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Open File Report 5659

Geology of the Kawashegamuk Lake Area, District of Kenora

by

D.U. Kresz

1987

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Kresz, D.U.

1987: Geology of the Kawashegamuk Lake Area, District of Kenora; Ontario Geological Survey, Open File Report 5659, 201p., 14 figures, 13 tables, 18 photos, 3 appendices, and 3 map in back pocket. P.2569 P.2570 P.3100

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Preface

Kawashegamuk Lake Area

Until 1980 the geological map coverage of the Kawashegamuk Lake Area was at a reconnaissance level. The detailed mapping project described in this geological report was designed to encourage mineral exploration interest and to provide a basis for a land use potential evaluation.

The Precambrian bedrock of the study area host several precious metal occurrences and some copper mineralization. Molybdenite associated with numerous quartz veins was found in two places. A former gold producer, the Van Houten Mine has produced a total of about 3700 ounces of gold and minor silver.

V.G. Milne
Director
Ontario Geological Survey

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Abstract

The Kawashegamuk Lake area lies between Latitudes 49°22'30" and 49°32'20"N and Longitudes 92°15' and 92°30'W and covers 333 km^2. Kawashegamuk Lake lies in the east-central part of the area about 45 km southeast of Dryden. The rocks belong to an arcuate metavolcanic-metasedimentary belt of Archean age that is part of the Western Wabigoon Subprovince. Large granitic batholiths outside the map area flank the belt on three sides, smaller intrabelt granitic plutons intrude the greenstone assemblage in several places. Within the map area, the belt is composed mainly of both mafic and felsic volcanic rocks with their intrusive equivalents and of epiclastic rocks composed of conglomerate and arenite derived largely from the volcanics. The supracrustal rocks fall into four distinct major lithologic groups that have been folded about the east-west trending Kamanatogama syncline. The south limb of the syncline consists of the Wapageisi lake Group being represented by a thick sequence of tholeiitic flows overlain by felsic pyroclastic rocks and the Stormy Lake Group being essentially an epiclastic sequence. The north limb is composed of the Kawashegamuk Lake Group, a thick, mixed sequence of basalt, andesite and felsic pyroclastic rocks of tholeiitic and calc-alkalic affinity. Both the Kawashegamuk and the Stormy Lake Groups are overlain by the Boyer Lake Group, a thick assemblage that is dominated by tholeiitic basalt flows and that straddles the Kamanatogama Syncline. The rocks were deformed during the Kenoran Orogeny which imposed large scale folds, faults and penetrative fabrics on the rocks. This orogeny was

accompanied by regional low grade dynamo-thermal metamorphism. Granitic plutonism that accompanied deformation have left thermal aureoles in the intruded rocks.

During the Pleistocene epoch, glaciers moved in from a northerly direction scouring the peneplained Precambrian rocks and depositing unconsolidated glacial sediments upon recession bearing moraine outwash and lacustrine material.

The area is well known for its gold potential: a prospecting rush during the late nineteenth and early twentieth centuries was responsible for the discovery of several quartz vein hosted gold deposits in the northern part of the map area. Two deposits have received significant attention. The Tabor Lake prospect and the Van Houten Mine; the latter has produced a total of 3,670 ounces of gold and 145 ounces of silver. Starting in 1952 the area became the scene for the search of base metals, and a number of exploration programmes including geophysical surveys, detailed geological mapping geochemical sampling, and diamond drilling were carried out by mining companies.

Minor copper mineralization was found associated with felsic volcanic rocks and small intrusion.

Molybdenite associated numerous quartz veins at the margin of the Revell Batholith was found in two places.

GEOLOGY OF THE KAWASHEGAMUK LAKE AREA

DISTRICT OF KENORA

by

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Manuscript approved for publication by A.C. Colvine, Chief Geologist, Ontario Geological Survey, August 25, 1987.

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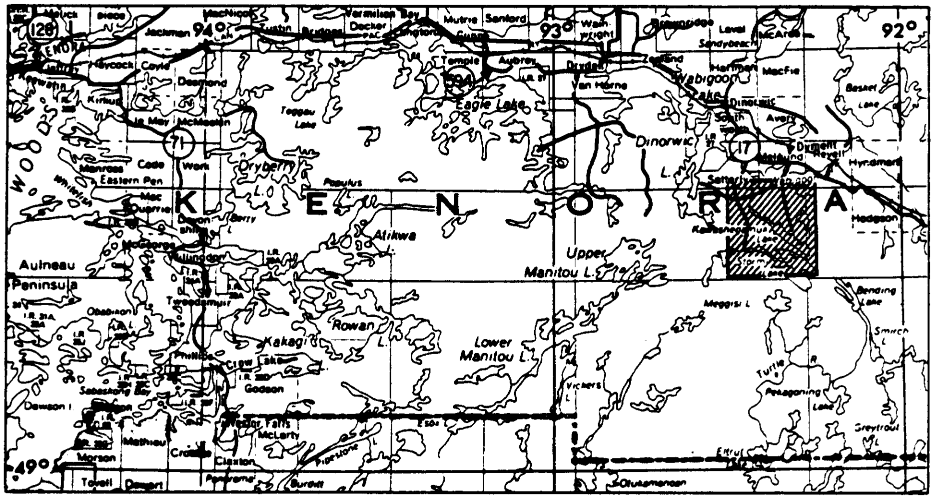

LOCATION MAP

Scale: 1:1 584 000 or 1 inch to 25 miles

Figure G.1: Key map showing the location of the Kawashegamuk Lake Area.

INTRODUCTION

The area described in this report lies between latitudes 49°22'30"N and 49°32'20"N and longitudes 92°15'W and 92°30'W, in the District of Kenora. The map covers 333 km^2 (128.5 $miles^2$). It is included in the Dryden sheet No.52F of the National Topographic Series, the O.G.S. Geological Compilation Map No.2443 (Kenora-Fort Frances), the O.D.M.-G.S.C. Aeromagnetic Maps 1144G and 1145G and the O.G.S. Aeromagnetic maps covering the Manitou-Stormy Lakes areas. Kawashegamuk Lake is 45 km southeast of Dryden, the nearest town situated on the Trans-Canada Highway (Highway 17).

The Kawashegamuk Lake area lies in the east-central part of a crescent shaped greenstone belt that is some 70 km long and that extends from Lower Manitou Lake in the west to Smirch and Kinmoapiku Lakes in the east. This belt is called the Manitou-Stormy Lakes Belt (Blackburn, 1982). The greenstone terrain covered by the present study is composed largely of mafic and felsic volcanic rocks and epiclastic sedimentary rocks. These rocks have been deformed, metamorphosed and intruded by granitic plutons during he Kenoran Orogeny. One of these granitic plutons, the Taylor Lake Stock is 2695 Ma old (Davis et al. 1982) and is situated west of the map-area.

The Kawashegamuk Lake area has been the scene of considerable gold prospecting, since 1897 when an area some 12 km wide extending from the southern shore of Kawashegamuk Lake to the Canadian Pacific Railway line in Melgund and Satterly Townships became known as the "New Klondike". Most of the presently known gold deposits were found between 1897 and 1902. In the later years, long periods of inactivity followed but the Van Houten Mine which produced a total of 3,669 ounces of gold and 145 ounces of silver between 1899 and 1947 and the Tabor Lake prospect were reevaluated several times. Beginning in 1952, the area intermitently received attention by a number of exploration companies searching for base metals. When the present mapping survey was completed in 1982, the area was under considerable investigation and individuals as well as companies were actively searching for gold and base metals. Exploration and development work were being done at the Van Houten Mine and the Tabor Lake Prospect.

Access

The northern limit of the map area lies 4.8 km south of Borups Corner on the Trans Canada Highway. Two all weather gravel roads give excellent access to the area. A lumber road (Snake Bay Road) currently in use by Great Lakes Forest Products intersecting with Highway 17 at Jackfish Lake 10 km east of Dinorwic. This road provides access to the western part of the map-area and to Stormy Lake. Further to the east a township road leaves Highway 17 at Borups Corner and provides access to the eastern part of the map area and to Kawashegamuk Lake. A third road (Sandy point Lake Road) connects the two principal access roads in the northern part of the map area. Numerous subordinate roads once used during lumbering operations provide access by four wheel drive vehicle to a number of places and lakes. Most places can be reached by light motor boat or by canoe via the extensive network of lakes and short portages.

Acknowledgements

The author was ably assisted in the field during the 1981 field season by W.R. Kramer and in 1982 by E. Kresz. During 1980 the project was supervised by C.E. Blackburn who mapped about one third of the area and was assisted by F.B. Fraser and the author who were then senior assistants and by junior assistants W.R. Kramer, E. Kristof, T.J. Lariviere and V.K. Opekar. Thanks are due to Helen and Allan Van Patter who provided many appreciated services, hospitality and courtesies to the field parties in 1980, 1981, and 1982.

Previous Geological Work

From 1897 to 1902 the area was visited by geologists and inspectors of the then Ontario Bureau of Mines whose interests were aimed principally at the gold discoveries in the "New Klondike". The first notable geological work was made by William McInnes (1895, 1896, 1897) of the Geological Survey of Canada around the Manitou Lakes and a map, including the western part of the present survey-area, was published in 1902 (McInnes, 1902).

The second notable geological mapping survey covering the entire present map area was made in 1932 by J.E. Thomson (1933). At that time an intensive search for gold deposits was going on and the Manitou Lakes area to the west was receiving much attention. Mapping carried out by the former Ontario Department of Mines covered the townships of Melgund, Revell and Hyndman adjoining the present map area to the north (Satterly, 1960). To the west in the Manitou Lakes area, C.E. Blackburn carried out mapping to a scale of 1 inch to 1/4 mile over the period 1972 to 1975 (Blackburn 1976, 1979, 1981) and three reports as well a a synopsis of these reports (Blackburn, 1982) have been published. No systematic mapping has been carried out to the south, southeast and east of the present map area. The present map area was also included in a special study in 1977 (Trowell et al. 1980) on the stratigraphy, structure, emplacement and timing of mineral deposits in he Savant through Crow Lake Region. In 1982 the area was visited during a field trip held in conjunction with the annual meeting of the Geological Association of Canada in Winnipeg. Four stops were made within the present map-area and the geological features are described in Blackburn et al. (1982). The map-area was also included in three thesis studies: W.E. Bertholf (1946) did a structural study of the Washeibemaga-Thundercloud Lakes area. G.E. Master (1978) carried out a geochemical study of the volcanic rocks around Thundercloud Lake including some of the western part of the present map area and finally the author included the entire map area in a study on the stratigraphy, petrography, structure, geochemistry, volcanology, sedimentology and evolution of an Archean greenstone assemblage (Kresz, 1984a). Much of the geological aspects described in this report have been excerpted from the latter thesis study.

Present Geological Survey

C.E. Blackburn began mapping between Tabor Lake and the Van Houten Mine in 1979. During the summer of 1980 the mapping programme continued under the direction of C.E. Blackburn. The author then employed as a senior assistant returned to the area in 1981 to complete the field work and also spent one month during the summer of 1982 to collect additional samples for laboratory investigations. The field maps were prepared at a scale of 1:15840 (1 inch to 1/4 mile). Vertical air-photos of the same scale were used to plot the field data. Rock exposures were examined along lake shores, roads, and pace and compass traverse lines separated on the average by a distance of 400 m, less than 400 m in geologically more complex areas. Photo interpretation played an important role in preparing the field preliminary and final maps. Areas of abundant bedrock exposure have been shown on the map as one outcrop unit for clarity and in areas of great lithological uniformity, intervening rock exposures from air photo studies between visited outcrops have been infered and indicated as such on the maps. Preliminary maps P.2569 and P.2570 (Kresz et al. 1982a, b) have been published by the Ontario Geological Survey.

Geomorphology and Drainage

The topography of the Kawashegamuk Lake area is typical of that of much of the Canadian Shield. Kawashegamuk Lake is 374 m (1227 feet) above sea level and the local relief is less than 50 m in most places. Much of the gently rolling peneplained surface is covered by lakes which are connected by rivers and streams. The outline, size and distribution of these lakes is largely controlled by bedrock and structures. Stormy and Kawashegamuk lakes, the two largest lakes lie on major structures such as the Mosher Bay-Washeibemaga Lake Fault along Snake Bay of Stormy Lake. The Kamanatogama synclinal axis follows the main body of Stormy Lake. The Kawashegamuk Lake lies along a zone of schistosity. These structure controlled lakes are commonly characterized by great depths, of in places over 40 m. Lakes with highly irregular outlines and with many islands such as Aiabewatik, Boyer, Shonwashu, Seggemak, Noxheiatik and Mennin Lakes lie in areas underlain by rocks with few fabrics, most of these lakes are shallow. The higher topographic features dominate the north shore of Snake Bay and the western shore of Kawashegamuk Lake, more resistant gabbro or basalt form these hills which are marked by steep slopes and cliffs along the Mosher Bay - Washeibemaga Lake Fault and along Kawashegamuk Lake. The entire area falls into one watershed previously outlined by McInnes (1902); Kawashegamuk Lake and Mennin Lake receive the waters from the surrounding land and drain the area through Kawashegamuk River and Mennin River which both flow northward into the Wabigoon River.

Toponyms

Place names used in mining company reports, by prospectors and by local residents may vary from official usage. Listed below are alternative names to official names shown on the

Kawashegamuk Lake map (Map XXXX, back-pocket).

Official Usage	Alternate Usage
1) Church Lake	Kirk Lake
5) Mennin Lake	Shallow Lake
2) Kawashegamuk Lake	Long Lake
3) Kawashegamuk River	Smoke River
4) Lowery Lake	Lowry Lake
	(After Captain H. Lowry)

General Geology

Introduction

The Kawashegamuk Lake area is situated in the central part of the western Wabigoon Subprovince and occupies the east-central part of an arcuate belt, the Manitou-Stormy Lakes greenstone belt (Blackburn, 1982), extending from Lower Wabigoon Lake in the west to Smirch and Kinmoapiku Lakes in the east. To the north this belt is continuous with the Eagle-Wabigoon metavolcanics. The Manitou-Stormy Lakes belt is flanked by three batholithic complexes: the Irene-Eltrut Lakes batholithic complex in the south, the Atikwa Batholith in the northwest and the Revell Batholith in the east. Smaller intrabelt plutons intrude the greenstone assemblage in several places. The internal structure of the belt is essentially parallel to its outline such that in the Kawashegamuk Lake area volcanic and sedimentary rock units together with planar rock fabrics trend in a NW-SE direction. In the Manitou Lakes the trend is in a NE-SW direction. Similarly major folds in the central parts of the belt, namely the Manitou Anticline and the Kamanatogama Syncline as well as major faults such as the Manitou Structures fault and the Mosher Bay-Washeibemaga Lake Fault follow similar trends.

The Manitou-Stormy Lakes area is underlain by metavolcanic[1] and metasedimentary[1] rocks of Archean age that have been emplaced between 2800 Ma and 2700 Ma according to recent isotopic data (Davis et al. 1982). These isotopic ages also suggest that the volcanic-sedimentary assemblage has been deformed and intruded by granitic rocks between 2700 Ma and 2600 ma ago.

Younger cross-cutting diabase dikes are considered to be of Proterozoic age according to isotopic age determinations (Wanless 1970). From current mapping (Kresz et al. 1982a, b) the metavolcanic-metasedimentary assemblage underlying the map area may be divided into four distinct lithologic groups, three of which have been defined from mapping to the west of the present map area by Blackburn (1981, 1982). They are the Wapageisi Lake Group, the Stormy Lake Group and the Boyer Lake Group. The fourth Group, underlying the northeastern half of the map-area has been named after Kawashegamuk Lake on which it is well exposed (Blackburn and Kresz, 1981). The four lithologic groups have been subdivided into constituent units[2] which have been given informal names and because of the lack of suitable toponyms many have been designated by numbers or letters.

Within the Kawashegamuk Lake area, the rocks strata have been tilted at steep angles on each side of the east-west trending Kamanatogama synclinal axis and consequently the exposed units represent a cross-section through part of the Archean

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1 All volcanic and sedimentary rocks underlying the map-area underwent profound mineralogical, chemical and textural changes following burial and widespread tectonism. As a result all volcanic and sedimentary rocks have been metamorphosed.

2 In this report, the stratigraphic subdivisions as Groups, sub-groups, formations and members are described as rock-stratigraphic units, according to the rules set forth in the Code of Stratigraphic Nomenclature (American Commission on Stratigraphic Nomenclature, 1961).

stratigraphy in the area. Because of lithologic dissimilarities on each limb of the Kamanatogama Syncline, correlation across it is uncertain. The stratigraphy as described in the following sections is outlined in Table G2.

Since the tectonic events of the Kenoran Orogeny, the general area has remained stable. During the Pleistocene Epoch, several continental glaciers moved over the peneplained Precambrian craton shedding their load of sediments as they receded.

The present landscape of low rolling hills and innumerable lakes is typical of a recently glaciated area. Table G1 lists the lithological successions through geological time.

Wapageisi Lake Group

The Wapageisi Lake Group (Trowell et al. 1980; Blackburn, 1982) is a continuous sequence at the base of the Manitou - Stormy Lakes Greenstone Belt extending from Lower Manitou Lake in the west to Wapageisi Lake and beyond in the east (Blackburn, 1980). The group consists of an 8,000 m thick homoclinal sequence of mafic volcanic rocks that Blackburn (1981; 1982) has further subdivided south of Manitou Lakes. Only a small part of the mafic sequence is exposed in the southern part of the map-area. Directly overlying the mafic rocks of the Wapageisi Lake Group at Kawijekiwa, Gawiewiagwa and Stormy Lakes is a sequence of felsic pyroclastic rocks that has been included by the author as part of the Wapagiesi Lake Group. This sequence probably represents a centre of felsic volcanism. Because of the differences in the nature of the volcanism and chemical composition, the Wapageisi Lake Group has been divided into two subgroups namely subgroup I including the lower mafic volcanics and subgroup II comprising the overlying felsic rocks. Subgroup II itself has been further subdivided into four formations based on differences in character and composition of the volcanic deposits.

Subgroup I

Only the upper part of the thick, lower mafic basaltic succession is represented in the map-area and due to its limited exposure has not been further subdivided. It consists mainly of a monotonous succession of massive and pillowed flows. Pillows vary in size from centimetre scale to about 1 metre. Small pillows are commonly subround, large ones show ameboid outlines. Pillow selvages appear as dark green chloritic rims 0.5 - 2 cm thick contrasting with lighter colored interiors on the weathered surface. In most places the pillow lavas consist of closely packed pillows, but aquagene tuff and hyaloclastite commonly occupy inter-pillow spaces. In some places pillows have been brecciated by rapid cooling.

Massive flows have commonly medium to coarse grained interiors. In some places the flows are plagioclase porphyritic with saussurized phenocrysts attaining up to 5 cm and having retained a euhedral outline. Amygdaloidal basalts with small chlorite-filled vesicles occur locally and are more abundant towards the top of the Wapageisi Lake Group. These basalts probably are shallow marine. One exposure just south of the southernmost bay of Katisha Lake shows a basalt with elliptical, white variolitic structures.

The widespread and almost uninterrupted sequence of basalts forming the Wapageisi Lake Group suggests long periods of mafic, quiescent, submarine volcanic activity.

In four exposures, along strike near Katisha Lake and Seggemak Lake, a thin bed about 30 cm thick of fine-grained, laminated, siliceous water-lain tuff with associated lapilli tuff at Katisha Lake is intercalated within the mafic flows and probably is derived from a distant felsic centre (Photo G1). Subgroup I has undergone little deformation. Bedding dips reported by Blackburn (1981, 1982) to be shallow near the Meggisi pluton are progressively steeper northward. According to pillow orientations, the whole mafic sequence is facing to the north.

Mafic Intrusive Rocks Within Subgroup I

In many places it is difficult to distinguish gabbro dikes and sills from coarse-grained interiors of extensive flows. Flow boundaries and intrusive contacts are seldom seen. A non equivocal feeder dike has been observed by the author about 1 km due south of Kawijekiwa Lake on the southern map boundary. The 2-3 m thick dike cuts pillow basalts at a high angle and carries a light coloured, felsic rounded xenolith. This xenolith is 20 cm long and exhibits sharp edges.

Two layered gabbro sills occur within the map area. One such sill is exposed at Katisha and Seggemak Lakes; it is 2.8 km long and has a maximum thickness of 600 m. This gabbro sill, here named the "Katisha Lake Gabbro Sill" displays mineralogical, textural and chemical variations across it. Table G3 lists macroscopic features from samples collected across the sill. Fig. G8 shows the chemical composition of the same samples. A 500 m thick, layered sill of undetermined length was traced discontinuously for 3.2 km within the map area southwest of the Katisha Lake Gabbro Sill. The timing of emplacement of these sills is not certain but because they have been metamorphosed and are found associated exclusively with basaltic rocks, they are here considered as being synvolcanic intrusions that have probably been emplaced during magma replenishment episodes.

Subgroup II

Overlying the mafic composite basalt-gabbro sills sequence is a thick, wedge-shaped north facing sequence of felsic pyroclastics. This felsic wedge tapers off at both ends at Kawijekiwa Lake in the west and near Bending Lake in the east (Blackburn, 1980). The exposed central portion o the sequence is approximately 2.5 km thick. The felsic volcanic rocks are considered by the author to belong to the Wapageisi Lake Group assuming that felsic volcanism took place during the final stages of mafic volcanism. There is no evidence of an unconformity between the mafic and felsic volcanics.

Subgroup II has been subdivided into four distinct formations:

Formation 1; the lowermost formation is composed of mafic to intermediate tuff, lapilli-tuff and tuff-breccia.

It has been further subdivided into two members.

Formation 2 is composed of intermediate to felsic lapilli tuff and tuff breccia deposits.

Formation 3 consists of felsic tuffs, crystal tuffs and lapilli-tuff.

Formation 4 -the uppermost unit, is composed of felsic to intermediate pyroclastics

Each formation is described separately below:

1) Formation 1 is divided into a basal unit: Member 1A, and an upper member, Member 1B.

Member 1A directly overlies subgroup I basalt.

Near the contact is a unit of fine-grained, thinly bedded, mafic to intermediate tuff, no more than several metres thick. In one location, south of Gawiewiagwa Lake it displays sedimentary structures characteristic of turbidites including graded bedding, laminations and soft sediment deformation such as load casts and flame structures. A similar occurrence has been found further west where subgroup II tapers out, near the portage linking Katisha and Kawijekiwa Lakes. Other fine-grained, mafic tuffs have been seen along strike between the two locations described. Member 1A has been traced discontinuously over 3 km; it is rapidly transitional upwards into Member 1B.

Member 1B: It is approximately 150 m thick on average and 2500 m long within the map area, consists of lapilli-size to block-size fragmentals having a heterolithic composition. Intermediate, mafic and minor felsic clasts are set in a chloritic matrix (Fig. G3). It is worth noting that some more felsic clasts have inclusions of mafic fragments that present a thin reaction rim.

Formation 2 is characterized by intermediate to felsic lapilli tuffs and tuff breccias. Towards the bottom of the formation coarse fragmentals having a bimodal clast composition, with mafic and dacitic clasts set in a chloritic tuff, are found. This heterolithologic rock unit is overlain by lapilli-tuff and tuff-breccia with a more uniform dacitic composition. The clasts are commonly highly vesicular. Primary structures are uncommon: bedding, apparently dipping at a steep angle has been recognized in a few places near Kawijekiwa Lake. A strong foliation parallels bedding on the outcrop surface and clasts are highly strained. Two intermediate to mafic beds of limited lateral extent occur within the pyroclastics; one is situated just east of Kawijekiwa Lake, the other near the western shore of Stormy Lake. Formation 2 has been traced for 9 km within the map area.

Formation 3 directly overlies formation 2 and is well defined by its uniform character of dacitic to rhyolitic composition. The formation is thickest just south of Katisha Creek where it is 1,000 m wide. It tapers off at Kawijekiwa Lake and is gradational westward into coarser fragmentals of Formation 4.

The bulk of this unit consists essentially of crudely bedded crystal-tuffs, lapilli tuffs and lesser tuff breccia. At Kawijekiwa Lake, Gawiewiagwa Lake and south of Katisha Creek, the felsic tuffs are very homogeneous. They contain up to 80 percent sodic plagioclase and quartz crystals and commonly about 10% of quartz-feldspar porphyry fragments set in an aphanitic sericite-rich matrix. In the field the rock may be mistaken for a porphyritic intrusive rock or a coarse sandstone, however the presence of angular rock fragments having in places a slightly different composition possibly argues against the first interpretation and the freshly broken aspect of the crystals does not support an intrusive nor an epiclastic origin. Coarser fragmental rocks of the same composition as the crystal-tuff, including rhyolitic breccia, occur at Gawiewiagwa Lake. The tuffs at Gawiewiagwa and Kawijekiwa Lakes may represent a ignimbrite sheet, following the arguments by Sparks et al. (1973). The very high crystal concentration in the tuffs can be achieved by a mechanical concentration process which takes place during the explosive emanation of a pumiceous lava (Walker, 1972).

Formation 4 is at the same stratigraphic level as formation 3 although its lithologic make up is somewhat different. The thickest part is probably along the western shoreline of Stormy Lake where the formation is 2500 m wide on surface. Along strike it can be traced outside the present map-area for about another 7 km to the southeast. Formation 4 is composed mainly of dacitic to rhyolitic tuffs, lapilli-tuff, tuff-breccia and pyroclastic breccia. In the upper part of the formation, just west of the straight connecting Snake Bay to Stormy Lake, a unit of slaty mafic tuff with lenses ranging up to 80 cm in thickness of magnetite-chert iron-formation is interbedded with the felsic rocks. Chloritoid bearing felsic tuffs of slightly more mafic appearance are exposed on the western shoreline of Stormy Lake along strike with the iron-formation. The chloritoid appears as closely spaced, black tabular crystals 1 mm in size. At the straight between Snake Bay and Stormy Lake is a zone of rocks with a pronounced schistosity steeply dipping to the south. The felsic sericite schist exposed on the shoreline has a waxy luster and a yellow to pink colouration; away from the straight, clasts in felsic breccias have been considerably elongated and flattened. "Z" type mesoscopic drag folds indicate that the shearing was right-lateral. Formation 4 is pervasively and strongly foliated in a NW-SE direction with an average dip of 60°S. The strong planar fabrics have somewhat obscured bedding structures. Where recognizable, however, the bedding trace on surface parallels foliation. Several bedding attitudes in sediments in the lower part of the Stormy Lake Group show a similar dip to foliation which suggest that the beds have been overturned.

According to the presence of turbiditic structures at the base of subgroup II and the presence of iron-formation at the top, it appears that the volcanic deposits making up subgroup II have been deposited under water, however it is possible that much volcanic material has been erupted subaerially. Many fragmental units and particularly the heterolith types may represent debris flows and lahar deposits.

The Stormy Lake Group

The Stormy Lake Group (Blackburn, 1982) is a 3,000 m thick north facing sequence of epiclastic and pyroclastic rocks and minor flows overlying the Wapageisi Lake Group and was included as part of the Manitou "Series" by Thomson (1933). Because the Stormy Lake Group is separated from the Manitou Group by the Taylor Lake Intrusion and because relationships across it are not clear, Blackburn (1982) divided Thomson's Manitou "Series" into two distinct groups. A wide range of distinctive, mappable lithologies have been encountered. The various pyroclastic and epiclastic rocks of the Stormy Lake Group differ in their physical characteristics but are genetically interrelated as presented in Table G4. The Stormy Lake Group has been subdivided into five facies based on the nature of deposits and environments of deposition. Each facies is described below and summarized in Table G4.

Facies I, a mainly pyroclastic unit, lies mostly beyond the western boundary of the present map area, and has been described by McMaster (1978) who subdivided this assemblage into six facies units:

Facies F: Argillaceous rocks at Washeibemaga Lake.

Facies E: Autoclastic breccia

Facies D: Quartz porphyry (Thundercloud Lake subvolcanic intrusion)

Facies C: Coarse pyroclastics

Facies B: Laharic breccias and related sediments

Facies A: Dacitic and rhyolitic flows

Only McMaster's facies B and C are continuous within the present map area; Facies B and C have been recognized by the writer to be largely composed of epiclastic, heterolithic and volcani-clastic conglomerates. Both McMaster (1978) and Thomson (1933) point out the difficulty in distinguishing between pyroclastic and epiclastic rocks. From field relationships, it appears that pyroclastic deposits representing a felsic vent related to the Thundercloud porphyritic intrusion, occur west of Washeibemaga Lake and conglomerates to the east of this lake. A wide zone of interfingering units of poorly reworked rocks that were directly shed from the flanks of the felsic vent and more reworked distal debris form a transitional zone. In this transition zone, rocks occur that contain both angular and well rounded fragments

(Figure G4). Thus McMaster's (1978) parts of facies B and C that lie to the east of Washeibemaga Lake have been respectively included in Facies II and III in this report, and only the rocks mapped by Blackburn (1981) and McMaster (1978) as pyroclastic mostly to the east of Washeibemaga Lake have been considered as Facies I. McMaster's Facies F, mapped by Blackburn (1981) as sediments is considered by the author to be part of facies III.

The differences in interpretation among workers coupled with the fact that the boundary separating Blackburn's (1981) mapping and the present map area straddles a zone of lithological transition have resulted in a conflicting correlation in parts of the Stormy Lake Group. McMaster's Facies D refers to the Thundercloud Lake porphyry stock (Blackburn 1982) that intrudes the top of the Wapageisi Lake Group at Thundercloud Lake. The stock is considered to be a subvolcanic equivalent of adjacent felsic autoclastic and pyroclastic rocks (McMaster, 1978). Only apophyses and dikes projecting radially from the stock and cross cutting mafic volcanics of the Wapageisi Lake Group are exposed within the present map area. The dikes have a similar composition as the stock which is composed of quartz and alkali feldspar phenocrysts set in a felsic fine-grained matrix. Detailed descriptions of the stock are in McMaster (1978); Blackburn (1981) and Kresz (1984a). Among the pyroclastic rocks exposed, within the map area, is a thin wedge 100 to 300 m wide north of Seggemak Lake that extends further west. The wedge is composed of rhyolitic intrutelluric crystal tuff with quartz and alkali feldspar crystals. The tuff resembles a quartz porphyry and probably has a similar composition to the Thundercloud Lake porphyry. It is strikingly similar to the tuffs of formation 3 in subgroup II of the Wapageisi Lake Group.

Facies II has been divided into two subfacies with a gradational contact. It is 300 to 400 m thick north of Seggamak and Katisha Lakes, but thickens rapidly at Kawijekiwa Lake forming a lens shaped body 1,500 m wide at Gawiewiagwa Lake, that thins out at Snake Bay. Facies II is a unit of conglomerates with a high variety of clast lithologies, and interbedded lenses and beds of lithic arenite.

Subfacies IIa, situated north of Seggemak and Katisha Lakes is 150 to 300 m thick and 2.5 km long. It consists of matrix-supported conglomerates and lithic arenites with pebble beds. The conglomeratic units display a large variety of clast types and sizes. They range from 1 mm to 15 cm; the larger clasts are generally well rounded while the smaller ones are angular. 90 percent of all clasts are of volcanic origin ranging from rhyolite (white) to basalt (dark green). Vesicular and porphyritic types are common. Quartz porphyry clasts, based upon petrography are believed by the author to be derived from the Thundercloud porphyry and its volcanic equivalents. Clasts of red jasper, vein quartz, and schistose types of probable volcanic origin (Photo G3) are also present. The matrix of the conglomerates is chloritic with 5% or less sand size grains. Bedding is clearly visible within the sandy parts of subfacies IIa and is marked by changes in clast sizes, pebble beds and cross-beds. Subfacies IIa has been interpreted as river and channel deposits related to the margins of an alluvial fan (Kresz, 1984a).

Subfacies IIb represents the bulk of facies II. It is easily distinguished from the overlying conglomerates of facies III by virtue of the wide variety of clast types making up the conglomeratic units. Primary structures observed in the sandy beds and lenses between the conglomerate are bedding, large scale cross-beds, scour marks and pebble beds (Photo G4). The base of subfacies IIb consists mainly of volcaniclastic conglomerate with subangular to well rounded clasts ranging up to boulder-size. Most clasts are felsic to intermediate, but they seldom bear visible quartz and are commonly highly vesicular to pumiceous. A large number of these clasts are spotted with dark green chlorite masses that are probably degraded pyroxene or amphibole phenocrysts; no similar source rocks have been observed in the Wapageisi Lake Group; moreover, mafic fragments are relatively uncommon and rarely exceed 10% of the total clast content. The more felsic, i.e. rhyolitic clasts are commonly green from the presence of fuchsite.

The volcaniclastic part of subfacies IIb, containing few exotic clasts grades upward into conglomerates with a large variety of clast types (Photo G5). Among clast lithologies are: volcanics (large compositional range), jasper, jasper-magnetite and chert magnetite ironstone, porphyry, various granitic rocks (some with blue quartz), vein quartz and conglomerate. Clast sizes range up to 1 m in diameter. Clasts with light coloured weathering rinds up to 5 cm thick are common, particularly near the base of facies II (Photo G6) this provides supporting evidence that the sediments were deposited in a terrestrial environment. The conglomerate is mostly clast supported; in the volcaniclastic parts, the matrix consists of tuff and volcanic fragments whereas in the highly polymictic parts the matrix is more sandy with up to 15% angular to well rounded quartz grains; other components are feldspar and lithic fragments. In the arenite beds a higher degree of maturity has been achieved through sorting, probably by water in channels on the slopes of an alluvial fan. Quartz grains make up 30% of the rocks, the rest being dominated by lithic fragments of volcanic origin and feldspar.

Bedding attitudes west of Kawijekiwa Lake trend consistently east-west, however in the thickest part of the facies, the bedding parallels the outline of the bulge of subfacies IIb. Dips range from 60°N to 90°. Foliation and bedding trends are in most places at an angle such that the NW-SE foliation intersects the NE-SW bedding in the western part of the bulge at high angles and the NW-SE bedding in the east side of the bulge at a lower angle.

Facies III. This facies conformably overlies facies II and consists mainly of coarse, reworked pyroclastic rocks and volcaniclastic conglomerates. This facies is over 2,500 m thick at Washeibemaga Lake. The lower contact is marked by a abrupt decrease of exotic clasts in the conglomerate and a net increase in volcanic clasts. This increase in the volcanic character of the clasts is preceeded in three places by rhyolitic, vent facies lapilli-tuffs and in one place just south of a round pond, 500 m north west of Kawijekiwa Lake, the breccias are overlain by a 2 to 4 m thick layer of well-bedded air-fall tuffs that show a compositional layering. The tuffs are in turn overlain by conglomerate with well rounded clasts and arenite beds displaying large-scale cross-stratification.

Within facies III the degree of reworking of the clasts is highly variable. In some exposures subangular to subrounded clasts predominate, elsewhere well rounded shapes prevail. Most volcanic clasts weather white on surface and are of andesitic to dacitic composition. The degree of vesicularity of the fragments varies from 0 to 50%. In most places, the composition of clasts is uniform, however, some exposures reveal more diversified types and in one place near Dark Horse Lake individual pillows have been found within the conglomerate. Exotic clasts including granitic rocks, ortho to quartz-arenite, jasper-magnetite-iron-formation and quartz-feldspar porphyry occur and admixed with the volcaniclastic material but never exceed 1 to 2% of the total clast content. A slight increase in these exotic clasts has been noticed towards the top of facies III, just south of Snake Bay. In most cases sorting is very poor, and clast sizes range up to 1 m in diameter. In the west the conglomerates have high clast to matrix ratios whereas this ratio decreases in the east where the thickness of facies III pinches out. As the clast abundance decreases eastward, sandy units up to several tens of metres become abundant, showing well developed bedding and large-scale cross-beds. In one location, about halfway between Gawiewiagwa

Lake and Snake Bay along a north trending line, a large exposure shows alternating beds of lithic arenite up to 1 m thick and thinner wacke-rich layers with a faint size grading. The arenaceous units of facies III in general consist predominantly of lithic volcanic fragments and feldspar, these form the matrix to the conglomerates in the east whereas in the west interclast material is mainly tuffaceous material or very immature lithic arenite. South of Dark Horse Lake, abundant 2-3 mm quartz grains occur within the conglomerate, probably derived from weathering of the Thundercloud porphyry and its derivatives. This is supported by the presence of felsic clasts with a fuchsitic green colouration which also are found in facies I. Cobbles and boulders displaying weathering rinds as in facies II are present.

Bedding structures within facies III strike east-west to NW-SE. Foliation of the rocks is in a NW-SE direction near Snake Bay but becomes East-West towards Washeibemaga Lake.

Several single basaltic flows have been delineated within facies III east of Dark Horse Lake. The flows are several tens of meters thick, up to 1000 m long and are characterized by aboundant amygdules of sugary white quartz and brown ankerite. In two places lava toes were formed by subaerial flows entering small bodies of water as represented by pillow-like forms.

Facies III has been interpreted as an overlapping alluvial fan drapping over facies II that has formed following an episode of intermediate to felsic volcanism (Kresz, 1984a).

Facies IV is a maximum of 2,000 m thick and consists of arenite, siltstone, wacke and argillite. These rocks are exposed along Snake Bay and Stormy Lake over a distance of over 10 km. In the west facies IV conformably overlies facies III but the nature of the transition is vague due to poor exposure. At Stormy Lake it directly overlies the felsic volcanics of subgroup II of the Wapageisi Lake Group, but the contact is all underwater. The best exposures are at Stormy Lake where outcrops along the shoreline display thick beds of lithic arkose, feldspathic litharenites, wacke and argillite. The arenites generally contain up to 40% quartz and 60% white feldspar, lithic fragments and matrix. These rocks are usually dark grey, coarse grained (0.5-2 mm) with angular grains, suggesting little reworking. Sandstone which contains more than 15 percent matrix is designated as wacke. Normal size grading is associated with them as well as turbiditic siltstone and mudstone beds. Only the A, B, D and E divisions of the Bouma (1962) cycle have been observed. Argillite beds ranging from 1 cm to several metres in thickness normally have well developed slaty cleavage. Garnets less than 1 mm in size have been found in an argillite and chloritic tuff near a granodiorite stock intrusion north of Snake Bay. In the central part of the map area, at Snake Bay, minor conglomeratic units occur as well as a small unit of limited lateral extent composed of rhyolitic crystal-tuff. In two exposures the tuff has a black colour; under the microscope the black colouration appears to be due to an ultrafine black substance disseminated in feldspar. According to chemical tests and X-ray diffraction on a black residue after hydrofluoric acid digestion of the rock by the Geoscience Laboratories of the

Ontario Geological Survey in Toronto, the black substance is finely disseminated elemental carbon.

Bedding in facies IV trends NW-SE while dips range from 60° to 90° southward. All top indicators (graded beds, cross beds) suggest the beds face north, implying overturning in most places. Foliation appears to be coplanar with bedding.

Facies IV has been interpreted to have been deposited in a submarine fan environment (Kresz 1984a).

Facies V. Southeast towards Bending Lake, the sediments are magnetite iron formation intercalated with arenites of probable distal turbidite origin (Trowell et al. 1980). This facies is exposed outside the map area.

Nature of the Contact Between the Stormy Lake Group and the Wapageisi Lake Group

The Stormy Lake Group directly overlies the volcanic rocks of the Wapageisi Lake Group although the contact itself has not been seen in exposure. The abrupt change in the west from marine conditions to terrestrial deposition leads to the assumption that a prolonged period of non-deposition and perhaps of weathering occured following uplift.

The Kawashegamuk Lake Group

The Kawashegamuk Lake Group and a large part of the Boyer Lake Group constitute the north limb of the Kamanatogama Syncline. The Kawashegamuk Group in a south-facing sequence of alternating mafic and felsic volcanic rocks that occur within the map area between Kawashegamuk Lake and the Revell Batholith and has a maximum apparent thickness of 7,000 m. From the geological compilation map (Blackburn, 1980) and from facing direction indicators (Satterly, 1960; this survey) the Kawashegamuk Lake Group is an east-west trending anticlinal structure whose axis straddles the northern boundary of the map area. Thus the north limb of the anticline is exposed in Satterly, Melgund, Revell Townships and perhaps beyond. On the other side, the south limb is continuous all the way to Kinmoapiku Lake. The anticline axis straddling the northern boundary of the map area is a significant structure in the area and the name of "Tabor Lake Anticline" is here proposed after Tabor Lake, the only named place near the axis. It appears that the Revell Batholith has been emplaced in the core of the anticline and therefore should be considered as an intrabelt pluton.

The Kawashegamuk Lake Group is essentially a volcanic assemblage with minor sedimentary units near the Van Houten Mine. It may be subdivided into two units each of which is composed of a lower mafic volcanic part and an upper felsic part. Because of this cyclicity the units have been referred to as a lower Cycle I and an upper Cycle II. The lower mafic units are laterally continuous whereas the upper felsic units are discontinuous and marked rather by a net increase in felsic volcanic rocks over mafic ones. Individual felsic units occur more as discrete lenticular bodies.

Cycle I

The lower most part of the group consists of massive and pillowed, tholeiitic, aphyric basalts extending from Mennin Lake northward into Melgund Township and are apparently girdling the north side of the Revell Batholith. Near Mennin Lake the basaltic rocks interfinger with felsic rocks which are laterally limited by a wide lobe of the Revell Batholith. The basalts are fine-grained, dark green to almost black and are very hard. These basalts, have been subjected to amphibolite facies conditions aureole around the Revell Batholith; original textures and fabrics have been destroyed by recrystallization, and primary structures such as pillow selvages have been subdued. Within the map area the maximum thickness of the basaltic unit is 1,500 m near Church Lake. The felsic rocks overlie and in part are interfingered with the basalts. They consist of monolithic felsic tuffs, tuff-breccias, breccias an some massive types being possibly flows. This highly irregular unit digitates into overlying mafic rocks at high angles to the general bedding which suggests that the rocks have been tightly folded. This is further supported by the fact that bedding in epiclastic sediments and tuffs near the Van Houten Mine are also at high angle to the general bedding trend and that high bedding-foliation angles have been found. Near the Van Houten Mine, a wedge of epiclastic rocks of limited extent is intercalated between mafic and felsic rock units. The sediments consist of medium to coarse-grained, lithic arenite and wacke interbedded with siltstone, argillite and some narrow magnetite iron-formation beds. Bedding attitudes have been observed only near the Van Houten Mine where they are oriented in a NE-SW direction and have steep to vertical dips. Pods of gabbro intrude the volcanics in several places; one gabbro body is 6 km long and underlies Lowery, Church and Brown Lakes.

Cycle II

Cycle I is overlain by a thick unit consisting of intermediate to mafic lavas and small scattered interflow beds of pyroclastic rocks. The whole unit stretches across the map area in a NW-SE direction and continues into Satterly Township in the north and towards Bending Lake in the south. In the northern part of the map the unit is exposed over a width of nearly 5 km, in the south much of the lower part of cycle II has been removed by the Revell Intrusion and the mafic assemblage there is much narrower.

The rocks occur as massive and pillowed flows; while these rock types predominate, there are much more fragmental rocks than in the Wapageisi or Boyer Lake Groups. Chemically, much of the rocks classify as calc-alkalic basalts and andesites; some tholeiitic flows occur as well but they are not very common. The calc-alkalic rocks have commonly a grey to grey-green colour rather than the dark green colour of more iron-rich tholeiitic rocks.

In pillowed flows size and shape of pillows is variable. Large pillows up to 2 m are common. Pillow outlines in many instances have been modified by strain and as a result are flattened. In the northern part of the map area, near Tabor Lake pillows are relatively undeformed (Photos G 7, 8, 9). Lavas are commonly vesicular and large gas cavities up to 5 cm in diameter filled with white quartz or ankerite are commonly observed (Photo G9) in both massive and pillowed flows. The presence of such large vesicles may be indicative that the lavas were deposited in shallow water depths (Jones, 1969); this is further supported by the increased abundance of fragmental mafic rocks. Nowhere, however are there unequivocal signs of subaerial deposition. The nature of the mafic to intermediate fragmental deposits are varied, ranging from narrow interpillow or interflow tuff beds to horizons composed of tuff and breccia several tens of metres thick or perhaps more. Tuffs are commonly composed of hyaloclastic material that has formed upon quenching of lava by water. The fine-grained material was originally glassy and has been readily altered. Coarser fragments in hyaloclastite, pillow breccia and flow breccia are highly angular and commonly show quench structures which resemble a spider web like fabric. Massive breccias showing quench structures were found near Lee Lake and at Kawashegamuk Lake near Sandy Point Camp. A spectacular outcrop just west of the Kawashegamuk River and immediately south of Satterly Township displays pillows with peculiar shapes. The pillow outlines are due to lava that flowed over water logged ash layers; the high density contrast between ash and lava caused the lava to bud and lava toes intruded the ash displacing the soft subjacent layers (Photo G7). Several detached pillows with ameboid shapes occur within mafic hyalo tuff. Steam generation created gas pockets (now filled with quartz) in some pillows. Most pillows have an unexplained layering possibly created by a spalling effect during quenching.

Porphyritic basalts and andesites are common within Cycle II and some of them form traceable horizons such as "Formation P". It is defined as a band some 8 km in length along the eastern shoreline of Kawashegamuk Lake. In it, pillowed to massive basalts and andesites carry concentrations of up to 30% of small, white plagioclase phenocrysts, no more than 5 mm in size, or glomerophyric aggregates of plagioclase. Just east of Tabor Lake, pillow lavas contain white, felsic varioles set in a dark green chloritic matrix (Photo G8). Individual varioles increase in size up to 5 mm towards the pillow interior were they coalesce. Variolitic rocks at Tabor Lake have been observed over a strike distance of 2,500 m ("Formation V"). The varioles at Tabor Lake have been described in detail in Kresz, 1984a and have been interpreted to be the products of spherulitic crystallization in a cooling basalt glass (Kresz, 1984b). Numerous beds and lenses of felsic tuff, lapilli-tuff and tuff-breccia have a limited length and width and are intercalated between the mafic flows. Near Tabor Lake, to the east, minor turbiditic wacke and argillite, form a thin interflow bed that has been disrupted by the overlying flow. In one place fine-grained wacke and argillite has been "squeezed" between pillows (Photo G9).

The felsic portion of cycle II does not form a continuous unit like the basalt-andesite unit but rather constitutes a series of lenticular bodies of mainly pyroclastic rocks which interfinger with the basaltic-andesitic unit. Two large-scale felsic units have been delineated: the largest is exposed across Kawashegamuk Lake in the southeastern part of the map area and one lies at the west plunging closure of the Tabor Lake Anticline in the northwestern corner of the map area. Both units lie at the same stratigraphic level and may be part of two separate volcanic vents; they are overlain to the southeast by basalts of Boyer Lake Group.

The larger of the two felsic units is an assemblage composed of tuff, lapilli-tuff, tuff-breccia and breccia of andesitic to dacitic composition with minor rhyolitic rocks. A crescent shaped body of fine-grained, massive, rhyolitic rock girdles the north part of a quartz diorite stock south of Oldberg Lake and is interpreted to be a short rhyolite flow. South of the dioritic body is a quartz porphyry exposed over 400 m. It is 200 m wide and has also been interpreted by the author as a flow. The abundance of felsic rocks increases southward and the unit reaches a thickness of 2,500 m at the southern boundary of the map area. In the thickest part of the felsic unit, felsic pyroclastic rocks are interbedded with more mafic tuffs and lapilli tuffs some of which are feldspar phyric. Towards Sandy Point the felsic assemblage becomes narrower and thins out at the northern end of Kawashegamuk Lake; there the felsic rocks consist mainly of tuff-breccia and breccia some of which display quench structures.

The felsic unit in the northwest corner of the map area is folded in the Tabor Lake Anticline, thus forming a crescent shaped structure. At the southern limb of the crescent the rocks are felsic and have been intensively carbonatized and sericitzed, and many have a strong schistosity. These sericite schists have probably a dacitic to rhyolitic composition. At the northern boundary of the map area and at the concave side of the crescent monolithologic volcanic breccias with highly angular clasts occur (Photo G10). On surface the rocks are of a purple-brown colour with clasts being in some cases almost white. The matrix is of a dark purple or brown colour. The fresh rocks have a similar colour.

The rocks have been significantly altered and in places white quartz occupies interclast space suggesting silicification of the rocks. The strong alteration has cast uncertainty as to the original composition of the rock but pillowed rocks with similar colour on surface suggest that the breccias are of mafic to intermediate composition. Three analysed samples of breccia (K61, 62, 63) reveal a silica composition between 60 and 70 percent. These values may not be the original ones as the rocks have probably been silicified. Other values are Al_2O_3: 14.5 - 16.4; FeO (Total Fe): 1.8-5.7; MgO: 0.3-0.8; CaO: 1.3-2.4; Na_2O: 3.4-7.3; K_2O: 0.2-1.8; TiO_2: 0.24-0.6; MnO: 0.03-0.1; P_2O_5: 0.1-0.15.

The surface weathering greatly enhances textures and structures. Clasts within the breccia are of two types: one is angular with conspicuous quench cracks and has a white weathering colour, the other is angular and has been weakly welded onto other clasts. They have a purple colour on the weathered surface and probably were originally glassy. Most of the latter type are small and provide a matrix to the former kind. This large, hyaloclastite deposit, "Formation H", probably represents flows which have been brecciated during quenching. In many places the breccias have been strongly sheared and altered (carbonatized). Locally well stratified felsic tuffs occur among the breccias, confirming the bedding of an otherwise chaotic deposit. One spectacular outcrop within "Formation H" displays irregular pillows set in a darker, mafic matrix. A layering is defined by reverse size grading of pillows (Blackburn, 1982). A nearby outcrop shows pillows with a concentric layering (Blackburn, 1982).

The top of the Kawashegamuk Lake Group along Kawashegamuk Lake is marked by a 100 to 300 m thick unit of felsic pyroclastic rocks. At the north end of Kawashegamuk Lake is a 1,200 m by 300 m body of rhyolite porphyry with abundant quartz phenocrysts. This body probably represents a subvolcanic intrusion. The felsic pyroclastics along the contact of the Boyer Lake Group with Cycle II are schistose and units of felsic breccias show highly flattened clasts.

Gabbroic intrusions are few in cycle II. One differentiated sill has been traced for 5 km at the top of cycle II in the north western part of Kawashegamuk Lake. South of Oldberg Lake, two elliptical stocks of foliated quartz diorite intrude the volcanics. Because of their pretectonic origin and a similar chemistry to neighbouring extrusive rocks, they are considered to be related to volcanism. In the northwestern part of the map area, around Tabor Lake, a large number of dacite porphyry dikes and irregular stocks intrude the volcanics over a large area.

The intruded volcanic rocks are also altered (carbonatized, sericitized, silicified). The alteration, however, is not as strong and extensive near Tabor Lake as further to the west. The porphyry is altered in most places.

The Boyer Lake Group

The Boyer Lake Group (Blackburn, 1982) is a thick, monotonous sequence of massive and pillowed basalts folded in the Kamanatogama Syncline. Thickness is indeterminate due to folding and in the west this group is exposed over a much wider area than in the east. The relationship between the Boyer Lake Group and mafic volcanics at Dinorwic and Wabigoon Lakes remains unclear (Blackburn, 1980). The contact between the Boyer Lake and Stormy Lake Groups is faulted and sheared in the west but appears to be conformable in the east.

Within the present map area the Boyer Lake Group consists almost entirely of massive and pillowed tholeiitic basalt flows that are intruded in numerous places by gabbro sills. Pillows are commonly flattened, especially near the Kamanatogama Syncline, occur throughout and range from 0.5 to 1 m in size. Their rims have commonly carbonate filled vesicles. Pillow orientations have been used to determine the position of the Kamanatogama Syncline axis. The lavas are essentially aphyric but a few plagioclase porphyritic flows have been found near Aiabewatik Lake that may belong to a narrow single unit. Sparce plagioclase phenocrysts have also been seen between Stormy Lake and Kawashegamuk Lake. Variolitic basalts, being mostly pillowed have been observed at Shongwashu Lake, Boyer Lake and at the Snake Bay Road west of Aiabewiatik Lake. The concentration of varioles in the pillows increases inward and the varioles coalesce in the middle.

