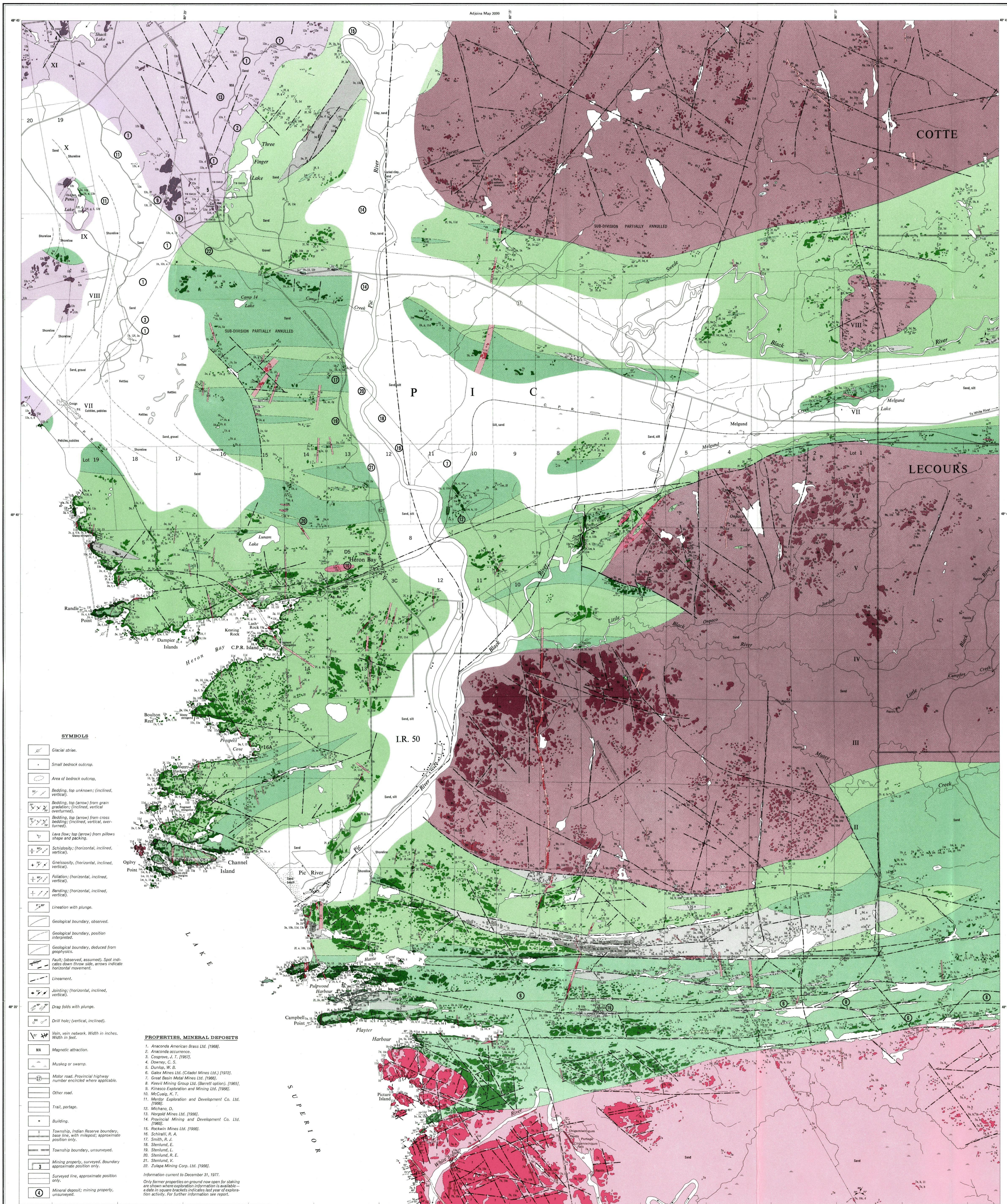
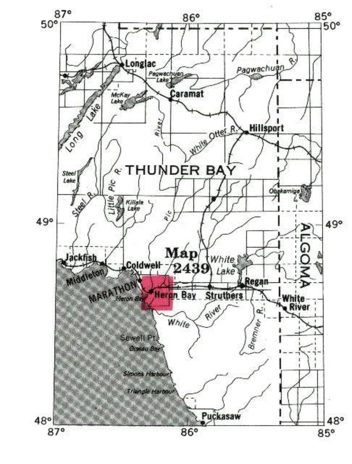


Figure 3 Location of samples taken for Chemical Analyses within the Heron Bay Area.

