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Geology of MacGregor Township

by

J. Scott

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(back pocket)

MacGregor Township Area, District of Thunder Bay
Scale 1:15 840 (1 inch to ¼ mile)
P.2984 and P.2985
(revised)

ABSTRACT

This report describes the geology and mineral potential of MacGregor Township, located immediately east of the City of Thunder Bay. The township is bounded on the south by the waters of Thunder Bay, Lake Superior and on the north by Latitude 49°30′36″N. Longitudes 88°48′W and 89°11′W mark the eastern and western limits of the map area respectively.

MacGregor Township geology is reasonably complex in that the Archean rocks consist of Quetico Subprovince migmatites and metasedimentary rocks, metavolcanic sequences and associated lithologies of the Shebandowan-Thunder Bay portion of the Abitibi-Wawa Subprovince of the Superior Province of the Canadian Shield; these are overlain by rocks of the Proterozoic Animikie Group of the Southern Province. The unconformity is exposed in several localities. All bedrock is Precambrian in age.

The Abitibi-Wawa (Shebandowan-Thunder Bay Sector) Subprovince lithologies consist of metavolcanics and associated metasedimentary rocks, mafic to ultramafic intrusions, hornblende syenite, porphyritic diorite, granite, quartz monzonite and quartz-feldspar porphyries.

The metavolcanics have been subdivided into two mafic to felsic cycles. The felsic metavolcanic rocks consist of rhyolite flows and pyroclastic units. The intermediate to mafic metavolcanics consist of massive amphibolitic flows, amygdaloidal flows, tuffs and tuff breccia. Komatiitic rocks also occur, but appear to be limited in extent.

Archean felsic intrusions form two large granitoid bodies within the map area. These have been designated the Penassen Lakes Stock and the Mackenzie Granite. The Penassen Lakes Stock is very coarse grained, generally porphyritic and ranges in composition from granite to quartz monzonite with hornblende syenite phases. The Mackenzie Granite is a medium to coarse grained, pink to slightly green granite composed of microline, oligoclase, quartz and biotite with accessory sphene, apatite, opaques (magnetite, pyrite) sericite and epidote.

MacGregor Township has a history of silver mining; some exploration for iron took place in the early 1900′s. Current mapping has delineated several areas that should be investigated for gold. Gold occurs in veins and composite vein systems located at or near the contact between granite intrusives and metavolcanic rocks; as sulfide vein systems in fractures situated at or near the Proterozoic/Archean unconformity; and as quartz vein systems in felsic metavolcanic rocks.

Other commodities that should be investigated for potential extraction are amethyst, granite and diabase. The numerous old silver mines provide excellent "rockhounding" opportunities for galena, sphalerite and quartz crystals (both clear and amethystine).

In the Quaternary Section, Resource Units of good potential for sand and gravel extraction are briefly described.

GEOLOGY OF MACGREGOR TOWNSHIP

by

John Scott

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Manuscript approved for publication by V.G. Milne, Director, Ontario Geological Survey, September 28, 1989.

INTRODUCTION

Location and Access

The geographic Township of MacGregor is situated in the Municipality of Shuniah and is located immediately northeast of the City of Thunder Bay. The township has an area of approximately 380 km^2 of which 86 km^2 is underlain by water (mostly Lake Superior). The map area is bounded on the south by the waters of Thunder Bay, Lake Superior and on the north by latitude 49°30′36″N. Longitudes 89°11′W and 88°48′W mark the western and eastern limits of the map area respectively.

Highway 11-17 (TransCanada Highway) cuts across the southern portion of the Township near Lake Superior; Highway 527 (Spruce River Road) traverses northward across the western sector of the township. Hydro lines, the TransCanada gas pipeline and bush roads provide access to more than 75% of the township. The least accessible areas are the northwestern sector away from Highway 527 and the area where longitude 89°00′W intersects the north boundary of the map area. Access by float plane is restricted to several small lakes in the northwest corner of the map area. Several well-used trails access a few of the other lakes in the map area.

Physiography

MacGregor Township can be subdivided into two general physiographic regions. The northwestern sector is dominated by rugged uplands with notable local relief. The area is characterized by deep valleys and high rocky knobs that have elevation differences of up to 110 m (360 ft.). The highest point in the township is a quartz monzonite pinnacle that is located approximately 1 km south of the western Penassen Lakes. This knob rises up to 566 m (1857 ft.) above sea level or 383 m (1255 ft.) above Lake Superior. The southern flank of this area forms a high buttress of granitic rock that overlooks Lake Superior approximately 7 km to the south. From that high vantage point, one has an exceptional view of up to 50 km in almost every direction.

The rest of the township is generally flat and slopes toward Lake Superior. A linear ridge is situated approximately 2.5 km inland from Lake Superior and subparallels the shore throughout most of the township. This ridge attains a maximum elevation of 411 m above sea level or 228 m above Lake Superior. The Mackenzie River has cut through this ridge just northwest of Conmee Point, Lake Superior.

A broad, flat-bottomed, fault-controlled valley lies between this ridge and the granitic uplands to the north. The Mackenzie River flows through this valley and drops 122 m over the 15 km distance within MacGregor Township. The river drops 107 m through the last 4.5 km and this section is characterized by rapids, waterfalls, pools and gorges. Map 2 depicts the physiography of MacGregor Township. Figure 1 shows the topographic profile through MacGregor Township.

Other main drainage systems in the township are the North Current River, Walkinshaw Creek, Penassen Creek, Savigny Creek, Wildgoose Creek, Blind Creek, Mackenzie Creek and Beck Creek. All systems flow into Lake Superior.

Renewable Resources

FOREST RESOURCES

The following section on forest resources unless otherwise noted was obtained from P. McAlister (Forester, Thunder Bay District, Memorandum, 1985.10.18).

The forest cover of MacGregor Township consists predominately of hardwood species such as white birch and poplar. Other species such as balsam fir, spruce and pine also occur but are not as abundant. Tree ages fall into three major groups: 41-60 years in the western section, 81-100 years in the central portion and 61-80 years in the eastern part of the township.

There have been few forest fires in the township during the past 40 years. During the 1930's, a portion of the northwest portion of the township was burnt over as was an area west of Mackenzie Station on the Canadian Pacific Railroad. A portion of the central west part of the township was burnt during the 1920's.

Timber harvesting on Crown land has been minimal in the township during the last 20 years although logging on private land is common. The 1982-2002 Management Plan for the Port Arthur Crown Management Unit (in which MacGregor Township is located) calls for timber harvesting in a number of locations in the township during this period. To access this timber, a number of new roads is proposed. A new road (constructed during the Fall of 1985) accesses the area to the north of Penassen Lakes.

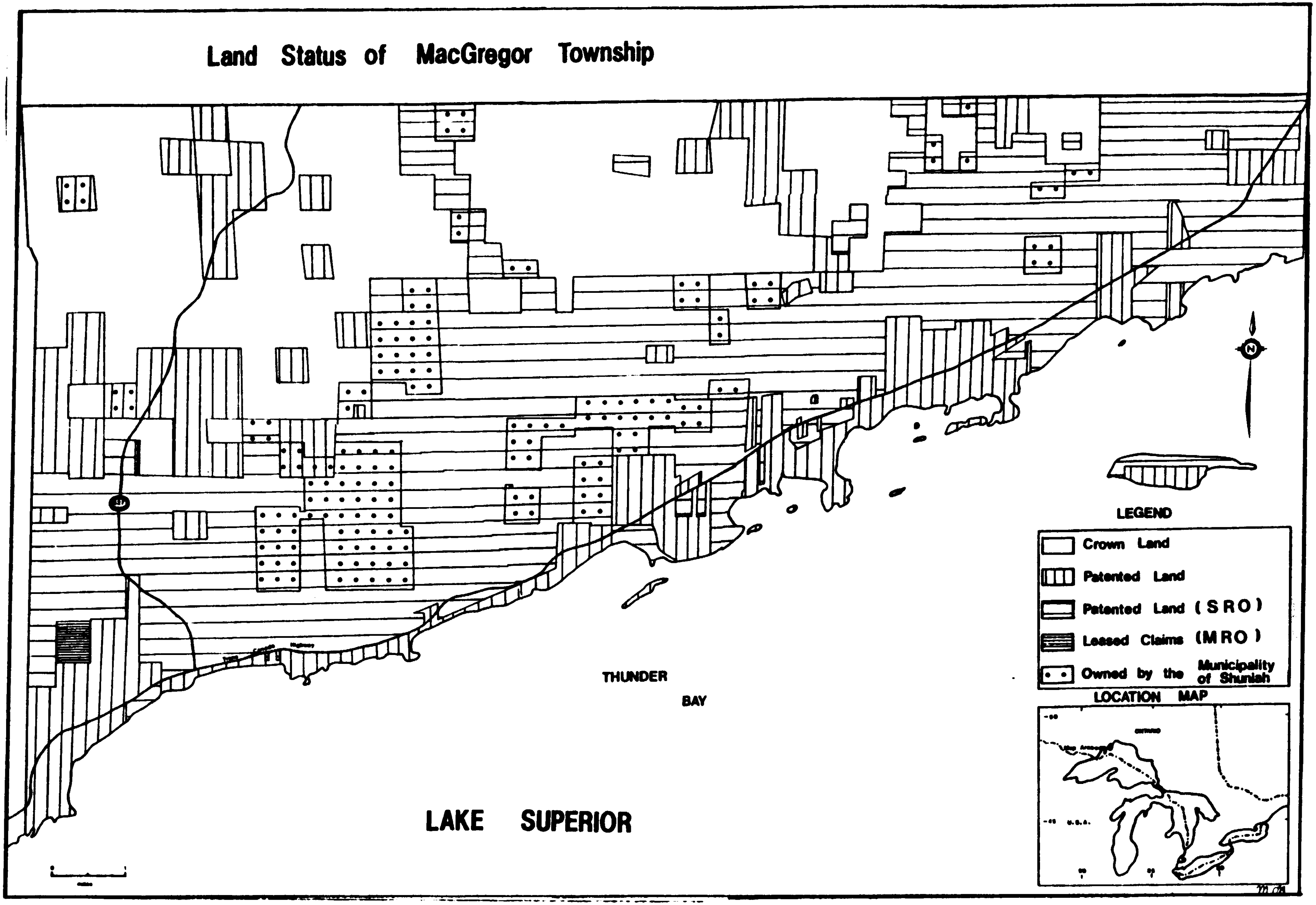


Figure 1: Land Status of MacGregor Township

MAP 2: TOPOGRAPHIC MAP - MACGREGOR TOWNSHIP

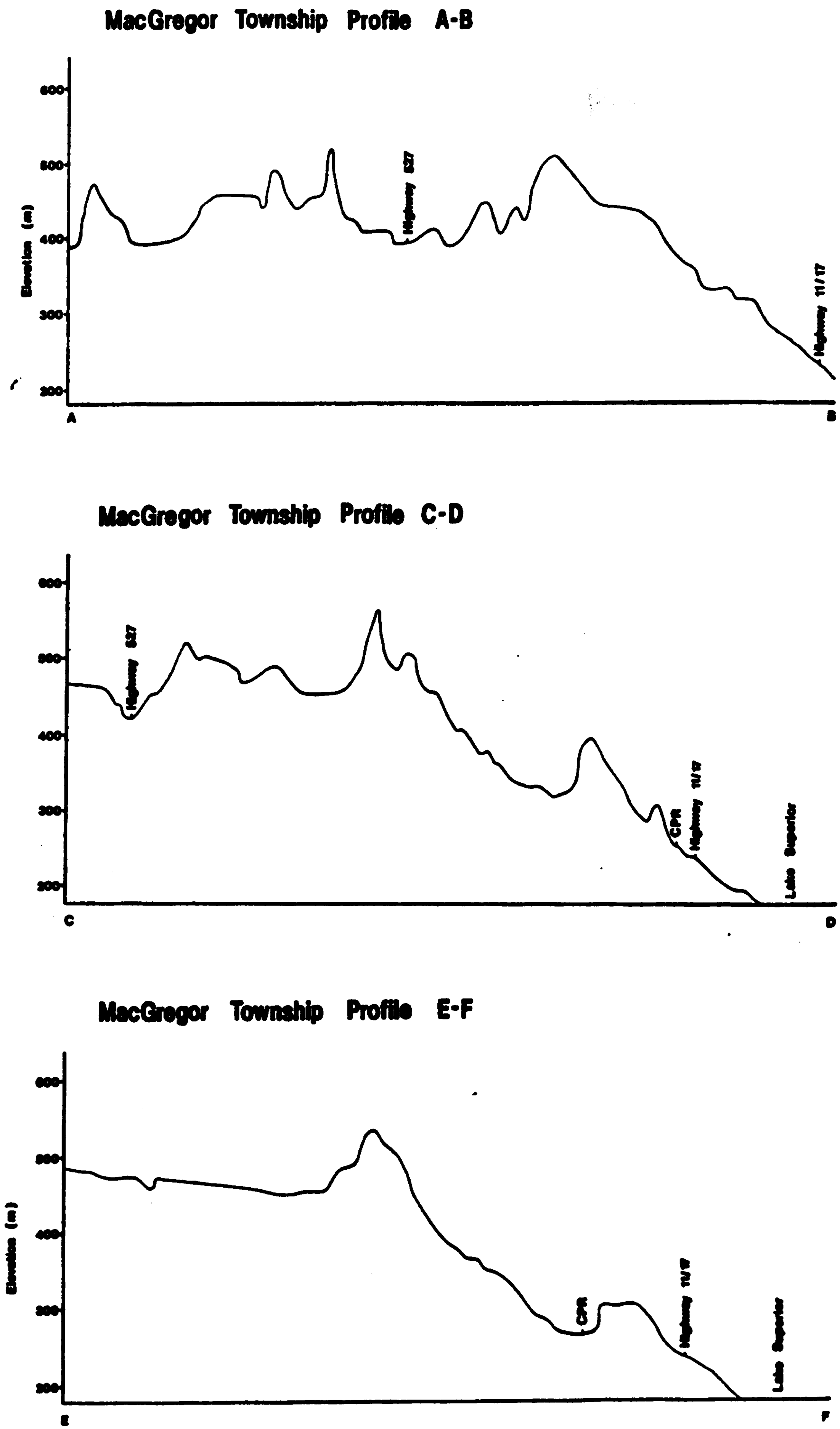


Figure 3: Topographic Profiles of MacGregor Township

Previous Geological Work

The extreme northwestern sector of the township was mapped by MacDonald (1939). Morehouse (1960) mapped the Middle Precambrian Gunflint Formation that is exposed in the southern section of the map area proximal to Lake Superior. McIlwaine (1971a, 1971b, 1975) mapped McTavish Township which lies immediately east of the present map area. Tanton (1928) mapped parts of the northeastern sector and McKellar (1874) described some of the earliest discovered mineral occurrences of the area. Franklin (1970), Shegelski (1982), Franklin & Mitchell (1977) and Franklin et al. (1980) provide detailed accounts of the Proterozoic geology of the area.

Present Survey Methodology

In the 1984 and 1985 field seasons, the geology of MacGregor Township was mapped along traverses spaced approximately 400-500 m apart. This spacing varied depending on topography. Additional traverses were conducted along roads, hydro lines, pipelines and railroads. Shorelines of some of the inland lakes were mapped from a canoe. The extreme northwest corner of the township, west of Waller Lake and north of the TransCanada Pipeline, was mapped with a helicopter. In this case, all rock outcrops that were accessible by helicopter were mapped. An eight-day fly camp was set up at the Penassen Lakes to access the northeast quadrant of the west half of the township.

Traverses were controlled by using 1:15,840 air photographs that were obtained from the Ministry of Natural Resources. Data was plotted on mylar overlays attached to the photographs. Traverses were planned to maintain the required spacing as well as to examine all outcrops identified on the photographs.

Data was then transposed onto a 1:15,840 coronaflex base map of the township derived from the Forest Resources Inventory Maps. Due to the distortion inherent to air photograph geometry, some adjustments had to be made when transposing outcrop patterns and data from the overlays to the base map. Thus the geology is not necessarily tied to survey lines; however, care was taken to accurately plot the outcrop patterns relative to easily recognizable features such as roads, railroads, hydro lines, lakes, rivers and if possible, survey posts. The map should be accurate within the scale limits.

Prospecting and Mining Activity

Prospecting and mining has been an ongoing although intermittent activity in MacGregor Township since the middle 1800's. During the silver boom of the time, emphasis was on discovering silver occurrences and developing them to mines. Deposits of iron, copper, zinc, cobalt, nickel as well as amethyst were found.

The Thunder Bay Silver Mine, the Silver Harbour Mine, the 3A Mine and the Cornish Mine were developed and each produced some silver. The Shuniah Mine, located 2 km west of the map sheet, was also found at this time and was developed by extensive underground workings to a depth of 221 m (752 feet). Numerous pits, trenches and exploration shafts exist throughout the southern third of the township.

Currently, there are several small groups of active mining claims in the township. The main commodity sought is silver and amethyst. Traces of galena and sphalerite also occur in these veins. Several claims have been staked for gold and samples assaying up to 4 oz/ton have been collected in the Nelson Road-Highway 11/17 intersection area. Gold up to 0.18 oz/ton in grab samples, usually associated with chalcopyrite and quartz veins, occurs in felsic metavolcanic rocks near the hydro line north of Highway 11/17 north of the Lakehead Transformer Station.

Map 1 depicts the ground available for staking in the township as of 1986. Approximately one-quarter of the township is patented or leased land; a little under half of the township, only the surface rights are patented, but the mining rights are available for staking. The balance of the township is Crown land.

Acknowledgments

During the 1984 and 1985 field seasons, the author was assisted by J.M. Sequin. M. Hine and F.J. Kristjansson provided assistance at various times. Thanks to Dr. P. Thurston who supervised the project and to Mr. Ken Fenwick for supporting the concept of geological mapping out of the regional office.

F.J. Kristjansson summarized the quaternary geology of the map area and is responsible for that section. Mark O'Brien assisted in the drafting of the figures.

GEOLOGY

Tectonic Setting and General Geology

All rocks in MacGregor Township are of Precambrian age. Rocks of both the Superior and Southern Province of the Canadian Shield are exposed in the map area. As currently exhumed, the unconformity between the Superior and the overlying Southern Province rocks straddles the southern portion of MacGregor Township and subparallels the north shore of Thunder Bay, Lake Superior. The dominant structural element present is the Lake Superior Basin and its associated lithologies.

The Lake Superior Basin is the northeasterly extension of the mid-continent structure that has been traced from Kansas to Lake Superior. The structure's signature is that of a gravity high. The mid continent structure is an arcuate fault-bound trough containing Keweenawan mafic volcanic rocks, minor felsic volcanic rocks, gabbroic intrusions and clastic sedimentary rocks. According to King and Zietz (1971) and Card et al. (1972), the Lake Superior Basin resembles global rift systems in that there is a thickening of the earth's crust beneath Lake Superior, prevalent anomalously high crustal densities, has great length, exhibits en echelon fault patterns, and has characteristic outpourings of great volumes of mafic lavas and dike swarms on the adjacent craton.

In MacGregor Township, major fault systems are subparallel as well as radial to the Superior Basin. Southern Province lithologies include the Middle Precambrian Animikie Group and the Late Precambrian Sibley Group. Remnant Osler Group volcanic rocks also occur in the area.

The Animikie Group consists of the Gunflint Formation and Rove Formations. The former has been described in detail by Tanton (1931), Morehouse (1960), Goodwin (1960), Ingall (1887), Gill (1926) and Shegelski (1982). The latter has been described by Morey (1969) and Geul (1970, 1973).

The Gunflint Formation consists of a patchy basal conglomerate, algal cherts, tuffaceous shales, minor volcanic flows, taconite iron formation and a fragmental limestone. The Rove Formation is made up of massive to bedded greywacke and black fissile shale.

The Sibley Group is a red bed sequence located in an elongated basin extending northerly to northwesterly from Nipigon, Ontario. It consists of three conformable formations and these are from the oldest to the youngest: the Pass Lake Formation, the Rossport Formation and the Kama Hill Formation (Franklin et al. 1980). The Sibley Group has been dated by Franklin et al. (1980) at 1339± 33 Ma. The reader is referred to Franklin et al. (1980) for a complete description of the Sibley

Group rocks. Sibley Group rocks occur mainly to the south, east and north of the map sheet. Many boulders of Sibley Group rocks, some of them up to 1.5 m in diameter, occur in the map area. Sibley Group rocks are also found as inclusions in some of the fault-controlled amethystine veins in the area.

Osler Group rocks have been described by Tanton (1931), Giguere (1975), Wallace (1972, 1981) and McIlwaine & Wallace (1976). The reader is referred to these authors for a description of the Osler Group. Osler Group basaltic flows and related rocks are found mainly on Black Bay Peninsula and on the St. Ignace Island archipelago. Only one outcrop of Osler volcanic rocks was found in MacGregor Township and is located approximately 0.8 km south of the CKPR-TV tower at Mount Baldy.

The majority of Early Precambrian (Archean) rocks in MacGregor Township have been assigned to the Shebandowan portion of the Abitibi-Wawa Subprovince of the Canadian Shield. These rocks consist of two cycles of metavolcanic rocks ranging in composition from ultramafic, mafic, intermediate to felsic, and are present both as flows and pyroclastic units. Associated with the metavolcanic rocks are metasedimentary rocks and subvolcanic quartz- and quartz-feldspar porphyries, mafic to ultramafic intrusives and felsic plutonic rocks.

The balance of the Archean rocks consist of migmatitic and metasedimentary packages that have been grouped with rocks of the Quetico Subprovince. These rocks consist of massive to foliated quartz-feldspar-biotite gneisses, metawackes and metamudstones.

Based on lithological differences, the boundary zone between the Quetico Subprovince rocks and rocks of the Abitibi-Wawa-Shebandowan Subprovince of the Canadian Shield could extend generally east-west across the central portion of the map area. The demarcation between the two subprovinces should be examined at the academic level. Major differences are characterized by metasedimentary rocks to the north of and metavolcanic rocks to the south of the boundary zone. The Mackenzie granite appears to have intruded at or near this interface.

Diabase dikes intrude all lithologies and are considered to be Late Precambrian in age.

TABLE 1 | LITHOLOGICAL UNITS FOR MACGREGOR TOWNSHIP

PHANEROZOIC

CENOZOIC

QUATERNARY

RECENT
lacustrine sands, beach gravels, stream and swamp deposits

PLEISTOCENE
glacial, glaciofluvial and glaciolacustrine deposits, raised beaches, till, sand, gravel, clay and silt

- GREAT UNCONFORMITY -

PRECAMBRIAN

LATE PRECAMBRIAN

OSLER GROUP
(a) amygdular basalts

LOGAN DIABASE
(a) xenolithic
(b) granophyric
(c) porphyritic

SIBLEY GROUP
(a) Kama Hill Formation
(b) Rossport Formation
(c) Pass Lake Formation

MIDDLE PRECAMBRIAN

ANIMIKIE GROUP
(a) Rove Formation
(b) Gunflint Formation
(a) fragmental limestone
(b) taconite, hematitic ironstone
(c) shale (tuff-argillite)
(d) chert-carbonate
(e) lapilli tuff
(f) algal chert
(g) conglomerate

- GREAT UNCONFORMITY -

EARLY PRECAMBRIAN

Felsic Igneous Intrusive Rocks

(a) granite
(b) syenite
(c) quartz-monzonite
(d) trondhjemite
(e) quartz feldspar porphyry

Migmatitic Rocks

(a) unsubdivided
(b) quartz-biotite-feldspar schist (metasedimentary migmatite)
(c) hornblende-feldspar schist (metavolcanic migmatite)

Mafic to Ultramafic Rocks

(a) hornblendite
(b) gabbro
(c) lamprophyre
(d) peridotite

Metasedimentary Rocks

(a) arenaceous
(b) wacke
(c) graphitic
(d) siliceous iron formation
(e) chert
(f) chert-carbonate iron formation
(g) conglomerate

Felsic Metavolcanic Rocks

(a) pyroclastic
(b) blue quartz-eye porphyry
(c) crystal tuff
(d) pumiceous lapilli tuff
(e) tuff brecia

Intermediate to Mafic Metavolcanic Rocks

(a) pyroclastic
(b) amygdular
(c) tuffaceous, fragmental
(d) amphibolite
(e) diabasic texture
(f) porphyritic (feldspar phenocrysts)

Early Precambrian

The Early Precambrian rocks in MacGregor Township include two cycles of metavolcanic rocks consisting of felsic, intermediate to mafic and minor ultramafic flow and pyroclastic rocks, two groups of metasedimentary rocks and various types of intrusives that include granite, quartz monzonite, hornblende gabbro and hornblendites. These rocks will all be described in detail.

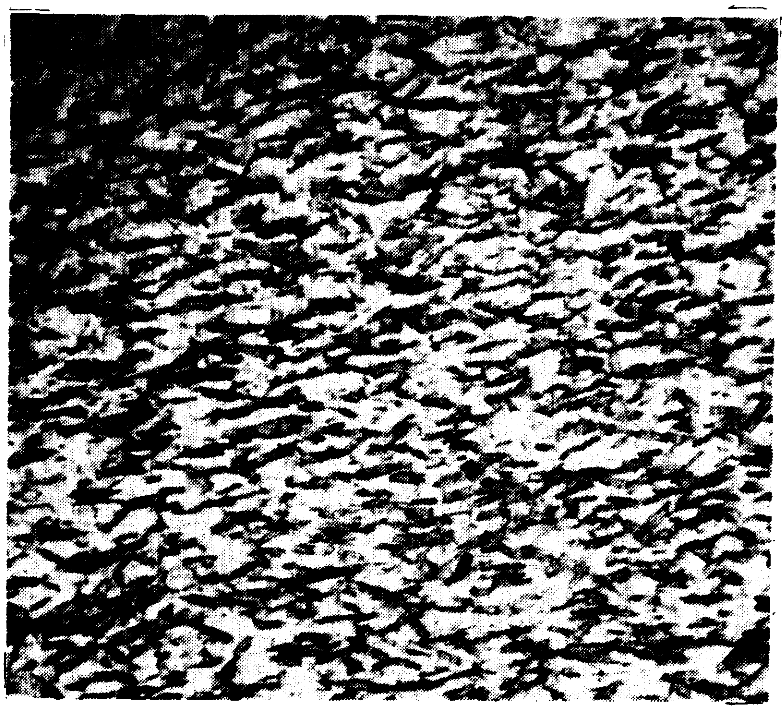
TYPE I METASEDIMENTARY ROCKS

The metasedimentary rocks of this type have been described by MacDonald (1939) as "Coutchiching" but using contemporary nomenclature, these rocks should be designated "Quetico Type". They form a relatively wide belt that trends east to northeasterly across the northern third of Gorham Township. This belt also strikes into MacGregor Township and forms an easterly trending unit across the central portion of the map area. On a regional scale, these metasedimentary rocks are also found north of the Penassen Lakes Stock north of the map area.

