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Geology of the

Chapleau Area

Districts of Algoma, Sudbury, and Cochrane

By

P.C. Thurston, G.M. Siragusa, and R.P. Sage

Geoscience Report 157

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Scale 1 inch to 4 miles (1:253,440).

Map 2351–Folyet, Districts of Algoma, Cochrane and Sudbury.
Scale 1:250,000.

Map 2352–Chapleau, Districts of Algoma and Sudbury.
Scale 1:250,000

CHARTS

(back pocket)

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ABSTRACT

The map-area lies in north-central Ontario and is bounded by Latitudes 49°00′ and 46°45′ North, and Longitudes 82°00′ and 84°00′ West, excluding the area west of Longitude 83°30′ and south of Latitude 47°30′. This region, comprising about 13,400 square miles (34,700 km²), was mapped by helicopter-supported reconnaissance in 1970.

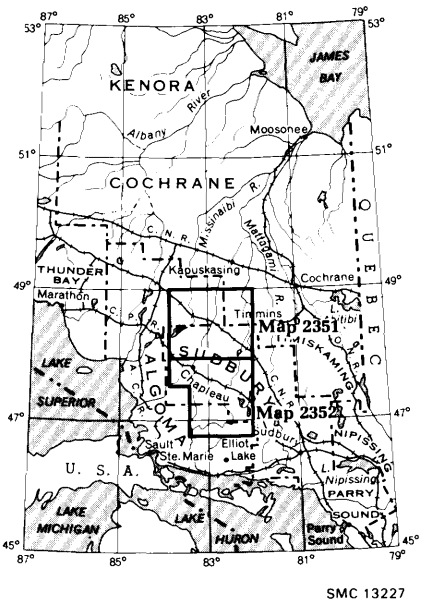


Figure 1–Key map showing location of Chapleau area.
Scale 1 inch to 200 miles (1:12,672,000).

All bedrock in the area, except lamprophyre dikes, is of Precambrian age. The oldest rocks are Early Precambrian metavolcanics and metasediments, which form parts of the Abitibi and Wawa Subprovinces. The metavolcanic-metasedimentary belts and surrounding granitic rocks are intruded by numerous small mafic to ultramafic stocks which represent several ages of intrusion. The belts are surrounded by later granitic batholiths and migmatized sedimentary and volcanic rocks, and are truncated by a large NNE-trending block of highly metamorphosed supracrustal rocks forming the Kapuskasing Structural Zone. The authors believe this zone to be a horst, which developed in Middle Precambrian time (i.e. after the Kenoran Orogeny). The southern segment of the Structural Zone is the site of a 450-square mile (1200 km²) basement-type anorthosite of Early Precambrian age. All these rock-units are cut by diabase dikes. From 1103 m.y. to 128 m.y., predominantly alkalic magmatism spatially associated with the Kapuskasing Structural Zone has produced at least three carbonatite-alkalic complexes, a monzonite-syenodiorite-diorite stock, several mafic intrusions, and lamprophyre dikes.

During the Pleistocene Epoch, the northern part of the area was covered by glacial Lake Barlow-Ojibway. Lake Sultan, a smaller proglacial lake, existed in the central part of the map-area, giving rise to extensive lacustrine deposits. In the southern part of the region Pleistocene cover is relatively thin and discontinuous.

Occurrences of antimony, apatite, arsenic, bismuth, copper, gold, iron, lead, molybdenum, niobium, rare earth elements, silver, thorium, uranium, zinc, and zirconium are known within the map-area. Production of gold, silver, and asbestos is recorded. The only operating mine at the time of writing is the Reeves mine of the Canadian Johns-Manville Company Limited in Reeves Township.

Geology

of the

Chapleau Area

Districts of Algoma, Sudbury, and Cochrane

by

P.C. Thurston[1], G.M. Siragusa[1], and R.P. Sage[1]

INTRODUCTION

Operation Chapleau was the fifth in a series of Ontario Division of Mines helicopter-supported regional mapping projects. Mapping was done at a scale of 1 inch to 2 miles (1:126,720) of an area of about 13,400 square miles (34,700 km^2) for publication at a scale of 1:250,000 as Maps 2351 and 2352 (back pocket); the mapping has also been incorporated in Map 2221, a revision of the Chapleau-Foleyet Sheet (Carlson and Donovan 1967, Map 2116) of the Geological Compilation Series at a scale of 1 inch to 4 miles (1:253,440). Preliminary outcrop maps including a compilation of the Pleistocene geology were issued in 1971 (Thurston, Siragusa, and Sage 1971a; 1971b; 1971c; 1971d).

Location and Access

The map-area is bounded by Latitude 49°00′ on the north, 46°45′ on the south, and West Longitudes 82°00′ and 84°00′, but excludes the rectangular area bounded by Latitude 47°30′ on the north and Longitude 83°30′ on the east. The map-area includes parts of the Sudbury, Porcupine and Sault Ste. Marie Mining Divisions. The map-area covers a relatively settled part of north-central Ontario. It is served by only a few main roads, but a good network of private roads services most of the region. Highway 129 from Thessalon to Chapleau transects the map-area in a north-south direction. The other major road, Highway 101, extends from Wawa to Chapleau and thence via Foleyet to Timmins. A variety of forest access roads (open to the public) and road systems built by private interests cover the central part of the region. Given the large number of secondary

[1]Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Toronto; manuscript submitted May 1972, approved for publication by the Director, Geological Branch, May 1973. The 'Shawmere Anorthosite Complex' section of the report was revised April 1974.

roads within the region, only those appearing on the air photographs, and more recent major secondary roads are indicated on the preliminary maps.

A major system of private roads east and south of Sultan, a settlement on the Canadian Pacific railway east of Chapleau, is maintained by The E.B. Eddy Company Limited. Access to this road system is restricted to pass-holders by company gates at Sultan and Webbwood. Passes are available at these two points for those having business in the area.

Both the Canadian National Railway and the Canadian Pacific Railway transcontinental lines pass through the region. Daily local trains, carrying passengers and freight, provide access to points along the railways. When arrangements have been made in advance, unaccompanied freight will be dropped off at all sidings on the lines and passengers will be transported to any point requested on the lines, a means of access used occasionally during this survey.

Charter aircraft were available at Unegam Lake, Chapleau, and Ivanhoe Lake near Foleyet within the map-area. This is the best means of access to the southern part of the region where roads are not numerous. The northern part of the region, with few lakes and scarcely any roads, is best suited to helicopter transportation. Most lakes are suitable for float or ski-equipped aircraft. However, at the time of mapping Rocky Island Lake contained very abundant floating logs from recent clearing operations, making aircraft landings there impossible at times and hazardous at best. Some of the medium-sized lakes in the northeastern and far northern parts of the map-area are shallow and muddy, making summer landings impossible. Although stretches of the larger rivers are suitable for aircraft landings, they are mostly in the northern part of the area where they traverse abundant clay and (or) sand rendering the water too turbid, at high water in particular, for safe landing.

Resident Population

The main settlement in the map-area is Chapleau with a population of 3,365. It is a lumbering and tourist centre, with commercial facilities adequate for provisioning field crews, lying on the Canadian Pacific railway and served by Highways 101 and 129. Foleyet, a village (population 637) on the Canadian National railway, is primarily a lumbering community with some tourist facilities concentrated nearby on Ivanhoe Lake.

Small settlements occur at section points along both railroads. Along the Canadian National railway the only settlement besides Foleyet with permanent residents is Elsas (population 28). Elsas provides access via the Chapleau River to a tourist lodge.

Along the Canadian Pacific railway the following settlements occur: Esher (population 143), Devon (population 37), Nemegos (population 25), Kormak (population 144), Sultan (343), Ramsey(111), and Biscotasing (population 62)[1].

[1]All population figures: 1971 Census of Canada, Population Unincorporated Places; Statistics Canada, Special Bulletin, Catalogue 92-771 (Sp-1) March 1973.

Sultan and Kormak are settlements built around lumbering camps and cutting operations. Ramsey and Biscotasing are primarily lumbering centres but a certain amount of tourist outfitting is done there. Tophet is the settlement within Indian Reserve 76A occupying the whole of Mountbatten Township and includes 100 to 200 people. Small Indian Reserves with small but unknown populations lie 1 to 4 miles (1.6 to 6 km) south of Chapleau. Indian Reserve 73 in the north-eastern part of the map-area did not appear inhabited to the authors.

Tourist establishments offering fly-in fishing and hunting operate on a number of lakes during the summer and fall months. Information on this is available from the Ontario Ministry of Industry and Tourism.

Natural Resources

The northern part of the map-area lies within the Boreal Forest region and the southern part within the Great Lakes–St. Lawrence Forest Region (Rowe 1972). The area is well forested in areas removed from the extensive pulp-logging operations in the northern and northeastern parts of the map-area and the lumbering operations along the Canadian Pacific railway in the Chapleau-Sultan-Biscotasing area. In the predominantly granitic uplands of the southern part of the region, white pine, white spruce, white birch, red pine, and jack pine are the principal tree types. To the north, white pine, red pine, and yellow birch disappear between Chapleau and Foleyet. In the largely swampy lowlands north of this zone, black spruce, tamarack, and cedar become abundant, with balsam fir, black spruce, white birch, and poplar being found on the better-drained, sandy, high ground.

Pickerel and pike are the most common fish, found in most of the lakes and streams. Brook trout and lake trout have been found in the Devon area and on minor watersheds feeding the Missinaibi, Groundhog, Ivanhoe, and Swayze Rivers. Sport fishing is sufficiently good to maintain numerous tourist establishments.

Moose are fairly abundant and deer were seen occasionally by members of the field party. Bear, beaver, wolf, otter, rabbit, weasel, red fox, muskrat, skunk, and groundhogs were identified by sight, spoor, or skeletal remains.

Topography and Drainage

The map-area lies on the divide between the Hudson Bay–James Bay drainage system and the Great Lakes drainage system. The height of land extends through the central part of the Swayze-Deloro metavolcanic-metasedimentary belt, with the Kapuskasing, Missinaibi, Groundhog, and Ivanhoe Rivers flowing north. The main southward flowing streams are the Kebskwasheshi, Wenebegon, Aubinadong, and Mississagi Rivers.

The northern part of the region is mantled with glaciolacustrine sediments and is flat. The courses of most of the waterways in this part of the region are

controlled by the various Pleistocene deposits. To the south, i.e. well south of the Swayze-Deloro metavolcanic-metasedimentary belt, the Pleistocene deposits are not as extensive, and the drainage pattern is controlled by fractures in the granitic rocks. This is particularly true in the vicinity of Rocky Island Lake and for 10 to 12 miles (16 to 19 km) to the north.

The terrain in the northern part of the map-area consists of low, flat, sandy plains with drumlin fields and eskers rising above the plains in a few places. In the central part of the map-area, numerous moraines give rise to rolling topography succeeded to the south by rocky, dissected uplands with Pleistocene deposits restricted to the larger stream valleys. The western side of the map-area, particularly in the Missinaibi Lake–Rennie Township area, is relatively free of sand and gravel and more rugged in topography, with 200- to 300-foot (60 to 90 m) high hills common. The area underlain by the Shawmere anorthosite complex and immediately northeast of it is characterized by 300- to 500-foot (90 to 150 m) hills, some with good rock exposures, some mantled by drift.

Previous Work

Robert Bell returned from James Bay to Lake Superior via Missinaibi River and Dog Lake (west of the map-area) in 1875, doing the earliest mapping in the region (Bell 1877). W.J. Wilson (1906) travelled some of the rivers in the westernmost part of the area. Wilson and W.H. Collins (1911) produced a compilation map at a scale of 1 inch to 8 miles (1:506,880) based on field work in the interval 1903-1905. This map-area covered the northwestern part of the region, principally part of Missinaibi Lake, Missinaibi River, and Brunswick Lake, the only feature of interest shown being the metavolcanic belt crossing the Missinaibi River at St. Peter Portage (St. Peter Rapids).