Ministry of Natural Resources
Ontario





Scale, 1 inch to 50 miles

N.T.S. reference 42D/9

SYMBOLS

- Glacial striae.
- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, top unknown; (inclined, vertical).
- Bedding, top (arrow) from grain gradation; (inclined, vertical overturned).
- Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).
- Lava flow; top (arrow) from pillows shape and packing.
- Schistosity; (horizontal, inclined, vertical).
- Gneissosity, (horizontal, inclined, vertical).
- Foliation; (horizontal, inclined, vertical).
- Banding; (horizontal, inclined, vertical).
- Lineation with plunge.
- Geological boundary, observed.
- Geological boundary, position interpreted.
- Geological boundary, deduced from geophysics.
- Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
- Lineament.
- Jointing; (horizontal, inclined, vertical).
- Drag folds with plunge.
- Drill hole; (vertical, inclined).
- Vein, vein network. Width in inches. Width in feet.
- MA Magnetic attraction.
- Muskeg or swamp.
- Motor road. Provincial highway number encircled where applicable.
- Other road.
- Trail, portage.
- Building.
- Township, Indian Reserve boundary, base line, with milepost; approximate position only.
- Township boundary, unsurveyed.
- Mining property, surveyed. Boundary approximate position only.
- Surveyed line, approximate position only.
- Mineral deposit; mining property, unsurveyed.

PROPERTIES, MINERAL DEPOSITS

1. Anaconda American Brass Ltd. [1968].
2. Anaconda occurrence.
3. Cosgrove, J. T. [1957].
4. Downey, C. S.
5. Dunlop, W. B.
6. Galex Mines Ltd. (Citadel Mines Ltd.) [1972].
7. Great Basin Metal Mines Ltd. [1966].
8. Keevil Mining Group Ltd. (Barrett option). [1965].
9. Kinasco Exploration and Mining Ltd. [1956].
10. McCuaig, K. T.
11. Mentor Exploration and Development Co. Ltd. [1956].
12. Michano, D.
13. Norgold Mines Ltd. [1956].
14. Provincial Mining and Development Co. Ltd. [1965].
15. Rockwin Mines Ltd. [1956].
16. Schiralli, R. A.
17. Smith, R. J.
18. Stenlund, E.
19. Stenlund, L.
20. Stenlund, R. E.
21. Stenlund, V.
22. Zulapa Mining Corp. Ltd. [1956].

Information current to December 31, 1977.

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

LEGEND

PHANEROZOIC

CENOZOIC[a]

QUATERNARY

PLEISTOCENE AND RECENT

Swamp, lake and stream deposits. Glaciolacustrine varved clay, clay, silt, sand; pebble, cobble, and boulder deposits.

UNCONFORMITY

PRECAMBRIAN[b]

LATE PRECAMBRIAN (PROTEROZOIC)

ALKALIC INTRUSIVE ROCKS

ALKALIC AND RELATED DIKES

13 Unsubdivided.
13a Alkalic gabbro, diabase.
13b Porphyritic alkalic diabase.
13c Gabbroic lamprophyre.
13d Ultramafic lamprophyre.
13e Porphyritic gabbro.
13f Porphyritic syenite.
13g Carbonatite.
13h Intrusive breccia.

PORT COLDWELL ALKALIC COMPLEX

12 Unsubdivided.
12a Biotite gabbro.
12b Olivine gabbro.
12c Pyroxene monzonite.
12d Hornblende quartz syenite pegmatite.
12e Contact breccia.
12f Layered.
12g Hybrid.

INTRUSIVE CONTACT

MIDDLE TO LATE PRECAMBRIAN (PROTEROZOIC)

MAFIC INTRUSIVE ROCKS

11 Unsubdivided.
11a Olivine-bearing diabase.
11b Quartz-bearing diabase.
11c Porphyritic diabase.
11d Equigranular diabase.

INTRUSIVE CONTACT

EARLY PRECAMBRIAN (ARCHEAN)

INTERMEDIATE TO FELSIC INTRUSIVE ROCKS

LATE FELSIC DIKES AND SILLS

10 Unsubdivided.
10a Quartz-feldspar porphyry.
10b Feldspar porphyry.
10c Aplite.
10d Pegmatite.
10e Trondhjemite.

INTRUSIVE CONTACT

HERON BAY PLUTON

9 Unsubdivided.
9a Porphyritic (microcline) biotite-hornblende granodiorite.
9b Hornblende-biotite granodiorite.
9c Biotite granodiorite.
9d Porphyritic (hornblende) biotite-hornblende granodiorite.
9e Porphyritic (plagioclase) biotite-hornblende granodiorite.
9f Hybrid rock.