In MacGregor Township, these metasedimentary rocks are generally fine to medium grained; bedding, if present, is thick to finely laminated and dips are steep in a southerly direction. The rock is grey to dark grey to brownish grey in colour. Where grain gradations were encountered, they indicate a southerly facing sequence. Where the rock is relatively unmetamorphosed, grain gradations are quite straightforward. When metamorphosed, the fine grained pelitic top portions of the bed contain coarse metacrysts of andalusite(?) making stratigraphic top determinations difficult.

These metasedimentary rocks have compositions which vary from arenites to wackes and mudstones. They have been metamorphosed to massive biotite-rich rock containing quartz and feldspar. Where a schistosity is discernible, it is due to the alignment of the biotite flakes and is subparallel to the bedding. As one approaches the contact between the metasedimentary rocks and the granitoid intrusives, an increase in the local metamorphic grade of the sedimentary rocks is evident. This is manifested by the occurrences of gneissic textures in the metasedimentary rocks although grain gradation within the beds still may be distinguished. Some increase in the presence of garnets was noted at a very local scale near the granitic intrusives and was usually confined to metasedimentary blocks which are considered to be large scale xenoliths or roof pendants within the Penassen Lakes Stock in the Waller Lake-Bentley Lake areas in the northwest sector of the map area.

The frequency of granitic and aplitic dikes increases as the contact with the granitic batholiths is approached. Clear white quartz veins cut these metasedimentary rocks in many areas. Pyrite staining in the veins is present and although numerous quartz veins associated with the metasedimentary rocks were sampled and assayed not one of the "bull" quartz veins sampled returned any gold values of note.



Photograph 1

Biotite crystals defining foliation.
Note the drag folding of
foliation near micro-faults.
Field of view: 3 mm

Photograph 2

In thin section these rocks are fine grained, massive in nature and generally consist of biotite, quartz and feldspar. Biotite crystal alignment defines the foliation in the rock (Photo 1). In the sample examined, the foliation is folded near micro faults (Photo 2). What was thought to be andalusite in outcrop was examined in thin section but could not be positively identified as andalusite. The metacrysts consist of a mixture of muscovite ± sericite and the unknown metasilicate. The metacrysts have a ragged outline and the biotite in the vicinity of the metacrysts has been altered to chlorite. Feldspar and quartz grains appear unaltered. This perhaps indicates that the andalusite(?) growth is at the expense of the biotite. When this metasedimentary rock is very siliceous and fine grained, examination with a petrographic microscope is impractical.

TYPE II METASEDIMENTARY ROCKS

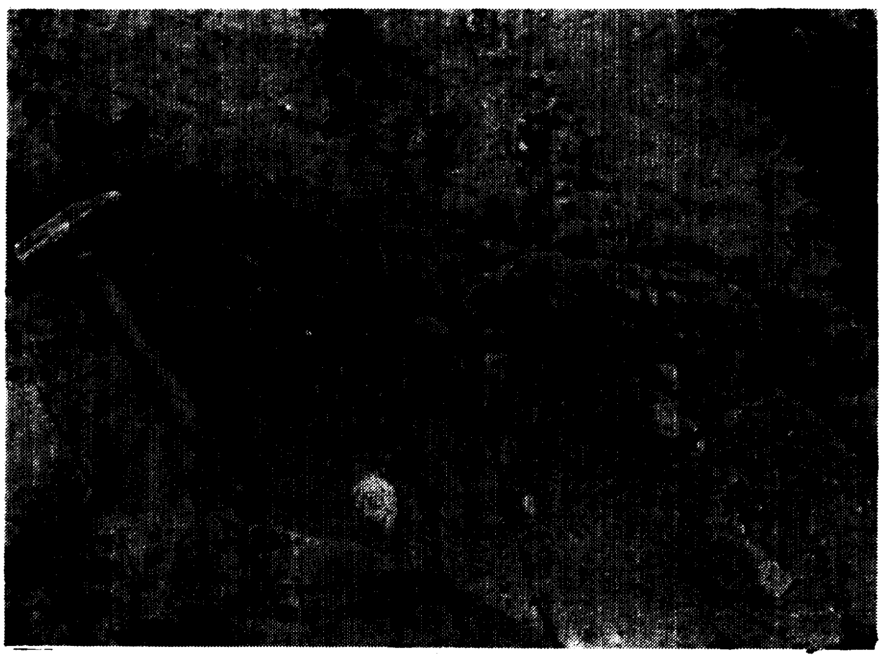
Metasedimentary rocks assigned to this group appear to be stratigraphically higher in the section than those of Type I. Type II metasedimentary rocks are intimately associated with and contain clasts of rocks associated with the second volcanic cycle. These metasedimentary rocks consist of conglomerate, wacke, lithic wackes and iron formation. They exhibit well-preserved sedimentary structures such as graded beds (Photos 3 & 4), crossbedding and rip-up clasts all of which indicate a southward younging direction.

The conglomerates associated with this group are exposed at several localities, the most accessible of which is along Highway 11/17 approximately 0.8 km east from a point where the highway crosses the Canadian Pacific Railway tracks. The unit is also exposed along the CPR right-of-way to the northeast of the above location. Clast size is variable with the largest size approximately 6 cm long. Clast lithologies include banded black chert-magnetite iron formation, granitoids and metavolcanic fragments.

Iron formation crops out on the 230 kv hydro line approximately 0.6 km west of Wildgoose Creek and in several outcrops approximately 0.6 km south of the CKPR-TV tower on Mount Baldy. Banded iron formation does not crop out east of the above conglomerate outcrop area. From the regional magnetic expression (Map 4), the banded iron formation strikes into Thunder Bay, Lake Superior, in the Mary Harbour-Silver Harbour area. In the Silver Harbour area, the Archean iron formation is overlain by Proterozoic supercrustal rocks.

The position of the Archean conglomerates with respect to the Keewatin rocks, coupled with the fact that the conglomerate contains clasts of inferred Keewatin iron formation, would imply that the conglomerates be assigned to rocks designated

Photograph 3: Crossbedding in Type II metasedimentary rocks, Highway 11/17 near Shuniah Landfill Site.



Photograph 4: Coarse grained gradations in grit conglomerate. Same location as Photograph 3.

"Timiskaming-type". Care must be taken not to confuse the Kakabeka conglomerate, which is the basal unit of the Proterozoic Gunflint Formation, with the conglomerates of the Archean. In MacGregor Township, this conglomerate was found to lie unconformably over Archean volcanics and granitoids. The exposures are generally small, widely scattered and in various stages of preservation. The reader is referred to the section on the Gunflint Formation in MacGregor Township.

In general, the Type II metasedimentary rocks consist of poorly sorted massive wackes, lithic wackes with minor argillaceous and/or graphitic beds. The lithic wackes contain broken feldspar crystals, small rock fragments and angular to rounded quartz clasts. Lithic fragment types are dominated by volcanic fragments. Minor amounts of granitoid fragments are present in some exposures.

In thin section, these rocks appear fresh and virtually unmetamorphosed. Feldspar crystals are clear with no alteration visible.

METAVOLCANIC ROCKS

The metavolcanic rocks in MacGregor Township have been subdivided into two cycles: a lower cycle located in the west central part of the township and an upper cycle exposed in the southern portion of the west part of the township.

The major constituents of lower cycle volcanic rocks are massive to pillowed basaltic flows with minor andesite units and a felsic pyroclastic horizon consisting of cherty graded tuffs, crystal tuffs and agglomerates. Minor interflow metasedimentary rocks and some iron formation units exist near the top of the lower cycle volcanic rocks.

The basaltic rocks are dark green to black in colour. Grain size varies from fine to medium although some units are coarse grained. Pillow forms, when present, are too deformed to use as a reliable top indictor but suggest a south facing sequence. Coarser grained portions of otherwise medium to fine grained units have been interpreted to be the central cores of flow units.

At one locality, approximately 6.5 km north on Hwy. 527, well-preserved columnar jointing can be seen in a basaltic flow unit. The jointing is best seen in plan view.

Lensoid white quartz veins with up to 5% pyrite occur in some outcrops of the mafic volcanics. Notable occurrences are in the large rockcut situated approximately 9.6 km north (from Highway 11/17) on Highway 527. A series of quartz veins up to 30 cm wide exist in a large outcrop of mafic metavolcanics located 0.8 km east of the Highway 527 location. A small gossan stained pit was seen at this site.

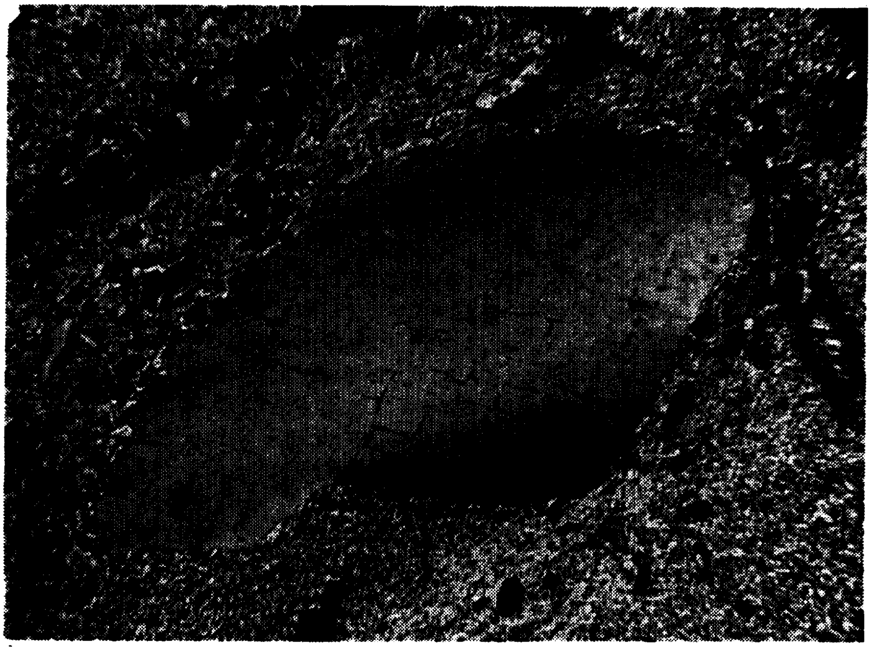
Intermediate to felsic fragmental rocks overlie the mafic flow units. Where exposed, these rocks consist of finely laminated tuffs, massive crystal tuffs and agglomerates. The crystal tuffs are dense, siliceous and often break with sharp conchoidal fractures. The rock is light applegreen in colour. Densely packed, rounded to euhedral quartz and feldspar crystals, as well as lithic fragments, make up the bulk of the rock. Some lithic fragments exhibit flow banding. Chloritic whisps that probably were glassy shards also occur in the rock. The matrix is made up of a very fine grained mixture of quartz and feldspar with a dark, dusty, epidote rich alteration. In thin section, some quartz grains exhibit a well-developed stain-induced orthogonal cleavage (Photo 5).

The finely laminated tuffs exhibit graded bedding and are conformable with the massive crystal tuffs. The grading is defined by plagioclase crystals deposited near the base of the individual beds. The bed tops contain very fine laminations of what is considered to be compacted dust and ash.

The coarser pyroclastics in this sequence are best exposed on Copenhagen Road immediately north of Mitchell Road. Here the pyroclastic rocks are light green in colour and speckled with darker green chloritic blebs. Clast size is in excess of 12 cm but average less than 6 cm across. The rock exhibits carbonate alteration and contains up to 2-5% disseminated sulphides. The clasts appear to be similar in appearance as to the matrix. The Lakehead Gold Mines gold occurrence is situated in similar rocks on strike five kilometers to the west. Exposures on Copenhagen Road are relatively small.

The upper cycle volcanic rocks are situated in the southern portion of the west half of the map area and trend easterly to the Silver Harbour area where they are covered by the Proterozoic Gunflint Formation.

These rocks consist of massive to fragmental komatiites plus their locally derived sedimentary units, massive to pillowed flows, pillow breccias (hyaloclastic rocks) and intermediate pyroclastic rocks. These ultramafic and mafic metavolcanic rocks are overlain by felsic to intermediate pyroclastic rocks that range in texture from pumiceous tuffs to agglomerates to rhyolitic flows. These felsic metavolcanic units are the strike extension of a similar felsic unit mapped by MacDonald (1939) in Gorham Township. Subvolcanic quartz and quartz-feldspar porphyries are an important constituent of the volcanic pile as exposed in the southern part of the map area.



Photograph 5: Quartz phenocryst in quartz-eye rhyolite exhibiting strain induced orthogonal cleavage. Field of view 5 mm.

Photograph 6: Mylonitic texture, quartz feldspar porphyry. Field of view 5 mm.

Komatiitic rocks are exposed at the intersection of Wildgoose Creek and the major hydro transmission line north of Highway 11-17 and at the intersection of the same hydro electric transmission line and Blind Creek located approximately 1.2 km to the northeast of the above location.

These rocks are dark green in colour, medium to fine grained and slightly magnetic. In the Wildgoose Creek area, the rock has a fragmental texture with the fragments up to 3 to 4 cm across. Fragment lithologies range from laminated ultramafic volcanic to diabasic-textured ultramafic volcanic. Lack of sufficient exposures precludes a detailed description of the unit, but the following observations have been made. Chemically the rocks are ultramafic with compositions ranging between 43.9 to 45.3% SiO_2, 21.7 to 27.9% MgO, 4.77 to 6.73% Al_2O_3, 10.0 to 11.0% Fe_2O_3 and 4.08 to 8.89% CaO. Nickel, chrome, cobalt and copper are also elevated with values as high as 2120 ppm for chrome and 1480 ppm for nickel.

In the Blind Creek portion, textures range from very finely laminated to massive. Clast sizes range up to several centimeters across but typically average less than 5 mm across. Some larger clast aggregates show a possible preferred orientation more or less subparallel to the laminations. Gelinas et al. (1977) described similar occurrences of ultramafic volcanoclastics from Spinifex Ridge in Lamotte Township, Province of Quebec. Gelinas et al. (1977) observed two types of volcanoclastics: one type accumulated in channels formed by the juxta-position of ultramafic lava tubes with volcanoclastics resting conformably on the chill margin of the ultramafic flows (TYPE A) and deposits that cut across existing ultramafic flows (TYPE B). The characteristics of Type A deposits are that the beds are usually less than 1 m thick graded with some cross laminations; Type B beds are massive and contain angular fragments of all the divisions of an ultramafic flow. Beds of Gelinas et al. (1977) type B units are probably exposed at Wildgoose Creek.

Spinifex-like features have not been positively identified at the MacGregor Township site, probably due to lack of sufficient exposure. Some spinifex-like textures do occur in the area east of Wildgoose Creek where a logging road intersects the 230 kv hydro line.

TABLE 2 | CHEMICAL COMPOSITION OF KOMATIITES IN MACGREGOR TOWNSHIP

SAMPLE NO. / ELEMENT	JFS-3-9	JFS-3-10	JFS-3-15	
	Wt%	Wt%	Wt%	
SiO_2	44.20	43.90	45.30	
TiO_2	0.38	0.45	0.48	
Al_2O_3	4.77	6.08	6.73	
Fe_2O_3	10.40	11.00	10.00	
FeO	0.00	0.00	0.00	
MnO	0.14	0.17	0.17	
MgO	27.90	26.20	21.70	
CaO	4.08	7.00	8.89	
Na_2O	0.00	0.36	0.53	
K_2O	0.06	0.12	0.25	
P_2O_5	0.04	0.06	0.09	
CO_2	0.20	0.17	0.11	
S	0.31	0.23	0.01	
H_2O+	0.00	0.00	0.00	
H_2O-	0.00	0.00	0.00	
LOI	6.90	4.20	4.60	
TOTAL	99.38	99.94	98.86	
Au	Tr	Tr	Tr	
Ba	30	80	200	ppm
Co	77	71	66	
Cr	1450	1420	2120	
Cu	48	45	56	
Ni	1480	1220	815	
Sr	80	325	235	
V	100	110	135	
Zn	51	68	68	
Zr	18	23	30	

Analysis by O.G.S. Laboratory

Pillowed basaltic flows are highly sheared and in certain locations individual pillows are difficult to recognize. Where pillow structures are identifiable, the pillows are still too deformed to give reliable structural data. In most cases where the pillows are recognizable, they are no larger than 0.6 m long, averaging about 30 cm. They are typically dark green with fine grained, often darker green, selvages. Varioles are present in many instances and these are usually filled with quartz or calcite.

Good exposures of pillowed volcanics can be found on the 230 kv hydro line 400 m west of Highway 527. The pillow lavas are exposed in a series of small low lying outcrops on the hydro line. Other exposures are found on the same hydro line 1.2 km to the west near the banks of the North Current River. Four hundred meters south of the above location, sheared pillow lavas are exposed at the base of a concrete dam on the North Current River. Severely sheared and deformed pillow lavas are exposed in a sand pit located between the dam and Copenhagen Road.

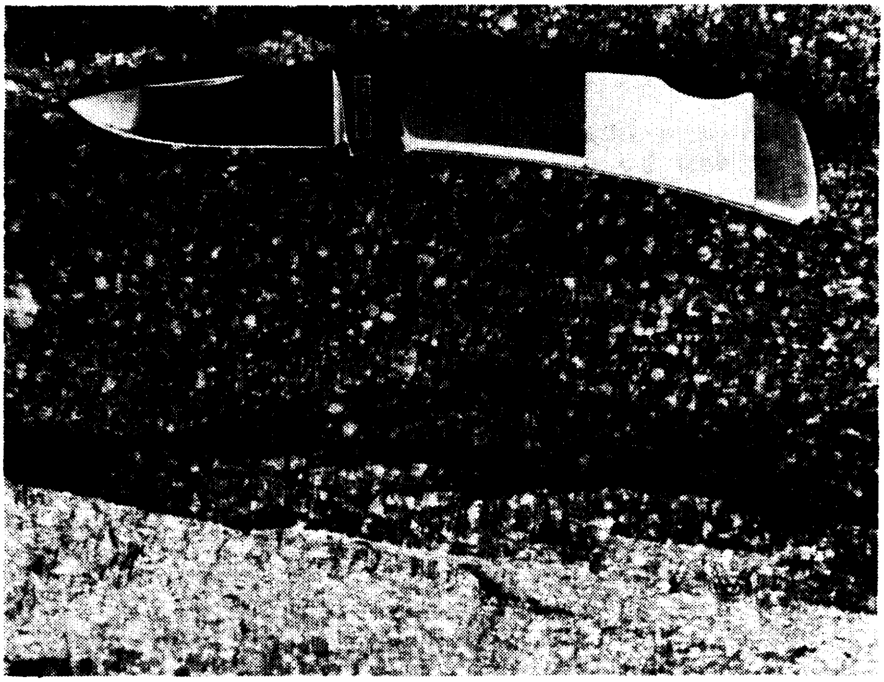
Here, deformation is so severe that pillow forms are not recognizable. The rock is volcanic but is laminated, sheared and cut by quartz-amethyst vein systems. The laminated appearance is due to the closely spaced and stretched out pillows and their selvages.

Pillowed lavas are also exposed near the junction of Lakeshore Drive and the Silver Harbour Road. Here the individual pillows are up to mattress size and are quite vesicular. Pillow lavas appear to grade into vesicular flows.

Pillow forms were not recognized anywhere else in the map area.

Central sections of some flow units are very coarse grained with some amphibole crystals up to 3 cm long. In thin section, the mafic metavolcanic rocks exhibit textures that range from massive to diabasic to vesicular or amygdaloidal. Where vesicular, the vesicles are filled with chlorite, quartz and carbonate. The ground mass is usually fine grained and consists of an aggregate of amphibole (hornblende) quartz and albititic feldspar. Calcite is common in the ground mass.

The upper cycle felsic volcanic rocks overlie the upper cycle mafic volcanics and extend from Gorham Township, where they were mapped by MacDonald (1939), through MacGregor Township and trend into Thunder Bay, Lake Superior, in the Mary Harbour area.



Photograph 7: Quartz-feldspar porphyry (chloritic matrix).

Photograph 8: Quartz-feldspar porphyry (sericitic matrix).

These rocks are characterized by a chalky white weathered surface, pale green to green colour on the fresh surface and are fine grained. For the most part, the rocks in this package are fragmental, but some units have been interpreted to be quartz-eye rhyolite flows. The felsic flow units appear massive but exhibit laminations that have been interpreted to be flow banding; other units within the felsic package are highly foliated and contain up to 5% disseminated pyrite.

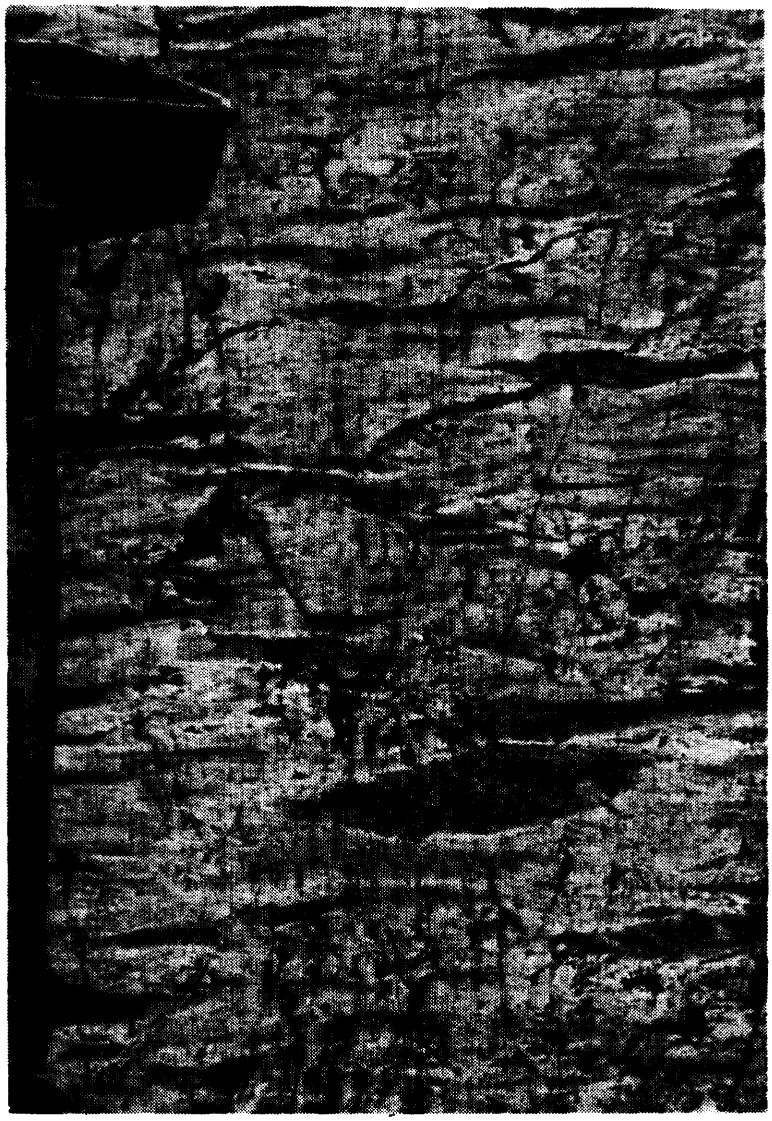
Subvolcanic quartz and quartz feldspar porphyries are associated with the felsic volcanic fragmentals and are best exposed along Highway 11/17 just east of Highway 527. The feldspar crystals are no longer than 5-8 mm; the quartz eyes are as long as 1 cm but average about 9 mm.

There are two major porphyry types (Photos 7 & 8) associated with the upper cycle volcanic rocks and they can be distinguished by their matrix and by the relative amounts of quartz and feldspar. One type has a dark green chloritic matrix and weathers to a dark green colour. Quartz phenocrysts are present although not abundant. Where deformed, the porphyry assumes a mylonitic texture with the quartz phenocrysts being ribboned out and the feldspar crystals rotated, broken up and boudinaged (Photo 6).

The other porphyry type has a sericitic matrix and contains abundant quartz and feldspar phenocrysts. The unit is light beige in colour and weathers a chalky white. The porphyry is foliated subparallel to the strike of the rocks.

While it is not possible to differentiate the various units in the felsic package at the current mapping scale, nevertheless, there are broadly definable units within the felsic package. The bulk of the felsic package is fragmental with minor quartz-eye rhyolitic flows. The fragmentals range from fine pumiceous tuffs to very coarse agglomerates where the fragment sizes exceed 60 cm in length. The fine grained tuffaceous units are best exposed along the major hydro line north of Highway 11/17.

Pumiceous fragments are wispy with a bleached rind and a greenish epidotized core. They are set within a finer grained tuffaceous matrix (Photo 9).



Photograph 9: Felsic pumiceous tuff.
Hydro line north of the KOA Campgrounds.

TABLE 3 | FRAGMENT COMPOSITIONS--FELSIC AGGLOMERATE

	JMS10-5	JMS10-5A	JMS10-5B	JMS10-5C
SiO_2	74.00%	74.50%	71.50%	71.20%
TiO_2	0.54	0.68	0.57	0.54
Al_2O_3	15.00	14.60	16.40	16.30
Fe_2O_3	0.45	0.33	0.76	0.77
FeO	0.00	0.00	0.00	0.00
MnO	0.02	0.02	0.01	0.02
MgO	0.36	0.37	0.43	0.76
CaO	2.27	2.49	3.20	3.52
Na_2O	4.89	4.76	4.36	3.98
K_2O	0.65	0.58	0.96	0.75
P_2O_5	0.15	0.14	0.13	0.15
CO_2	0.45	0.69	0.31	0.29

Analysis by O.G.S. Geoscience Laboratory, Toronto

The coarse grained agglomerates are best exposed along Highway 11/17 2 km east from where Highway 11/17 crosses the CPR tracks. Here the agglomerate is very siliceous and contains fragments that exceed 0.6 m in length. Fragments are quartz-eye rhyolite with the composition as shown on Table 2. The fragments are a pale, apple green in colour, very hard and break with a conchoidal fracture. Edges are very sharp. Small specks of chalcopyrite can be seen in some samples. The fragments are subrounded in outline although some exhibit remarkable angularity. The rounding is attributed to transport in a hot semi-plastic state.

FELSIC INTRUSIVE ROCKS

Archean plutonic rocks in MacGregor Township range in composition from granite to pyroxenite with rocks of granitic composition dominant. Hornblende gabbro sills intrude metasedimentary rocks in the east central portion of MacGregor Township. Hornblendite plugs occur within the granitic rocks in the northwestern portion of the map area.