Most of the volcanics occur as massive flows or closed packed pillow basalts. In some places, particularly in the vicinity of Aiabewatik Lake, zones of abundant pillow breccia occur, however the are not very extensive. In the southeast part of the map area mafic tuffs and lapilli-tuffs have been found between Stormy Lake and Kawashegamuk Lake. In the northwest part of the map area, units of felsic and mafic fragmentals consisting of breccias (Photo G 11) and tuffs are found between the mafic rocks. In the southeast, at Stormy Lake, four units of sedimentary rocks interfinger with the basalts and straddle the Kamanatogama Syncline. The four units merge into one, southward (on the stratigraphic map these sediments appear as "Formation B"). The rocks are similar to sediments in facies IV of the Stormy Lake Group, and consist mainly of wacke with lithic and feldspathic arenite interbeds siltstone and argillite. Primary turbidite structures such as graded bedding have been observed. The interfingering of the sediments with the basalts on either side of the synclinal axis is interpreted as a structural repetition due to folding.

The Boyer Lake Group is intruded by numerous extensive gabbro sills that are up to several hundred metres thick and up to 8 km long. The thick sills are differentiated according to differences in texture and mineral composition. One such sill, the Gabbro Lake Sill at Boyer Lake, and lying just west of the map area has been studied by McMaster (1975) who found significant chemical and petrographic differences across. As in the Wapageisi Lake Group, the gabbro intrusions are related to Boyer Lake Group volcanism. In the northwestern part of the map area the volcanic rocks have been intruded by many felsic porphyry stocks and dikes which brought upon pervasive carbonatization of the rocks. Some of the rocks have been so altered that none of their original features remain.

As a whole, it appears that volcanism of the Boyer Lake Group was entirely effusive submarine. This interpretation is based on the presence of pillow lavas. A few felsic units in the northwest testify to sporadic, short lived, felsic, explosive volcanism.

Intrusive Rocks

1) Pretectonic Intrusions

a) Ultramafic Rocks

Ultramafic rocks are not common within the map area. Ultramafic volcanic rocks appear to be absent. A subhorizontal, several metres thick ultramafic dike is exposed in the road cut between Katisha Lake and Kawijekiwa Lake. An alkalic dike directly underlies the ultramafic rock. The rock is light green, soft and has a shiny waxy luster on a broken surface due to chlorite. A chemical analysis (sample W3) gave 18 weight percent MgO and 43.4% SiO_2 (these values are not adjusted to an anhydrous basis (LOI = 14.5%).

b) Gabbro Intrusions

Gabbro occurs mostly as sills which have been described for each of the lithologic groups underlying the map area. The sills are considered to be related to volcanism. Large sills, such as the Katisha Lake Gabbro Sill, are differentiated petrographicaly and geochemically (Table G3; Fig. G8). Some of the smaller sills may be mistaken as coarse grained flows.

A 12 m thick monzogabbro dike occurs at the contact between the Wapageisi Lake and Stormy Lake Groups. The dike probably belongs to the Wapageisi Lake Group as it cross cuts basaltic rocks. The rock consists of dark, shiny euhedral pyroxene about 5 mm in size and a lesser amount of 7 mm long laths of plagioclase. A chemical analysis (sample W7) reveals a high alkali content (Na_2O=4.8%, K_2O=1.96%). A clast of similar appearance within the conglomerate at the base of the Stormy Lake Group has been found and has a similar chemical composition (sample S4) to the monzogabbro dike except for lower MgO and somewhat lower Na_2O contents.

c) Lamprophyre

Lamprophyres have been found as isolated, narrow (<1 m) dikes within the Stormy Lake, Boyer Lake and Kawashegamuk Lake Groups. They occur as black, mafic and biotite rich rocks which weather more easily than the enclosing rock. In one dike at the northeastern shore of Kawashegamuk Lake, granitic xenoliths are present. Some lamprophyres are weakly foliated. The timing of emplacement in unclear and no volcanic equivalents have been found. Chemically analysed lamprophyre are W18, B17, B22, K39 (Table C1).

d) Alkalic (Syenitic) Dikes

Several east-west trending dikes near Katisha Lake and Seggemak Lake present a medium grained, pink to grey-pink rock. A several metre thick, subhorizontal dike underlies an ultramafic dike between Katisha and Kawijekiwa Lakes and is exposed at the road cut. Chemical analysis of the dike (sample W22) reveals an alkalic affinity.

e) Quartz Diorite

Two small stocks of foliated quartz diorite intruded the rocks at the base of the Kawashegamuk Lake Group near Oldberg Lake. The two bodies are 1 by 2 km and 1 by 0.5 km in size respectively, and are separated by a distance of only 1 km suggesting a likely connection at depth. The diorite occurs as a light to dark grey, medium-grained rock consisting of plagioclase, 5 to 30% amphibole and 2 to 10% modal quartz. The proportions of the various minerals is variable throughout, as well as the texture. These rocks are considered to be linked to volcanism mainly because of their similar chemical composition to the volcanics nearby.

f) Felsic Hypabyssal Rocks

A large number of porphyritic felsic dikes occur throughout the map area. The rocks are characterized by a very fine-grained quartzofeldspar assemblage with variable amounts of phenocrysts. These consist of quartz, alkali feldspar and in places biotite.

Quartz-feldspar porphyry dikes are common near Seggemak Lake where they are related to the Thundercloud Lake porphyry intrusion. They also occur throughout the Kawashegamuk Lake Group. Feldspar porphyry, a grey aphanitic rock with white plagioclase phenocrysts and in places small biotite crystals occurs as dikes crosscutting volcanic and sedimentary rocks. These dikes although not restricted to any specific area, are widespread at Stormy lake where they form a swarm in the middle part of the Lake, with dikes crosscutting rocks of the Wapageisi Lake, Stormy Lake and Boyer Lake Groups, and are dispersed throughout the Kawashegamuk Lake Group. Porphyry dikes are uncommon within the Boyer Lake Group north of Snake Bay.

In the northwestern part of the map area, the volcanic rocks from both the Kawashegamuk Lake Group and the Boyer Group have been intruded by numerous feldspar-quartz porphyry dikes and small stocks. The porphyry is grey when unaltered but in many cases it has been carbonatized and sericitized and appears as a light buff coloured rock. Petrographic examinations reveal a high feldspar phenocryst content in some of the rocks; these feldspar crystals are sericitized to some extent and commonly possess an overgrowth of clear albite and/or symplectic intergrowths of albite and quartz. Quartz phenocrysts are not very abundant and are always heavily embayed. As a result of CO_2 metasomatism, altered porphyries carry abundant ferroan carbonate rhombs.

2) Syn to Post-tectonic (Late) Intrusions

a) Quartz Diorite

A 2 km long, 200 m thick arcuate body of quartz diorite intrudes the basalts of the Boyer Lake Group in the southeast corner of the map area. It consists of a medium-grained, grey, massive and homogeneous quartz diorite. A contact aureole is present in the surrounding basalts.

b) Granodiorite

The most prominent post-tectonic intrusion is the Revell Batholith poking through central part of the Kawashegamuk Lake Group. The rock is a massive, coarse-grained, equigranular, light coloured biotite bearing granodiorite. The rock is exceedingly homogeneous throughout; no structures are present except numerous joints. A contact aureole girdles the batholith.

Four smaller granodioritic intrusions which may be part of a larger mass at depth, occur within the southern part of the map area. The larger of the four intrudes Facies IV of the Stormy Lake Group at Stormy Lake. Another body straddles the southern map boundary within subgroup II of the Wapageisi Lake Group. Two very small bodies occur in subgroup II and the Boyer Lake Group respectively. All four intrusions are composed by the same massive, equigranular granodiorite. Thermal aureoles have affected the rocks around the granodiorite.

c) Felsic Dikes

In a few places, quartz porphyry and feldspar porphyry dikes occur within the Revell granodiorite. One 4.5 m wide dike east of Mennin Lake consists of a strongly foliated, sericitized felsic porphyry containing alkali feldspar, quartz and muscovite phenocrysts. Small, 0.5 mm red garnet crystals are dispersed throughout the porphyry. The time of emplacement of the porphyry is not known but its sharp contact with the granodiorite suggests a later age.

Mineralized Veins

1) Quartz Veins

Numerous white quartz veins cut across various lithologies. Most of them are deformed and boudinaged. In the northern part of the map area, notably at Tabor Lake, the Van Houten Mine, Church Lake, Brown Lake and Lee Lake the veins have been mineralized with gold, silver and carry disseminated sulphides. Late stage quartz veins are associated with the Revell Batholith and are mineralized with molybdenite. At Katisha Lake, beside the Snake Bay road, a peculiar quartz vein of indeterminate width is stained green by fuchsite and carries disseminated pyrite. No gold was detected in one sample assayed by the Geoscience Laboratories of the Ontario Geological Survey.

2) Carbonate-quartz Veins

Veins consisting entirely of yellow ferroan carbonate and white quartz cross-cut basaltic rocks at Kawashegamuk, Stormy and Seggemak Lakes. These veins pinch out after short distances and are not over 2 m wide. Basaltic breccia with highly angular fragments commonly occurs within the vein. The surface weathers like a typical carbonate rock leaving a deep brown limonitic crust. Associated minerals may include fuchsite and pyrite. One brecciated carbonate vein 800 m east of Katisha Lake is mineralized with disseminated chalcopyrite. The following assay results on one sample by the Geoscience Laboratories, Ontario Geological Survey, are: Au = 0.12 oz/ton; Ag = 0.30 oz/ton.

Proterozoic

Geological activity in the general region during the Proterozoic was limited to the intrusion of NW-SE trending diabase dikes that are presumably related to the Keweenawan event centered around Lake Superior. No such dikes have been encountered within the map area but to the north, in Melgund Township, a 100 feet (30 m) wide dike has been traced and described by Satterly (1960). The dike cuts across the Revell Batholith and the diabase has a relatively fresh mineralogy. Several similar dikes, but somewhat narrower, have been mapped to the west in the Upper Manitou Lake area and are described by Blackburn (1981 and 1982). One such diabase dike has been dated at 1675 Ma (Wanless, 1970).

PHANEROZOIC

During the Phanerozoic the region went throughout a period of tectonic stability and erosion leveled the entire Superior province to a vast peneplain. Some areas likely did get covered with terrestrial sediments, however these deposits were then removed by the powerful scouring action of the Pleistocene glacier which in turn shed their load of transported detritus. These sediments were locally reworked by melt water, rivers and glacial Lake Agassiz to form outwash, river and lacustrine deposits.

Cenozoic

Quaternary

Pleistocene

The geologic features and deposits of the Pleistocene Epoch are all representative of the latest ice age (Wisconsin) with only fragmental evidence of earlier events (Zoltai, 1961). Three major types of glacial deposits have been recognized within the map area:

1) Moraine Deposits:

The scarcity of load carried by the glaciers did not favor the building of extensive moraines (Zoltai, 1961). Locally more elevated ground covered with boulders and shallow ablation till offers evidence of material deposited directly from the ice. South of Stormy Lake is a thicker cover of ground moraine consisting of sandy till (Roed, 1980a). A well developed terminal moraine extending from near the mouth of the Wabigoon River to Steep Rock Lake called the Finlayson moraine or Eagle-Finlayson moraine (Zoltai; 1961, 1965) is exposed just off the southwestern corner of the map area and is associated with the latest Patrician glacier (Zoltai; 1961).

2) Glaciofluvial and Outwash Deposits

Between the west end of Snake Bay and Washeibemaga Lake, a pronounced valley is filled with thick deposits of stratified sand and gravel (Photo G12). These deposits are limited in areal extent (Roed, 1980a) and have presumably been formed by rivers flowing between lobes of the wasting glaciers (Zoltai; 1961).

3) Glaciolacustrine Deposits

A broad area extending from the northern part of Kawashegamuk Lake to the Town of Dryden and beyond is covered with varved to massive clay and silt deposits which were deposited in glacial Lake Agassiz (Zoltai; 1961; 1965). Within the map area these sediments consist of clay and fine sand which on surface are grey to yellow. No sections were seen to confirm the nature of the stratification. In one place beside the Snake Bay road, numerous calcareous concretions with a boytroidal habit lie on surface of the clays; they are most likely of diagenetic origin. The area covered by the glaciolacustrine sediments offers less bedrock exposure probably because some of the lower rock knolls are draped with unconsolidated material. More over, the northwestern part of the map is underlain by an abundance of altered rocks which makes them prone to more rapid erosion.

Ice Movements

Flow directions of glaciers are determined mostly from grooves left behind on rock surfaces by the abrasive action of particles carried within the ice. Most striations and grooves found on polished rock surfaces are marks left by the last major ice advance from the northeast. Zoltai (1961) notes that striations made by earlier glacier movements are seldom found as the scouring action of subsequent glaciers obliterated most of the previous abrasion marks. Within the present map area the average out of 102 glacial striae measurements is 051.5° the extremes being 023° and 082°. Figure G3 shows the trends of glacial striaes depicted on a rose diagram. It is assumed that the ice was moving from a northerly direction in every case. Direction indicators such as shatter marks are rare. Local differences in striae trends may be due to the power that topographic features and bedrock structures had to deflect the flow direction of the ice.

For more information concerning the Pleistocene geology and glacial history of northwestern Ontario, the interested reader is referred to Zoltai (1961). The surficial geology of the present map area is also included in the Northern Ontario Engineering Geology Terrain Studies No.22, and 38 by M.A. Roed (1980).

Holocene

Following deglaciation, innumerable lakes remained in topographic depressions and organic-rich sediments probably accumulated at their bottom since the last glacier retreated from the region approximately 10,000 years ago (Prest, 1970).

Numerous areas are covered by muskeg around lakes, bordering streams and rivers and low lying areas. The muskegs, however are not extensive.

Structural Geology

1) General Structure

The overall structural grain within the Manitou-Stormy Lakes belt essentially parallels the outline of the belt. The rock stratigraphy, major folds and faults, and the general rock fabric all follow a similar trend. Within the map area a large number of facing indicators (pillows, graded beds in turbiditic sediments, cross beds) have defined two major folds about which the supracrustal rocks are folded. Steep bedding dips suggest a tight folding style. Lithological boundaries have become, during regional deformation, the locus of faults being represented by zones of high schistosity. The overall structural picture has been imparted by a single major tectonic event that was accompanied by metamorphism and granitic intrusion.

2) Folds

a) The Kamanatogama Syncline

The most important structure within the map area is the Kamanatogama Syncline (Blackburn, 1982) in which the Boyer Lake Group is tightly folded. The position of the axial trace has been ascertained from numerous pillow top determinations, graded bedding in turbiditic sediments and the trend of magnetic lines on the aeromagnetic maps. Bedding attitudes indicate that the interlimb angle at Stormy Lake is small but it gradually increases to the west. A folded gabbro sill at Noxheiatik Lake provides evidence in otherwise poorly bedded strata of a westerly plunge direction, but due to the great length of the fold the same plunge direction may not be maintained further east. The large distance over which the fold occurs suggests a shallow plunge. From bedding and foliation attitudes, orientation of stretched pillows and the fact that the north limb of the Boyer Lake Group in the west is much wider than the south limb, the axial plane is inclined steeply to the south. At Stormy Lake, formation B forks into four sedimentary fingers in the northern part of the lake which probably represent repetitions of a single sedimentary horizon by parasitic folding in the hinge zone. The Kamanatogama Syncline has been traced and described in the west by Blackburn (1981, 1982) and likely continues in the southeast towards Bending Lake. The distance over which the syncline extends from the Manitou Lakes Fault to Bending Lake therefore is in the order of 50 km. The Kamanatogama Syncline was earlier named by Goodwin (1965, 1970) the Mosher Bay Syncline but this name had to be discontinued because mapping by Blackburn (1981 and 1982) confirmed the fold to be further to the north, thus not underlying Mosher Bay.

b) The Tabor Lake Anticline

The second largest fold determined by means of facing indicators is a broad anticlinal structure that straddles the north map boundary and has been here named the "Tabor Lake Anticline". The curving of lithological units to the west implies a plunge in that direction. In the east, the core of the structure is intruded by the Revell Batholith. Only the south limb of the anticline is exposed within the present map area. A part of the north limb has been mapped by Satterly (1960). In the Van Houten Mine - Tabor Lake area, bedding and foliation attitudes at high angle to the regional trends suggest the presence of smaller-scale folds having been possibly induced by the tightening of the Tabor Lake Anticline. The lack of facing direction indicators and the lack of exposure coupled with insufficient mapping at a more detailed scale have not permitted the localization of these folds.

3) Faults

The fractures along which relative displacement took place may be classified into the following two types: (1) Faults that have formed along pre-existing weakness zones such as lithological boundaries and unconformities. These are represented by the Mosher Bay-Washeibemaga Lake Fault, a long zone of schistosity at Kawashegamuk Lake, and other schist zones along lithological transitions. 2) Faults that transect rock units at high angles and are apparently not associated with previous zones of weakness.

a) Mosher Bay-Washeibemaga Lake Fault

The Mosher Bay-Washeibemaga Lake Fault, defined in the west by Thomson (1933) and Blackburn (1981, 1982) on the basis of an angular discordance between the Boyer Lake Group and Manitou and Stormy Lake Groups, and highly sheared rocks along the contact

between these groups. Within the present map area, the fault is evidenced by the following features: 1) intense shearing in rocks along Washeibemaga Lake and Snake Bay. On the north shore of Snake Bay, a steep cliff in pillowed basalts displays a 0.5 to 1.5 m wide zone of highly strained rocks with a fine-grained, chloritic, and pulverulent gouge (Photo G13). The attitude of the shear is 090/65S. Pillows nearby are strongly stretched and have a subvertical plunging long axis. Rocks across Snake Bay within the Stormy Lake Group have also been highly sheared but the strain is more homogeneous than on the north shore.
2) The presence of small mesoscopic folds and crenulations with a northeasterly plunge of 45° at the top of the Stormy Lake Group and strong lineations plunging to the northeast at steep angles at Washeibemaga Lake.
3) The presence of steep hills and cliffs on the north shore of Snake Bay and Washeibemaga Lake coupled with the great depth of these lakes.

All these features progressively fade eastwards. Mapping to the west (Blackburn 1981, 1982) confirmed that the Mosher Bay-Washeibemaga Lake Fault ends abruptly against the Manitou Straits Fault; its eastern termination is undefined but weaker tectonic structures, fabrics and topographic relief suggest diminishing movement along the fault towards a point of zero-displacement. Blackburn (1982) and Kresz (1984a) independently reached the conclusion that the Mosher Bay-Washeibemaga Lake Fault is a thrust fault whereby the Boyer Lake Group has been thrusted over the Stormy Lake Group with increasing movement westward and reaching maximum offset against the Manitou Straits Fault.

b) Shear Zone Along Kawashegamuk Lake

A long northwest-southeast trending zone of strong schistosity with a poorly defined width due to the high pervasive foliation occurs at the contact between the Kawashegamuk Lake and Boyer Lake Groups. Along the southern shoreline of Kawashegamuk Lake rocks are very fissile and clasts have been strongly stretched and flattened defining a southwesterly lineation with an average plunge of 70°. In the northern most part of Kawashegamuk Lake pillow basalts have been highly strained, showing mineral lineations and stretched amygdules. The rocks display widespread horizontal jointing and tension gashes filled with carbonate. These rocks have also been pervasively carbonatized. Graphite and pyrite bearing schists along the southwest shoreline of Kawashegamuk Lake have been observed but no silified rocks have been seen there. The shear zone probably represents a thrust fault along which the Boyer Lake Group overrode the Kawashegamuk Lake Group.

c) Other Shear Zones

A zone of fissile sericite schists is present at the strait between Stormy Lake and Snake Bay. Numerous mesoscopic "Z" type folds and kink bands indicate a dextral motion. Other schist zones exist throughout the map area and have parallel trends to bedding: they represent bands of increased ductile deformation.

These zones are mostly present in areas underlain by rocks of low competency such as pyroclastic rocks and sediments. In areas of basalts and intrusive rocks, schist zones are narrower and occur mainly at contacts. Within the more competent intrusive rocks, deformation has produced a widely spaced fracture cleavage.

d) Cross Faults

NE-SW oriented faults are at high angle to strata and have been defined by airphoto lineaments along which lithologies appear to have been offset. Because of their consistent trend and high angle to fold axes they are considered to have been generated by transform mechanisms to dissipate differential deformation rates across major folds. They have not offset major shear zones within the map area.

e) Photo Lineaments

Examination of aerial photographs has revealed a large number of narrow linear depressions, many of which may be faults because of their similar trends to defined faults on the basis of shear zones and lithological offsets. The majority of lineaments are oriented in a NE-SW direction (Figure G2).

4) Minor Structures and Rock Fabrics

a) Joints

Joints are present everywhere within the map area, however they prevail in rocks with a low degree of anisotropy. Undoubtedly some of the older joints are related to major structures. Joint symbols on Maps P.2569 & P.2570 (back pocket) have been taken on sets of several parallel joints.

b) Minor Folds

Minor folds of mesoscopic size are few within the map area. One well developed isolated drag fold in a sandstone bed north of Gawiewiagwa Lake has been found. The low number of observed minor folds may be attributed to the lack of well developed bedding structures and possibly to the lack of horizontal sense of movement during deformation. Brittle folds such as kink bands are developed near shear zones in slaty rocks.

Crenulation bands have been seen in foliated clasts in conglomerate near the top of the Stormy Lake Group and are probably related to the Mosher Bay-Washeibemaga Lake Fault.

c) Miscellaneous Tectonic Structures

These include tension gashes found near shear zones particularly at Kawashegamuk Lake, and boudinaged quartz veins in the less competent greenstones.

d) Foliation and Lineation

During regional deformation, penetrative fabrics imparted by platy and prismatic minerals and lithic clasts were pervasively developed throughout the whole Manitou-Stormy Lakes Belt. Under the term foliation, are included schistosity, slaty cleavage, gneissosity and fracture cleavage. Truly gneissic fabrics i.e. banded, compositionally layered rocks, have not been found within the map area. In general, foliation is better developed in the felsic volcanic units and sedimentary rocks than in the mafic volcanics. This may directly be attributed to different rheologic properties of the various rocks. Both planar and linear fabrics are much better developed near faults and shear zones. Away from zones along which movement occurred, cores of relatively undeformed rocks are found. Intrusive rocks have a high degree of competency and are in many cases massive. In thermal aureoles near granitic intrusions, fabrics have been obliterated or subdued due to recrystallization. Syn-to-post tectonic intrusions do not show any fabrics. Generally speaking, foliation within the map area parallels the outline of the belt, bedding, and major structures; however in the northeast and north central part, foliation is at right angle to the regional grain.

Lineation has been imparted by prismatic minerals and by stretched bodies in heterogenous rocks. Varioles, clasts in conglomerate, lapilli and larger fragments in pyroclastic rocks, amygdules and pillows may impart a lineation in the rocks. Lineation is contained within the plane of foliation. Linear fabrics are well developed at the Mosher Bay-Washeibemaga Lake Fault, at the shear zone along Kawashegamuk Lake and within felsic pyroclastic rocks in the Kawashegamuk Lake Group. At Tabor Lake, stretched felsic varioles in pillow basalt define a subvertical lineation.

Unfortunately, many strain indicators such as pillows, can only be seen in two dimensions in the field and as a result in many places it is difficult to ascertain the presence of a linear component to the planar fabric.

Metamorphism

Three types of prograde metamorphic events have affected the rocks underlying the map area: (1) Regional dynamo-thermal metamorphism; (2) Post-tectonic, thermal metamorphism and (3) hydrothermal metamorphism. Dynamo-thermal metamorphism has affected all the rocks underlying the map area with the exception of post-tectonic granitic intrusions. Evidence for penetrative deformation resulting in planar and linear fabrics is ubiquitous. Basalts, andesites and their intrusive equivalents bear the typical mineral paragenesis of low grade metamorphism (Winkler, 1979) or greenschist facies. The characteristic assemblage in mafic rocks is:
albite-actinolite-clinozoisite/epidote-chlorite-titanite-quartz calcite-white mica (sericite).

In the vicinity of post-tectonic granitic intrusions, the rocks have been affected by a thermal metamorphic overprinting and near the Revell Batholith, the effects are noticeable as far as 1 to 1.5 km away from the greenstone-granodiorite contact. Smaller plutons at Stormy Lake display narrower contact aureoles. Contact metamorphic recrystallization under low stress conditions removed earlier fabrics and the rocks are typically massive hornfelses. The most distant thermal effect from granitic plutons has given rise to the albite-epidote hornfels facies of Winkler (1979) while closer to the plutons, hornblende is diagnostic and the mineral assemblage pertains to the lower hornblende hornfels facies (Winkler, 1979).

In the northwestern part of the map area, the volcanic rocks as well as the numerous feldspar-quartz porphyry stocks and dikes have been affected by pervasive hydrothermal metamorphism. The rocks have been carbonatized and in some places silicified. Numerous short shear zones have been most altered and possibly represent channels through which hydrothermal fluids have migrated.

The felsic rocks have undergone less alteration than mafic lithologies because of the higher stability of their mineral components during low grade metamorphism. As a consequence, most original textures have been preserved in those rocks. The common secondary product is white mica (sericite) from the degradation of feldspars. The epiclastic sediments, composed of volcanic-plutonic detritus, underwent the same type of alteration as the volcanics; labile rock fragments of mafic composition have reverted to chlorite, that forms a matrix to the more resistant grains in sandstones.

Petrography

An account on the distinguishing petrographic features of the principal rock types is presented in this chapter. All rocks except the late intrusive rocks have been metamorphosed and exhibit mineralogies stable under the conditions of pressure and temperature prevailing during the last major tectono-thermal event that affected most of the Superior Province.

i) Mafic to Ultramafic Rocks

a) Volcanic Rocks

The distinction between mafic volcanic rocks belonging to the four lithological groups of the Kawashegamuk Lake area is difficult on a petrographic basis. None of the original essential minerals are preserved and only relicts of plagioclase laths and phenocrysts remain (Photos G14, 16). In this section most basaltic and andesitic rocks consist of fine-grained, felted masses of chlorite, actinolite-tremolite, epidote, clinozoisite, albite, quartz, calcite and titanite. Calcic plagioclase phenocrysts and laths are degraded to fine-grained clinozoisite, albite, quartz with in places, appreciable amounts of epidote or chlorite. Primary textures are preserved only in the least deformed rocks. In such rocks, plagioclase relicts ophitically enclosed in a mesostasis of mafic minerals now degraded to chlorite and actinolite are commonly seen (Photo G15). Ultra-fine-grained textures in which individual minerals cannot be identified, probably represent originally glassy material commonly found in pillow rims, hyaloclastite and variolitic pillows (Photo G8). Pyroxenes and olivines have lost their original outlines and have been replaced by low temperature ferromagnesian minerals. Accessory phases including magnetite, ilmenite, titanite, apatite and zircon have commonly retained their original habit (Fig. G16). Ilmenite has degraded to fine-grained leucoxene (Fig. G16). Basaltic and andesitic rocks near the margin of late stage syn-to post-tectonic granitic plutons are characterized by higher grade metamorphic mineralogies and textures. These rocks are found at the contact of the Revell Batholith and around the smaller intrabelt plutons at and near Stormy Lake. The aureole around the Revell Batholith is well developed and can be perceived at 1.5 km away from the contact. Three zones within the thermal aureole have been distinguished petrographically:

1) Rocks in the outer part of the aureole (1,500 to about 700 m away from the intrusive contact) carry actinolite recrystallized to green pleochroic hornblende. Slender amphibole and biotite needles impinge into clear recrystallized albite and quartz. Xenoblastic epidote has recrystallized to idioblastic grains of epidote and clinozoisite and biotite has grown from chlorite.

2) Rocks situated near the contact (100 to about 700 m) have similar mineralogies as above, however green hornblende has recrystallized into idioblastic columnar crystals. Plagioclase has recrystallized to clear albite and biotite crystals are well developed.

3) Rocks closest to the contact (less than 100 m) have a granoblastic, polygonal texture (Fig. G17). Primary textures are completely destroyed. The assemblage consists of hornblende-plagioclase, quartz, epidote and biotite. Plagioclase is clear and has sharp polysynthetic twins. Occasional xenoliths enclosed in granodiorite show the same mineralogy.

Rocks which have undergone contact metamorphism are characterized by a dark green to black coloration in hand specimens and are harder than the normal greenstone. Mafic rocks metamorphosed under regional greenschist facies conditions and belonging to cycle II of the Kawashegamuk Lake Group may be distinguished from the ones in other groups by the lighter coloration ranging from greyish-green to light grey. This is due to a lower content of Mg-Fe rich minerals and higher contents of clinozoisite and albite. Many such rocks have been found to be andesites from chemical classification. Several horizons in the dominantly calc-alkalic Kawashegamuk Lake Group, for example "formation P", carry up to 30% white plagioclase phenocrysts not exceeding 5 mm in size visible in hand specimen, and sometimes glomerophyric aggregates. Feldspar phenocrysts have also been observed elsewhere in tholeiitic flows and mostly within the Wapageisi Lake Group where porphyrytic horizons have been traced discontinually for distances up to 10 km along strike (Blackburn, 1982). The phenocrysts occur as white degraded crystals larger than 5 mm and commonly attaining 3 cm.

In the northwest part of the map area, basaltic rocks have been substantially altered by late hydrothermal activity (see Maps P.2569&70, back pocket). Depending on the degree of alteration, rocks may have retained relict and typomorphic textures, however superimposed textures have in many cases replaced original textures especially in and near shear zones. Up to 1.5 mm rhombs of erroan carbonate which weathers to goethite on surface, embay earlier minerals throughout the altered zone. The carbonate rhombs are more concentrated near small fractures. The amount of carbonate varies from a few percent to 50 percent. Feldspars have been variably altered to fine-grained muscovite but have commonly retained the original crystal outline. Relict textures are more common in coarse grained rocks. Where alteration is pervasive, recognition of the original rock type is nearly impossible, except by macroscopic features such as pillow selvages and amygdules.

b) Mafic Intrusive Rocks

The distinction between coarse-grained mafic flow interiors and mafic intrusive rocks is in some cases difficult to make in handspecimen and thin section. Minor mineralogical and textural differences, however, can be observed. The common amphibole is a pale blue-green pleochroic ferro-actinolite which is either the fibrous variety (uralite) or less commonly centimetre scale long, twinned, columnar crystals penetrating other minerals. Accessory minerals are those encountered in basalts but at Kawashegamuk Lake a gabbro sill displays a layer containing up to 20 percent ilmeno-magnetite that has been traced for 3,300 m. Such layers enriched in certain minerals are characteristic of differentiated sills. One such sill, the "Katisha Lake Gabbro Sill" displays variation in mineralogy and texture across thereby reflecting original compositional layering (Table G3). In thermal aureoles, gabbros have been affected in the same manner as basalts.

c) Ultramafic Rocks

Ultramafic rocks are rare within the map area. One dike between Katisha Lake and Kawijekiwa Lake has been classified as ultramafic based on its chemical composition (sample W3). The secondary mineral assemblage consists principally of chlorite, carbonate and minor quartz.

ii) Intermediate to Felsic Volcanic Rocks and Related Hypabyssal Rocks

Under the microscope the more felsic volcanic rocks reveal a dominantly quartzofeldspathic composition with alkali feldspar prevailing and variable amounts of ferromagnesian components such as chlorite, actinolite, iron oxides. Mineral degradation in least deformed rocks is not as pronounced as in the mafic types and as a result igneous and clastic textures are well preserved. The main alteration products are albite, sericite, clinozoisite, epidote and quartz for felsic rocks. Foliated rocks underwent a higher degree of alteration and highly strained types due to their high fine-grained white mica content are sericite schists. These schists are characterized by a light yellow to green colour, waxy luster and a strong cleavage.

Felsic porphyry dikes and stocks have in many cases well preserved original mineralogies and igneous textures because of their relative impermeability to fluids. The porphyries consist of phenocrysts of feldspar, quartz, and in places, biotite set in a very fine grained quartzofeldspathic matrix. Plagioclase phenocrysts are commonly zoned in an oscillatory manner with the more calcic cores and zones showing an increased alteration over the more sodic feldspar. Polysynthetic albite and pericline twins as well as Carlsbad twins are common. Potash feldspar phenocrysts have been occasionally seen in highly felsic rocks such as in the Thundercloud Lake Porphyry Stock where microcline after orthoclase has been observed, or in perthitic intergrowths with albite. Quartz phenocrysts are commonly encountered as euhedral crystals with embayments. The high temperature polymorph type has not been observed.

Accessory minerals are apatite, titanite, iron oxide and pyrite.

iii) Alkalic Rocks

a) Syenitic Rocks

Syenitic rocks found in a few places as narrow dikes consist essentially of alkali feldspar, mainly albite. Dark spots of actinolite are seen in some dikes.

b) Lamprophyres

Lamprophyric rocks are recognized by their high biotite content; plagioclase phenocrysts are present in non-altered dikes. Altered types consist of chloritized biotite, carbonate, epidote, albite and quartz. In hand specimen these rocks are black or dark brown and have a medium-grained texture.

iv) Late Intermediate to Felsic Plutonic Rocks

Within the map area these rocks are represented principally by an equigranular, coarse-grained, massive granodiorite seen in the Revell Batholith and in small intrusions at Stormy Lake. The original mineralogy of the granodiorite is well preserved. The main constituents are plagioclase, commonly zoned in an oscillatory manner, potassium feldspar present as microcline and as perthitic intergrowths with albite, quartz, biotite and the minor constituents such as muscovite, epidote, apatite, titanite and zircon. Hornblende xenocrysts have been observed near the contact of the Revell Batholith.

Petrochemistry

1) Introduction

A total of 180 rock samples collected within the map area have been analyzed for major element oxides. 95 samples have been analyzed for trace elements. In addition, 47 samples have been collected and analyzed by Blackburn in 1977 for the Savant Lake - Crow Lake regional study (Trowell, et al. 1980). Most samples were selected from least deformed and altered rocks to avoid types in which elements have been lost or introduced during metamorphism. However a few altered samples have been collected for the purpose of checking the degree of mobility of various elements. Table G5 shows elemental variation in two rock types: G5a gives three analyses across 2 pillows from subgroup I, Wapageisi Lake Group. G5b shows analysis from samples taken across a gabbro exposure with a variable degree of alteration. The results suggest that some elements, e.g. Na, K, Ca, Si, Mg, Ba, Sr are mobilized more easily than others e.g. Al, Ti, P, Zr and the rare earth elements, but that under drastic alteration conditions (samples W10 (selvage), W20 (selvage), B41C, all elements have been affected to a significant degree. The present amount of total volatile content, determined as LOI, and mostly H_2O and CO_2 is certainly not representative of the original content but nevertheless all calculations and variations diagrams have been done on a volatile free basis.

Analyses were carried out by X-ray fluorescence and atomic absorption spectrophotometry at the Department of Geology at Brock University. The data is tabulated in Appendix B. Precision and accuracy for the various elements is given in appendix C. Analytical details are presented in Kresz (1984a).

The geochemical data is here used to show the major differences in chemistry of the various lithologies within the map-area[1]. In Kresz (1984a), the data is also used in the discussion of a genetic model in light of current knowledge on magma generation, and concepts on Archean volcanism. Furthermore, rare-earth elements data is presented and discussed for each lithologic group.

2) Major Rock Groups: Subalkalic and Alkalic Rocks

Sampling of rocks for chemical analyses was carried so as to include most lithologies encountered in the field. All chemically analyzed rocks have been first classified into the two broad groups of rocks defined by Chayes (1966) as the subalkalic and the alkalic rocks, depending whether the rocks are undersaturated or supersaturated. These terms are used here as suggested by Wilkinson (1968) to include both the tholeiitic and the calc-alkalic basalt series. The alkalies versus silica diagram (McDonald, 1968) is here used to distinguish between

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1 Because subgroup I of the Wapageisi Lake Group is poorly represented within the map area as only the upper part is exposed, chemical data from the Starshine Lake geochemical traverse (Blackburn, 1982), which is situated tothe southwest of the area discussed in this report, have been used to

subalkalic and alkalic rocks because it makes direct use of the analytical data Fig. G4. It may be readily seen that all rocks fall within the subalkalic field with the exception of a syenite dike at the top of the Wapageisi Lake Group near Katisha Lake. Samples A 8 and B20 have probably been depleted with respect to silica. The other rock types that fall short of the divider are the lamprophyric rocks. Thus it appears that alkalic rocks of extrusive origin are apparently inexistent within the map-area.

3) Distinction between Subalkalic Rock Series: The Tholeiitic and Calcalkalic Rocks

Within the map area, the subalkalic rocks fall within two series which underwent distinct differentiation trends: one is represented by an iron-enrichment trend (tholeiitic), the other is characterized by continuous iron-depletion (calc-alkalic) throughout differentiation of magmas. In this report, the classical $Na_2O+K_2O-FeOt-MgO$ (AFM) ternary diagram is used in distinguishing the two series, in the manner adopted by Irvine and Baragar (1971). Figure G5 depicts the volcanics of the four major lithological groups composing the Kawashegamuk Lake area on AFM plots. The essential characteristics of the volcanics for each group are also featured in MgO variation diagrams shown in Figures G6 and G7 which are used in continuation with the AFM ternaries. The principal geochemical features of each group are as follow:

a) The Wapageisi Lake Group

On the AFM ternary diagram, the Wapageisi Lake Group basalts clearly show a progressive increase in the FeOt/MgO ratio with stratigraphic height. On the MgO variation diagram (Figure G6) it can be seen that the lower part of the group is more magnesium-rich than the upper part. Despite this fact, ultramafic lavas have not been reported within the Wapageisi Lake Group (Blackburn, 1981, 1982). Iron enrichment is faint. Al_2O_3, TiO_2, SiO_2 and Na_2O show a slight enrichment however CaO, K_2O, MnO and P_2O_5 remain unchanged. Variation of the trace elements with MgO is not conclusive due to lack of data. Ni shows a well defined positive correlation with MgO.

On the other hand, felsic rocks of subgroup II cluster on a trend of continuous iron-depletion on MgO variation plots; they cannot be distinguished from other felsic rocks in the area.

b) The Kawashegamuk Lake Group

The AFM diagram reveals both tholeiitic and calc-alkalic rocks. Mafic rocks from cycle I fall into the tholeiitic field while mafic lavas from cycle II fall predominantly within the calcalkalic field and along a trend of continuous iron-depletion. The felsic rocks of both Cycle I and II fall along the same trend. A significant gap occurs along the trend indicating a bimodal composition of the volcanics. The silica-frequency plot in Figure G10 further supports this argument. The gabbroic rocks fall onto a well defined tholeiitic trend typical of differentiated mafic intrusions. Compositions of the foliated quartz diorite stocks south of Oldberg Lake is similar to andesitic rocks within the Kawashegamuk Lake Group. On the MgO variation diagram, the Kawashegamuk Lake Group is readily distinguishable from the other groups. FeO, TiO_2, MnO, and CaO are continuously depleted during differentiation while SiO_2, Na_2O and K_2O are continuously enriched. Al_2O_3 follows a trend of enrichment but in the felsic spectrum it becomes rapidly depleted due to separation of plagioclase. Variation of the trace elements is such that Ni, Cr, Cu, Zn, V, become depleted with increasing differentiation (positive correlation) while the incompatible elements Ba, Rb, Zr became strongly enriched in the melt.

c) The Boyer Lake Group

On the AFM diagram, the Boyer Lake Group basalts cluster in a narrow compositional range within the tholeiitic field. The basalts may be classified as iron-rich tholeiites compared to Wapageisi Lake Group basalts that are more magnesian.

On the MgO variation diagrams, the iron-enrichment of the Boyer Lake Group is distinct from Wapageisi Basalts; TiO_2 and MnO are enriched similar to FeO. The Boyer Lake Group basalts are somewhat less enriched in Al_2O_3 and CaO probably because the plagioclase component is lower, having been separated through differentiation unlike Wapageisi Lake Group basalts which show distinct plagioclase phyric horizons. Na_2O, K_2O, P_2O_5 are enriched with respect to Wapageisi basalts but the silica content is similar. From these observations it is concluded that the Boyer Lake Group is chemically more evolved than the Wapageisi

Lake Group. No distinctive trend has been obtained on the trace element variation plot on Figure G7.

d) The Stormy Lake Group

The Stormy Lake Group is essentially an epiclastic sequence. Compositions of 12 analyzed clasts fall within a large area in the calc alkalic field (Kresz, 1984a), indicating that the Stormy Lake Group is essentially an accumulation of debris shed from central type volcanic edifices with admixed clasts from an older sialic hinterland that is nowhere exposed at present.

One sample from a basaltic flow within the conglomerates plots in the calcalkalic field and classifies as a basaltic andesite. Its chemical composition is quite distinct from other rocks in the map area.

e) Petrochemical Variations Across the Katisha Lake Gabbro Sill

A geochemical sampling traverse was made across one of the thicker gabbroic sills within the map area and a suite of 15 samples were taken along the north shoreline of Katisha Lake where the sill is well exposed. The sill appears to be zoned based on petrographic examination, see Table G3. The various elements where plotted against distance from the south contact (Figure G8) and show that the gabbro sill is chemically zoned, undoubtedly as a result of differentiation. McMaster (1975) carried out a similar investigation on a gabbro sill near Boyer Lake: the Gabbro Lake sill, which is just west of the present map area. His results are analogous to those obtained on the Katisha

Lake sill.

f) Intrusive Rocks

Fig. G.9 presents an AFM plot of the intrusive rocks with the exclusion of gabbro sills and the various porphyry dikes throughout the map area showing a large spread of compositions throughout the calc-alkalic field. Calcalkalic and alkalic rocks cannot be distinguished on the AFM ternary and from Fig. G4, only one truly alkalic rock (W22) has been found within the Kawashegamuk Lake area.

4) Classification and Compositional Abundances of Volcanic Rocks

All volcanic rocks have been classified on a volatile-free silica content as follows: basalt (48-52 wt%); basaltic andesite (52-56%); andesite (56-64%); dacite (64-68%) and rhyolite >68% SiO_2 and the rock name given for each sample presented in Appendix B is based on that scheme. All rocks collected from the Wapageisi Lake, Boyer Lake and Kawashegamuk Lake Groups have been shown on three separate SiO_2 compositional frequency histograms in Figure G10 for comparison between the three volcanic sequences and to visualize the compositional range of Archean volcanics in the Kawashegamuk Lake area. The histograms indicate that: (1) the Wapageisi Lake Group as a whole appears to be bimodal. Subgroup II has not been adequately sampled because the felsic volcanics are in most cases fragmental and vesicular rock types that would certainly give highly inaccurate data as far as original compositions are concerned. However from field observations it appears that andesitic rocks are uncommon. (2) The Boyer Lake Group is composed largely of basalts. Felsic breccias, which have not been chemically analyzed due to their high vesicularity, in the northwest part of the area point towards limited felsic volcanism in the Boyer Lake Group. (3) The Kawshegamuk Lake Group hosts a large range of compositions with an SiO_2 gap between 58 and 60%, a compositional gap is also apparent on the AFM ternary (Fig. G5). Despite this compositional gap, andesites commonly reported to be poorly represented in Archean volcanic sequences, constitute an essential part of cycle II.

Geochronology

No isotopic ages on Precambrian rocks within the map area were available at the time of writing. However, ages have been obtained from U-Pb chronology on zircons (Davis et al. 1982) from rocks lying best west of the present map area to supplement regional and geochemical investigations of the Crow Lake-Savant Lake belt (Trowell et al. 1980). A minimum age of 2,755 $\pm$ 1.7 Ma (Davis et al. 1982) has been given by the Thundercloud porphyry that intrudes the top of the Wapageisi Lake Group thus providing a minimum age for the top of this group; this implies that the lower part of the Wapageisi Lake Group is older. This age is to date the oldest in the Wabigoon Subprovince. A rhyolitic tuff from the upper Boyer Lake Group gave an age of 2,702 +14.6/-4.5 Ma. These two dates alone suggest that deposition of the Manitou-Stormy Lake Greenstone Belt took place over a period of time of at least 55 million years. A third age obtained on the post-tectonic Taylor lake Stock is 2,695$\pm$3.6 Ma giving a minimum age for the end of maximum deformation during the Kenoran Orogeny in the Manitou Stormy Lakes belt; and further suggest that regional deformation set in soon after deposition of the Boyer Lake Group.

Correlations of Geology with Aeromagnetic Data

Comparison of the accompanying geologic map (Map , back pocket) with the Wabigoon and the Stormy Lake aeromagnetic maps (ODM-GSC, 1961) and the OGS airborne survey over the General Manitou-Stormy Lakes area (OGS, 1980) show significant magnetic patterns that correlate well with geological features. The later survey contracted by the Ontario Geological Survey provides a more detailed aeromagnetic map than the earlier survey in 1961. Lithologic contacts and major structures have been inferred from the continuing magnetic signature in areas of poor exposure and large water bodies. For example the Kamanatogama Syncline axial trace has been inferred over Stormy Lake with the aid of the well defined magnetic expression of the syncline axial plane. The magnetic pattern for each lithological group is quite different: The Boyer Lake Group, subgroup I of the Wapageisi Lake Group, and cycle I of the Kawashegamuk Lake Group are distinguished by higher magnetic relief than the Stormy Lake Group and Cycle II of the Kawashegamuk Lake Group. These differences define well major geological boundaries. The contact of the Kawashegamuk Lake Group with the Boyer Lake Group is characterized by a sharp magnetic contrast; similarly, the contact between Subgroup II of the Wapageisi Lake Group and the Stormy Lake Group is well defined particularly at Gawiewiagwa Lake. Two outstanding areas of magnetic highs underlie the western part of Snake Bay and Stormy Lake respectively. 1) A series of magnetic highs coincide with the Mosher Bay-Washeibemaga Lake Fault at Washeibemaga Lake and Snake Bay. At Snake Bay a magnetic high reaches 65,500 gammas which is 4,500 gammas above magnetic background considering a background value for the area of 61,000 gammas. The second considerable outstanding magnetic feature is a pair of anomalies on each side of the strait linking Snake Bay to Stormy Lake. On the Snake Bay side one anomaly reaches 67,500 gammas and at Stormy Lake the anomaly attains 75,500 gammas which is 14,500 gammas above background. A zone of intense schistosity in felsic rocks underlies these two anomalies. It is possible that buried iron-formation is the cause of the anomalies. At Snake Bay, lenses of magnetite iron formation have been found on the shoreline and a magnetic intensity of 63,500 gammas is situated above the iron-formation. Gabbro bodies underlying the area bear a strong magnetic expression. The more conspicuous ones are the Katisha Lake Gabbro sill with a magnetic intensity of 61,700 gammas, a gabbro sill along the west shore of Kawashegamuk Lake with a high of 61,600 gammas; gabbro at Church Lake (61,550 gammas) and a gabbro body in the north part of Stormy Lake (61,700 gammas). The magnetic highes are probably caused by magnetite in the gabbros. Two localized magnetic high of 61,250 and 61,800 gammas are situated over the Tabor Lake Prospect and the Van Houten Mine respectively.

Economic Geology

The Kawashegamuk Lake area received much exploration attention during the last years of the 19th century because of its high gold potential. Gold is known to occur in the Rainy Lake and the Lake of the Woods Region; it had also been reported to the east in the Manitou Lakes area, near the village of Wabigoon and near Ignace (Coleman, 1895). Coleman (1895) also pointed out that the region extending from the Manitou Lakes to Ignace was promising in its gold potential.

In 1898 within the map-area the earliest gold discovery in quartz veins (Bow, 1898) was near Tabor Lake and at mining location H.W 416 which later became the Sakoose Mine and the Van Houten Mine. Several other quartz veins were also found in that vicinity. All these finds sparked a gold rush which became known as the "New Klondike" extending from Kawashegamuk Lake (Long Lake) in the west to Mennin Lake (Shallow Lake) in the east and from the southernmost bay of Kawashegamuk Lake to the Canadian Pacific Railway line in Satterly and Melgund Townships. The Sakoose Mine entered production shortly after discovery and most of the ore recovered was mined before 1902. Little reported activity took place in the "New Klondike" after 1902, however, to the west in the Manitou Lakes, mining continued until 1912.

Thomson (1934, p. 1) says: "Since that time (1912) sporadic attempts have been made to reopen a few of the old mines (in the Manitou Lakes area) but so far (1933) without success. The failure of these early mining ventures somewhat curbed prospecting activity in the area, although each year a few prospectors have returned to the area generally to do development work on old mining locations." A new burst of activity appeared in the early 1930's when the old Sakoose Mine and the Tabor Lake prospect generated renewed interest that lasted until about 1947. During this period much exploration and development work was done but gold production was limited. At Tabor Lake, another pulse of activity occurred between 1957 and 1960. In 1979, exploration on both the Van Houten and the Tabor Lake gold properties occurred and at the time of writing efforts were being made to bring the properties into production.

In the early 1950's, geophysical prospecting for copper and nickel deposits was carried out by the International Nickel Company of Canada Limited (8).

In 1969, the discovery of the Cu-Zn-Pb deposits at Sturgeon Lake by Mattagami Lake Mines triggered a new surge of exploration activity. The map area has received considerable attention by the Lynx Canada-DeJour Mines consortium (1970), by Canadian Nickel Company Limited (1970-71), Asarco Exploration Company of Canada Limited (1970-71), Underwood McLelland Limited and Newmont Mining Corporation (1973-75), Hudson Bay Exploration and Development Company Limited (1974), Selco Mining Corporation (1976-78) and more recently by Corporation Falconbridge Copper (Falconbridge Copper Limited) (1979-81) and Sulpetro Minerals (1981-82).

Mineral deposits found within the map area to December 1982 include: gold and silver associated with quartz veins in mafic and felsic metavolcanic rocks and their related intrusions; molybdenite in quartz veins within the Revell Batholith along its western margin; chalcopyrite and nickeliferous pyrrhotite at the margins of a diorite intrusion near Kawashegamuk Lake; minor chalcopyrite associated with pyrite and pyrrhotite in volcanic rocks, and in gabbro sills.

Gold Deposits

Within the map area, gold occurs mainly associated with quartz in fissure veins. Another mode of minor occurrence is in aureoles in volcanic rocks near vein systems and shear zones.

Relationship of Gold Deposits to Geologic Features

Examination of the Kenora-Fort Frances geological map (Blackburn et al., 1979) suggests that: 1) all gold occurrences are confined to volcanic and sedimentary assemblages that have been affected by low grade metamorphism, 2) the majority of gold deposits are closely associated with felsic volcanic formations, i.e. few gold showings have been found within mafic volcanic successions, for example the Wapageisi Lake Group or the Boyer Lake Group. However an irregular, brecciated ferroan carbonate vein found by the author 700 m east of Katisha Lake, within the mafic Wapigeisi Lake Group is mineralized with gold. The vein presents a thick limonitic weathering crust on surface and contains disseminated chalcopyrite. One assay by the Geoscience Laboratories of the Ontario Geological Survey in Toronto indicated 0.12 oz/ton gold and 0.30 oz/ton silver. The vein is approximately 0.5 m thick and occurs within pillowed basalts. 3) A large number of deposits occur along major fault zones, for example the Manitou Straits Fault, the Quetico and the Seine River Fault system and the Pipestone-Cameron Fault (Poulsen 1984). Within the map area it can be seen that all gold deposits found to date are in the northeastern part of the map, confined to the Kawashegamuk Lake Group.

This distribution of auriferous veins may be indicative of a genetic association with felsic volcanic rocks. No significant gold mineralization has been found in the mafic Wapageisi Lake and Boyer Lake Groups, or the epiclastic Stormy Lake Group. The author believes that the conditions controlling gold mineralization have a stratigraphic component as well as a structural component.