T.L. Tanton (1916) produced a compilation map at a scale of 1 inch to 4 miles (1:253,440) which included most of the northeastern part of the region. This work, based on surveys by Tanton and C.H. Freeman (1916) indicated the approximate outline of the northern part of the Swayze-Deloro metavolcanic-metasedimentary belt. However, this map sheet did not extend north of Oates Township.

W.A. Parks (1900) reported on the geology along Niven's Base Line, which he mapped in 1899, in addition to mapping along the Woman, Groundhog, and Ivanhoe Rivers.

The Geological Survey of Canada engaged in the first detailed mapping in the region, in the period 1923-1927 and 1928 to 1930. These surveys covered parts of the Swayze-Deloro metavolcanic-metasedimentary belt (see Emmons and Thomson 1929; Bannerman 1933).

The first semi-detailed work by the Ontario Department of Mines in the region was that of A.R. Graham (1931), who examined an area along the eastern margin of the region including Poulett, Belford, Montcalm, Fortune, Nova, Strachan, Enid, and Frey Townships. This was followed by a series of reports on various parts of the Swayze-Deloro belt by Furse (1932), Rickaby (1934), Harding (1937), Meen (1942), Prest (1950), Moorhouse (1949), Laird (1935a, b), Donovan (1965d; 1968) and Milne (1972).

McMurchy (1960) examined the Saganash Lake-Wakusimi River area in the north-central part of the map-area. Burwash (1935) and Bruce (1942) were early workers in the Michipicoten metavolcanic-metasedimentary belt followed by Ferguson (1968a, b) and Riley (1971).

Several road-logs were published soon after completion of the various major roads passing through the region. In general these maps were not successful in presenting a regional geologic picture. Included here are: Carlson (1963), Giblin (1967), and Harding (1950). Robertson (1968a) published some material on granites in the southern part of the area.

The Geological Survey of Canada completed a study of the northern part of the Kapuskasing Structural Zone (MacLaren *et al.* 1968). Parts of this study have application to the map-area.

This section of the report is not a complete compilation of all previous geologic work in the region; it attempts only to mention the major items. For a more complete bibliography, consult the list of references of this report.

Present Geological Survey

Field work summarized in this report was carried out in the summer of 1970, and a small amount of additional work in 1971. The crew consisted of three staff geologists, five senior assistants, and seven junior assistants.

The nominal scale of mapping was 1 inch to 2 miles (1:126,720). In practice this meant that the granitic regions of the map-area were mapped by means of a grid of outcrop examinations at roughly 2-mile (3.2 km) intervals. Most of the exposures along easily accessible roads in granitic areas were examined. In the Kapuskasing Structural Zone all helicopter-accessible outcrops were examined, and virtually all outcrops observable from aircraft were examined by ground traversing, except where previously mapped. The Shawmere anorthosite complex was traversed at 1- to 3-mile (1.6 to 4.8 km) intervals, access and outcrop distribution permitting, and all helicopter-accessible outcrops were visited. All major streams and roads were examined.

Large parts of the metavolcanic-metasedimentary belts of the map-area have been recently mapped in detail (see section 'Previous Work'). Accordingly, work in the belts was concentrated in relatively unknown sections where traverses were run at 1 mile (1.6 km) intervals. Lakeshore examinations were made in these areas of the belts. In addition, as a check on the consistency and accuracy of the previous mapping, roadside and lakeshore outcrops were checked and critical areas examined by helicopter.

Mapping was done using air photographs at a scale of 1 inch to 1 mile (1:63,360) supplied by the National Air Photo Library, Department of Energy, Mines, and Resources, Ottawa. Outcrop geology and the boundaries of outcrop areas were plotted in the field on acetate overlays to the air photographs; the data were transferred to base maps prepared by the Cartography Section, Surveys and Mapping Branch, Ontario Division of Lands at a scale of 1 inch to 2 miles (1: 126,720) from reductions of Forest Resources Inventory maps (scale 1 inch to ¼ mile or 1:15,840) of the Timber Branch of the Ontario Ministry of Natural Resources.

The present survey was integrated where possible with previous mapping. In the Swayze-Deloro belt in particular, in places where the present mapping was not consistent with previous work, it was assumed that the previous, more detailed work was valid. Not all outcrops shown on the preliminary maps were visited. In the metavolcanic-metasedimentary belts in particular, many outcrop areas shown on the maps represent generalization of previous work. In areas outside the belts, ourcrop areas shown were usually delineated by helicopter observation with some air photo interpretation. Within the dashed lined delineating outcrop an **x** (i.e. the symbol for small outcrops on conventional ODM maps) denotes a point where that outcrop was actually examined. Outcrop codes (for example **5a**) are placed as close as possible to the site of examination. The scale of mapping has meant that some detailed information, particularly some structural measurements, could not be shown on the maps because of lack of space.

The survey was conducted from a base camp at Foleyet in the early part of the field season. Thereafter, the operation was conducted from Chapleau.

The helicopter was used for delineation of the metavolcanic-metasedimentary belts and all mapping of granitic rocks north of the Canadian National railway, where access is poor. South of Latitude 47°30′, helicopter mapping and a limited amount of lakeshore and road checking was carried out. The party used a Bell J-2 helicopter for most of the field season, and a Bell G-4a helicopter for a month in mid-summer. A total of about 425 hours were flown with a breakdown of utilization similar to that previously reported for Operation Fort Hope (Thurston and Carter 1970, p.5).

R.P. Sage was responsible for examination of mineral deposits and properties, compilation of assessment data, location of all mineral deposits on the maps, and the following sections of the report: 'Economic Geology', 'Carbonatite-Alkalic Complexes', and 'Shenango Intrusive Complex'.

G.M. Siragusa assembled all geological information previous to the field work and was responsible for the following sections of the report: 'Metavolcanics', and 'Felsic Igneous and Metamorphic Rocks'.

P.C. Thurston was reponsible for the remainder of the report. The bulk of the helicopter-mapping and planning of the project were handled by P.C. Thurston and G.M. Siragusa.

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W.R. Troup served as winter assistant on this project and is responsible for the compilation of Pleistocene geology, modal analyses of rocks, some thin section examinations, point counting of stained rock slabs and some draughting.

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All assays, chemical analyses, spectrographic analyses, and mineralogical determinations involving X-ray diffraction or reflected light work, quoted in this report were done by the Mineral Research Branch, Ontario Division of Mines unless otherwise stated.

Information quoted from the files of the Mineral Resources Branch, Department of Energy, Mines, and Resources, Canada, was obtained from the Geoscience Data Centre, Ontario Division of Mines.

Terminology

MAJOR SUBDIVISIONS OF THE SUPERIOR PROVINCE

All bedrock in the map-area lies within the **Superior Province** of the Canadian Shield. Parts of three subprovinces of the Superior Province underlie the map-area, i.e. the **Wawa Subprovince**, the **Abitibi Subprovince**, and the **Kapuskasing Structural Zone**. These tectonic units are outlined by Stockwell (1970) and Ayres *et al.* (1971a); in the literature these units are also referred to as "Belts", but in this report "belts" (uncapitalized) is reserved for metavolcanic-metasedimentary belts ('greenstone' belts).

At the present time, the tectonic boundaries of the Kapuskasing Structural Zone are not well defined, particularly at its southern end. Therefore, in this report, the term *Kapuskasing Structural Zone* is used in the lithologic sense for

the unit comprising the granulites and other highly metamorphosed rocks occurring within the homonymous tectonic subprovince. This lithologic unit has been referred to elsewhere in the literature as the 'Kapuskasing Granulite Complex' or 'Kapuskasing Metamorphic Complex'.

SUBDIVISIONS OF THE SUBPROVINCES

For the sake of convenience, 'greenstone' belts and other prominent structural and lithological units within the subprovinces have been informally named. In this report, 'greenstone' belts are referred to as *metavolcanic-metasedimentary belts*, or simply *belts*. The term *volcanic complex* (after Goodwin and Ridler 1970) is also referred to (e.g. Swayze volcanic complex), but in this report, the term is used for a conceptual model rather than a discrete lithologic unit.

The names used in the report are listed below according to the subprovince in which they occur. The locations are shown on Figure 2 (Chart A, back pocket).

Wawa Subprovince
- Michipicoten metavolcanic-metasedimentary belt
- Kabinakagami Lake metavolcanic-metasedimentary belt
- Saganash Lake metavolcanic-metasedimentary belt

Abitibi Subprovince
- Swayze-Deloro metavolcanic-metasedimentary belt
- Belford-Strachan metavolcanic-metasedimentary belt

Kapuskasing Structural Zone (units which are spatially associated with the Zone and probably fall within its tectonic boundaries)
- Shawmere anorthosite complex
- Nemegosenda Lake carbonatite-alkalic complex
- Seabrook Lake carbonatite-alkalic complex
- Shenango intrusive complex

GNEISSIC AND MIGMATITIC ROCKS

The term *gneiss* is used for a foliated, banded and recrystallized rock in which no obvious intrusive (or age) relationship is present between the leucocratic and melanocratic portions of the rock. When the origin of the gneiss is apparently intrusive, it is referred to as, for example, gneissic granodiorite; when the origin is uncertain, it is described by its mineralogy, for example, biotite-quartz-feldspar gneiss, in order of increasing abundance.

The term *migmatite* is used for mixed rocks in which the leucocratic portion of the rock has intruded (and is therefore younger than) the melanocratic portion. Where the migmatite is composed predominantly of intrusive rock (leucosome) it is described as such, for example, migmatitic trondhjemite; where the origin of the melanocratic portion can be determined, it is described as metavol-

TABLE 1–CLASSIFICATION OF PLUTONIC ROCKS USED BY THE ONTARIO DIVISION OF MINES (AFTER AYRES 1972).

	RATIO POTASSIC FELDSPAR / TOTAL FELDSPAR	COMPOSITION OF PLAGIOCLASE			
		An_{0-10}	An_{10-30}	An_{30-50}	An_{50-100}
QUARTZ > 10%	> $\frac{2}{3}$	GRANITE			?
	$\frac{1}{3}$ – $\frac{2}{3}$	ALBITE QUARTZ MONZONITE	(OLIGOCLASE) QUARTZ MONZONITE	ANDESINE QUARTZ MONZONITE	?
	$\frac{1}{8}$ – $\frac{1}{3}$	ALBITE GRANODIORITE	(OLIGOCLASE) GRANODIORITE	QUARTZ DIORITE	QUARTZ GABBRO
	< $\frac{1}{8}$	ALBITE TRONDHJEMITE	(OLIGOCLASE) TRONDHJEMITE		
QUARTZ < 10%	> $\frac{2}{3}$	SYENITE			?
	$\frac{1}{3}$ – $\frac{2}{3}$	ALBITE MONZONITE	(OLIGOCLASE) MONZONITE	ANDESINE MONZONITE	CALCIC MONZONITE
	$\frac{1}{8}$ – $\frac{1}{3}$	ALBITE SYENODIORITE	(OLIGOCLASE) SYENODIORITE	DIORITE	GABBRO
	< $\frac{1}{8}$				

canic or metasedimentary migmatite. Where the melanocratic portion of the rock predominates (10 to 25 percent of the rock is granitic material) and its origin can be determined, it is described as, for example, a migmatized metavolcanic. Other migmatites may be described by the mineralogy of component rock-types.