The Penassen Lakes Stock, centered on the Penassen Lakes and the Mackenzie Granite, located along the southern flank of the Township, dominate the area's geology and physiography.

The Penassen Lakes Stock

The Penassen Lakes Stock forms a granitic upland that rises to 566 m (1857 feet) above sea level or 383 m (1200 feet) above Lake Superior. The stock can be subdivided into three general units: a core phase, a discontinuous peripheral zone of foliated xenolithic syenitic rocks and a xenolithic phase characterized by abundant inclusions of metasedimentary host that range in size from several centimeters to hundreds of metres across.

The core phase is characterized by a massive, although jointed, coarse grained granite. In outcrop, the weathered surface exhibits a rough texture caused by differential weathering of the mineral components: the potassic feldspars and quartz tend to weather in relief; the plagioclase feldspars and mafic constituents weather low. The potassic feldspars are generally up to 1.5 cm in length, pink to brick red in colour, and appear to be, on average, slightly larger than the plagioclase or quartz crystals. The plagioclase feldspars have a greenish hue that is due to the partly sericitized condition of the crystals. The quartz grains are usually clear and white but in some outcrops may have a bluish tinge.

The rock is well-jointed; dominant joint directions based on frequency measured are 065°, 140° and 5°. The Penassen Lakes occupy a major depression within the stock that could be a major arcuate fault zone. The core section of the stock is dissected by numerous steep-walled valleys that strike northerly across the stock. Elevation differences between the floors of the valleys to the top of the hills can be as much as 106.7 m (350 feet).

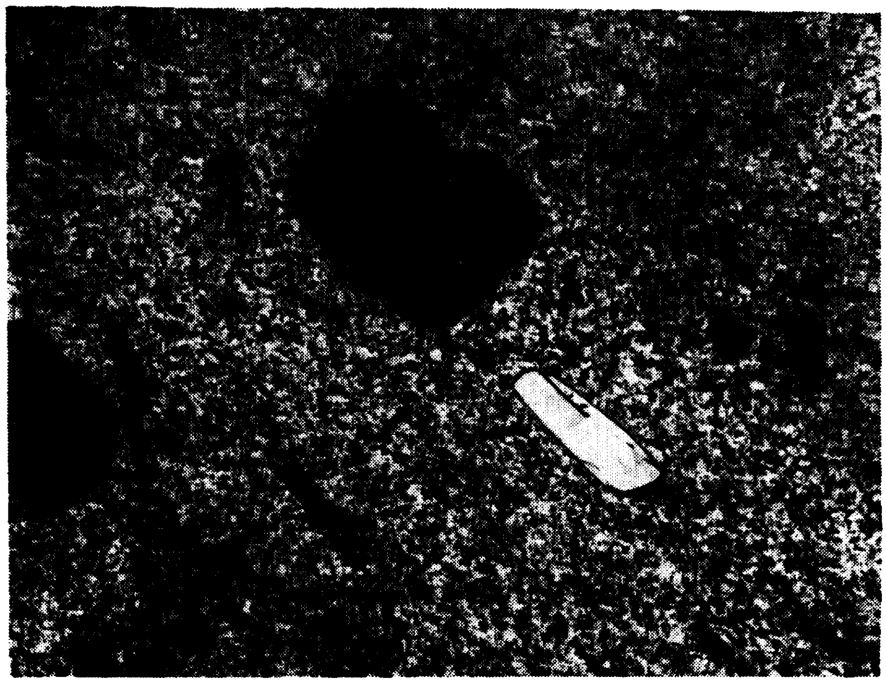
The northern sector of the Penassen Lakes Stock, as exposed on Highway 527 north of the 13 km mark, is characterized by a slightly foliated, xenolithic syenitic rock. The syenite is brick red in colour and is essentially composed of potassic feldspar, plagioclase and hornblende. Trace amounts of pyrite, normally less than one percent, occur throughout the rock as disseminated cubic crystals. This phase of the stock is a minor constituent and as exposed, appears to be restricted to the northwesterly section of the stock. The xenoliths are generally small in size averaging about 2 cm in length; they are elongated in the general foliation direction of 110°. Xenoliths consist of mafic clots that could be metamorphosed biotite schist.

The third phase of the Penassen Lakes Stock is exposed west of Highway 527 in the Waller Lake area. Here the rock is generally white in colour and is of medium grain size. Composition is variable but appears to be a xenolithic trondhjemite. Xenoliths of up to 30 cm in length are common. These xenoliths are metasedimentary rocks of Type I and are characterized by dark brown coloration and show distinct borders with the granitoid (Photo 10). Xenoliths that are roof pendant-like in size exist in the Waller Lake portion of the stock. These xenoliths are Type I metasedimentary rocks (Quetico Type) that have been stoped into the intruding granitic magma. In places, especially southwest of Waller Lake, those xenoliths exhibit the development of garnets. The garnets have developed as single crystals as well as large aggregates of small crystals.

If one accepts the assumption that all the granitic rocks of the Penassen Lakes Stock belong to the same intrusive complex then we can make the following statements:

1. The xenolithic western portion of the complex is interpreted to represent the uppermost section of the magma chamber by virtue of large concentrations of xenoliths, some up to roof pendant in proportions.
2. The syenitic phase, although minor in terms of exposure , is an intermediate or hybrid phase that is midway between the xenolithic western sector and the core phase.
3. The core phase is the central portion of the magma chamber. This phase is characterized by a coarse grained granite.

The western portion of the core phase has as its signature a broad but discernible magnetic anomaly. Small amphibolitic stocks mapped within the complex are interpreted to be small discrete stocks of hornblende-rich gabbro or metamorphosed xenoliths of mafic volcanic rocks. The majority of these occur in the western sector of the complex and are centered near Waller Lake.



Photograph 10: Xenolithic trondhjemite - Waller Lake area.

Typically, these rocks are dark green, soft and are usually coarse grained. Hornblende crystals attain two to three centimeters in length. Notable exposures occur north of Waller Lake. The rocks consist of hornblende crystals set in a finer grained matrix of hornblende/biotite and feldspar. The rock is not usually magnetic. No sulphide mineralization was seen in the rock of this type.

The Mackenzie Granite

The Mackenzie Granite is situated in the southern portion of MacGregor Township and occupies an area from Mount Baldy in the west to Birch Beach on Thunder Bay to the east, a distance of about 22 km. The Mackenzie Granite has been faulted and generally attenuated in the area 1.6 km northwest of Mary Harbour, but where not faulted, the granitic body is in the order of 3.2 km wide.

The intrusive is a medium to coarse grained, pink to slightly greenish and at times reddish hued granite composed primarily of microline, oligoclase, quartz and biotite with accessory sphene, apatite, opaque minerals and secondary sericite plus epidote (Rogers, 1979). In many respects, the Mackenzie Granite is similar to the core phase of the Penassen Lakes Stock and may be related to it.

Melanocratic phases do occur but are an exceedingly minor constituent of the intrusive. At one such occurrence, notable only because it is situated on Highway 11/17 near the junction with Amethyst Beach Road, normal Mackenzie Granite grades into an extremely dark green to black phase that is essentially composed of hornblende, chlorite and dark glassy quartz. This phase is very local and is in the form of pods and segregations with gradational contacts with the granite. These may represent partially assimilated xenoliths of mafic volcanic rocks. Analysis of this rock by the OGS Geochemistry Laboratory can be found in Table 3. The depletion of alkalies coupled with enrichment of iron and alumina might suggest that this particular phase is a baked mafic volcanic xenolith.

The Mackenzie Granite has been quarried for bridge abutments for the Canadian Pacific Railway as well as building facings. Two old granite quarries exist in the map area.

Major jointing shows no dominant preferred direction on a rose diagram, but the three major sets are generally 0°, 40° and 85°.

MINOR FELSIC INTRUSIVES

Quartz Feldspar Intrusives

A coarse grained quartz-feldspar sill-like intrusion is exposed in the central portion of the east half of the map area. Outcrop pattern suggests the sill is arcuate in form, but this only reflects the regional strike of the metasedimentary rocks it intrudes. The sill appears to thin out in an easterly direction and disappears under deep overburden associated with the Mackenzie Moraine near its western extremity. Several small outcrops of a similar rock type occur at the same stratigraphic position in the east portion of the western sector of the map area; these may be part of the same sill.

The rock appears subvolcanic in nature. The matrix is extremely siliceous and very fine grained. Quartz and feldspar phenocrysts are up to 1 cm in length and average 0.5 cm. Chemical analysis of this rock can be found in Table 3. On the weathered surface, the quartz and feldspar phenocrysts weather in relief with the quartz weathering higher than the feldspar. The colour of the fresh surface is light grayish green to beige; the weathered surface is usually chalky white. The quartz phenocrysts are dark grey in colour and stand out against the chalky weathered surface.

The sill has been affected by faulting in several areas. Two notable areas are where the Walkinshaw Creek and an unnamed creek four kilometers to the east of Walkinshaw Creek cut across the sill. These creeks flow southerly in fault-controlled valleys. Based on outcrop pattern, the fault displacement is sinistral.

No obvious mineralization or quartz veining was seen to be associated with this intrusive either along its length or in the vicinity of the fault zone.

Syenitic Rocks

Minor syenitic rocks that could be associated with either the Penassen Lakes Stock or the Mackenzie Granite are exposed in several places. Two hornblende syenites are exposed north of the village of Mackenzie which is located on the Canadian Pacific Railway mainline. The southern exposure is characterized by bedrock knobs protruding through the Mackenzie Moraine. The rock is massive with a faint foliation. Colour on the weathered surface is brick red mottled with darker phases.

Dark portions are characterized by a higher percentage of hornblende crystals. The rock is medium to coarse grained; the blocky hornblende crystals constitute approximately forty percent of the rock by volume. Two feldspar types are present: plagioclase has been sericitized and appears cloudy; potassic feldspars are relatively unaltered and exhibit microcline twinning. Quartz, although scarce, is present. Accessory minerals include apatite, zircon and sphene. Small scale breccias are evident in thin section. The breccias occur along small fracture sets and they reflect regional faulting.

A similar rock is exposed east of Walkinshaw Creek near the north boundary of the Township. Both the above rocks are similar to the syenite phase associated with the Penassen Lakes Stock that crops out near the north boundary of the map area on Highway 527. The contact area is not exposed, thus, the relationship with the Penassen Lakes Stock or the Mackenzie Stock cannot be determined.

A pinnacle of coarse grained porphyritic syenite crops out south of Mount Baldy. The rock is a cumulate of zoned feldspar crystals. The inter-crystal spaces contain amphibole. Feldspars are euhedral and exhibit strong zoning. The rim is perthitic; internal zoning is somewhat clouded by sericite alteration but it is still discernible. Individual crystals can be as long as 2 cm but average about 0.5 cm in length (Photos 11 & 12).

A striking porphyritic syenitic rock is situated just east of Walkinshaw Creek at a point approximately 8 km north of Silver Harbour. Coarse potassic feldspars, up to 10 cm in length, typifies this rock. As exposed in outcrop in the creek bed, the feldspar phenocrysts do not show any preferred orientation but to the east, outcrops show excellent parallelism of feldspar crystals that define a classic mineral foliation. The matrix contains smaller potassic feldspar crystals, biotite, pyroxene and altered amphibole. The feldspars exhibit very fine string perthite. No quartz was observed in the rock either in hand sample or in thin section. Based on chemistry, the rock has an alkaline chemical affinity (Table 3).

The area underlain by this rock appears to be a fault bounded block. Feldspar crystals weather out from the rock and are concentrated in pockets along the creek bed where they can be collected.

Photograph 11: Syenite intrusion south of Mount Baldy.

Photograph 12: Thin section of syenite south of Mount Baldy. Cummulate of zoned feldspars with amphibole in the feldspar interspaces. Field of view 5 mm.

Proterozoic

ANIMIKIE GROUP

The Animikie Group consists of two formations: the Gunflint Formation and the Rove Formation.

The Gunflint Formation has been described by Gill (1927), Tanton (1931), Goodwin (1960) and Morehouse (1960). Detail work on various aspects of the Gunflint Formation was done by Shegelski (1982), Floran and Papike (1975), Kwiatkowski (1975), Hagatsu et al. (1983), Purucker (1983); the Gunflint Formation microfossil assemblages have been described by Barghoorn and Tyler (1965), Barghoorn (1971), Edhorn (1973), Awramik and Barghoorn (1977), Schopf et al. (1965), Cloud (1965, 1983) and Knoll et al. (1978). Franklin et al. (1982) describes the Proterozoic geology of the Northern Lake Superior area and is a good general reference. Franklin (1970) describes the metallogeny of the Proterozoic rocks.

The Rove Formation has been described by Morey (1969) and Geul (1970, 1973).

Within the present map area, the Gunflint Formation sits unconformably on the Archean basement rocks and is exposed as a narrow belt that subparallels the northern shoreline of Thunder Bay, Lake Superior. The largest area interpreted to be underlain by rocks of the Gunflint Formation is situated near the intersection of Highway 527 and the North Branch (Trowbridge) Road. Gunflint Formation rocks in MacGregor Township consist of a patchy basal conglomerate, a shaley tuffaceous unit, a chert carbonate unit and microfossil bearing algal cherts.

The basal conglomerate is a very thin, discontinuous unit consisting of vein-quartz pebbles, jasper pebbles and iron formation clasts. The matrix varies from being siliceous to chloritic. Notable exposures of the basal conglomerate in the map area can be found near the intersection of North Branch Road and Highway 527 along an old dirt road where it crosses Savigny Creek; intermittently along the shore of Lake Superior between the mouth of Blind Creek and Mary Harbour; about 0.8 km north of Crystal Beach; on the hydro electric transmission line northeast of the intersection of Birch Beach Road and Highway 11-17. Other exposures occur and those located while mapping are plotted on the map.

Where preserved, basement rocks under the conglomerate show evidence of weathering. The rocks are generally hematized and chloritized and are characteristically reddish and greenish in colour. Where the basement underneath the conglomerate is granitic, the granite is crumbly and friable. Feldspar minerals have been sericitized and in extreme cases have been replaced by clay minerals. In outcrops where the actual unconformity is present, as one approaches the unconformity, the basement rocks become increasingly hematized and chloritized.

Clasts within the conglomerate are locally derived. This is exemplified in a series of rock outcrops on the hydro line just north of the intersection of Highway 11/17 and Birch Beach Road. At the base of the first hydro tower west of the small creek (first tower east of the jog in the transmission line), a one-foot thick layer of Gunflint basal conglomerate rests unconformably on weathered Archean metasedimentary rocks.

The clasts in the conglomerate consist of large (up to 5 cm) coarse angular white quartz which exhibit internal zoning, small, clear, well-rounded quartz pebbles, granitic fragments, jasper clasts and blocks of basement metasediments. The matrix is sandy. Quartz clasts are from two sources: the angular, white, zoned clasts are derived from an area that is located approximately 200 m to the north. Here, exposed in a similar metasedimentary rock, are numerous quartz veins, some of them up to 30 cm wide and exhibit the same characteristic internal zoning as seen in the clasts. The well-rounded, clear quartz pebbles in the conglomerate are derived from a more distal source.

Blocks of basement metasedimentary rocks are also incorporated in the conglomerate. These are from the immediate outcrop and is perhaps indicative that some reworking of the weathered zone has taken place by a transgressive beach line. Small quartz veins, approximately 2 mm wide, cut across the unconformity as parallel sets.

The basement rocks at this locale are very fine grained, massive metasedimentary rocks that exhibit discrete layers of oxidation, probably a result of weathering.

Other units of the Gunflint Formation that are exposed in MacGregor Township are the Upper Limestone Member, fissile tuffaceous shales, chert carbonate member and the Lower Algal Chert Member.

The Upper Limestone Member is best exposed in a vertical exposure situated on the north side of Highway 11/17 about 150 m east of the Terry Fox Lookout. Here, the Upper Limestone Member rests on the tuffaceous shale and is overlain by the shales of the Rove Formation. The sequence has been intruded by a diabase sheet that now overlies the Rove Formation shale. A fault zone is exposed at the eastern extremity of the outcrop. Quartz carbonate veining of the Thunder Bay Silver Mine occupies this fault zone.

The Upper Limestone is massive, grey and crystalline. Numerous xenoliths consisting of volcanic shards, rip up clasts and small lithic fragments make up about 10% of the rock. Shegelski (1982) states that the Upper Limestone is a fining upward sequence of beach rock. The shard-like fragments in the limestone as exposed near the top of the unit are interpreted by Shegelski (1982) to be curled mudchips that were lifted from the desiccated intertidal mudflat and redeposited along the bedding planes.

The chert-carbonate member is best exposed in the eastern section of the map area near O'Connor Point and along the CNR railroad tracks just east of the map area. Here the chert-carbonate is brecciated and folded. The chert and carbonate beds that comprise this unit are thinly and regularly bedded. In places, the chert beds are brecciated and boudinaged with the carbonate beds squeezed between the chert fragments. Brecciated chert-carbonate unit is quite extensive in the O'Connor Point area and is perhaps indicative of a local but significant tectonic event.

Algal cherts, as exposed at the southeastern corner of the map area, form large algal mounds several feet across. The darker, more organic rich portions, contain microfossils of early life forms. These Gunflint microfossils have been described by many workers and the reader is referred to some of the references cited at the beginning of this section.

On a regional scale, the various members of the Gunflint Formation show rapid changes in lithology along strike as well as with depth. This lack of continuity, coupled with relative lack of exposure, make stratigraphic correlations and descriptions difficult. Shegelski (1982) has defined the various members of the Gunflint Formation on the basis of their facies association.

He summarizes as follows:

> "Grainstone-micrite members formed in areas of the shallow carbonate shelf and were possible barrier islands that were the sites of actively precipitating chert and/or carbonate and therefore escaped siliciclastic dilution. They probably represent barrier island complexes which migrated parallel to the shoreline. Shale members formed in lagoonal areas and mudflats along the shelf within shallow depressions. They received sufficient siliciclastic muds from river mouths and from longshore drift to gradually accumulate thick sequences of shallow water calcareous mudrock. Grainstone-shale members represent areas in which chemical precipitation and siliciclastic deposition occurred simultaneously and in which these two types of sediments were subsequently reworked and redistributed by tidal currents. The only other influences affecting sedimentation were a brief period of weathering on the Archean peneplain which produced the basal Kakabeka conglomerate and minor explosive intermediate volcanism which deposited lapilli-tuff in the lower Gunflint Formation."

Rove Formation crops out in only two localities: the first and largest exposure is Caribou Island; the second exposure is situated on the north side of Highway 11/17 about 150 m east of the Terry Fox Lookout. The Rove Formation in the Lake Superior area has been described by Morey (1969), Geul (1970, 1973) and Franklin (1970).

The Rove Formation shales are so similar to the Gunflint Formation shales that it is virtually impossible to tell them apart in the field. Identification is tenuous and is usually accomplished by considering the outcrop in relation to others in the immediate area while taking its inferred stratigraphic position into account.

In the map area, the Rove Formation consists mainly of dark coloured fissile shales. Calcareous concretions characterize the Rove Formation. Some of them are up to 2.4 m across. These concretions are best exposed near Pass Lake (east of map area) and and in the Slate River gorge (west of Thunder Bay). Morehouse (1960) describes the concretions as occurring at specific horizons within the shales; they partly replace and preserve the bedding of the shales and in some cases displace and distort the bedding. The concretions are generally calcium carbonate in composition of fine grain and usually tan to brown in colour, although darker colouration is also possible. Centers of the concretions usually consist of pyrite or marcasite and occasionally small nuclei of organic material. The levels of concretions may be related to water table levels at the time the concretions were formed.

The Rove Formation appears to be conformable with the Gunflint Formation.

SIBLEY GROUP

Rocks of the Sibley Group were not encountered in MacGregor Township although it is probable that they once covered a portion of the map area but now have been eroded away. Sibley Group rocks do occur very close to the eastern and northern boundaries of the present map area.

Sibley Group (Pass Lake Formation) forms the high cliffs along the south shore of Thunder Bay and underlies large segments of McTavish Township (McIlwaine 1971, 1972) immediately to the east of the map area.

The Sibley Group has been described by Tanton (1931), Franklin et al. (1980) and Franklin and McIlwaine (1982). The reader is referred to Franklin et al. (1980) for a detailed description of the Sibley Group.

Evidence that Sibley Group rocks once covered portions of MacGregor Township is manifested by large volumes of Sibley Group rocks in the tills and gravels in the area, by large boulders of Pass Lake Formation, some of which are several meters across, that exist in the map area and by inclusions of Sibley Group rocks in some of the unconformity-related lead-zinc amethyst vein systems that occur in the area.

Keweenawan

OSLER GROUP

Osler Group volcanic rocks in the Thunder Bay area are exposed on Black Bay Peninsula and on the St. Ignace Island Archipelago as well as along the western shore of Lake Superior in Minnesota. These have been described by McIlwaine and Wallace (1976), Wallace (1972, 1981) and Giguere (1975). Similar rocks have been described by Annells (1973, 1974) and Giblin (1974) in the eastern Lake Superior region north of Sault Ste. Marie. In Minnesota, rocks of equivalent age and type have been described by Green (1972).

In MacGregor Township only one exposure of Keweenawan volcanic rocks was found. This outcrop is located south of the Mount Baldy CKPR-TV tower.

The outcrop is rubbly, dark green, highly vesicular mafic lava. Pipe amygdules as well as normal spherical amygdules are present. The rock is fine grained and weathers relatively easily. The volcanic rock appears to sit unconformably on Archean metavolcanic rocks.

LATE MAFIC INTRUSIVES

Rocks in this category consist of Keweenawan diabase that has intruded all rock types. The diabase has intruded as dikes at the Archean-Proterozoic Unconformity and as sills and dikes within other lithologies. Diabase is best exposed west and south of the intersection of Highways 11/17 and 527 as well as along the northern shoreline of Thunder Bay. Caribou Island is capped by a diabase sill that dips southward. The islands along the north shore of Thunder Bay, as well as the shape of the various headlands, owe their existence to diabase dikes.

The diabase is medium grey in colour, usually of fine grain size, and exhibits an orange-brown weathered surface. In sills, well-developed columnar jointing is common. Granophyric phases exist in a series of small quarries north of the Terry Fox Lookout. Peculiar inclusions of banded agate-like chert and partially assimilated shales can be found in the diabase. These xenoliths are of Gunflint and Rove Formation rocks that have been incorporated in the diabase during its emplacement.

Quaternary

The following section on glacial geology has been prepared by F.J. Kristjansson. Work by Mollard (1979) and Burwasser (1981) was the main source of this data.

Up to seventy percent of the map area is bedrock dominated terrain characterized by exposed bedrock or discontinuous thin drift cover. Striated and groved bedrock surfaces and stoss and lee features associated with bedrock obstacles indicate that the area has undergone at least three periods of glacier advance. The earliest features are interpreted to have been formed by Patrician ice which advanced south and southwest across the study area. A later more prominent set of directional indicators that are attributed to the Dog Lake lobe of the Hudson Bay ice mass are situated in the northern sector of the map area and suggest glacier advance to the southwest.

The latest set of ice direction features are found in the southern sector of the map area and represent a west to northwest advance of the Superior lobe.

Sometime prior to 12400 years BP, Patrician ice advanced south to southwesterly across the map area. This ice sheet deposited a highly compacted fine sand till with a high clast content. Patrician till occurs throughout the study area as a thin discontinuous sheet immediately overlying bedrock. This ice mass retreated and or melted from about 12400 to 10200 year BP.

The regional pattern of glacier retreat was characterized by periods of still stand and glacier readvance. The Dog Lake lobe of the Hudson Bay ice mass advanced southwest across the north part of the study area about 12000 year. BP. A discontinuous stony, sandy, loam till is representative of this event. The Superior lobe advanced west to northwest across the southern part of the map area about 11800 year BP. A compact fissile, gritty silt till was deposited as a discontinuous thin sheet throughout the southern part of the study area during this time.

It is probable that the Dog Lake lobe and the Superior lobe occurred in juxtaposition for at least part of their history. The Mackenzie Moraine which trends WSW-ENE across the central portion of the map area, possibly marks a suture zone representing the juncture of these lobes of glacier ice. An abundance of glaciofluvial ice contact landforms and sediments are characteristic of this moraine. The area of the Mackenzie Moraine represents an important source for sand and gravel. The possibilities of marked discontinuities within and between deposits, as well as the presence of deleterious lithologies, such as friable mudstones and cherts, presents problems with suitability of the gravel.

The dissolution of the Dog Lake and Superior lobes marked the final retreat of glacier ice from the study area and the initiation of glaciolacustrine deposition within the Superior Basin. The presence of glaciofluvial ice contact and outwash sand and gravel deposits in both the northern and southern parts of the study area and of glaciolacustrine sand in the southern part of the study area is representative.

Figure 4 depicts various units of aggregate potential in MacGregor Township. The following is an assessment of each unit.

RESOURCES UNITS 1, 2, 3 AND 5

Glaciofluvial outwash sands have been designated the dominant aggregate resource of these particular units (Burwasser and Ferguson 1980, Preliminary Map P.2203). The coarse aggregate probability is considered low. The depth and spatial extent of these deposits would appear adequate. The development potential is considered high.

RESOURCES UNITS 4 AND 6

Ice contact stratified sand and gravel are present as the dominant aggregate resource (Burwasser and Ferguson 1980, Map P.2203). The probability of extracting coarse aggregate is interpreted as being moderate. The depth and spatial extent of these granular deposits appear to be considerable. The potential for aggregate extraction is considered high.

RESOURCE UNIT 7

A glaciofluvial outwash plain constitutes the dominant landform of this terrain unit (Mollard 1979, Map 5045). Although gravel is apparently of primary significance, (Burwasser and Ferguson 1980, Map P.2203), sand probably comprises an important secondary component. The coarse aggregate probability is considered moderate to high. The depth and lateral extent of aggregate deposits very likely is substantial. The potential for development is considered high.