Concerning the Manitou Lakes area, Thomson (1942) wrote: "The veins all strike around N35°E and have a very steep dip. The "breaks" run about parallel to the strike of the rock formations but occasionally truncate them at low angles, which indicates that they have been produced by faulting movements". Structural factors are controlling the existence of vein or lode type auriferous deposits with fractures acting as channel ways for hydrothermal solutions and as sinks and repositories for precious metals and other minerals (Kerrich and Fryer 1979; and Kerrich 1981). Individual gold deposits are described in "Descriptions of Properties and Mineral Explorations". In summary most deposits are mineralized quartz veins hosted by basalts (Lee Lake Occurrences), felsic volcanic rocks (Van Houten

Mine), Gabbro (Church Lake Occurrence) or felsic porphyry bodies (Tabor Lake Prospect). Quartz veins occur as single fractures e.g. at Church Lake or Brown Lake or in multiple fractures such as at Tabor Lake. The lode type deposit is not apparent in the present map area except at Tabor Lake where in some places the porphyritic host rock is invaded by numerous quartz veinlets and stringers (Photo E 1), however it appears that the economic gold concentrations are contained within the larger quartz vein systems. The configuration and size of quartz veins varies between deposits; veins may be 300 m or more in length and up to 3 m wide; they may be discontinuous due to faulting and their width is generally variable. Due to continuing deformation after emplacement of the veins, some present a series of bulges and pinch-out structures; this was observed during the sinking of a shaft in 1899 just north of Brown Lake. Gold and associated sulphides, forming erratic concentrations, fill late cracks in quartz. Some quartz veins without accessory minerals may contain exceedingly high gold values such as at Church Lake, where parts of a vein hosted by gabbro contain abundant visible gold. The second type of gold occurrence is in sheared volcanic rocks. One such type has been found by the author on an island in the southern part of Kawashegamuk Lake: a strong shear zone two metres wide in a porphyritic andesite appears on surface as a highly oxidized, friable rock with a yellow to brown coloration. A strong sulphur smell emanates from a freshly broken surface. One assay of the oxidized material submitted to the Geoscience Laboratories of the Ontario Geological Survey in Toronto gave 0.03 oz/ton Au. Numerous other sulphide zones in volcanic rocks have been located within the map area, mainly by diamond drilling; none seems to carry economic gold concentrations.

Silver is always present in subordinate amounts in auriferous deposits within the map area.

Sulphide Deposits

Pyrite, pyrrhotite, chalcopyrite and molybdenite have been found in a number of locations on surface exposures, in trenches and test pits or by drilling conductive zones. Nickeliferous pyrrhotite and chalcopyrite have been found at the margins of a diorite stock on the east side of Kawashegamuk Lake (International Nickel Company of Canada (8) and Canadian Pacific Railway Company (3); Pyrrhotite and pyrite with minor amounts of chalcopyrite have been found in most diamond drill intersections. Graphite is responsible for a great number of conductive zones in the area. The writer found a zone 0.5 m wide carrying about 30% pyrite in sheared volcanic rock along the western shore of Kawashegamuk Lake. Loose material among the boulders on the shore have also revealed pyrrhotite bands in an altered felsic schist and highly fissile dark grey graphitic schist. Sparse chalcopyrite grains were found occasionally in gabbro sills near the western shoreline of Kawashegamuk Lake. Beside sulphides in volcanic rocks, sphalerite, chalcopyrite, galena, pyrite and pyrrhotite occur in variable amounts in auriferous quartz veins. Molybdenite occurs in late-stage quartz veins within massive granodiorite of the Revell Batholith. One deposit has been explored by Dome Exploration Limited at Oldberg Lake; another deposit of the same type was found by the writer in 1982 near the western shore of Mennin Lake approximately 3 km north of Oldberg Lake; every quartz vein, regardless of width, carries at least some molybdenite.

Relationship of Sulphide Deposits to Geological Features

Three distinct base metal associations have been sought by individuals and companies in the Kawashegamuk Lake area:

1) Cu-Ni sulphides associated with large mafic-ultramafic intrusions (Davies and Watowich, 1956) or with mafic volcanic rocks (Setterfield et al. 1983).
2) Sulphides known to occur in felsic metavolcanics similar to the Sturgeon Lake deposits. Silver and gold concentrations commonly enhance the value of this type of deposit.
3) Molybdenum mineralization which is hosted by granitic rocks (Dome Exploration Limited).

The search for nickel and copper by International Nickel Company of Canada Limited in 1952, Falconbridge Nickel Mines Limited in 1957 and the Canadian Nickel Company Limited in 1970 was aimed towards mafic intrusive bodies, whereas the search for copper-zinc-lead deposits of the Sturgeon Lake or Rouyn-Noranda camps type was directed more on mafic-felsic volcanic assemblages e.g. the Lynx-Canada-Dejour Mines consortium in 1969, Hudson Bay Exploration and Development Company in 1974 and Selco Mining Corporation in 1976. Beginning in 1979 Falconbridge Copper Limited investigated a wide area in the northwestern part of the map area underlain by mafic and felsic rocks with numerous quartz-feldspar porphyritic dacite dikes and stocks which have been pervasively altered.

Within the map-area all drilled conductors known from airborne electromagnetic surveys filed for assessment work have shown graphite-pyrite zones. The only sulphides of economic importance found to date are associated with an early quartz-diorite stock that was probably linked with Kawashegamuk Lake Group volcanism. As well, minor mineralization occurs in gabbro sills and auriferous quartz veins. Two molybdenite deposits have been found within the map area separated by a distance of approximately 3 kilometres. One deposit is situated near Oldberg Lake and was investigated by Dome Exploration Limited in 1966; the other found in 1982 by the writer is near the western shore of Mennin Lake (see map - in back pocket). The initial discovery was on a hill overlooking Mennin Lake, but upon close examination of every quartz vein and veinlet in the surrounding area it was found that each quartz filled fracture contained at least the occasional molybdenite flake. Both deposits occur in the Revell granodiorite and are at the same distance from the intrusive contact with the greenstone. The deposit at Mennin Lake is similar in every respect to the one at Oldberg Lake which is described under Dome Exploration Limited (6). The first quartz vein found is about 25 centimetres wide trending North-South with subvertical dip, and is situated near the intrusive contact. It contains disseminated molybdenite and small crystalline clusters within the vein and also in the adjacent greisenized granodiorite. Other veins less than 3 centimetres thick have a north to northeast trend and a steep dip; in one of the veins, minor chalcopyrite was found.

Structural Materials

Building Stone

Most of the metavolcanic and metasedimentary formations are strongly foliated or have uneven weakness zones due to their fragmental nature such as pillows and breccias, thus offering poor potential as building stone. At Stormy Lake, slate occurs in several places. The granodiorite of the Revell Batholith may be favourable for building material as it is massive, equigranular throughout and is exceedingly homogeneous.

Sand and Gravel

Most of the area has been covered by ground moraine during the last ice age (Roed, 1980 a, b). Topographic highs have little or no cover, but pockets of bouldery and gravely unconsolidated deposits occur in many intervening lows. Between Snake Bay and Kawashegamuk Lake, a pronounced valley has been filled with stratified sand and gravel. A more widespread cover of gravel and sand extends from the northern part of Kawashegamuk Lake towards Tabor Lake and Satterly Township. Numerous sand and gravel pits are exposed along the Snake Bay Road and the road that follows the east shoreline of Kawashegamuk Lake. No attempt was made during the present survey to assess these deposits.

Suggestions for Mineral Exploration

The Kawashegamuk Lake area has long been known for its gold potential, together with the Manitou Lakes region, recently described by Blackburn (1976; 1981; 1982). For many years attempts have been made to bring the Van Houten Mine and the Tabor Lake prospect to production; reason for past failures are not clear. The initial success at the Van Houten Mine was certainly linked to low operating costs as mining of the ore was carried out by trenching from the surface. There is little doubt that in the future, mining would have to be underground.

Besides the Tabor Lake and Van Houten deposits which to date appear to be the largest in the area, a number of smaller deposits may offer limited but profitable possibilities as some veins may be exceedingly rich in places (cf. recent activity in the Mine Center area).

The entire area particularly east of Kawashegamuk Lake still has high gold potential as most gold deposits have been discovered to the north of Kawashegamuk Lake. However, recently interesting gold and silver values have been found in a silicified carbonate vein east of Katisha Lake (see Table E 5). Auriferous quartz veins may be hosted by any type of rock but they do not occur randomly: Some geologic features to bear in mind based upon general features of Archean lode gold deposits are:

- Faults and shear zones
- Areas underlain by folded strata
- Marginal areas between volcano-sedimentary sequences and

large plutons

- Areas intruded by abundant felsic porphyry dikes and stocks
- Areas of intense alteration (carbonatized, sericitized, silicified rocks)
- Areas just within the greenschist facies along belt margins of amphibolite facies

The following minerals have been found in association with gold and should be watched for: carbonate (especially the ferroan varieties) in quartz, pyrite, pyrrhotite, sphalerite, galena, chalcopyrite, arsenopyrite, chromian muscovite (fuchsite) and tourmaline.

The search for base metals has so far met little success. The possibilities for Ni-Cu mineralization related to differentiated mafic intrusions are remote as most of the bodies which are present within the map area are relatively small.

Favourable areas to search for base metal mineralization particularly of the Cu-Zn-Pb association would be the Kawashegamuk Lake Group and the thick sequence composed of felsic volcanics south of Stormy Lake. The two similar molybdenite deposits at Oldberg Lake and at Mennin Lake suggest the possibility of deposits elsewhere at the periphery of the Revell Batholith. In the southeast, iron-formation occurs towards Bending Lake.

Descriptions of Properties and Exploration

Information on properties and exploration work has been obtained from company reports submitted to the Assessment Files

Research Office, Ontario Geological Survey, Toronto and the Resident Geologist Files, Kenora, the latter being also the source of reports on earlier work. Much work which had been done in the late nineteenth and early twentieth centuries has been reported in Annual Reports by the Ontario Bureau of Mines and later by the Ontario Department of Mines and reference to the proper source is given within the descriptions.

Properties are titled in this report according to ownership as of December 1982.

Depending on the amount and type of work done in the past, a mineral deposit mentioned herein is defined as: a mine, if it has been a former producer of any amount of a particular commodity; a prospect, if it has received significant exploration and (or) development work; an occurrence if no lateral development was done and it has had less than 600 m (2000 feet) of diamond drilling.

- Areas of exploration are titled according to the last owner that performed work on a parcel of land and are listed alphabetically.
- Dates in square brackets following titles indicate the year during which the last work had been performed on a parcel of land.
- Numbers in parentheses following titles correspond to those on the map (see Map no. ---, back pocket).

Every effort has been made to list all properties or areas of exploration and to give as much information as possible on previous activity.

Undoubtedly work has been performed by individuals or companies that has not been recorded and thus has escaped the author's scrutiny.

Table E1 summarizes all reported activities since 1898.

PROPERTY DESCRIPTIONS

P. Anderson [1960] (1)

One 120.5 feet (36.7 m) long hole was drilled by New Dickenson Mines Limited for P. Anderson on claim K30895: The hole was drilled in a southwesterly direction at a 45° angle (Resident Geologist's Files, Kenora, Ontario). Drilling was presumably carried out to check mineralization previously found on surface as no reported geophysical work preceded the drilling.

The hole was drilled just off the granodiorite contact of the Revell Batholith at the base of the Kawashegamuk Lake Group in fine grained mafic to intermediate volcanic rock, weakly mineralized with chalcopyrite (Resident Geologist Files, Kenora, Ontario). Deeper within the hole, a quartz eye felsic porphyry was encountered mineralized with chalcopyrite, pyrite and pyrrhotite (Resident Geologist Files, Kenora, Ontario). No further work had been reported.

Asarco Exploration Company of Canada Limited (1971) (2)

In 1970-1971, Asarco Exploration Company of Canada Limited, while on a search for base metals, diamond drilled four conductive zones. No records have been found on how the conductors had been located; one anomaly situated on a lake 3 kilometres northeast of Boyer Lake had presumably been located by the airborne survey conducted the year before by Lynx-Canada Explorations Limited and Dejour Mines Limited. One hole had been drilled on the lake to a length of 252 feet (77 m) which intersected graphite-rich zones in sediments (Resident Geologist Files, Kenora, Ontario). The rocks surrounding the lake are light coloured mafic to intermediate flows, some of which have pillow structures. A band of felsic volcanic rocks is inferred under the lake from exposures of felsic types on the opposite side of the lake. One short hole had been drilled to 56 feet (17 m) on the north shore of Snake Bay where a wide gabbro sill is exposed and on which the Canadian Nickel Company Limited (3) conducted a ground magnetometer survey the following year. No mineralization had been found (Resident Geologist's Files, Kenora, Ontario). Two other short holes were drilled in mafic volcanics at the eastern shore of Stormy Lake at the south eastern corner of the present map area. Pyrrhotite and chalcopyrite mineralization was found in small amounts. Assays on core samples yielded up to 0.04% Cu and trace amounts of gold and silver (Resident Geologist Files Kenora, Ontario).

Canadian Nickel Company Limited [1971] (3)

In 1971 the Canadian Nickel Company Limited carried out a magnetometer survey over two claims (K261152-53) between Noxheiatic Lake and Snake Bay in order to locate anomalies within ultramafic rocks (Resident Geologist's Files, Kenora, Ontario). The two claims are underlain by tholeiitic basalts in the north and by a thick gabbro sill in the south. Only a few anomalous readings were obtained and no further work was done.

During the same year, a diamond drilling program of six holes was carried out in Stormy Lake (1). Information as to what kind of previous work had been done to locate the drill targets has not been found and it is assumed that sulphide mineralization on surface was observed previously by prospecting. A summary of the diamond drilling is presented in table E 2 below:

Canadian Pacific Railway Company (1955) (4)

In 1955 the Canadian Pacific Railway Company conducted a geological reconnaissance over a 170 square kilometre area between Church Lake, Mennin Lake, Stormy Lake and Cox Lake in the southeast. The commodities sought by the company were base metals and gold. Reported finds (Assessment Files Research Office, Ontario Geological Survey, Toronto) are:

1) Pyrrhotite and chalcopyrite 500 m to the north of the most southerly of the bays on the eastern side of Kawashegamuk Lake. The mineralization was found in 1981 by the present author. Rock surfaces at the occurrence are stained by limonite due to the weathering of pyrite, pyrrhotite and chalcopyrite in narrow shear planes and fractures in medium-grained, grey quartz diorite with blue quartz eyes near the margin of a small elliptical shaped diorite stock 1000 m long and 500 m wide on surface. An analysis of one sample containing disseminated pyrite and pyrrhotite by the Geoscience Laboratories of the Ontario Geological Survey returned the following values: 0.04% Cu, 70 ppm Zn, Ni was not

detected.

2) Sulphides in a diorite stock at the eastern shore of Kawashegamuk Lake about midway along its length. The showing was not found by the C.P.R. Survey crew but it has apparently been reported earlier, probably by C. Alcock who first optioned a group of 17 unpatented claims encompassing the entire diorite stock to the International Nickel Company of Canada (10). Sulphide mineralization (possibly the original discovery by Alcock) was found in 1981 by the author on the north eastern margin of the elliptical shaped quartz diorite stock (see map). The sulphides are mostly finely disseminated chalcopyrite and pyrrhotite in a fine-grained diorite. Analysis of one sample by the Geoscience Laboratories in Toronto gave 0.064% Cu, 76 ppm Zn and 5 ppb Au; Ag was not detected. Assay values reported by the C.P.R. company are 0.63% Cu and 0.37% Ni from a chalcopyrite-pyrrhotite mineralized gabbro found adjacent to a 'drift-filled topographic depression". A company report (Assessment Files Research Office, Ontario Geological Survey, Toronto) also mentions a chalcopyrite mineralized rhyolite from the same area with 4.14% Cu.

3) A quartz vein occurring in felsic to intermediate tuffs has been found about 1 kilometre from the most southerly bay of the east side of Kawashegamuk Lake (just beyond the eastern boundary of the present map area). The same vein has been found by the writer. It is 2.5 m wide trending SE-NW for an undeterminate length. The vein consists of a pure white, sugary quartz that is not mineralized with other substances. A quartz-feldspar

porphyry dike with white feldspar phenocrysts and blue quartz eyes parallels the quartz vein; it contains fine-grained disseminated pyrite. Between the porphyry dike and the vein, a 50 cm wide shear zone consisting of a fine-grained black mica schist carries abundant pyrite and inconspicuous needles of black tourmaline. Geochemical analyses for gold by the Geoscience Laboratories in Toronto returned the following results: vein quartz: 13 ppb Au; schistose material: 28 ppb Au; quartz feldspar porphyry: 240 ppb Au.

Church Lake Occurrence (5)

A north-south trending quartz vein approximately 40 cm wide set in a coarse-grained gabbro is exposed on the side of a hill near the western shoreline of Church Lake. An old trench several metres long occurs on the vein. The quartz is a white to light grey variety with a highly fractured aspect. It has a characteristic ribboned appearance due to the presence of thin layers of dark chloritic material which parallel the strike of the vein; these probably represent wall rock material plucked during the opening of the fracture. The rim is mineralized with disseminated pyrrhotite, pyrite, chalcopyrite and visible gold which occur preferentially along the chloritic bands within the vein. No perceptible alteration of the wall rock has been observed by the author. Eleven contiguous claims have been staked by A. Kozowy. in 1981. Bow (1899) on P. 75 reports a similar occurrence on location H.W. 460 which is just to the south east of the vein described above:

"An occasion was taken advantage of to visit H.W. 460, a location belonging to Thomas Hogan, which proved specially interesting on account of the formation, which was gabbro, of a rather coarse texture. Extending up the sloping face of a hill about 200 feet in height, several small veins were observed, ranging in width from several inches to two feet, and traceable for from 25 to 100 feet, and said to be found also on the other side of hill. A little stripping and blasting had been done, but assay values were too low to warrant any further work expenditure. The quartz is blue, with no visible concentrates. Inclusions of green schist were found associated with one of the veins. At another place on the location several hundred yards distant, a band of this schistose rock 10 to 15 feet in width extended through the gabbro, and contained some splashes of white quartz well charged with pyrites. Some blasting had been done, but assays were low and work was discontinued."

Dome Exploration (Canada) Limited (Oldberg Lake Occurrence) (1966) (6)

Molybdenum mineralization was found in narrow quartz veins near Oldberg Lake all within a monotonous mass of granodiorite by A. Sanderson while prospecting for Dome Exploration (Canada) Limited in 1965 (1). As a result of his discovery, Sanderson staked a group of 57 contiguous unpatented claims and did some trenching where molybdenite was to be seen. In 1966 Dome carried out an exploration programme on 23 claims (K 36104 - 106, 108

-111, 116 -119, 122 - 129, 136, 138, 140, K 36142), the first phase of which consisted of a soil geochemical survey. B and C soil horizons were sampled at regular intervals (presence of soil permitting) on grid lines. (1) The molybdenum concentrations in the soil samples outline a north-trending area of soil anomalies (Figure E 1). A trenching programme was undertaken following the results of the soil survey and 1,710 feet (521 m) of diamond drilling from three holes was done in the fall of 1966 (Resident Geologist's Files, Kenora, Ontario). No single, discrete mineralization zone was intersected by the drilling; it was found instead that the granodiorite is invaded by numerous quartz veins and stringers ranging from a fraction of a centimetre to over 15 centimetres wide mineralized with molybdenite flakes and fine grained films on slip planes and minor chalcopyrite, pyrite and fluorite (Resident Geologist's Files, Kenora, Ontario). It was also observed that the granodiorite adjacent to same veins was greisenized (Resident Geologist's Files, Kenora, Ontario). All three drill holes revealed similar mineralization patterns and vein distributions. Examination of material found in trenches by the present author confirmed the drilling results. Quartz veins up to two feet (60 cm) in width were found; quartz veins in the trenches trend in a northeast direction and have the shallow to intermediate dips to the south. The quartz is a sugary white variety with molybdenite occurring as microscopic to 2 mm large crystals or small crystal aggregates and also as dark grey, fine-grained films along narrow fractures. Numerous fractures in the quartz are coated with shiny muscovite flakes.

Chalcopyrite, purple fluorite and pyrite are present in minor amounts. Bright yellow ferrimolybdite stains are commonly associated with molybdenite-bearing quartz. The granodiorite wall rock is altered adjacent to some veins (greisen) and is characteristically of a greenish-brown colour with the silvery sheen of abundant light green muscovite. Microscopic examination reveals a composition similar to the unaltered granodiorite with the exception of abundant muscovite and small amounts of purple fluorite.

Although some veins carry appreciable amounts of molybdenite in places the content varies significantly along the length of each vein, further more the quartz-filled fractures are too narrow and too sparsely distributed to form an economical deposit.

An attempt to compare molybdenum mineralization in Archean granitic rocks and mineralization of epizonal felsic porphyritic plutons of Mesozoic and Cenozoic age has been made by Ayres and Averill (1971) after the discovery of a molybdenum deposit in a granodiorite stock at Setting Net Lake near Favourable Lake, northwestern Ontario. Molybdenum mineralization at Setting Net Lake occurs along the margins of narrow variably spaced quartz veins filling joints over an area 8,000 by 1,500 feet (2500 by 500 m) in a porphyritic granodiorite stock, exposed on surface over an area of 5 square miles (13 km^2) (Wolfe, 1973; Ayres, 1971). The veins have a relatively uniform trend, are steeply dipping and are traceable for long distances along strike (Wolfe, 1973). Associated minerals are minor pyrite and chalcopyrite.

Despite certain differences between the molybdenum deposits (Oldberg Lake and Mennin Lake) within the present map area, and at Setting Net Lake, a parallel may be drawn between the two areas; however further study is needed in order to equate Archean molybdenum deposits with Phanerozoic porphyry type Mo-Cu deposits. Another molybdenum deposit has been found by the writer near Mennin Lake and is described in the section entitled "Relation of sulphide deposits to geological features".

Falconbridge Copper Limited (1980) (7)

Two claim groups totalling 180 unpatented claims were staked in 1979 for Falconbridge Copper Limited half of which lie within the northwestern part of the present map area. The first phase of exploration consisted of a reconnaissance lithogeochemical survey done in 1979 (Assessment Files Research Office, Ontario Geological Survey, Toronto). The following year, geophysical work consisting of magnetic and V.L.F.-E.M. surveys was carried out on both claims groups and detailed geological mapping was done in the western group, with additional lithogeochemical sampling (Assessment Files Research Office, Ontario Geological Survey, Toronto). A large number of electromagnetic anomalies were detected, some of which had coincident magnetic highs (Assessment Files Research Office, Ontario Geological Survey, Toronto); at least half of these anomalies had been attributed to conductive zones in the bedrock or in fractures. The rocks in the general surveyed area consist of mafic and some felsic volcanic rocks which had been intruded by numerous felsic porphyry dikes and stocks; many of the rocks have been altered to a significant degree: they are characterized by thick limonitic crusts from the weathering of iron rich carbonate and are friable. No further work was done and the claims were allowed to lapse.

Falconbridge Nickel Mines Limited (1957) (8)

While on a search for copper and nickel deposits, Falconbridge Nickel Mines Limited diamond drilled four holes within the map area. One of the holes (Muk - 1) on claim No K 21112 is situated on the property that was optioned to International Nickel Company of Canada in 1952. The hole has been drilled at the western margin of a diorite stock at a 20o angle and is 416 feet (127 m) long. No mineralization of economical importance was found. Three holes were drilled in the winter of 1957 on Church Lake: Hole CH-1 on claim K 24960 is 98 feet (30 m) long and intersected mostly mafic volcanic rocks. Minor pyrite was encountered. Hole CH-2 on claim K 24959 is 350 feet (107 m) long; mostly intermediate to felsic volcanic rocks were intersected with no mineralization. Hole CH-3 on claim K 24957 is 120 feet (36 m) long. Incomplete log data were submitted for this hole. From lithologies occurring around Church Lake it is inferred that the rock types beneath the lake consist of gabbro in the eastern part and northwesterly trending mafic to felsic volcanics units in the western part. All information taken from company drill reports the Assessment Files Research Office, Ontario Geological Survey, Toronto).

Hudson Bay Exploration and Development Company Limited (1974) (9)

During the summer of 1974, Hudson Bay Exploration and Development Company Limited carried out an electromagnetic survey over a group of 47 contiguous, unpatented claims (K-404012-404059) between Church and Mennin Lakes. The claims are underlain by felsic volcanic rocks stratigraphically situated in the lower Kawashegamuk Lake Group. Eight conductors were found in dacitic to rhyolitic rocks; all conductors were drilled with a Winkie diamond drill yielding E-size core. The drilling results are summarized in Table E3 below. Locations of all eight holes on map --- in back pocket are approximate only (all information provided by courtesy of Hudson Bay Exploration and Development Company Limited, Toronto).

International Nickel Company of Canada Limited (1952) (10)

Exploration for base metals within the present map area started in 1952 when the International Nickel Company of Canada Limited optioned a group of 17 contiguous claims (K. 15452, 53, 56-58, 61-63; K15829-31, 34-36, 38-40) from C. Alcock of Kenora who apparently found sulphide mineralization in a diorite stock (Report by the Canadian Pacific Railway Company, Assessment Files Research Office, Ontario Geological Survey, Toronto). A magnetometer survey was carried out over the diorite body. No significant anomalies were observed and the isolated magnetic highs on claims K15458, K15430 and K15453 were found to be caused by magnetite (Assessment Files Research Office, Ontario

Geological Survey, Toronto). The claims were allowed to lapse as a result of the discouraging geophysical survey. In 1957 a hole was diamond drilled by Falconbridge Nickel Mines Limited (8) on the diorite body.

Lee Lake Occurrences (11)

Discovery of gold in the "New Klondike", particularly at Tabor Lake and on the Sakoose property which have received much attention, has sparked a prospecting rush over a wide area around Kawashegamuk Lake at the turn of the past century. Despite the discovery of several mineralized quartz veins in the vicinity of Lee Lake at the beginning of this century, little information on these finds is now available. Three locations around Lee Lake may be mentioned.

1) A brief report by the resident Geologist dated February 1964 from the Resident Geologist files in Kenora, mentions that a group of four claims (K9885-K9888) had been staked probably at the beginning of this century around a "high grade" quartz vein found by N. McKinnon. The vein located on claim K9887 was said to be 6 inches (15 cm) wide and to contain visible gold. It tails out to a crack in one direction and runs into a boulder filled ravine in the other. The vein was not found during the present survey. The four claims were all staked over pillowed and massive basalts.

2) Long Lake Mining Company: Santa Marie or Long Lake claims

A short anonymous and undated report from the Resident Geologist files in Kenora, states that a group of four claims

(S.V. 353-355, H.W. 575) just west of Lee Lake was prospected in 1902 by the Long Lake Mining Company of Manchester, England. Two shafts 21 and 18 feet (6.5 and 5.5 m) deep were sunk and a pilot mill installed. A total of five veins were found, one quartz vein which had been stripped occurs between quartz porphyry and a dolomitic limestone. The report mentions free gold seen in the vein along with pyrite, galena and minor copper minerals. A second vein occurring 300 feet (90 m) away to the north is reportedly very wide and returned gold values. The other three veins have received less attention but were described in the report as being similar to the first two. The property was later acquired by W.L. Olsen but little work had apparently been done. The approximate location of the two shafts (on claim H.W. 575) is shown on the map in the back pocket.

3) A series of trenches and pits over a distance of 50 metres have been found by the writer near the southeastern shore of Lee Lake (see location on map). The diggings are on an irregular steeply dipping quartz vein about 20 centimetres wide from which numerous offshoots depart at high angles. The quartz is white and brittle with a blocky fracture; abundant yellow iron-rich carbonate stringers occur within the quartz. The common metallic mineral is pyrite, which exists as cubes up to 1 centimetre in size; galena has been found in one pit. The vein is contained on surface in a feldspar porphyry which is altered to a yellow sericite - carbonate rich rock with abundant disseminated pyrite cubes: pyrite mineralization is strong at the quartz-porphyry contact, the porphyry itself is hosted by pillowed basalts. Two

samples of vein material have been sent to the Geosciences Laboratories of the Ontario Geological Survey and the results are given in Table E 4 below.

Lynx-Canada Explorations Limited - Dejour Mines Limited (1970) (12)

Following the discovery of the Sturgeon Lake base metals deposit (Cu-Zn-Pb-Ag) by Mattagami Lake Mines Limited plans were made by Lynx-Canada Exploration Limited and Dejour Mines Limited to jointly carry out an airborne geophysical survey over an area of 180 square miles (466 km^2) between Dinorwic and Kawashegamuk Lakes. Approximately one fourth of the flown area has been over the northwest portion of the present map area (Resident Geologist Files, Kenora, Ontario). Following the airborne survey, 155 claims in 13 groups were staked to secure the most interesting anomalies (Resident Geologist Files, Kenora, Ontario). Two claim groups, namely group 'A" and "M" lie within the present map area, claim group "A" consisting of three separate blocks. Ground follow up work consisting of magnetic and E.M. surveys; geological mapping and some soil sampling was initiated shortly after. Diamond drilling [2] took place to determine the nature of the conductive zones in areas of thick overburden. Claim group "A" with 41 claims located between the Van Houten Mine and Brown Lake, hosted several north trending airborne E.M. anomalies with moderate magnetic correlation (Resident Geologist Files, Kenora, Ontario). Trenching and stripping showed that the anomalies were caused by disseminated pyrite and pyrrhotite in shear zones within metavolcanic rocks. Chemical analyses of soil sampled over conductive zones showed no increase in Cu-Zn content over normal background values (Resident Geologist's Files, Kenora, Ontario). One hole 303 feet (92 m) long was diamond drilled; stringers of pyrite-pyrrhotite with minor amounts of chalcopyrite were found.

Claim Group "M", with 10 claims located half way between Boyer Lake and the Kawashegamuk River, covered two parallel northwest trending conductive zones with little magnetic correlation (Resident Geologist's Files, Kenora, Ontario). Because of the lack of exposures, each conductor was tested by diamond drilling. The first hole (No. 2), 301 feet (92 m) long intersected several zones rich in pyrite and graphitic schists in very soft carbonatized greenstone; assayed core samples of sulphide-bearing schists gave values up to 0.04% Cu and 0.18% Zn over lengths of 1 foot (Resident Geologist's Files, Kenora, Ontario). The second hole (No. 3) 304 feet (93 m) long also intersected graphitic schists and pyrite-rich zones in similar rock type as No. 2 hole (Resident Geologist's Files, Kenora, Ontario). Owing to the discouraging results in general over the entire surveyed area, work was discontinued.

Maw and Greening Syndicate (1898) (13)

Report is made in Bow (1899) p. 74 that J. Maw and S.O. Greening acquired five claims (H.W. 455, H.W. 476, H.W. 477, H.W. 478 and H.W. 479) in the "New Klondike". On H.W. 479 a claim adjoining H.W. 419 (see Northwestern Ontario Exploration

Company) (15) a 40 foot (12 m) shaft has been sunk on a quartz vein 2 feet wide and traceable for 250 feet (75 m). The vein's trend is 60° and the dip is vertical. The quartz is mineralized with chalcopyrite, pyrite and pyrrhotite.

On claim H.W. 477 which adjoins H.W. 416 (on which the Van Houten Mine is situated) several quartz veins had been found and a few test pits were made. Bow (1899) describes these veins as "... fairly well representative of this part of the country".

None of the veins or excavations mentioned above have been found by the present survey.

McLean Syndicate (Shallow Lake Claims) [1943] (14)

A group of 23 claims (K-4510-4511; 4598-4618) were staked around a long mineralized shear zone situated between Church Lake and Mennin Lake. The property was owned by Mrs. E.M. McLean who acted also as a executive for Tabor Lake Gold Mines (16).

The showing was examined in 1943 by Sylvanite Gold Mines Limited who sampled 15 trenches which were made over a length of 1250 feet (380 m) prior to 1943 (see map P.2569&70 in back pocket). All assay returns gave only traces of gold and recommendations were made to allow the claims to lapse (Company report by Sylvanite Gold Mines Limited, Resident Geologist Files, Kenora). The same report describes the showing as being a strong shear zone trending in an east-west directions and having a dip of 40° to 70°N. The shear zone carries lenticular bodies and stringers of quartz as well as heavily carbonatized rock. The only metallic mineralization is finely disseminated pyrite. Two bulk samples assayed for gold, gave values of 0.17 and 0.09 oz Au/ton (Beard and Garratt, 1976). A distinct NW-SE trending air-photo lineament coinciding with an offset of the Revell Batholith contact with the greenstones intersects the linear succession of trenches at a 30o angle; the lineament has been interpreted as a late fault. A genetic relationship of that fault with the shear zone in which the quartz occurs is uncertain. Both the shear zone and the fault occur in felsic metavolcanic rocks. Selco Mining Corporation (17) found a strong conductive zone in the same area as the trenched shear zone during a geophysical investigation in 1977; the electromagnetic anomaly was drilled in 1978.

Northwestern Ontario Exploration Co. (1899) (15)

A number of mining locations had been taken up by Walker and Brown, the first prospectors in the "New Klondike", who in 1898, made an offer to anybody who would sink a 250 foot shaft on any of their ground. Northwestern Ontario Exploration Company of London, England, accepted the offer and sank two shafts on quartz veins situated on locations H.W. 418 and H.W. 419 (Bow, 1899).

Location H.W. 418 (from Bow, 1899). A 12 foot (3.6 m) pit was made on what appeared at first to be a large body of quartz, but which in fact was flat lying vein. The near horizontal vein was followed into a nearby bluff into which a shaft was sunk to a depth of 78 feet (24 m). The vein was intersected at a depth of 44 feet (13.5 m); it is characterized by a 3 feet (1 m) of pure quartz and about 12 feet (4 m) of a mixture of quartz and greenstone. Gold concentration were not satisfactory and exploration was stopped. Neither the pit nor the shaft have been located by the present survey.

Location H.W. 419 (from Bow, 1899)

A shaft 142 feet (43 m) deep was sunk on a east-west trending, subvertical quartz vein. On the surface the vein was only 4 to 6 inches (10-15 cm) wide and could be traced for 1,000 feet (300 m). At depth the vein appeared to have a pinch and swell structure and the widest portion was encountered at a depth of 74 feet (23 m) where it is 5 feet (1.5 m) wide; below that depth the vein pinched out suddenly and reappeared at a depth of 97 feet (30 m). A description of vein material is given by Bow (1899):

> "The quartz varies from white to blue at different depths. It is slightly mixed with country rock and heavily charged with copper pyrites (chalcopyrite) with a fair quantity of zincblende (sphalerite) and pyrrhotite; iron pyrite is rare. Considerable visible gold has been found. This mineralization applied to the upper portion of the vein, before it disappeared at a depth of 75 or 80 feet. The lower portion differs in that the zincblende has entirely disappeared, none having been found since the vein appeared the second time".

The writer visited the site upon which the shaft had been sunk. Vein material sampled on the dump matched the description given by Bow (1899). It was noticed that many quartz samples carried a substantial amount of brown carbonate (siderite?). The country rock on surface is an unaltered greenstone (basalt); The vein has not been observed on surface and is probably hidden by the dump near the shaft. At depth Bow (1899) describes the rock as being massive, dark coloured and felsitic, and near the bottom of the shaft" the vein is included in a dike of hard felsitic rock 3 to 4 feet in width with softer schistose rock on each side".

Four samples have been collected on the dump by the writer for assaying. The results are listed in the Table E 5 below.

On the same claim, at the bottom of the hill on which the shaft is located and about 800 feet from it in a westerly direction a 50 feet (15 m) long adit has been driven in a vein which varies from 2 inches to 2 feet in thickness. The adit has not been located by the writer.

H.W. 419 is at the time of writing on private land held by M. Brockman and has been restaked within a group of seven claims by A. Kozowy.

Location H.W. 417

This mining location adjoining H.W. 418 to the north, has a white quartz vein two to seven feet in width. Two test pits several feet deep have been sunk 40 feet (12 m) apart (Bow 1899). The vein has not been located by the author. The location lies on mafic and felsic rocks intruded by gabbro; all rocks have been upgraded by contact metamorphism imposed by the Revell Batholith.

It is possible the veins found on mining locations H.W. 417, 418-419 are of the same association; the fact that quartz veins in the area are highly boudinaged and the presence of several air-photo lineaments suggest significant post vein emplacement deformation likely accompanied by faulting. Such movements would disrupt and offset vein systems implying that more veins may exist beside those found during the late nineteenth century.

J.W. Redden (Van Houten or Sakoose or Golden Whale Mine) (16)

a) History of exploration, development and mining

The earliest report (Bow, 1898) mentioned a very promising showing in the New Klondike area. The original operators, Munroe and Kirk carried out only some trenching on the property (H.W. 416) then known as the Munroe Mine, which was later sold to the Hon. Robert Watson. In 1899 the property became known as the Golden Whale and underwent considerable exploration and development work including the sinking of three shafts: Shaft No. 1, 105 feet (32 m); shaft No. 2, 105 feet (32 m) and shaft No. 3, 80 feet (24 m) and surface trenching of the main vein for a distance of 500 feet (152 m). Mining, and ore processing equipment was also installed (Bow, 1900). In the spring of 1900 the property, then consisting of locations H.W. 416, 468, 475 and N.T. 22, as sold to the Ottawa Gold Milling and Mining Company Limited which was the owner of the Keewatin Reduction works at Keewatin (now Kenora). The mine again changed name and became the Sakoose Mine under the new owners. To facilitate the shipment of the ore to the Reduction Works in Keewatin, a railway spur was built between the mine and the main C.P.R. line at

Dyment. Under the new management, shaft No. 1 was deepened to a depth of 165 feet (50 m) with additional drifting. Ore was shipped to the Reduction Works as soon as the railway spur was completed (Carter, 1901). The mining and shipping of ore continued until March 1902 when the operations were suspended as most of the ore had been quarryied out from the main vein and due to management/shareholders difficulties (Carter, 1902). By that time a total of 8028 tons of ore had been milled yielding 3,413 ounces of gold (Resident Geologist's Files, Kenora, Ontario, see Table E 4). Activity on the property ceased until 1931 when the mine received new attention: The following account is taken from Thomson's (1934) report:

> "The mine was examined by Percy E. Hopkins, consulting geologist in June 1931, and 500 feet of diamond drilling was done. Mr. Hopkins has informed the writer that No. 1 shaft averaged $17 per ton (The price of gold in 1931 was based on a figure of $35.00 U.S. per ounce) in gold across 18 inches to a depth of 120 feet, and sampling of the open cut immediately east of this shaft averaged around $10 per ton in gold. Four short diamond-drill holes were sunk west of the shaft in an endeavour to find the extension of the vein under drift, but it was not located".

In 1934 the property was acquired by Sakoose Gold Mines Limited. Shaft No. 1 was dewatered and the stope remnants were sampled. A total of 2973 feet (906 m) of diamond drilling was done from 7 holes (see figure E 2). A two compartment shaft (shaft No. 4) was started 500 feet (150 m) southwest of shaft

No. 1 and sunk to a depth of 143 feet (43 m) (Sinclair et al., 1935; 1936). All work was suspended in May 1935 and in August of that year the assets of the company were taken over by Nordic Sturgeon Gold Mines Limited (Sinclair et al. 1936). The property was then acquired by Van Houten Gold Mines Limited in 1944 who installed a mill designed to test run a 6,000 ton dump that has been left by the former operators (Smith, 1945). Development operations resumed during the months of August and September 1946 and 204 feet (62 m) of drifting was done. Thirty-one holes were diamond drilled from the surface over an aggregate length of 1,601 feet (488 m) and 25 holes totalling 2,891 feet (881 m) were drilled from underground (Smith, 1947). Mining was carried out from January to November 1947 and the mill treated 801 tons of ore from which 231 ounces of gold and 141 ounces silver were recovered. A further 158 feet (48 m) of drifting, 2,000 feet (610 m) of diamond drilling from 20 holes on surface and 1,000 feet (305 m) of drilling from 15 holes underground had been accomplished (staff of the Inspection Branch, ODM Annual Report vol. 56, pt. 2 p. 93, 1948). The operations ceased at the end of 1947. In 1958 the property was restaked by G.L. Pidgeon of Wabigoon who optioned it to Brewis and White Limited of Toronto (Satterly, 1960). Two diamond drill holes totalling a length of 992 feet (302 m) were put down south of Shaft No. 3. (see Figure E 2) by Mid North Engineering Services Limited in 1960. Intersected quartz vein assays gave only traces of gold. The claims were then abandoned. In 1978, J. Redden restaked the property with five claims; since that date exploration consisted of bulldozer trenching, rock sampling, collection of soil samples for a geochemical survey, geological mapping, a magnetometer and V.L.F. - E.M. surveys and the examination of the underground workings (3). By 1982 extensive bulldozer stripping had been done and a leaching platform was laid.

b) Geology of the Van Houten Mine

Rocks in the immediate vicinity of the Van Houten Mine are highly diversified and consist of tholeiitic, mafic, massive and pillowed flows and their intrusive equivalents, felsic volcanic units of tuff, lapilli-tuff and tuff breccia which are commonly well stratified and units of epiclastic sediments represented by arkose, wacke, slate and interlayered bands of wacke, slate, mafic tuff and magnetite-bearing iron formation. Mudstone may have a high sulphide (pyrite) content and is then characterized by a rusty weathering colour on surface. Numerous feldspar and quartz-feldspar porphyry dikes up to several metres in thickness cross-cut the rocks mentioned above at various angles. A large body of massive granodiorite, the Revell Batholith, intrudes the volcanic-sedimentary assemblage and a few dikes related to the batholith are found near its margin. All rocks except the granodiorite have been metamorphosed under greenschist facies conditions. Rocks as far as 1,500 m away from the granodiorite have been subjected to thermal metamorphism, the effects of which became increasingly noticeable approaching the contact. Mafic rocks which were subjected to lower amphibolite grade metamorphism are typically dark green to black and are very hard.

Felsic rocks and epiclastic sediments may have inherited a cherty appearance.

The structural aspect of Van Houten Mine area remains unclear because mapping had not been done at a level adequate to define the smaller scale structures which occupy the core of the anticline whose axis straddles the northern boundary of the map area. The following observations that were made in the field point towards a complex picture that could only be clarified by a more detailed mapping project:

- Bedding attitudes present non uniform strike directions throughout a small area; dips are steeply inclined to vertical.
- Foliation has been found to intersect bedding at high angles.
- Mesoscopic folds are commonly observed in stratified rocks.
- Shear zones are frequently encountered as well as quartz filled fractures some of which are mineralized with sulphides and gold.
- The major structural trend is oriented in a north easterly-southwesterly direction, whereas the overall trend of the Kawashegamuk Lake Group is northwest-southeast. It is inferred that a set of folds with northeast-southwest axes whose position have not been determined, govern the structural trends of the rocks in the Van Houten Mine area. Further, it may be speculated that quartz veins in the area are filled tension fractures related to folding.

The main quartz vein which was mined occurs in felsic meta-volcanic rocks which are cut by numerous feldspar-quartz porphyry dikes. The vein may be followed on surface for over 200 m along a northeast-southwesterly trending line, is up to 2 m thick and dips at 70° to the south. At a distance of 115 metres from Shaft No. 1, the vein makes a 90° bend for 30 m before it takes a northeasterly trend again (Figure E 2). The south wallrock to the vein is a dark feldspar porphyry dike with white feldspar phenocrysts and a few small quartz eyes. The vein has a coplanar attitude to the porphyry dike which may suggest that the open fracture through which mineralizing solutions were channeled was controlled by the dike. A distinct slickenside lineation is present on the south wall of the open cut where the vein is in contact with the porphyry. Close to Shaft No. 3, loose rock fragments of unknown provenance were showing a brecciated quartz eye porphyry in which the very angular fragments are cemented by grey vein quartz. In 1981, the writer examined the vein material from the mine. Near Shaft No. 1 abundant vein quartz occurred in a large dump: it ranges from a milky variety to a black type and is highly fractured. The white quartz variety is free from any other minerals besides iron-rich carbonate which may account for approximately 20% of the vein material, whereas the dark variety carries sphalerite, chalcopyrite, pyrite, pyrrhotite, minor galena and free gold as disseminations and small massive pods. Company reports also mention native silver, native copper and bornite (Resident Geologist's Files, Kenora, Ontario, Assessment Files Research Office, Ontario Geological Survey, Toronto). The metallic minerals are found as late fracture fillings in the quartz. Upon inspection of the open cut near Shaft No. 1, little quartz was left to see. One sample which was still attached to the wall rock revealed a dark variety of quartz carrying abundant sulphides with much sphalerite near the vein contact and white quartz, barren of metallic minerals away from the wall rock (sample 1302, Fig. E 2). Away from Shaft No. 1, the white variety of quartz predominates; at location 1305 (Fig. E 2) numerous narrow parallel quartz veins crosscut an altered porphyry in which iron-carbonate, green fuchsite, pyrite, pyrrhotite and chalcopyrite are found. At location 1306 the vein is up to 4 m wide and consists of light coloured quartz mineralized with pyrite. Near Shaft No. 3 the dark variety of quartz is found again. In two places, 450 m and 950 m northwest of Shaft No. 1 dark quartz veins have been found. The former one is black with chalcopyrite and pyrite fracture infillings. A test pit has been made on the vein in the past. At Shaft No. 4 the quartz vein is not observed on surface but samples from an adjacent dump reveal dark grey porphyry and grey quartz with abundant ferroan carbonate and iron sulfides. It is worth noting that all veins which have received attention extending from Shaft No. 4 to a small quartz vein 1000 m away to the northeast are almost colinear.

c) Economic aspects of the Van Houten Mine

Production at the Van Houten Mine started shortly after its discovery in 1897 and most gold obtained to the present date was recovered between 1899 and 1902 (see Table E 6). At the time of discovery, the up to 2 metre wide quartz vein was exposed on surface over a length of approximately 200 metres, and it was an easy operation to just quarry the vein out. In the following years, exploration work was carried out in order to probe the potential of the deposit at depth. A diamond drilling program by Sakoose Gold Mines Limited and four holes previously drilled under the supervision of P.E. Hopkins (see drill hole positions on Figure E 2) helped to delineate the ore body; samples from vein material in drifts assisted in property evaluation. From the exploration data available in 1936, the ore reserves were calculated at 44,000 tons at an average ore grade estimate of 0.3 oz gold/ton (Assessment Files Research Office, Ontario Geological Survey, Toronto). The value of 0.3 oz/ton has mainly been taken from an extensive sampling program carried out in 1934 inside No. 1 shaft from which values ranging up to 2.0 oz/ton gold and 1.6 oz/ton silver over a width of 4 feet were encountered (Assessment Files Research Office, Ontario Geological Survey, Toronto). In addition to this, a 450 pound sample from the 70 ft. level was sent to the Mines Branch in Ottawa in 1934. The assay gave: gold, 0.28 oz/ton; silver 0.24 oz/ton; copper, 0.28%; zinc, 0.50%; lead, 0.05% and arsenic, 0.03% (Resident Geologist's Files, Kenora, Ontario, Assessment Files Research Office, Ontario Geological Survey, Toronto).

It appears that gold and silver are mostly associated with quartz mineralized with sulfides and in particular with sphalerite and chalcopyrite. Furthermore, these minerals are intimately associated with the dark coloured quartz: Table E 7 shows analytical and assay results of vein material from some locations along the strike of the vein.

Selco Mining Corporation Limited[6] (1978) (17)

During the years 1976 to 1978 Selco Mining Corporation Limited has carried out exploration work on four unpatented claim groups within the present map area, namely blocks 800-3, 800-6, 800-7 and 800-19.

Claim block 800-3 straddles the southern boundary of Melgund Township and only 6 claims out of a group of 20 claims are within the map area. Ground geophysical exploration had delimited a conductor in Melgund Township just north of map limit, and a 148 feet (45 m) deep hole was diamond drilled. It was found that graphite-bearing sediments caused the anomaly.

Claim block 800-6 contains 70 claims between Lowery and Mennin Lakes which comprise claim numbers K449815-K449859, K484068-K484071 and K488156-K488176. Ground geophysical work and geological mapping had been done in 44 claims using grid lines. The geophysical work consisted of a magnetic survey and a horizontal loop electromagnetic (H.L.E.M.) survey using a frequency of 1777 Hz and a coil separation of 400 feet. A total of 29 conductive zones had been picked up, of which 10 warranted further investigation. Two holes had been drilled in 1978: Hole 800-6-1, 187 feet (57 m) long trending at 040o and a dip of 50° has been put down on a conductor in felsic volcanic rocks with a coincident high magnetic anomaly. The hole occurs near a series of trenches which had been emplaced on a mineralized shear zone for the McLean Syndicate in 1943. Mineralized zones with pyrrhotite and minor chalcopyrite in a felsic volcanic fragmental

6 All information from reports by Selco Mining Corporation Limited submitted to the Assessment Files Research Office, Ontario Geological Survey, Toronto.

rock have been intersected. Assays gave 0.01-0.05% Cu, and 0.02-0.07% Zn and a trace of gold. Hole 800-6-2 has been drilled in an area underlain predominantly by mafic volcanic rocks with a low magnetic expression that stratigraphically underlie the felsic rocks in which hole 800-6-1 was drilled and form the basal unit of the Kawashegamuk Lake Group. It is 61 m (200 feet) long, trends, 040o and dips 50o at the collar. Pyrrhotite and traces of chalcopyrite have been intersected in rhyolitic lapilli tuff, which is interpreted as being an interflow felsic horizon.

Claim block 800-7 adjoins block 800-6 to the north. It comprises 14 contiguous claims (K-449782-449791 and 488152-488155) four of which have received exploration work consisting of a magnetometer survey and an electromagnetic (H.L.E.M.) survey. One good conductive zone was detected but no further work was done.

Claim block 800-19 is a group of 10 claims (K 449530 - K449539) situated about 3 km north of Boyer Lake. Work consisted of ground geophysics (Magnetometer - Horizontal Loop E.M. surveys) along grid lines. Two bedrock source conductors were detected in addition to several weak overburden responses. One conductor was drilled in 1976 (Hole No. 800-19-1; trend 180; dip; 50o length: 91 m (298 feet). Graphitic zones associated with carbonate veins in a dacitic rock were found to be the cause of the anomaly. The hole was drilled in an area of poor surface exposure within the predominantly mafic Boyer Lake Group. The felsic rocks encountered in the hole are indicative of limited felsic volcanic pulses as is evidenced by breccias consisting of felsic fragments set in a mafic tuff and by felsic units found nearby on surface.

Sulpetro Minerals Limited (Tabor Lake Prospect) (18)

a) History of Exploration and Development

Within the map area, the ground immediately north of Tabor Lake has received more attention than any other part of the Kawashegamuk Lake area except the Van Houten Mine. The long history of exploration and development goes back to 1897 when two prospectors, J. Tabor and J. Stephenson staked location S.V. 258 (later claim K912) centered on a quartz vein reported to be 1 foot wide and 100 feet along from which gold could be panned (Mineral Resources Branch, Dept. Energy, Mines and Resources, Ottawa, Files on Gold, Tabor Lake). In 1898 Eastern Townships Mining and development company of Sherbrooke, Quebec became the operator of the property after if was leased by the original owners. A 60 foot (18 m) shaft had been sunk on a 80o incline and some trenching had also been done along the main vein (Bow, 1899). The property was later abandoned. Prior to 1934 it was acquired by the Clark Syndicate which became incorporated in October 1934 to undertake further development work that was carried out until November 1935. The property then consisted of one patented claim (K912) and 14 unpatented claims around it (K3875, K3877, K4750-K4752, K4781, K4787-K4789, K4791, K4792, K4794-K4796). Limited open cut mining was done and several shipments of ore were made (Sinclair et al., 1936). The net yield was as follows:

Ore Milled	Au (Oz)	Overall grade	Total value Au	Total value Ag
77 tons	35.6	0.462 oz/ton	Can. $(*) 1248	Can.$(*) 2

Source: Statistical Review of the Mineral Industry of Ontario for 1935 - Ontario Department of Mines Annual Report Vol. 45 pt 1 p. 11.