FELSIC INTRUSIVE ROCKS (GRANITIC ROCKS)

The nomenclature used for the felsic intrusive rocks is best understood by referring to Table 1, which illustrates the rock classification system used by the Ontario Division of Mines. The three parameters to the system are: (1) the

amount of quartz; (2) the ratio of potassium feldspar to total feldspar; and (3) the composition of the plagioclase. The first two parameters can be determined by point counting stained rock slabs and by simple calculations.

CARBONATITE-ALKALIC ROCKS

The following definitions were taken mostly from Parsons (1961, p.3).

Alkali, Alkalic, and Alkaline. These terms are used in a similar sense by different authors to designate minerals and rocks relatively rich in sodium and potassium (Parsons 1961).

Aegerine-Augite. Sodium-ferric iron pyroxene.

Carbonatite. The term karbonatite was introduced by Brögger... to embrace a family of carbonatite-rich and silicate-carbonate rocks, which he believed to be igneous in origin and crystallizing from a carbonatic magma derived from an alkaline magma that had become enriched in CO_2 by the assimilation of sedimentary limestone. Pecora... who reviewed the carbonatite problem, defines "carbonatites as,... a special kind of carbonate-rich rock genetically related to the alkalic rock-forming process and alkalic-magma irruptions". [Parsons used] the term only for the carbonate-rich foliated rocks that occur as distinctly definable masses with relatively sharp boundaries, and avoided its use for what appear to be carbonate-bearing rocks of a definite metasomatic replacement type (Parsons 1961).

Fenite. Von Eckermann defines this term as '*in-situ* metasomatically altered (without substantial material exchanges) older contacting rocks irrespective of composition, but the term does not apply to mobilized (rheomorphic) and transported hybridic mixed rocks even if their origin may be fenitic' (Parsons 1961).

Foyaite. The original Foya type from Portugal has orthoclase as its chief constituent with nepheline, sodalite, and various ferromagnesian minerals. The composition referred to in this report ... is that used by Brögger and Von Eckermann for their classical memoirs on Fen in Norway, and Alnö in Sweden, respectively (Parsons 1961).

Ijolite. This is a rather melanocratic crystalline rock consisting of nepheline and soda pyroxene. Strictly speaking it defines rocks containing about equal proportions of these two minerals; however, normally the percentages may be highly variable. Melteigite is a related type rich in soda pyroxene, and urtite is a type rich in nepheline (Parsons 1961).

Juvite. This is a leucocratic variety of nepheline syenite consisting of about equal proportions of nepheline and alkali feldspar and minor ferromagnesian minerals. Here it has been used for a distinctive coarse nepheline-rich syenite in the Nemegosenda complex (Parsons 1961).

Jacupirangite. This is used here for a melanocratic series of rocks consisting of varying amounts of apatite, magnetite, and pyroxene. Strictly speaking it applies to rock consisting essentially of titanian augite with accessory magnetite, apatite, nepheline, etc. (Parsons 1961).

Malignite. This is a mesocratic to melanocratic variety of nepheline syenite. Here it has been specifically used for rocks with about equal proportions of alkali feldspar and sodic pyroxene (Parsons 1961).

Niobium (Columbium). This element, No. 41, was first named columbium, however, by international agreement in 1949, chemists agreed to use the term niobium, a later name for the same element (Parsons 1961).
Pulaskite. This term is used for a feldspar-rich alkaline syenite with minor amounts of nepheline and mafic minerals (Parsons 1961).
Rauhaugite. The term used by Heinrich (1966) for carbonatite of dolomitic composition.
Sövite. The term was introduced by Brögger for the calcite-rich member of his carbonatite family. Such terms as biotite-sövite, sövitic fenite, etc. introduced by Von Eckermann are very useful names for carbonate-rich rocks in these complexes (Parsons 1961).

MINERAL DEPOSITS

Mineral deposits of economic or potentially economic value are classified according to (1) whether or not actual production of the commodity has taken place and (2) if no production has taken place, the amount of work done on the deposit.

In this report, a *mine* is defined as a deposit from which *any* amount of the commodity (e.g. gold, copper, asbestos, etc.) has been produced. A mine may be presently in production or a past-producer. In some Ontario Division of Mines reports and maps, the classification of *mine* is reserved for those with some minimum level of production, e.g. $25,000 or 100 ounces of gold etc.

A *prospect* is a deposit which has been developed or explored by underground workings or by more than 2,000 feet (600 m) of diamond drilling, but has not been brought into production.

An *occurrence* is a potentially economic deposit on which less than 2,000 feet (600 m) of diamond drilling and no underground work have been done, and which has not been brought into production.

Note that in the text, the descriptions of mineral deposits are listed under the owner's name if the deposit is on a property held in good standing as of December 31, 1970. If the deposit is not on a property, it is listed under its local name or a geographic name.

GENERAL GEOLOGY

Summary

All bedrock in the Chapleau area is Precambrian in age except lamprophyre dikes which may be Mesozoic. Parts of three structural subprovinces of the Superior Province (Stockwell 1970, p.46) lie within the map-area: the Wawa Subprovince, the Abitibi Subprovince and the Kapuskasing Structural Zone. The Wawa and Abitibi Subprovinces include extensive metavolcanic-metasedimentary belts, surrounded by granitic rocks. The Kapuskasing Structural Zone con-

sists of high grade (granulite facies and upper almandine-amphibolite facies) metasediments and scattered occurrences of mafic intrusive rocks. In the southern part of this subprovince there is a relatively large body of Archean basement-type (Windley *et al.* 1973) anorthosite. The generalized geology of the Chapleau area is shown in Figure 2 (Chart A, back pocket), and the corresponding aeromagnetic expression in Figure 3 (Chart A, back pocket).

In the Abitibi Subprovince the western end of the largest assemblage of metavolcanics and metasediments in the Canadian Shield extends westward into the map-area from Quebec and is abruptly terminated against rocks of the Kapuskasing Structural Zone by a fault zone. The assemblage has been subdivided by Goodwin and Ridler (1970, p.13) into several 'volcanic complexes', each characterized by a mafic to felsic volcanic sequence and associated sedimentary and intrusive rocks. Those complexes lying in part within the map-area are: the Swayze volcanic complex[1], the Deloro volcanic complex[1] and the Kamiskotia volcanic complex. The Swayze volcanic complex consists of an east-trending belt of metavolcanics and metasediments 16 miles (26 km) wide at the eastern edge of the area. It extends westward from the eastern boundary of the region 46 miles (74 km) to the Mountbatten-Crockett Townships area, where it is terminated by a north-trending fault zone. The complex consists, from the margins inwards, of mafic metavolcanics succeeded by metasediments termed the Ridout Series by Rickaby (1934, p.7), up to 4½ miles (7.2 km) wide. Scattered along the length of the complex are several centres of Early Precambrian felsic volcanism and related shallow-water shelf and continental-rise volcanogenic sedimentation, i.e. the Benton-Marion Townships centre, the Denyes-Swayze Townships centre and the Raney Township centre.

The Swayze volcanic complex is succeeded to the north by the Deloro volcanic complex, which underlies the Horwood Lake and Reeves-Penhorwood Townships areas. Structural trends in the Deloro complex have been extensively modified by compression accompanying the intrusion of adjacent granitic rocks, but in general vary from east in the Reeves-Kenogaming area to northeast in the Horwood Lake area. The Deloro complex consists dominantly of mafic metavolcanics with only minor metasediments and is distinguished from the Swayze complex by different types of felsic metavolcanics and a greater abundance of mafic and ultramafic rocks. Minor pyroclastic and extrusive felsic metavolcanics are found in the vicinity of Keith Township (Prest 1950) but the most abundant felsic igneous rocks in the Groundhog Lake area are subvolcanic (Breaks 1973, p.37). Mafic and ultramafic rocks, perhaps representing relatively high-level intrusions are abundant in this complex (Milne 1972). The Deloro volcanic complex is a maximum of 8 miles (13 km) wide where it enters the region along the eastern boundary in Kenogaming and Sewell Townships. It extends westward for about 24 miles (39 km), where it is terminated by fault zones and granitic intrusions, both possibly related to the Kapuskasing Structural Zone.

The western tip of the Kamiskotia volcanic complex, represented by the largely mafic metavolcanics of the Belford-Strachan Townships area (Bennett

[1]Although the Swayze and Deloro volcanic complexes are considered to represent separate episodes of volcanism, the parts within the map-area form contiguous lithologic units and are referred to collectively as the Swayze-Deloro metavolcanic-metasedimentary belt.

1969), is about 16 miles (26 km) north-south by 12 miles (19 km) east-west.

In the Wawa Subprovince the eastern tip of the Michipicoten metavolcanic-metasedimentary belt (Goodwin 1968, p.77) is exposed in Rennie, Stover, Brackin, Leeson, Lang, and Marsh[1] Townships. A prominent Early Precambrian felsic volcanic complex, characterized by extensive fine-grained pyroclastic rocks, is centred on Rennie Township (Riley 1971, p.29). Extrusive felsic volcanic rocks occur in Stover and Rennie Townships (Bruce 1942), where the structural trends vary from west to north.

The eastern extension of the Kabinakagami Lake metavolcanic-metasedimentary belt, forming part of the Wawa Subprovince, is represented mainly by mafic metavolcanics. This belt is 3 to 4 miles (5 to 6 km) wide and enters the region in Walls Township and continues southeastward, interrupted by north-trending faults, for a distance of 32 miles (51 km) to Coderre Township (Maynard 1929; Map 2351, back pocket).

The Saganash Lake belt extends south for about 9 miles (14 km) from the north boundary of the map-area. The major rock types are mafic metavolcanics, iron formation, and post-tectonic dioritic rocks.

The remainder of the Wawa Subprovince consists of granitic and migmatitic rocks. The granitic rocks of the map-area in general form large, compositionally distinct, composite batholiths of quartz monzonitic to granodioritic composition. These batholiths are surrounded by, and appear to intrude, migmatitic zones which border the batholiths. In general, it can be tentatively suggested that several ages of granitic rocks exist: (1) the leucosome or light coloured component of the migmatitic rocks, which could be, in part, coeval with the rocks of granitic batholiths, and form roof zones over the batholiths; (2) the main granitic batholiths themselves; (3) small granitic plutons associated with the metavolcanic-metasedimentary belts; (4) syenitic and granitic stocks spatially associated with the Kapuskasing Structural Zone, i.e. Halcrow Township (Donovan 1968, p.24, 25) and in the Borden Lake area where granite has been found to possibly postdate metasediments in the Kapuskasing Structure.

The Kapuskasing Structural Zone or Subprovince is a structurally discordant zone, bounded by abrupt changes in lithology and metamorphic grade indicative of faults. The structural discordance is characterized by the ubiquitous occurrence of mylonitization and recrystallization of, in particular, granitic rocks adjacent to the zone. The southwestern end of the Zone may not be fault bounded; it is marked by recrystallized granitic rocks extending southwestwards for an unknown distance (S.B. Lumbers[2] 1971, personal communication). The Zone consists of several discrete fault-bounded blocks of metasediments and metamorphosed intrusive and volcanic rocks trending northeast and having shallow northwest dips. Emplacement of the Zone through an upfaulting mechanism appears to postdate the Kenoran orogeny because structural trends in metavolcanic-metasedimentary belts and in the granitic rocks are truncated. The geological relationships of various Early to Middle Precambrian diabase dike swarms

[1]Formerly Township 44.

[2]Formerly Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Toronto.