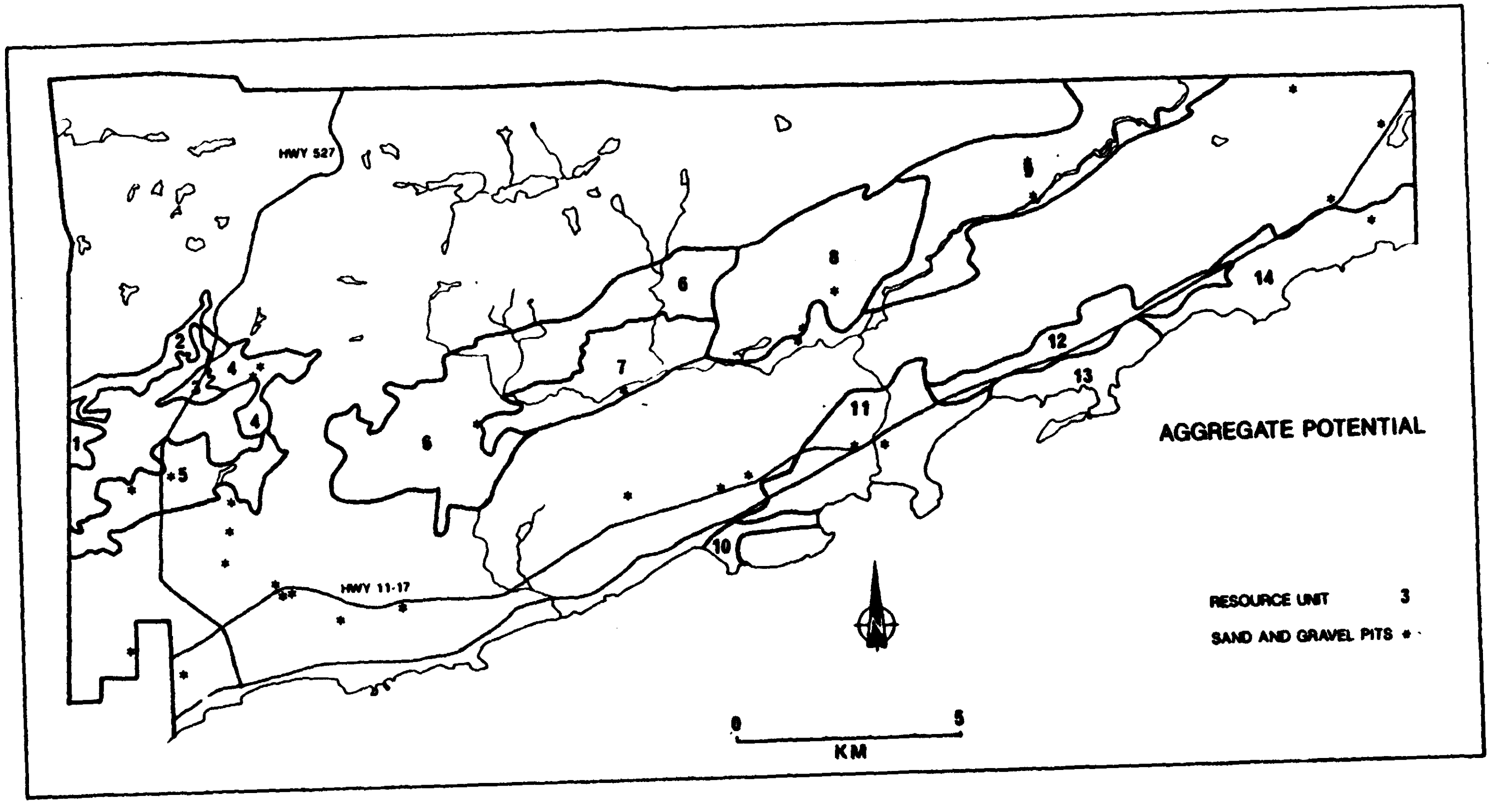


Figure 4: Aggregate Potential of MacGregor Township

RESOURCE UNIT 8

Eskers and outwash plain(s) are present as subordinate landforms (Mollard 1979, Map 5046). Sand and gravel are designated as being of primary and secondary importance respectively. The coarse aggregate probability is considered low to moderate. Aggregate deposits would appear to be of local significance only. Depth and spatial extent may in fact constitute development constraints. The problem of spatial extent may in fact constitute development constraints. The problem of spatial constraint is compounded further when one considers that granular materials comprising ice contact stratified deposits (i.e. eskers) very likely will exhibit abrupt changes in, and a wide range of, grain size. The development potential of this resource unit is considered moderate.

RESOURCE UNIT 9

A glaciofluvial outwash plain(s) is present as the dominant landform (Mollard 1979, Map 5046). The dominant sediment type comprising the deposit would appear to be sand. However, gravel is noted as being of secondary importance. The coarse aggregate probability is considered low to moderate. Bedrock knobs are present as a subordinate landform and probably exert a significant influence upon the general topographic expression of the terrain unit. Surficial deposits could occur as veneers overlying bedrock. Consequently, depth might constitute a development constraint. The development potential of these aggregate resources is considered moderate.

RESOURCE UNITS 10, 13 AND 15

Raised beach materials (Resource Units 10 and 13) and glaciofluvial outwash (Resource Unit 15) comprise the aggregate resource (Mollard 1979, Map 5046). Sand predominantly is the primary sediment type. The coarse aggregate probability is interpreted as being low. Organic terrain (i.e. peat and muck), in each case, occurs as a veneer overlying the aggregate resource. Peat accumulates under saturated substrate conditions. Consequently, a high water table could prove a serious development constraint. The development potential of these resource units is considered low.

RESOURCE UNIT 11

A glaciolacustrine delta constitutes the dominant landform of this terrain unit (Mollard 1979, Map 5046). Both sand and gravel comprise important components of this granular deposit although it should be noted that sand is dominant. The coarse aggregate probability is interpreted as low to moderate. Aggregate deposits very likely will exhibit both depth and lateral extent. Development potential is considered moderate to high.

RESOURCE UNIT 12

Raised beaches are present as subordinate landforms (Mollard 1979, Map 5046). Sand overwhelmingly is the predominant sediment type. The coarse aggregate probability must be described as low. These beach materials occur as a veneer overlying a bedrock plain and development constraints may relate to deposit depth. The development potential is considered low.

RESOURCE UNIT 14

Raised beach materials constitute the dominant resource of this terrain unit (Mollard 1979, Map 5046). Sand and gravel comprise dominant and subordinate sediment types respectively. The coarse aggregate probability on this basis is considered low to moderate. Raised beach materials occur primarily as veneers overlying bedrock. Therefore, deposit depth may constitute a development constraint. The development potential is considered to be moderate.

RESOURCE UNIT 16

Glaciofluvial outwash materials are present as the dominant aggregate resource (Mollard 1979, Map 5046). The deposit is composed predominantly of sand although a gravel component is important. The coarse aggregate probability then may be described as low to moderate. Aggregate resources would appear to exhibit both depth and lateral extent. The development potential is considered high.

RESOURCE UNIT 17

An outwash plain(s) occurs as a subordinate landform in this particular terrain unit (Mollard 1979, Map 5046). Deposits are composed primarily of sand with gravel present as a secondary component. The probability of extracting coarse aggregate then is interpreted as being low to moderate. Aggregate deposits may only be of local significance with depth and lateral extent possibly constituting development constraints. The potential for development is considered moderate.

Geochemistry

During the 1984 and 1985 field season, approximately fifty samples were selected for major element analysis. These samples were chosen to represent the numerous igneous rock suites that were mapped in MacGregor Township. The analyses have been grouped into two major divisions, namely metavolcanic rocks and the plutonic rocks. All analyses were done by the Ontario Geological Survey Geoscience Laboratory, Toronto.

The analyses were plotted on several types of plot configurations that included the AFM plot, the Jensen or cation plot, Na_2O+K_2O versus SiO_2 plot. From the AFM plot, it is apparent that the metavolcanic rocks in the MacGregor Township fall into two major trends - a calc-alkaline trend and a tholeiitic trend. Some analyses indicate that a few of the rocks have alkaline affinities (Table 3). These major trends can also be seen on the Jensen plot; the komatiitic rocks are more clearly delineated. A bimodality of rocks is apparent from the Na_2O+K_2O versus SiO_2 and the AFM plots. The rocks appear to plot in two distinct groups: where SiO_2 ranges between 48-56%, Na_2O+K_2O varies between 2.2-4.8%; the second group has a SiO_2 range between 67-78% and a Na_2O+K_2O range between 5.6-7.20%. A general lack of rocks of dacitic composition contributes to this apparent bimodality. This feature might suggest two different volcanic sequences. An Ab-An-Or plot suggests that this bimodality is a result of the differences in the rocks based on soda versus potash. This may be a reflect of two rock suites or a regional alteration feature.

A QAP plot after Streckeisen (1976) indicates that the granitic rocks fall into the following groups: one analysis was in the quartz-rich granitoid field, six analyses plotted in the granite field and one each in the quartz-alkali feldspar syenite, quartz syenite, quartz monzonite and granodiorite fields. Analyses that do not show up on the QAP diagram are those from alkaline intrusives with felspathoid minerals. One such intrusion is situated on Walkinshaw Creek near the north limit of the map area and may represent an undersaturated complex.

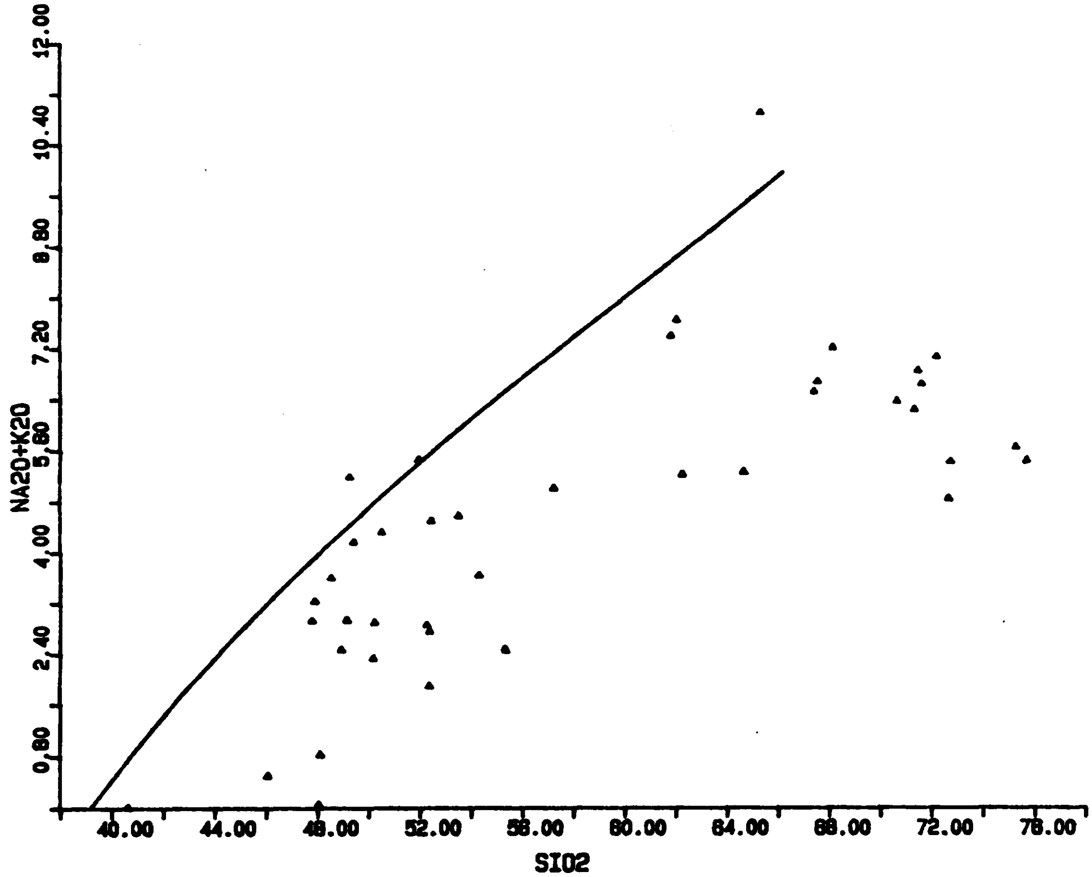


Figure 5a: Na_2O+K_2O vs. SiO_2 Plot
Metavolcanic Rocks, MacGregor Township

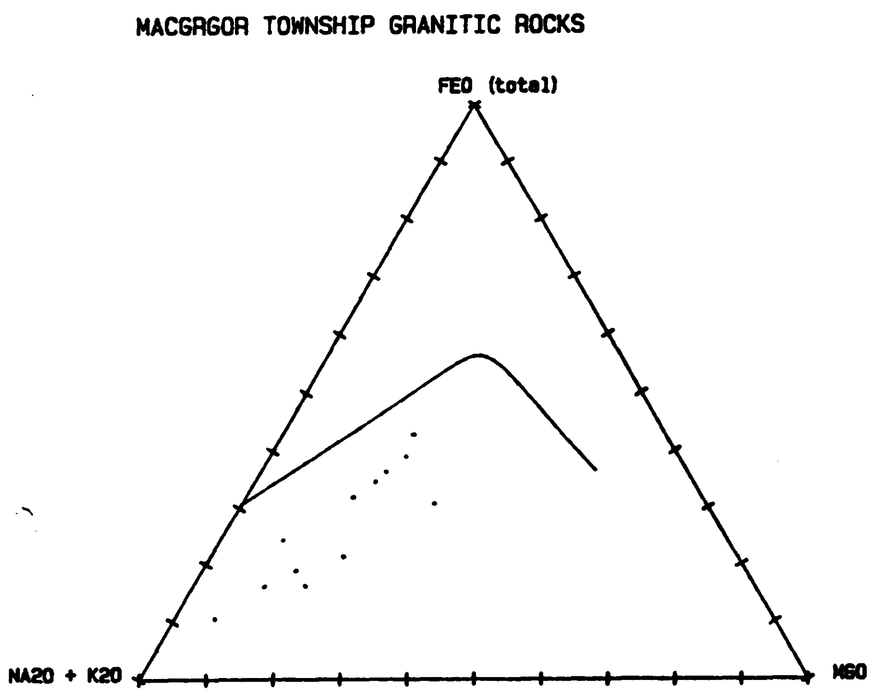


Figure 5b: AFM Plot, Granitic Rocks, MacGregor Township

MACGREGOR TOWNSHIP METAVOLCANIC ROCKS

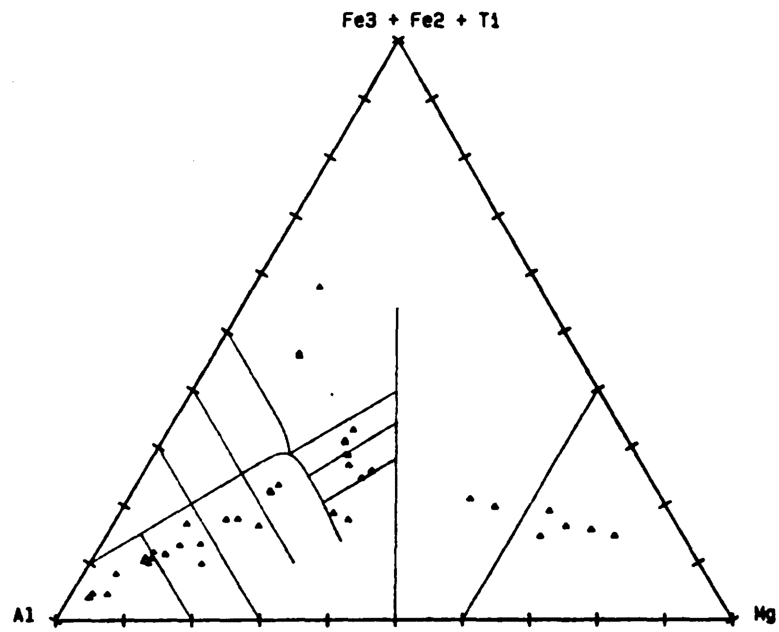


Figure 6a: Jensen Plot, Metavolcanic Rocks, MacGregor Township

MACGRGOR TOWNSHIP METAVOLCANIC ROCKS

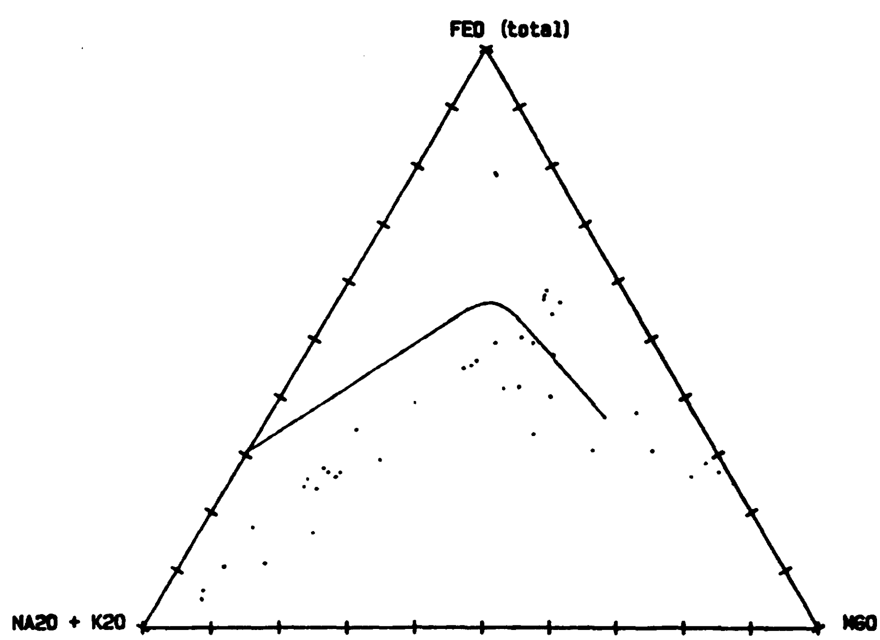


Figure 6b: AFM Plot, Granitic Rocks, MacGregor Township

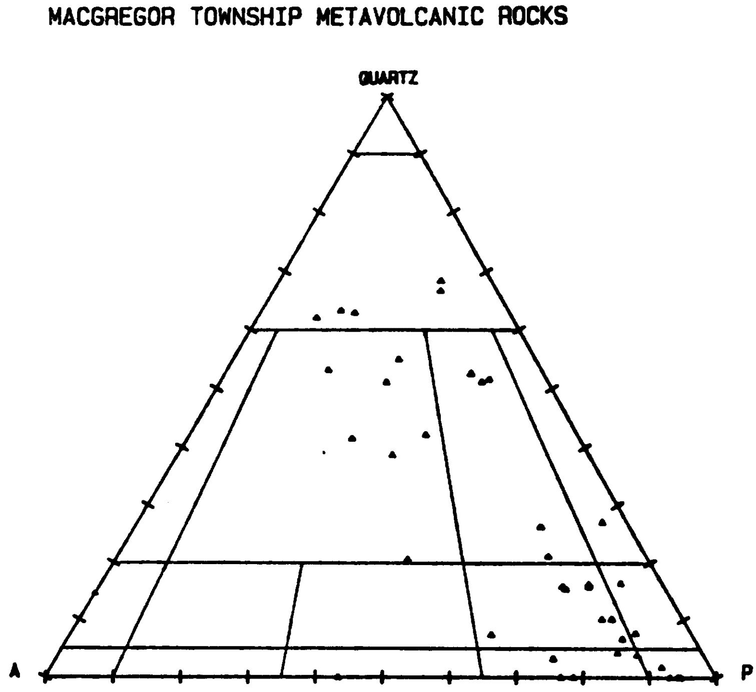


Figure 7a: Q.A.P. Plot, Metavolcanic Rocks, MacGregor Township

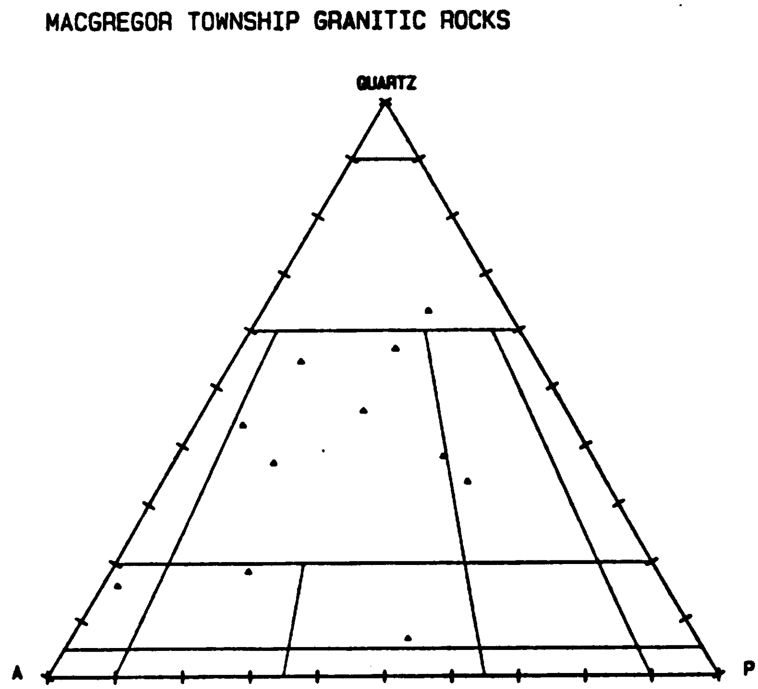


Figure 7b: Q.A.P. Plot, Granitic Rocks, MacGregor Township

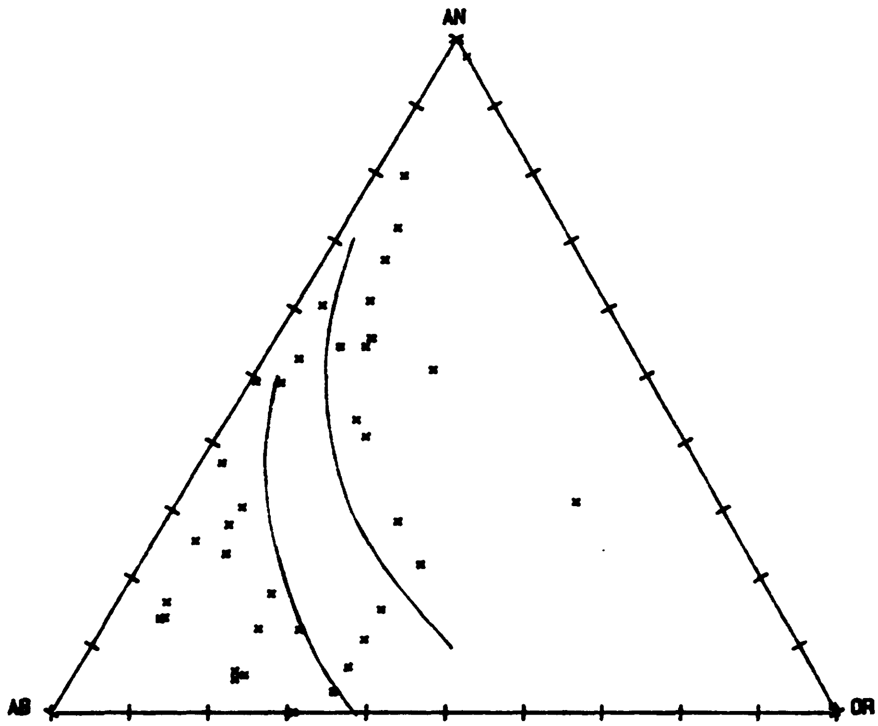
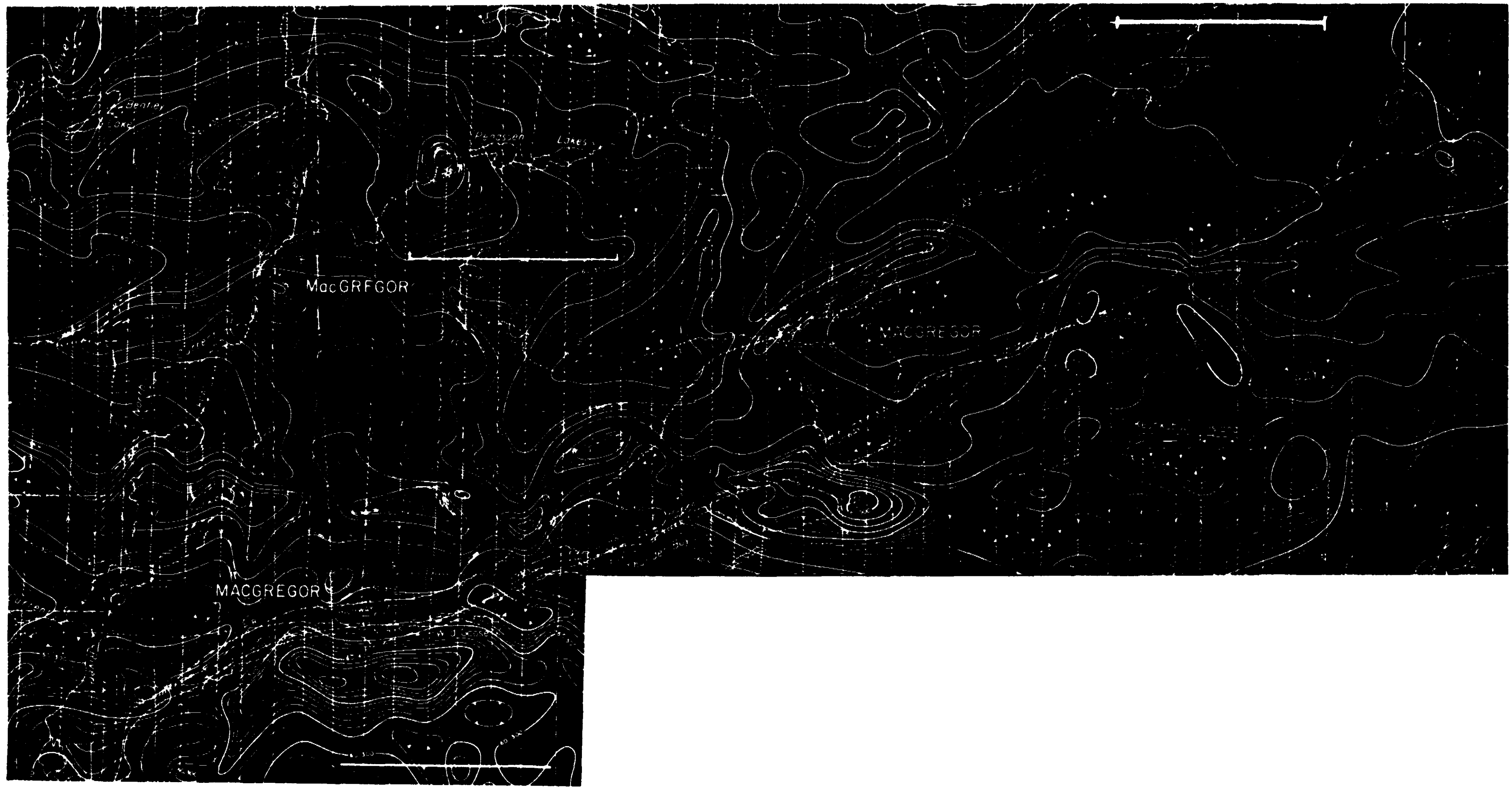


Figure 8: Albite-Anorthite-Orthoclase Plot, Metavolcanic Rocks, MacGregor Township



MAP 6: AEROMAGNETIC MAP OF MACGREGOR TOWNSHIP

Upon analysis, some rocks exhibit intense depletion of alkalies coupled with an enrichment of iron. Archean rocks with this alteration pattern were collected close to the Proterozoic/Archean unconformity. No specific sampling pattern to positively identify this trend was attempted, but this trend should be investigated further as part of a general study of the unconformity.