Underground work was started in April 1935 and suspended at the end of September 1935. During this time interval, the original shaft was cut to vertical and timbered. A level was established at 20.7 m (68 feet) and 6 m (20) feet of drifting was done (Sinclair et al. 1936). During 1936, the 2-compartment shaft was enlarged to 3-compartments and was deepened to 45 m (148 feet) with a level established at 38 m (125 feet). At this level, 39 m (129 feet) of crosscutting and 24 m (78 feet) of drifting were done; an additional 3.7 m (12 feet) of drifting was done on the 68 foot level. At the end of September 1936, the underground operations were suspended; however diamond drilling was initiated and by the end of that year 165 m (540 feet) of drilling had been accomplished (Sinclair et al., 1937). During 1937, fifteen diamond-drill holes totalling 1368 m (4,500 feet) were drilled from the surface. Underground work was resumed by deepening the shaft to 85 m (280 feet) and establishing a third level of 76 m (250 feet). Lateral work consisted of 10 m (32 feet) of drifting on the 68-foot level, 41 m (134 feet) of crosscutting and 41 m (134) feet of drifting on the 125-foot level (Sinclair et al., 1938). That year two bulk samples were sent away for assaying. A 1300 pound sample of ore obtained from channel sampling at the 125-foot level was sent to the Mines Branch in Ottawa for assaying and testing. The results obtained were going to be decisive in choosing the type of mill which was going to be erected on the property (Assessment Files Research Office, Ontario Geological Survey, Toronto). The returned report dated october 13th, 1937 prepared by the ore dressing and metallurgical laboratories, Ottawa is apparently the most complete account on the vein material of the Tabor Lake prospect filed so far (Assessment Files Research Office, Ontario Geological Survey, Toronto). A quoted section is given here:

> "Six polished sections were prepared and examined microscopically for the purpose of determining the character of the ore.
>
> The gangue is somewhat variable in character, the components being white vein quartz, light grey and fine-textured siliceous rock with considerable finely disseminated carbonate and cut narrow veinlets of calcite, and fine-textured green chloritic rock.
>
> Pyrite, the most prominent metallic mineral in the ore, is present in very small quantity as sparsely disseminated medium to very small grains. There is a distinct tendency for the mineral to occur most abundantly along narrow sinuous stringers in the quartz. Along these stringers occur very small amounts of galena and sphalerite, usually

associated with pyrite"...

...Small irregular grains of native gold occur along the pyrite stringers. As shown in the following table, 60 percent of the gold occurs alone in the quartz while 40 percent is in contact with the pyrite grains. No cases of gold grains being included in pyrite were noted."

The present author made very similar observations upon examination of samples from the existing tailing piles. An assay of the vein material gave 0.36 oz Au/ton (Assay by the Geoscience Laboratories, Ontario Geological Survey, Toronto). A different bulk sample weighing 1,716 kg (3,788 pounds) obtained from a drift at the 125 feet level (see Fig. E 4b) was sent by the company to the Timiskaming Testing Laboratories in Cobalt, Ontario and assayed at 1.365 oz Au/ton (Assessment Files Research Office, Ontario Geological Survey, Toronto). Other assays were performed for Clark Gold Mines Limited on smaller samples from channel sampling and diamond drilling yielding encouraging results (see Fig. E 4b). No underground work had been done in 1938 but six diamond-drill holes were drilled from the surface totalling a length of 705 m (2,315 feet). Facilities were erected to house a projected 35-tons per day mill, an assay office and a pump house (Sinclair et al. 1939). Despite the optimistic outlook according to various reports and letters at that time, activity ceased in 1938.

In July 1942 a new company, Tabor Lake Mines Limited was incorporated and acquired the property.

During the years 1942-1957 little activity took place at the prospect site which was examined during 1943 by Sylvanite Gold Mines. In 1957 the 15 claims were leased to Pantan Mines Limited. Work resumed in July 1957; the flooded shaft was dewatered and some sampling was done. Six diamond-drill holes were drilled from surface totalling 675 m (2214 feet). A new head frame and housing were also erected (ODM Annual Report (1959) Vol. 68 pt. 2 pp. 51-52). In 1959, 56 m (185 feet) of drifting and 185 feet of crosscutting were completed on the 250 foot level; surface mapping of the property was also done. At the end of that year a mill was constructed capable of handling about 15 tons of ore daily to test a stockpile left by the previous operators (O.D.M. Annual Report 1960, Vol. 69 pt. 2 p. 51) and the necessary equipment to process the ore was installed the following year (ODM Annual Report (1961) vol. 70 pt. 2 pp. 52-53).

No further work was carried out in the following years as a result of financing difficulties. In May 1964 Pantan became Medallion Mines Limited through amalgamation and assigned their lease to the new company. Medallion was later dissolved and the 15 claims reverted to Tabor Lake Gold Mines (The Northern Miner, Vol. 59 No. 44, 1974). In 1976 the Ontario charter of Tabor Lake Gold Mines was cancelled. In 1979, the area was restaked with 39 contiguous claims for St. Joseph Explorations Limited. Surface work consisting of geological mapping, ground geophysics (magnetometer, VLF-EM and H.L.E.M.), sampling of vein material and the diamond drilling of four holes totalling 621 m (2037 feet) was carried out in 1979-1980 (Assessment Files Research

Office, Ontario Geological Survey, Toronto). In 1981, Sulpetro Minerals Limited (formerly St. Joseph Explorations Limited) dewatered the underground works and performed geological mapping and sampling at the 125 foot and 250 foot levels (Assessment Files Research Office, Ontario Geological Survey, Toronto). Sulpetro Minerals also carried out ground geophysical work in 1981-82 on several claim groups at Kawashegamuk Lake (K563539-K563542, 600791-600794, 600795-600798) Gawiewiagwa Lake (K566712-566713), Kawijekiwa Lake (K600785), Katisha Lake (K563548) and Seggamak Lake (K563549-563551, 570628-570630, 570638-570640) in order to delineate airborne electromagnetic and magnetic anomalies.

b) Geology of the Tabor Lake Prospect

The rocks underlying the area consist mostly of mafic massive and pillowed flows which may be locally plagioclase porphyritic, amygdaloidal or variolitic. Felsic rocks are abundant northeast of Tabor Lake. Epiclastic metasediments consisting of wackes and mudstones are restricted to narrow interflow units.

The metavolcanic rocks have been intruded by numerous felsic porphyry stocks and dikes. A vast area spanning from Tabor Lake to and beyond the western margin of the map has undergone significant alteration which is probably related to the intrusion of the porphyry. Both the porphyry and the surrounding rocks have been carbonatized to varying degrees and in places where the rocks have been sheared the alteration is particularly strong.

The felsic rocks including the porphyry have also been strongly sericitized. The unaltered porphyry is commonly light grey to medium dark grey in colour whereas the altered type is buff to salmon pink. Sericitized rocks are distinguished by their waxy luster and a yellow-green colouration. The geological report prepared by Sulpetro Minerals Limited (Assessment Files Research Office, Ontario Geological Survey, Toronto) states that the colouration of the rocks - which supposedly is indicative of the degree of alteration - is gradational within a unit. It is worth noting that the abundance of porphyry intrusions as well as alteration decreases east of Tabor Lake, thus it is clear that the gold bearing veins at Tabor Lake occur near the margin of an intrusive body which suggests that mineralization is related in space and in time with the emplacement of the porphyry.

The geological setting of the deposit at Tabor Lake has been deduced mostly from exploration and development work carried out by past operators as surface exposure is poor. Diamond drilling and underground excavation have defined an east-west trending porphyry dike approximately 30 m (100 feet) thick and dipping 70^{o}S (Assessment Files Research Office, Ontario Geological Survey, Toronto). Along the north contact of the porphyry is a strong shear zone whose attitude is coplanar with the dike; it carries lenticular bodies of quartz but neither the sheared rock nor the quartz appears to carry significant gold values (Assessment Files Research Office, Ontario Geological Survey, Toronto). Within the dike is a second parallel shear steeply dipping to the south along which is associated a "strong" quartz vein. A description given by a report for Tabor Lake Mines (Assessment Files Research Office, Ontario Geological Survey, Toronto) written by Holbrooke (1943) states:

"This vein has been traced for about 330 feet down the dip and it varies in width from 1 feet to 3 feet. It consists of dark, fine grained, sugary quartz, mineralized by pyrite, galena and chalcopyrite and shows interesting values in gold. It has a dip of 50o South until, in its upward course, it encounters the South shear from which point it follows up along this shear and on surface shows a dip of 80o South."

This vein, called No. 1 vein, is the only vein that intersects the surface and is the one from which 77 tons of ore had been extracted and processed by Clark Gold Mines in 1935 (see section a). Three other quartz veins which carry significant gold values have been intersected by diamond drilling; they are up to 3 feet thick. In addition to these four main veins are numerous smaller veins and stringers which are likely to be offshoots from the main fractures; the concentration of which is variable across the dike.

Rock samples collected by the author on the tailing pile are consistent with descriptions given in earlier company reports. It was noted that all quartz is intimately associated with a buff-to-salmon-pink coloured quartz porphyry. Many porphyry specimens are sheared and show quartz filled fractures parallel to the cleavage of the rock. Numerous quartz veinlets intersect those at various angles (Photo E 1). The latter set of veins present en echelon offsets which took place along the cleavage direction of the porphyry and also present a very distinct fracture cleavage. The porphyry adjacent to some fractures has been silicified (Photo E 1). Small disseminated pyrite cubes occur within the porphyry and probably represent late magmatic sulfide phases. Vein quartz picked on the tailing piles is typically white and shows a hackly fracture. Vein material is commonly mineralized with minor, disseminated pyrite, chalco- pyrite, sphalerite, galena and free gold.

c) Economic aspects of the Tabor Lake deposit

Extensive work has been carried out in the past 50 years on the Tabor Lake property and the compilation of all the geo- logical, chemical and drilling data, (some of which is presented in Figure E 4a), that was generated as a result of this work should provide a good insight to the economic potential of the property. Unfortunately most of the efforts were concentrated on the original find made by Tabor and Stephenson; giving good control at depth where the shaft is located however the lateral extensions of the vein system remain uncertain, particularly to the west of the shaft where a thicker blanket of glacial sediments covers the bedrock.

Numerous assays have been obtained from channel sampling in the underground drifts and crosscuts and from vein material intersected by drilling between 1935 and 1938. Figure E-4b shows a cross-section of the underground development work as well as locations where significant gold concentration have been encountered. The extensive sampling done by Sulpetro Minerals was carried out in the same locations as that done by Clark Gold Mines. An average grade of 0.4 oz/ton gold over a width of 1.2 m (4 feet) and a length of 7.6 m (25 feet) at the 125 feet level and 0.58 oz/ton over a width of 4 feet and a length of 21 m (70 feet) at the 250 feet level were obtained underground (Assessment Files Research Office, Ontario Geological Survey, Toronto). From four diamond drilled holes on surface (see figure E 4a) only two holes intersected significant values: Hole T-1-80: 0.305 oz/ton Au, 0.06 oz/ton Ag over a core length of 1 foot T-2-80: 1.05 oz/ton Au, 0.1 oz/ton Ag over a length of 2.0'. Sampling vein material on surface was also done, and out of 12 veins sampled, one yielded 1.18 oz/ton Au and 0.31 oz/ton Ag over a length of 0.25 m (Assessment Files Research Office, Ontario Geological Survey, Toronto) Silver is always present in minor amounts and ranges from 0.2 to 3 ppm Ag and locally values as high as 0.8 oz Ag ton have been obtained (Assessment Files Research Office, Ontario Geological Survey, Toronto). No silver minerals have yet been reported and it is assumed that it is tied with the gold.

In 1941 ore reserves were calculated according to the data obtained from underground development and diamond drilling within specified limits.

The following breakdown for the calculation was prepared by R.R. Clark and presented in the Tabor Lake Mines Report, 1942 (Assessment Files Research Office, Ontario Geological Survey, Toronto):

"A" vein shows in the drilling for a distance of 150 feet in length and 400 feet in depth, with stopping-width of 3 feet ... 13,846 tons

"B" vein shows for 330 feet in length and 250 feet in depth, with a stopping-width of 3 feet....19,038 tons

"C" vein shows for 280 feet in length and 250 feet in depth, with a stopping-width of 3 feet....16,154 tons

Total Indicated Ore Reserves....49,038 tons

The average recovery was then estimated at US $20.00 ton (*The dollar figures given in most reports from 1935 to 1941 are based on a gold value of $35.00 Can./ounce and a silver value of $0.50 Can./ounce) which is equivalent to a grade of 0.57 oz/ton Au.

In a report dated from September 1980 by Sulpetro minerals, mention is made of a quartz vein 31 m (100 feet long, 122 m (400 feet) deep and 1.2 m (4 feet) wide from which 13,300 tons of ore at 0.34 oz/ton Au have been inferred (Assessment Files Research Office, Ontario Geological Survey, Toronto).

Underwood McLelland and Associates Limited (Newmont option) (1975) (19)

In 1973 an airborne geophysical survey was flown over the Boyer Lake Area for Underwood McLelland and Associates Limited using a Questor Surveys Limited Mark VI INPUT (R) system. Seventeen conductor zones were located from the air and as a result 231 unpatented claims were staked. These claims were then optioned in 1974 to Newmont Mining Corporation of Canada Limited who conducted ground follow up of the conductors, five of which are within the present map-area. Twelve of the seventeen anomalies received detailed electromagnetic and magnetic surveys conducted by Geoterrex Limited (Assessment Files Research Office, Ontario Geological Survey, Toronto). Three diamond drill holes, two of which are within this map area have been done to test the nature of the most promising conductors. Reconaissance geological mapping was also done by Newmont. Conductor No. 16 situated two kilometers southwest of the Van Houten Mine, was drilled by V.M.A. Mines Limited for Newmont. The 300 feet (91 m) long hole revealed pyrite and graphite as being the conductor which is set in a dacitic tuff; also pyrite nodules and veinlets were found in a dacitic fragmental. The graphitic tuff contained small veinlets of brown sphalerite. The drill hole intersected similar rocks as the ones encountered by Asarco (2) which is 3 kilometers northeast of Boyer Lake (Assessment Files Research Office, Ontario Geological Survey, Toronto). In the two holes (number 13-1 and 13-2 being 212 feet), "graphitic sediments" were encountered that are in fact volcanic tuffs. (64 m) and 89 m (292 feet) long holes have confirmed the presence of strong graphite-pyrite zones (Assessment Files Research Office, Ontario Geological Survey, Toronto) which were found by Asarco Explorations Limited while drilling on the same lake in 1971 (Assessment Files Research Office, Ontario Geological Survey, Toronto). No further work was reported on the property and all the claims were allowed to lapse.

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List of companies, properties and mineral deposits described in the text.

1) Anderson, Percy
2) Asarco Exploration Company of Canada Limited
3) Canadian Nickel Company Limited
4) Canadian Pacific Railway Company
5) Church Lake Occurrence
6) Dome Exploration (Canada) Limited
7) Falconbridge Copper Limited
8) Falconbridge Nickel Limited
9) Hudson Bay Exploration and Development Co. Limited.
10) International Nickel Company of Canada Limited.
11) Lee Lake Occurrences
12) Lynx Canada Explorations Limited - Dejour Mines Limited
13) Maw and Greening Syndicate
14) McLean Syndicate
15) Northwestern Ontario Exploration Company
16) Redden, J.W.
17) Selco Mining Corporation
18) Sulpetro Minerals Limited
19) Underwood McLelland and Associates Limited

Appendix A: Sample numbers used in this study and their corresponding original number

	Sample Number	Corresponding O.G.S. Number		Sample Number	Corresponding O.G.S. Number
W	W1	80-0198	B	B1	80-0210A
A	W2	80-0220	O	B2	80-1169
P	W3	80-1014	Y	B3	81-1189
A	W5	80-1127	E	B4	81-1192
G	W6	80-1145	R	B5	81-1413
E	W7	80-1443		B6	81-1427
I	W8	82-1	L	B7	81-1429
S	W9	82-3C	A	B8	81-1428
I	W-10-S	82-4	K	B9	81-1468
	W-10-R	82-4	E	B10	81-1476
L	W-10-C	82-4		B11	81-1480
A	W-11	82-5	G	B12	81-1482
K	W-12	82-8	R	B13	81-1513
E	W-13	82-14	O	B14	81-1516
	W-14	82-15	U	B15	81-1517
G	W-15	82-17	P	B16	81-1528
R	W-16	82-22		B17	81-1540
O	W-17	82-25		B18	81-1620
U	W-18	82-51		B19	82-146
P	W-19	82-54		B20	82-148
	W-20-S	82-121		B22	82-156
	W-20-R	82-121		B23	82-169
	W-20-C	82-121		B24	82-176
	W22	82-131		B25	82-179B
	W23	82-132		B26	82-182
	W24	82-257		B27	82-184
	W25	82-288		B28	82-186
	W26	82-290		B29	82-187
	W27	82-297		B30	82-189
				B31	82-190
				B32	82-191
				B33	82-193
				B34	82-203B
				B35	82-208
				B36	82-228
				B37	82-231
				B38	82-275
				B41-A	80-0141A
				B41-B	
				B41-C	
				B44	80-0144
				B45	80-0137
				B47	80-1167
				B48	80-1177
				B49	80-1186
				B50	80-1431
				B51	80-1438

Group	Sample Number	Corresponding O.G.S. Number
THUNDER CLOUD LAKE PORPHYRY	T1	81-T-1
	T10	81-T-10
	T17	81-T-17
	T19	81-T-19
	T28	81-T-28
	T32	81-T-32
	T38	81-T-38
KATISHA GABBRO	G0	82-101
	G1	82-100
	G2	82-99
	G3-A	82-98A
	G3-B	82-98B
	G3-C	82-98C
	G4	82-97
	G5	82-96
	G6	82-102
	G7	82-103
	G8	82-104
	G9	82-105
	G10	82-107
	G11	82-106
	G12	82-108
	G13	82-109

Group	Sample Number	Corresponding O.G.S. Number
STORMY LAKE GROUP	S1	80-0150
	S2	80-0207
	S3	80-1121
	S4	80-1444
	S5	82-42
	S6	82-43
	S7	82-78
	S8	82-82
	S9	82-136B
	S10	82-142
	S11	82-143
	S12	82-145
	S13	82-278
	S14	82-286A
	S15	82-286B
	S16	82-299
	S17	17-1-2A
	S18	17-1-2B
	S19	17-2
	S20	17-3
LATE GRAN-ITIC ROCKS	L1	80-0132
	L2	80-1042
	L3	81-1319
	L4	81-1638
	L5	81-1640
	L6	82-163
	L7	82-203A
	L8	82-280

	Sample Number	Corresponding O.G.S. Number	Sample Number	Corresponding O.G.S. Number
	K1	81-1201	K50	81-1586
	K2	81-1206	K51	81-1587
K	K3	81-1208	K52	81-1590A
A	K4	81-1209A	K53	81-1590B
W	K5-M	81-1210	K54	81-1605
A	K5-F	81-1210	K55	81-1606
S	K6	81-1211	K56	81-1611
H	K7	81-1212	K57	81-1612
E	K8	81-1214	K58	81-1622
G	K9-M	81-1215	K59	81-1623
A	K9-F	81-1215	K60	81-158
M	K10	81-1220	K61	DM-6
U	K11	81-1222	K62	DM-11-1
K	K12	81-1223	K63	DM-?
	K13	81-1233A	K64	80-0139
L	K14	81-1278	K65	80-0146
A	K15	81-1290		
K	K16	81-1291A		
E	K17	81-1310		
	K18	81-1313		
G	K19	81-1316		
R	K20	81-1329		
O	K21	81-1331		
U	K22	81-1350		
P	K23	81-1364		
	K24	81-1380		
	K25	81-1397		
	K26	81-1412		
	K27	81-1419		
	K28	81-1426		
	K32	81-1450		
	K33	81-1452		
	K34	81-1453		
	K35	81-1462		
	K36	81-1467		
	K37	81-1471		
	K38	81-1472		
	K39	81-1474		
	K40	81-1486		
	K41	81-1494		
	K42	81-1497		
	K43	81-1501		
	K44	81-1505		
	K45	81-1510		
	K46	81-1563		
	K47	81-1565		
	K48	81-1568		
	K49	81-1570		

Appendix B: Chemical data

Table C1

Sample No.	SiO2	Al2O3	Fe2O3[1]	MgO2	CaO	Na2O2	K2O	TiO2	MnO2	P2O5	LOI	Total	Description[1]
W1	63.06	15.46	4.57	1.95	3.19	a3.96	1.74	0.47	a 0.04	0.20	3.95	98.59	Dc,FP,Di
W1-D	63.19	15.53	4.44	1.93	3.23	3.75	1.72	0.47	a 0.04	0.20	3.95	98.45	Dc,FP,Di
W2	50.56	15.51	0.20	a 5.02	10.73	a2.31	1.07	0.45	a 0.21	0.10	4.46	100.62	BA,Ca,Tf
W3	43.37	5.91	10.29	18.00	7.16	0.00	0.04	0.39	0.18	0.10	14.56	100.00	Um,Di
W5	67.57	15.61	4.50	0.96	3.76	3.77	0.73	0.50	0.06	0.14	1.53	99.13	Rh,Ca,Tf
W6	54.77	10.09	19.83	3.47	9.34	a0.55	0.11	0.29	0.37	0.10	1.35	100.29	Ba,Th,Fl
W7	54.02	13.45	9.10	a 6.40	6.44	4.76	1.96	0.77	a 0.11	0.37	2.44	99.81	Ga,Al,Di
W8	50.55	14.65	13.55	a 4.25	11.93	a2.67	0.17	0.85	a 0.21	0.09	1.71	100.63	Ba,Th,Fl
W9	73.10	14.03	1.11	a 1.40	2.00	1.82	2.58	0.15	a 0.02	0.03	3.76	100.00	Rh,Ca,Di
W10-S	34.22	17.65	23.50	a11.91	4.22	0.40	0.02	1.07	0.30	0.12	7.25	100.66	Ba,Th,Fl
W10-R	55.79	14.01	9.16	a 4.11	10.35	n2.52	0.06	0.82	a 0.13	0.07	3.94	100.98	Ba,Th,Fl
W10-C	49.98	14.49	13.67	5.76	11.50	n0.90	0.05	0.82	0.18	0.05	3.72	101.12	Ba,Th,Fl
W11	48.53	14.99	13.31	a 7.37	10.64	n1.50	0.05	0.91	0.16	0.13	3.74	100.27	Ga,Th,Si
W12	48.12	15.19	13.49	a 7.40	11.89	a1.84	0.05	0.88	a 0.20	0.14	2.76	100.48	Ba,Th,Fl
W12-D	48.03	14.74	13.71	7.65	11.94	-	0.05	0.88	a 0.20	0.10	2.76	100.06	Ba,Th,Fl
W13	48.17	14.34	15.67	a 5.53	8.48	a3.17	0.72	1.20	0.18	0.13	3.17	100.76	Ga,Th,Si
W14	47.75	16.12	11.76	a 5.07	11.21	a1.33	0.20	0.80	a 0.16	0.08	7.88	102.36	Ga,Th,Si
W15	50.83	14.70	13.68	a 6.52	7.15	a3.38	0.09	1.45	a 0.18	0.06	2.06	100.10	Ba,Th,Fl
W16	73.41	14.13	1.24	a 0.40	2.00	5.46	1.95	0.18	a 0.01	0.06	0.75	99.60	Rh,Ca,Di
W17	58.13	14.29	5.29	4.96	7.08	3.35	2.05	0.47	0.14	0.14	3.39	99.29	Ad,Ca,Di
W18	50.12	11.90	9.34	a 9.05	7.87	a2.87	2.35	0.64	a 0.14	0.25	5.52	100.30	Lm,Al,Di
W19	61.71	14.23	4.52	a 3.40	4.14	a4.70	1.98	0.49	a 0.06	0.22	4.34	99.79	Ad,Ca,Di
W20-S	35.70	16.87	20.78	7.40	9.80	a0.60	0.02	2.06	a 0.28	0.12	6.77	100.40	Ba,Th,Fl
W20-R	54.90	13.74	10.99	4.49	6.89	a4.33	0.06	1.30	0.15	0.16	2.44	99.45	Ba,Th,Fl
W20-C	50.06	14.24	13.33	5.29	9.80	a3.10	0.05	1.33	a 0.18	0.15	3.19	100.72	Ba,Th,Fl
W22	56.04	15.88	5.34	a 2.33	4.94	a6.75	1.42	0.56	0.06	0.10	5.50	98.92	Sy,Al,Di
W23	60.69	16.77	6.49	a 4.40	0.73	a0.40	4.53	0.48	a 0.05	0.15	4.40	99.09	Ad,Th,Fl
W24	-	-	1.31	a 0.52	1.68	a3.97	2.85	0.18	0.03	0.01	1.28	-	Rh,Ca,Tf
W25	65.51	15.10	3.50	a 1.54	3.99	a4.07	1.53	0.37	a 0.03	0.16	4.08	99.88	Da,FP,Di
W26	75.18	12.58	1.36	a 0.65	3.19	n3.07	1.61	0.40	a 0.02	0.07	1.28	99.41	Rh,Ca,Tf

Table C1

Sample No.	SiO2	Al2O3	Fe2O3[1]	MgO[2]	CaO	Na2O[2]	K2O	TiO2	MnO[2]	P2O5	LOI	Total	Description[3]
W27	71.88	14.17	1.92	a0.81	2.52	n4.10	2.66	0.22	a0.03	0.03	1.46	100.00	Rh,Ca,Tf
S1	69.00	15.68	2.71	a1.21	2.20	n4.20	2.40	0.32	a0.03	0.16	2.19	100.10	Rh,Ca,Tf
S2	65.46	14.51	3.14	2.10	3.82	a4.48	1.78	0.39	a0.04	0.18	2.87	98.78	Rh,Ca,Cl
S3	58.52	13.68	5.51	a7.90	4.68	a4.40	1.88	0.59	a0.08	0.18	2.34	99.76	Ad,Ca,Cl
S4	56.59	16.16	7.69	a1.88	4.81	a3.39	1.52	0.79	a0.12	0.45	5.53	98.93	Ad,Ca,Cl
S4-D	56.56	15.71	7.85	a1.82	4.79	a3.23	1.52	0.80	0.13	0.53	5.53	98.47	Ad,Ca,Cl
S5	66.96	14.98	2.32	a0.80	1.83	a4.68	2.45	0.49	a0.03	0.24	3.89	98.67	Da,Ca,Cl
S5-D	67.08	14.90	2.28	a0.80	1.82	-	2.37	0.48	a0.03	0.27	3.89	98.60	Da,Ca,Cl
S6	62.55	14.70	2.19	a0.88	5.27	5.83	1.27	0.53	a0.06	0.26	5.70	99.24	Da,Ca,Cl
S7	72.03	14.22	1.02	a0.40	2.05	4.04	2.58	0.17	a0.02	0.04	2.81	99.38	Rh,Ca,Tf
S8	57.76	13.04	5.76	5.63	5.09	4.87	0.62	0.55	a0.08	0.17	5.21	98.78	Ad,Ca,Dl
S9	64.74	15.14	2.53	a1.20	2.69	a4.67	2.05	0.41	a0.05	0.13	4.59	98.20	Sy,Al,Dl
S10	63.28	14.43	2.68	a2.57	4.56	a4.96	1.65	0.49	a0.05	0.22	4.41	99.30	Da,Ca,Cl
S11	52.03	15.31	11.35	a5.98	3.41	n3.58	1.33	1.43	a0.09	0.15	6.54	101.20	BA,Ca,Fl
S12	64.54	-	2.36	a2.20	1.35	a3.23	3.30	0.43	a0.02	0.07	2.49	-	Da,Ca,Cl
S13	60.95	14.31	9.54	a3.40	1.12	2.99	2.32	0.66	a0.14	0.09	3.60	99.12	Wacke
S14	74.47	11.36	1.15	a0.38	1.27	a4.96	1.03	0.16	a0.02	0.14	1.18	96.12	Rh,Ca,Cl
S15	62.40	12.99	3.90	a1.62	3.51	2.83	2.86	0.56	a0.13	0.12	4.11	95.03	Ad,Ca,Cl
S16	73.92	14.04	1.23	a0.26	1.81	a5.10	1.83	0.16	a0.02	0.03	1.53	99.93	Rh,Ca,Tf
S17	67.72	16.09	2.18	a0.83	1.41	a4.46	3.00	0.70	a0.02	0.24	2.28	98.93	Rh,Ca,Cl
S18	71.67	13.94	2.10	a1.09	1.53	a3.64	2.51	0.28	a0.02	0.14	2.39	99.30	Rh,Ca,Cl
S19	56.94	15.32	6.81	a4.47	3.69	a6.45	0.78	0.45	a0.10	0.21	5.72	100.94	Ad,Ca,Cl
S20	57.17	16.44	6.12	a5.40	1.69	a4.64	3.01	0.62	a0.03	0.24	4.66	99.72	Ad,Ca,Cl
T1	72.25	16.03	1.43	a0.52	1.71	n3.33	2.43	0.16	a0.02	0.12	1.66	99.66	Rh,QFP,S
T10	71.06	14.90	1.39	a0.35	2.05	n4.56	2.58	0.16	a0.01	0.07	2.14	99.27	Rh,QFP,S
T17	74.31	15.03	1.39	a0.36	1.87	n3.72	2.60	0.17	a0.02	0.03	0.44	99.97	Rh,QFP,S
T19	72.14	15.35	1.27	a0.43	2.07	n4.54	2.14	0.16	a0.03	0.08	1.03	99.24	Rh,QFP,S

Table C1

Sample No.	SiO2	Al2O3	Fe2O3t	MgO2	CaO	Na2O2	K2O	TiO2	MnO2	P2O5	LOI	Total	Description3
T19-D	72.50	14.86	1.22	a0.43	2.06	a4.73	2.16	0.16	a0.03	0.07	1.03	99.24	Rh,QFP,S
T28	70.88	15.40	1.33	a0.46	2.30	4.70	2.95	0.17	a0.03	0.05	1.57	99.84	Rh,QFP,S
T32	65.60	14.73	4.61	a2.11	2.12	n3.54	2.05	0.43	0.05	0.13	3.31	98.69	Da,Bx,S
T38	63.94	14.29	4.69	a2.31	3.48	3.86	1.98	0.50	a0.08	0.15	4.43	99.71	Da,Bx,S
T38-D	64.13	14.26	4.57	a2.32	3.53	3.81	2.00	0.49	a0.08	0.16	4.43	99.78	Da,Bx,S
B1	48.10	16.39	11.35	8.18	10.22	1.74	0.64	0.46	0.18	0.05	3.46	100.77	Ga,Ta,Si
B1-D	47.82	16.35	11.31	8.79	10.31	-	0.64	0.46	0.17	0.05	3.46	101.10	Ga,Ta,Si
B2	53.01	14.62	8.01	a3.15	8.67	4.18	0.07	0.77	0.16	0.12	7.21	99.96	Ad,Th,Fl
B3	66.37	14.41	3.20	a0.82	3.23	3.37	3.53	0.40	a0.04	0.13	4.35	99.84	Rh,QFP,S
B3-D	68.61	14.64	2.54	0.36	2.64	-	3.51	0.40	0.04	0.11	4.35	-	Rh,QFP,S
B4	62.81	14.12	3.36	a1.34	3.94	5.11	2.22	0.42	a0.05	0.13	6.61	100.10	Da,Fp,S
B5	49.67	14.50	11.89	6.67	10.83	a2.68	0.41	0.88	a0.18	0.10	2.91	100.71	Ba,Th,Fl
B6	48.31	13.63	16.95	a4.77	9.31	a2.23	0.10	1.84	a0.21	0.21	2.68	100.24	Ba,Th,Fl
B7	48.74	12.69	17.10	5.31	6.88	3.67	0.20	1.53	a0.23	0.21	3.16	99.72	Ba,Th,Fl
B8	48.59	13.56	17.12	4.47	7.91	3.31	0.39	1.37	a0.19	0.15	2.20	99.26	Ga,Th,Si
B9	51.29	14.24	11.82	a5.65	10.23	a2.74	0.10	0.88	a0.18	0.18	2.69	100.00	Ga,Th,Si
B10	49.44	14.46	12.62	5.08	12.33	1.41	0.14	0.86	a0.18	0.13	3.89	100.54	Ba,Th,Fl
B11	50.23	13.97	12.19	6.79	9.74	2.35	0.14	0.83	0.18	0.20	3.41	100.03	Ga,Th,Fl
B12	47.25	14.59	14.50	5.63	10.47	3.35	0.16	1.26	0.14	0.08	2.00	99.43	Ba,Th,Fl
B13	66.86	15.19	3.14	a1.01	2.45	4.80	2.40	0.43	a0.04	0.19	2.55	99.06	To,Ca,S
B14	65.37	15.10	2.85	a1.10	2.52	5.38	2.39	0.45	a0.04	0.17	1.37	96.26	To,Ca,S
B15	48.90	13.03	19.08	4.91	10.05	a1.31	0.32	1.66	0.32	0.13	1.79	101.50	Ga,Th,Si
B16	48.56	14.65	13.96	5.78	10.74	a2.49	0.21	1.23	a0.18	0.11	1.75	99.66	Ga,Th,Si
B17	54.06	14.77	8.47	a3.95	5.34	4.65	2.50	0.87	a0.13	0.33	4.35	99.42	Lm,Al,Di
B18	63.83	15.25	3.91	a1.30	3.20	6.03	2.25	0.53	a0.06	0.29	2.30	98.75	Da,Fp,Di
B19	48.72	14.50	14.91	a3.59	7.89	2.85	0.08	1.53	0.22	0.14	7.23	101.66	Ba,Th,Fl
B20	45.14	16.85	12.46	a4.84	8.33	a4.75	0.09	1.31	a0.24	0.11	7.47	101.59	Ba,Th,Fl
B22	49.02	11.88	16.34	a2.17	8.00	2.94	1.00	1.64	a0.22	0.25	7.58	101.04	Lm,Di

Table C1

Sample No.	S102	A1203	Fe2031	Mg02	CaO	Na202	K20	T102	Mn02	P205	LOI	Total	Description3
B22-D	48.07	11.25	16.74	a2.14	7.95	3.46	0.99	1.64	a0.20	0.21	7.58	100.23	Lm,Dl
B23	48.54	12.63	14.58	a3.92	8.83	2.68	0.20	1.36	a0.25	0.18	8.25	101.41	Ba,Th,Fl
B23-D	48.59	12.40	14.88	a4.10	9.02	2.63	0.21	1.37	a0.25	0.15	8.25	101.85	Ba,Th,Fl
B24	46.96	14.62	15.21	4.63	6.36	3.86	0.59	1.29	0.21	0.11	7.74	101.58	Ba,Th,Fl
B25	52.01	13.11	16.59	4.82	8.84	1.44	0.12	1.03	0.24	0.08	2.99	101.27	Ga,Th,Sl
B26	51.95	13.55	13.80	a5.36	6.61	a2.29	0.03	1.09	a0.18	0.06	6.61	101.53	Ba,Th,Fl
B27	49.47	13.98	16.44	a3.74	7.71	3.34	0.44	1.44	a0.19	0.16	4.07	100.98	Ba,Th,Fl
B28	48.26	13.17	14.72	a4.26	9.84	2.22	0.19	1.45	0.15	0.14	5.75	100.15	Ba,Th,Fl
B29	53.28	14.35	11.87	a4.10	7.05	a4.65	0.08	1.53	0.16	0.08	4.44	101.59	BA,Th,Fl
B30	46.51	12.16	13.30	3.20	9.11	3.92	0.22	1.42	0.54	0.21	12.24	102.84	Ba,Th,Fl
B31	45.51	11.23	16.09	a3.75	7.85	1.77	0.33	1.28	0.52	0.12	13.17	101.62	Ba,Th,Fl
B32	43.67	13.32	12.88	a4.66	8.77	2.05	0.24	1.12	a0.15	0.06	15.56	102.48	Ba,Th,Fl
B33	51.26	13.29	7.01	a2.57	6.56	a3.24	1.18	0.66	0.06	0.09	10.92	96.84	Da,Th,Fl
B34	61.82	15.04	4.27	1.76	3.61	5.85	2.84	0.57	a0.17	0.23	2.63	98.69	Da,FP,Dl
B35	47.56	14.61	17.26	a5.64	6.67	n3.82	0.25	1.49	a0.20	0.11	2.39	100.00	Ba,Th,Fl
B36	49.92	13.42	14.45	a7.02	7.82	a3.60	0.20	1.34	a0.18	0.13	2.52	100.60	Ba,Th,Fl
B37	49.45	15.22	12.08	7.70	10.38	2.15	0.18	0.62	a0.20	0.09	2.25	100.32	Ga,Th,Dl
B38	57.84	15.43	12.36	a2.61	2.30	3.07	1.77	0.64	a0.09	0.08	2.31	98.50	Wacke
B41-A*	45.60	15.80	14.10	6.78	5.40	2.45	0.02	1.23	0.17	0.05	8.40	95.69	Ba,Th,Fl
B41-B*	46.50	16.60	13.90	3.47	5.41	1.10	0.91	1.36	0.14	0.06	10.70	96.28	Ba,Th,Fl
B41-C*	58.30	16.00	7.91	1.38	4.33	1.87	0.85	0.69	0.09	0.08	7.80	96.18	Ba,Th,Fl
B44*	63.60	15.60	3.24	1.03	3.10	4.66	1.33	0.48	0.04	0.09	5.70	97.96	Da,Ca,Fl
B45*	37.10	10.90	14.30	8.12	9.10	0.73	0.00	0.94	0.20	0.05	17.30	97.30	Ba,Th,Fl
B47*	58.80	15.90	6.27	1.42	3.79	3.98	1.40	0.71	0.09	0.07	6.10	96.74	Ad,Th,Fl
B48*	70.30	15.70	2.47	0.27	0.72	4.99	1.48	0.35	0.05	0.07	1.70	96.98	Rh,Ca,S
B49*	53.20	13.70	9.50	9.03	3.37	3.59	0.00	0.67	0.14	0.04	6.70	95.76	Ba,Th,Fl
B50	48.45	13.17	17.60	5.94	9.59	1.21	0.25	1.46	0.27	0.13	2.61	100.93	Ga,Th,Sl
B51	50.86	15.07	11.35	4.91	12.27	a2.19	0.12	0.90	0.19	0.07	2.18	100.11	Ba,Th,Fl

Table C1

Sample No.	S102	A1203	Fe2031	Mg02	Ca0	Na202	K20	T102	Mn02	P205	LOI	Total	Description3
K1	76.37	12.86	0.99	a0.15	0.50	6.14	0.68	0.04	a0.02	0.02	0.89	98.65	Rh,Ca,Bx
K2	51.65	15.88	10.96	4.58	5.00	4.73	0.61	1.10	a0.10	0.17	6.31	101.09	BA,Ca,Fl
K3	67.65	14.48	2.24	a0.59	2.78	6.18	1.80	0.27	a0.19	0.12	3.34	99.64	Rh,FP,Di
K4	51.12	14.70	10.01	a3.38	8.93	1.77	0.91	1.05	a0.13	0.14	7.57	99.71	BA,Th,Fl
K5-M	45.58	17.17	16.74	6.76	2.61	a1.27	1.17	2.29	a0.15	0.20	6.72	100.66	Var,Mx
K5-F	59.08	12.93	2.62	a0.82	8.07	5.76	0.35	1.47	a0.08	0.14	7.19	98.51	Var,VI
K6	48.94	13.02	9.43	a3.50	10.09	a2.91	0.56	1.74	a0.15	0.18	9.32	99.84	Var,Fl
K7	59.97	15.03	5.67	a1.46	5.35	3.22	1.47	0.59	a0.07	0.13	6.11	99.07	Ad,Ca,Fl
K8	49.84	14.76	13.35	a7.31	10.01	a1.42	0.03	0.74	a0.19	0.11	3.85	101.10	Ba,Th,Fl
K8-D	48.89	14.17	13.68	7.51	9.93	a1.16	0.03	0.73	a0.19	0.06	3.85	100.20	Ba,Th,Fl
K9	43.51	14.03	19.04	7.93	5.36	0.44	0.05	2.36	0.10	0.14	7.52	100.57	Var,Mx
K10	70.57	14.21	1.62	0.51	2.14	5.52	1.17	0.16	0.04	0.07	2.55	98.56	Rh,QFP,S
K11	54.20	16.65	10.55	a2.77	7.76	3.53	0.03	1.11	0.14	0.09	2.76	99.59	Ad,Th,Fl
K12	68.94	14.85	2.09	a0.83	2.82	5.40	0.86	0.26	a0.04	0.14	3.12	99.35	Rh,FP,Di
K13	56.28	14.72	10.08	a4.02	5.65	3.22	0.44	1.03	a0.13	0.27	3.49	99.34	Ad,Th,Fl
K14	50.03	15.41	12.99	5.32	10.18	1.96	0.24	1.05	a0.09	0.18	2.63	100.08	Ba,Th,Fl
K15	45.81	11.81	21.18	a4.37	7.76	2.49	0.12	2.60	0.31	0.08	2.71	99.24	Ga,Th,Si
K15-D	46.02	11.93	21.16	4.41	7.74	-	0.11	2.57	0.32	0.09	2.71	99.55	Ga,Th,Si
K16	58.10	15.32	7.22	3.94	4.69	3.83	0.98	0.84	a0.07	0.19	3.59	98.77	Ad,Ca,Fl
K17	70.51	14.05	2.90	a0.93	3.06	4.31	1.69	0.33	a0.04	0.06	2.38	100.26	Rh,FP,Di
K18	49.08	13.08	15.34	a4.63	9.24	n2.47	0.25	1.49	0.18	0.05	4.43	100.24	Ba,Th,Fl
K19	48.60	13.43	18.40	a5.51	9.11	2.45	0.17	1.38	a0.19	0.17	0.56	99.97	Ba,Th,Fl
K20	78.94	10.95	0.92	a0.21	2.04	3.28	1.14	0.11	a0.02	0.03	0.39	98.03	Rh,Ca,Bx
K21	60.54	16.45	6.34	a3.73	5.56	n3.10	1.08	0.57	a0.01	0.10	2.16	99.64	Ad,Ca,Fl
K22	50.68	15.30	9.00	a5.09	6.85	3.94	0.03	1.03	0.12	0.15	7.31	99.50	BA,Ca,Fl
K23	58.63	18.22	6.93	a3.13	2.66	a5.64	1.05	0.57	a0.06	0.15	2.63	99.67	Ad,Ca,Fl
K24	71.80	13.79	2.21	a0.55	2.05	n4.18	2.16	0.25	0.03	0.08	2.86	99.96	Rh,Ca,S
K25	53.17	19.15	7.69	a3.68	9.27	n2.98	0.73	1.60	0.24	0.20	0.95	99.66	Ad,Ca,Fl
K26	72.02	13.38	2.01	a0.46	1.75	a4.25	2.24	0.23	a0.01	0.12	3.35	99.84	Rh,Ca,S
K27	48.02	15.94	11.66	7.27	12.48	a1.51	0.07	0.61	a0.18	0.07	2.80	100.63	Ga,Th,Si

Table C1

Sample No.	SiO2	Al2O3	Fe2O31	MgO2	CaO	Na2O2	K2O	TiO2	MnO2	P2O5	LOI	Total	Description3
K28	45.43	12.71	20.30	4.06	9.82	1.82	0.07	2.96	a0.22	0.17	2.50	100.06	Ga,Th,Si
K32	61.32	15.21	6.08	3.44	5.62	n3.23	0.30	0.50	0.07	0.11	3.11	98.99	Ad,Ca,Fl
K33	54.83	15.93	8.04	4.43	5.57	4.29	0.10	0.74	a0.10	0.12	5.27	99.42	Ad,Ca,Fl
K35	51.07	14.65	13.00	a6.02	7.33	a2.74	0.23	1.30	a0.17	0.24	2.24	98.99	Ga,Th,Si
K36	71.82	14.13	2.11	a0.53	1.35	a5.22	1.71	0.23	a0.03	0.07	1.72	98.92	Rh,Ca,Fl
K37	51.38	15.67	9.08	a4.91	6.14	a2.74	0.81	0.76	a0.10	0.13	7.58	99.38	BA,Ca,Fl
K37-D	51.57	15.71	9.20	a5.00	6.09	-	0.80	0.77	a0.11	0.13	7.58	99.70	BA,Ca,Fl
K38	58.18	16.10	6.76	a2.83	5.55	a1.40	2.16	0.63	a0.07	0.20	5.55	99.43	Ad,Ca,Fl
K39	56.27	15.21	5.88	4.11	6.51	3.45	2.55	0.63	0.13	0.31	3.95	99.00	Lm,Al,Di
K40	75.51	11.87	n0.65	a0.48	2.85	n3.71	1.69	0.09	a0.02	0.03	2.40	99.30	Rh,Ca,Fl
K41	51.89	17.15	7.82	5.35	9.81	a3.10	0.46	0.73	0.12	0.25	2.28	99.00	To,Ca,S
K42	59.30	15.91	6.59	2.76	5.12	a3.86	0.92	0.63	0.08	0.17	3.56	98.90	To,Ca,S
K43	61.41	16.22	5.40	a2.68	6.49	n3.55	0.91	0.54	0.06	0.12	1.76	99.14	To,Ca,S
K44	58.99	19.09	4.79	a2.81	6.26	a4.20	1.13	0.46	a0.07	0.15	1.49	99.44	To,Ca,S
K45	56.02	14.68	9.54	3.39	5.89	a3.37	0.61	1.05	a0.13	0.30	4.03	99.01	Ad,Ca,Fl
K46	44.65	16.40	10.24	a11.02	10.17	2.29	0.28	0.37	a0.12	0.16	3.67	99.15	Ga,Th,Si
K46-D	44.33	16.78	10.45	11.16	9.98	2.20	0.28	0.39	a0.13	0.06	3.67	99.52	Ga,Th,Si
K47	45.71	16.93	10.18	10.06	10.29	2.90	0.31	0.45	0.04	0.03	3.92	100.82	Ga,Th,Si
K48	55.83	15.18	7.86	4.00	13.72	a1.47	0.05	0.79	a0.16	0.14	0.80	100.00	Ad,Th,Fl
K49	56.96	15.18	9.34	4.59	7.35	n4.30	0.33	1.00	a0.14	0.21	0.91	100.31	Ad,Th,Fl
K51	66.62	15.33	3.63	a1.60	3.47	n4.99	2.25	0.33	a0.04	0.07	1.13	99.46	Da,Ca,Tf
K52	47.85	14.80	13.20	7.04	11.56	a2.29	0.22	0.88	a0.16	0.10	2.27	100.37	Ga,Th,Di
K53	54.18	15.68	10.13	5.17	6.61	3.39	0.42	0.93	a0.18	0.15	2.70	99.54	BA,Ca,Fl
K54	59.00	16.05	6.60	a3.51	6.18	4.26	1.31	0.54	a0.09	0.14	1.90	99.58	Ad,Th,Fl
K55	59.50	17.03	6.73	a2.88	2.26	5.70	0.58	0.57	a0.06	0.12	3.88	99.31	Ad,Ca,Fl
K56	58.35	15.74	8.41	a2.36	6.55	a3.63	0.10	0.65	a0.09	0.15	3.33	99.37	Ad,Th,Fl
K57	56.86	16.64	8.63	a4.22	5.04	4.54	0.66	0.76	a0.11	0.15	2.79	100.40	Ad,Ca,Fl
K58	55.38	17.38	5.38	a4.38	9.16	3.80	1.09	0.58	a0.09	0.12	1.78	99.14	To,Ca,S
K59	77.15	12.31	0.87	a0.17	0.81	3.43	4.45	0.05	a0.01	0.03	0.38	99.66	Rh,Ca,Fl
K60	54.48	16.24	11.99	a3.78	8.08	a3.48	0.36	0.94	a0.15	0.12	0.27	99.89	BA,Th,Fl

Table C1

Sample No.	SiO2	Al2O3	Fe2O3[1]	MgO2	CaO	Na2O2	K2O	TiO2	MnO2	P2O5	LOI	Total	Description[3]
K61	65.28	14.77	5.51	a0.63	2.36	a7.30	0.18	0.45	a0.07	0.15	2.86	99.56	Da,Ca,BX
K62	61.27	16.44	6.32	a0.83	2.26	a3.39	1.84	0.59	a0.10	0.15	5.55	98.74	Ad,Th,BX
K63	70.80	14.50	1.96	a0.27	1.27	a5.43	1.34	0.24	a0.03	0.10	2.60	98.54	Rh,Ca,Bx
K64*	58.10	13.80	7.79	1.56	3.44	2.15	2.69	1.28	0.11	0.25	8.20	98.42	Ad,Th,Fl
K65*	51.20	16.90	7.53	3.30	7.08	3.47	0.43	0.73	0.10	0.06	9.40	97.52	Ba,Ca,Fl
G0	60.69	14.82	5.03	a4.08	3.66	a3.36	2.69	0.49	a0.06	0.25	4.59	99.72	Ga,Ca,Si
G1	59.68	15.51	5.22	a3.63	3.71	a1.85	3.57	0.54	a0.06	0.28	5.03	99.08	Ga,Ca,Si
G2	48.82	15.03	14.45	7.46	8.10	1.44	0.08	1.41	0.18	0.15	3.34	100.46	Ga,Th,Si
G3-A	47.40	14.70	15.11	a6.85	9.64	1.95	0.16	1.01	a0.18	0.06	2.90	99.96	Ga,Th,Si
G3-A-D	47.29	14.74	15.01	6.54	9.62	a2.13	0.16	1.00	a0.18	0.07	2.90	99.64	Ga,Th,Si
G3-A-D	47.37	14.79	15.07	7.63	9.68	a1.95	0.16	1.02	0.18	0.09	2.90	100.84	Ga,Th,Si
G3-A-D	47.47	14.78	15.08	6.72	9.79	1.88	0.16	1.02	a0.17	0.06	2.90	100.03	Ga,Th,Si
G3-A-D	47.38	14.59	15.16	7.62	9.42	1.85	0.15	1.03	a0.16	0.05	2.90	100.31	Ga,Th,Si
G3-B	49.46	14.31	17.65	6.77	5.82	a2.27	0.35	1.31	a0.13	0.16	2.58	100.81	Ga,Th,Si
G3-C	44.45	15.74	18.23	8.69	6.34	a2.20	0.12	1.09	a0.16	0.08	3.77	100.97	Ga,Th,Si
G4	46.28	15.68	13.54	10.06	9.38	a1.19	0.08	0.74	0.17	0.07	4.04	101.23	Ga,Th,Si
G5	44.78	14.44	14.07	11.52	9.14	1.24	0.07	0.66	a0.17	0.05	4.32	100.46	Ga,Th,Si
G5-D	44.45	14.42	14.47	11.65	8.95	a1.31	0.07	0.68	a0.18	0.04	4.32	100.54	Ga,Th,Si
G6	45.43	16.79	9.52	6.17	10.75	a2.65	0.23	0.61	a0.15	0.19	8.97	100.86	Ga,Th,Si
G7	42.86	17.71	10.91	a4.33	15.10	a1.17	0.04	0.73	a0.14	0.09	8.39	101.46	Ga,Th,Si
G8	49.61	14.40	1.53	a4.85	9.99	a2.77	0.32	1.13	a0.19	0.12	8.76	107.39	Ga,Th,Si
G9	42.92	17.75	12.39	a5.01	8.35	a2.17	0.37	1.34	a0.19	0.15	10.11	100.75	Ga,Th,Si
G10	45.83	13.86	13.17	a5.97	8.47	0.99	0.14	0.92	a0.21	0.07	9.54	99.17	Ga,Th,Si
G11	47.46	15.47	13.20	6.92	10.88	a1.70	0.08	0.86	a0.15	0.04	3.46	100.22	Ga,Th,Si
G12	47.17	14.82	15.02	7.48	9.27	0.65	0.07	0.99	a0.18	0.13	3.87	99.65	Ga,Th,Si
G13	47.83	14.14	16.29	6.24	8.54	1.16	0.12	1.38	0.17	0.14	4.47	100.48	Ga,Th,Si
L1	68.53	15.47	2.35	a0.84	2.28	a5.23	2.71	0.34	a0.03	0.11	1.67	99.56	Gnd
L1-D	68.69	15.20	2.27	a0.72	2.32	5.18	2.71	0.34	0.03	0.14	1.67	99.27	Gnd
L2	66.79	15.18	2.94	0.95	2.77	a5.20	2.62	0.42	a0.04	0.19	1.99	99.09	Gnd
L3	75.47	13.38	1.13	a0.17	1.11	4.70	2.70	0.09	a0.02	0.01	0.53	99.31	Gnd
L4	75.79	14.23	1.35	a0.39	1.99	3.18	2.37	0.15	a0.03	0.04	0.44	99.96	Gnd
L5	72.68	14.33	2.06	a0.77	2.57	a5.04	1.60	0.25	a0.03	0.11	0.80	100.24	Gnd
L6	66.87	15.81	3.34	a1.22	3.81	a5.47	1.39	0.36	a0.04	0.09	0.43	98.83	Gnd
L7	69.08	14.49	2.78	a0.93	2.22	a5.80	2.64	0.41	a0.04	0.15	1.55	100.09	Gnd
L8	-	-	3.00	a1.03	2.59	a4.01	2.79	0.42	a0.03	0.10	1.99	-	Gnd