TABLE 2 | TABLE OF LITHOLOGIC UNITS FOR THE CHAPLEAU AREA

CENOZOIC
PLEISTOCENE AND RECENT
Till, sand, gravel, boulders, clay

UNCONFORMITY

MESOZOIC
?LATE JURASSIC TO EARLY CRETACEOUS
Lamprophyre dikes

INTRUSIVE CONTACT

PRECAMBRIAN
LATE PRECAMBRIAN
MAFIC TO INTERMEDIATE INTRUSIVE ROCKS[1]
Hornblende syenite, syenodiorite and diorite, hornblende monzonite, porphyritic hornblende diorite, quartz diorite, and gabbro, mafic hornfels

CARBONATITE-ALKALIC COMPLEXES[1]
Alkalic syenite, pulaskite, brecciated alkalic syenite, fenitized rocks, massive mafic nepheline syenite (malignite), massive to foliated nepheline syenite, sovite (calcite-rich igneous rocks), magnetite-apatite rock, urtites, ijolites, melteigites (nepheline-pyroxene rocks)

INTRUSIVE CONTACT

EARLY TO MIDDLE PRECAMBRIAN
MAFIC INTRUSIVE ROCKS
Diabase, quartz diabase, granophyre

INTRUSIVE CONTACT

EARLY PRECAMBRIAN
SHAWMERE ANORTHOSITE COMPLEX
Anorthosite to gabbroic anorthosite, anorthositic gabbro and gabbro, brecciated anorthositic to gabbroic rocks, gneissic to flaser-textured tonalite and monzonite

INTRUSIVE CONTACT

KAPUSKASING STRUCTURAL ZONE ROCKS
Metamorphosed mafic to intermediate intrusive rocks, melanocratic granulite, pelitic and psammitic granulites, metasedimentary and metavolcanic gneiss (upper amphibolite facies), arkosic metasediments

FAULT CONTACT

FELSIC IGNEOUS AND METAMORPHIC ROCKS

Felsic Intrusive and Hybrid Rocks

Massive to gneissic, biotite and hornblende trondhjemite, granodiorite, quartz monzonite, and minor quartz diorite, syenitic rocks, pegmatite, aplite, augen gneiss, granodiorite to diorite (in part hybrid rocks), porphyritic 'granitic' rocks

INTRUSIVE OR GRADATIONAL CONTACT

Migmatitic Rocks

Migmatite with metavolcanic paleosome of quartz-feldspar-hornblende gneiss, migmatite with metasedimentary paleosome of biotite-quartz-feldspar gneiss

INTRUSIVE CONTACT

MAFIC TO ULTRAMAFIC INTRUSIVE ROCKS

Diorite, gabbro, ultramafic rocks and their serpentinized equivalents

INTRUSIVE CONTACT

METASEDIMENTS[2]

Greywacke, arkose, quartzite, conglomerate, argillaceous fine-grained metasediments, biotite-quartz-feldspar schist and gneiss, migmatized metasediments, iron formation

METAVOLCANICS[2]

Felsic to Intermediate Metavolcanics

Rhyolite to dacite flows and fragmental rocks, tuff, lapilli-tuff, agglomerate, breccia, porphyritic flows, quartz-feldspar porphyry, iron formation

Mafic to Intermediate Metavolcanics

Basalt to andesite flows and porphyritic flows, pillow lava, mafic pyroclastic rocks, layered amphibolite, diorite, gabbro, migmatized mafic metavolcanics, iron formation

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Notes:

1 Relative ages unknown, radiometric ages equivalent; these units appear to be spatially associated with the Kapuskasing Structural Zone.

2 Age relationships among mafic metavolcanics, felsic metavolcanics and metasediments are variable.

indicate emplacement of the Structural Zone at its present crustal level at between 1,690 ± 93 m.y.[1] and 2,147 ± 68 m.y. (Rb-Sr radiometric ages from Gates 1971, p. 36; discussed in the section on "Diabase Dikes", "Set 4"). Further detail on the approximate age of uplift is provided by a K-Ar age of 2,519 m.y. on hornblende from the Shawmere anorthosite complex (Watkinson *et al.* 1972).

Toward the southern edge of the Kapuskasing Structural Zone is a highly metamorphosed basement-type anorthosite body with an approximate area of 450 square miles (1200 km^2). Primary pyroxenes are scarce in the anorthosite; the mafic minerals are common hornblende, pargasite, and garnet. Tonalitic, granodioritic, and gabbroic phases, with all intermediate rock types, are present, with anorthosite or gabbroic anorthosite constituting about 80 per cent of the complex. According to the classification proposed by Windley (1973) this calcium-rich, iron-poor complex would be a basement-type anorthosite. Indirect evidence indicates that the anorthosite may have intruded the rocks of the Kapuskasing Structural Zone and that this event occurred before uplift of the Zone.

Three or more carbonatite-alkalic complexes, an alkali-calcic mafic to intermediate stock (the Shenango intrusive complex) and myriad lamprophyre dikes are spatially associated with the Kapuskasing Structural Zone. Magmatism took place through the time interval 1,103 m.y. (age of Seabrook Lake carbonatite-alkalic complex, Gittens *et al.* 1967, p.653) to Late Jurassic or Early Cretaceous (Wanless *et al.* 1973, p.61).

Early Precambrian

METAVOLCANICS

Metavolcanics and metasediments underlie approximately 8.2 percent of the map-area (i.e. approximately 1,100 square miles or 2,849 km^2 out of 13,400 square miles or 34,700 km^2). The largest metavolcanic-metasedimentary belt occurs in the eastern half of the map-area; at its centre are the rocks of the Swayze volcanic complex (Goodwin and Ridler 1970). These are fringed to the south by the metavolcanics of the Shipley[2]-Hong Kong Townships area, and to the north by those of the Deloro volcanic complex in the Horwood Lake area. The rocks of all three of these areas form the *Swayze-Deloro metavolcanic-metasedimentary belt.* The metavolcanics occurring in Carew, Joffre, and Margaret Townships to the southwest of the Swayze-Deloro belt are a thin and relatively highly metamorphosed branch of the latter.

Four other metavolcanic-metasedimentary belts occur in the map-area: (1) the eastern extension of the Michipicoten belt in the Rennie, Brackin, and Lang Townships area; (2) the eastern extension of the Kabinakagami Lake belt in the Walls, Puskuta, and Champlain Townships area; (3) the southern extension of

[1]m.y. = million years before present.
[2]Formerly Township 19.

TABLE 3 | FIELD CRITERIA FOR DISTINGUISHING METAVOLCANICS OF GREENSCHIST FACIES AND ALMANDINE-AMPHIBOLITE FACIES.

Feature	Greenschist Facies	Almandine-Amphibolite Facies
Grain size	Commonly fine to aphanitic	Commonly medium and medium-fine, occasionally coarse
Colour	Solid green and green-grey	Dark green to black
Appearance on fresh surface	Dull or matte in aphanitic rocks; sericeous (silky) in fine grained rocks	Fresh (recrystallized)
Primary structures and textures	Commonly recognizable to well developed	Absent or poorly recognizable
Foliation	Mostly schistosity often accompanied by fissility	Mostly gneissosity, no fissility

the Saganash Lake belt in the Seaton Township area; and (4) the Belford-Strachan belt in the Nova, Strachan, Belford, and Montcalm Townships area.

The Belford-Strachan belt forms a relatively large and isolated block pinching off to the north and narrowing close to the eastern boundary of the map-area, where it is in fault-contact with the metavolcanics and metasediments of the Timmins–Kirkland Lake region (see Ayres *et al.* 1971b).

On the basis of present mapping no connection exists between the above-mentioned belts within the map-area.

Mafic to intermediate metavolcanics (i.e. colour index ranging from 15 percent to 35 percent or more) are the predominant extrusive rocks. Both these and the felsic metavolcanics include massive, foliated, fragmental, and porphyritic phases. These rocks have been metamorphosed, largely under greenschist facies conditions, and locally under almandine-amphibolite facies conditions (Turner and Verhoogen 1960, p.533). With some exceptions, the features listed in Table 3 may be used as field criteria for distinguishing the rocks representing the two facies.

The greenschist-facies, mafic to intermediate metavolcanics are mostly found in the inner parts of the belts or where these have relatively great widths (e.g. Denyes, Greenlaw, Swayze, Dore, Heenan, Marion Townships). Mineralogically, they are characterized by varying proportions of albitic plagioclase, chlorite, epidote, and often carbonate, as dominant components, and subordinate hornblende, biotite, and quartz. No systematic study of the metamorphic mineral assemblages was made, but, generally, the examined thin sections showed scarcity of biotite in assemblages dominated by albitic plagioclase and chlorite, and a scarcity of pyroxene and garnet in those containing essential hornblende and plagioclase.

Amphibolite-facies, mafic to intermediate metavolcanics occur preferentially

toward the margins of the belts or where the belts narrow and pinch out between granitic batholiths. These rocks consist of varying proportions of hornblende and plagioclase as dominant components, and subordinate epidote, biotite, and quartz. Dark green to almost black hornblende may occasionally account for 70 percent of the rock. Garnet porphyroblasts, forming fringes 1 cm or less in thickness around hornblende-rich xenoliths, were locally seen in outcrops of the migmatitic rocks peripheral to the belts.

The largest and best-defined felsic metavolcanic units occur in the less metamorphosed central part of the Swayze-Deloro belt. Metamorphism of these rocks has resulted in assemblages characterized by varying proportions of feldspars (albitic plagioclase, microcline), quartz, sericite, and chlorite. In a few peripheral areas where felsic metavolcanics occur within amphibolite-facies, mafic to intermediate metavolcanics, the former contain appreciably less sericite than they do in greenschist facies areas.

Swayze-Deloro Metavolcanic-Metasedimentary Belt

MAFIC TO INTERMEDIATE METAVOLCANICS

Mafic to intermediate metavolcanics predominate throughout the Swayze-Deloro belt and include massive, pillowed, foliated, fragmental and porphyritic types.

In the townships of Greenlaw, Tooms, Halcrow, and Denyes the mafic to intermediate metavolcanics are massive to foliated fine-grained rocks of basaltic to latitic composition (Donovan 1968, p.19). The mafic metavolcanics of Swayze and Dore Townships are basaltic to andesitic in composition (based on mineralogical criteria, Donovan 1965, p.11), and those of Heenan, Marion, and northern Genoa Townships are predominantly andesitic (based on chemical criteria, Goodwin 1965, p.25). Mafic breccia, tuff, and porphyritic metavolcanics are associated with the massive rocks. The massive rocks are light grey to dark green and contain varying proportions of altered plagioclase, chlorite, hornblende, actinolite, sericite, epidote, and carbonate. The lighter coloured rocks are often found near felsic metavolcanics or siliceous metasediments, and may occur interlayered with dark green andesite within the same outcrop. The foliated rocks are largely chlorite-hornblende-plagioclase schist, mineralogically similar to the massive phase. The trend of metamorphic foliation in the metavolcanics tends to parallel the granite-metavolcanic contact with steep to subvertical dip angles. This is particularly apparent in the western part of Halcrow Township where the trend of schistosity changes from east to nearly north. Pillow structures are rather common and usually they occur in dark coloured, fine-grained andesite, in central Denys and Halcrow Townships, and in the southern part of Greenlaw Township. Pillows apparently occur at certain horizons within the intermediate to mafic metavolcanics. In many instances the pillows have been deformed to the extent that they are of little or no value as stratigraphic top indicators.

Fragmental mafic metavolcanics, including breccia and tuff, are scattered throughout the area. Mafic breccia is found in the vicinity of Cree Lake in

Swayze Township, along the Kinogama River in Halcrow Township, and south of the northernmost band of metasediments in Halcrow Township. It consists of fragments ½ inch (1 cm) to 6 inches (15 cm) in size set in a fine-grained, grey to dark green matrix. The angular fragments are generally pale grey rhyolite and grey-green andesite. Where the matrix is undeformed the fragments are randomly oriented, but where deformation has occurred the degree of shearing is reflected by the degree of elongation and orientation of the fragments. In extreme cases, the felsic volcanic rock fragments parallel schistosity and measure up to 12 inches (30 cm) in length and 2 inches (5 cm) in width. Locally, rock fragments make up as much as 40 percent of the rock. Dark green bedded tuff is exposed near Ridout Lake in Greenlaw Township; the thickness of the beds varies from ⅛ inch (0.3 cm) to several inches and banding in the tuff is best seen on weathered surfaces (Donovan 1968, p.21). The matrix is of andesitic composition and contains fragments of rock and minerals. The rock fragments are essentially of the same composition as the matrix, and altered plagioclase is the dominant mineral fragment.