Correlation of Geology and Aeromagnetic

Government aeromagnetic maps 2107G (Onion Lake Sheet), 2116G (Loon Lake Sheet) and 2106G (Twin Cities Sheet) cover the MacGregor Township map area. These are reproduced as Map 6.

There appears to be good correlation between the metavolcanic rocks (including the associated metasedimentary rocks) and a linear area of magnetic highs. This anomaly strikes into MacGregor Township from the west in the vicinity of the junction between Gorham Township, City of Thunder Bay and MacGregor Township. A flexure in the trend of the anomaly occurs about a mile north of Wildgoose Point. This area also exhibits an increase in magnetic intensity and is underlain by ultramafic flow rocks. Some of these may be, in part, intrusive.

From that locality, the magnetic trend swings north-northeasterly and then easterly to Mary Harbour-Silver Harbour area where it trends into Lake Superior.

North of Silver Harbour in the vicinity of Mackenzie and the area north near Walkinshaw Creek, the hornblende syenites appear to have a moderate magnetic signature.

The large expanse of metasedimentary rocks located in the eastern section of the map area is reflected by an area of reasonably flat magnetic response. The various small gabbroic intrusions have no positive magnetic signature at this scale although several appear to have a magnetic low association.

The west core portion of the Penassen Lakes Stock near the westernmost Penassen Lakes and the area near kilometer 13 on Highway 527 is defined by two bull's-eye type magnetic anomalies. The former location probably represents the porphyritic core phase of the Penassen Lakes Stock while the latter anomaly coincides with a syenitic phase. Hand samples from the core phase contain up to 5% magnetite.

ECONOMIC GEOLOGY

General Descriptions and Locations

MacGregor Township and adjacent areas have had a colourful exploration history dating back to the first settlements in the area around the 1800's. The bulk of the intensive mineral exploration activity occurred during the silver boom of the middle to late 1800's and early 1900's. During this period, more than 16 silver occurrences were developed; some of them became important mines from a historical perspective. Some of the mines of the day, such as the Shuniah Mine (just outside of the map area) and the 3A Mine had extensive underground development. Iron associated with the Gunflint Formation was evaluated in the early 1900's with the last active period being 1950's.

Silver production figures are not reliable as not all the silver produced was recorded.

MacGregor Township is well known for silver occurrences. These almost always occur as vein systems associated with the Proterozoic/Archean unconformity (Tanton 1932; Franklin 1970; Franklin and Mitchell 1977). These veins occupy fault or shear zones and contain sphalerite, galena, chalcopyrite, native silver, argentite, fluorite, calcite, amethyst, pale quartz and barite. The vein systems appear to crosscut all lithologies and are best exposed along Highway 11-17 east of Thunder Bay. Veins mapped in 1984 and 1985 field seasons vary in width from just a few centimeters wide to zones of several meters in width. Dominant strike direction of the vein sets is northeasterly or subparallel to the northern edge of Lake Superior Basin. Northerly and southeasterly sets also occur.

The amethyst veins are of the same relative age as the silver veins and occur throughout the map area. In most cases, they crosscut the Mackenzie Granite and the Penassen Lakes Stock. A significant amount of amethyst veining crosscuts felsic volcanic rocks as exposed on the hydro right-of-way approximately 2.4 km west of Mary Harbour.

Several old silver mines exist in the township. These are: Cornish Mine, 3A Mine, Beck Mine, Thunder Bay Silver Mine, Algoma Mine and the 7Z location. These will be described in the following pages.

During the course of mapping, many quartz veins were sampled by the author and assayed for gold and silver by the Geoscience Laboratory, Ontario Geological Survey. While not all samples yielded gold or silver values, there is enough potential in some areas to warrant exploration for these metals. For example, the area around an old quarry near the Nelson Road and Highway 11-17 junction warrants exploration. Sulphide-bearing veins, occupying shear zones and fractures in a dark siliceous metasedimentary rock, carry arsenopyrite, pyrite, zinc and gold. Grab samples of these veins assayed up to 1.06 ounces gold per ton and up to 4 ounces gold per ton have been reported by exploration companies.

A zone of quartz stockwork and silicification of country rock is located just north of the hydro line north of Birch Beach. No known exploration work has been done and no old trenches were seen while mapping. Some of the larger quartz veins are up to 30 cm wide and exhibit rusty gossan in places. One grab sample from the area yielded a trace of gold and 0.76 ounces silver per ton.

Further east, about 2.4 km north-northwest of Mary Harbour and west and north of the Canadian Pacific Railroad tracks on a southfacing slope, a quartz stockwork at the contact between volcanics and granites carries some gold. A grab sample collected during mapping and assayed by the Geoscience Laboratory, Ontario Geological Survey yielded 0.02 ounces gold per ton. Individual quartz veins are narrow, but the whole stockwork is at least 2 m wide. The owner of the surface rights, Mr. A. Kurikka of Thunder Bay, states that there are several old pits and one shaft located between this hill and the CPR tracks. These were not seen during mapping. A 3 m wide quartz vein with a crack and seal texture is situated on the north slope of this hill near a beaver pond. Grab samples from this vein yielded only a trace of gold. A similar quartz vein system situated approximately 0.8 km southwest of the 3 meter wide quartz vein also yielded trace amounts of gold. An old pit is situated at this locale. Further work is warranted to fully evaluate the quartz vein system at these localities.

Closer to the City of Thunder Bay on the hydro line just north of Highway 11-17 about 2.5 km east of the junction of Highway 11-17 and Highway 527, two separate outcrops of quartz stockwork in felsic volcanic rocks deserve to be prospected. The zones are approximately 0.4 km apart. Analysis of a rock sample taken from the hydro line, at a point 0.4 km north-northwest of where the hydro line crosses Highway 11-17, yielded 185 ppb gold upon assay by the Geoscience Laboratory, Ontario Geological Survey, Toronto. Another zone of silification is situated on the northwest shore of a small pond about 0.8 km south of the CKPR-TV Tower on Mount Baldy.

The following section divides the mineral prospects into type and presents a description of each. The main types are: 1) silver veins (includes amethyst, lead and zinc) 2) gold occurrences 3) iron occurrences. Rocks of the Penassen Lakes Stock or the Mackenzie Granite have good potential for building stone and should be explored. Several old quarries exist in the township.

Silver-Type and Lead-Zinc-Amethyst-Type Mineralization

Veins in this category are all very late and are associated with faults or fracture systems related to the Proterozoic-Archean unconformity. Tanton (1931), Franklin (1970), Franklin and Mitchell (1977) are the most recent references that describe these veins; Ingall (1887), Blue (1896), Bowen (1911), Miller (1913) and Parsons (1922) are some of the earlier workers.

A general metallogenic pattern is evident for similar occurring vein systems. To the southwest of the City of Thunder Bay in the Silver Mountain-Whitefish Lake area, veins are predominantly silver-bearing with galena, sphalerite, amethyst, calcite, fluorite and barite present in subordinate amounts. Here the geology consists of flat-lying shales and wackes of the Rove Formation that have been intruded by diabase dikes and sills and gabbro dikes and layered gabbroic bodies. As one proceeds northeasterly, the silver content of the veins diminishes as one proceeds down stratigraphy from the Rove Formation to Gunflint Formation rocks. At the same time there is a noticeable increase in the amounts of galena and sphalerite as the Sibley Group-Archean unconformity is reached. Thus it is apparent that the metal content of these veins is dependent on host rock and source areas: veins in areas underlain by Rove Formation, and to a lesser degree Gunflint Formation, are silver-rich; similar vein systems located in the Sibley Group are predominantly rich in lead and zinc with negligible silver content although in some cases are enriched in uranium (Enterprise, Dorion Amethyst).

In MacGregor Township, the Silver Harbour area appears to be in the main loci for the development of silver-type veins. The main occurrences are the 3A Mine, the Beck or Silver Harbour Mine and the Algoma Mine.

3A MINE

The 3A Mine vein system is in Lot 3A, MacGregor Township and extends easterly to Mackenzie Bay, Lake Superior. Access is by a dirt road that intersects Lakeshore Drive opposite the road into the Silver Harbour Conservation area. The 3A Mine vein system crosses this dirt road 0.5 km north of Lakeshore Drive.

Development:

The 3A vein system was discovered in 1870 by Ambrose Cyrette of Fort William. In the winter of 1871-72, a test pit was sunk 5.5 m and 22 barrels of ore were recovered. Between 1872 to 1874, the 3A Company was incorporated and the first stage of development consisted of two shafts being sunk: the No. 1 Shaft or West Shaft was sunk to 23.5 m and the No. 2 Shaft or Main

Shaft was sunk to 30 m. These were later deepened with the Main Shaft sunk to 45.7 m with levels at 8 and 12 metres. Development work ceased during the summer of 1874. Intermittent exploration continued through to 1922 with more drifting and crosscutting (1911) and a new exploration shaft to 13.5 m (1922).

General Geology:

The geology around the 3A vein system has been described by Tanton (1931), Ingall (1887), Morehouse (1960) among others. A collection of historical accounts and newspaper clippings are on file in the Thunder Bay Resident Geologist's Office.

At Lot 3A, Archean rocks consist of massive to pillowed mafic metavolcanic rocks, mafic to ultramafic sills or dikes and granitic dikes associated with the Mackenzie Granite. The Proterozoic Gunflint Formation unconformably overlies the Archean basement complex closer to the lakeshore. These consist of cherty iron formation (taconite), chert carbonate and shale. This younger, flat-lying assemblage has been intruded by a Keweenawan diabase sill.

The composite vein system is focussed in a shear and shatter zone that is about 0.6 m wide, strikes 60° and dips almost vertically. The fault zone subparallels the contact between the Mackenzie Granite and the metavolcanic rocks. The vein attitude is variable; strikes average 83° with a 60-70° northerly dip. The system has been traced through Lots 1A, 2A and 4A (Moorhouse 1960) for a distance of approximately 2.2 km.

Mineralogy:

The vein materials in order of relative abundance are white crystalline quartz, white calcite, amethyst and barite. Barite is mineralized with sphalerite, galena, pyrite, marcasite, chalcopyrite, silver and argentite (Tanton 1931). McKellar (1874) reports 1.4% cobalt and 25% nickel was obtained from a grab sample that was shipped to the Wyandotte Silver Smelting and Refining Company. The sample also assayed 2465.7 ounces per ton silver worth $3,205.41 per ton. In a report from the United States Assay Office in New York, J.M. Floyd, Chief Clerk reports that the ratio of gold to silver based on dollar value of samples assayed was $17.80 gold: $301.45 silver or approximately 1:17 (McKellar 1874). Estimated total silver production was $9,500.00 or about 7307 ounces of silver (at $1.30 per ounce based on the above figures) (McKellar 1874). Recalculated to 1989 dollars, based on 3.40 per ounce, the value of silver would be $25,574.50.

Present Status:

At present, the area of the 3A Mine has been subdivided for building lots. All shafts have been capped with reinforced concrete. The disposition of the subdivision has been delayed pending safety considerations with regard to the old mine workings. The death of one of the partners in the subdivision venture has also delayed the disposition of the lots.

SILVER HARBOUR MINE (BECK MINE)

The Silver Harbour Mine or the Beck Mine is situated in MacGregor Township on Lot 12Z. Access is by the Silver Harbour Road located approximately 12 km east of the junction between Lakeshore Drive and Highway 527. A trail located at approximately 1 km on the Silver Harbour (near the fork on the road) leads to the old mine site.

Historical Development:

Mr. Ambrose Cyrette of Fort William discovered the Silver Harbour vein in the summer of 1870. During the winter of 1870-71, approximately 15 men worked on the vein engaged in surface work. A 12-meter shaft was sunk at at this time. In the fall of 1872, all work was suspended and the property has remained idle since then.

Production:

While some silver was recovered from the vein, no reliable production figures are available. Several tons of ore were shipped, but the silver recovery was only $17 per ton. It is estimated that the 3A Mine together with the Beck Mine produced $10,000 worth of silver. McKellar (1874) estimates that the 3A Mine produced $9,500; therefore, the Beck Mine must have produced around $500 worth of silver.

Geology:

Tanton (1931) describes the geology of the Silver Harbour Mines as follows:

> "The vein on which this mine was started lies near the east boundary of lot 12Z, Macgregor township, about one-quarter mile north of the shore of lake Superior (See Map 214A). It was discovered in the summer of 1870. A 40-foot shaft was sunk and surface explorations were carried on until work ceased in the autumn of 1872.
>
> The country rock is Animikie iron formation. A diabase sill overlies these sediments in a cliff a short distance south of the shaft. The vein was said to have been well mineralized with silver in the upper part of the shaft, but toward the bottom was lean. It is reported[1] that 125 barrels of ore were shipped and that this material assayed $17 to the ton in silver.

Less than one-half mile southwest of the Beck mine, on the east headland of Silver harbour, a network of quartz veinlets in a zone 1 foot wide strikes north 55 degrees east along the faulted contact between Keewatin schist and flat-lying Animikie sediments. On the point and under water immediately off shore there is a network of veins over a width of 30 feet striking north 70 degrees east."

ALGOMA MINE

The Algoma Mine is located in Lot 13Z of MacGregor Township. Tanton (1931) describes the vein as follows:

"The vein worked on Algoma mine about 1872 occurs one-quarter mile southeast of Silver Harbour station[2] on the Canadian National railways, in lot 13Z, Macgregor township. It lies at the base of a northfacing cliff 50 feet high, which is capped by a diabase sill. The sill is 25 feet thick and lies on horizontal chert and iron carbonate, a phase of Animikie iron formation. It is reported that a shaft was sunk through 30 feet of unconsolidated material and 20 feet farther into the vein in the consolidated rock, and that to the east a second shaft was sunk on the vein and from it a crosscut was driven southerly through shaly iron formation to a point where diabase was encountered, which was interpreted as a vertical dyke cutting across the sediments. No vein was found at the contact.

The vein material consists of quartz and calcite irregularly mineralized with galena and pyrite. It cements a brecciated shatter zone striking east-northeast. No mineral deposit of commercial importance is known to have been found in this vein. The width of the vein has not been recorded."

Other Occurrences in the Silver Harbour Area:

2A OCCURRENCE

The 2A Occurrence is situated in the central portion of Lot 2A, MacGregor Township and is located on an east-west 8-m wide shatter zone that also hosts the 3A Mine. Morehouse (1960) depicts this fault zone quite clearly although the 3A Mine is not shown. A small trench is indicated in the vicinity of the 3A Mine. The 2A Occurrence was not found during the course of mapping but is assumed to be located by Morehouse (1960) on Map 1960 p.

1A OCCURRENCE

Tanton (1931) describes the 1A Occurrence as follows:

"In lot 1A, Macgregor township (See Map 214A), a composite vein was worked prior to 1887. The vein crosses the Canadian National railways 9 chains westerly from mile-post 134, and water-filled shafts and caved pits may be seen along its course for a distance of 2,000 feet in a direction north 80 degrees west. The vein continues easterly from the railway to the shore of lake Superior in the south part of lot 12. It occupies a fault. Along the western part of its course granite occurs on the north and Animikie iron formation and shale on the south side. Along the north side of the eastern part, inclusions of Keewatin lavas and ancient sediments lie in granitic intrusives with, on the gently undulating surface of these pre-Animikie rocks, scales up to 4 feet in thickness of Animikie basal conglomerate and the immediately overlying iron formation.

The composite vein consists of a shatter zone 25 feet wide through which there is a network, up to 4 feet in width, of veins, composed of quartz, amethyst, and calcite locally well mineralized with zinc blende, galena, pyrite, and a little chalcopyrite. It is reported by Mr. Ingall[1] that in the vicinity of the Three A mine a 2-foot vein of milky quartz was discovered carrying native bismuth and yielding on assay a little silver. It is possible that this interesting occurrence was found somewhere along the vein system on lot 1A."

THUNDER BAY SILVER MINE

Past History:

The Thunder Bay Silver Mine was discovered by Peter McKellar on September 20, 1866. The vein is located near the boundary of the City of Thunder Bay with MacGregor Township just a few hundred feet east of the Terry Fox Lookout on the north side of Highway 11/17. The workings strike N.E. across the boundary between Lot 1 and Lot 3. Most of the old mine is situated in Lot 1, MacGregor Township.

McKellar (1874) gives the following description of the find and its subsequent development:

"The next discovery of importance was the Thunder Bay Silver Mine, by myself, on the 20th of September, 1866, about five miles from Prince Arthur's Landing.

At the point of exposure the vein was about 20 feet wide, of quartz, enclosing large masses or belts of the country rock, which were also cut by numerous stringers of veinstone. It was a wonderful show of silver, consisting of native and glance, with some galena, zinc blende, and iron pyrites. The ore occurs in bunches--three to eighteen inches thick by six to forty feet in length--the silver being in strings, leaves, grains, &c., irregularly distributed through the veinstone which constituted the greater part of the bunch. At the first opening there were two of the streaks, one next the north or hanging wall, and one in the middle. It is not well defined, being generally in ribs, with considerable slate between.

The richness of this lode created a good deal of excitement; capitalists and explorers came the following spring in large numbers, and lands were taken up in every direction, but they were soon driven away by that unlucky Mining Bill of Mr. Richards.

In the fall of 1867 Mr. McIntyre of Fort William, and myself, brought two half barrels of the ore to Montreal. A company was formed--Mr. Hopkins, Governor of the Hudson Bay Company, being appointed President. It was divided into 80,000 shares, the par value of each being $5. Twenty thousand shares were sold for working capital, 60,000 being unassessable. A manager for the mine--Mr. McDonald--was sent for to Europe, and a director appointed in London, England. Even the stamp mill machinery was brought from England, when a great deal better could have been procured on this side.

The mill was erected at the mouth of the Current River, three miles from the mine, on a magnificent water-power. A good wagon road was cut to the mine, and a dock 200 feet long was built into the lake, of cribwork filled with stone. Miners were set to work, two shafts sunk to the depth of 68 feet, 300 feet apart, and the connecting level was partly run. Another shaft was sunk to the depth of about 25 feet to the north-east of No. 2 shaft some 300 feet--in all of which they got silver. The surface between them was partly stoped when the manager was discharged, and another, Mr. McIntosh, put in his place.
He commenced by driving a drift at the ten fathom level north-westward from No. 1 shaft, to find the vein as he expected against the trap that is seen a little back on the hill, although this trap is in the form of a bed,

resting horizontally on the slates, at an elevation of about 80 feet above the drift. He also commenced sinking a shaft half way between No. 2 and No. 3 shafts, which he sunk some 35 feet, the rest of the men being employed stoping the ground between the two extreme shafts, a length of 600 feet, in which the silver was found in bunches, as above described.

The vein from the surface down, for 25 to 30 feet, passes through dolomite and chert principally, and was strong and carrying the silver. Below that, as far as they went, it passed through argillaceous strata, in which the vein was found in small stringers, with some galena, &c., but very little silver. The same conditions of things was met with at the Beck or Silver Harbor Mine, but the Thunder Bay Mine showed much more silver.

Had they spent the money in sinking instead of spending it on the surface, it is my firm belief that the mine would be working to this day; for the change in character of the vein in the argillaceous beds in nothing but what might be expected, as it is known the argillaceous strata, by pressure, are liable to expand laterally more than the more solid siliceous and dolomitic strata, which, of course, would result in partly or completely closing fissures within them. (See Sir Charles Lyell's "Geology," page 484, on this subject. He states it to be a common phenomenon in mineral veins).

There seems to me to be no doubt that the vein, if followed down into more solid strata, would resume its original size and character, with a good chance of being much richer as it approached or passed into the Huronian, which I do not think lie over a few hundred feet from surface.

Mr. McIntosh's theory proved a failure; the shaft turned out the same as the others, and the vein or trap was not reach by the drift; so the works were discontinued in the spring of 1869.

The value of the ore raised--which was according to Mr. Charles Robb's report, 3294 lbs.--was $2,592, or an average of $1,513 per ton.

There is no knowing how much ore had been carried away by the miners and others, but we have good reasons to believe that there had been a good deal. One party left the mine in the middle of the night, crossing Lake Superior in a small boat to Portage Lake, who were said by reliable persons to have brought six or seven kegs of washed silver, which could not have come from any other place at the time. And we know that the manager, by order of the Company, had a large quantity pulverized and washed some time previous.

The property contains over 1,700 acres; and the amount expended is about $60,000."

Production Figures:

The old production figures are unreliable. McKellar (1874) stated that 3294 pounds of ore was mined for an average value of $1,513 per ton. Sergiades (1968) stated that the total production was 16,000 ounces of silver for a value of $20,000.

Geology:

The Thunder Bay Silver Mine is situated near the contact between the Gunflint and Rove Formations. The best place to observe the relationship between the rock types is in a vertical exposure approximately 300 m east of the Terry Fox Lookout on Highway 11/17.

Here, the bottom third of the exposure is Gunflint Formation consisting of shaley rock and the Upper Limestone member. This member has been described by Shegelski (1982) as a fining upward sequence of beach rock; the shard-like fragments in carbonate mudrock matrix near the top of the member are curled mudchips which were lifted from the desiccated intertidal mudflat and redeposited along bedding planes.

Overlying the Upper Limestone member of the Gunflint Formation is the black fissile shale of the Rove Formation. Regionally, as one proceeds south to southwest, the Rove Formation undergoes an upward facies change to turbidites (Morey 1972). Generally, the Rove Formation shales are almost indistinguishable, at least on a macroscopic scale, from shale members of the Gunflint Formation.

The top two-thirds of the cliff consist of an intrusive Logan diabase sill. Columnar jointing within the diabase is typical for the area.

In the extreme eastern section of the exposure, a quartz-calcite-±galena-±sphalerite vein system occurs in a fault zone. Fragments in the breccia zone exhibit well-developed slickensides. This is part of the vein system of the Thunder Bay Silver Mine. Some of the old trenches and adits (now bulldozed closed) can still be examined approximately fifty to the northeast of the exposure. One of the main shafts was filled in during the construction of Highway 11/17 in 1968.

The vein systems have been described by many workers including McKellar (1874), Ingall (1888) and Tanton (1931). Most of the following description is from Tanton (1931):

> "The mine workings consist of four shafts sunk on a composite vein, a crosscut driven northwest at the 60-foot level, and some drifting between the two deepest shafts. No. 1 and No. 2 shafts are each 70 feet deep, No. 2 lying 300 feet northerly from No. 1; 150 feet north of No. 2 is the third shaft, 35 feet deep, and 150 feet north of it is the fourth, 25 feet deep. Ore was mined between the two extreme shafts, a

distance of 600 feet. A large calcite vein parallel to the composite silver-bearing vein and some 20 feet south of it, was mined by a crosscut from the foot of No. 2 shaft, during the second period of the mine's activity in 1874.

Besides the erection of necessary buildings, 3 miles of wagon road was constructed to the shore of Thunder Bay, where a stamp mill was erected, as well as a dock 200 feet long.

The country rock consists of cherty carbonate of the iron formation and black shales, striking north 34 degrees east and in the vicinity of the vein dipping as high as 22 degrees southeast, but within 100 feet northwest of the mine the sediments are nearly horizontal and are capped by a diabase sill 40 feet thick. There are two parallel veins, 20 feet apart, occupying faults, striking north 34 degrees east. The southeasterly vein is from 6 feet to 12 feet wide and consists chiefly of coarsely crystalline, white calcite. It dips steeply southeast. No silver ore was found in it. The other is a composite vein and consists of numerous veins and veinlets up to one inch in width, ramifying through shale and iron formation in a zone 10 feet wide. Its general dip is 65 degrees northwest. The vein consists of white quartz, accompanied by galena, zinc blende, and pyrite. A small amount of pink and white calcite occupies the central part of the larger veinlets. According to Mr. McKellar native silver and argentite occurred in pockets, 3 to 18 inches thick by 6 to 40 feet in length, the silver being in leaves and grains irregularly distributed among the other vein minerals. When first opened two ore-bodies were found, one next the north or hanging-wall and one in the middle."

Currently all the shafts and adits have been slumped in; the adit has been bulldozed shut. In the main series of pits and trenches, a composite vein system is exposed containing small amounts of galena, sphalerite, amethyst, calcite, fluorite and quartz. No samples were taken for assay.

SHUNIAH MINE (DUNCAN MINE)

While this old mine is not located within the current map area, several features associated with this property are significant from a regional perspective and therefore a brief description is warranted.