1 - Total iron as Fe2O3
2 - Data from atomic absorption spectrophotometry (a) and neutron activation analysis (n)
3 - Key to abbreviations:

Ad - Andesite
Ba - Basalt
BA - Basaltic Andesite
Da - Dacite
Ga - Gabbro
Gnd- Granodiorite
Lm - Lamprophyre
Rh - Rhyolite
Sy - Syenite
To - Tonalite
Um - Ultramafic
Var - Variolite

Al - Alkalic
Ca - Calc-alkalic
FP - Feldspar Porphyry
Mx - Matrix
QFP- Quartz-Feldspar Porphyry
Th - Tholeiitic
Vl - Variole

Bx - Breccia
Cl - Clast
Di - Dike
Fl - Flow
S - Stock
Si - Sill
Tf - Tuff

Table C2

Sample	Ba1	Zr	Y2	Sr3	Rb	Zn3	Cu3	Ni3	Cr1	Sc4	Hf4	Ta4	U4	V
W2		97		378	36	108	90	59						70
W3		66		171	11	36	0	706	x1936					83
W6		77		482	5	206	53	236						67
W7		185		628	80	84	104	120	x476					117
W8		53		480	7	108	110	59						176
W10-S	0	49		688	7	205	90	146	x409					225
W10-R	25	65	13	100	8	69	204	93						158
W10-C	25	57	14	367	7	86	153	99	n232	41.5	1.2	0.4	0.13	158
W11	-	-	14	-	-	-	-	-	n290	41.2	1.0	0.2	-	
W12	24	57	14	297	8	101	215	123	n264	47.2	1.3	0.3	0.06	166
W12-D		56			7				x279					166
W14	119	56		79	12	117	35	53	x450					145
W16	441	160		538	67	22	10	5						14
W18	633	150		430	75	94	91	179	x792					113
W20-S	22	83		141	6	184	60	121						295
W20-R	22	85		48	9	90	124	80						234
W20-C	n23	78	21	276	8	99	110	84	n140	42.6	2.0	0.5	0.06	226
W23	487	114		115	103	82	34	121						85
W24	660	167		237	118	40	97	0						15
W27	n838	165	4	434	63	47	9	12	n29	4.2	2.2	0.5	0.30	17
S4		307		630	43	142	47	84						105
S4-D	720	305			42	103	39	80						100
S6	502	256		153	56	31	38	40						64
S11	585	111	9		30				n340			0.47	0.52	166
S12	1232	188		117	102	33	25	75						74
S16	576	162		21	62	19	13	10						12
T1	n536	159	4	116	100	41	10	0	n8	2.5	2.1	0.80	0.20	12
T10	n996	174	4	140	112	23	0	6		1.9	2.3	0.60	0.48	8
T17	n648	155	4	278	97		1	16		2.0	2.4	0.80	0.40	12

Table C2

Sample #	Ba1	Zr	Y2	Sr3	Rb	Zn3	Cu3	Ni3	Cr1	Sc4	Hf4	Ta4	U4	V
T19	n591	158	3	326	92	40	6	2		2.3	2.3	0.80	0.33	10
T19-D	x564	160		326	90	40	5	2						9
T28		150		126	104	44	9	8						11
T32	n614	146	8	154	72	61	46	2	n86	13.2	2.1	0.54	0.52	69
T38	n474	159	9	214	67	60	39	74	n186	12.6	2.6	0.51	0.68	74
T38-D	n491			205		58	38	76					0.68	
B3	400	216	10	79	111	48	3	10						29
B3-D	549	209		111	111	45								26
B4	499	166		97	84	63	3	13						34
B5	274	58		65	13	90	103	94						164
B6	21	88	29	25	8	132	91	49						248
B7	80	79			9		28	63						217
B10	109	57		120	10	94	137	101						164
B14	870	237		353	82	135	7	11						45
B16		72		165	8	114	114	91						211
B17	991	199			93	92	37	45						112
B22	203	95		33	24	111	95	16						251
B22-D	180	95		251	22	197	129	22						248
B23	93	81		109	9	127	146	37						237
B23-D	85	82		104	8	125	139	31						237
B26	0	79		131	9	118	72	43						196
B27	120	84		220	8	135	137	68						228
B28	146	87		78	10	123	113	69						200
B29	73	98		125	8	113	200	38						254
B31	188	75	8	280	14	137	164	19						246
B32	101	76	19	97	11	110	107	93						194
B33	278	134	-	402	42	64	66	43						104
B35		86		141	7	136	90	63	n129	41.3	2.4	0.38	0.16	236
B36	n73	77	19	165	7	71	176	48	n130	46.5	1.9	0.40	0.14	245

Table C2

Sample #	Ba1	Zr	Y2	Sr3	Rb	Zn3	Cu3	Ni3	Cr1	Sc4	Hf4	Ta4	U4	V
B41-A	x40					x117	x95	x84	x298					
B41-B	x230					x66	x6	x112	x201					
B41-C	x170					x46	x140	x107	x93					
B44	x380					x56	x165	x7	x10					
B45	x200					x132	x146	x250	x176					
B47	x200					x82	x34	x20	x9					
B48	x480					x48	x7	x-5	x8					
B49	x80					x95	x26	x220	x288					
K9-M		87		126	8	211	45	195	x444					264
K13	222	124			22	102	16	37						144
K14	77	93		86	11	94	74	85						159
K18	n41	72	21	120	12	116	112	28	n23	43.8	1.9	0.28	0.7	243
K19		65		110	10	119	270	29						256
K20	354	211	11	118	56	15	12	2		2.0	3.5	1.70		13
K21	n329	131	9	141	37	79	35	56	n120	16.1	2.5	0.60	0.49	80
K22	21	111		83	10	77	65	80						157
K23	418	154		138	38	81	59	20						84
K24	n598	176	9	47	93	40	3	4		2.9	3.1	1.00	1.14	16
K28		60		130	9	166	121	33						513
K32	n190	157	10	62	19	69	28	48	n116	14.8	3.5	0.70	1.02	69
K33	40	134		60	14	89	50	75						122
K34	486	126		171	28	94	36	64						106
K37		111		107	31	92	40	99						142
K38	444	145		88	66	67	64	37						83
K40	n471	136	6	105	69	5	1	2		1.3	2.1	1.06	0.35	0
K41		102	9	366	19	79		86						116
K42		149		332	35	61	32	51						84
K43	n193		8							12.2	3.4	0.95	0.23	
K44	284	137		112	52	45	10	48						63

Table C2

Sample #	Ba[1]	Zr	Y[2]	Sr[3]	Rb	Zn[3]	Cu[3]	Ni[3]	Cr[1]	Sc[4]	Hf[4]	Ta[4]	U[4]	V
K45	161	139		94		89	4	41						135
K49	n194	127	15	84	23				n50	25.9	3.4	1.04	0.26	142
K50	n132	115	14	239	14	98	92	104	n65	22.5	2.2	0.34	0.34	135
K56	72	134	-	-	21	79	42	55						95
K58	333	125		146	12	98	4	84						77
K59		107		-	34	67	6							0
K60	118	97		234	146	93		49						168
K64	x510				14	x74	x30	x-5	x-5					
K64-D	x480					x75	x31	x-5	x-5					
K65	x130					x82	x35	x54	x43					
G0	788	200		111	80	67	30	64	x296					69
G1	1157	201		59	87	67	8	56	x277					73
G2	54	75		283	9	111	124	91	x256					247
G3A	67	59		70	9	87	153	115	x294					161
G3A-D1	69	59		79	11	80	156	114	x294					166
G3A-D2	70	60		79	9	84	160	121	x292					166
G3A-D3	69	60		76	10	82	149	111	x305					165
G3A-D4	58	60		71	9	80	154	116	x294					167
G3A-D5		60			9				x296					166
G3B	86	69		43	14	39	18	74	x254					240
G3C	40	64		126	9	90	11	136	x320					198
G4	48	52		155	9	161	147	325	x280					126
G5	17	44		62	10	100	50	332	x276					118
G5-D	24	44		59	5	99	105	336	x281					111
G6	79	57		216	13	64	263	72	x595					111
G7	56	52		170	9	58	185	68	x267					116
G8	110	68		230	16	88	44	30	x160					180
G9	68	81		126	16	52	57	54	x350					246
G10	69	58		178	10	82	191	83	x320					175
G11	65	60		228	7	86	198	113	x313					142
G12	21	57		104	9	92	164	145	x190					161
G13	32	70		66	9	113	162	74	x209					198
L2	x948	217		732	89	66	6	16						36

1: x - Analyses by X-Ray Fluorescence Spectroscopy (XRFS)
a - Analyses by Atomic Absorption Spectrophotometry (AAS)
n - Analyses by Instrumental Neutron Activation (INA)

2: Analyses by Inductively Coupled Plasma Spectroscopy (ICPS)
3: Analyses by AAS
4: Analyses by INA

* Negative numbers indicate that concentration is below detection limit

Appendix C

Analytical Precision and accuracy limits:

1) X-ray Fluorescence

Precision (reproducibility) has been checked by running duplicate samples and standards. Accuracy has been determined by running a rock standard a large number of times. The followig USGS rock standards: AGV-1, GSP-1, G-H, G-2, BHV-1, BCR-1, PPB-1, BBR-1, MRG-1 and STM-1, described in Flannagan, (1969) have been used as reference standards.

Precision and accuracy for the following elements is:

SiO_2 ± 1.0 wt%; Al_2O_3: ± 0.8; Fe_2O_3, ± 0.4; MgO (<4 wt%): ±1 0.5; MgO (>4wt%): ± 0.5; CaO: ± 0.2; Na_2O; ± 1.1; K_2O: ± 0.05; TiO_2: ± 0.03; MnO: ± 0.1; P_2O_5: ± 0.07; Zr: ± 47 ppm; Rb: ± 18; V: ± 20.

2) Atomic absorption spectrophotometry (AAS)

The elements Na, Mg, Mn, Ba, Ni, Cu, were determined by AAS. The following rock standards were used to check accuracy: BHV-1, GSP-1, STM-1, MAG-1, SCO-1. From duplicate sample analyses precision for the following elements is:

Na_2O: ± 0.25wt%; MgO: ± 0.2; MnO: ± 0.03; Ba: ± 20 ppm; Ni; ± 10; Cu: ± 10; Zn: ± 10; Sr: ± 20.

Accuracy from analysed standards has been set at twice the precision limits except for Sr which is 3 times.

Table G1: Table of lithologic units for the Kawashegamuk Lake Area

PHANEROZOIC
Cenozoic
Holocene
Reworked pleistocene sediments, organic deposits
Pleistocene
sand, gravel, boulders, clay
Major Unconformity
PRECAMBRIAN
Early Precambrian (Archean)
Felsic and intermediate intrusive rocks (Revell Batholith, stocks ad dikes): massive, equigranular biotite granodiorite; massive, equigranular quartz diorite
Intrusive Contact
Dacite porphyry stocks and dikes in Kawashegamuk and Boyer Lake Groups
Intrusive Contact
Metavolcanic and related intrusive rocks; metasedimentary rocks:
Metasedimentary rocks:
Volcanic-clast conglomerate
Polymictic conglomerate with volcanic, granitic, chert, and magnetite iron-formation clasts
Arenite
wacke
siltstone
argillite
magnetite iron formation
reworked volcanic tuffs
Metavolcanic and related intrusive rocks:
Rhyolite (flows, and pyroclastics) - rhyolite porphyry
Dacite (pyroclastics) - dacite porphyry
Andesite (flows and pyroclastics) - gabbro - rite
Alkalic intrusive rocks (lamprophyric and syenitic dikes)
Major Unconformity
Early Undefined Basement

Table G2: Stratigraphic organization of the lithologic units within the Kawashegamuk Lake Area

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BOYER LAKE GROUP
Formations M & B

KAWASHEGAMUK LAKE GROUP
- Cycle I
- Cycle II

Intrusive Contact
(Revell Batholith)

North limb of Kamanatogama Syncline

BOYER LAKE GROUP
Formations M & B

STORMY LAKE GROUP
- Facies V
- Facies IV
- Facies III
- Facies II
  - Subfacies IIb
  - Subfacies IIa
- Facies I

WAPAGEISI LAKE GROUP
- Subgroup II
  - Formation 4
  - Formation 3
  - Formation 2
- Subgroup I
  - Formation 1
    - member 1B
    - member 1A

Intrusive Contact
(Irene-Eltrut Lakes Batholithic Complex)

South limb of Kamanatogama Syncline

TableG3 Petrographic description of samples taken from the "Katisha Lake Gabbro Sill". Sample numbers shown on stratigraphic map from Kresz (1984)

G0 :	Medium-grained, dark grey-green, 25% dark coloured min., 75% white feldspars, foliated.
G1 :	Similar to G0; weak foliation.
G2 :	Fine-grained, green colour, basaltic appearance: chill margin or basalt enclave; massive.
G3A:	V. coarse-grained, dark green; abund. disseminated oxide phases (leucoxene); massive.
G3B:	Fine to medium-grained rock; dark green, basaltic aspect, massive.
G3C:	Medium-grained, dark green, disseminated oxides; massive.
G4 :	Very coarse-grained to pegmatitic, amphibole crystals 1 cm; porphyritic.
G5 :	Pegmatitic gabbro with amphibole crystals 2 cm in size; massive.
G6 :	Medium-grained; light green-grey, approximately 20% mafic phase; 5% oxides, massive.
G7 :	Similar to G6; mineralogy dominated by white feldspar.
G8 :	medium-grained, dark grey-green, large magnetite grains; abundant tiny specks of ilmenite, massive.
G9 :	Medium-grained, green-grey, 40% dark minerals; 10% large brown grains of leucoxene; foliated.
G10:	Medium-grained; similar to G9, faint foliation.
G11:	Medium-to coarse-grained gabbro, diabasic texture; grey-green; massive.
G12:	Very coarse-grained gabbro; dark green; massive.
G13:	Coarse-grained gabbro, dark green; abundant Fe-Ti oxides; massive.

Table G4: Summary of sedimentary characteristics of each facies (mappable units) within the Stormy Lake Group accompanied by sedimentary processes and deduced environment of deposition (after Kresz, 1984)

	Facies I	Facies II	Facies III	Facies IV	Facies V
Lithological Characteristics	-Autoclastic breccias -Felsic lava flows -Volcanic breccias and tuffs -Minor epiclastic sediments	-Coarse conglomerate -High clast-matrix ratio -Highly diverse clast lithologies -Poorly sorted -Well rounded clasts -Poorly bedded conglomerates -Sandstone interbeds with restricted lateral continuity -Immature sandstone -Large scale cross-stratification in sandy units -Scour marks -No graded bedding in sandy units -common weathering rims on clasts	-Cobble to boulder conglomerate -Essentially volcaniclastic with a few exogeneous clasts near the top -Angular to well rounded clasts -very poor size sorting -High to low clasts-matrix ratio -Very immature matrix -some bedded sandstone with restricted lateral continuity -Large scale cross-beds in sandy units -No graded bedding -A few clasts show weathering rims	-Stratified arenite, siltstone and slate -Normal grading characteristic of turbidites, Bouma (1962) cycles A and B, common -A few thick bedded, poorly graded and poorly sorted, coarse arkoses and lithic arkoses -Common interbedded siltstone and slate -Some conglomeratic beds in the west -No large scale cross-stratification	-slates predominate with some siltstone beds, Bouma(1962) cycles C,D,E -Abundant iron-formation of oxide facies at Bending Lake
Sedimentary Processes	-Vent facies volcanic deposits -Lahar flows -Mass wasting	-Sheet flows -Debris flows -Channel deposits	-Sheet flows -Debris flows -Channel deposits -Sieve deposits?	-Deposition mainly by turbidity currents -Some sediment creep on unstabilized slopes (poorly sorted, non graded beds)	-Deep basin sedimentation, background sedimentation interrupted by turbidity currents very quiet conditions

Interpreted environment of deposition	-Deposition on volcanic slopes -Shallow marine to emergent island	-Terrestrial, alluvial fan	-Terrestrial alluvial fan	-Submarine fan on basin slope	-Lower fan to basin plain

Table G5a: Major and trace element abundances within selvage, inner rim (8 cm away from pillow margin) and core zones of two basaltic pillows, from the Wapageisi Lake Group (from Kresz, 1984a).

	W10			W20			
	Selvage	Rim	Core	Selvage	Rim	Core	
SiO_2	36.63	57.50	51.31	38.13	56.60	51.33	wt%
Al_2O_3	18.89	14.43	14.90	18.03	14.16	14.60	
Fe_2O_3	25.16	9.44	14.03	22.19	11.33	13.66	
MgO	12.75	4.23	5.91	7.90	4.63	5.42	
CaO	4.52	10.66	11.81	10.47	7.10	10.05	
Na_2O	0.43	2.59	0.92	0.64	4.46	3.18	
K_2O	0.02	0.06	0.05	0.02	0.06	0.05	
TiO_2	1.14	0.84	0.84	2.20	1.34	1.36	
MnO	0.32	0.13	0.18	0.30	0.15	0.18	
P_2O_5	0.12	0.07	0.05	0.13	0.16	0.15	
Ba	0	25	25	22	22	23	ppm
Sr	688	100	367	141	48	276	
Rb	7	8	7	6.2	9.0	8.0	
Zn	205	69	86	184	90	99	
Cu	90	204	153	23	54	41	
Ni	146	93	99	121	80	84	
Cr	369	220	232	310	220	216	
V	225	158	158	295	234	226	
La	-	2.4	2.3	-	-	-	
Sm	-	8.3	8.2	-	-	-	
Yb	-	2.0	2.2	-	-	-	
Y	-	14	13	-	-	-	
Zr	49	65	57	83	85	78	

Table G5b: Major and trace element abundances across a carbonatized zone in a gabbroic body within the Boyer Lake Group, B41A: least altered, B41C: most altered. (Analyses by the Geoscience Laboratories, Ontario Geological Survey, Toronto), (from Kresz, 1984a)

	W10		W20	
	B41A	B41B	B41C	
SiO_2	45.60	46.50	58.30	wt%
Al_2O_3	15.80	16.60	16.00	
Fe_2O_3	14.10	13.90	7.91	
MgO	6.78	3.47	1.38	
CaO	5.40	5.41	4.33	
Na_2O	2.45	1.10	1.87	
K_2O	0.02	0.91	0.85	
TiO_2	1.23	1.36	0.69	
MnO	0.17	0.14	0.09	
P_2O_5	0.05	0.06	0.08	
CO_2	4.08	6.83	4.68	
S	0.01	0.00	0.00	
Ba	40	230	170	ppm
Co	48	52	35	
Cr	298	201	93	
Cu	95	6	140	
Li	34	18	11	
Ni	84	112	107	
Rb	5	5	5	
Zn	117	66	46	
LOI	8.40	10.70	7.80	wt%

Petrographic Descriptions (all modal percentages are approximate)

B41A: slightly altered gabbro; chlorite: 40%, carbonate rhombs*: 15%; opaques (Fe-Ti/oxides): 8%, Fine-grained mesostasis of albite, chlorite, quartz: 37%

B41B: Moderately altered gabbro; chlorite: 25%, carbonate* rhombs: 30%, opaques (Fe-Tioxides): 5%, fine grained mesostasis of albite, quartz, chlorite, sericite: 40%

B41C: Strongly altered gabbro: Plagioclase relict: 40%, carbonate*: 15%, quartz: 8%, chlorite: 10%, Albite: 15%, seriate 10%, opaques (Fe-Ti oxides): 2%

* All carbonate is a ferrous variety weathering to limonite on surface.

Table E.1: Summary of exploration and development work in the Kawashegamuk Lake area since 1898 and file numbers in assessment work files

	Company/ Operator	Number on map	Year(s) of activity	Claims worked on	Commodity sought	Type of work	File No. Toronto	Kenora
1)	Anderson P.	1	1960	K30895	base metals (?)	diamond drilling	-	52F/93
2)	Asarco Exploration Company of Canada Ltd.	2	1970-1971	?	base metals	diamond drilling (4 holes)	-	52F/8NW
3)	Canadian Nickel Company Limited	3	1970-1971	K241295, 258722, 261152-53 261190, 261375, 271533, 285818	Cu, Zn, Pb	Magnetometer survey diamond drilling	2.317; D.D. Reports No. 12-17 Kawashegamuk Lake)	52F/8NW
4)	Canadian Pacific Railway Company Ltd.	4	1955	-	basemetals, Au	Geological reconnaissance	-	52F/8NW
5)	Clark Gold Mines Limited	18	1934-1938	K-912, 3875, 3877, 4750-52 4781, 4787-89, 4791, 4792, 4794-96.	Au	Underground exploration & development, diamond drilling, some mining	-	52F/9SW
6)	Dome Exploration Limited	6	1966	K-36104-106, 108-111, 116-119, 122-129, 136, 138, 140, 142	Mo	Soil geochem. trenching, diamond drilling	63A.478	52F/8NW
7)	Eastern Townships Mining and Develop. Co. 18		1898	K-912	Au	1 shaft trenching	-	-
8)	Falconbridge Copper Limited	7	1979-1980	K-554742-57, 554816-27 554881-97, 554956-67, 554759-83, 554898-923	base metals, Au	Ground geophysics Geological mapping Lithogeochem.	2.3866 2.4713	52F/8NW 52F/9SW
9)	Falconbridge Nickel Mines Limited	8	1957	K21112, 24957, 24959 24960	Ni, Cu	Diamond drilling	D.D. report Nos.10, 11 (Kawashegamuk Lake)	52F/8NW
10)	Hudson Bay Exploration and Development Co. Ltd.	9	1974	K404012-404059	Cu, Zn	E.M Survey; Diamond drilling		52F/8NW
11)	International Nickel Company	10	1952	K-15452, 53, 56-58, 61-63 K15829-31, 34-36, 38-40	Ni, Cu	Magnetometer Survey	63.290	52F/8NW
12)	Long Lake Mining Company	11	1902	S.V. 353-355; H.W.575	Au	2 shafts; trenching	-	52F/8NW
13)	Lynx-Canada Explorations Ltd. Dejour Mines Ltd.	12	1970	?	base metals	Airborne geophysics; Ground geophysics Geological mapping Diamond drilling	-	52F/9SW

14) Maw and Greening Syndicate	13	1898	H.W. 455, 476-479	Au	1 shaft, test pits, trenching	-	-
15) McLean Syndicate	14	?-1943	K-4510-11, 4598-4618	Au	trenching	-	52F/8NW
16) Mid-North Engineering Services Ltd.	16	1960	K29045	Au	Diamond drilling	DDR report No.10 (Tabor Lake)	-
17) Munroe and R. Watson	16	1898-1899	HW. 416, 468, 475, N.T.22	Au	trenching; 3 shafts under ground develop. minig	-	-
18) Northwestern Ontario Exploration Company	15	1899	H.W.417, H.W.418, H.W.419	Au	2 shafts; 1 adit, test pits, trenching	-	-
19) Pantan Gold Mines Limited	18	1957-1960	K912, 3875, 3877, 4750-52 4781, 4787-89, 4791, 4792, 4794-96	Au	Underground work, diamond drilling installation of mine	-	-
20) Ottawa Gold Milling and Mining Co.	16	1900-1902	HW.416, 468, 475, N.T. 22	Au, Ag	Underground development, mining	-	52F/9SW
21) J.W. Redden	16	1978-	K513188, 603428	Au	stripping, geological mapping, soil geochemical survey, Mag., E.M.	2.3548 2.3601, 2.4087, 2.4250, 2.4528	52F/9SW
22 Sakoose Gold Mines Limited	16	1934-1935	H.W.416	Au, Ag	Underground work, 1 shaft diamond drilling	-	52F/9SW
23 Selco Mining Corporation	17	1976-1978	claim groups 800-3, 800-6, 800-7, 800-19	base metals	Ground geophysics geological mapping Diamond drilling	2.2705.2, 2.2562 D.D. report Nos. 12, 13 (Tabor L.) No.19 (Kawashegamuk L.)	52F/8N 52F/9SW
24 Sulpetro Mineral Limited (St. Joseph Explorations Limited)	18	1979-	K-502044-45; 510202, 510204, K-507446-509475	Au	Ground geophysics geological mapping Underground sampling Diamond drilling	2.2927, 2.3279 2.4369, 2.4370 2.5120 D.D. Rep. No.14 (Tabor Lake)	52F/9SW
		1981-1982	7 claims groups in Stormy-Kawashegamuk L. area	base metals, Au	Ground geophysics	2.4604 2.4605 2.4607 2.4608 2.4610 2.4611 2.4612	52F/8NW
25 Tabor Lake Mines Limited	18	1942-1957	K912, 3875, 3877, 4750-52, 4781, 4787-89, 4791, 4792, 4794-96	Au	examination of property	63.3192	SMDR

26	Underwood McLelland and Associates Ltd. (Newmont Mining Corporation)	19	1973-1975	K-315759-315770 315785-315842 363988-364021 364026-27, 364061-62	base metals	Airborne Geophysics Ground geophysics geological mapping diamond drilling	2.1312 2.1690 2.1778 D.D.R. Nos. 11 (Tabor L.) 18 (Kawashegamuk Lake)	52F/8NW 52F/9SW
27	Van Houten Gold Mines Limited	16	1944-1947	H.W. 416	Au, Ag	Underground work diamond drilling mining	-	52F/9SW

Table E2: Data from diamond drilling by the Canadian Nickel Company Limited.

Hole No.	Claim No.	Azimuth	Dip angle	Core length feet (m)	Mineralization	Surface lithology
42772	K-261190	000	50o	166(50)	pyrite in gabbro	Dacite
48505	K-258722	090	50	521(159)	pyrrhotite pyrite graphite in basaltic rock	Diorite
48506	K-241295	000	50o	418(127)	pyrrhotite pyrite in metasediments	Basalt
48508	K-271533	000	60o	419(128)	pyrite graphite in metasediments	Metawacke
48519	K-285818	090	60o	449(137)	pyrite in basaltic tuff and metasediments	Basalt/ Feldspar porphyry
48520	K-261375	000	50	353(108)	pyrrhotite pyrite graphite Iron Fm. in meta-sediments	Meta-arenite

All holes were drilled within the Boyer Lake Group five of which are located along a line which approximately coincides with the Kamanatogama synclinal axis. Compiled from Company diamond drilling reports, Assessment Files Research Office, Ontario Geological Survey, Toronto.

Table E3: Summary of diamond drilling by Hudson Bay Exploration and Development Company Limited.

Hole No.	Claim	Length (m)	Azimuth	Angle	Lithology on Surface	Mineralization (host rock)	Assays (highest values)				Width assayed (feet)
							oz/ton Au	oz/ton Ag	% Au	% Zn	
131-1	404053	35.5	270	45	Rhyolite	Po, Py, bn, cp (rhyolite)	tr	tr	tr	0.1	1.0
131-2	404037	61.5	060	45	Dacite	Py, Po (rhyolite)	tr	tr	0.1	0.2	4.5
131-3	404037	40	060	45	Fragmental dacite	Py, Po, tr.cp (rhyolite)	tr tr tr tr	tr tr tr tr	0.2 0.15 0.10 0.10	0.3 0.3 0.1 0.1	1.0 3.0 0.5 1.5
131-4	404021	40.5	045	45	Fedspar porphyry	Py, Po tr.cp (Rhyolite, Dacite)	tr tr tr	tr tr tr	0.15 0.15 0.20	0.3 0.3 0.2	1.5 2.5 3.0
131-5	404026	32	105	45	Andesite	Po, minor Py, cp	tr	tr	tr	0.1	2.0
131-6	404028	42	180	45	Rhyolite	Py, Po, tr.cp	tr	tr	tr	tr	
131-7	404022	64.5	140	45	Dacite tuff	Po, Py, tr.cp	tr	tr	tr	tr	
131-8	404022	44	140	45	Dacite	Po, Py	tr tr	tr tr	0.10 0.15	0.4 0.5	1.0 1.0

Data from Hudson Bay Exploration and Development Company Limited.

Table E 4: Analyses of two grab samples taken at a quartz vein near Lee Lake

Sample Number	Description	Au (ounces per ton)	Ag (ounce per ton)	Pb (ppm)	Zn (ppm)
1286A	Quartz-ankerite vein mineralized with pyrite	Tr. (<0.01)	Tr. (<0.1)	-	-
1286B	White quartz mineralized with pyrite and galena	0.04	0.1	2180	61

Table E 5: Analyses of mineralized vein material collected on the dump beside the shaft at mining location H.W. 419 situated north of Brown Lake (analyses by the Geoscience Laboratories, Ontario Geological Survey, Toronto).

Sample No.	Description	Au (ounces) ton	Ag (ounces) ton
1537A	Quartz mineralized with pyrite and chalcopyrite	12.66	1.50
1539B	Grey quartz with disseminated sulphides (chalcopyrite, sphalerite, pyrrhotite, pyrite) and brown carbonate. Note: a native gold speck has been removed from the sample	2.92	0.60
1539C	White quartz mineralized with sphalerite, pyrrhotite, chalcopyrite, pyrite, contains chloritic bands	2.16	0.20
1631	White quartz mineralized with sphalerite, chalcopyrite, pyrite and brown carbonate	0.05	trac

The above assay values indicate that some vein material carries high gold concentrations, however due to the erratic nature of gold, these samples are not necessarily representative of the vein as a whole.

Assays by the Geoscience Laboratories, Ontario Geological Survey,

Table E.6: History of gold and silver production from the Van Houten Mine (14).

Year	Ore milled (tons)	Gold recovered (ounces)	Silver, recovered (ounces)	Ore grade from recoverable gold ounces/ton	Ore grade from recoverable silver ounces/ton	Source
1899	450	342	-	0.76	-	1
1900	843	496	-	0.59	-	1
1901	6735	2575	-	0.38	-	1
1899-1902	8028	3413	-	0.43	-	
1945	?	25.1	4	?	?	2
1947	801	231	141	0.29	0.176	3
1945-1947	?	256	145			
1899-1947	8829+	3669	145			

Sources of information:

1. Resident Geologist Files: Kenora, Ontario
2. Statistical Review for 1945. Ontario Department of Mines, Annual Report (1946) Vol.55, pt.1. Insert to face page 10.
3. Statistical Review for 1947. Ontario Department of Mines, Annual Report (1948) Vol.57, pt.1. Insert to face page 10.

Table E.7: Geochemical analyses from the Van Houten Mine (14); See sample location on Figure E2.

Sample Number	Gold ounces/ton	Silver ounces/ton	As PPM	Cd PPM	Co PPM	Cr PPM	Cu PPM	Ni PPM	Pb PPM	Zn PPM	Sample Description/provenance
1300A	0.50	0.21	3	82	12	21	1120	17	<10	1.05%	vein quartz; dark grey mineralized with sphalerite, chalcopyrite, pyrite/loose sample found near No. 1 shaft.
1300B	0.02	<0.10	<2	..	<5	<5	8	<5	<10	62	vein quartz, white; no sulphide mineralization/loose sample from dump near No.1 shaft.
1301	0.04	..	<2	..	<5	26	220	6	18	112	vein quartz; grey; mineralized with chalcopyrite and pyrite/in-situ sample from open cut near wall rock
1302	0.11	..	8	..	34	<5	4920	22	14	4.80%	vein quartz; smoky near wall rock, white to light grey away from it; smoky quartz well mineralized with sphalerite, chalcopyrite, pyrrhotite
1303	0.21	..	<2	.	<5	6	96	<5	5	200	vein quartz; white to light grey/in-situ sample, sampled over 30 cm near wall rock
1306	0.02	..	<2	..	<5	23	285	9	5	170	vein quartz; white to light grey; mineralized with pyrite and pyrrhotite, in-situ sample
1307	<0.01	..	<2	..	18	32	46	18	11	370	vein quartz; black/loose sample found near No.3 shaft.
1311	0.07	..	<2	..	5	5	220	6	<5	58	vein quartz with associated brown iron rich carbonate; mineralized with chalcopyrite, pyrrhotite, pyrite/loose sample near No.4 shaft.
1321	0.01	..	<2	..	..	..	..	..	..	..	15 cm (5 inches) wide quartz vein; dark grey/1,000 m north east of No.1 shaft
	1	2	3	4	5	6	7	8	9	10	

Gold and silver in columns 1 and 2 determined by fire assay. Elements in columns 3-10 determined by Atomic Absorption spectrophotometry. All assays and analyses made by the Geoscience Laboratories, Ontario Geological Survey.

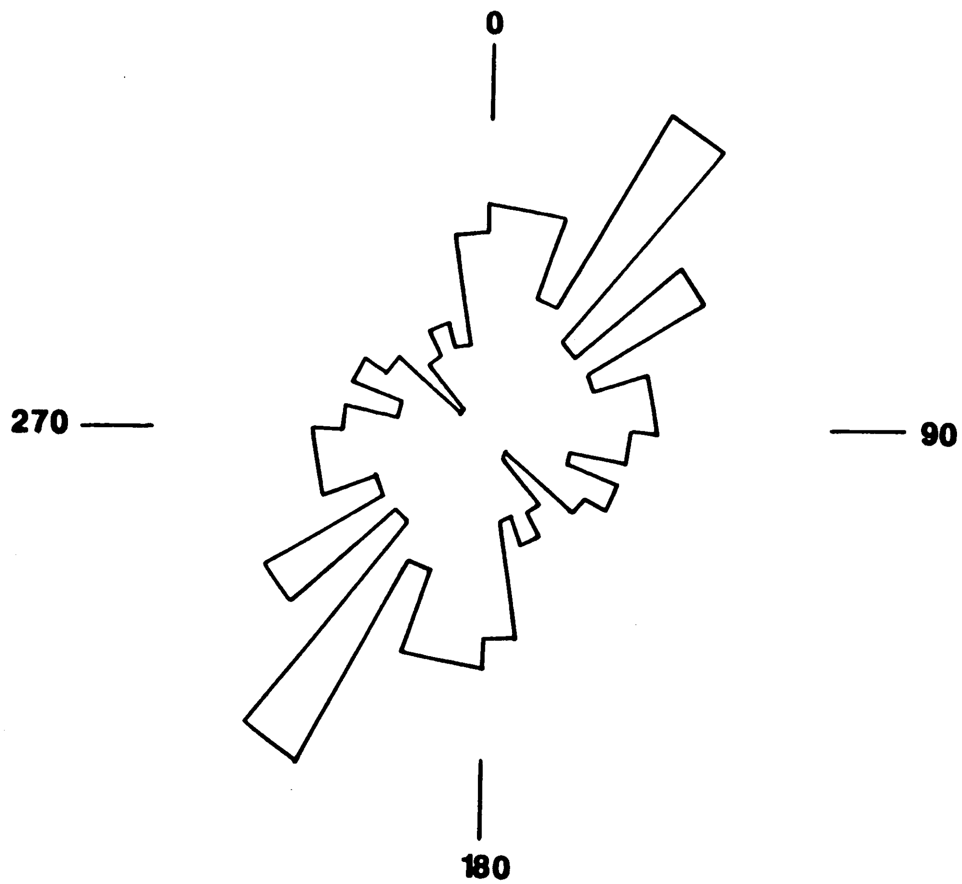


Figure G.2: Rose diagram showing the orientation of airphoto lineament, shown on Map No. ...., back pocket; based on 97 measurements.

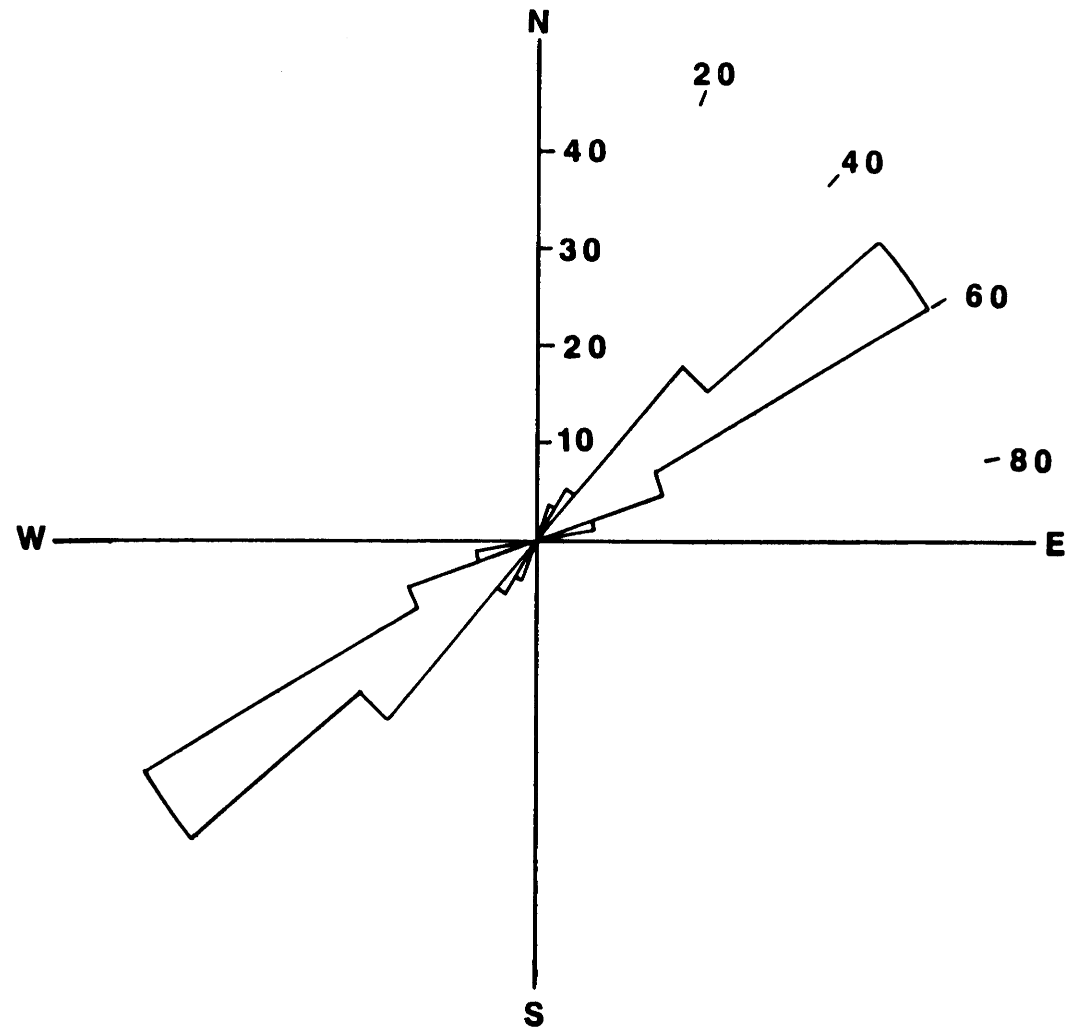


Figure G.3: Rose diagram of glacial striae on bedrock surfaces, from a total of 102 measurements.

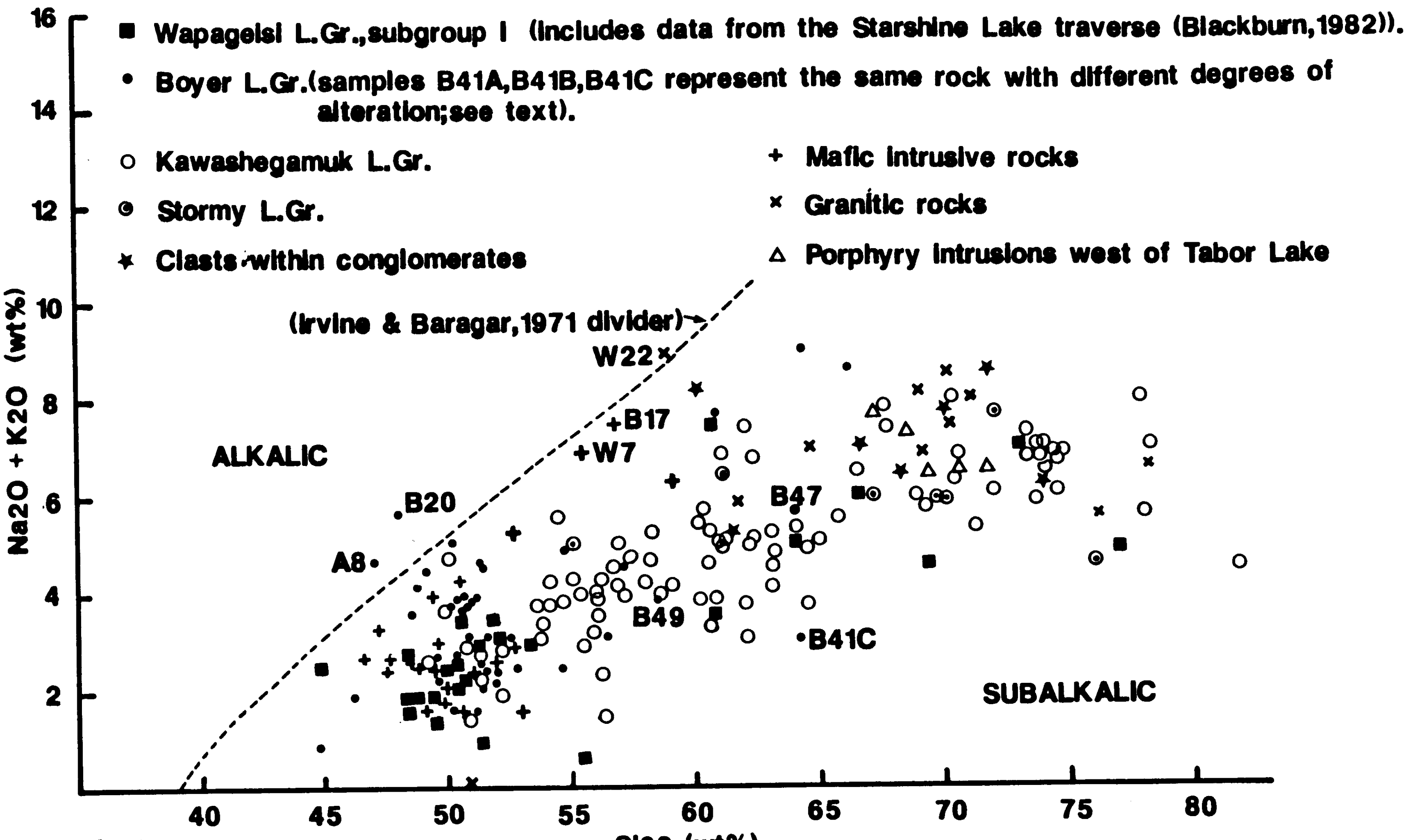


Fig G4

Figure G.4: Alkalies versus silica diagram. All analyzed rocks have been plotted, including unpublished data from Blackburn (A series and KAW series, see Map 2 in back pocket for sample location). (From Kresz, 1984a).

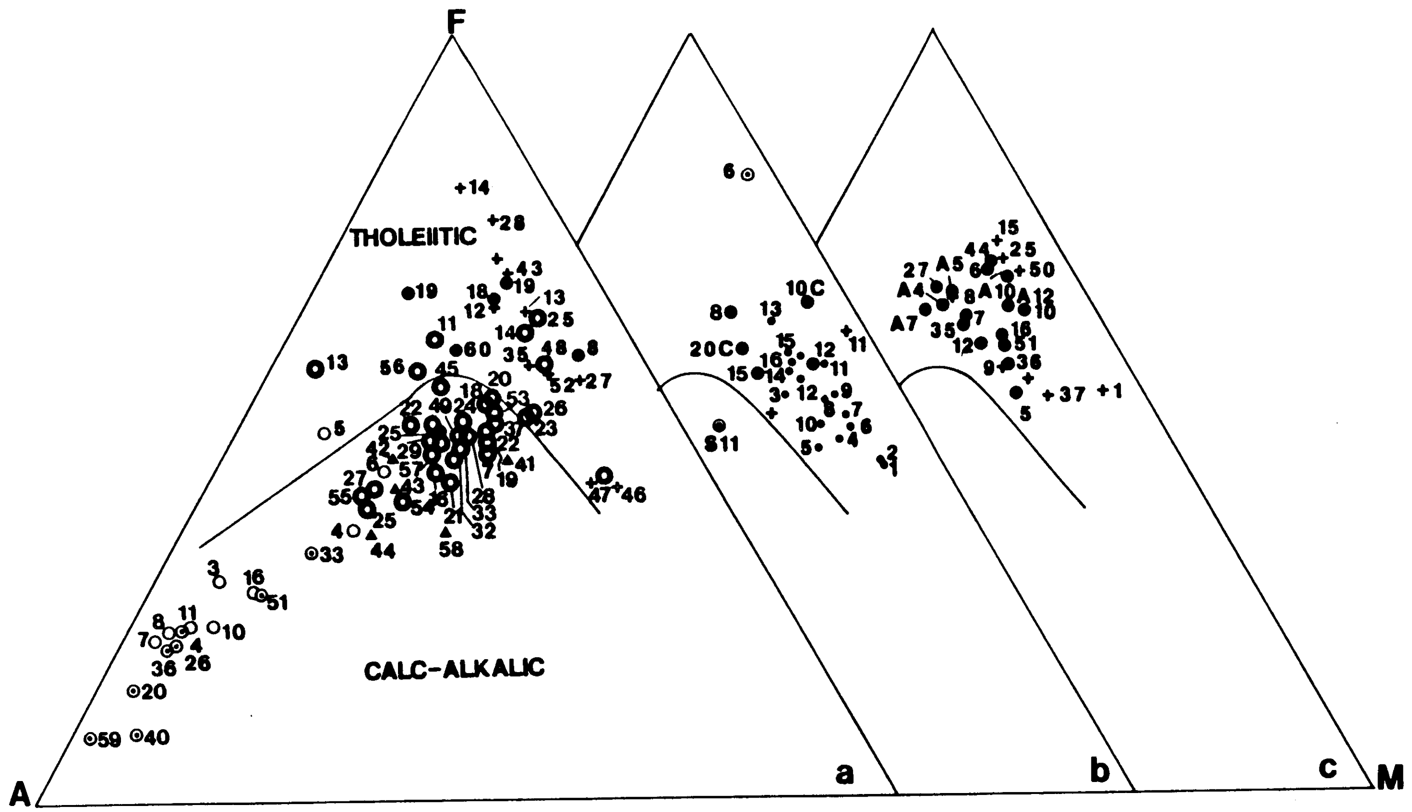


Figure G.5: A(Na2O + K2O) - F(FeOt) - M(MgO) diagrams of the principal volcanic and related intrusive rocks in the Stormy Lake - Kawashegamuk Lake area (From Kresz, 1984a).

a. Kawashegamuk Lake Group. Numbers in brackets refer to C.E. Blackburn's (1977) data (KAW traverse).

- ● Cycle I, mafic lavas
- o Cycle I ,felsic lavas
- **o** Cycle II, mafic and intermediate lavas
- ⊙ Cycle II, felsic lavas
- \+ Gabbroic intrusions
- ▲ Quartz diorite intrusion

b. Wapageisi Lake Group. Numbers in brackets refer to C.E. Blackburn's (1982) data (Starshine Lake Section).

- ●• Mafic lavas
- \+ Gabbro
- ● Single basalt flow within the Stormy Lake Group (sample S11)

c. Boyer Lake Group. Sample numbers preceded by "A" are from C.E. Blackburn's (1977) (A traverse).

- ● Mafic lavas
- \+ Gabbro intrusives

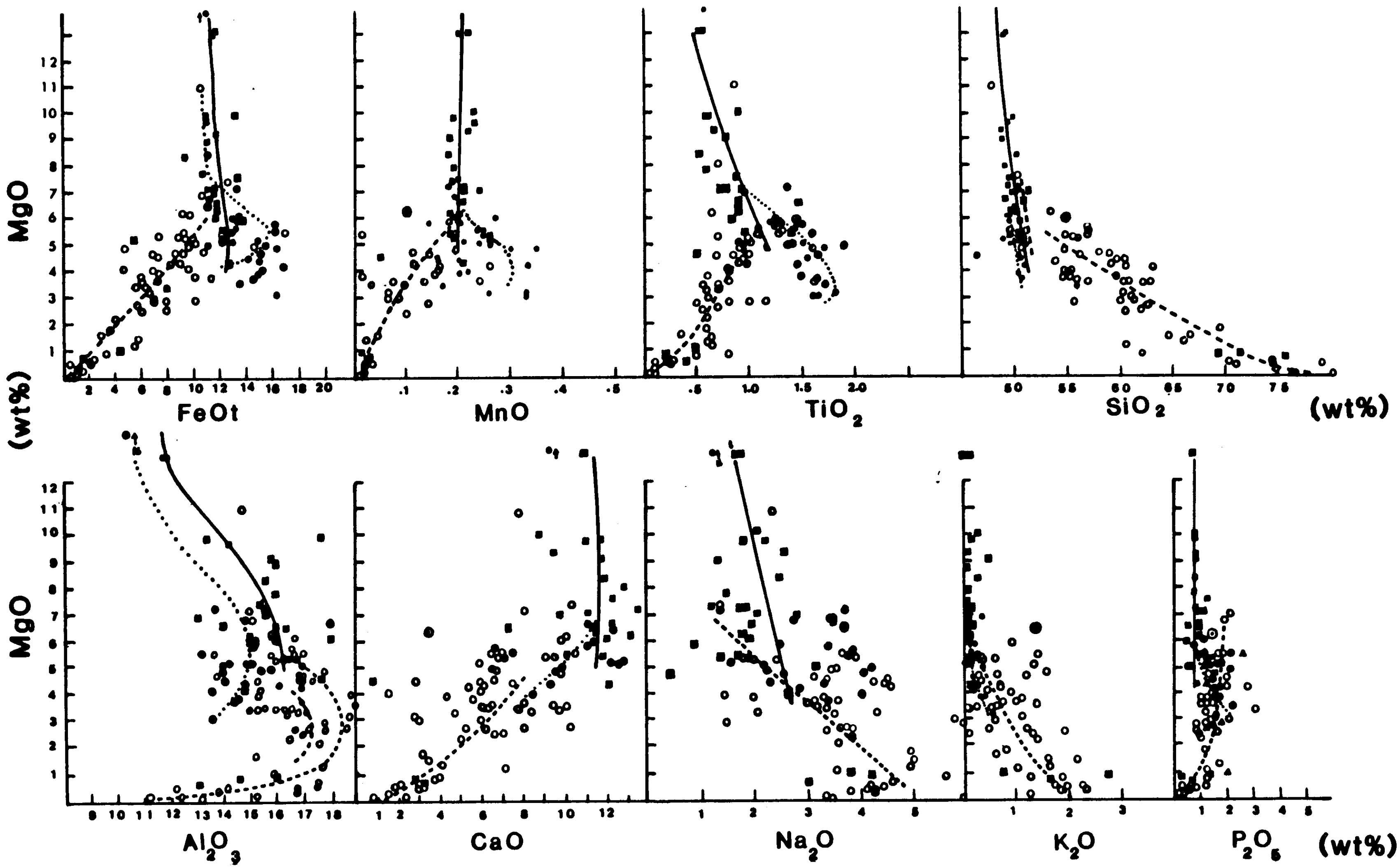


Figure G.6: Variation diagrams of volcanic rocks from the Wapageisi Lake Group (■), Boyer Lake Group (●), Kawashegamuk Lake Group (o), and a mafic flow within the Stormy Lake Group (⊙), where all major elements are shown against MgO. Unpublished data from C.E. Blackburn (1977) (A and KAW traverses), and data from the starshine traverse (Blackburn, 1982) have also been plotted (From Kresz, 1984a).