Coarse-grained dioritic to gabbroic rocks and mafic porphyritic rocks are closely associated with the metavolcanics in a few scattered localities. The major constituents are plagioclase, hornblende, and augite; minor constituents are biotite, quartz, magnetite, epidote, chlorite, zoisite, and carbonate. These rocks are readily recognized where they are associated with felsic metavolcanics but otherwise their origin is problematic because of the textural and compositional similarity to the coarse-grained central parts of mafic flows.

The metavolcanics of the western side of the Swayze-Deloro belt are in contact with the granitic rocks associated with the Kapuskasing Structural Zone along a fault which follows approximately the western boundaries of Halcrow, Tooms, and Eisenhower Townships. In the western part of Halcrow Township outcrops are numerous and thus the mapped location of the granite-metavolcanic contact is fairly precise. In the contact zone small granitic veinlets and stringers occur within the foliated metavolcanics, and granitic sills and dikes projecting from the main granitic body have chilled margins against the metavolcanics. Amphibolite xenoliths are also found in the granitic rocks at some distance from the contact. Towards the contact, the grain size of the metavolcanics becomes coarser, and the recrystallized quartz, plagioclase, hornblende, and biotite give a fresh appearance to the metavolcanics. Similar features are found in small outcrops in the southeastern corner of Hellyer Township, and southwest of the settlement of Kinogama (de Gaulle Township). The latter locality is also the locus of an inferred north- and northeast-trending fault west of which no major metavolcanic occurrences are present. Close to the eastern boundary of Mountbatten Township outcrops are scarce; medium-grained, equigranular, faintly foliated granodiorite containing 4 percent biotite is found on the west shore of Whitney Lake, and foliated, carbonatized, sheared, and locally silicified and pyritized, greenschist-facies metavolcanics occur less than 3,000 feet (900 m) west of the granodiorite. Owing to lack of outcrop, the relationship between these two rock types is unknown. Approximately 4 miles (6 km) west and north of the low-grade metavolcanics, relatively large amphibolite-facies metavolcanic xenoliths and disrupted bands occur within gneissic granodiorite, which has been locally intruded by magnetite-bearing pegmatite. The amphibolite-facies metavolcanics are believed to be autochthonous whereas the low-grade rocks may have reached

their present site as a result of the process of faulting and thus could represent an allochthonous block detached from the bulk of the volcanic rocks by the emplacement of the granitic rocks.

Metavolcanics having a stratigraphic thickness exceeding 20,000 feet (6100 m) are present in the area which includes most of Heenan Township, the northern part of Marion Township, and a thin strip along the northern boundary of Genoa Township (Goodwin 1965, p.25). The metavolcanic sequence includes andesitic to basaltic flows, felsic porphyritic and pyroclastic rocks, thin shaly interflow metasediments, and massive dioritic rocks. Among these the andesitic flows are predominant (Goodwin 1965, p.25).

In Marion Township, zones of pillowed and brecciated lava are present in the interval approximately defined by the iron formation to the south and by the east-flowing segment of the Woman River to the north. The zones are a few hundred to several thousand feet thick and consist of grey, dense, and strongly zoisitized rock of andesitic composition. Flow-breccia zones, generally less than 6 feet (2 m) thick and containing lenticular mafic fragments up to 6 inches (15 cm) long, are associated with the andesite. Numerous thin zones of felsic pyroclastics are indiscriminately scattered throughout the sequence and indicate that felsic discharge continued during the accumulation of the predominantly mafic metavolcanic sequence; a 60-foot (18 m) thick zone of this type is exposed in the northwestern corner of Northcott Bay (Genoa Township) (Goodwin 1965, p.26). Porphyritic varieties of mafic metavolcanics are present and contain altered euhedral crystals of plagioclase and hornblende.

Numerous well-formed pillows, with tops facing north and northwest occur west of the Woman River in Heenan Township. Individual pillows are up to 6 feet (2 m) long and 2 feet (0.6 m) wide but are commonly 1 by 3 feet (0.3 by 0.9 m) in size. Amygdaloidal tops and chloritic rims are present and nests and stringers of white chert commonly occupy pillow interstices.

Grey-weathering intermediate to mafic metavolcanics characterize some localities in the southern part of the Swayze-Deloro belt. In the field, these rocks may be mistaken for intermediate to felsic metavolcanics owing to their pearl grey and greenish grey colours, but microscopic observation and chemical analyses indicate that they vary in composition from dacite to basalt (Laird 1935a, p.10). They are found mostly in Benton Township, but also in Esther, Mallard, Osway Townships, and in the northern part of Garnet Township. Although their appearance is generally fresher than that of typical mafic metavolcanics, these rocks generally consist of little other than alteration products (Laird 1935a, p. 10; Meen 1942, p.8) such as tremolite, epidote, clinozoisite, albite, carbonate, and chlorite. They are separated from the granitic rocks to the north and to the south by zones approximately 1½ miles (2.4 km) wide of hornblende-rich, schistose to gneissic, mafic metavolcanics of equivalent composition but darker colour (Laird 1935a; Map 2221, map-units 1d and 1e), and the difference in colour reflects essentially the difference in metamorphic grade (Moorhouse 1949, p.4). The rocks in these outer zones exhibit pillow structures, amygdaloidal cavities, and fragmental tops. These structures are particularly well developed in outcrops along the west shore of the North Arm of Opeepeesway Lake. Individual flows rarely exceed 100 feet (30 m) in thickness and commonly have a lower part of rather massive andesite, a medial part of pillowed andesite, and a top part of amygdaloidal and fragmental rock. The amygdules are elliptical in shape, up to

1 inch (2.5 cm) in length, and are partially or totally filled with quartz and epidote. Much of the fragmental material is autoclastic in origin, being the crust of partially consolidated flows subsequently brecciated by further upwelling of underlying liquid lava (Laird 1935a, p.7). Narrow bands of tuff and agglomerate are interbedded with the flows, and these pyroclastics closely resemble the autoclastic rocks. In places they may be distinguished by the occurrence of amygdules in the autoclastics and their absence in the pyroclastics.

The granite-metavolcanic contacts are exposed in Mallard, Arbutus, Fingal, Osway, and Esther Townships and show intrusive relationships similar to those previously described in western Halcrow Township.

Mafic metavolcanics of the Horwood Lake area include massive and foliated rocks of dominantly andesitic composition. The foliated rocks are probably slightly less common than the massive ones, and are characterized by a high content of chlorite in contradistinction to the massive rocks which have a high content of hornblende. In places the two types are clearly gradational into each other. Layered amphibolite, although present, is rather uncommon. Pyroclastic rocks consisting of sheared agglomerate and lapilli-tuff were observed only in two localities close to each other, and consequently, they are assumed to be uncommon in the area. Pillowed structures, usually elliptical in shape and averaging 1 foot by 2 feet (0.3 by 0.6 m) in size are common in the area, but, in general, they cannot be used as reliable top indicators.

An irregularly-shaped projection of the Swayze-Deloro belt extends southward into the northeastern part of Shipley Township[1], the northern part of Hong Kong Township, and the western part of Edith Township. This projection consists of predominantly green, aphanitic to fine-grained, schistose to gneissic, intermediate to mafic metavolcanics. The general trend of schistosity and gneissosity is west; dips are subvertical or predominantly to the south close to the southern granite-metavolcanic contact, and subvertical or predominantly to the north close to the northern granite-metavolcanic contact. In Edith Township, minor bedded tuff was found within aphanitic schistose metavolcanics. Granite-metavolcanic contact relationships were observed approximately 2 miles (3 km) north of the pronounced southward pointing turn of the Canadian Pacific tracks in Shipley Township[1]. Although no felsic metavolcanics were found in the few outcrop areas which were examined, they may be present in this relatively large metavolcanic unit which has not been mapped in detail.

A small southeasterly trending belt of highly metamorphosed metavolcanics extends from southern Edith Township to the eastern boundary of Margaret Township. The belt includes black schists and gneisses composed essentially of euhedral, green to brown, hornblende, and intermediate to calcic plagioclase, with lesser amounts of quartz, biotite, chlorite, epidote, sphene, apatite, and magnetite (Rogers 1962, p.10). The belt is bordered by hybrid gneisses consisting largely of migmatized mafic metavolcanics, grading outward into granitic rocks.

[1]Formerly Township 19.

FELSIC TO INTERMEDIATE METAVOLCANICS

The central part or core of the Swayze-Deloro metavolcanic-metasedimentary belt includes approximately 200 square miles (500 km^2) of terrain delimited by the six contiguous Townships of Halcrow, Denyes, Swayze, Dore, Heenan, and Marion; prominent felsic metavolcanic and metasedimentary units are found in this area.

In Marion and Heenan Townships felsic to intermediate metavolcanics form a wedge-shaped unit approximately 10 miles (16 km) long and up to 3 miles (5 km) wide. This unit has an estimated maximum stratigraphic thickness of 10,000 feet (3000 m) (Goodwin 1965, p.4) and includes rocks which vary considerably in composition and texture. The felsic to intermediate metavolcanic unit is bordered on the southeast by younger granitic and dioritic rocks, and on the northwest by the Woman River Iron Formation and overlying metavolcanics of intermediate to mafic composition. The iron formation and adjoining metavolcanics (felsic to the southeast and mafic to the northwest) lie along the northwest limb of the Woman River anticline. The felsic to intermediate metavolcanics include rhyolitic, dacitic, and trachytic pyroclastic rocks and flows, commonly alternating (Goodwin 1965, p.5). Of these, rhyolite is the dominant component. Andesitic flows and tuff are also frequently intercalated with the rhyolite and are generally less than 60 feet (20 m) thick. The fragments of the pyroclastic rocks are generally more felsic in composition than the matrix, although in places the reverse occurs. In rare instances, both mafic and felsic fragments occur in a uniformly mafic matrix. Because of these features the felsic to intermediate metavolcanics and particularly the pyroclastic rocks display great heterogeneity. However, Goodwin (1965, p.5,6) suggested that, in general, the relatively fine-grained phases are common in the lower stratigraphic part of the volcanic sequence and toward the northeast margin of the unit, whereas the upper stratigraphic parts of the unit, adjacent to the overlying iron formation, contain a high proportion of relatively coarse-grained tuff and pyroclastic breccia. The finer grained phases range in colour from white to grey and greyish green and are dense to banded and porphyritic in texture. The coarse-grained phases contain angular blocks up to 2 feet (0.6 m) in size. These variations reflect a change from moderate to explosive volcanic activity and the concentrations of larger fragments (e.g. near Strata Lake, Marion Township) may indicate proximity to source vents. The occurrence of iron formation in a zone of transition from felsic to mafic metavolcanics, the presence of massive base metal sulphides in the iron formation (see 'Economic Geology'), and the association of these features with a major fold (Woman River anticline), present a picture which is unique within the map-area. Fine-grained to aphanitic felsic tuffs occur in the northeastern part of Benton Township. These rocks are predominantly foliated and their consistent southeastern trend indicates that they may lie on the southern limb of the Woman River anticline. However, the reconnaissance scale of mapping was insufficient to accurately define the southern limb of this structure and the areal extent of the felsic metavolcanics south of Heenan Township and Marion Township. Furthermore, no iron formation was found in the area but the possibility exists that some critical outcrops were missed during the mapping. Because of these limitations, the geological boundaries shown on the map should be re-

garded as approximate; detailed mapping may be desirable in view of the possibility that the Woman River Iron Formation and associated base metal sulphides extend to the northeastern part of Benton Township.