GOWAN LAKE PLUTON

8 Unsubdivided.
8a Porphyritic (microcline) biotite-hornblende quartz monzonite.
8b Biotite-hornblende quartz monzonite.
8c Hybrid.

PUKASKWA GNEISSIC COMPLEX

7 Unsubdivided.
7a Porphyritic (plagioclase) hornblende-biotite granodiorite gneiss.
7b Porphyritic (plagioclase) hornblende-biotite trondhjemite gneiss.
7c Biotite granodiorite.
7d Biotite quartz monzonite.
7e Hybrid.

METAMORPHOSED ULTRAMAFIC INTRUSIVE ROCKS

6 Unsubdivided.
6a Lherzolite, dunite.
6b Pyroxenite.
bc Carbonatized.
6d Talcose.
6e Tremolitized.
6f Chloritized.

METAMORPHOSED MAFIC INTRUSIVE ROCKS

5 Unsubdivided.
5a Gabbro.
5b Diorite.
5c Schistose gabbro dike.
5d Schistose gabbroic diatreme dike.
5e Schistose diorite dike.

INTRUSIVE CONTACT

METASEDIMENTS

CHEMICAL METASEDIMENTS

4a Banded magnetite-amphibole-chert iron formation.
4b Chert-carbonate-pyrite rocks.

CLASTIC METASEDIMENTS

3 Unsubdivided.
3a Shale, siltstone.
3b Finely laminated mudstone, siltstone.
3c Bedded sandstone.
3d Wacke, arkose.

METAVOLCANICS

INTERMEDIATE TO FELSIC METAVOLCANICS

2 Unsubdivided.
2a Light grey or green to white flows.
2b Light green pillowed flows.
2c Spherulitic flows.
2d Quartz-feldspar porphyry (rhyolite).
2e Pyroclastic breccia, tuff-breccia.
2f Lapilli-tuff, tuff.
2g Crystal tuff.
2h Rhyolite pyroclastic breccia.

MAFIC METAVOLCANICS

1 Unsubdivided.
1a Dark green flows.
1b Medium green flows.
1c Pillowed flows.
1d Variolitic flows.
1e Amygdaloidal flows.
1g Porphyritic (plagioclase) flows.
1h Porphyritic (hornblende) lapilli-tuff.
1j Pillow breccia.
1k Pyroclastic breccia, tuff-breccia.
1m Lapilli-tuff, tuff.
1n Laminated (epidote layers).
1p Medium to coarse grained.

Ag	Silver.
Au	Gold.
bn	Bornite.
cp	Chalcopyrite.
Cu	Copper.
Mo	Molybdenum.
mo	Molybdenite.
po	Pyrrhotite.
py	Pyrite.
q	Quartz.
S	Sulphide mineralization.
Zn	Zinc.

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

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

SOURCES OF INFORMATION

Geology by T. L. Muir, E. S. Barnett and assistants, Ontario Geological Survey, 1977. Geology is not tied to surveyed lines.

Assessment work files, OGS, Resident Geologist's Office, Thunder Bay.

Aeromagnetic map 2156G, ODM-GSC.

Map 40d, Heron Bay Area, 1931; Map 2099, Bamoos Lake Sheet, 1966; Ministry of Natural Resources (ODM).

Preliminary maps (OGS) P. 114, Port Coldwell Area, scale 1 inch to 1/4 mile, issued 1961, re-issued 1967; P. 494, Manitouwadge Sheet, scale 1 inch to 2 miles, issued 1968; P. 541, Operation Pukaskwa, scale 1 inch to 2 miles, issued 1969; P. 1981, Heron Bay Area (Northern Part), scale 1 inch to 1/4 mile, issued 1978; P. 1982, Heron Bay Area (Southern Part), scale 1 inch to 1/4 mile, issued 1978.

Cartography by S. H. Wu and assistants, Surveys and Mapping Branch, 1979.

Base map derived from maps of the Forest Resources Inventory, Surveys and Mapping Branch, with additional information by T. L. Muir.

Magnetic declination in the area was approximately 3°W, 1977.

Muir, T. L. and Barnett, E. S.
1981: Heron Bay; Ontario Geological Survey Map 2439, Precambrian Geology Series, scale 1:31 680. Geology 1977.

Published 1981

Ontario Geological Survey
Map 2439

HERON BAY

THUNDER BAY DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1 2 Miles

Metres 1000 0 1 2 3 Kilometres

Feet 1000 0 5,000 10,000 Feet