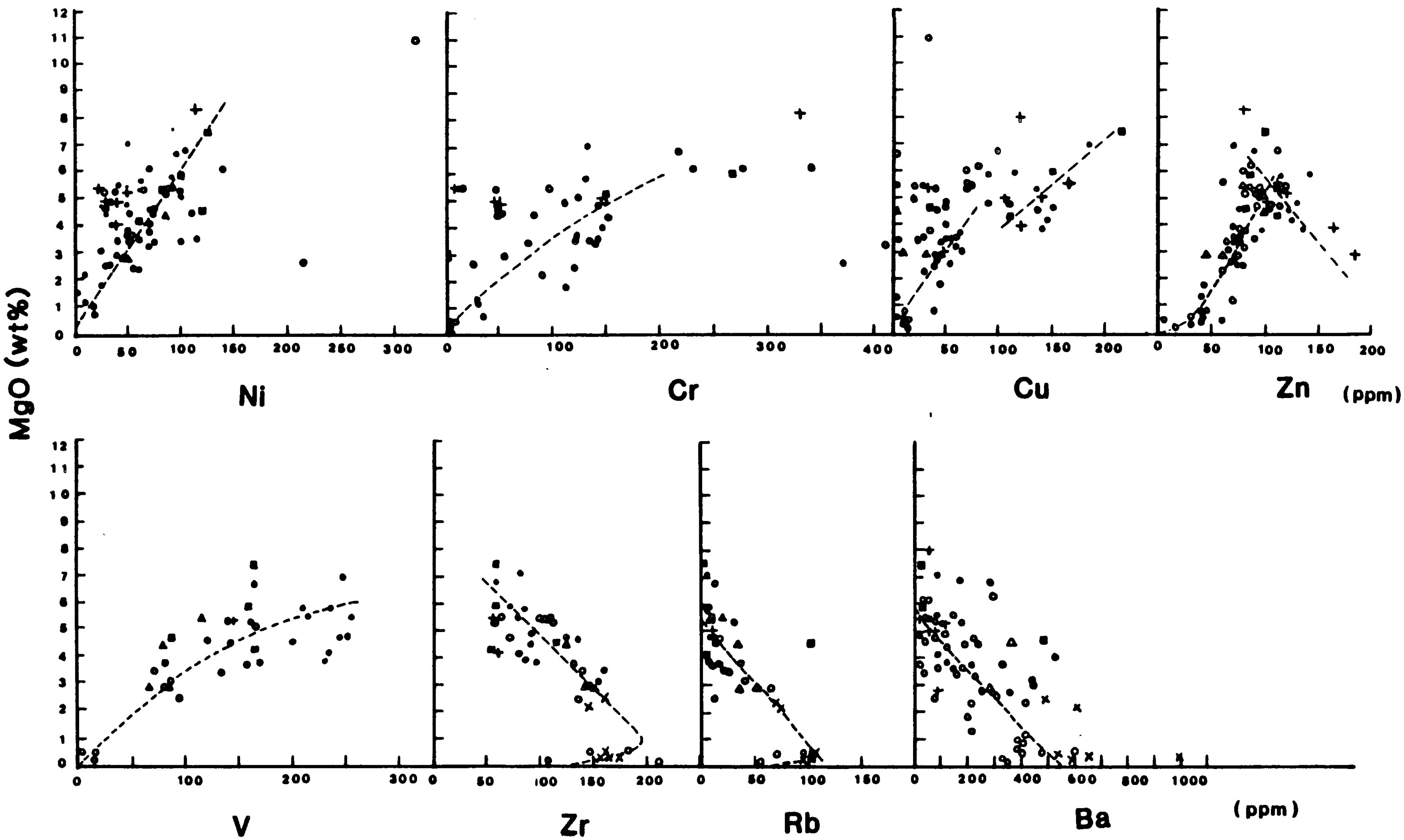


Figure G.7: Relationship between MgO and selected trace elements for volcanic rocks of the Wapageisi Lake Group, Subgroup I (■), Boyer Lake Group (•), Kawashegamuk Lake Group (o); gabbro sills (+), tonalite intrusion within Kawashegamuk Lake volcanics (▲), Thundercloud Lake Porphyry (X). Additional unpublished data from Blackburn (1977) for Ba, Cr, Cu, Ni, Zn (A and KAW traverses) (From Kresz, 1984a).

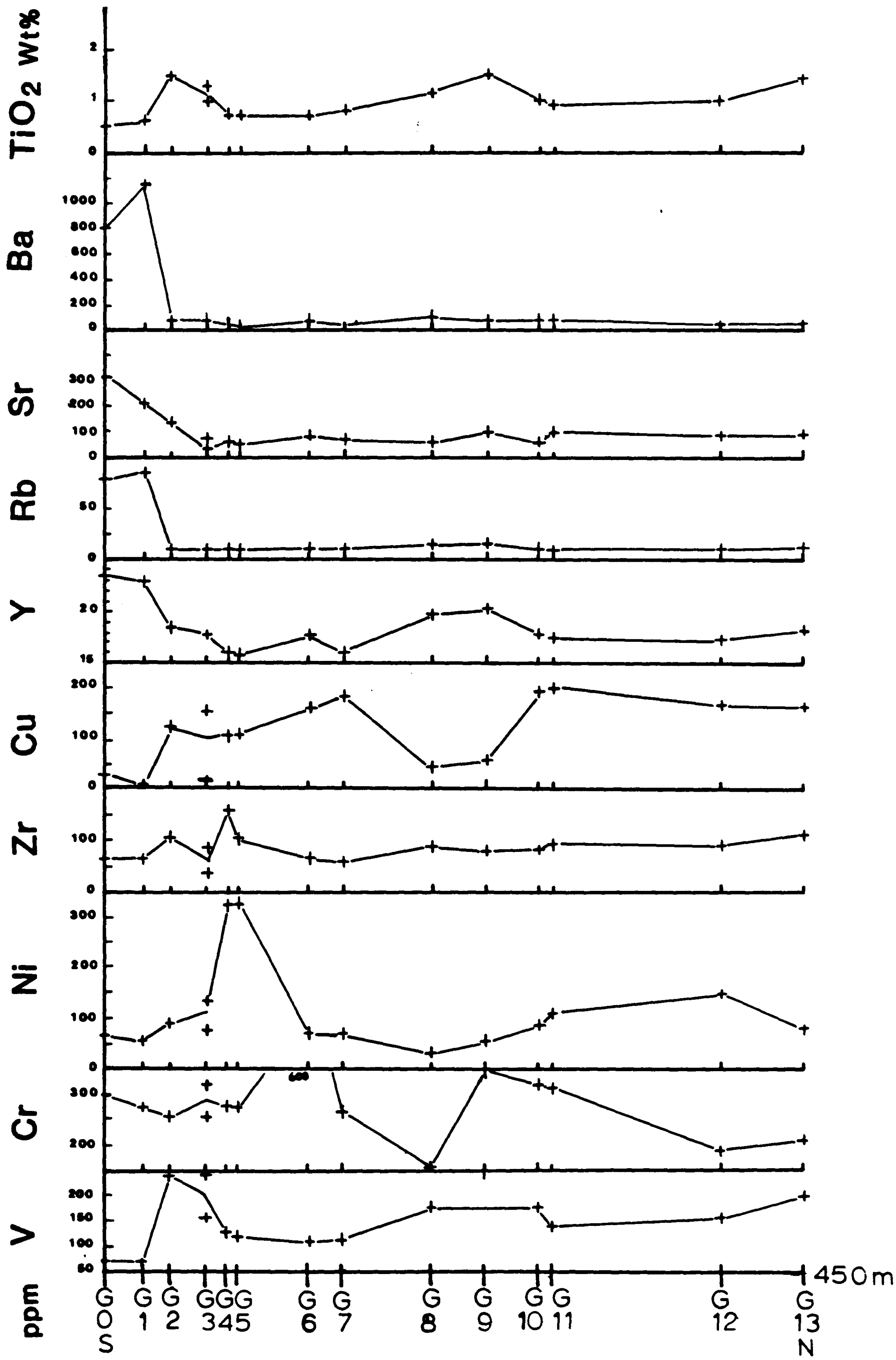


Figure G.8: Oxide (weight %) and trace elements (ppm) variation from south to north across the "Katisha Lake Gabbro Sill". See stratigraphic map in back pocket for sample location. (From Kresz, 1984a).

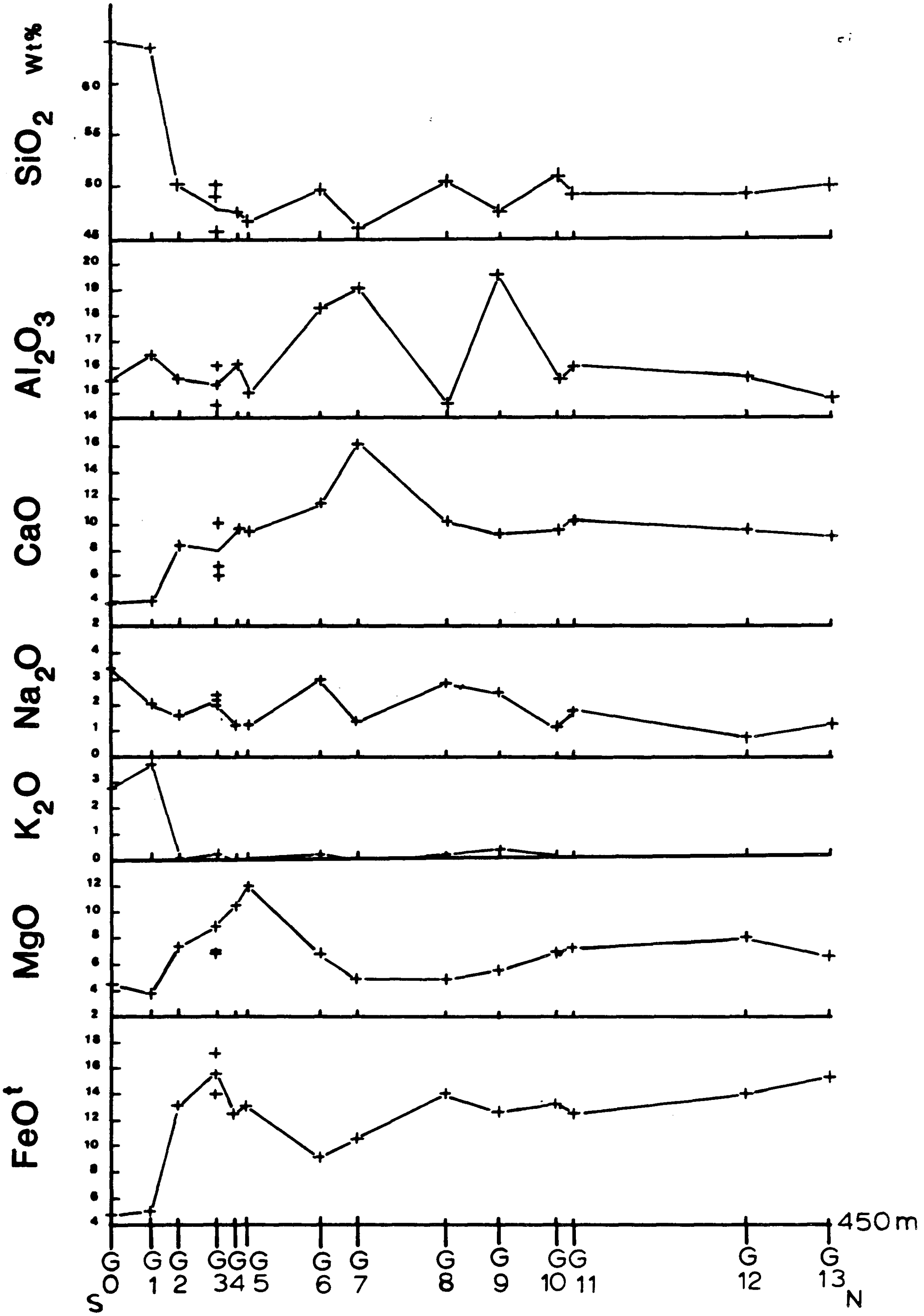

SiO2 Wt%
Al2O3
CaO
Na2O
K2O
MgO
FeOt
450m
G 0
G 1
G 2
G 3
G 4
G 5
G 6
G 7
G 8
G 9
G 10
G 11
G 12
G 13
S
N

Fig. G8: contd

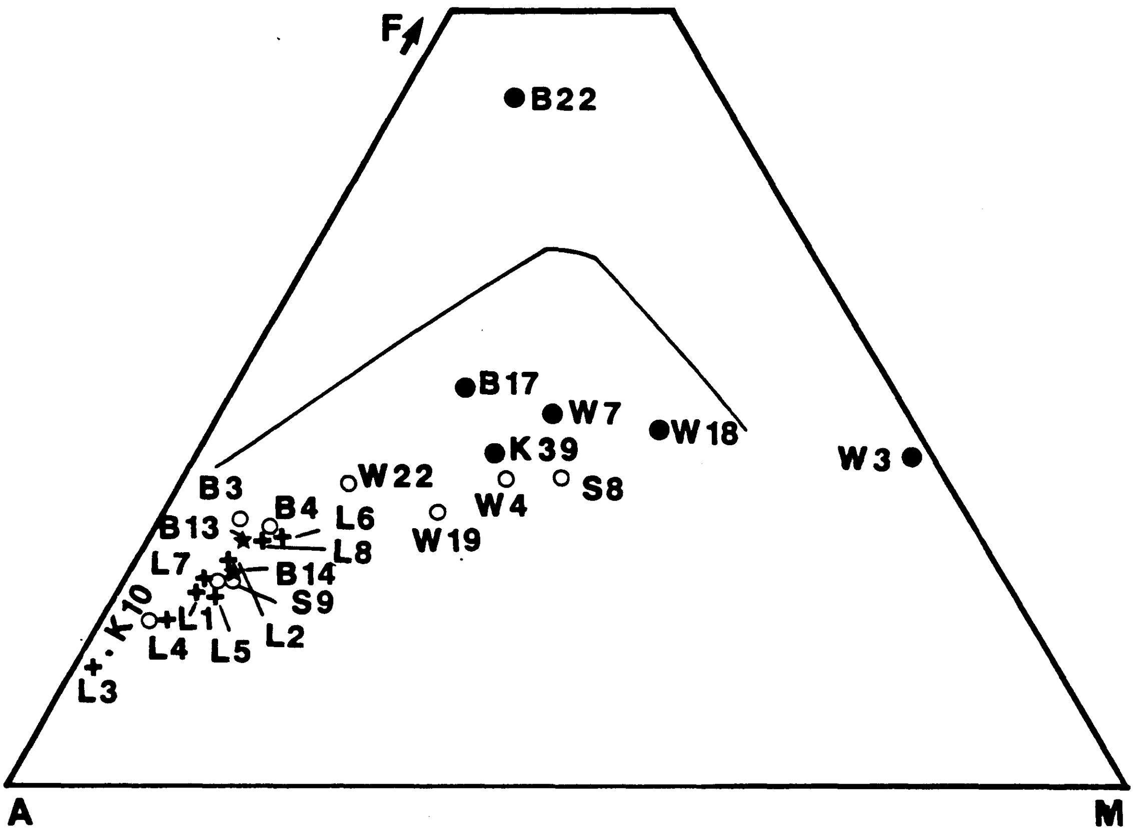


Figure G.9: AFM diagram of diverse intrusive rocks (From Kresz, 1984a).

- ● Ultramafic (W3) and monzogabbro (W7) dikes
- • Lamprophyric rocks
- **O** Alkalic and granitic dike rocks
- ✳ Post-tectonic tonalite intrusion within the Boyer Lake Group
- o Felsic porphyry, from dikes and stocks near Tabor Lake
- + Post-tectonic granodiorite (Revell Batholith and stocks at Stormy Lake)

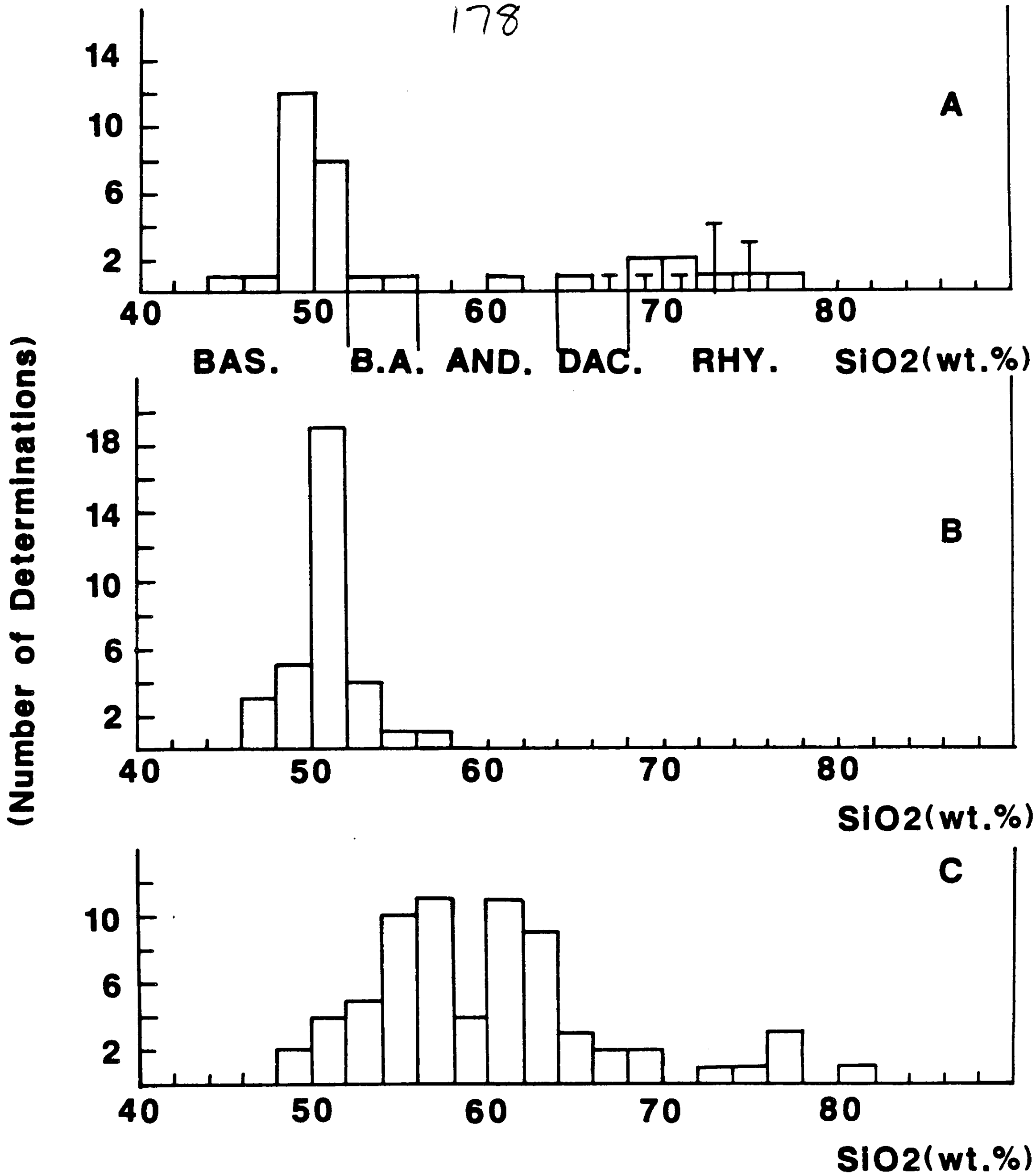


Figure G.10: SiO2 frequency histograms for metavolcanics of the Stormy-Kawashegamuk Lakes area (From Kresz, 1984a).

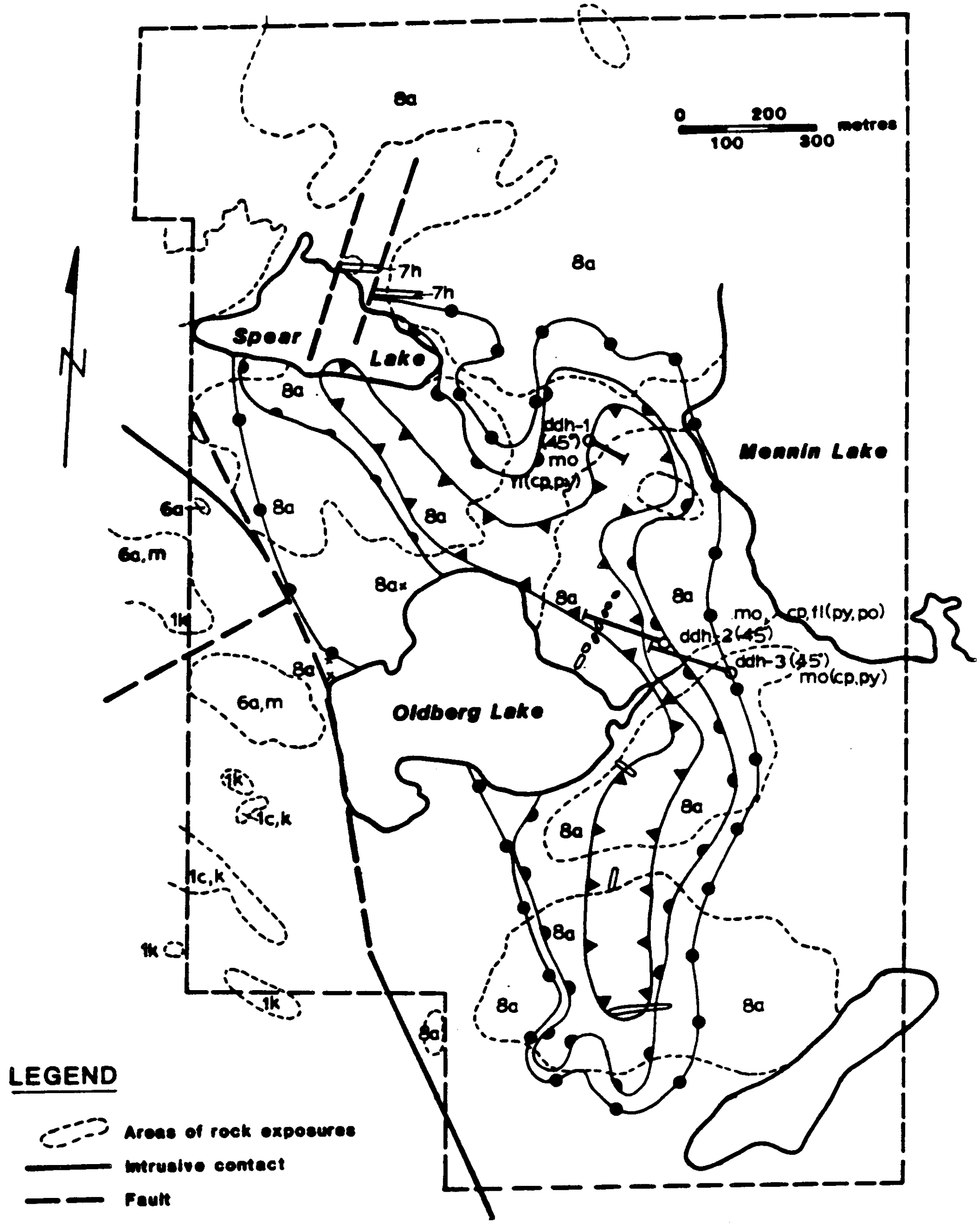
(a) Wapageisi Lake Group, Subgroups I and II (Bars depict the Thundercloud Lake Porphyry)

(b) Boyer Lake Group

(c) Kawashegamuk Lake Group, Cycles I and II.

All silica values have been calculated on a volatile free basis

Figure E-1 : Map showing the geology and the soil geochemical (Mo) anomaly over the Oldberg Lake molybdenum occurrence. Diamond drill holes and trenches are also shown. (Geology by D. Kresz, 1981; Geochemical contours traced after analytical data from map accompanying company report, Assessment Files Research Office, Ontario Geological Survey, Toronto).



LEGEND

Areas of rock exposures

Intrusive contact

Fault

Lithologies

1 : mafic volcanic rocks (c: pillowed rocks, k: amphibolite)

6 : gabbro (a: coarse grained, m: amphibolite)

7h : feldspar porphyry

8a : massive biotite granodiorite

Claim group boundary

Soil Geochemical Survey (B and C horizons)

Contour outlining areas with high incidence of samples with more than 65 ppm Mo

Contour outlining area with high incidence of samples with between 35 and 65 ppm Mo

Contour outlining areas with high incidence of samples with between 15 and 35 ppm Mo. Outside the contour line, Mo values are below 15 ppm.

Trenches, carried out in 1965 and 1966

mo (py) Diamond drill hole, projected vertically mineralization indicated, mineralization indicated in parentheses has been found in minor or trace amounts

Figure E-1

(FIGURE IN BACK POCKET)

Figure E-2: Plan of the Van Houten Mine showing development work carried out on the property, diamond drill hole locations, locations of samples taken for chemical analyses and some surface geology. (Map compiled from company reports: Sakoose Gold Mines Limited, Mid-North Engineering Services, Nordic-Sturgeon Gold Mines Limited, Resident Geologist Files, Kenora, Ontario; and from field work carried out by the writer in 1981).

Figure E.4a: Plan of the Tabor Lake Property

showing: the shaft location with the projection of underground workings, trenches, an outline of the porphyry dike with quartz veins observd on surface, the projection of diamond drill holes and their intersected lithologies. Interesting gold values are shown as ounces Au/ton over length in feet.

Legend:

Dior: Diorite
GS: Greenstone (metavolcanic rocks)
POR: Porphyry
OV: Overburden
SHR: Shear zone
V: Vein


Diamond drill hole location (Clark Gold Mines Limited)


Diamond drill hole location (St. Joseph Exploration Limited)

(Redrawn after a figure accompanying a report by Sylvanite Gold Mines Ltd. (1943) with added information from reports by Sulpetro Minerals Limited (1983) Assessment Files Research Office, Ontario Geological Survey, Toronto)

(FIGURE IN BACK POCKET)

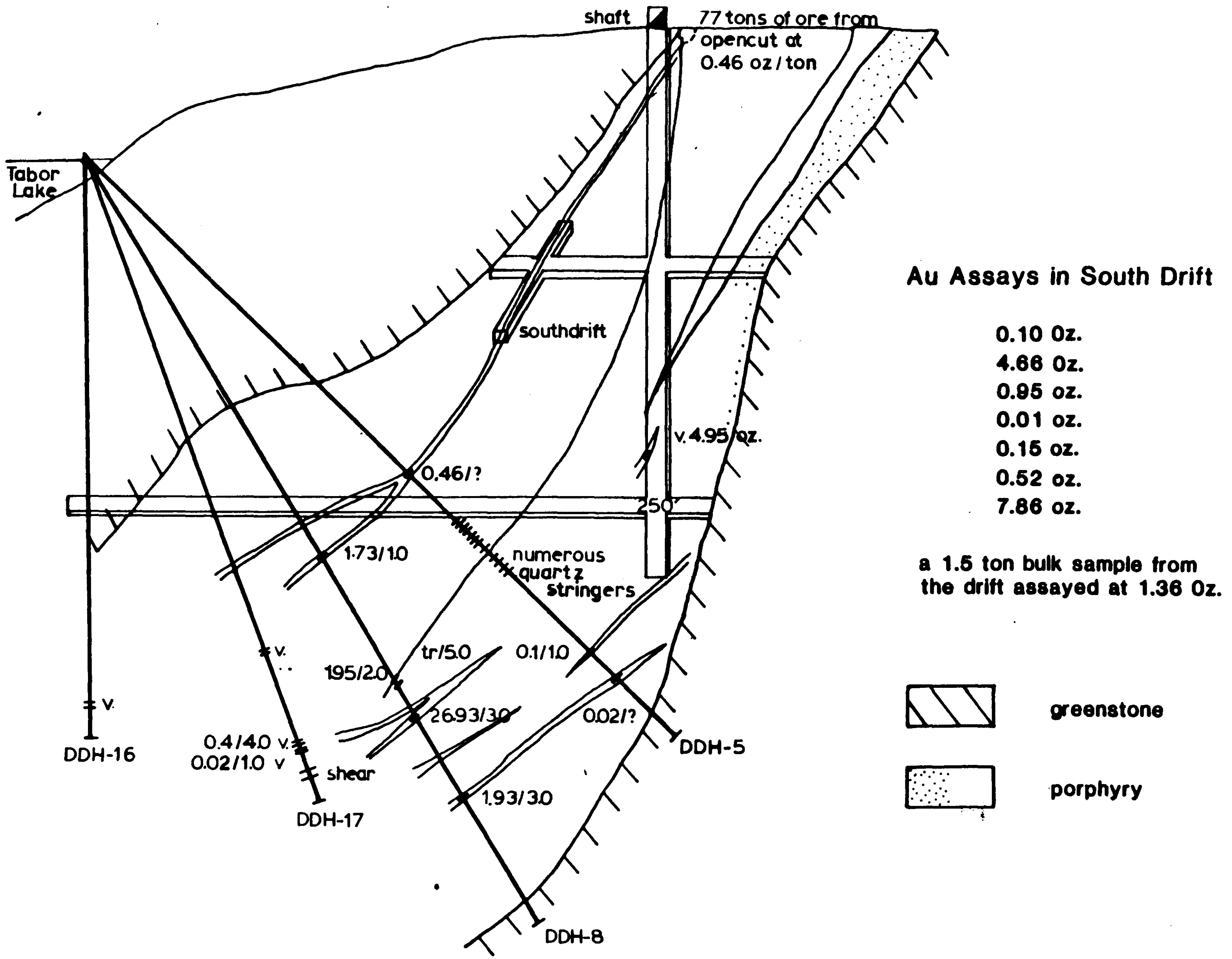


Figure E-4b Cross section showing the configuration of the underground excavations and diamond drill holes no. 5,8,16,17. Intersections with significant gold concentrations are noted. (Redrawn from a company report figure by R.S. Douglas (1938) for Clark Gold Mines Limited with added information from a section by G.L. Holbrooke (1943) for Sylvanite Gold Mines. Assessment Files Research Office, Ontario Geological Survey, Toronto.)

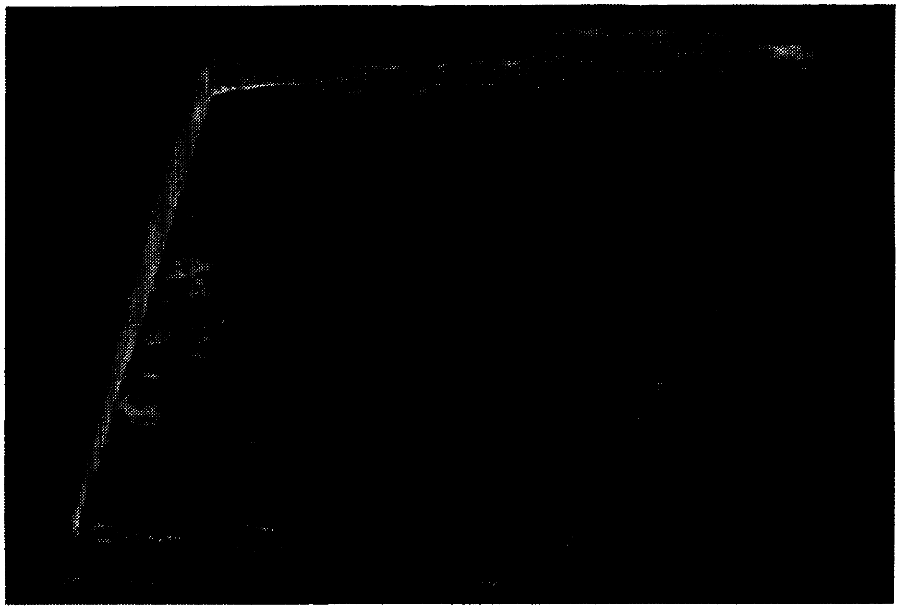


Photo G 1: Thin bedded, fine-grained, siliceous water lain tuff occurring among pillow basalts of Subgroup I.

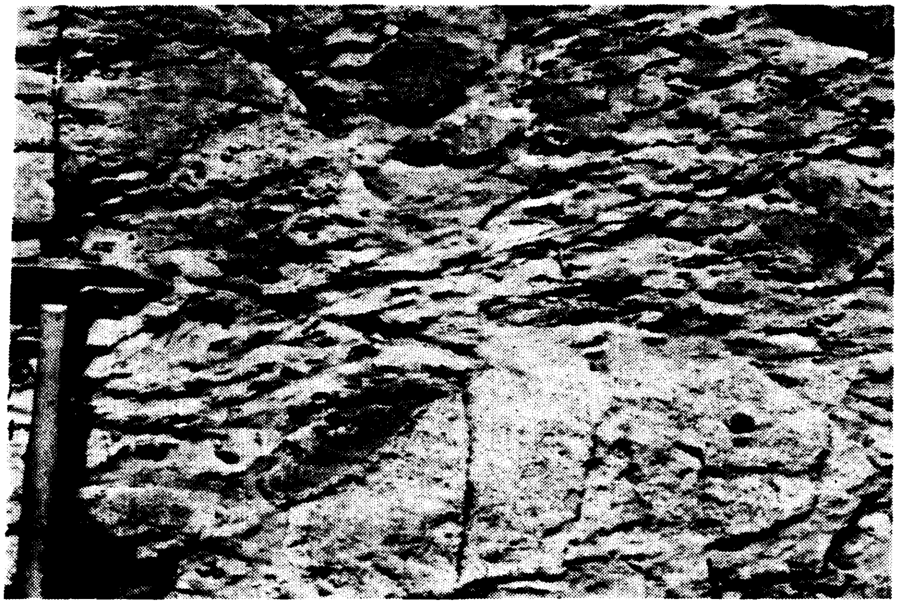


Photo G 2: Heterolithologic tuff-breccia in formation I with mafic and intermediate to felsic fragments. The large clast in the middle shows mafic components set in a more felsic host; a narrow reaction rim is visible.

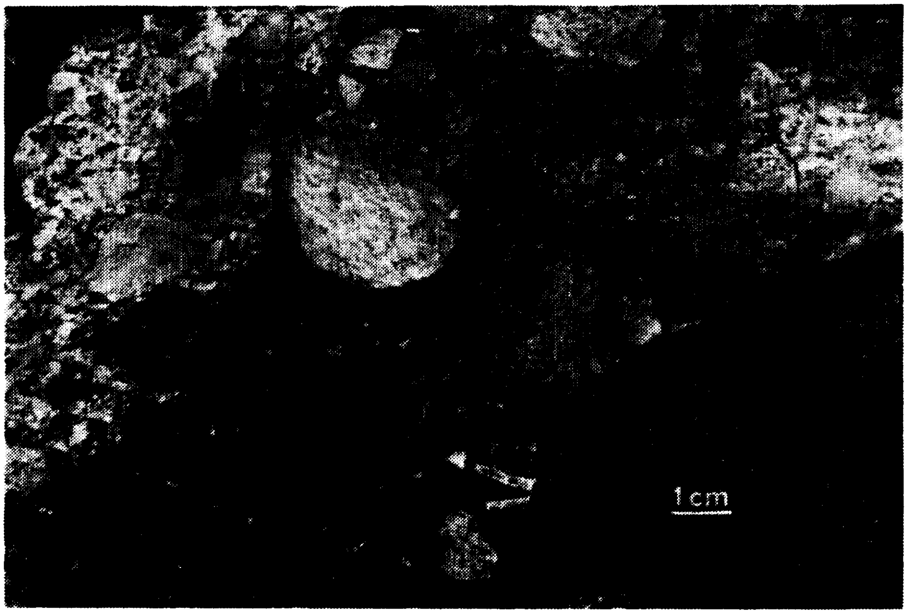


Photo G 3: Conglomerate from Subfacies II near Facies I. Poorly reworked volcanic clasts are dominant. This rock sample shows also admixed well rounded clasts of volcanic material, jasper iron formation and a foliated type. All clasts are set in a matrix of very immature sandstone and grit.

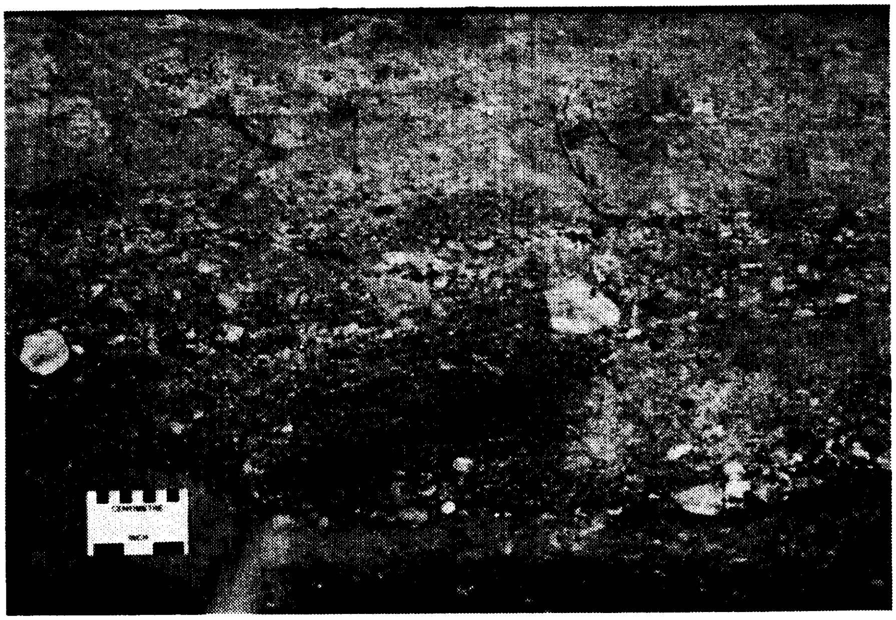


Photo G 4: Large scale cross-stratification in lithic sandstone defined by pebbly beds in Subfacies IIb.

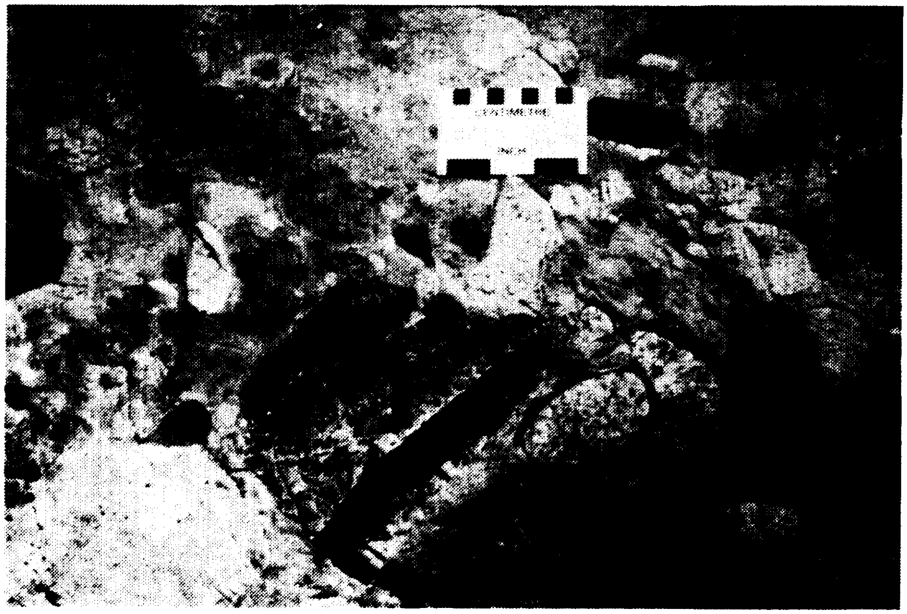


Photo G 5: Polymictic conglomerate with highly diversified clast lithologies in Subfacies IIb. The picture shows a well bedded jasper-magnetite iron formation clast, granitic and volcanic types.

Photo G 6: Two clasts exhibiting weathering rinds in volcaniclastic conglomerate at the base of Subgroup IIb.

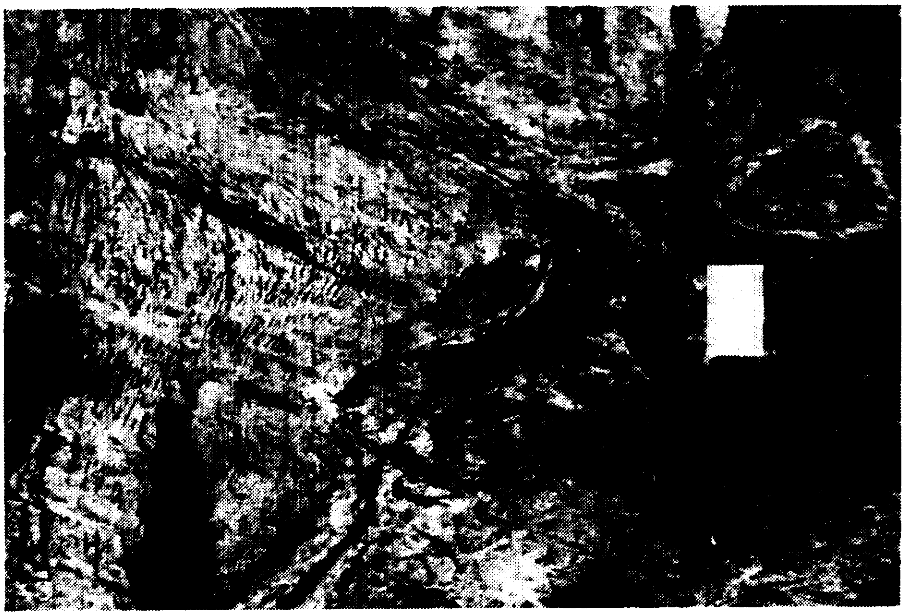


Photo G 7: Density contrast between a pillow basalt and mafic tuff: the large pillow on top sank in a water logged ash layer; note the detached pillow beneath Cycle II.

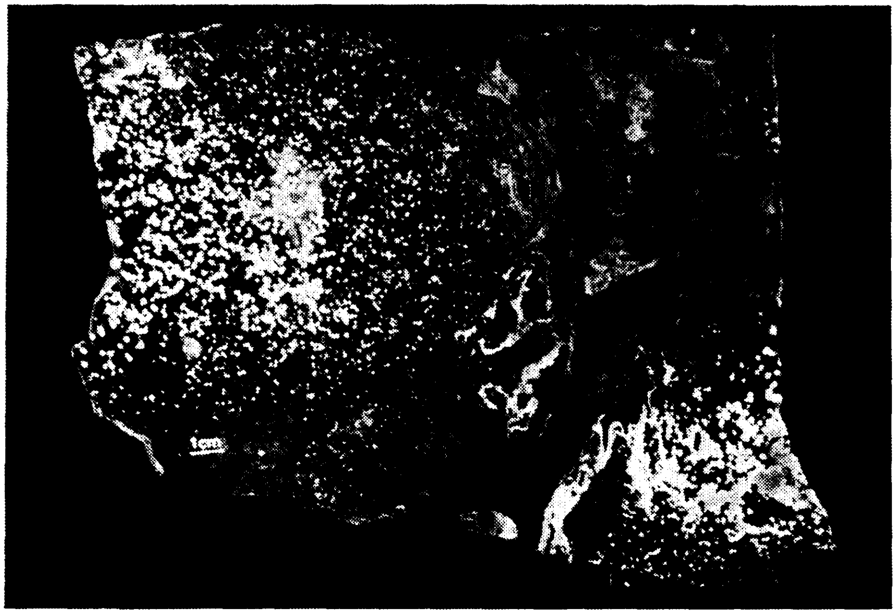


Photo G 8: Polished slab of three variolitic pillows from Cycle II. Felsic varioles increase in size towards the pillow interior where they tend to agglutinate. The matrix to the varioles is an iron-rich devitrified glass. Note the spalled pillow rims forming pillow breccia.

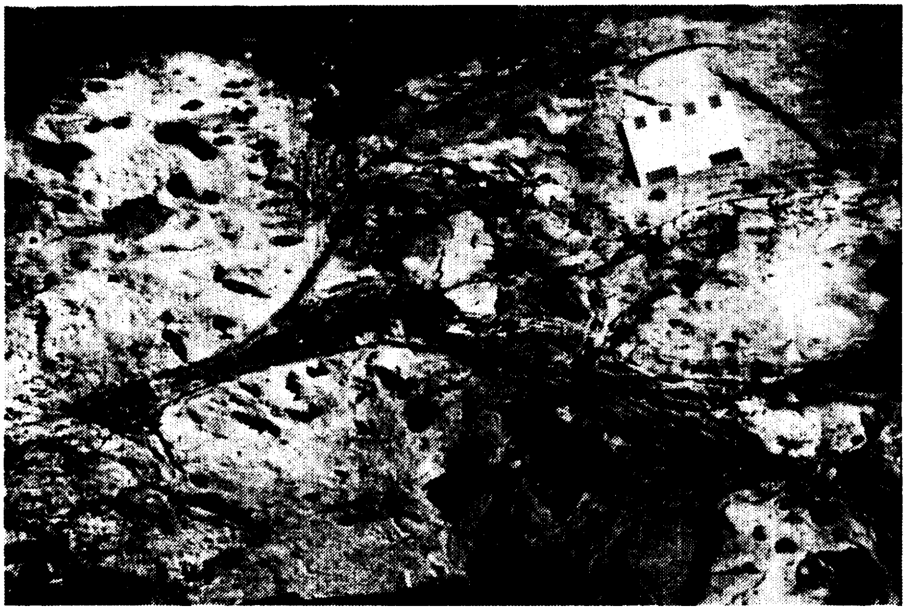


Photo G 9: Interflow wacke bed disrupted by the flowage of pillowed andesitic lava over unconsolidated sediments; note the large radial pipe vesicles (carbonate filled) in the pillow rims. Cycle II at Tabor Lake.

Photo G10: Hyaloclastite in "Formation H", Cycle II; the purplish matrix to the white coloured clasts showing quench structures is a finely fragmented, divitrified glass. The rock has been highly altered.

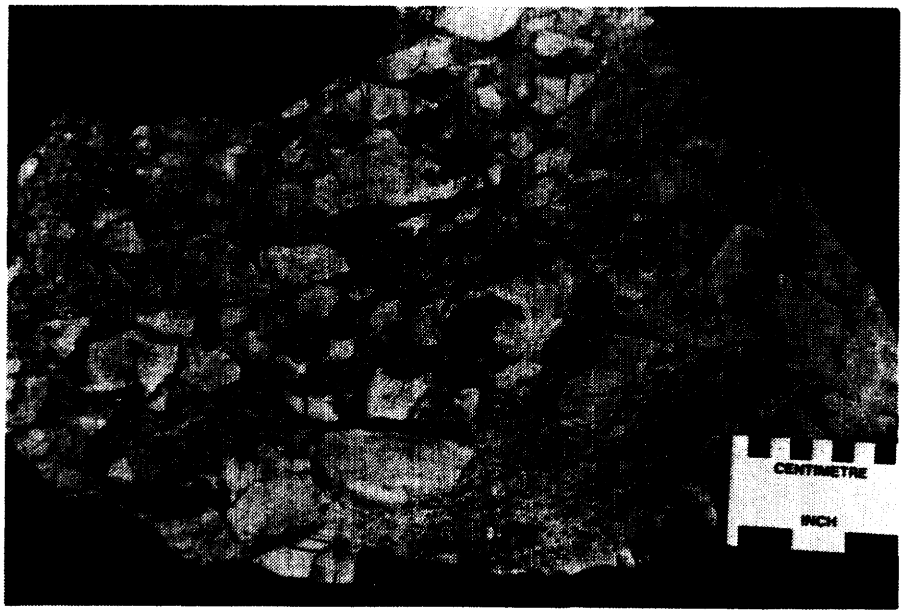


Photo G11: Felsic breccia in a mafic tuff matrix from the lower part of the Boyer L. Gr. with an intermediate colour indicated by arrow. The felsic fragments are highly vesicular. This breccia is comparable with the breccia shown in photo G 2.

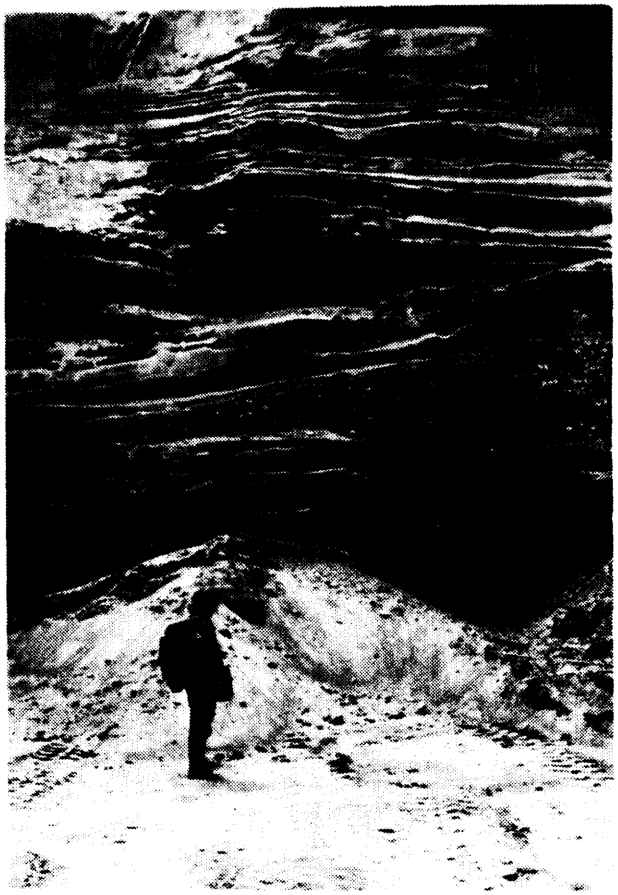


Photo G12: Stratified sand and gravel in a glacio-fluvial deposit filling a valley at the west end of Snake Bay.

Photo G13: Intense narrow shear zone in pillow basalt in a cliff on the north shore of Snake Bay. Movement along the Mosher Bay - Washeibemaga Lake Fault is indicated by rock gouge and highly stretched pillows.

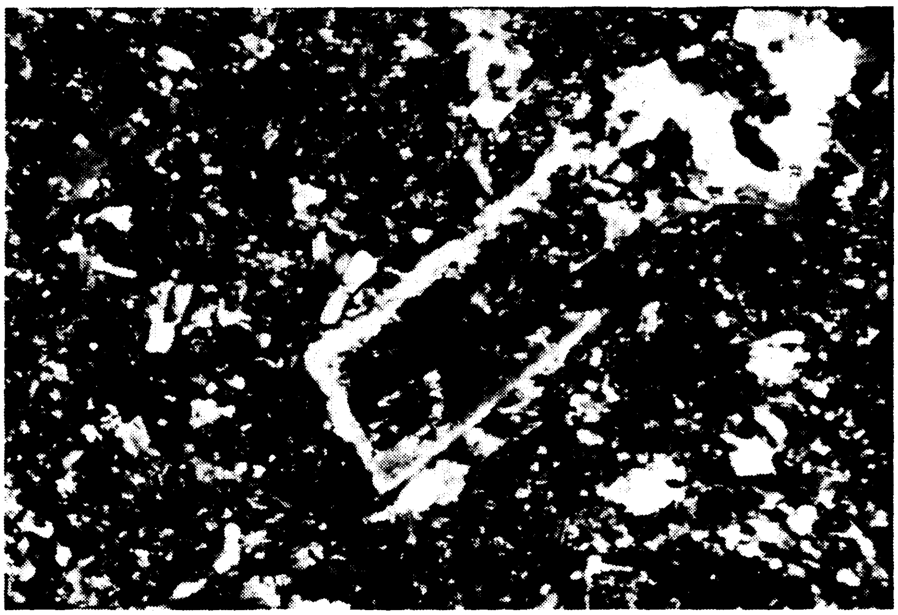


Photo G14: Saussuritized plagioclase relicts in a coarse textured rock from the Wapageisi L. Group rimmed by clear albite. Note secondary albite laths. Other minerals are chlorite, actinolite, quartz and carbonate. Crossed polars X 20.

Photo G15: Ophitically enclosed plagioclase relicts in a chlorite-actinolite mesostasis from a pillowed basalt near the top of the Kawashegamuk Lake Group. Plane light X 20.