A large mass of rhyolite porphyry extends from the junction of the Woman River and Rush River (Marion Township) westward to the centre of Dore Township, a distance of approximately 12 miles (19 km). It has a maximum width of approximately 7,500 feet (2300m) in Heenan Township. This rock contains prominent glassy quartz "eyes", commonly shattered and distorted, and locally, sheared plagioclase phenocrysts in a schistose quartz-feldspar-sericite matrix (Goodwin 1965, p. 26-27). The body contains zones of undetermined size composed of recognizable pyroclastic material. The precise origin of the body is unknown; it is interpreted as either an extrusive or a subjacent intrusive phase of felsic volcanism. Similar although smaller occurrences are found in Swayze and Dore Townships (Donovan 1965d, p.6). They consist of lenticular units of felsic metavolcanics enclosed with sharp boundaries within intermediate to mafic metavolcanics. A felsic unit of this type 3 miles (5 km) long and ½ mile (0.8 km) wide is located in east-central Swayze Township. Felsic units are quite likely more numerous than shown by the map and their presence at different stratigraphic levels within predominantly mafic metavolcanics may be interpreted as the result of cyclic volcanism.

An east-trending unit of felsic to intermediate metavolcanics approximately 24 miles (39 km) long extends from the eastern half of Halcrow Township to the southern part of Newton Township. It attains a maximum width of about 2½ miles (4 km) in the Brett Lake area of Swayze Township where it is cut by a steeply dipping, northwest-trending fault. Near the western boundary of Denyes Township the unit thins appreciably and wedges out toward the centre of Halcrow Township. East of Dore Township the unit first thins and then widens in the southern part of Newton Township to thin again and finally pinch out toward the east. In Denyes, Swayze, and Dore Townships, the unit is lithologically characterized by predominantly massive, fine-grained dacite (Donovan 1965, p.4; 1968, p.6). Porphyritic and fragmental phases are locally associated with the massive phase. The massive phase is whitish to buff in colour and weathers to pink, pale grey, and green hues. It is composed of potassium feldspar, quartz, and plagioclase with lesser amounts of biotite, hornblende, and magnetite, and secondary sericite, chlorite, epidote, clinozoisite, and carbonate; outlines of formerly euhedral crystals are commonly obscured by sericitization and saussuritization. In many places the massive phase underwent carbonatization, which is not evident in hand specimens but is indicated in thin sections by calcite stringers and disseminations. In several localities the massive rock has been metamorphosed to sericite-quartz-feldspar schist, the foliation of which is virtually parallel to the regional trend of the major rock units. A few small attenuated lenses of intermediate to mafic metavolcanics occur within the felsic unit; most of these consist of fine-grained and massive green andesite.

The porphyritic felsic phase is associated with the massive phase into which it grades imperceptibly. It consists of pale grey to colourless quartz phenocrysts set in a fine-grained, light grey, rhyolitic matrix. The quartz phenocrysts are usually rounded and less than 3 mm in diameter. Feldspar porphyry containing phenocrysts of potassium feldspar and plagioclase (oligoclase-andesine), and a few of quartz and hornblende, occurs along the north shore of Brett Lake

(Swayze Township). This rock is mostly grey on the fresh surface and weathers to a pink colour.

The fragmental phase includes volcanic breccia found in outcrops southwest of Denyes Lake (Denyes Township), and in the Ackerman Lake–Brett Lake–Swayze River area of Swayze Township. The breccia contains felsic rock fragments commonly 0.5 to 10 cm or more in size set in a dense rhyolitic to dacitic matrix. In most cases the fragments consist of white and buff rhyolite; pink trachytic fragments may be locally abundant, and fragments of vesicular or 'pumice-like' rock are of rare occurrence (Donovan 1965d, p.6). Most fragments are angular but a few show rounded and corroded edges. Generally no sorting or stratification is present and adjacent fragments in many size ranges are in chaotic disarray.

The eastern part of the Halcrow-Newton Townships felsic to intermediate metavolcanic unit is exposed in the southern half of Newton Township where the dominant rock-type is still a massive, light green, and usually aphanitic rock, weathering pale grey. The rock is composed of strongly altered albitic plagioclase, quartz, sericite, and chlorite, and accessory chlorite (variety penninite), carbonate, epidote, and iron oxides. Networks of minute, pervasive fractures occur within this rock. The fractures are filled with calcite and subordinate secondary quartz. This rock is pillowed and the size of the pillows ranges from 12 inches (30 cm) in length and 6 inches (15 cm) in width to 3 feet (90 cm) in length and 1 foot (30 cm) in width. It appears that the lighter weathering the rock, the smaller are the pillows and the greater is their degree of distortion. Although chemical data are not available to help classify the rock, it is shown as a felsic to intermediate metavolcanic on the map because of the colour of its weathered surface, its hardness and its fractured character.

In Raney, Rollo, Coppell, and Newton Townships, felsic metavolcanic flows and tuffs form relatively thin bands within intermediate to mafic metavolcanics except for the previously mentioned occurrence in southern Newton Township. These bands are generally too small to be shown on the map, and due to scarcity of outcrops it is difficult to establish whether they extend over significant distances.

In the Raney Lake–Denyes Lake area (Raney and Denyes Townships) intermediate to felsic metavolcanics are associated with pelitic metasediments and conglomerates. The latter contain pebbles of rhyolite, porphyritic rhyolite, chert, andesite, and granitic rocks. East-trending schistose metavolcanics of intermediate to felsic composition, and felsic tuff, occur locally in southeastern Raney Township. Lack of outcrop does not permit the areal extent of these rocks to the west to be established, but the author [Siragusa] tentatively suggests that the whole area of approximately 1½ by 4 miles (2 by 6 km) to the east of Raney Lake and to the south of Denyes Creek (Raney Township) is underlain by intermediate to felsic metavolcanics.

Banded felsic tuff and massive felsic metavolcanics are found in the Rollo Lake and Hanson Lake areas of Rollo Township; they range in colour from grey (southeastern shore of Rollo Lake) to white and yellowish (Hanson Lake) and weather to greenish and buff hues. The tuff is generally well bedded and resembles similar small occurrences scattered throughout the Swayze-Deloro belt; the massive phases contain 50 to 70 percent altered albitic plagioclase and are probably dacitic in composition.

A subvolcanic intrusion extends about 2 miles (3 km) westward from the west shore of Groundhog Lake in southern Keith Township and is about 1 mile (2 km) in width. Because of the scale of the survey, the body was not examined and all information on it is the result of mapping by Milne and Breaks (1972a). According to Breaks (1973, p. 33-37) the body consists predominantly of intrusive, quartz-feldspar porphyry, with minor amounts of associated pyroclastic breccia and lapilli-tuff.

In the northern part of the Swayze-Deloro belt, felsic metavolcanics are found as small, discrete local occurrences within the intermediate to mafic metavolcanics, and as relatively continuous west-trending units. These are, however, less conspicuous and less well defined than those in the central part of the belt. Small occurrences of greyish to white weathering agglomerate containing lenticular felsic pebbles and subordinate lapilli-tuff were observed in a few outcrops in the Horwood Lake area; detailed mapping subsequent to the present reconnaissance work (Milne and Breaks 1972a; 1972b) has outlined several small units of tuff and pyroclastic breccia in this area.

An east-trending unit of felsic rocks extends from the central part of Keith Township to the western side of Penhorwood Township where it is bounded by iron formation to the north. In Keith Township, this unit includes mainly fine-grained tuff and porphyry with local layers of coarse pyroclastic breccia containing fragments varying in size from less than 1 inch (2.5 cm) to more than a foot (30 cm) (Prest 1950, p.9). Exposures of these rocks are found on the east side of the Groundhog River. In Penhorwood Township, the unit is essentially unexposed but data from diamond drill core show that it consists of agglomerate interbedded with greywacke, conglomerate, and slate. The association of thin lapilli-tuff and agglomeratic layers with metasediments is also characteristic of the few outcrops in the southeastern corner of Foleyet Township, close to the southern boundary of Muskego Township, and in the southwestern corner of Reeves Township. Some of these outcrops display structural and textural complexity due to deformation and incipient granitization related to the emplacement of the granitic batholiths to the north.

Michipicoten Metavolcanic-Metasedimentary Belt

MAFIC TO INTERMEDIATE METAVOLCANICS

The Rennie-Brackin-Lang Townships area is underlain by an eastern extension of the Michipicoten metavolcanic-metasedimentary belt (Ayres *et al.* 1971b). Mafic to intermediate metavolcanics underlie approximately one-third of Rennie Township, most of the western half of Brackin Township, the northwestern corner of Lang Township, and the northern part of Marsh[1] Township. Minor mafic metavolcanic occurrences in southern Winget and Amik Townships have been interpreted as parts of two metavolcanic units, one of which (i.e. Winget Township) projects westward outside the map-area, and the other (i.e. Amik

[1]Formerly Township 44.

Township) is the northeastern extension of the mafic metavolcanics in Rennie Township.

Metamorphism has produced mineral assemblages characteristic of the greenschist, almandine-amphibolite, and hornblende-hornfels facies (Riley 1971, p.7). Greenschist-facies rocks are characterized by essential albite, amphibole, and epidote and they may contain one or more of chlorite, biotite, quartz, or carbonate. The almandine-amphibolite-facies and hornblende-hornfels-facies rocks are mineralogically identical and are characterized by plagioclase and amphibole and one or more of epidote, biotite, quartz, and carbonate; plagioclase is more calcic than An_{10}, locally shows albite- and pericline-twinning, and in places, is zoned. The accessory minerals are iron-titanium oxides, pyrrhotite, sphene, apatite, and rarely, potassium feldspar and garnet. The amount of quartz in the mafic metavolcanics found in the Rennie, Meath, and Glasgow[1] Townships area has been estimated by Riley (1971, p.7) as less than 10 percent with average content of approximately 4 percent. The greenschist-facies metavolcanics are generally fine-grained grey-green to dark green on weathered surfaces, and medium green on fresh surfaces. The amphibolite-facies rocks are fine grained to medium grained, massive to foliated, and dark green to black in colour. These rocks are probably predominantly basaltic in composition (Riley 1971, p.7). A basaltic composition has been also suggested by Bennett for the mafic metavolcanics occurring in Lang and Marsh[2] Townships (Bennett 1971, p.53). In these two townships, the predominant metavolcanic is a black, medium- to fine-grained rock consisting mainly of amphibole and plagioclase; biotite, garnet, epidote, and magnetite are locally abundant.

Pillows in greenschist-facies mafic metavolcanics were noted by Riley (1971, p.7-8) along the Renabie Road east of the southern end of Colborne Lake (Rennie Township); one occurrence of pillows in almandine-amphibolite-facies rocks was also reported by Riley to occur on the north side of Butler Creek at its outlet from Trem Lake (Rennie Township). Pillows were not found by the authors in the outcrops of mafic metavolcanics visited southeast of Rennie Township.

The granite-metavolcanic contacts generally are sharp in the Crooked Lake area and are migmatitic along the northern shore of Missinaibi Lake. Considerable amounts of injected biotite trondhjemite characterizes exposures along the shore of Ash Lake in Marsh[2] Township but to the north of the lake the predominant granitic rock is quartz diorite blending with granodiorite toward the east.

FELSIC TO INTERMEDIATE METAVOLCANICS

Felsic to intermediate metavolcanics occur in the southeastern quarter of Rennie Township, in parts of northern Stover Township, and close to the western boundary of Brackin Township. In Rennie Township the felsic to intermediate metavolcanics consist largely of massive to foliated porphyritic tuffs ranging

[1]Meath and Glasgow Townships are outside the map-area; Meath is adjacent to and west of Rennie Township, and Glasgow is west of Meath.