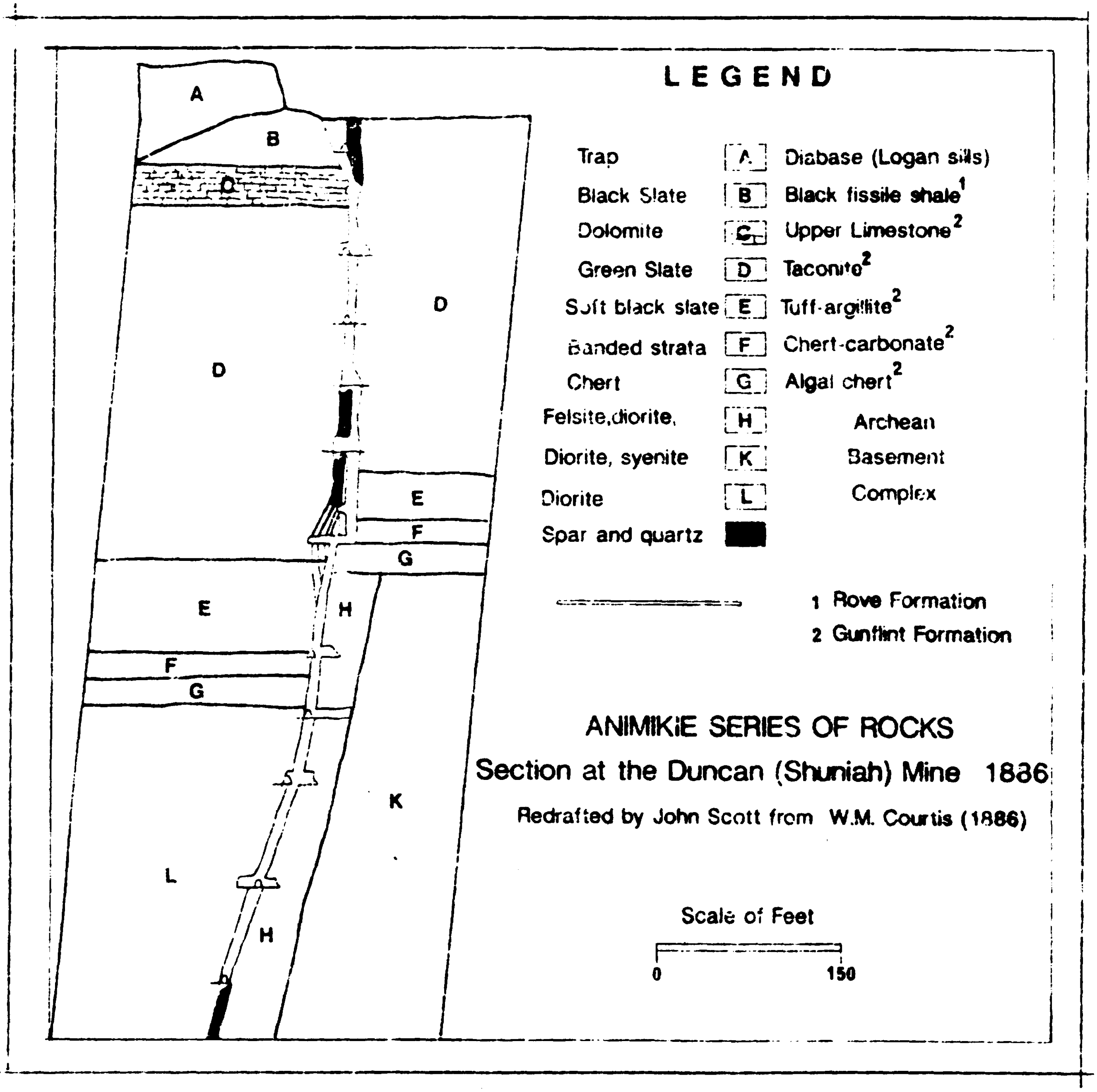


Figure 10: Cross-section of Shuniah Mine (1886)

Location and Access:

The Shuniah (Duncan) Mine is situated in the southern portion of Lot 9, McIntyre Township, within the present City of Thunder Bay. The mine workings can be examined approximately 100 m north of a radio beacon tower. Access is via a dirt road that intersects the Expressway (Highway 11-17) approximately midway between Balsam Street and Hodder Avenue.

Historical Development:

The vein at the Shuniah Mine was discovered in 1867 by George McVicar. By 1870, two shafts, one to 41 m, were sunk. In addition, crosscuts and drifts on several levels were developed. Some ore material was removed. The property was temporarily closed and reopened under the name 'Duncan Mine'.

In 1873, surface work consisted of 1488 m of diamond drilling; the drilling intersected the vein at a depth of 219 m. A ten-stamp mill and four Frue Vaners were installed and operated for several months. In 1881, the mine closed down due to a collapse of silver prices. The main reason, though, was the lack of ore. Final depth of the shaft was 220 m. Total value of ore extracted from the mine was $20,00 from an approximate outlay of $500,000 (Sergiades 1968).

Geology:

The geology of the Shuniah Mine has been described by Courtis (1888), Ingall (1887), Bowen (1911), Tanton (1931) and staff of the Regional Geology Office of the Ministry of Northern Development and Mines. Numerous old newspaper clippings are also on file that describe the Shuniah Mine.

Based on a reinterpretation of the cross-section (Courtis 1888), the mine geology depicts a section from the Archean through the Rove Formation. A complete section through the Gunflint Formation was exposed in the mine workings. According to the geological cross-section, the Archean basement consists of syenitic to dioritic plutonic rocks. Based on the descriptions provided by Courtis (1888), the granitic complex underlying the Gunflint appears to be altered. The plagioclase was very altered, decomposed and 'very dusty', but the banding was still visible; quartz was in 'pellucid masses and grains with some large and many small fluid inclusions with moving bubbles'; the hornblende was very altered with greenish veins running through it; apatite was present as colourless needles.

Without access to old core or the mine workings, it would be speculation to voice an opinion as to the nature and cause of the alteration. Three possibilities that come to mind are: 1) that the alteration is due to the effects of the vein system 2) the described alteration at the unconformity is a regolith and represents a lithified weathered profile now buried under the Gunflint sedimentary rocks 3) the alteration is some sort of diagenetic phenomena associated with the lithification process of the Gunflint Formation rocks.

Photograph 13: Silver-type vein system in Gunflint Formation shales - Highway 11/17 - 1¼ km east of Highway 527.

The normal sequence of Gunflint Formation is apparent from the section. Overlying the Gunflint Formation is a thin wedge of Rove Formation shale. The total thickness of the Gunflint Formation is 157 m; a 24 m thick diabase sill caps the Animikie Group.

The vein system occupies a fault zone that has a generally easterly strike and dips 80° to the south. The vertical displacement along the fault is approximately 30 m with the south side the down-thrown side. This is illustrated in the cross-section, Figure 3. Surface trenching has exposed the vein system for 2.4 km along strike.

Gangue minerals associated with the system include white quartz, pale pink and white calcite, green fluorite, white fluorite, amethystine quartz. Ore minerals include sphalerite, galena, chalcopyrite, pyrite, argentite and native silver. There appeared to be a spatial association between the sphalerite and silver. The bulk of the silver ore was found to be within 21 m of the surface. The silver mineralization was thought to be secondary in origin (Tanton 1931). The calcite fluoresces bright red.

CORNISH MINE

The Cornish Mine is situated in Lot 5B, MacGregor Township, approximately 2.5 km west of Mackenzie, a small village on the Canada Pacific Railway about 4 km north of Silver Harbour.

A calcite-quartz vein system strikes easterly at that location and is approximately 2.5 m wide. The vein is mineralized with galena, sphalerite and pyrite. In 1873, a group of Cornish miners from the Beck Mine sunk a shaft on the vein. The shaft was of unknown depth but currently the estimated depth is 15 m. The size of the shaft is approximately 2.7 m x 2.7 m. An adit, now slumped in, was driven southward into the hill to intersect the shaft and vein. A large pit is located immediately west of the shaft. The vein and vein material on the dump can be examined there. The vein system is hosted by Archean metavolcanic rocks and quartz feldspar porphyries. The structure in which the vein is situated in is related to the Thunder Bay-Loon Lake Fault. No known silver production has been recorded from the Cornish Mine. Assays of mine dump grab samples gave traces of silver, gold, copper, lead and 4.02% zinc.

Miscellaneous Silver-Type Veins and Amethyst Occurrences

Silver-type vein systems occur throughout the map area. Many of the occurrences are minor in nature even though extensive surface work may have been done on the veins in the 1800's. Some of them may have some potential for amethyst. In addition, the reader is referred to Tanton (1931) for additional descriptions.

Amethystine veins occur throughout the township and occur as a very late event. The veins are mainly found in granitic rocks although they also occur in felsic and mafic metavolcanic rocks, metasedimentary rocks and have been found to cut across rocks of all age classes in the map area.

The Penassen Lakes Stock appears to have the highest concentration of amethystine veins followed by the Mackenzie Granite and then by the area proximal to the Proterozoic-Archean unconformity.

Several amethyst occurrences encountered during the course of mapping were of sufficient interest to warrant specific mention either due to their size or to the colour of the amethystine quartz.

The occurrences along Highway 527 in the vicinity of "Eight Mile Hill" deserve to be investigated. The crystal colour of some of the veins is an exceptional purple. Amethystine float at the base of "Eight Mile Hill" indicates that the vein system could be larger than indicated from the road outcrops.

A one-meter wide vein system is situated on the east shore of the south end of a small lake that is located south of the second Penassen Lakes. The crystals are generally purple; alteration of feldspar in the host granitic rock is almost complete. The vein system might be larger than indicated and the area should be investigated for amethyst.

Numerous amethystine vein systems occur north of Crystal Beach area. Some of the vein systems cut across Highway 11/17 in the vicinity of the Crystal Beach Store. Amethyst occurs in the vein systems in ML 7Z that were initially developed for silver in the late 1800's.

Amethystine veins occur south of the Mount Baldy Road just east of Highway 527. Here reasonable quality of purple amethyst occurs in a vein system close to the Gunflint Formation-Archean unconformity. Trenching and stripping have exposed the vein system. Some extraction has occurred.

Amethystine veinlets are coded QTZ 2 on the map. If good quality crystals are seen, the occurrence was coded AMY.

Significant quantities of good quality amethyst float were encountered along a new road that subparallels the northern boundary of the map area. Amethyst float occurs 2.65 km east of where Walkinshaw Creek crosses the road.

Gold Occurrences

Three different types of gold occurrences are found in MacGregor Township. These are quartz veins located at or near the contact between granitic intrusives and the metavolcanic rocks; sulfide vein systems in fractures situated at or near the Proterozoic/Archean unconformity; and thirdly, quartz vein systems in felsic metavolcanic rocks.

Quartz veins associated with the first type can be quite wide - up to 5 meters in width. Typically, they form a zone of anastomosing quartz veinlets containing disseminated pyrite. The larger quartz veins exhibit crack-seal textures. These veins might be related to a fault system that strikes northeasterly through the central portion of the township. The quartz system sampled in Lot 20Z yielded 0.02 oz/t gold in a grab sample. Several large pits occur 0.8 km southwest of the 20Z occurrence and appear to be on a strike extension of the 20Z veins. Further work is required on these two locations to fully assess their potential for gold.

The highest values for gold were obtained from grab samples of sulfide vein material from the Nelson Road Quarry area. The high grade material yielded up to 4 oz/t (Bill Hayne, personal communication - assay by Noranda Exploration). Samples by the author yielded assays as high as 1.06 oz/t gold. These sulfide veins contain pyrite, sphalerite, arsenopyrite and galena. These vein systems crosscut a very dark to black siliceous metasedimentary rock with intercalated tuffaceous units. Fractures and veinlets in outcrop exhibit well-developed alteration zones. The alteration consists of bleaching and hematization of the area adjacent to the veinlets. Up to 3.10% arsenic was obtained. The sample sites were located in the first outcrop west of the quarry road. In 1986, Esso Minerals Canada did a reconnaissance geochemical survey in the area and delineated several arsenic anomalies north of the quarry site. These have not been followed up. The showing area is very near the present day exposure of the Archean-Proterozoic unconformity. It is not clear what role this unconformity had, if any, in the development of the Au-As-Zn-Cu system found to date in the Nelson Road Quarry area. A small granite stock with crosscutting tourmaline-quartz veins crops out just west of the occurrence area.

Around the northwestern sector of the quarry, muck piles resembling trench or shaft debris have been found. Their source is not known, but a reasonable assumption is that initially there was a shaft or large trench at the site and that must have been the starting point when the quarry was established. The debris consists of sulfide-rich vein material essentially containing pyrite, some galena and vuggy quartz. Assays yielded only trace amounts of gold.

The third type of gold occurrence in the township occurs as quartz crosscutting felsic metavolcanic rocks. These are best exposed along the 230 kv hydro line just north of Highway 11/17 near a point where the line crosses the highway just east of the KOA Campgrounds.

Here, narrow (<30 cm) quartz veins containing pyrite and chalcopyrite are hosted by pumiceous tuffs and highly sheared felsic metavolcanic rocks. The sheared metavolcanics contain about 3-5% sulfides and are anomalous in gold. Grab samples have yielded up to 0.18 oz/t gold. Power stripping, prospecting and airborne geophysics have been done on the property. Traces of sphalerite were also noted.

The property is covered by twenty-three claims. These are owned by Dennis Seargeant of Thunder Bay.

Stone Quarries

Several old stone quarries exist in the map area. Three different rock types have been quarried, each with its own set of characteristics and end use. The diabase quarries located in the southwestern corner of the township and at Silver Harbor were mainly developed to supply large blocks of riprap in the construction of the Thunder Bay Harbor breakwall and in remedial erosion control on the Kaministikwia River and local river diversions within the City of Thunder Bay.

The quarries located in the Mackenzie Granite were the source of material for bridge abutments for the Canadian Pacific Railway in the MacGregor Township area. These quarries are situated near the railroad in Lot 16Z and Lot 21Z of MacGregor Township.

The third rock type to be quarried was a dense, siliceous meta tuff. Its probable end use was either railroad ballast or aggregate material for road construction. One of these is situated in Lot 16Z and the other is located north of the intersection of Highway 11-17 and Nelson Road.

No recorded production figures are available for any of the quarries situated in the township.

Lead-Zinc Occurrences

Many of these occurrences are relatively small and generally of minor importance. Invariably, many of the Proterozoic type silver veins also contain galena and sphalerite.

A small fracture vein located on Highway 527 approximately 1.8 km north of the Pipeline Compressor Station road intersection. The vein is a narrow (15 cm max.) and short gash-type fracture in syenitic rock filled with calcite, galena and sphalerite. Grab samples yielded the following assays: 8.88% Zn, 3.24% Pb, 2.30 oz/t Ag and <0.01 oz/t Au. This occurrence is of the silver-amethyst type.

Other occurrences of similar type occur on Highway 11/17 approximately 0.4 km west of the Shuniah Land Fill Site; in the Silver Harbor-Mackenzie Bay area (associated with silver-type veins); on Highway 11-17 approximately 400 m east of the Crystal Beach Store (1.88% zinc, 0.42% lead, 0.10 oz/t silver, trace gold); and on Conmee Point. There probably are others. A small rusty shear zone near the north boundary of the map sheet about 9 km north of Conmee Point yielded trace gold, 0.70 oz/t silver and 38 ppm copper.

Iron Occurrences

The section near Eldorado Beach Road - Nelson Road areas are underlain by Gunflint Formation rocks. Secondary enrichment of this deposit took place during the Cretaceous (Purucker, M. 1983). Iron occurrences were bulk sampled in the early 1900's. One sample collected by the author was massive bedded hematite that gave the following analysis: SiO_2: 29.9%; Al_2O_3: 0.35%; Fe_2O_3: 62.2%; MgO: 0.24%; TiO_2: 0.03%; MnO: 0.49%; S: 0.02%. Current importance would be academic and mineralogical rather than economic.

Banded iron formation occurs southeast of the Mount Baldy CKPR-TV tower and has a slight magnetitic expression associated with it. There is no economic significance for iron at this locality.

Recommendation for Prospecting

GOLD

Recent mapping has delineated structures and litho types that warrant exploration for gold. The volcanic belt located in the southern portion of the map area should be explored for gold. Rocks anomalous in gold have been mapped along the 230 kv hydro line. Assays of up to 0.18 oz/t from grab samples have been recorded. For the most part, these rocks are sheared felsic to intermediate tuffs and tuff breccias; portions contain more than 10% pyrite. Large regional shear and fault zones dissect the area and should be investigated. Areas of epidote-hematite alteration as well as silification zones should be thoroughly looked at. Areas of intense silification occur in the area north of Birch Beach; the area should be carefully prospected for quartz veining that might host gold mineralization.

In the Nelson Road - Highway 11/17 area, arsenic anomalies located by Esso Minerals Canada should be investigated for possible associated gold. Gold is associated with arsenopyrite and sphalerite as narrow sulfide-rich veinlets in the quarry area.

SILVER

Proterozoic veins containing silver were actively explored at the turn of the century. The area around Silver Harbor was most intensively investigated and while there is no doubt that the prospectors and miners did a commendable job, the area has never been investigated using modern exploration methods. When market conditions warrant, the silver potential of the Silver Harbor area should be reassessed.

AMETHYST

Amethystine veins occur in all rock types throughout the township but appear to be concentrated in the Penassen Lakes Stock and the Mackenzie Granite. While most of the veins encountered were very small, the ones that deserve further work are coded "amy" on the map.

Prospectors for amethyst should be looking for large breccia zones that might contain amethystine vein systems. The fault controlled valleys typical of the Penassen Lakes Stock would be a logical starting point. The zone east of the south end of small unnamed lake located 500 m south of the second Penassen Lakes should be evaluated. Here, amethystine veins up to 2.5 m wide crosscut altered and brecciated granitic rocks.

Analysis of amethystine vein orientation indicates that the majority of the veins are situated in fracture systems that trend northeasterly to easterly, i.e. between 045° and 090°. This coincides with joint sets in the Penassen Lakes Stock and one major joint direction (090°) in the Mackenzie Granite.

A search of talus slopes and new road construction areas should be conducted for signs of amethyst. There are pieces of amethyst float along the new road being constructed north of the Penassen Lakes. Several claims for amethyst have been acquired in the area north of MacGregor Township.

BASE METALS

The search for base metals should be directed to locate volcanogenic massive sulfide deposits in the metavolcanic belt near Thunder Bay. Felsic pyroclastic volcanics with bomb-size clasts occur in the belt.

Lead and zinc also occur in the Proterozoic silver-type veins, but their importance from a base metal standpoint is minimal. The western portion of this belt in Dawson Road Lots contain excellent base metal targets associated with a felsic/mafic volcanic contact.

IRON

No Archean iron formations of any size exist in MacGregor Township. The Proterozoic Gunflint Formation was investigated for iron in the early 1900's. High grade hematite exists in the area of Highway 11/17 between the junctions of Eldorado Beach Road to just east of the junction of Nelson Road. Up to 62.2% Fe_2O_3 was obtained from one sample collected by the author. In 1909, 6720 tons of ore material were shipped by Dominion Bessemer One Company from the Eldorado Beach Road location.

STONE

Mackenzie Granite has a history of being quarried for stone. Granite blocks were used by the Canadian Pacific Railway for bridge abutments.

The Mackenzie Granite, the Penassen Lakes Stock and some of the smaller intrusives should be explored for possible sites.

Diabase has been quarried for riprap. Quarry sites are located at Navilus and Silver Harbor areas.

INTRUSIVES

	JFS1-10	JFS14-2	JFS42-4	JFS-35A-1	JFS12-13	JFS12-14	JFS23-5	JFS47-12	JFS8-9
SiO_2	71.50	70.80	69.90	67.40	65.50	64.70	63.40	61.00	57.00
TiO_2	0.17	0.33	0.33	0.18	0.50	0.36	0.29	0.47	0.70
Al_2O_3	15.00	15.20	16.40	19.50	15.80	15.60	15.00	15.90	17.70
Fe_2O_3	1.21	2.61	2.10	1.46	4.06	2.95	2.84	6.92	6.72
MnO	0.04	0.04	0.03	0.02	0.06	0.06	0.05	0.09	0.12
MgO	0.64	0.90	1.40	0.87	1.83	2.46	2.59	3.19	3.15
CaO	0.62	2.00	1.67	1.19	3.20	1.81	2.17	0.80	4.23
Na_2O	3.37	5.62	5.24	2.41	3.74	5.11	6.33	4.24	4.52
K_2O	5.29	0.80	1.51	3.58	2.23	2.20	4.10	3.43	3.78
P_2O_5	0.02	0.12	0.19	0.01	0.15	0.19	0.10	0.17	0.38
CO_2	0.22	0.38	0.14	0.12	0.29	0.91	0.32	0.49	0.08
S	0.01	0.01	0.03	0.03	0.21	0.02	0.02	0.01	0.03
TOTAL	98.09	98.81	98.94	96.77	97.57	96.37	97.21	96.71	98.41
LO1	1.00	1.10	0.90	1.90	1.80	2.50	1.00	2.60	1.10
SpGr	2.62	2.67	2.66	2.72	2.71	2.67	2.68	2.68	2.78
	Porphyritic Granite Blue Quartz Eyes	Quartz Feldspar Porphyry	Quartz Feldspar Porphyry	Quartz Feldspar Porphyry	Quartz Feldspar Porphyry	Quartz Feldspar Porphyry	Porphyritic Syenite	Augen Gneiss	Hornblende Syenite

INTRUSIVES

	JFS8-8	JFS75-2	JFS21-5	JMS31-4	JFS37-6	JFS3-15	JFS3-10	JMS26-2
SiO_2	56.00	54.10	52.60	48.60	46.00	45.30	43.90	38.30
TiO_2	0.79	0.62	0.57	0.47	0.37	0.48	0.45	0.44
Al_2O_3	17.50	14.80	7.39	16.50	15.30	6.73	6.08	13.80
Fe_2O_3	6.70	6.62	8.28	9.20	9.16	10.00	11.00	37.70
MnO	0.06	0.12	0.17	0.18	0.15	0.17	0.17	0.16
MgO	5.60	5.65	12.50	8.23	12.80	21.70	26.20	3.23
CaO	1.43	7.36	11.70	10.90	10.20	8.89	7.00	0.37
Na_2O	4.16	3.86	2.99	1.87	1.17	0.53	0.36	0.00
K_2O	3.79	4.20	1.33	2.23	1.54	0.25	0.12	0.01
P_2O_5	0.40	0.58	0.18	0.20	0.05	0.09	0.06	0.21
CO_2	0.18	0.14	0.53	0.27	0.40	0.11	0.17	0.42
S	0.03	0.03	0.04	0.01	0.01	0.01	0.23	0.01
TOTAL	96.64	98.16	98.28	98.66	97.15	94.26	95.74	94.65
LO1	3.10	0.70	1.70	1.50	3.10	4.60	4.20	5.30
SpGr	2.69	2.82	3.01	3.01	3.00	2.93	3.05	3.03
	Hornblende Syenite	Porphyritic Syenite	Pyroxenite	Hornblende Gabbro	Hornblende Gabbro	Ultramafic Volcanic	Ultramafic Volcanic	Melanocratic Phase Mackenzie Granite

METAVOLCANICS

	JFS1-2	JFS1-3	JFS1-4	JFS3-1A	JFS3A-1	JFS3-9	JFS3-10	JFS3-15	JFS11-5
SiO_2	52.40	48.20	47.00	59.20	64.30	44.20	43.90	45.30	69.10
TiO_2	0.36	0.97	0.99	1.06	0.50	0.38	0.45	0.48	0.38
Al_2O_3	13.30	14.00	13.50	14.60	15.50	4.77	6.08	6.73	15.40
Fe_2O_3	22.60	12.60	13.10	8.63	3.98	10.40	11.00	10.00	2.59
MnO	0.16	0.18	0.25	0.15	0.09	0.14	0.17	0.17	0.04
MgO	3.24	7.52	6.94	4.34	2.47	27.90	26.20	21.70	1.29
CaO	0.21	7.82	9.69	2.08	2.29	4.08	7.00	8.89	2.02
Na_2O	--	3.87	1.93	4.43	3.16	0.00	0.36	0.53	4.23
K_2O	2.32	0.26	0.25	0.52	3.04	0.06	0.12	0.25	1.79
P_2O_5	0.07	0.02	0.04	0.10	0.09	0.04	0.06	0.09	0.05
CO_2	0.07	1.83	3.25	0.27	0.43	0.20	0.17	0.11	0.49
S	0.01	0.02	0.02	0.79	2.06	0.31	0.23	0.01	0.04
TOTAL	97.74	97.29	96.96	96.17	97.91	92.48	95.74	94.26	97.42
LO1	4.30	4.20	6.30	3.30	3.40	6.90	4.20	4.60	1.80
SG	2.83	2.85	3.29	2.79	2.74	2.87	3.05	2.93	2.69
	Tholeitic Basalt	Tholeitic Basalt	Tholeitic Basalt	Calc. Alk. Basalt	Calc. Alk. Dacite	Ultramafic Volcanic (Pyroclastic Texture)			Rhyolite/ Dacite

METAVOLCANICS

	JFS11-11	JFS12-5	JFS12-12	JFS12-16	JFS14-2	JFS24-11	JFS25-4	JFS25-9	JFS25-10
SiO_2	55.70	69.30	65.20	69.80	70.80	46.60	70.40	65.40	59.50
TiO_2	0.73	0.41	0.52	0.30	0.33	0.75	0.57	0.54	0.77
Al_2O_3	13.80	15.50	15.10	15.90	15.20	16.20	15.90	16.50	17.00
Fe_2O_3	7.11	2.93	3.61	2.84	2.61	9.10	1.77	3.35	5.44
MnO	0.11	0.03	0.06	0.03	0.04	0.17	0.03	0.08	0.09
MgO	7.73	1.14	1.84	1.18	0.90	4.57	0.68	1.37	2.00
CaO	7.06	0.96	2.32	0.85	2.00	12.00	1.19	3.01	3.55
Na_2O	4.04	4.59	3.64	4.75	5.62	2.93	3.75	4.51	3.33
K_2O	0.83	1.81	3.24	1.92	0.80	1.98	3.12	1.94	3.99
P_2O_5	0.22	0.12	0.17	0.12	0.12	0.32	0.13	0.15	0.29
CO_2	0.46	1.10	0.69	0.12	0.38	3.52	0.23	0.53	0.19
S	0.17	0.01	0.24	0.02	0.01	0.03	0.22	0.41	1.31
TOTAL	97.96	96.88	96.63	97.83	98.81	98.17	97.99	97.79	97.46
LO1	2.10	1.70	2.40	1.80	1.10	5.30	1.70	2.20	2.50
SG	2.86	2.67	2.68	2.68	2.67	2.82	2.68	2.72	2.73
	Tholeitic Basalt	Calc. Alk. Rhyolite	Calc. Alk. Dacite	Calc. Alk. Rhyolite	Calc. Alk. Rhyolite	Alkaline Affinity	Calc. Alk. Rhyolite	Calc. Alk. Dacite	Calc. Alk. Dacite

METAVOLCANICS

	JFS26-11	JFS30-4	JFS35A-4	JFS38-3	JFS40-1	JFS71-1	18-10-85-1	18-10-85-2
SiO_2	68.50	51.50	46.00	51.50	52.60	46.80	47.30	60.50
TiO_2	0.47	1.24	0.42	0.41	0.89	0.95	0.56	0.48
Al_2O_3	15.20	13.40	7.01	19.70	12.50	10.95	20.40	19.60
Fe_2O_3	3.06	14.10	11.40	7.77	11.60	11.70	8.22	3.67
MnO	0.07	0.21	0.20	0.13	0.19	0.22	0.27	0.06
MgO	1.59	6.80	20.00	5.42	8.13	15.30	4.48	1.66
CaO	1.81	8.41	7.73	8.76	7.20	7.28	12.10	4.62
Na_2O	3.90	1.86	0.62	3.93	2.22	2.31	1.95	6.50
K_2O	2.25	0.95	2.48	0.49	1.30	0.05	0.87	0.73
P_2O_5	0.13	0.07	0.17	0.12	0.23	0.12	0.09	0.09
CO_2	0.26	0.27	1.06	0.20	0.45	0.61	1.68	0.35
S	0.22	0.17	0.05	0.10	0.04	0.22	0.47	0.07
TOTAL	97.46	98.98	97.14	98.53	97.35	94.46	98.39	98.33
LO1	1.90	1.20	3.00	.90	2.10	3.40	3.90	1.10
SG	2.69	3.00	2.98	2.87	2.90	2.96	3.00	2.76
	Calc. Alk. Dacite	Tholeitic Basalt	Kom. Flow	Calc. Andesite	Tholeitic Basalt	Kom. Basalt	Calc. Alk. Andesite	Calc. Alk. Rhyolite