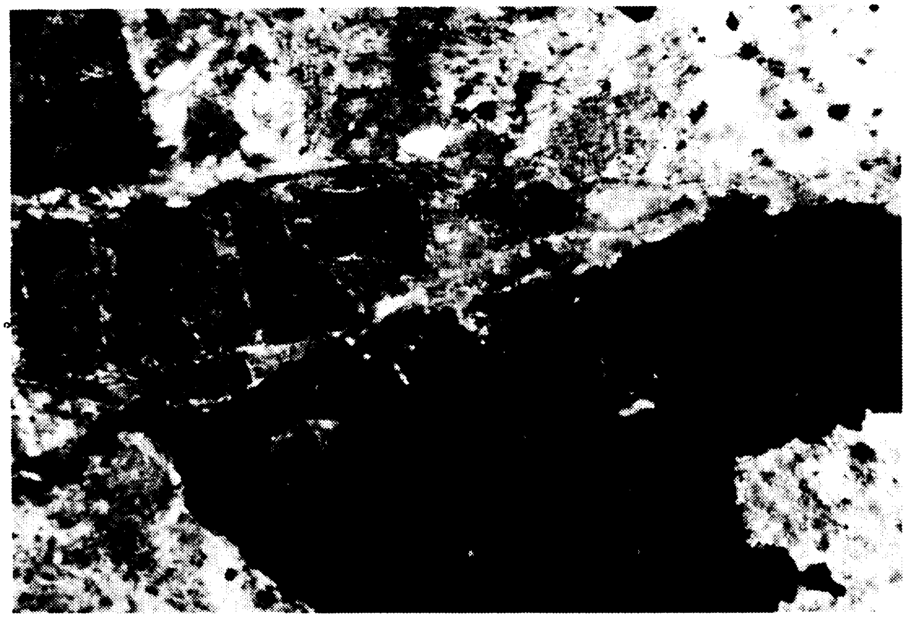


Photo G16: Large magnetite relic with exolved lamellae of ilmenite (now fine grained sphene) in a chlorite-actinolite mesostasis. Note large saussuritized plagioclase laths on the left. From gabbro sill at the top of the Kawashegamuk Lake Group. Plane light X 20.

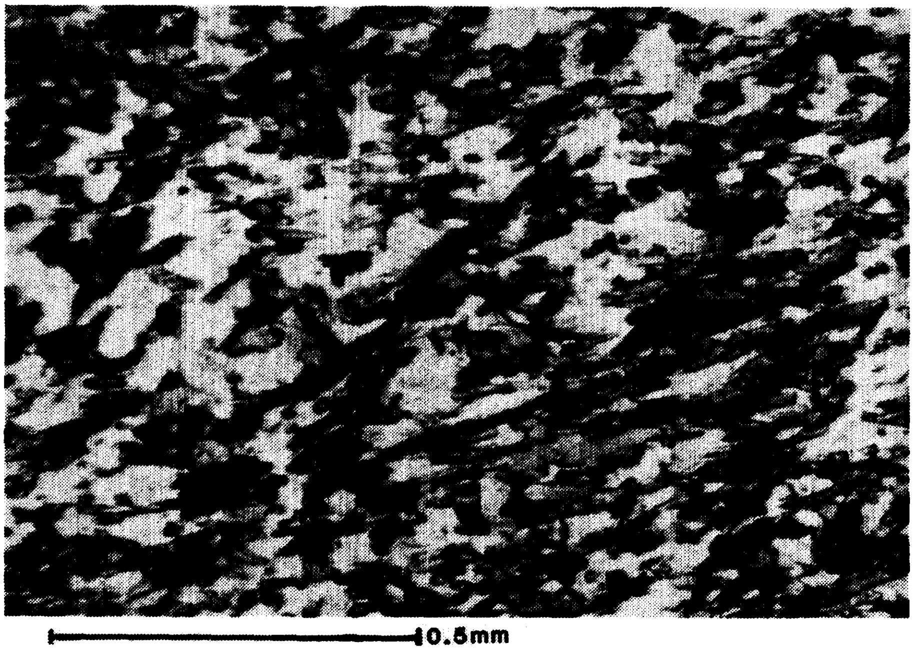
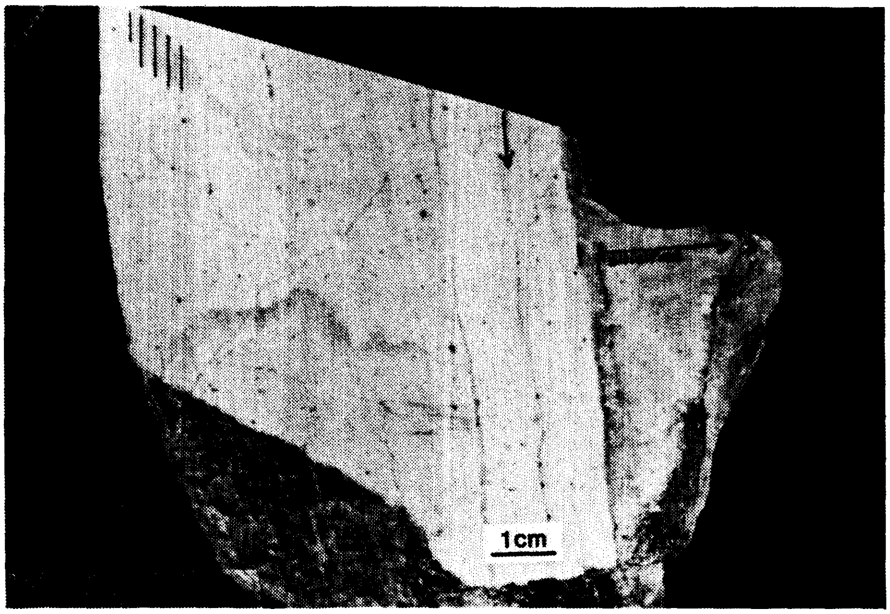
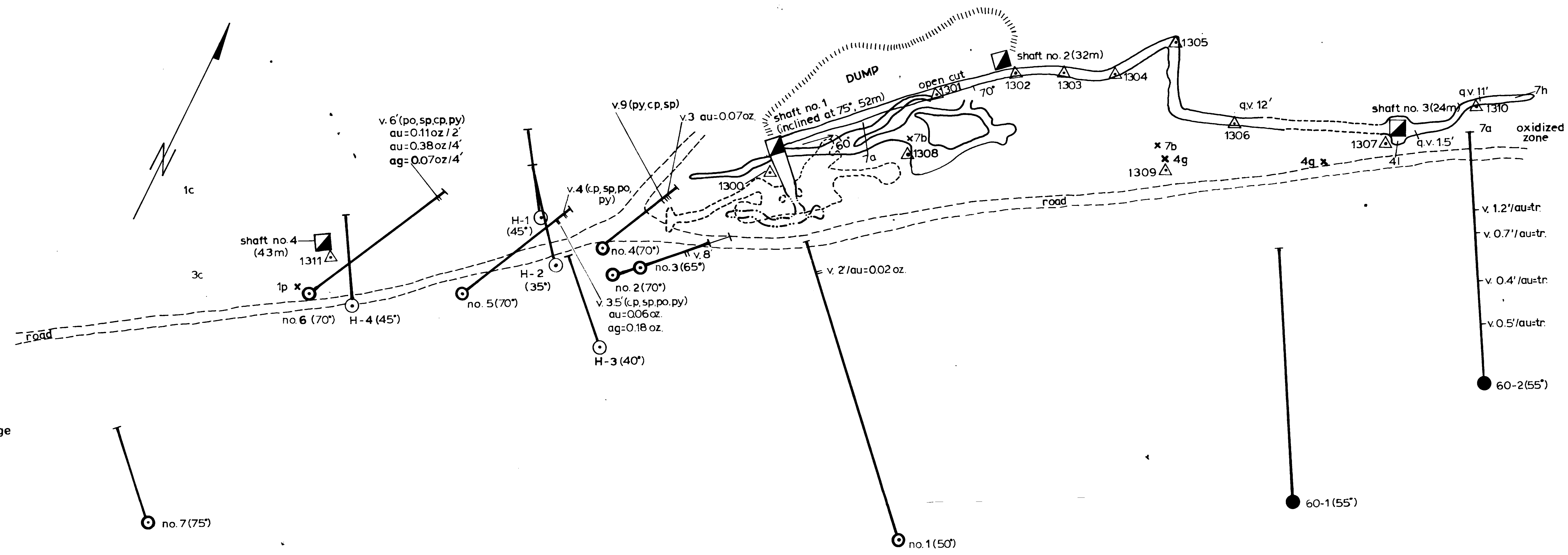


Photo G17: Photo micrograph of a basaltic hornfels at Mennin Lake showing a granoblastic texture typical of rocks near post-tectonic granitic intrusion contacts. Minerals are chiefly hornblende, plagioclase and quartz. Plane light X 20.

Photo E 1

Photograph showing a sample of quartz eye felsic porphyry collected from the tailing pile on the Tabor Lake property. The porphyry is sheared and shows yellow to pink banding and a silicified zone. Numerous quartz veinlets occur throughout the rock. Stripes show the direction of a pronounced fracture cleavage in the veins.





LEGEND

1c pillowed mafic flows
1p carbonatized mafic rocks
3c felsic tuff breccia, breccia
4g arenite
4l slate
7a quartz-feldspar porphyry
7b felsite
7h feldspar porphyry
q.v. 1' quartz vein, width in feet
× small exposure
→ 6 lineation (slickensides) direction with plunge
shaft, depth in metres (43m)

Plan of Underground Development (shaft no. 1)

—— 70 ft (21m) level
– – – 120 ft (36m) level
–·–·– 170ft (52m) level

△ 1300 sample locations and number

Diamond Drill Holes, projected vertically (inclination indicates in brackets)

H-3 P.E. Hopkins (1931)

no.7 v. 9' (py, cp, sp) Sakoose Gold Mines Limited (1935), (quartz veins, v. length of core, mineralization and assay value in ounces/ton indicated)

60-1 v. 0.5'/au=tr. Mid North Engineering Services Ltd. (1960), (quartz veins, v. length of core and gold value indicated: tr-trace)

cp : chalcopyrite
py : pyrite
po : pyrrhotite
sp : sphalerite

Note: no information on diamond drill locations from Van Houten Gold Mines Limited has been found.

Figure E-2

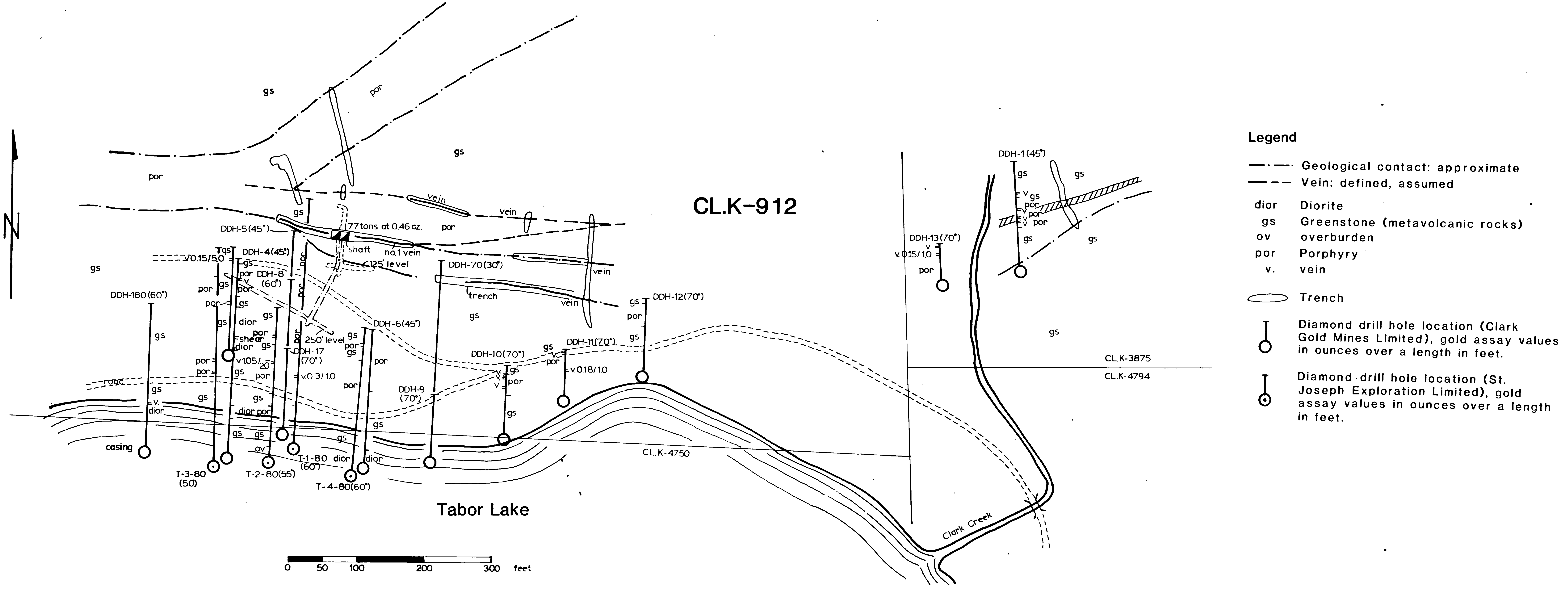
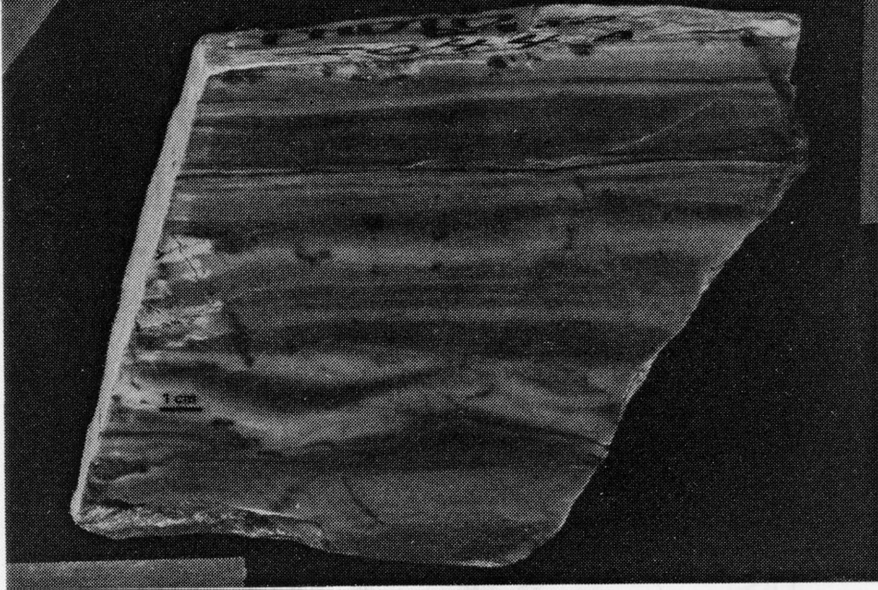

CL.K-912
Tabor Lake
Clark Creek
CL.K-3875
CL.K-4794
CL.K-4750
77 tons at 0.46 oz.
shaft
no.1 vein
125' level
250' level
trench
vein
road
casing
DDH-5(45°)
DDH-4(45°)
DDH-8 (60°)
DDH-17 (70°)
DDH-6(45°)
DDH-70(30°)
DDH-9 (70°)
DDH-10(70°)
DDH-11(70°)
DDH-12(70°)
DDH-13(70°)
DDH-1(45°)
DDH-180(60°)
T-1-80 (60°)
T-2-80(55)
T-3-80 (50)
T-4-80(60°)
v0.15/5.0
v1.05/20
v0.3/1.0
v0.18/1.0
v.0.15/1.0
0 50 100 200 300 feet
Legend
Geological contact: approximate
Vein: defined, assumed
dior Diorite
gs Greenstone (metavolcanic rocks)
ov overburden
por Porphyry
v. vein
Trench
Diamond drill hole location (Clark Gold Mines Limited), gold assay values in ounces over a length in feet.
Diamond drill hole location (St. Joseph Exploration Limited), gold assay values in ounces over a length in feet.

Figure E4a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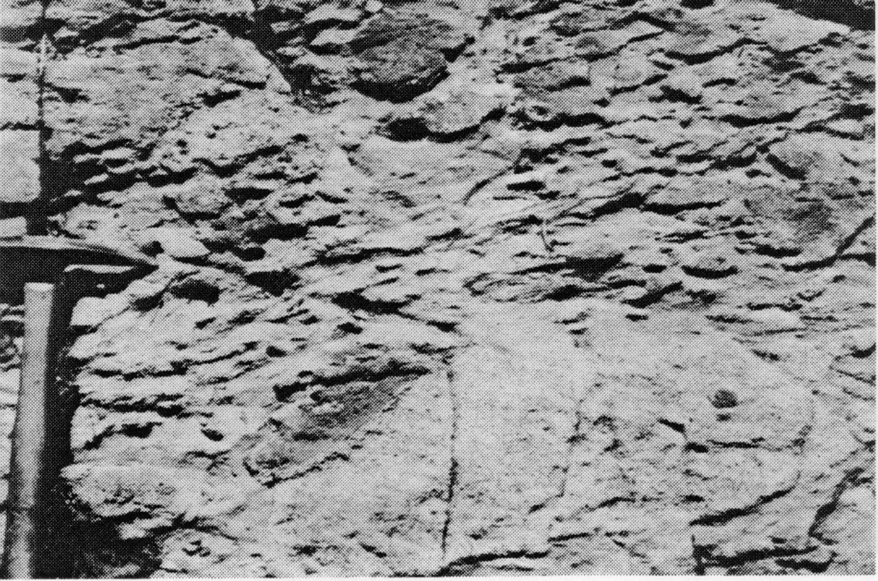

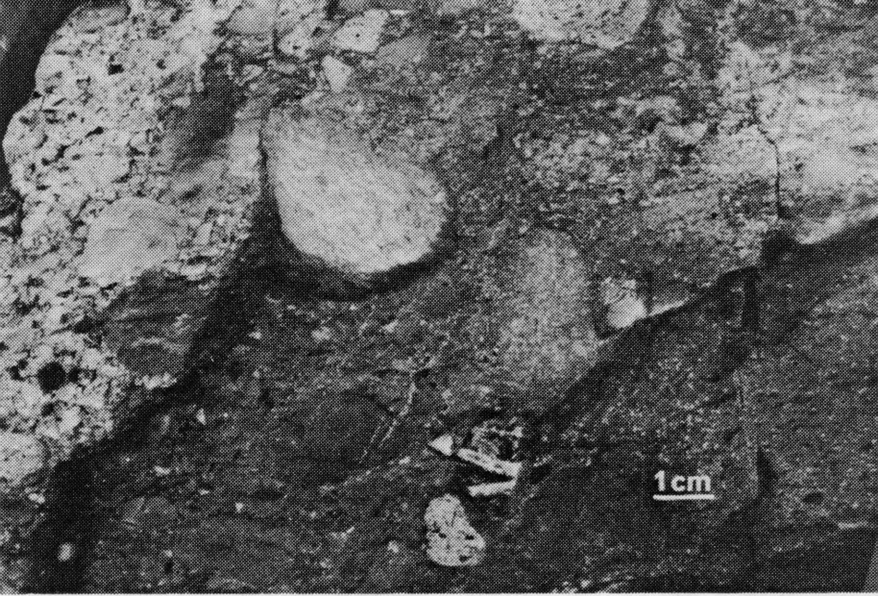
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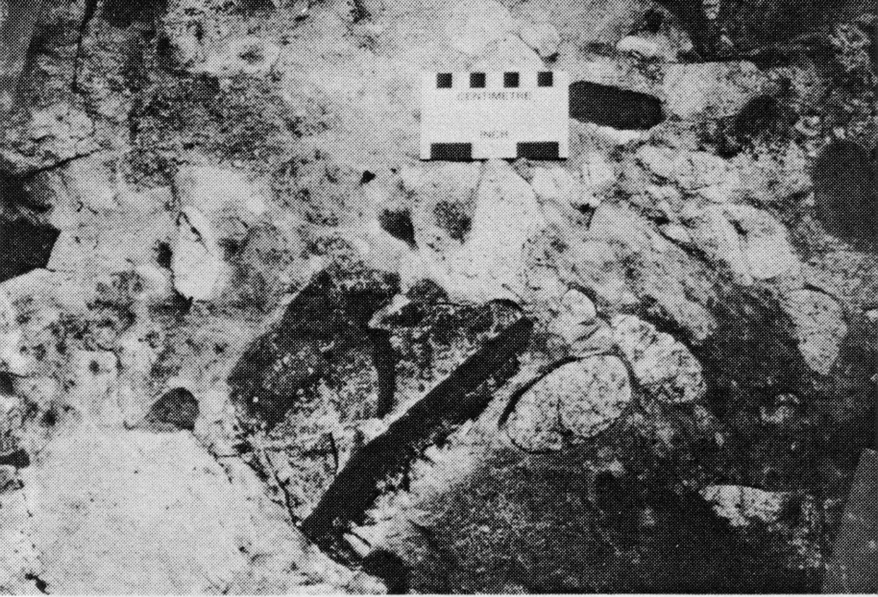

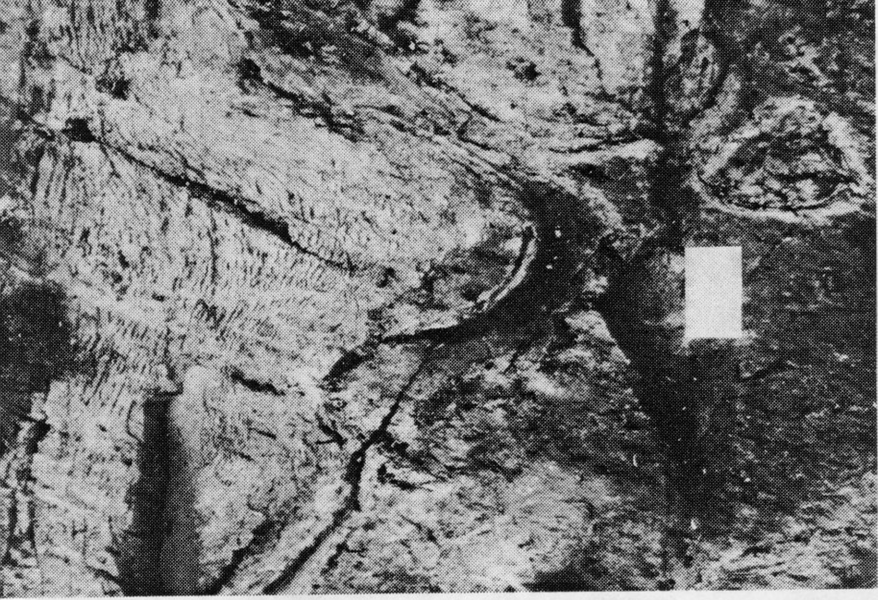

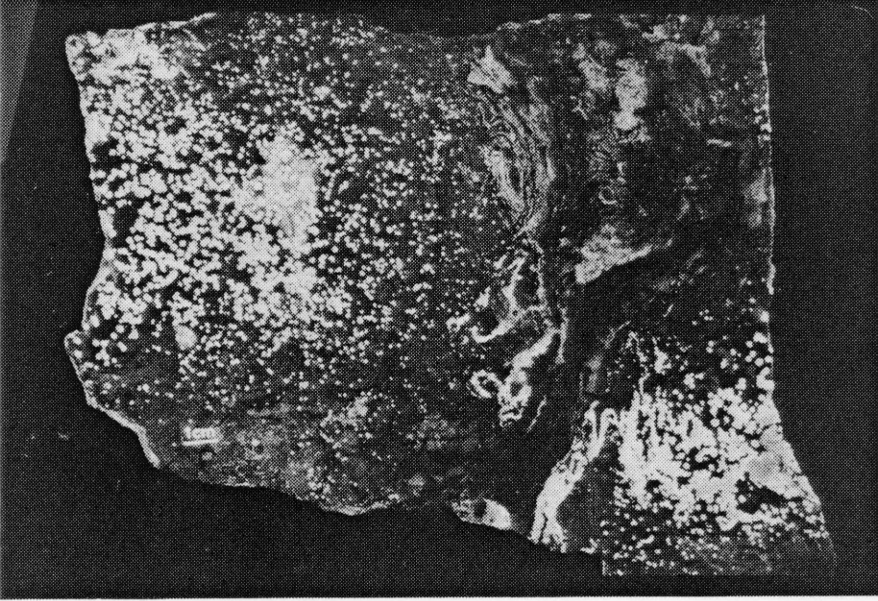
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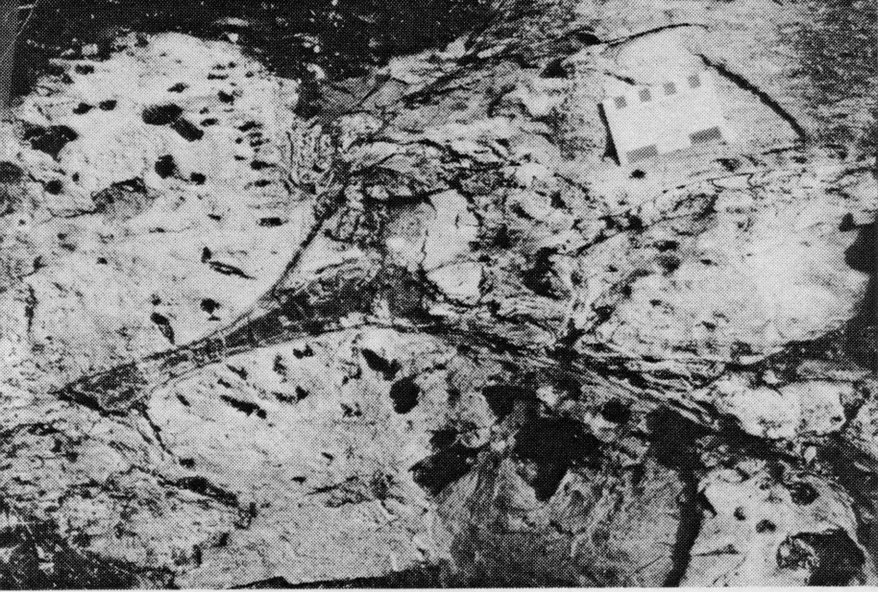

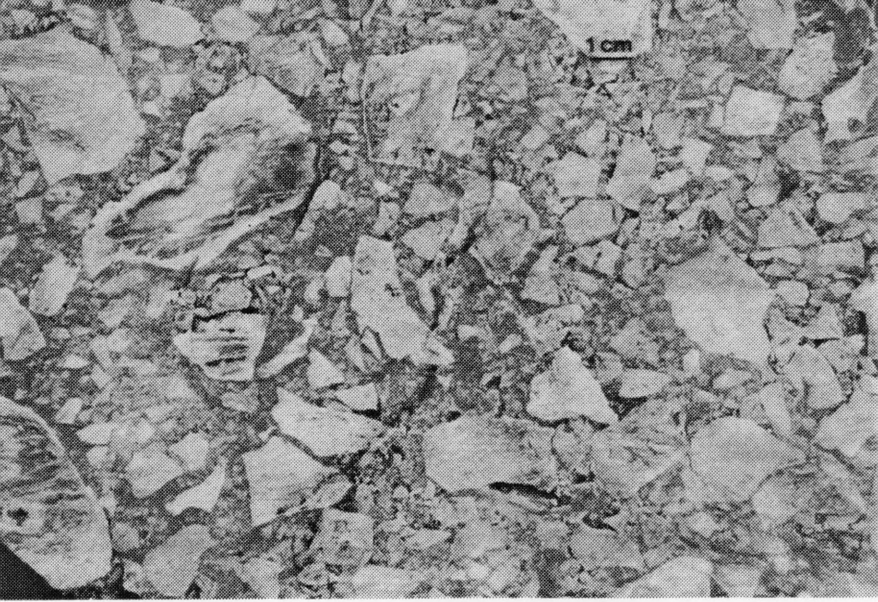
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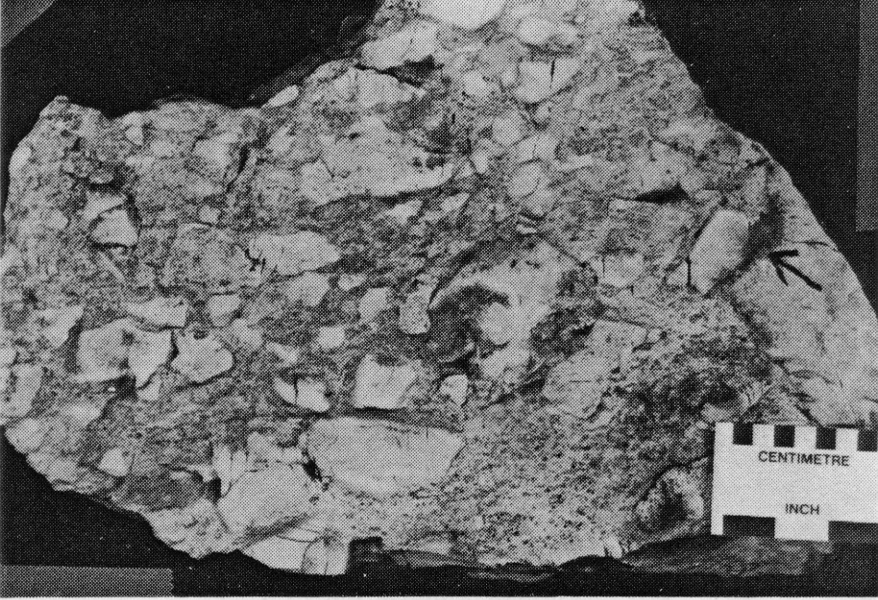
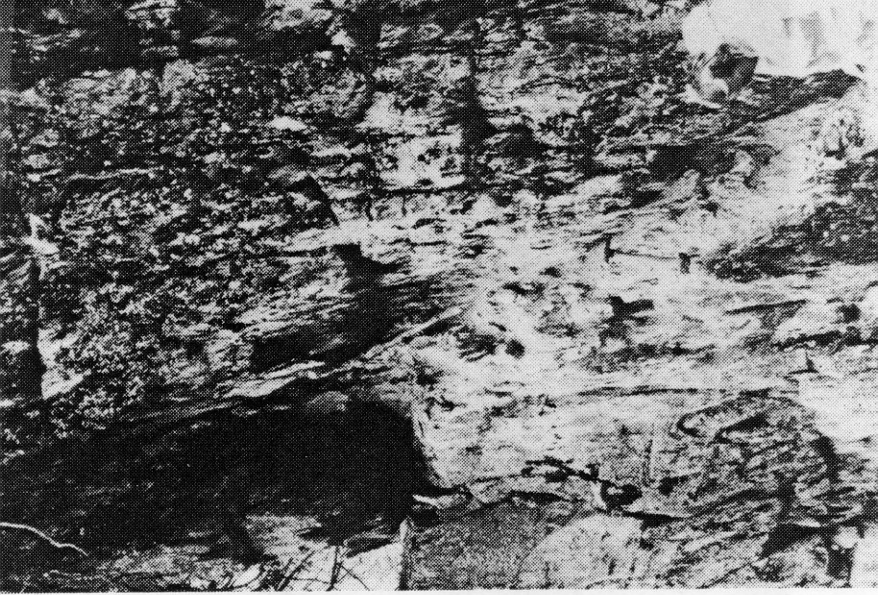
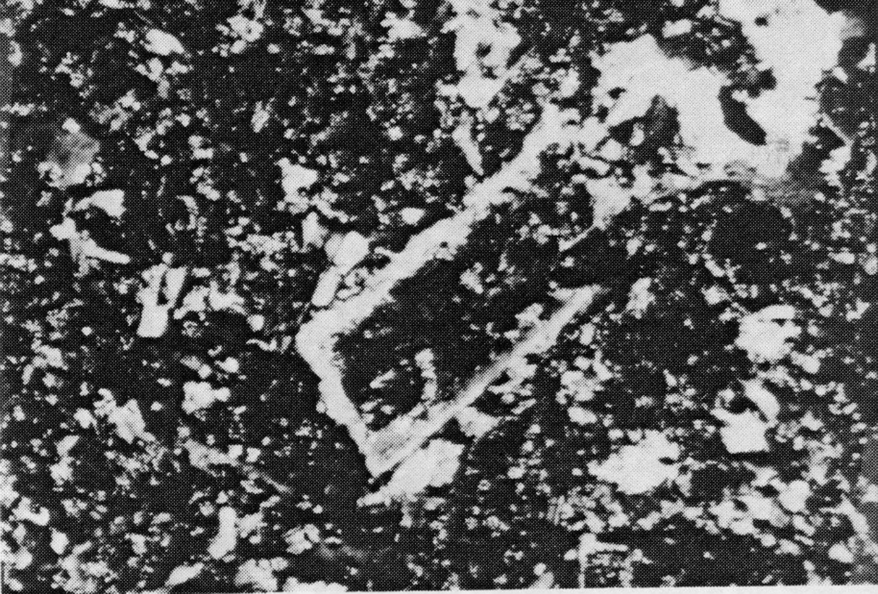
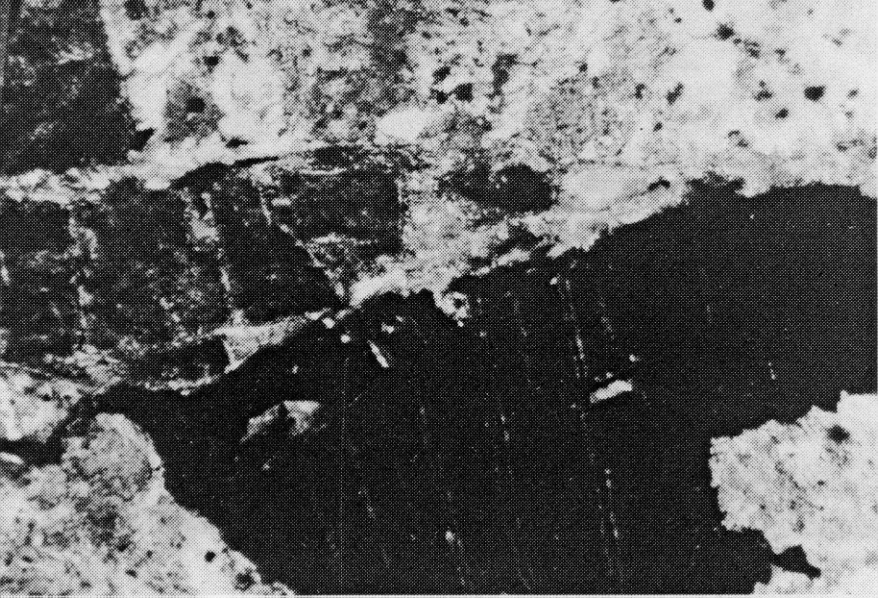
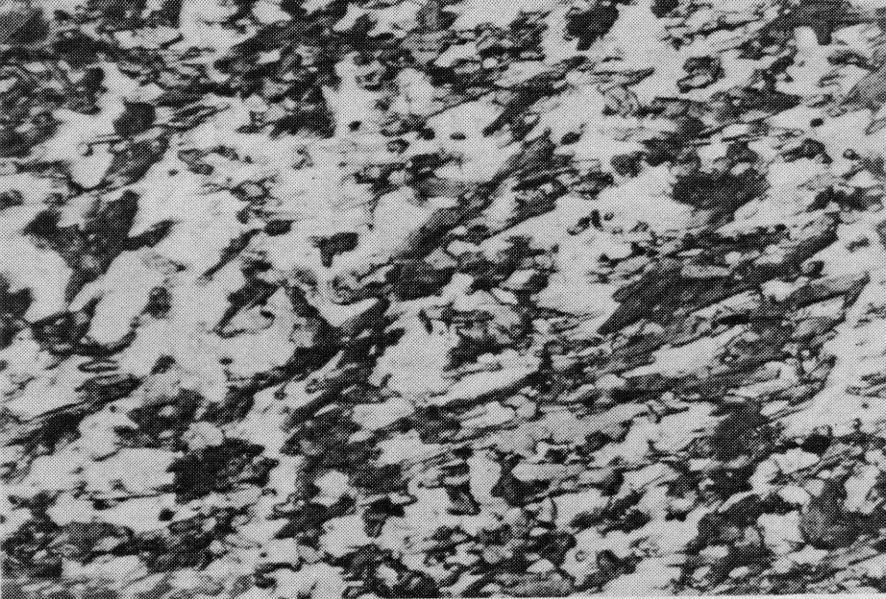
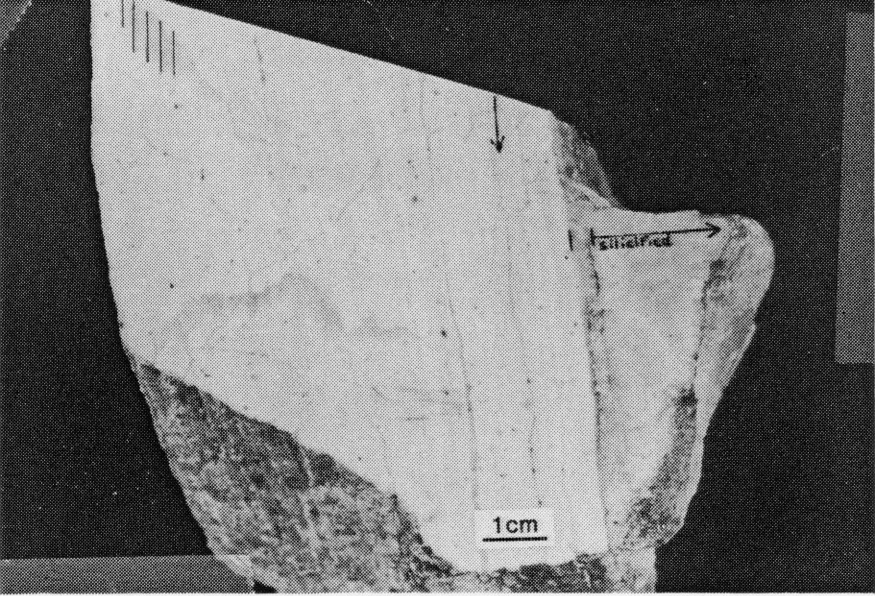

CENTIMETRE
INCH










silicified
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MARGINAL NOTES

LOCATION AND ACCESS

Kawashegamuk Lake lies about 30 km southeast of Dryden. The map-area is included in NTS map sheets 52 F/8 and 59 F/9.

A lumber road commences at Highway 17 at Jackfish Lake, 10 km east of Dinorwic. This road gives access to the western part of the map-area and to Stormy Lake. A township road that commences at Borups Corners on Highway 17 gives access to the eastern part. A third road in the north-central part of the map-area links these two roads. Most of the map-area can be reached by canoe or light watercraft as many lakes are interconnected by short portages.

MINERAL EXPLORATION

In the latest years of the past century, the Lake of the Woods region became the scene of considerable exploration and mining for gold.

During the period 1895 to 1912, at least 20 mines and prospects were opened in the Manitou Lakes area, which lies west of the map-area (Thomson 1933). During these years, prospecting activity started in the Kawashegamuk Lake area. This became known as the "New Klondike" area after gold had been discovered south of Melgund Township, on original claims S.V.258, H.W.416, H.W.418, and H.W. 419. The Tabor prospect (S.V.258, No.20) was held in 1898 by J. Tabor and J. Stephenson who first staked the property in 1897. During 1934 and 1935, Clark Gold Mines Limited developed the property and produced 36 ounces of gold and 4 ounces of silver[1]. This recovery was mainly from 200 feet (61 m) of surface trenching yielding 87 tons of ore. Other exploration and development work consisted of sinking a shaft 280 feet (85 m) deep with levels at 68 feet (21 m), 125 feet (38 m), and 250 feet (76 m) below the surface. 7355 feet of surface diamond drilling was done from a total of 21 holes[1]. The operations were suspended in 1938. In July 1942, Tabor Lake Gold Mines Limited took over the property later leased to Pantan Mines Limited in 1957[1]. Further work was then undertaken, including lateral development, and six holes were diamond drilled indicating an extension of the vein system to the 375-foot (114.3 m) level along a strike length of 400 feet (122 m). Samples assayed an average of 0.45 ounce gold per ton over 3 feet for a length of 35 feet (10.7 m) at the 125-foot level and 0.5 ounce gold per ton over 3 feet for a length of 67 feet (20.5 m) at the 250-foot level[1]. Reserves had been estimated as 50 000 tons of ore averaging 0.5 ounce gold per ton (Canadian Mines Handbook 1960, p.194). The Ontario charter of Tabor Lake Gold Mines Limited was cancelled in 1976[1].

In 1979, the area was restaked with 37 contiguous claims for St. Joseph Explorations Limited who then carried out ground magnetic and V.L.F. electromagnetic surveys and the diamond drilling of four holes on the north shore of Tabor Lake during the winter of 1979 and 1980[1]. Additional work during the 1980 field season consisted of geological mapping and geochemical sampling for gold. Sulpetro Minerals Limited (formerly St. Joseph Explorations Limited) continued the work in 1981 with dewatering of the shaft for sampling.

The Sakoose Mine (H.W.416, No.18), formerly known as the Munroe and Watson Mine or the "Golden Whale" (Satterly 1960), was the only mine which produced in the area. In 1899, extensive clearing and trenching had been carried out, as well as the sinking of shafts No.1, 2, and 3. A standard gauge railway spur was built from the Canadian Pacific railway station in Dyment, south to the mine. Between 1900 and 1902 development work continued on the property which was owned and operated then by the Ottawa Gold Mining and Milling Company Limited. 7735 tons of ore (Carter 1902) were shipped to the Keewatin Reduction Works at Keewatin, Ontario [1,2]. Most of the ore having been extracted from shafts No.1 and 2 and from surface quarrying of the quartz vein[2], the mining operations were suspended in 1902. In 1931, exploration resumed by surface diamond drilling. Development work was continued in July 1934 by Nordic Sturgeon Gold Mines Limited who at that time owned and operated the property. The work consisted of diamond drilling of 7 holes which totalled 2 973 feet (906 m) of core [1,2]. The calculated remaining tonnage of gold ore in the developed part of the deposit was estimated at 44 000 tons[1,2]. Shaft No.4 had been sunk to a depth of 165 feet (50 m). In 1944, Van Houten Gold Mines Limited acquired the property. Development was carried out during 1946 and 1947, including underground work and the drilling of a total of 41 surface diamond-drill holes and 40 holes underground. The total production from 1944 to 1947 amounted to 256 ounces of gold[2]. Operations ceased in 1947. By that year, the total production from the mine had been 3 669 ounces of gold and 145 ounces of silver from 8 828 tons of ore averaging 0.41 ounce gold per ton[2]. In 1958, G.L. Pidgeon restaked the property but it was later dropped. **Stripping and trenching has been done at the mine intermittently over the last few years by J. Redden.**

In 1899, work had been done on claims H.W.418 and H.W.419 after the discovery of quartz veins by Walker and Brown, the first prospectors in the New Klondike[2]. North Western Ontario Exploration Company (whose head office was in London, England) sank a shaft 142 feet (43.3 m) deep on a quartz vein, located on H.W.419, striking in a westerly direction and having a subvertical dip[2]. This vein is mineralized with chalcopyrite, sphalerite, pyrrhotite, pyrite, and visible gold. No other work has been done to date. A. Kozowy staked a group of seven claims around H.W.419, including the original claim, in August 1981.

Exploration for base metals started in 1952 when the International Nickel Company of Canada Limited conducted a magnetic survey on a diorite body on the northeast shore of Kawashegamuk Lake (No.13). In 1957, Falconbridge Nickel Mines Limited diamond drilled one hole of 416 feet (127 m) on which minor pyrite was reported on the claim group previously investigated by the International Nickel Company of Canada Limited. Three holes were drilled the same year by Falconbridge on Church Lake (No.7) while searching for copper and nickel.

In 1955, the Canadian Pacific Railway Company conducted a geological reconnaissance over the general Stormy Lake-Kawashegamuk Lake area[1].

In 1965 and 1966, Dome Exploration (Canada) Limited carried out a programme of prospecting, geochemical soil sampling, trenching, and 1 710 feet (521 m) of diamond drilling from three holes on a molybdenite occurrence situated between Mennin and Oldberg Lakes (No.5). Results showed a broad northerly trending area of moderate molybdenite anomalies. The molybdenite anomaly coincides with the zone of outcrop in which the molybdenite-bearing quartz veins were found[1]. The drilling programme revealed minor amounts of disseminated molybdenite, fluorite, and trace amounts of pyrite, chalcopyrite, and gold in narrow quartz veins. Following the discovery of the Cu-Zn-Pb-Ag deposits at Sturgeon Lake in 1969, a number of companies flew airborne geophysical surveys over the general Manitou-Stormy Lakes area. In 1970, plans were made by Lynx-Canada Explorations Limited and Dejour Mines Limited to jointly fly an area south of Wabigoon, Ontario[1] encompassing the Boyer Lake, Tabor Lake, and the Sakoose Mine areas. As a result, 155 claims were staked on the most promising anomalies.

Ground follow up work started in May 1970 and continued through to September[1]. Drilling of some electromagnetic anomalies revealed that many conductors were caused by disseminated pyrite and graphitic zones[1]. No encouraging results were encountered and the claims were allowed to lapse. The same year, Asarco Exploration of Canada Limited diamond drilled three holes (No.1): one situated on a gabbro body on the north shore of Snake Bay, and two holes on the southeastern shoreline of Kawashegamuk Lake, both indicating minor amounts of Cu(0.04 percent) and trace amounts of Ni, Ag, Au. In 1971, Asarco Exploration of Canada Limited drilled a hole northeast of Boyer Lake on a conductor picked up by the airborne survey the previous year. This hole confirmed the nature of the conductor as fine-grained disseminated pyrite and sheared pyrite nodules in graphitic zones[1]. Airborne geophysics were performed again in 1973 for Underwood-McLelland and Associates Limited. As a result 231 claims were staked over the airborne conductors. These claims were then optioned to Newmont Mining Corporation of Canada Limited in 1974[1]. Ground follow up of the conductors was carried out and three of them were located by diamond drilling (No.17). Pyrite, pyrrhotite, and graphite mineralization have been reported as the cause of the anomalies.

In 1971, the Canadian Nickel Company Limited carried out a ground magnetic survey over two claims on a gabbro body on the north shore of Snake Bay (No.3), as well as a drilling program on several claims in the northern and central part of Stormy Lake[1]. The drilling revealed local mineralization with disseminated pyrite and pyrrhotite.

In 1976, Selco Mining Corporation Limited staked three claim groups in the map-area (No.19): one northeast of Boyer Lake, one straddling the south boundary of Melgund Township, north of the Sakoose Mine, and one in the Church-Mennin Lakes area. Ground geophysical exploration was done on all claim groups and four diamond-drill holes were drilled to check out some conductor zones. The hole northeast of Boyer Lake confirmed graphite in shear planes as the conductor. The three holes in the north-central part of the map-area revealed minor pyrite, graphite and traces of chalcopyrite. Low copper (0.02 to 0.05 percent) and zinc (0.02 to 0.05 percent) assay values were reported from one hole east of Church Lake[1].

In 1980, as follow up to a regional exploration programme in the general Kawashegamuk Lake area commenced in 1979, Falconbridge Copper Limited carried out detailed geochemical sampling for gold mineralization on property adjoining St. Joseph Explorations Limited west of Tabor Lake (No.6). Sulpetro Minerals Limited, in addition to work on its Tabor Lake property, has conducted ground follow up to both its own and the Ontario Geological Survey airborne electromagnetic surveys released in the spring of 1980, in the general Manitou-Stormy Lakes area.

GENERAL GEOLOGY

The Kawashegamuk Lake area was previously mapped by Thomson (1933) as part of a reconnaissance survey extending from Lower Manitou Lake to Stormy Lake. The present map-area was also investigated as part of a regional study in 1977 (Trowell *et al.* 1977; Trowell *et al.* 1980). To the north, the Dyment area comprising Melgund, Revell, and Hyndman Townships, was mapped by Satterly (1960). To the west, the Boyer Lake area was mapped during the field seasons of 1974 and 1975 (Blackburn 1976a), and to the southwest, the Meggisi Lake area was mapped during the field season of 1975 (Blackburn 1976b).

The map-area lies in the east-central part of a metavolcanic-metasedimentary belt which extends from Lower Manitou Lake to Wabigoon Lake. Bedrock is of Early Precambrian (Archean) age, consisting of thick metavolcanic and metasedimentary sequences intruded by mafic sills, felsic porphyry stocks and dikes, and granitic rocks in the east.

Mapping west of the current map-area (Blackburn 1980a) has established three stratigraphic groups of supracrustal rocks: the Wapageisi Lake Group, the Stormy Lake Group, and the Boyer Lake Group, that have all been traced into this area.

The metavolcanics of the Wapageisi Lake Group underlie the southern part of the map-area. They are a thick sequence facing homoclinally in a north-northeasterly direction. It consists principally of pillowed mafic flows of tholeiitic affinity (Trowell *et al.* 1980) intruded by gabbroic sills, overlain by felsic pyroclastic rocks. These latter rocks are intruded, in the south-central part of the map-area, by a quartz porphyry body which appears to be the source of felsic flows and pyroclastic rocks at Gawjewiaga and Kawijekiwa Lakes. To the southwest, a quartz porphyry stock intrudes the mafic metavolcanics at Thundercloud Lake out of the map-area (only the northeastern margin of the stock appears on the present map). To the north, and genetically related to the porphyry (Blackburn 1980a) is a unit of felsic autobreccias, flows, pyroclastic rocks and coarse-grained sandstones which is exposed south of Dark Horse Lake. Numerous felsic dikes have been observed at Seggemak Lake.

Overlying the Wapageisi metavolcanics with probable unconformity is the Stormy Lake Group, a 3 000 m thick sequence of conglomerates. The basal part is characteristically polymictic with felsic to mafic volcanic clasts, non foliated granitoid clasts, and clasts of magnetite and hematite iron formation and chert. Overlying conglomerates are virtually devoid of granitoid and chemical sedimentary clasts and composed almost exclusively of volcanic clasts. The conglomerate sequence diminishes in thickness in the south-central part of the map-area where deepwater sandstone, siltstone, and greywacke become abundant. These metasediments are transitional eastward into more distal turbidites at Bending Lake with intercalated magnetite iron formation beds (Trowell *et al.* 1980). The entire sequence faces to the north and northeast. Within the proximal facies (conglomerates), several mafic flows and a felsic pyroclastic unit have been traced over up to 800 m. A small body of massive granodiorite and numerous fine-grained felsic dikes intrude the metasediments at Stormy Lake. North of the Stormy Lake Group is the Boyer Lake Group, a thick sequence of mafic pillowed flows and composite gabbro sills of tholeiitic affinity (Blackburn 1980), which is folded about the Kamanatogama syncline (Blackburn 1980a). The Boyer Lake Group is in fault contact with the Stormy Lake Group (Blackburn 1980a, 1980b, 1981). Underlying the Boyer Lake Group to the northeast is a thick sequence of metavolcanics facing homoclinally southwest which has been named the Kawashegamuk Lake Group (Blackburn and Kresz 1981). Chemical analyses of samples collected during the 1977 regional study (Trowell *et al.* 1977, Trowell *et al.* 1980) revealed that the sequence consists of calcalkaline andesite to rhyolite at Church Lake and tholeiitic to calcalkaline basalt to andesite at Morey Lake. Coarse monolithic breccia which becomes increasingly abundant to the southeast overlies the mafic metavolcanics on the north shore of Kawashegamuk Lake. The north-central part of Kawashegamuk Lake is underlain by andesitic pillowed flows. A felsic tuff unit which can be traced along the whole length of the western shore of Kawashegamuk Lake marks the top of the Kawashegamuk Lake Group. The contact with the Boyer Lake Group appears to be conformable and characterized by the transition from calcalkaline to tholeiitic volcanism.