[2]Formerly Township 44.

in composition from dacite to quartz latite (Riley 1971, p.10-11). On the weathered surface these rocks have cream, tan, grey, and grey-green colours; they are characteristically porphyritic with quartz and feldspar phenocrysts. The quartz phenocrysts are generally larger than the feldspar phenocrysts, are commonly opalescent, and average approximately 0.5 cm in size. These rocks have been metamorphosed largely under greenschist facies conditions, and locally under almandine-amphibolite facies conditions. Greenschist-facies varieties are composed of albite, quartz, muscovite, biotite, and minor amounts of one or more of epidote, chlorite, carbonate, blue-green hornblende, potassium feldspar, and garnet. Rocks representative of the almandine-amphibolite facies contain sodic oligoclase, quartz, biotite, and smaller amounts of epidote and sericite. Magnetite-ilmenite, leucoxene, hematite, pyrite, apatite, rutile, sphene, and tourmaline are the accessory minerals (Riley 1971, p.10). Volcanic breccia and tuff-breccia are commonly associated with the tuffs but their distinction from the latter is difficult because of poor exposure. Volcanic breccia composed wholly of fragments of fine-grained, light grey dacite porphyry is found at the north end of Stephenson Lake (Rennie Township; felsic to intermediate tuff-breccia associated with breccia units occurs east and south of Rennie Lake. Generally the fragments account for 25 percent of the rock but locally their proportion may be as high as 60 percent; they are subangular in shape and have an average length of 2 inches (5 cm) and a length-width ratio of 2:1.

The southwestern corner of Rennie Township is underlain by a southeast-trending unit of felsic to intermediate pyroclastic rocks (Riley 1971, Map 2210) which extends southeastward to Stover Lake and vicinity in Stover Township (Bruce 1942 and Horwood 1942, Map 51g). Present mapping has shown that the southwestern shore of Stover Lake is underlain by felsic agglomerate containing ellipsoidal fragments of felsic metavolcanics, including felsic tuff, varying in length between a few inches and 1½ feet (0.5 m). The matrix ranges in texture from very fine grained to medium grained, and varies in composition from felsic to intermediate. The eastern side of the lake is underlain by well foliated greenschist-facies mafic metavolcanics locally grading into medium- to coarse-grained, hornblende-plagioclase dioritic rocks. The trend of foliation in both felsic and mafic rocks varies between N65W and N30W and dips are nearly vertical or steep to either the northeast or the southwest. Minor felsic pyroclastic units interbedded with mafic metavolcanics occur also in the vicinity of Crooked Lake (Brackin Township) and in the southern part of the Missinaibi Lake area (Lang Township). The structural features are similar to those of the Stover Lake area; but the thickness of the felsic units and the number of fragments in the agglomerates are considerably reduced with respect to the Stover Lake occurrences. Thus, from northwest to southeast (i.e. from Stover Lake to Missinaibi Lake) the felsic agglomerate appears to grade along strike into felsic tuff, and this in turn interdigitates with intermediate to mafic metavolcanics to the southeast.

Kabinakagami Lake Metavolcanic-Metasedimentary Belt

The Walls-Puskuta-Champlain Townships area is underlain by the eastern extension of the Kabinakagami Lake metavolcanic-metasedimentary belt.

Within the map-area the widest segment of this belt occurs in Walls and Minnipuka Townships; a narrow and poorly exposed southeastern branch of the belt extends through Puskuta and Champlain Townships to pinch off to the south, presumably in northern Coderre Township. Most of the rocks of this belt consist of amphibolite grade metavolcanics. They are fine to medium grained in texture, green to dark green in colour, and probably are andesitic in composition. Minor metasedimentary (greywacke) and felsic metavolcanic units are found in two localities in Walls Township. Possibly more significant occurrences of felsic metavolcanics are found in an outcrop area approximately 1½ miles (2 km) long and less than a mile (1.6 km) wide adjacent to the southern shoreline of Goat Lake (Minnipuka Township), and to the east of the stream connecting this lake with Lower Minnipuka Lake. These occurrences are exposed in a few outcrops scattered over a distance of about ½ mile (0.8 km) near the western margin of the present map-area but owing to the outcrop distribution, it is not known whether they are separate units, or part of one continuous unit over this distance. They consist of grey-weathering, fine-grained, strongly foliated rocks containing occasional feldspar phenocrysts, and probably mainly felsic in composition. They are in sharp contact with the mafic metavolcanics at the rapids approximately 1 mile (1.6 km) downstream from the southwest end of Goat Lake. Here the felsic metavolcanics are fine grained, slightly tuffaceous, and have estimated feldspar, quartz, and hornblende contents of 60, 30, and 10 percent, respectively. They contain numerous quartz lenses and elongated pods a few inches in length. The mafic metavolcanics are also foliated although not as distinctively as the felsic metavolcanics, and near the contact, they contain several concordant bands of very fine-grained to aphanitic felsic metavolcanics up to 6 inches (15 cm) in thickness.

From sparse field data gathered on the southeast-trending branch of the belt it appears that this branch consists essentially of amphibolite-facies mafic metavolcanics possibly bordered by a thin fringe of metasediments close to its southern boundary.

The outcrop pattern and the attitude of foliation in Walls and Minnipuka Townships are indicative of isoclinal folds. The foliation trends in the Walls-Minnipuka Townships area, and in Puskuta Township, cluster around N68W and N45W, respectively, and it is thought that this has resulted from displacement caused by a southwest-trending fault in eastern Legge and Minnipuka Townships.

Saganash Lake Metavolcanic-Metasedimentary Belt

The Seaton-Fenton Townships area is underlain by the southern extension of the Saganash Lake metavolcanic-metasedimentary belt. Within the map-area, the rocks of this belt consist essentially of hornblende schist and gneiss which are largely the metamorphic equivalents of mafic to intermediate flows. The metamorphic grade is almandine-amphibolite, and although pillowed structures and tuffaceous bedding are present in a few localities (e.g. south shore of Saganash Lake) primary features are generally lacking. The dominant rock is a fine- to medium-grained, dark green, plagioclase-hornblende schist. This rock

may contain as much as 60 percent hornblende and locally it contains abundant garnet crystals varying in size between 0.1 and 0.5 inch (0.3 to 1.2 cm) (McMurchy 1960, p.8). Where quartz is present in significant amounts the rock is grey rather than green, and grades into medium- to coarse-grained quartz-plagioclase-hornblende gneiss. Biotite is present locally and garnet is occasionally prominent.

Small bodies of amphibolite occur in the northern part of Seaton Township. This rock is dark green to almost black in colour and in hand specimen it appears to be composed almost entirely of hornblende (McMurchy 1960, p.8). It ranges from fine to coarse grained and generally it has the texture of an intrusive rock. It is usually conformable with the foliated rocks but in a few places it transects them. Some of the amphibolite contains feldspar phenocrysts up to 5 mm in size. The amphibolite has been interpreted as the metamorphic derivative of mafic lava flows by McMurchy (1960, p.8) and by the present authors.

Belford-Strachan Metavolcanic-Metasedimentary Belt

MAFIC TO INTERMEDIATE METAVOLCANICS

Mafic to intermediate metavolcanics underlie substantial portions of Belford, Montcalm, Nova, and Strachan Townships; and on the basis of geophysics they are also assumed to underlie portions of Watson and Poulett Townships. The extent of these rocks to the south is uncertain because the southern boundary of the Belford-Strachan belt is not well defined. On the basis of aeromagnetic interpretation, the mafic metavolcanics are assumed to extend into the extreme northeastern corner of Oates Township, where they are (presumably) in fault contact with the rocks of the Kapuskasing Structural Zone to the west, and truncated to the southeast by large quartz monzonite intrusions.

In eastern Oates Township, the mafic metavolcanics do not extend south more than 3 miles (5 km), where meta-igneous rocks of the Kapuskasing Structural Zone outcrop.

In the northwestern corner of Melrose Township, the contact zone was observed to be broad and migmatitic, with amphibolite grading into migmatitic rocks, which further south grade into biotite quartz-monzonite. On the basis of these contact relationships, the southern boundary of the Belford-Strachan belt lies well to the north of outcrops of massive to foliated, biotite quartz-monzonite in northeastern Oswald Township; the contact is probably slightly north of the southern boundary of eastern Nova Township.

The least altered mafic metavolcanics are fine-grained, massive to faintly foliated, dark green or grey rocks. They consist essentially of saussuritized plagioclase (albite to andesine), and clinopyroxene which has been partly or completely altered to chlorite and uralite (Bennett 1969, p.7). Epidote is abundant in the most altered rocks, and magnetite, ilmenite, and sulphide minerals are generally present as accessories. The higher grade metavolcanics (amphibolite facies) are dark green to black on the fresh surface and consist essentially of hornblende and plagioclase with accessory leucoxene, chlorite, magnetite, and sulphide min-

erals. At several localities in the southwest corner of Strachan Township the amphibolite grades into hornblende-biotite schist. Parts of central Nova Township are underlain by amphibolite which displays well developed, alternating, plagioclase and amphibole-rich bands ranging in thickness from ¼ inch to 1 inch (0.5 to 2.5 cm). The composition and mineralogy of this rock are essentially the same as those of the unbanded amphibolite, and the banding or layering was probably caused by metamorphic differentiation (Bennett 1969, p.8).

FELSIC TO INTERMEDIATE METAVOLCANICS

Part of southern Belford Township and most of the western half of Nova Township are underlain by felsic to intermediate metavolcanics and metasediments (Bennett 1969, p.4). The degree of recrystallization and the low outcrop density preclude subdivision of the rocks into metavolcanic and metasedimentary units (Bennett 1969, p.4). However, Bennett suggested that this area is underlain largely by felsic metavolcanics with thin interbands of metasediments which were probably derived from the volcanic rocks. The felsic to intermediate metavolcanics are grey and green-grey, fine-grained, foliated rocks that weather buff and pale grey. They contain plagioclase (albite-oligoclase), quartz, biotite, hornblende, chlorite, and white mica as essential minerals, and magnetite, iron sulphides, zircon, apatite, and microcline as accessories.

Two units of agglomerate associated with porphyritic dacite extend across the Groundhog River in northern Strachan Township. The agglomerate is mottled grey to buff and contains pale grey to grey fragments set in a dacitic matrix. Individual fragments have undergone extreme deformation and range in width from 0.1 to 1 inch (0.3 to 2.5 cm) to 2 or 3 inches (5 to 8 cm) and in length from 1 inch (3 cm) to at least 5 feet (1.5 m) (Bennett 1969, p.6).

Apart from the two small and separated felsic to intermediate metavolcanic occurrences in northern Belford Township and in northeastern Montcalm Township no other felsic to intermediate metavolcanics were found in northern Belford Township and Montcalm Township. The extrapolation of this data to indicate a relatively wide felsic to intermediate metavolcanic band extending across the area was inferred from aeromagnetic data by L.D. Ayres[1] (1971, personal communication).

METASEDIMENTS

Swayze-Deloro Metavolcanic-Metasedimentary Belt

Metasediments form a small part of the Swayze-Deloro belt, making up no more than 10 percent of the exposed area. The rock types found, in approximate

[1]Formerly Geologist, Geological Branch, Ontario Division of Mines, Toronto.

order of abundance, are greywacke, arkose, conglomerate, quartzite, and argillite. The major occurrences of metasediments are: *(1)* a west-northwest trending band in the southern part of the Swayze-Deloro belt, extending from Yeo Township to Halcrow Township; *(2)* a smaller band in Halcrow and Denyes Townships, just to the north of *(1)*; and *(3)* an east-trending band in the northern part of the Swayze-Deloro belt, in Keith and Penhorwood Townships. The first two occurrences are referred to here collectively as the Ridout metasediments, but no formational status is implied.