METAVOLCANICS

	JMS10-4	JMS10-5	JMS10-5A	JMS10-5B	JMS10-9	JMS10-10
SiO_2	62.20	74.00	74.50	71.50	61.50	49.30
TiO_2	0.81	0.54	0.68	0.57	0.99	1.19
Al_2O_3	14.70	15.00	14.60	16.40	14.80	14.00
Fe_2O_3	8.29	0.45	0.33	0.76	7.48	13.50
MnO	0.07	0.02	0.02	0.01	0.10	0.25
MgO	4.08	0.36	0.37	0.43	3.04	7.39
CaO	0.81	2.27	2.49	3.20	3.43	9.58
Na_2O	2.83	4.89	4.76	4.36	4.15	1.86
K_2O	2.22	0.65	0.58	0.96	1.72	0.98
P_2O_5	0.21	0.15	0.14	0.13	0.23	0.08
CO_2	0.23	0.45	0.69	0.31	0.24	0.13
S	0.04	0.01	0.01	0.01	0.05	0.08
TOTAL	96.49	98.79	99.17	98.64	97.73	98.34
LO1	3.30	1.30	1.50	1.20	1.20	1.40
SG	2.71	2.68	2.70	2.69	2.78	3.03
	Calc. Alk. Basalt	Calc. Alk. Rhyolite	Calc. Alk. Rhyolite	Calc. Alk. Rhyolite	Calc. Alk. Andesite	Tholeitic Basalt

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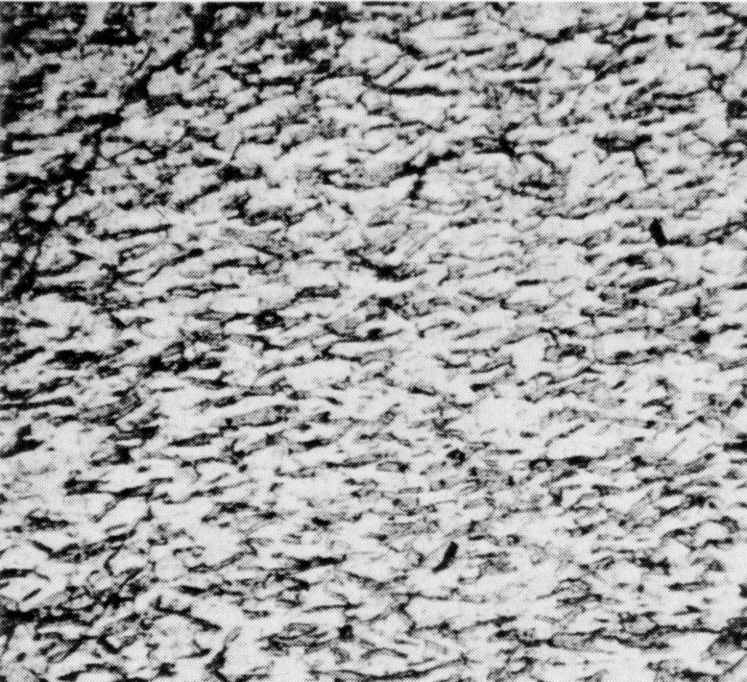
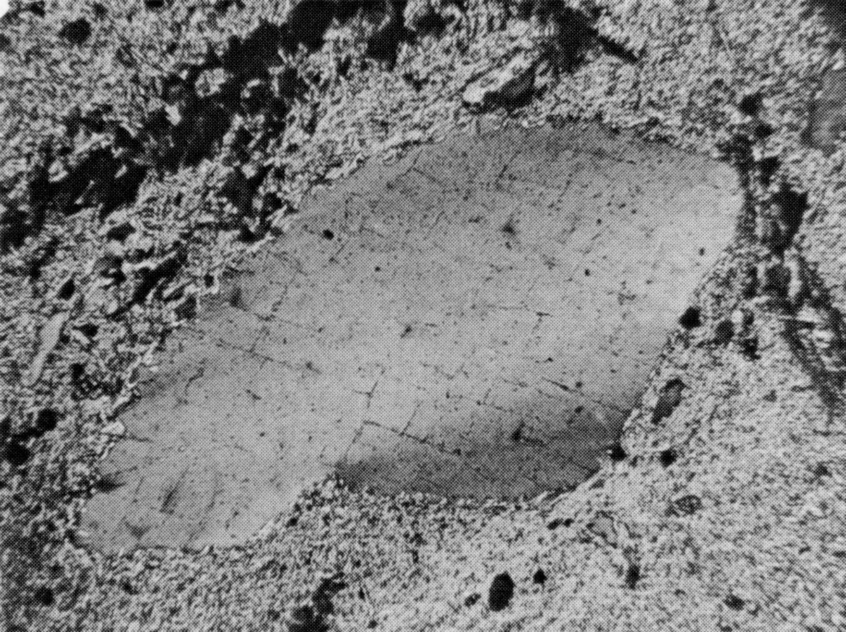





CENTIMETRE

MARGINAL NOTES

Introduction

During the 1984 and 1985 field season about 90% of MacGregor Township was geologically mapped at a scale of 1:15 840. Most of the area not yet traversed is located at the north boundary near the central part of the map area.

Location and Access

MacGregor Township is situated in the Municipality of Shuniah and lies immediately northeast of the City of Thunder Bay, Ontario. The map area is bounded on the south by Thunder Bay of Lake Superior, and on the north by Latitude 49°30'36"N; Longitudes 88°48'W and 89°11'W, mark the eastern and western limits of the map area, respectively.

Highway 11-17, the Trans-Canada Highway, cuts across the southern portion of the Township near Lake Superior; Highway 527, the Spruce River Road, traverses northward across the western sector of the township. Hydro lines, a pipeline, and bush roads provide access to more than 75% of the township. The least accessible areas are the northwestern sector away from Highway 527, and the area where Longitude 89°00'W intersects the north boundary.

Previous Geological Work

The northern sector of the Township was mapped by MacDonald (1941). Moorhouse (1960) mapped the Proterozoic Gunflint Formation located in the southern section of the township near Lake Superior. McIlwaine (1971a, 1971b, 1975) mapped McTavish Township, immediately east of the present map area. Tanton (1926) mapped parts of the northeastern sector of the area. McKellar (1874) describes some of the earliest discovered mineral occurrences of the area. Scott (1984) gave a preliminary account of the geology of the western half of the map area.

General Geology

A variety of Archean and Proterozoic rocks are found in MacGregor Township. The Archean rocks form part of the Abitibi-Wawa Subprovince, and consist of metavolcanics and associated metasediments, mafic to ultramafic intrusions, hornblende syenites, porphyritic diorites, granites, quartz monzonites, and quartz-feldspar porphyries.

The metavolcanics have been classified into three major subdivisions: felsic (pyroclastics and flows), intermediate to mafic (mainly flows), and ultramafic (flows and possibly pyroclastics). They uniformly face south and form two mafic to felsic volcanic cycles.

The felsic volcanic rocks of the upper cycle trend easterly across the southern part of the map area from the western boundary near the McIntyre Township/MacGregor Township line, and disappear under Lake Superior in the Mary Harbor area.

These rocks consist mainly of pyroclastic felsic volcanic rocks ranging from pumiceous tuffs to tuff breccia. Clasts in the tuff breccia are up to 30 cm long, but typically average less than 10 cm. Collapsed pumice fragments are readily identified on the hydro line north of Highway 11-17 and east of Highway 527 in the lower felsic unit.

Felsic metavolcanics of the lower cycle trend eastward through Gorham Township north of the metasedimentary belt near the Gorham Gold Mines Property. They form a sequence about 1.6 km wide, extending into MacGregor Township as far as Waylan Lake, where they terminate against the MacKenzie Granite.

The sequence is poorly exposed due to thick overburden, but where they outcrop, the lower cycle felsic metavolcanics consist of tuff-breccia, tuffs, crystal tuffs, and tuffaceous cherty units.

The tuff-breccia exposed on Copenhagen Road north of the Mitchell Road intersection, consists of pale green, fist-size fragments set in a slightly darker green matrix. Quartz eyes, pyrite (<1%), minor carbonate, and a blocky fragmental appearance are typical of the unit.

The crystal tuff, as exposed midway between the intersection of Mitchell Road and Pipeline Compressor Station Road with Highway 527, is massive, light green and relatively hard. The unit consists of a partially welded mass of quartz (eyes), and feldspar crystals set in a fine-grained matrix of what is now sericite plus quartz. The northern end of the exposure consists of graded tuffaceous chert beds that indicate a southerly top direction.

Quartz-feldspar porphyritic stocks are also associated with these felsic volcanic rocks. Some of the stocks contain blue quartz eyes: they intrude the felsic metavolcanics and are best exposed along Highway 11-17, approximately 1.5 km east of the Highway 527/Highway 11-17 junction.

The northern felsic metavolcanic sequence mapped in MacGregor Township appears to be on strike with similar rocks in Gorham Township, mapped by MacDonald (1941). Rocks of the Early Proterozoic Gunflint Formation overlie the southern metavolcanic unit, thus correlation between the felsic rocks in Gorham Township and the southern sequence in MacGregor is subject to interpretation.

Intermediate to mafic metavolcanics consist of massive amphibolitic flows, amygdular flows, tuffs, and tuff breccias. These rocks are situated north of the previously described felsic metavolcanics, and disappear under Lake Superior in the Mary Harbor-Silver Harbour area. The general strike of both the felsic and mafic metavolcanic packages is east-west.

Associated with the mafic metavolcanics, and in places intercalated with them, are metawackes plus thin iron formation units. Iron formation is exposed southeast of the Mount Baldy area; although clasts of that type occur in a conglomerate about 1 mile northwest of Mary Harbor, no other exposures of iron formation were noted in the area. Where facing directions can be discerned, graded beds indicate that the area is underlain predominantly by a south-facing sequence.

Several small exposures of komatiitic rocks occur along the hydro line just west of Wildgoose Creek. That area has been faulted, and a wedge of granitic rock now separates the two main exposures of ultramafic rock. The eastern exposure is situated approximately 1.2 km east of the intersection of Wildgoose Creek and the hydro line. Analysis of this unit returned up to 0.15% nickel. These rocks are fragmental in part, and could represent ultramafic pyroclastics, but more detailed study is required to support this interpretation. Such brecciation may also have been produced by diatreme emplacement or tectonism. In other exposures, the komatiites are massive to laminated and show possible spinifex texture in thin section.

In the northern portion of the eastern half of the map area, a thick section of metawackes are intruded by distinctive hornblende gabbro bodies. Hornblende phenocrysts up to 1 cm long form about 15% to 20% of the rock in a matrix of fine-grained feldspar and amphibole. The rock is massive and hard. It has intruded the host metasediments as one or more sill-like bodies. Overburden cover makes it difficult to unequivocally interpret the body as a single sill, or several smaller intrusions.

A distinctive quartz feldspar porphyritic stock intrudes the metasediments in the north-central portion of the eastern half of the area mapped. The quartz phenocrysts are as large as 1 cm in diameter. The porphyry has been sheared and thus the matrix is composed mostly of sericite. It weathers chalk white and exhibits a mottled, apple green fresh surface. The porphyry can be traced over several miles across the central part of the township.

Archean felsic plutonic rocks form two large granitoid bodies within the map area. The southern one, the MacKenzie Granite, is a large intrusion consisting of medium- to coarse-grained, pink to slightly greenish granite composed primarily of microcline, oligoclase, quartz, and biotite with accessory sphene, apatite, opaque minerals, and secondary sericite plus epidote (Rogers 1979). The intrusion underlies most of the southern flank of the map area occupying the area from Mount Baldy to Birch Beach on Thunder Bay, a distance of approximately 22 km. The MacKenzie Granite has been faulted and generally "attenuated" in the area 1.6 km northwest of Mary Harbor, but where not distorted by faulting, the granitic body is in the order of 3.2 km wide.

The northern body, the Penassen Lakes Stock, is very coarse-grained, generally porphyritic, and ranges in composition from granite to quartz monzonite with hornblende syenite and hornblendite phases. The syenitic and hornblendite phases appear to be restricted to the area near, and to the west of, Highway 527. East of Highway 527, in the vicinity of the Penassen Lakes, the rock is a coarse-grained porphyritic quartz monzonite.

A similar satellite intrusion of hornblende syenite, and a curious coarse porphyritic gabbro, occur on the eastern flanks of the Penassen Lakes Stock. Feldspar crystals in the porphyritic gabbro are up to 13 cm long, comprise up to 80% of the rock, and define a near perfect mineral foliation.

The Proterozoic supracrustal rocks of MacGregor Township consist of clastic and chemical metasediments of the Animikie Group. This group consists of two formations resting unconformably on the Archean basement, the Gunflint Formation and the Rove Formation. In the map area, the Rove Formation is exposed in a narrow strip near Lake Superior. Isolated outcrops of a basal conglomerate occur throughout the southern portion of map area. In each case the Archean rocks beneath the conglomerate have been severely altered and weathered, possibly due to a period of pre-Gunflint weathering.

Late diabase sills and dikes intrude all other rock types in the area.

Structural Geology

The metavolcanic-metasedimentary sequence has a general easterly trend. Schistosity strikes parallel to the trend of the major units, and has in many instances destroyed primary structures. The schistosity dips very steeply to vertical. Locally the schistosity undulates, and may vary by several tens of degrees in single outcrops. Locally, shearing has severely deformed the rocks, in some cases mylonitic textures are evident. Near the granitoid contacts, primary features such as pillows in volcanic rocks, and graded bedding or crossbedding in sedimentary rocks, have been obliterated.

Where facing directions are discernible, they indicate a southward facing sequence; locally, some units face north, probably reflecting small-scale folding in the metavolcanics.

Major regional faults transect the map area, trending northeast, north-northeast, and northwest. Some fault zones contain late diabase dikes. Just southeast of Pass Lake Corners, at the far northeastern corner of the map sheet, Gunflint Formation chert-carbonate rocks have been brought into fault contact with Archean metasediments, suggesting that several episodes of faulting occurred.

In most places the Gunflint Formation is generally flat lying or shallow dipping toward the south, and unconformably overlies the Archean rocks. However in the area between Blende Lake and O'Connor Point on Lake Superior, the chert-carbonate member of the Gunflint Formation exhibits extraordinary brecciation and folding. This deformation appears to be restricted to the eastern portion of the map area.

Economic Geology

MacGregor Township is well known for old silver occurrences. Typically these occur as veins associated with the Proterozoic/Archean unconformity (Tanton 1931; Franklin 1970). Commonly these veins occupy fault or shear zones and contain sphalerite, galena, chalcopyrite, native silver, argentite, fluorite, calcite, amethyst, pale quartz, and barite. The vein systems appear to crosscut all lithologies and are best exposed along Highway 11-17 east of Thunder Bay. Veins mapped in 1984 and in 1985 varied in width from just a few centimetres wide to zones several meters wide. They generally strike north-south, but are also found in some fault zones that strike northeastward (Cornish Mine).

The amethyst-bearing veins are of the same relative age as the silver veins and occur throughout the map area. In most cases they crosscut the MacKenzie Granite and the Penassen Lakes Stock. A significant concentration of the amethyst-bearing veins crosscut felsic metavolcanics exposed on the hydro right-of-way approximately 2.4 km west of Mary Harbor.

Several old silver mines exist in the township. These are: Cornish Mine, 3A Mine, Beck Mine, Thunder Bay Silver Mine, Algoma Mine, and 7Z Mine. While the economic viability of silver deposits today might be low, veins of this type have excellent potential for amethyst.

During the course of mapping many quartz veins were sampled by the author and assayed by the Geoscience Laboratory, Ontario Geological Survey (OGS) for gold and silver. While not all samples returned gold values, there is enough potential in some areas to warrant further exploration for gold.

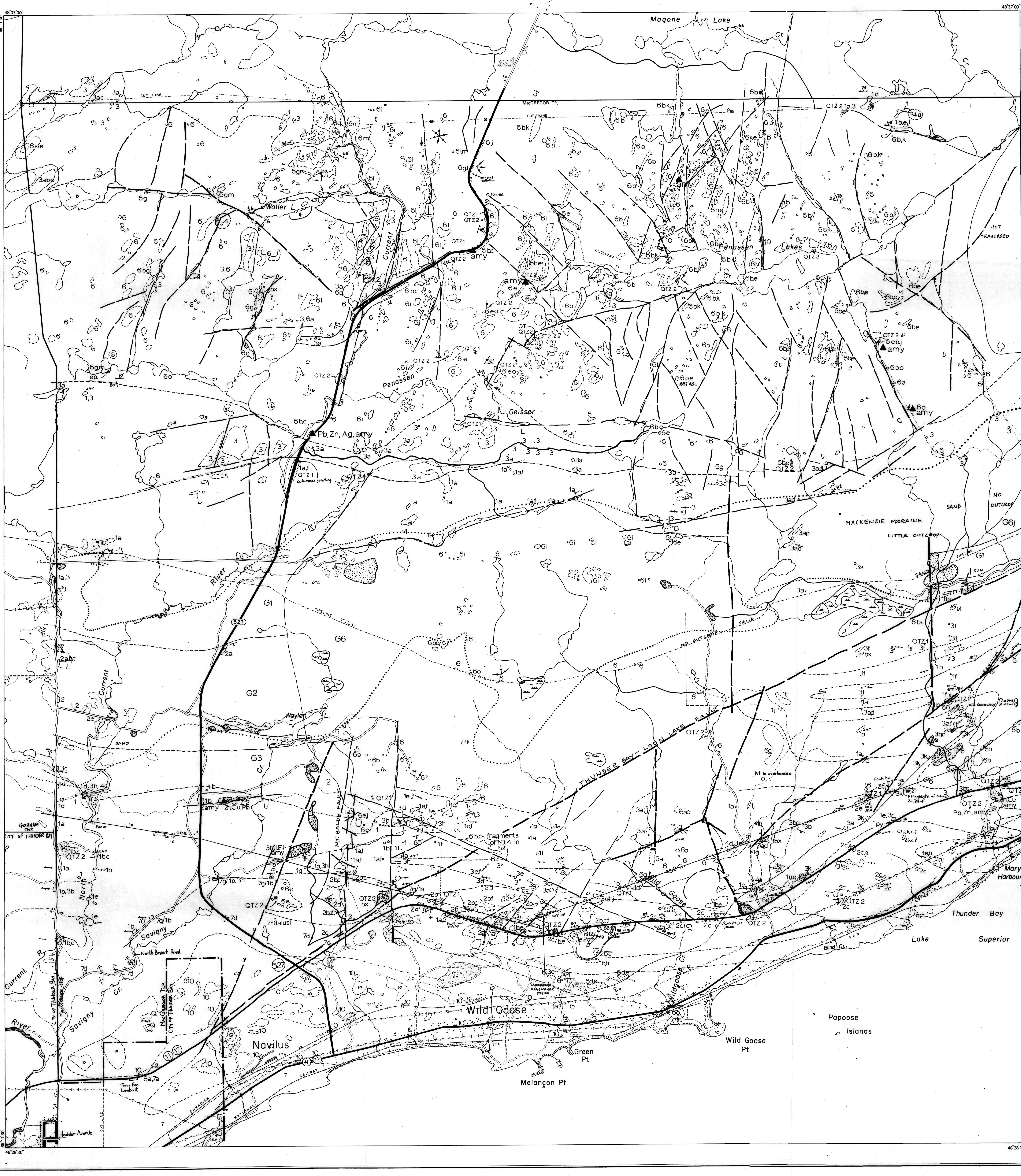
One area of interest is that around an old quarry near the Nelson Road-Highway 11-17 junction. There narrow sulphide-bearing veins, probably occupying shear zones in a dark siliceous, metasedimentary rock, carry arsenopyrite, pyrite, zinc, and gold. Values of up to 1.06 ounces gold per ton were obtained from these veins in grab samples collected by the author and assayed by the Geoscience Laboratory, OGS. This property is currently held by Bill Hayne of Thunder Bay.

A zone of quartz stockwork and silicification exists north of the hydro line north of Birch Beach. No known exploration work has been done in that location. Some of the larger quartz veins are up to 30 cm wide and exhibit pyrite gossan in places. One grab sample from the area returned values of trace gold, and 0.76 ounce silver per ton (sampled by the author, assayed by the Geoscience Laboratory, Ontario Geological Survey). The area has good potential for gold, and should be prospected.

Further east, about 2.4 km north-northwest of Mary Harbor and east and north of the Canadian Pacific Railway tracks, on a south facing slope, there is a quartz stockwork that carries gold. A grab sample collected by the author and assayed by the Geoscience Laboratory, OGS ran 0.02 ounce gold per ton. The individual quartz veins are narrow, but overall the zone itself is at least 2 m wide where exposed. The owner of the surface rights, Mr. A. Kurikka of Thunder Bay, states that there are several old pits and one shaft located between the CPR tracks and the hill. These were not seen during mapping. A 3 m wide quartz vein with a crack and seal texture is located on the northern face of the above slope near a small beaver pond. Further work is warranted.

Closer to the City of Thunder Bay on the hydro line just north of Highway 11-17, about 2.5 km east of the junction of Highway 11-17 and Highway 527, two separate outcrops of quartz stockwork in felsic volcanic rocks should be prospected. The zones are approximately 0.4 km apart. Analysis of a sample taken by the author from the hydro line at a point 0.4 km north-northwest of where it crosses Highway 11-17, returned 185 ppb Au upon assay by the Geoscience Laboratory, OGS.

Komatiitic rocks located near Wildgoose Creek and the hydro line assayed up to 0.15% nickel.



Ontario
Ministry of Northern Development and Mines

Ontario Geological Survey
MAP P.2984
Geological Series-Preliminary Map

PRECAMBRIAN GEOLOGY
MacGREGOR TOWNSHIP
West Half
DISTRICT OF THUNDER BAY

Scale 1:15 840

Mile ⅛ 0 ¼ ½ Mile
Metres 100 0 0.2 0.4 0.6 0.8 1 Kilometre

NTS Reference: 52 A/11
ODM-GSC Aeromagnetic Maps: 2107G
ODM Geological Compilation Map: 2065

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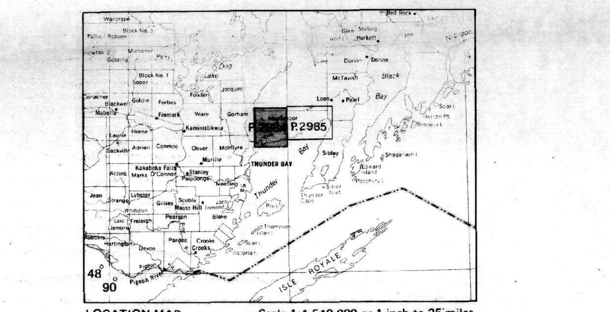

LOCATION MAP Scale 1:1 548 000 or 1 inch to 25 miles

LEGEND

PHANEROZOIC
CENOZOIC
QUATERNARY
RECENT
Lacustrine sands, beach gravels, stream, and swamp deposits
PLEISTOCENE
Glacial, glaciofluvial, and glaciolacustrine deposits, raised beaches, till, sand, gravel, clay, and silt

GREAT UNCONFORMITY

PRECAMBRIAN
PROTEROZOIC
OSLER GROUP[1]

11 — 11a Amygdular basalt

UNCONFORMITY

LOGAN DIABASE

10 — 10a Xenolithic diabase
10b Granophyric diabase
10c Porphyritic diabase

INTRUSIVE CONTACT

SIBLEY GROUP[2]

9 — 9a Kama Hill Formation
9b Rossport Formation
9c Pass Lake Formation

UNCONFORMITY

ANIMIKIE GROUP

8 — 8a Rove Formation

GUNFLINT FORMATION[4]

7 — 7a Fragmental limestone (calc-arenite)
7b Taconite, hematitic ironstone
7c Shale (tuff-argillite)
7d Chert-carbonate rocks
7e Lapilli tuff
7f Algal chert
7g Conglomerate

UNCONFORMITY

ARCHEAN
FELSIC INTRUSIVE ROCKS[4]

6 — 6a Unsubdivided
6b Massive
6c Foliated
6d Gneissic
6e Porphyritic
6f Sheared
6g Xenolithic
6h Pegmatitic
6i Granite
6j Syenite
6k Quartz-monzonite
6l Hornblende-rich
6m Biotite-rich
6n Muscovite-rich
6o Coarse grained
6p Medium grained
6q Fine grained
6r Trondhjemite
6s Brecciated
6t Quartz-feldspar porphyry

MIGMATITIC ROCKS[4]

5 — 5a Unsubdivided
5b Quartz-biotite-feldspar schists (metasedimentary migmatite)
5c Hornblende-feldspar schists (metavolcanic migmatite)

MAFIC TO ULTRAMAFIC INTRUSIVE ROCKS[4,5]

4 — 4a Hornblendite
4b Gabbro
4c Lamprophyre
4d Fragmental
4e Porphyritic gabbro
4f Peridotite

INTRUSIVE CONTACT

METASEDIMENTS[3]

3 — 3a Massive
3b Bedded
3c Sheared
3d Quartz-rich
3e Arenite
3f Wacke
3g Graphitic
3h Siliceous ironstone
3i Chert
3j Chert-carbonate ironstone
3k Clast supported granule and pebble conglomerate (probably Timiskaming-type)

FELSIC METAVOLCANICS[4]

2 — 2a Massive
2b Foliated
2c Pyroclastic
2d Blue quartz eye porphyry
2e Crystal tuff
2f Pumiceous lapilli tuff
2g Tuff-breccia

INTERMEDIATE TO MAFIC METAVOLCANICS

1 — 1a Massive
1b Sheared
1c Pillowed
1d Amygdular
1e Tuffaceous, fragmental
1f Amphibolite
1g Diabasic texture
1h Porphyritic (feldspar phenocrysts)
1i Brecciated

Notes:
1. Osler Group basaltic flows are found mainly on Black Bay Penninsula and on the St. Ignace Island archipelago. Only one outcrop area of possible Osler Group basalts was found in MacGregor Township and it is located approximately 0.8 km south of the Mount Baldy Ski area, adjacent to a small pond.
2. Sibley Group rocks occur mainly to the south, east, and north of the map sheet. Many boulders of Sibley Group rocks, some of them up to 1.5 m in diameter, are found in the map area. Sibley Group rocks are also found as inclusions in some of the amethystine veins of the area.
3. May be in part "Timiskaming-type".
4. Rocks in these groups are subdivided lithologically, and the order does not necessarily imply age relationships within or among groups.
5. Hornblende-rich gabbroic rocks are mainly found intruding Timiskaming-type metasediments, therefore they may represent a separate intrusive event.