In the Sakoose Mine area is a northeast-trending wedge of metasediments consisting of sandstones, greywackes, argillites, and narrow bands of chert magnetite iron formation. In the northwestern part of the map-area where rocks are pervasively altered, felsic metavolcanics occur mainly as sericitic and carbonatized schists. Irregular gabbro bodies (KAW 12-14 have a tholeiitic basalt composition) intrude the metavolcanics in many places. Two elliptical shaped intrusions of foliated diorite to quartz diorite are exposed in the southeastern part of Kawashegamuk Lake. In the north at Tabor Lake, and to the west, numerous irregular shaped felsic intrusions and felsic dikes occur. They are invariably sheared, carbonatized, and sericitized. The metavolcanics around these felsic intrusions are strongly altered in many places and they have a characteristic rusty-brown weathering color. The most conspicuous secondery alteration product in the mafic metavolcanics is iron carbonate, while in the felsics it is sericite and carbonate. The alteration event is presumed to be pretectonic. The basal metavolcanics in the northeast and east part of the map-area are intruded by massive granodiorite of the Revell batholith (Satterly 1960).

The rocks underlying the map-area have been affected by low grade regional metamorphism of greenschist facies rank. Near the margin of the Revell batholith and as far as 1.5 km away from the granodiorite mass, thermal metamorphism produced rocks belonging to the hornblende-hornfels facies (Satterly 1960).

STRUCTURAL GEOLOGY

The east-trending Kamanatogama syncline is the only major fold in the map-area.

The Mosher Bay-Washeibemaga Lake Fault (Blackburn 1980a, 1980b, 1981) that diminishes in displacement eastward, cannot be recognized east of the northern bay of Stormy Lake. Other faults of lesser magnitude offset metavolcanic units at Kawashegamuk Lake and gabbro sills at Kawijekiwa and Gawjewiagwa Lakes. The northeast-southwest trending shear zone at Kawashegamuk Lake may be considered a tectonic boundary between the Boyer Lake Group and the underlying metavolcanics of the Kawashegamuk Lake Group to the northeast. The contact of the Revell batholith with the supracrustal rocks is in part faulted.

The supracrustal rocks underlying the map-area have been pervasively foliated in an east-southeasterly regional direction.

Primary structures such as pillows in mafic flows, graded beds, cross beds, laminations and bedding in metasediments and tuffs are often well preserved.

ECONOMIC GEOLOGY

The general area covered by this map is known mainly for its gold potential. To the present date, only the Sakoose Mine has produced a significant amount of gold. Quartz veins, up to seven feet wide[1] are associated with quartz-feldspar porphyry dikes and intrude metavolcanics and metasediments. Gold is associated mostly with blue-grey quartz in which pyrite, sphalerite, chalcopyrite, galena, and native gold are present.

Values from two quartz samples are as follows: Au 0.5 ounce per ton, Ag 0.21 ounce per ton (grey quartz, sulphides present), and Au 0.02 ounce per ton (white quartz, no sulphides present)[3]. At Tabor Lake gold occurs as disseminated free fold in white quartz which occurs as a series of veins cutting an east-trending porphyry dike. Carbonate and minor pyrite and galena occur in the vein as well. Other gold occurrences exist in the area. On H.W.419 (No.2) value of quartz samples taken from the tailing pile and at the shaft site, containing carbonate and sulphides are Au 12.66, 2.92, 2.16, 0.05 ounce per ton; Ag 1.50, 0.60, 0.20 ounce per ton[3]. One sample taken from an old shaft site located on original claim H.W.418 gave a gold value of 0.02 ounce per ton[3] (the shaft has not been located). At Lee Lake, a quartz sample from a vein network contained 0.04 ounce per ton gold[3]. At Church Lake visible gold occurs in a white quartz vein cutting a gabbro.

The mapping has shown that in the vicinity and west of Tabor Lake, mafic and felsic metavolcanics have been pervasively carbonatized and sericitized. Sheared and intensively altered porphyries are associated with the altered metavolcanics and it is suggested that gold, silver, and possibly base metals were leached and redeposited in favorable structures as a result of hydrothermal activity.

At least three gabbro-diorite bodies which have been delineated by the field party have been exploration targets in the 1950s for the Canadian Nickel Company Limited, Falconbridge Limited, and more recently by Selco Mining Corporation Limited. Chalcopyrite and nickeliferous pyrrhotite have been described in a report for the Canadian Pacific Railway Company[1] at the margin of a small diorite body just east of the southern most bay of Kawashegamuk Lake where the field party recognized a quartz diorite with blue quartz eyes containing 1 to 3 percent disseminated sulphides. The rock has a rusty weathering color. Fine-grained pyrrhotite and pyrite have been recognized occurring in a similar fashion on the north margin of the diorite intrusive which lies to the northwest. Chalcopyrite and green copper staining (malachite) have been found by the field party in several gabbro bodies at Kawashegamuk Lake. Abundant pyrite mineralization is found in intensively sheared rocks along the southern lake shore of Kawashegamuk Lake along which a long shear zone appears to be.

Between Mennin Lake and Oldberg Lake, disseminated molybdenite with fluorite, pyrite, and traces of chalcopyrite and gold occur in numerous white quartz veins of varying thickness. The granodiorite of the Revell batholith which hosts these quartz veins is greisenized in numerous places near the mineralized quartz veins.

SUGGESTIONS FOR FUTURE MINERAL EXPLORATION

Prospecting and exploration for gold should be directed toward favourable structures (shear zones, faults, porphyry, fold hinges). Gold occurrences are known to exist in the north-central and northeast part of the map-area but gold mineralization is not associated with a particular lithology.

Further exploration for base metals is warranted at the margin of mafic to intermediate intrusives, in zones of intense deformation and shearing and at the margin of the Revell batholith.

[1] Assessment Files Research Office, Ontario Geological Survey, Toronto.

[2] Information from Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora.

[3] Analyses by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

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SYMBOLS

- Glacial striae
- Small bedrock outcrop
- Area of bedrock outcrop
- Bedding, top unknown; (inclined, vertical)
- Bedding, top indicated by arrow; (inclined, vertical, overturned)
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned)
- Bedding, top (arrow) from crossbedding; (inclined, vertical)
- Lava flow, top (arrow) from pillows shape and packing
- Pillow elongation
- Schistosity; (inclined, vertical)
- Foliation; (inclined, vertical)
- Banding
- Lineation with plunge
- Geological boundary, observed
- Geological boundary, position interpreted
- Fault; (assumed)
- Lineament
- Jointing; (horizontal, inclined, vertical)
- Drag folds with plunge
- Kink bands with axial trace
- Syncline, with plunge direction
- Drillhole; (inclined)
- Drillhole; (projected vertically). Depth of overburden shown.
- Vein, vein network. Width in inches.
- Shaft; depth in feet

Ontario

Ministry of Natural Resources

Hon. Alan W. Pope, Minister

W.T. Foster, Deputy Minister

ONTARIO GEOLOGICAL SURVEY

MAP P.2569

GEOLOGICAL SERIES - PRELIMINARY MAP

PRECAMBRIAN GEOLOGY OF THE KAWASHEGAMUK LAKE AREA

WESTERN PART

KENORA DISTRICT

Scale 1:15 840

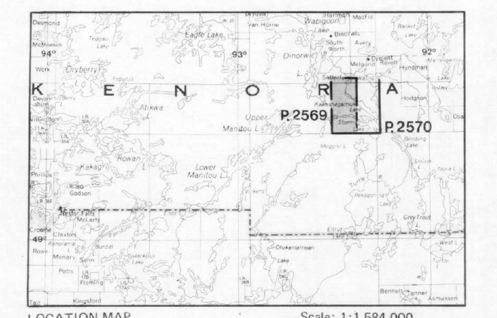
Mile ¼ 0 ¼ ½ Mile

Metres 100 0 0.2 0.4 0.6 0.8 1 Kilometre

NTS References: 52 F/8, 9

ODM-GSC Aeromagnetic Maps: 1144G, 1145G

ODM Geological Compilation Map: 2443



LOCATION MAP

Scale: 1:1 584 000 or 1 inch to 25 miles

LEGEND[a]

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Boulders, gravel, sand, swamp, lake, and stream deposits

UNCONFORMITY

PRECAMBRIAN

EARLY PRECAMBRIAN (ARCHEAN)

FELSIC PLUTONIC ROCKS[b]

REVELL BATHOLITH AND OTHER MINOR GRANITIC INTRUSIONS

8

- 8a Massive, medium- to coarse-grained biotite granodiorite
- 8b Quartz monzonite
- 8c Granite
- 8d Aplite

INTRUSIVE AND FAULTED CONTACT

INTERMEDIATE PLUTONIC ROCKS[b]

- 8e Fine- to medium-grained hornblende quartz diorite
- 8f Fine- to medium-grained hornblende diorite

INTRUSIVE CONTACT

INTERMEDIATE TO FELSIC HYPABYSSAL ROCKS[c]

7

- 7a Quartz and quartz feldspar porphyry[d]
- 7b Felsite
- 7c Granitic rocks
- 7d Sheared and sericitized felsic rocks
- 7e Carbonatized felsic rocks
- 7f Biotite quartz-feldspar porphyry
- 7h Feldspar porphyry
- 7j Biotite-feldspar porphyry

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS[b,e]

6

- 6 Unsubdivided
- 6a Medium- to coarse-grained gabbro
- 6b Medium- to coarse-grained leucogabbro
- 6c Pegmatitic gabbro
- 6d Quartz phyric gabbro
- 6e Diabase dike
- 6f Lamprophyre
- 6k Porphyritic gabbro (feldspar phenocrysts)
- 6m Amphibolite
- 6p Carbonatized mafic rocks
- 6v Epidotic pods

INTRUSIVE CONTACT

METASEDIMENTS AND METAVOLCANICS

METASEDIMENTS

Chemical Metasediments[b]

5

- 5a Banded chert magnetite iron formation
- 5b Chert
- 5c Carbonate rocks

Epiclastic Metasediments[d]

4

- 4a Volcanic clast conglomerate
- 4b Polymictic conglomerate[f]
- 4c Wacke
- 4d Lithic wacke
- 4e Feldspathic (arkosic) wacke
- 4f Quartzose wacke
- 4g Arenite
- 4h Lithic arenite
- 4j Feldspathic arenite
- 4k Quartzose arenite
- 4l Mudstone; slate
- 4m Sericitized rocks

METAVOLCANICS

Felsic Metavolcanics[d]

3

- 3a Dacite to rhyolite tuff
- 3b Dacite to rhyolite lapilli-tuff, lapillistone
- 3c Dacite to rhyolite tuff-breccia, breccia
- 3d Dacite to rhyolite flows
- 3e Dacite to rhyolite flow breccia
- 3f Carbonatized rocks
- 3g Sericite schist

Intermediate Metavolcanics[d]

2

- 2 Unsubdivided
- 2a Andesite to dacite tuff
- 2b Andesite to dacite lapilli-tuff, lapillistone
- 2c Andesite to dacite tuff-breccia, breccia
- 2d Andesite to dacite flows
- 2f Carbonatized rocks
- 2g Sericitized rocks

Mafic To Intermediate Metavolcanics[b]

1

- 1 Unsubdivided
- 1a Fine- to medium-grained flows
- 1b Medium- to coarse-grained flows[g]
- 1c Pillowed flows
- 1d Porphyritic flows (feldspar-phyric)
- 1e Pillowed porphyritic flows (feldspar-phyric)
- 1f Aquagene breccia, hyaloclastite
- 1g Flow breccia
- 1h Amygdaloidal flows
- 1k Amphibolite
- 1m Chloritic schist
- 1n Variolitic flows
- 1p Carbonatized rocks
- 1q Tuff
- 1s Lapilli-tuff, lapillistone
- 1t Tuff-breccia
- 1u Silicified rocks
- 1v Epidotic pods
- i Lithology inferred
- qc Quartz carbonate
- qv Quartz vein; (width in inches)

NOTES

a) This is a Field Legend and may be changed as a result of subsequent laboratory investigations.

b) Rocks in these groups are subdivided lithologically and order does not imply age relationships within or among groups.

c) May include some felsic flows or pyroclastic rocks.

d) May include quartz or quartz-feldspar crystal tuff.

e) May include unit 1b rocks.

f) Composed mostly of volcanic, granitic, chert and iron formation clasts.

g) May include unit 6 rocks.

C — Area of pervasive carbonatization.

LIST OF PROPERTIES AND OCCURRENCES

1. Asarco Exploration of Canada Limited [1971]*
2. Brockman, M.
3. Canadian Nickel Company Limited [1971]
4. Chamac Holding Limited
5. Dome Exploration (Canada) Limited (Oldberg Lake Mo occurrence) [1966]
6. Falconbridge Copper Limited (Corporation Falconbridge Copper)
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9. Higgins, G.S.
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11. Hoey and McMillan Limited
12. Howard, R.
13. International Nickel Company of Canada Limited, The [1952]
14. Laister, R.C.
15. Lynx-Canada Explorations Limited and Dejour Mines Limited [1970]
16. McKenzie, K., and McKenzie, C.
17. Newmont Mining Corporation of Canada Limited [1975]
18. Redden, J. (Sakoose Mine)
19. Selco Mining Corporation Limited [1978]
20. Sulpetro Minerals Limited (Tabor Lake Prospect)
21. Wallace, R.
22. Young, J.

* Date in square brackets indicates last date of exploration activity.

NOTE: The marginal notes, list of properties and occurrences, metal and mineral abbreviations, and symbols apply to both the Western Part (P.2569) and Eastern Part (P.2570) map sheets of the Kawashegamuk Lake Area, therefore, not all properties, occurrences, metal and mineral abbreviations, or symbols may be present on this map sheet.

MINERAL AND METAL ABBREVIATIONS

Ag	Silver
Au	Gold
chl	Chlorite
cp	Chalcopyrite
fl	Fluorite
fu	Fuchsite
gf	Graphite
gn	Galena
mo	Molybdenite
po	Pyrrhotite
py	Pyrite
tour	Tourmaline

SOURCES OF INFORMATION

Base map derived from the Forest Resources Inventory Map, Land and Waters Group, Ontario Ministry of Natural Resources, with minor corrections by D.U. Kresz and C.E. Blackburn.

Kenora-Fort Frances; Ontario Geological Survey, Map 2443, Geological Compilation Series, by C.E. Blackburn, 1981, scale 1:253 440.

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Aeromagnetic Map 1144G; Ontario Department of Mines/Geological Survey of Canada.

Aeromagnetic Maps 80460, 80461A, 80461B, 80462B, 80466A, 80466B, 80467A, 80467B, 80468, 80474; Ontario Geological Survey.

Geology is not tied to surveyed lines.

Magnetic declination approximately 3°30′ E, 1982.

CREDITS

Geology by D.U. Kresz, C.E. Blackburn, F.B. Fraser, and assistants, 1980, 1981.

Issued 1982

Information from this publication may be quoted if credit is given. It is recommended that reference be made in the following form:

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Ministry of Natural Resources
Hon. Alan W. Pope, Minister
W.T. Foster, Deputy Minister
Ontario

ONTARIO GEOLOGICAL SURVEY
MAP P.2570
GEOLOGICAL SERIES - PRELIMINARY MAP

PRECAMBRIAN GEOLOGY OF THE KAWASHEGAMUK LAKE AREA
EASTERN PART
KENORA DISTRICT

Scale 1:15 840

NTS References: 52 F/8, 9
ODM-GSC Aeromagnetic Maps 1144G, 1145G
ODM Geological Compilation Map 2443

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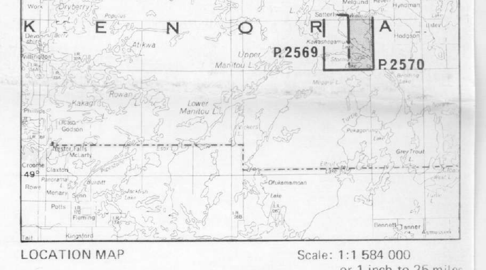

LOCATION MAP

Scale: 1:1 584 000 or 1 inch to 25 miles

MARGINAL NOTES

LOCATION AND ACCESS

Kawashegamuk Lake lies about 30 km southeast of Dryden. The map-area is included in NTS map sheets 52 F/8 and 59 F/9.

A lumber road commences at Highway 17 at Jackfish Lake, 10 km east of Dinorwic. This road gives access to the western part of the map-area and to Stormy Lake. A township road that commences at Borups Corners on Highway 17 gives access to the eastern part. A third road in the north-central part of the map-area links these two roads. Most of the map-area can be reached by canoe or light watercraft as many lakes are interconnected by short portages.

MINERAL EXPLORATION

In the latest years of the past century, the Lake of the Woods region became the scene of considerable exploration and mining for gold.

During the period 1895 to 1912, at least 20 mines and prospects were opened in the Manitou Lakes area, which lies west of the map-area (Thomson 1933). During these years, prospecting activity started in the Kawashegamuk Lake area. This became known as the "New Klondike" area after gold had been discovered south of Melgund Township, on original claims S.V.258, H.W.416, H.W.418, and H.W. 419. The Tabor prospect (S.V.258, No.20) was held in 1898 by J. Tabor and J. Stephenson who first staked the property in 1897. During 1934 and 1935, Clark Gold Mines Limited developed the property and produced 36 ounces of gold and 4 ounces of silver[1]. This recovery was mainly from 200 feet (61 m) of surface trenching yielding 87 tons of ore. Other exploration and development work consisted of sinking a shaft 280 feet (85 m) deep with levels at 68 feet (21 m), 125 feet (38 m), and 250 feet (76 m) below the surface. 7355 feet of surface diamond drilling was done from a total of 21 holes[1]. The operations were suspended in 1938. In July 1942, Tabor Lake Gold Mines Limited took over the property later leased to Pantan Mines Limited in 1957[1]. Further work was then undertaken, including lateral development, and six holes were diamond drilled indicating an extension of the vein system to the 375-foot (114.3 m) level along a strike length of 400 feet (122 m). Samples assayed an average of 0.45 ounce gold per ton over 3 feet for a length of 35 feet (10.7 m) at the 125-foot level and 0.5 ounce gold per ton over 3 feet for a length of 67 feet (20.5 m) at the 250-foot level[1]. Reserves had been estimated as 50 000 tons of ore averaging 0.5 ounce gold per ton (Canadian Mines Handbook 1960, p.194). The Ontario charter of Tabor Lake Gold Mines Limited was cancelled in 1976[1].

In 1979, the area was restaked with 37 contiguous claims for St. Joseph Explorations Limited who then carried out ground magnetic and V.L.F. electromagnetic surveys and the diamond drilling of four holes on the north shore of Tabor Lake during the winter of 1979 [illegible] Stormy Lake-Kawashegamuk Lake area[1].

In 1965 and 1966, Dome Exploration (Canada) Limited carried out a programme of prospecting, geochemical soil sampling, trenching, and 1 710 feet (521 m) of diamond drilling from three holes on a molybdenite occurrence situated between Mennin and Oldberg Lakes (No.5). Results showed a broad northerly trending area of moderate molybdenite anomalies. The molybdenite anomaly coincides with the zone of outcrop in which the molybdenite-bearing quartz veins were found[1]. The drilling programme revealed minor amounts of disseminated molybdenite, fluorite, and trace amounts of pyrite, chalcopyrite, and gold in narrow quartz veins. Following the discovery of the Cu-Zn-Pb-Ag deposits at Sturgeon Lake in 1969, a number of companies flew airborne geophysical surveys over the general Manitou-Stormy Lakes area. In 1970, plans were made by Lynx-Canada Explorations Limited and Dejour Mines Limited to jointly fly an area south of Wabigoon, Ontario[1] encompassing the Boyer Lake, Tabor Lake, and the Sakoose Mine areas. As a result, 155 claims were staked on the most promising anomalies.

Ground follow up work started in May 1970 and continued through to September[1]. Drilling of some electromagnetic anomalies revealed that many conductors were caused by disseminated pyrite and graphitic zones[1]. No encouraging results were encountered and the claims were allowed to lapse. The same year, Asarco Exploration of Canada Limited diamond drilled three holes (No.1): one situated on a gabbro body on the north shore of Snake Bay, and two holes on the southeastern shoreline of Kawashegamuk Lake, both indicating minor amounts of Cu(0.04 percent) and trace amounts of Ni, Ag, Au. In 1971, Asarco Exploration of Canada Limited drilled a hole northeast of Boyer Lake on a conductor picked up by the airborne survey the previous year. This hole confirmed the nature of the conductor as fine-grained disseminated pyrite and sheared pyrite nodules in graphitic zones[1]. Airborne geophysics were performed again in 1973 for Underwood-McLelland and Associates Limited. As a result 231 claims were staked over the airborne conductors. These claims were then optioned to Newmont Mining Corporation of Canada Limited in 1974[1]. Ground follow up of the conductors was carried out and three of them were located by diamond drilling (No.17). Pyrite, pyrrhotite, and graphite mineralization have been reported as the cause of the anomalies.

In 1971, the Canadian Nickel Company Limited carried out a ground magnetic survey over two claims on a gabbro body on the north shore of Snake Bay (No.3), as well as a drilling program on several claims in the northern and central part of Stormy Lake[1]. The drilling revealed local mineralization with disseminated pyrite and pyrrhotite.

In 1976, Selco Mining Corporation Limited staked three claim groups in the map-area (No.19): one northeast of Boyer Lake, one straddling the south boundary of Melgund Township, north of the Sakoose Mine, and one in the Church-Mennin Lakes area. Ground geophysical exploration was done on all claim groups and four diamond-drill holes were drilled to check out some conductor zones. The hole northeast of Boyer Lake confirmed graphite in shear planes as the conductor. The three holes in the north-central part of the map-area revealed minor pyrite, graphite and traces of chalcopyrite. Low copper (0.02 to 0.05 percent) and zinc (0.02 to 0.05 percent) assay values were reported from one hole east of Church Lake[1].

In 1980, as follow up to a regional exploration programme in the general Kawashegamuk Lake area commenced in 1979, Falconbridge Copper Limited carried out detailed geochemical sampling for gold mineralization on property adjoining St. Joseph Explorations Limited west of Tabor Lake (No.6). Sulpetro Minerals Limited, in addition to work on its Tabor Lake property, has conducted ground follow up to both its own and the Ontario Geological Survey airborne electromagnetic surveys released in the spring of 1980, in the general Manitou-Stormy Lakes area.

GENERAL GEOLOGY

The Kawashegamuk Lake area was previously mapped by Thomson (1933) as part of a reconnaissance survey extending from Lower Manitou Lake to Stormy Lake. The present map-area was also investigated as part of a regional study in 1977 (Trowell *et al.* 1977; Trowell *et al.* 1980). To the north, the Dyment area comprising Melgund, Revell, and Hyndman Townships, was mapped by Satterly (1960). To the west, the Boyer Lake area was mapped during the field seasons of 1974 and 1975 (Blackburn 1976a), and to the southwest, the Meggisi Lake area was mapped during the field season of 1975 (Blackburn 1976b).

The map-area lies in the east-central part of a metavolcanic-metasedimentary belt which extends from Lower Manitou Lake to Wabigoon Lake. Bedrock is of Early Precambrian (Archean) age, consisting of thick metavolcanic and metasedimentary sequences intruded by mafic sills, felsic porphyry stocks and dikes, and granitic rocks in the east.

Mapping west of the current map-area (Blackburn 1980a) has established three stratigraphic groups of supracrustal rocks: the Wapageisi Lake Group, the Stormy Lake Group, and the Boyer Lake Group, that have all been traced into this area.

The metavolcanics of the Wapageisi Lake Group underlie the southern part of the map-area. They are a thick sequence facing homoclinally in a north-northeasterly direction. It consists principally of pillowed mafic flows of tholeiitic affinity (Trowell *et al.* 1980) intruded by gabbroic sills, overlain by felsic pyroclastic rocks. These latter rocks are intruded, in the south-central part of the map-area, by a quartz porphyry body which appears to be the source of felsic flows and pyroclastic rocks at Gawjewiaga and Kawijekiwa Lakes. To the southwest, a quartz porphyry stock intrudes the mafic metavolcanics at Thundercloud Lake out of the map-area (only the northeastern margin of the stock appears on the present map). To the north, and genetically related to the porphyry (Blackburn 1980a) is a unit of felsic autobreccias, flows, pyroclastic rocks and coarse-grained sandstones which is exposed south of Dark Horse Lake. Numerous felsic dikes have been observed at Seggemak Lake.

Overlying the Wapageisi metavolcanics with probable unconformity is the Stormy Lake Group, a 3 000 m thick sequence of conglomerates. The basal part is characteristically polymictic with felsic to mafic volcanic clasts, non foliated granitoid clasts, and clasts of magnetite and hematite iron formation and chert. Overlying conglomerates are virtually devoid of granitoid and chemical sedimentary clasts and composed almost exclusively of volcanic clasts. The conglomerate sequence diminishes in thickness in the south-central part of the map-area where deepwater sandstone, siltstone, and greywacke become abundant. These metasediments are transitional eastward into more distal turbidites at Bending Lake with intercalated magnetite iron formation beds (Trowell *et al.* 1980). The entire sequence faces to the north and northeast. Within the proximal facies (conglomerates), several mafic flows and a felsic pyroclastic unit have been traced over up to 800 m. A small body of massive granodiorite and numerous fine-grained felsic dikes intrude the metasediments at Stormy Lake. North of the Stormy Lake Group is the Boyer Lake Group, a thick sequence of mafic pillowed flows and composite gabbro sills of tholeiitic affinity (Blackburn 1980), which is folded about the Kamanatogama syncline (Blackburn 1980a). The Boyer Lake Group is in fault contact with the Stormy Lake Group (Blackburn 1980a, 1980b, 1981). Underlying the Boyer Lake Group to the northeast is a thick sequence of metavolcanics facing homoclinally southwest which has been named the Kawashegamuk Lake Group (Blackburn and Kresz 1981). Chemical analyses of samples collected during the 1977 regional study (Trowell *et al.* 1977, Trowell *et al.* 1980) revealed that the sequence consists of calcalkaline andesite to rhyolite at Church Lake and tholeiitic to calcalkaline basalt to andesite at Morey Lake. Coarse monolithic breccia which becomes increasingly abundant to the southeast overlies the mafic metavolcanics on the north shore of Kawashegamuk Lake. The north-central part of Kawashegamuk Lake is underlain by andesitic pillowed flows. A felsic tuff unit which can be traced along the whole length of the western shore of Kawashegamuk Lake marks the top of the Kawashegamuk Lake Group. The contact with the Boyer Lake Group appears to be conformable and characterized by the transition from calcalkaline to tholeiitic volcanism.

In the Sakoose Mine area is a northeast-trending wedge of metasediments consisting of sandstones, greywackes, argillites, and narrow bands of chert magnetite iron formation. In the northwestern part of the map-area where rocks are pervasively altered, felsic metavolcanics occur mainly as sericitic and carbonatized schists. Irregular gabbro bodies (KAW 12-14 have a tholeiitic basalt composition) intrude the metavolcanics in many places. Two elliptical shaped intrusions of foliated diorite to quartz diorite are exposed in the southeastern part of Kawashegamuk Lake. In the north at Tabor Lake, and to the west, numerous irregular shaped felsic intrusions and felsic dikes occur. They are invariably sheared, carbonatized, and sericitized. The metavolcanics around these felsic intrusions are strongly altered in many places and they have a characteristic rusty-brown weathering color. The most conspicuous secondery alteration product in the mafic metavolcanics is iron carbonate, while in the felsics it is sericite and carbonate. The alteration event is presumed to be pretectonic. The basal metavolcanics in the northeast and east part of the map-area are intruded by massive granodiorite of the Revell batholith (Satterly 1960).

The rocks underlying the map-area have been affected by low grade regional metamorphism of greenschist facies rank. Near the margin of the Revell batholith and as far as 1.5 km away from the granodiorite mass, thermal metamorphism produced rocks belonging to the hornblende-hornfels facies (Satterly 1960).

STRUCTURAL GEOLOGY

The east-trending Kamanatogama syncline is the only major fold in the map-area.

The Mosher Bay-Washeibemaga Lake Fault (Blackburn 1980a, 1980b, 1981) that diminishes in displacement eastward, cannot be recognized east of the northern bay of Stormy Lake. Other faults of lesser magnitude offset metavolcanic units at Kawashegamuk Lake and gabbro sills at Kawijekiwa and Gawjewiagwa Lakes. The northeast-southwest trending shear zone at Kawashegamuk Lake may be considered a tectonic boundary between the Boyer Lake Group and the underlying metavolcanics of the Kawashegamuk Lake Group to the northeast. The contact of the Revell batholith with the supracrustal rocks is in part faulted.

The supracrustal rocks underlying the map-area have been pervasively foliated in an east-southeasterly regional direction.

Primary structures such as pillows in mafic flows, graded beds, cross beds, laminations and bedding in metasediments and tuffs are often well preserved.

ECONOMIC GEOLOGY

The general area covered by this map is known mainly for its gold potential. To the present date, only the Sakoose Mine has produced a significant amount of gold. Quartz veins, up to seven feet wide[1] are associated with quartz-feldspar porphyry dikes and intrude metavolcanics and metasediments. Gold is associated mostly with blue-grey quartz in which pyrite, sphalerite, chalcopyrite, galena, and native gold are present.

Values from two quartz samples are as follows: Au 0.5 ounce per ton, Ag 0.21 ounce per ton (grey quartz, sulphides present), and Au 0.02 ounce per ton (white quartz, no sulphides present)[3]. At Tabor Lake gold occurs as disseminated free fold in white quartz which occurs as a series of veins cutting an east-trending porphyry dike. Carbonate and minor pyrite and galena occur in the vein as well. Other gold occurrences exist in the area. On H.W.419 (No.2) value of quartz samples taken from the tailing pile and at the shaft site, containing carbonate and sulphides are Au 12.66, 2.92, 2.16, 0.05 ounce per ton; Ag 1.50, 0.60, 0.20 ounce per ton[3]. One sample taken from an old shaft site located on original claim H.W.418 gave a gold value of 0.02 ounce per ton[3] (the shaft has not been located). At Lee Lake, a quartz sample from a vein network contained 0.04 ounce per ton gold[3]. At Church Lake visible gold occurs in a white quartz vein cutting a gabbro.

The mapping has shown that in the vicinity and west of Tabor Lake, mafic and felsic metavolcanics have been pervasively carbonatized and sericitized. Sheared and intensively altered porphyries are associated with the altered metavolcanics and it is suggested that gold, silver, and possibly base metals were leached and redeposited in favorable structures as a result of hydrothermal activity.

At least three gabbro-diorite bodies which have been delineated by the field party have been exploration targets in the 1950s for the Canadian Nickel Company Limited, Falconbridge Limited, and more recently by Selco Mining Corporation Limited. Chalcopyrite and nickeliferous pyrrhotite have been described in a report for the Canadian Pacific Railway Company[1] at the margin of a small diorite body just east of the southern most bay of Kawashegamuk Lake where the field party recognized a quartz diorite with blue quartz eyes containing 1 to 3 percent disseminated sulphides. The rock has a rusty weathering color. Fine-grained pyrrhotite and pyrite have been recognized occurring in a similar fashion on the north margin of the diorite intrusive which lies to the northwest. Chalcopyrite and green copper staining (malachite) have been found by the field party in several gabbro bodies at Kawashegamuk Lake. Abundant pyrite mineralization is found in intensively sheared rocks along the southern lake shore of Kawashegamuk Lake along which a long shear zone appears to be.

Between Mennin Lake and Oldberg Lake, disseminated molybdenite with fluorite, pyrite, and traces of chalcopyrite and gold occur in numerous white quartz veins of varying thickness. The granodiorite of the Revell batholith which hosts these quartz veins is greisenized in numerous places near the mineralized quartz veins.

SUGGESTIONS FOR FUTURE MINERAL EXPLORATION

Prospecting and exploration for gold should be directed toward favourable structures (shear zones, faults, porphyry, fold hinges). Gold occurrences are known to exist in the north-central and northeast part of the map-area but gold mineralization is not associated with a particular lithology.

Further exploration for base metals is warranted at the margin of mafic to intermediate intrusives, in zones of intense deformation and shearing and at the margin of the Revell batholith.

[1] Assessment Files Research Office, Ontario Geological Survey, Toronto.
[2] Information from Regional Geologist's Files, Ontario Ministry of Natural Resources, Kenora.
[3] Analyses by the Geoscience Laboratories, Ontario Geological Survey, Toronto.

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SYMBOLS

- Glacial striae
- Small bedrock outcrop
- Area of bedrock outcrop
- Bedding, top unknown; (inclined, vertical)
- Bedding, top (dot) indicated by arrow (inclined, vertical, overturned)
- Bedding, top (arrow) from grain gradation (inclined, vertical, overturned)
- Bedding, top (arrow) from crossbedding (inclined, vertical)
- Lava flow, top (arrow) from pillow shape and packing
- Pillow elongation
- Schistosity (inclined, vertical)
- Foliation (inclined, vertical)
- Banding
- Lineation with plunge
- Geological boundary, observed
- Geological boundary, position interpreted
- Fault (assumed)
- Lineament
- Jointing (horizontal, inclined, vertical)
- Drag folds with plunge
- Kink bands with axial trace
- Syncline, with plunge direction
- Drillhole (inclined)
- Drillhole (projected vertically): Depth of overburden shown
- Vein, vein network. Width in inches
- Shaft, depth in feet

LEGEND[a]

PHANEROZOIC
CENOZOIC
QUATERNARY
PLEISTOCENE AND RECENT

Boulders, gravel, sand, swamp, lake, and stream deposits

UNCONFORMITY

PRECAMBRIAN
EARLY PRECAMBRIAN (ARCHEAN)
FELSIC PLUTONIC ROCKS[b]
REVELL BATHOLITH AND OTHER MINOR GRANITIC INTRUSIONS

8
- 8a Massive, medium- to coarse-grained biotite granodiorite
- 8b Quartz monzonite
- 8c Granite
- 8d Aplite

INTRUSIVE AND FAULTED CONTACT

INTERMEDIATE PLUTONIC ROCKS[b]
- 8e Fine- to medium-grained hornblende quartz diorite
- 8f Fine- to medium-grained hornblende diorite

INTRUSIVE CONTACT

INTERMEDIATE TO FELSIC HYPABYSSAL ROCKS[c]

7
- 7a Quartz and quartz feldspar porphyry[d]
- 7b Felsite
- 7c Granitic rocks
- 7d Sheared and sericitized felsic rocks
- 7e Carbonatized felsic rocks
- 7f Biotite quartz-feldspar porphyry
- 7h Feldspar porphyry
- 7j Biotite-feldspar porphyry

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS[b,e]

6
- 6 Unsubdivided
- 6a Medium- to coarse-grained gabbro
- 6b Medium- to coarse-grained leucogabbro
- 6c Pegmatitic gabbro
- 6d Quartz phyric gabbro
- 6e Diabase dike
- 6f Lamprophyre
- 6k Porphyritic gabbro (feldspar phenocrysts)
- 6m Amphibolite
- 6p Carbonatized mafic rocks
- 6v Epidotic pods

INTRUSIVE CONTACT

METASEDIMENTS AND METAVOLCANICS
METASEDIMENTS
Chemical Metasediments[b]

5
- 5a Banded chert magnetite iron formation
- 5b Chert
- 5c Carbonate rocks

Epiclastic Metasediments[d]

4
- 4a Volcanic clast conglomerate
- 4b Polymictic conglomerate[f]
- 4c Wacke
- 4d Lithic wacke
- 4e Feldspathic (arkosic) wacke
- 4f Quartzose wacke
- 4g Arenite
- 4h Lithic arenite
- 4j Feldspathic arenite
- 4k Quartzose arenite
- 4l Mudstone; slate
- 4m Sericitized rocks

METAVOLCANICS
Felsic Metavolcanics[d]

3
- 3a Dacite to rhyolite tuff
- 3b Dacite to rhyolite lapilli-tuff, lapillistone
- 3c Dacite to rhyolite tuff-breccia, breccia
- 3d Dacite to rhyolite flows
- 3e Dacite to rhyolite flow breccia
- 3f Carbonatized rocks
- 3g Sericite schist

Intermediate Metavolcanics[d]

2
- 2 Unsubdivided
- 2a Andesite to dacite tuff
- 2b Andesite to dacite lapilli-tuff, lapillistone
- 2c Andesite to dacite tuff-breccia, breccia
- 2d Andesite to dacite flows
- 2f Carbonatized rocks
- 2g Sericitized rocks

Mafic To Intermediate Metavolcanics[b]

1
- 1 Unsubdivided
- 1a Fine- to medium-grained flows
- 1b Medium- to coarse-grained flows[g]
- 1c Pillowed flows
- 1d Porphyritic flows (feldspar-phyric)
- 1e Pillowed porphyritic flows (feldspar-phyric)
- 1f Aquagene breccia, hyaloclastite
- 1g Flow breccia
- 1h Amygdaloidal flows
- 1k Amphibolite
- 1m Chloritic schist
- 1n Variolitic flows
- 1p Carbonatized rocks
- 1q Tuff
- 1s Lapilli-tuff, lapillistone
- 1t Tuff-breccia
- 1u Silicified rocks
- 1v Epidotic pods
- i Lithology inferred
- qc Quartz carbonate
- qv Quartz vein; (width in inches)

NOTES
a) This is a Field Legend and may be changed as a result of subsequent laboratory investigations.
b) Rocks in these groups are subdivided lithologically and order does not imply age relationships within or among groups.
c) May include some felsic flows or pyroclastic rocks.
d) May include quartz or quartz-feldspar crystal tuff.
e) May include unit 1b rocks.
f) Composed mostly of volcanic, granitic, chert and iron formation clasts.
g) May include unit 6 rocks.

C — Area of pervasive carbonatization

LIST OF PROPERTIES AND OCCURRENCES

1. Asarco Exploration of Canada Limited [1971]*
2. Brockman, M.
3. Canadian Nickel Company Limited [1971]
4. Chamac Holding Limited
5. Dome Exploration (Canada) Limited (Oldberg Lake Mo occurrence) [1966]
6. Falconbridge Copper Limited (Corporation Falconbridge Copper)
7. Falconbridge Nickel Mines Limited [1957]
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11. Hoey and McMillan Limited
12. Howard, R.
13. International Nickel Company of Canada Limited, The [1952]
14. Laister, R.C.
15. Lynx-Canada Explorations Limited and Dejour Mines Limited [1970]
16. McKenzie, K., and McKenzie, C.
17. Newmont Mining Corporation of Canada Limited [1975]
18. Redden, J. (Sakoose Mine)
19. Selco Mining Corporation Limited [1978]
20. Sulpetro Minerals Limited (Tabor Lake Prospect)
21. Wallace, R.
22. Young, J.

* Date in square brackets indicates last date of exploration activity.

NOTE: The marginal notes, list of properties and occurrences, metal and mineral abbreviations, and symbols apply to both the Western Part (P.2569) and Eastern Part (P.2570) map sheets of the Kawashegamuk Lake Area, therefore, not all properties, occurrences, metal and mineral abbreviations, or symbols may be present on this map sheet.

MINERAL AND METAL ABBREVIATIONS

Ag	Silver
Au	Gold
chl	Chlorite
cp	Chalcopyrite
fl	Fluorite
fu	Fuchsite
gf	Graphite
gn	Galena
mo	Molybdenite
po	Pyrrhotite
py	Pyrite
tour	Tourmaline

SOURCES OF INFORMATION

Base map derived from the Forest Resources Inventory Map, Land and Waters Group, Ontario Ministry of Natural Resources, with minor corrections by D.U. Kresz and C.E. Blackburn.

Kenora-Fort Frances: Ontario Geological Survey, Map 2443, Geological Compilation Series, by C.E. Blackburn, 1981, scale 1:253 440.

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Geology is not tied to surveyed lines.

Magnetic declination approximately 3°30' E, 1982.

CREDITS

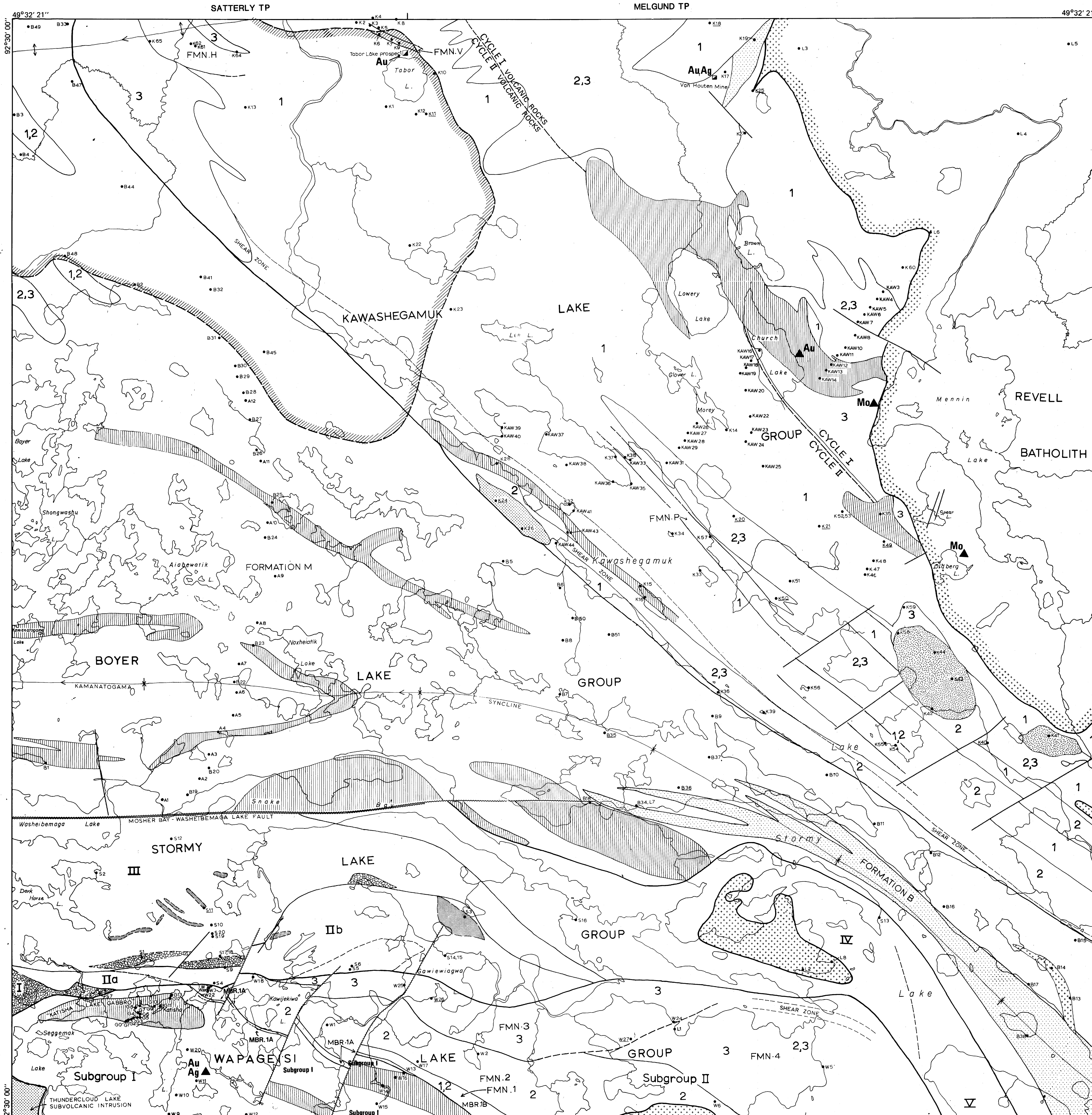
Geology by D.U. Kresz, C.E. Blackburn, F.B. Fraser, and assistants, 1980, 1981.

Every possible effort has been made to ensure the accuracy of the information presented on this map; however, the Ontario Ministry of Natural Resources does not assume any liability for errors that may occur. Users may wish to verify critical information; sources include both the references listed here, and information on file at the Resident or Regional Geologist's office and the Mining Recorder's office nearest the map-area.

Issued 1982

Information from this publication may be quoted if credit is given. It is recommended that reference be made in the following form:

Kresz, D.U., Blackburn, C.E., and Fraser, F.B.
1982: Precambrian Geology of the Kawashegamuk Lake Area, Eastern Part, Kenora District; Ontario Geological Survey, Map P.2570, Geological Series-Preliminary Map, scale 1:15 840 or 1 inch to ¼ mile. Geology 1980, 1981.



Ministry of Northern Development and Mines
Ontario
Mines and Minerals Division

Mines and Minerals Division
Ontario Geological Survey

MAP P.3100

Geological Series—Preliminary Map

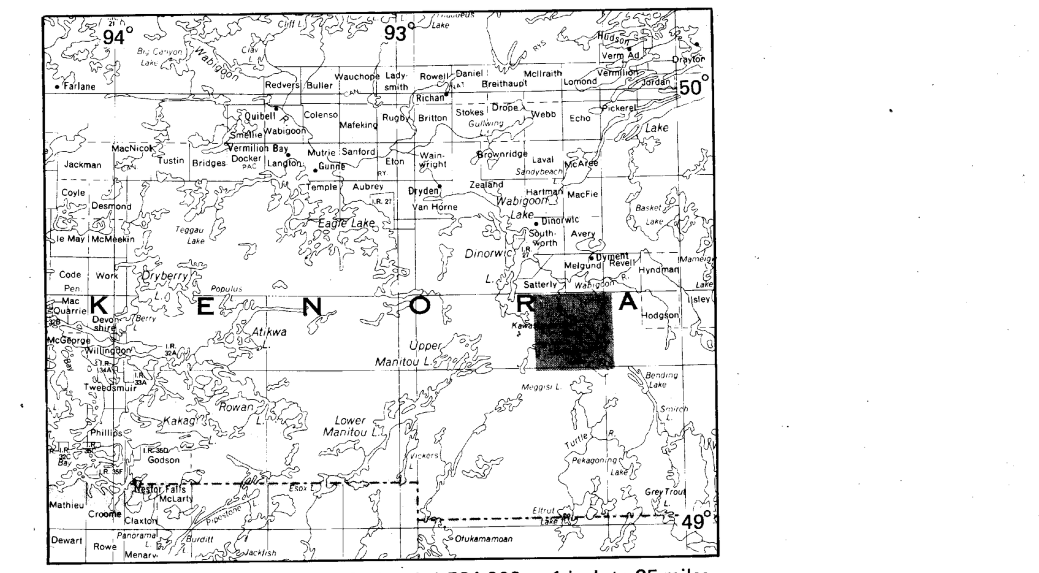
STRATIGRAPHIC MAP OF THE KAWASHEGAMUK LAKE AREA WITH SAMPLE LOCATIONS DISTRICT OF KENORA

Scale 1:31 680

Kilometre 0.5 0 0.5 1 Kilometre

Mile 0.5 0 0.5 1 Mile

NTS References: 52 F/8,9
ODM-GSC Aeromagnetic Maps: 1144G, 1145G
OGS Geological Compilation Map: 2443



LOCATION MAP

Scale : 1:1 584 000 or 1 inch to 25 miles.

STRATIGRAPHIC LEGEND[a]

BOYER LAKE GROUP[b]
- FORMATION M
  - Mafic tholeiitic flows and gabbro intrusions
- FORMATION B
  - Turbidites (arenite, wacke, siltstone, mudstone/slate, minor conglomerate

KAWASHEGAMUK LAKE GROUP
- CYCLE II VOLCANIC ROCKS
  - Basaltic and andesitic flows; intermediate to felsic pyroclastics
  - FORMATION H
    - Breccia, hyaloclastite, felsic tuff
  - FORMATION P
    - Plagioclase porphyritic basalt and andesite
  - FORMATION V
    - Variolitic basalt flow
- CYCLE I VOLCANIC ROCKS
  - Mafic tholeiitic flows and related gabbro intrusions, overlain by felsic pyroclastics; some wacke and mudstone intercalated within the volcanic rocks

STORMY LAKE GROUP
- FACIES V
  - Distal epiclastic sediments; wacke siltstone, mudstone, chert-magnetite iron formation
- FACIES IV
  - Feldspathic and lithic arenite, wacke, siltstone, mudstone, minor conglomerate and felsic pyroclastic lenses
- FACIES III
  - Volcanic clast-conglomerate with intercalated felsic pyroclastic units and basaltic flows
- FACIES IIb
  - Coarse polymictic conglomerate
- FACIES IIa
  - Lithic arenites with conglomeratic interbeds
- FACIES I
  - Felsic breccia, flows, pyroclastic deposits, and related epiclastic sedimentary rocks (mainly outside map area)

WANAGEISI LAKE GROUP
- SUBGROUP II
  - FORMATION 4
    - Coarse felsic pyroclastics
  - FORMATION 3
    - Crystal tuff, lapilli-tuff
  - FORMATION 2
    - Intermediate to felsic lapilli-tuff and tuff breccia
  - FORMATION 1
    - MEMBER 1B
      - Mafic to intermediate tuff breccia and lapilli-tuff of heterolithic composition
    - MEMBER 1A
      - Mafic to intermediate tuff
- SUBGROUP I
  - Mafic tholeiitic flows and related gabbro intrusions; minor interflow tuff beds

NOTES:

a) This organization chart is descriptive only and does not imply any age relationships.

b) Subdivision of the four lithological groups into constituent units is informal.

FMN. and MBR. on the map face indicate Formation and Member, respectively.

ABBREVIATIONS

Ag .... Silver
Au .... Gold
Mo .... Molybdenum

SYMBOLS

- 1 — Mainly mafic volcanic rocks
- Mafic flows within the Stormy Lake Group
- 2 — Intermediate to felsic volcanic rocks
- 3 — Felsic volcanic rocks
- Felsic volcanic rocks (breccia and pyroclastic deposits) within the Stormy Lake Group
- Epiclastic sediments within volcanic assemblages
- Mafic intrusions (gabbro)
- Subvolcanic quartz-feldspar porphyry intrusions
- Area of numerous feldspar-quartz porphyry intrusions. Within the zone, the rocks are highly carbonatized
- Pretectonic granitic intrusions (quartz-diorite to tonalite)
- Posttectonic granitic rocks
- Boundary between lithological groups
- Boundary between intragroup formations; dashed line represents poorly defined boundary or transitional change
- Fault
- Syncline, with plunge
- Anticline, with plunge
- Diamond-drill hole
- Shaft location
- Mineral occurrence
- ●B17 ●G10 ●K55 ●L9 ●S16 ●W34 — Sample location; underlined number indicates samples which have been analyzed for rare earth elements
- ● A1 ●KAW3 — Sample location; taken by C.E. Blackburn in 1977 (Trowell *et al.* 1980)

REFERENCE

Trowell, N.F., Blackburn, C.E., and Edwards, G.R.
1980: Preliminary Synthesis of the Savant Lake-Crow Lake Metavolcanic-Metasedimentary Belt, Northwestern Ontario, and its Bearing upon Mineral Exploration; Ontario Geological Survey, Miscellaneous Paper 89, 30p.

SOURCES OF INFORMATION

Basemap based on maps of the Forest Resources Inventory, Lands and Waters Group, Ontario Ministry of Natural Resources.

Precambrian Geology of the Kawashegamuk Lake Area, Western and Eastern Parts, Kenora District; by D.U. Kresz, C.E. Blackburn, and F.B. Fraser, 1982, Ontario Geological Survey, Maps P.2569 and P.2570, Geological Series-Preliminary Maps, scale 1:15 840 or 1 inch to 1/4 mile.

Preliminary Synthesis of the Savant Lake-Crow Lake Metavolcanic-Metasedimentary Belt, Northwestern Ontario, and its Bearing upon Mineral Exploration; by N.F. Trowell, C.E. Blackburn, and G.R. Edwards, 1980, Ontario Geological Survey, Miscellaneous Paper 89, 30p.

Geology not tied to surveyed lines.

Magnetic declination approximately 3°30′E in 1982.

Metric conversion factor: 1 foot = 0.3048 m.

CREDITS

Geology by D.U. Kresz, C.E. Blackburn, F.B. Fraser, and assistants, 1980, 1981

Issued 1987

Information from this publication may be quoted if credit is given. It is recommended that reference to this map be made in the following form:

Kresz, D.U.
1987: Stratigraphic Map of the Kawashegamuk Lake Area, with Sample Locations, District of Kenora; Ontario Geological Survey, Map P.3100, Geological Series-Preliminary Map, scale 1:31 680 or 1 inch to 1/2 mile. Geology 1980, 1981

To accompany Ontario Geological Survey Open File Report 5659, Geology of the Kawashegamuk Lake Area, District of Kenora.