SYMBOLS

- Glacial striae
- Esker
- Kettle hole
- Small bedrock outcrop
- Bedrock area outcrop
- Bedding, top unknown (inclined, vertical)
- Bedding, top indicated by arrow
- Foliation
- Lineation (with plunge)
- G2 Geological boundary (observed, inferred, based on geophysics)
- Fault or lineament
- Jointing (inclined, vertical)
- Drag folds with plunge
- Quartz vein network
- Shaft
- Pit or trench
- Quarry
- Sand or gravel pit
- Limit of MacKenzie Moraine
- Mineral occurrence
- QTZ 1 Milky vein quartz
- QTZ 2 Amethystine-type quartz vein
- QT Quartz-tourmaline vein
- Survey stake

ABBREVIATIONS

Ag	silver
amy	amethyst
As	arsenic
Au	gold
bx	breccia
carb	carbonate
Cu	copper
ep	epidote
Fe	iron
IF	iron information
Ni	nickel
Pb	lead
py	pyrite
Zn	zinc

PAST PRODUCING MINES

1. Cornish Mine
2. 3A Mine
3. Thunder Bay Silver Mine
4. Beck (Silver Harbour) Mine
5. 7Z Mine
6. Algoma Mine

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1971a: McTavish Township (West Part of North Half), District of Thunder Bay; Ontario Department of Mines and Northern Affairs, Preliminary Geological Series, Map P.720, scale 1:15 840 or 1 inch to 1/4 mile. Geology 1971.
1971b: McTavish Township (East Part of North Half), District of Thunder Bay; Ontario Department of Mines and Northern Affairs, Preliminary Geological Series, Map P.721, scale 1:15 840 or 1 inch to 1/4 mile. Geology 1971.

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1931: Fort William and Port Arthur, and Thunder Cape Map Areas, Thunder Bay District, Ontario; Geological Survey of Canada, Memoir 167, 222p.

SOURCES OF INFORMATION

Basemap derived from Forest Resources Inventory (F.R.I.), Ministry of Natural Resources, with corrections by J.F. Scott.

Moorhouse (1960); Tanton (1928, 1931); MacDonald (1941). See References.

Magnetic Declination is assumed to be 0°.

CREDITS

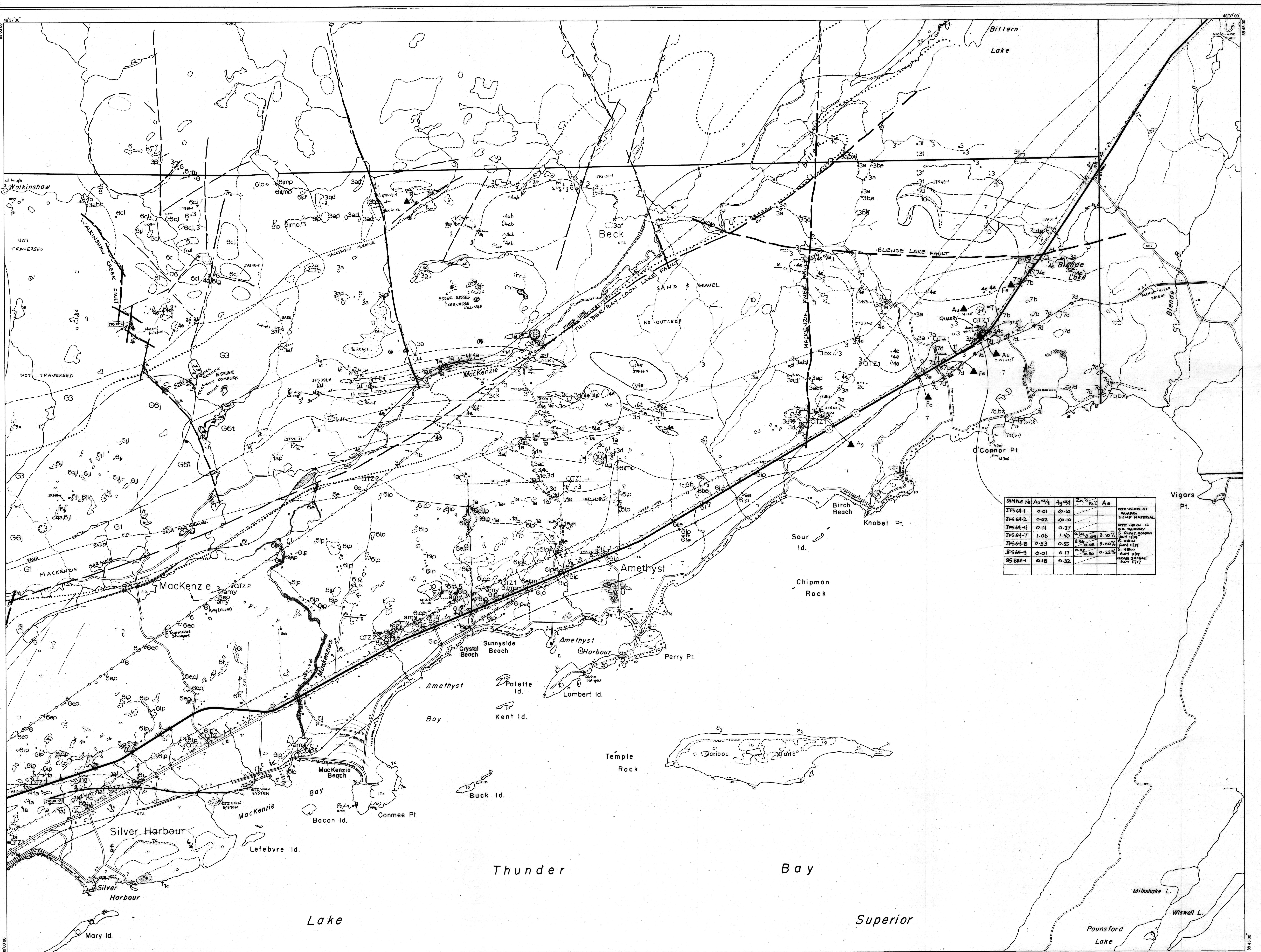
Geology by J.F. Scott and J.M. Sequin, 1984, 1985.

Every possible effort has been made to ensure the accuracy of the information presented; however, the Ontario Ministry of Northern Development and Mines 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 1986

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

Scott, J.F.
1986: Precambrian Geology of MacGregor Township, West Half, District of Thunder Bay; Ontario Geological Survey, Map P.2984, Geological Series—Preliminary Map, scale 1:15 840. Geology 1984, 1985.



SAMPLE No	Au oz/t	Ag oz/t	Zn % / Pb %	As	
JFS 64-1	0.01	<0.10	—		QTZ VEINS AT QUARRY
JFS 64-2	0.02	<0.10			DUMP MATERIAL
JFS 64-4	0.01	0.27			QTZ VEIN N OF QUARRY
JFS 64-7	1.06	1.40	0.30 / 0.09	3.10%	S Shear, gossan HWY 11/17
JFS 64-8	0.53	0.55	2.36 / 0.08	3.00%	S. VEIN HWY 11/17
JFS 64-9	0.01	0.17	0.02 / 0.30	0.22%	S. VEIN HWY 11/17
85 BBH-1	0.18	0.32			GRAB SAMPLE HWY 11/17

Ministry of Northern Development and Mines
Ontario

Mines and Minerals Division
Ontario Geological Survey

MAP P.2985 (revised)

PRECAMBRIAN GEOLOGY

MacGREGOR TOWNSHIP
East Half

Scale 1:15 840

500 m 0 0.5 1 km

Mile 1/4 0 1/2 Mile

NTS Reference: 52 A/10

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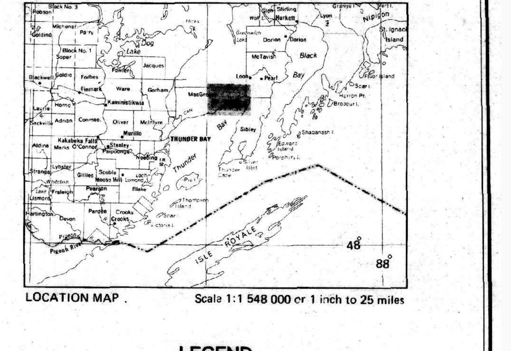

LOCATION MAP. Scale 1:1 548 000 or 1 inch to 25 miles

LEGEND

PHANEROZOIC
CENOZOIC
QUATERNARY
RECENT

Lacustrine sands, beach gravels, stream, and swamp deposits

PLEISTOCENE

Glacial, glaciofluvial, and glaciolacustrine deposits, raised beaches, till, sand, gravel, clay, and silt

GREAT UNCONFORMITY

PRECAMBRIAN
PROTEROZOIC
OSLER GROUP[1]

11 — 11a Amygdular basalt

UNCONFORMITY

LOGAN DIABASE

10 — 10a Xenolithic diabase; 10b Granophyric diabase; 10c Porphyritic diabase

INTRUSIVE CONTACT

SIBLEY GROUP[2]

9 — 9a Kama Hill Formation; 9b Rossport Formation; 9c Pass Lake Formation

UNCONFORMITY

ANIMIKIE GROUP

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GUNFLINT FORMATION[4]

7 — 7a Fragmental limestone (calc-arenite); 7b Taconite, hematitic ironstone; 7c Shale (tuff-argillite); 7d Chert-carbonate rocks; 7e Lapilli tuff; 7f Algal chert; 7g Conglomerate

UNCONFORMITY

ARCHEAN
FELSIC INTRUSIVE ROCKS[4]

6 — 6a Unsubdivided; 6b Massive; 6c Foliated; 6d Gneissic; 6e Porphyritic; 6f Sheared; 6g Xenolithic; 6h Pegmatitic; 6i Granite; 6j Syenite; 6k Quartz-monzonite; 6l Hornblende-rich; 6m Biotite-rich; 6n Muscovite-rich; 6o Coarse grained; 6p Medium grained; 6q Fine grained; 6r Trondhjemite; 6s Brecciated; 6t Quartz-feldspar porphyry

MIGMATITIC ROCKS[4]

5 — 5a Unsubdivided; 5b Quartz-biotite-feldspar schists (metasedimentary migmatite); 5c Hornblende-feldspar schists (metavolcanic migmatite)

MAFIC TO ULTRAMAFIC INTRUSIVE ROCKS[4,5]

4 — 4a Hornblendite; 4b Gabbro; 4c Lamprophyre; 4d Fragmental; 4e Porphyritic gabbro; 4f Peridotite

INTRUSIVE CONTACT

METASEDIMENTS[3]

3 — 3a Massive; 3b Bedded; 3c Sheared; 3d Quartz-rich; 3e Arenite; 3f Wacke; 3g Graphitic; 3h Siliceous ironstone; 3i Chert; 3j Chert-carbonate ironstone; 3k Clast supported granule and pebble conglomerate (probably Timiskaming-type)

FELSIC METAVOLCANICS[4]

2 — 2a Massive; 2b Foliated; 2c Pyroclastic; 2d Blue quartz eye porphyry; 2e Crystal tuff; 2f Pumiceous lapilli tuff; 2g Tuff-breccia

INTERMEDIATE TO MAFIC METAVOLCANICS

1 — 1a Massive; 1b Sheared; 1c Pillowed; 1d Amygdular; 1e Tuffaceous, fragmental; 1f Amphibolite; 1g Diabasic texture; 1h Porphyritic (feldspar phenocrysts); 1i Brecciated

Notes:
1. Osler Group basaltic flows are found mainly on Black Bay Penninsula and on the St. Ignace Island archipelago. Only one outcrop area of possible Osler Group basalts was found in MacGregor Township and it is located approximately 0.8 km south of the Mount Baldy Ski area, adjacent to a small pond.
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MARGINAL NOTES

Introduction

During the 1984 and 1985 field season about 90% of MacGregor Township was geologically mapped at a scale of 1:15 840. Most of the area not yet traversed is located at the north boundary near the central part of the map area.

Location and Access

MacGregor Township is situated in the Municipality of Shuniah and lies immediately northeast of the City of Thunder Bay, Ontario. The map area is bounded on the south by Thunder Bay of Lake Superior, and on the north by Latitude 49°30'36"N; Longitudes 88°48'W and 89°11'W, mark the eastern and western limits of the map area, respectively.

Highway 11-17, the Trans-Canada Highway, cuts across the southern portion of the Township near Lake Superior; Highway 527, the Spruce River Road, traverses northward across the western sector of the township. Hydro lines, a pipeline, and bush roads provide access to more than 75% of the township. The least accessible areas are the northwestern sector away from Highway 527, and the area where Longitude 89°00'W intersects the north boundary.

Previous Geological Work

The northern sector of the Township was mapped by MacDonald (1941). Moorhouse (1960) mapped the Proterozoic Gunflint Formation located in the southern section of the township near Lake Superior. McIlwaine (1971a, 1971b, 1975) mapped McTavish Township, immediately east of the present map area. Tanton (1926) mapped parts of the northeastern sector of the area. McKellar (1874) describes some of the earliest discovered mineral occurrences of the area. Scott (1984) gave a preliminary account of the geology of the western half of the map area.

General Geology

A variety of Archean and Proterozoic rocks are found in MacGregor Township. The Archean rocks form part of the Abitibi-Wawa Subprovince, and consist of metavolcanics and associated metasediments, mafic to ultramafic intrusions, hornblende syenites, porphyritic diorites, granites, quartz monzonites, and quartz-feldspar porphyries.

The metavolcanics have been classified into three major subdivisions: felsic (pyroclastics and flows), intermediate to mafic (mainly flows), and ultramafic (flows and possibly pyroclastics). They uniformly face south and form two mafic to felsic volcanic cycles.

The felsic volcanic rocks of the upper cycle trend easterly across the southern part of the map area from the western boundary near the McIntyre Township/MacGregor Township line, and disappear under Lake Superior in the Mary Harbor area.

These rocks consist mainly of pyroclastic felsic volcanic rocks ranging from pumiceous tuffs to tuff breccia. Clasts in the tuff breccia are up to 30 cm long, but typically average less than 10 cm. Collapsed pumice fragments are readily identified on the hydro line north of Highway 11-17 and east of Highway 527 in the lower felsic unit.

Felsic metavolcanics of the lower cycle trend eastward through Gorham Township north of the metasedimentary belt near the Gorham Gold Mines Property. They form a sequence about 1.6 km wide, extending into MacGregor Township as far as Waylan Lake, where they terminate against the MacKenzie Granite.

The sequence is poorly exposed due to thick overburden, but where they outcrop, the lower cycle felsic metavolcanics consist of tuff-breccia, tuffs, crystal tuffs, and tuffaceous cherty units.

The tuff-breccia exposed on Copenhagen Road north of the Mitchell Road intersection, consists of pale green, fist-size fragments set in a slightly darker green matrix. Quartz eyes, pyrite (<1%), minor carbonate, and a blocky fragmental appearance are typical of the unit.

The crystal tuff, as exposed midway between the intersection of Mitchell Road and Pipeline Compressor Station Road with Highway 527, is massive, light green and relatively hard. The unit consists of a partially welded mass of quartz (eyes), and feldspar crystals set in a fine-grained matrix of what is now sericite plus quartz. The northern end of the exposure consists of graded tuffaceous chert beds that indicate a southerly top direction.

Quartz-feldspar porphyritic stocks are also associated with these felsic volcanic rocks. Some of the stocks contain blue quartz eyes; they intrude the felsic metavolcanics and are best exposed along Highway 11-17, approximately 1.5 km east of the Highway 527/Highway 11-17 junction.

The northern felsic metavolcanic sequence mapped in MacGregor Township appears to be on strike with similar rocks in Gorham Township, mapped by MacDonald (1941). Rocks of the Early Proterozoic Gunflint Formation overlie the southern metavolcanic unit, thus correlation between the felsic rocks in Gorham Township and the southern sequence in MacGregor is subject to interpretation.

Intermediate to mafic metavolcanics consist of massive amphibolitic flows, amygdular flows, tuffs, and tuff breccias. These rocks are situated north of the previously described felsic metavolcanics, and disappear under Lake Superior in the Mary Harbor-Silver Harbour area. The general strike of both the felsic and mafic metavolcanic packages is east-west.

Associated with the mafic metavolcanics, and in places intercalated with them, are metawackes plus thin iron formation units. Iron formation is exposed southeast of the Mount Baldy area; although clasts of that type occur in a conglomerate about 1 mile northwest of Mary Harbor, no other exposures of iron formation were noted in the area. Where facing directions can be discerned, graded beds indicate that the area is underlain predominantly by a south-facing sequence.

Several small exposures of komatiitic rocks occur along the hydro line just west of Wildgoose Creek. That area has been faulted, and a wedge of granitic rock now separates the two main exposures of ultramafic rock. The eastern exposure is situated approximately 1.2 km east of the intersection of Wildgoose Creek and the hydro line. Analysis of this unit returned up to 0.15% nickel. These rocks are fragmental in part, and could represent ultramafic pyroclastics, but more detailed study is required to support this interpretation. Such brecciation may also have been produced by diatreme emplacement or tectonism. In other exposures, the komatiites are massive to laminated and show possible spinifex texture in thin section.

In the northern portion of the eastern half of the map area, a thick section of metawackes are intruded by distinctive hornblende gabbro bodies. Hornblende phenocrysts up to 1 cm long form about 15% to 20% of the rock in a matrix of fine-grained feldspar and amphibole. The rock is massive and hard. It has intruded the host metasediments as one or more sill-like bodies. Overburden cover makes it difficult to unequivocally interpret the body as a single sill, or several smaller intrusions.

A distinctive quartz feldspar porphyritic stock intrudes the metasediments in the north-central portion of the eastern half of the area mapped. The quartz phenocrysts are as large as 1 cm in diameter. The porphyry has been sheared and thus the matrix is composed mostly of sericite. It weathers chalk white and exhibits a mottled, apple green fresh surface. The porphyry can be traced over several miles across the central part of the township.

Archean felsic plutonic rocks form two large granitoid bodies within the map area. The southern one, the MacKenzie Granite, is a large intrusion consisting of medium- to coarse-grained, pink to slightly greenish granite composed primarily of microcline, oligoclase, quartz, and biotite with accessory sphene, apatite, opaque minerals, and secondary sericite plus epidote (Rogers 1979). The intrusion underlies most of the southern flank of the map area occupying the area from Mount Baldy to Birch Beach on Thunder Bay, a distance of approximately 22 km. The MacKenzie Granite has been faulted and generally "attenuated" in the area 1.6 km northwest of Mary Harbor, but where not distorted by faulting, the granitic body is in the order of 3.2 km wide.

The northern body, the Penassen Lakes Stock, is very coarse-grained, generally porphyritic, and ranges in composition from granite to quartz monzonite with hornblende syenite and hornblendite phases. The syenitic and hornblendite phases appear to be restricted to the area near, and to the west of, Highway 527. East of Highway 527, in the vicinity of the Penassen Lakes, the rock is a coarse-grained porphyritic quartz monzonite.

A similar satellite intrusion of hornblende syenite, and a curious coarse porphyritic gabbro, occur on the eastern flanks of the Penassen Lakes Stock. Feldspar crystals in the porphyritic gabbro are up to 13 cm long, comprise up to 80% of the rock, and define a near perfect mineral foliation.

The Proterozoic supracrustal rocks of MacGregor Township consist of clastic and chemical metasediments of the Animikie Group. This group consists of two formations resting unconformably on the Archean basement, the Gunflint Formation and the Rove Formation. In the map area, the Rove Formation is exposed in a narrow strip near Lake Superior. Isolated outcrops of a basal conglomerate occur throughout the southern portion of map area. In each case the Archean rocks beneath the conglomerate have been severely altered and weathered, possibly due to a period of pre-Gunflint weathering.

Late diabase sills and dikes intrude all other rock types in the area.

Structural Geology

The metavolcanic-metasedimentary sequence has a general easterly trend. Schistosity strikes parallel to the trend of the major units, and has in many instances destroyed primary structures. The schistosity dips very steeply to vertical. Locally the schistosity undulates, and may vary by several tens of degrees in single outcrops. Locally, shearing has severely deformed the rocks; in some cases mylonitic textures are evident. Near the granitoid contacts, primary features such as pillows in volcanic rocks, and graded bedding or crossbedding in sedimentary rocks, have been obliterated.

Where facing directions are discernible, they indicate a southward facing sequence; locally, some units face north, probably reflecting small-scale folding in the metavolcanics.

Major regional faults transect the map area, trending northeast, north-northeast, and northwest. Some fault zones contain late diabase dikes. Just southeast of Pass Lake Corners, at the far northeastern corner of the map sheet, Gunflint Formation chert-carbonate rocks have been brought into fault contact with Archean metasediments, suggesting that several episodes of faulting occurred.

In most places the Gunflint Formation is generally flat lying or shallow dipping toward the south, and unconformably overlies the Archean rocks. However in the area between Blende Lake and O'Connor Point on Lake Superior, the chert-carbonate member of the Gunflint Formation exhibits extraordinary brecciation and folding. This deformation appears to be restricted to the eastern portion of the map area.

Economic Geology

MacGregor Township is well known for old silver occurrences. Typically these occur as veins associated with the Proterozoic/Archean unconformity (Tanton 1931; Franklin 1970). Commonly these veins occupy fault or shear zones and contain sphalerite, galena, chalcopyrite, native silver, argentite, fluorite, calcite, amethyst, pale quartz, and barite. The vein systems appear to crosscut all lithologies and are best exposed along Highway 11-17 east of Thunder Bay. Veins mapped in 1984 and in 1985 varied in width from just a few centimetres wide to zones several meters wide. They generally strike north-south, but are also found in some fault zones that strike northeastward (Cornish Mine).

The amethyst-bearing veins are of the same relative age as the silver veins and occur throughout the map area. In most cases they crosscut the MacKenzie Granite and the Penassen Lakes Stock. A significant concentration of the amethyst-bearing veins crosscut felsic metavolcanics exposed on the hydro right-of-way approximately 2.4 km west of Mary Harbor.

Several old silver mines exist in the township. These are: Cornish Mine, 3A Mine, Beck Mine, Thunder Bay Silver Mine, Algoma Mine, and 7Z Mine. While the economic viability of silver deposits today might be low, veins of this type have excellent potential for amethyst.

During the course of mapping many quartz veins were sampled by the author and assayed by the Geoscience Laboratory, Ontario Geological Survey (OGS) for gold and silver. While not all samples returned gold values, there is enough potential in some areas to warrant further exploration for gold.

One area of interest is that around an old quarry near the Nelson Road-Highway 11-17 junction. There narrow sulphide-bearing veins, probably occupying shear zones in a dark siliceous, metasedimentary rock, carry arsenopyrite, pyrite, zinc, and gold. Values of up to 1.06 ounces gold per ton were obtained from these veins in grab samples collected by the author and assayed by the Geoscience Laboratory, OGS. This property is currently held by Bill Hayne of Thunder Bay.

A zone of quartz stockwork and silicification exists north of the hydro line north of Birch Beach. No known exploration work has been done in that location. Some of the larger quartz veins are up to 30 cm wide and exhibit pyrite gossan in places. One grab sample from the area returned values of trace gold, and 0.76 ounce silver per ton (sampled by the author, assayed by the Geoscience Laboratory, Ontario Geological Survey). The area has good potential for gold, and should be prospected.

Further east, about 2.4 km north-northwest of Mary Harbor and east and north of the Canadian Pacific Railway tracks, on a south facing slope, there is a quartz stockwork that carries gold. A grab sample collected by the author and assayed by the Geoscience Laboratory, OGS ran 0.02 ounce gold per ton. The individual quartz veins are narrow, but overall the zone itself is at least 2 m wide where exposed. The owner of the surface rights, Mr. A. Kurikka of Thunder Bay, states that there are several old pits and one shaft located between the CPR tracks and the hill. These were not seen during mapping. A 3 m wide quartz vein with a crack and seal texture is located on the northern face of the above slope near a small beaver pond. Further work is warranted.

Closer to the City of Thunder Bay on the hydro line just north of Highway 11-17, about 2.5 km east of the junction of Highway 11-17 and Highway 527, two separate outcrops of quartz stockwork in felsic volcanic rocks should be prospected. The zones are approximately 0.4 km apart. Analysis of a sample taken by the author from the hydro line at a point 0.4 km north-northwest of where it crosses Highway 11-17, returned 185 ppb Au upon assay by the Geoscience Laboratory, OGS.

Komatiitic rocks located near Wildgoose Creek and the hydro line assayed up to 0.15% nickel.

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SYMBOLS

- Glacial striae
- Esker
- Kettle hole
- Small bedrock outcrop
- Bedrock area outcrop
- Bedding, top unknown (inclined, vertical)
- Bedding, top indicated by arrow
- Foliation
- Lineation (with plunge)
- Geological boundary (observed, inferred, based on geophysics)
- Fault or lineament
- Jointing (inclined, vertical)
- Drag folds with plunge
- Quartz vein network
- Shaft
- Pit or trench
- Quarry
- Sand or gravel pit
- Limit of MacKenzie Moraine
- Mineral occurrence
- QTZ 1 Milky vein quartz
- QTZ 2 Amethystine-type quartz vein
- QT Quartz-tourmaline vein
- Survey stake

PAST PRODUCING MINES

1. Cornish Mine
2. 3A Mine
3. Thunder Bay Silver Mine
4. Beck (Silver Harbour) Mine
5. 7Z Mine
6. Algoma Mine

ABBREVIATIONS

Ag	silver
amy	amethyst
As	arsenic
Au	gold
bx	breccia
carb	carbonate
Cu	copper
ep	epidote
Fe	iron
IF	iron information
Ni	nickel
Pb	lead
py	pyrite
Zn	zinc

SOURCES OF INFORMATION

Basemap derived from Forest Resources Inventory (F.R.I.), Ministry of Natural Resources, with corrections by J.F. Scott.

Moorhouse (1960); Tanton (1928, 1931); MacDonald (1941). See References.

Magnetic Declination is assumed to be 0°

ODM–GSC aeromagnetic map 2116G, scale 1:50 000.

ODM geological compilation Map 2232, scale 1:50 000.

CREDITS

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Every possible effort has been made to ensure the accuracy of the information presented; however, the Ontario Ministry of Northern Development and Mines 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.

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

Scott, J.F. 1990. Precambrian geology, MacGregor Township, east half; Ontario Geological Survey, Preliminary Map P.2985 (revised), scale 1:15 840.