RIDOUT METASEDIMENTS

The main band of metasediments *(1)*, was first described in the map-area by Emmons and Thomson (1929, p.7-15) who named it the Ridout series. The band extends west-northwestward from the Opeepeesway Lake area. The band to the north *(2)*; in the Denyes-Raney Lakes area, formerly known as the Swayze series, was named and described by Furse (1932, p.41). Rickaby (1934, p.7,9) tentatively classed both 'series' as Timiskaming in age as did Moorhouse (1949, p.7). Later work (principally Donovan 1965d; 1968) indicated that the metasediments are in large part stratigraphically equivalent to the felsic metavolcanics.

Greywacke

Greywacke occurs as matrix material in conglomerate beds and as a separate rock type. Fresh surfaces are grey to black, and the more feldspathic and less chloritic varieties are lighter in colour. It is usually thin bedded with individual beds ranging from ⅛ inch (0.3 cm) or less to 1½ inches (4 cm) in thickness. Bedding varies from evenly laminated units to crossbedded units several tens of feet in thickness. Bedding is commonly graded, indeed outcrops where this feature cannot be picked out are rare. Individual beds are quite persistent on a small scale and can commonly be followed completely across an outcrop. Greywacke is not usually interbedded with other metasediments, but locally, particularly in the Opeepeesway Lake area, beds of slate and arkose are found within greywacke units. Greywacke seems to be more abundant in the eastern part of the Ridout metasediments than toward the western end. Commonly it grades laterally and vertically into subgreywacke and arkose. The slaty and arkosic beds mentioned earlier constitute only individual beds in a given outcrop. Lithic fragments and individual small feldspar and quartz clasts are frequently observed megascopically. Moorhouse (1949, p. 9) described the alteration of greywacke in the area immediately adjoining the Jerome Gold Mine in Osway Township. The alteration includes "carbonatization, sericitization, and albitization", in places imparting to the metasediments a pink colour resembling that of the adjacent porphyritic felsic metavolcanics. Microscopic examinations by the authors of this rock type concur with descriptions by Laird (1935a, p.14, 15), and the mineralogy is usually indicative of greenschist-facies metamorphism (Turner and Verhoogen 1960, p.533-541).

Conglomerate

Conglomerate is abundant throughout the Swayze-Deloro belt. It is quite variable with regard to the composition and grain size of the matrix and the composition and orientation of clasts within it. In the eastern part of the belt the matrix includes greywacke, arkose, quartzite, and slate, with greywacke as the dominant material. To the west, in parts of Denyes and Greenlaw Townships, the matrix was described by Donovan (1968, p.11) as "siliceous"; it consists of detrital grains, in large part derived from local accumulations of felsic volcanic rocks, and approaches arkose in composition. Argillaceous and greywacke-matrix are still, however, dominant in this area with occurrences just west of the Kinogama River fault in Halcrow Township (see Map 2352, back pocket), along the Kinogama River in southern Halcrow Township, and in Dore Township.

Donovan (1968, p.11) distinguished two types of conglomerate: one with a "siliceous" matrix, and one with a "basic" matrix. The two types are here referred to as *siliceous conglomerate* and *basic conglomerate* respectively.

The *siliceous conglomerate* is white to light grey on fresh and weathered surfaces, and varies from extremely massive cherty material with a subconchoidal fracture, displaying only occasional clasts, usually well rounded and less than 1 inch (3 cm) long, to poorly bedded material with interbeds of more mafic-rich metasediments, or, as in southern Denyes Township, interbeds of felsic metavolcanics. The principal occurrences of this rock type are in Denyes Township and in the Little Ridout Lake area of Greenlaw Township. Clasts, dominantly in the pebble size-range, are mostly felsic metavolcanics including rhyolite, rhyodacite, and porphyritic rhyolite, with minor amounts of other rock types, including mafic volcanic rocks and granitic rocks. Fragments of euhedral and subhedral quartz and feldspar are common.

Clasts are never very abundant in the siliceous conglomerate of the Denyes Township area, forming a maximum of 25 percent of the rock. They seem to be more abundant where dark sedimentary interbeds are more common. Where clasts decrease in size and abundance it would appear that felsic volcanic clasts are the most abundant type.

Donovan (1968, p.11) noted a sequence along Little Ridout Lake of interbedded conglomerate and quartzite about 300 feet (90 m) thick consisting of 1 to 20-foot (0.3 to 6 m) beds of both rock types; the coarse-grained rocks predominate to the south and fine-grained rocks to the north.

The origin of the siliceous conglomerate is problematical. Most samples of this rock type contain abundant fragments of single, angular grains of feldspar and quartz and rare clasts of non-felsic volcanic rock. Bedding was often found to show grain gradations but only rarely was scouring or crossbedding noted. The senior author was able to establish at Denyes Lake that at least some of this material is probably pyroclastic in origin. Some of the fragments have been stretched and are elongated in localities where the surrounding rock types are little deformed.

The *basic conglomerate* of Donovan (1968) is by far the dominant type of conglomerate in the Swayze-Deloro belt. Basic conglomerate has a matrix composed alternatively of argillite, greywacke, or volcanogenic metasediment composed of rounded grains of plagioclase and hornblende, and is usually distin-

TABLE 4 | COMPOSITION OF PEBBLES IN "BASIC" CONGLOMERATE (AFTER EMMONS AND THOMSON 1929, p.9).

Rock type	Number of pebbles
Granite	181
Schist*	56
Iron Formation	12
Diorite	6
Quartz	4

*Here this term is taken to include felsic and mafic metavolcanics and metasediments.

guished from the siliceous conglomerate by a dark fresh surface and a substantial content of mafic minerals. Principal occurrences are: Opeepeesway Lake, Kinogama River in northeastern Halcrow Township, east of Little Ridout Lake in Greenlaw Township, and in the Betty Lake-Hotstone Lake area of Tooms and Greenlaw Townships. On a weathered surface the matrix is medium to dark green or grey to black, fine- to medium-grained, massive to foliated, and consists of argillite, greywacke, or chloritic, volcanic-derived mineral fragments.

Basic conglomerate with a greywacke matrix, a particular type of the more broadly used term "basic conglomerate", is common in the Opeepeesway Lake area, along the Kinogama River (Halcrow Township), and along the Wakami River in Benton Township. The matrix has been described by Emmons and Thomson (1929, p.11) as "...chlorite and quartz, with minor amounts of carbonate, epidote, pyrite, and magnetite. In some examples the matrix is chiefly carbonate, chlorite, plagioclase, and quartz." Schistosity is defined by the mafic minerals and is apparent on the outcrop surfaces, which commonly show "flowing" of the matrix around individual clasts. Graded bedding is common in greywacke intercalations and lenses, particularly in the Opeepeesway Lake and Greenlaw Township localities; crossbedding and occasional scour and fill structures are present.

In the greywacke-matrix basic conglomerate the clasts vary widely in size and composition, and consist of granitic rock, diorite (coarse-grained flows and/or mafic intrusions), metasediments, felsic metavolcanics, mafic metavolcanics, iron formation, and vein quartz fragments. A pebble count by Emmons and Thomson (1929, p.9) over an area 4 feet (1.2 m) on a side including a 1-foot (30 cm) pebble-free bed is shown in Table 4.

It is difficult to estimate the average composition of clasts in the conglomerates because locally any of the above rock types may be the dominant member of the clast population. Donovan (1968, p.14) indicated that volcanic rock fragments are dominant in the Halcrow-Ridout Lakes area but the present survey found that if any type is dominant it is probably the granitic rocks. This concurs with Emmons and Thomson (1929, p.9). The clasts, particularly the pebble fraction, are usually elongated, sometimes in a pronounced fashion with long to short axis ratios of 6:1 or 8:1. Elongation, in addition to being selective with respect to size, is also found to be greater for the less competent metavolcanic and metasedimentary fragments than for the granitic rocks. In most outcrops, clasts

are poorly to well rounded, but occasionally angular blocks of vein quartz or iron formation are present. Clasts compose up to 70 percent of the rock, but more commonly the average is 30 to 50 percent with some beds in the 5 to 10 percent range. Clast-free greywacke and argillite beds from 1 foot (0.3 m) to 50 feet (15 m) in thickness are common in the sequence. Cobbles up to 8 inches (20 cm) were observed, by the authors' assistants, in the conglomerate first described by Emmons and Thomson (1929, p.10), north of Betty Lake in Tooms Township. Laird (1935a, p.13) reported boulders up to 2 feet (0.6 m) in the maximum dimension, with the observation that these are usually granitic in composition. The average size range is, however, typified by cobbles in the 2- to 6-inch (5 to 15 cm) range.

The greywacke-matrix basic conglomerate is gradational with a rock type having an argillaceous matrix. This latter rock type occurs north of Betty Lake in Tooms Township and eastward into Greenlaw Township and in scattered localities in Osway Township (Moorhouse 1949). The rock type has been adequately described by Emmons and Thomson (1929, *quoted in* Donovan 1968, p.13).

In general, the basic conglomerate is more abundant than the siliceous conglomerate. The latter is closely associated with felsic to intermediate metavolcanics, especially in the western part of the belt, i.e. northern Denyes Township, whereas the basic conglomerate predominates in the eastern part except for the local occurrence of lenses of arkosic conglomerate in Osway Township.

Quartzite, Arkose

Quartzite and arkose are common in the western part of the Ridout metasediments, particularly in Halcrow, Denyes, and Greenlaw Townships. Quartzite is grey to white weathering, fine to medium grained, and in places displays graded bedding where well bedded. This rock type has been described in thin section by Donovan (1968, p.15). On Denyes Lake it is interbedded with conglomerate and pelitic beds up to 1 foot (30 cm) wide. Chert is commonly interbedded with the quartzite which is properly classed as a feldspathic quartzite.

Pink-weathering, well to poorly bedded arkose is found in Osway Township and in scattered localities throughout the Halcrow-Ridout Lakes area, and in the southern part of Swayze Township. It occurs interbedded with conglomerate, quartzite, and, to a certain extent, greywacke. Arkose is not a major constituent of the sedimentary sequence and appears to form scattered lenses, principally in proximity to accumulations of felsic metavolcanics.

Shale, Argillite, Slate

Finely bedded, grey- to black-weathering, very fine grained shale and (or) slate occurs as a minor unit in the Ridout metasediments. Typical occurrences are found along the Kinogama River; on Hotstone Lake in Greenlaw Township; south of Dyment Lake in Denyes Township; along the southern boundary of

Swayze Township; in the southern part of the metasedimentary unit east of Ramsay Creek in Osway Township; and west of Rollo Lake in Rollo Township. This rock type occurs as thin (2 to 6 inches or 5 to 15 cm) interbeds in quartzite and arkose sequences, as in Denyes Township (Donovan 1968, p.10). Pelitic material is rarely found as the matrix in conglomerate (Osway Township). Its most common mode of occurrence is as finer grained interbeds of varying thickness (usually under 6 inches or 15 cm) in greywacke-arkose sequences, particularly in the eastern part of the belt. In general, in the western part of the belt, where greater thicknesses of pelitic rocks are found (e.g. the Hotstone Lake and Kinogama River occurrences), these rocks are more likely to be associated with arkose, feldspathic quartzites, and quartzites.

KEITH-PENHORWOOD TOWNSHIPS AREA

Metasediments consisting of argillaceous beds containing volcanic fragments, coarse conglomerate with a sandy matrix and a mixed clast population consisting of quartz porphyry and arkose (?) are found in Keith Township in the vicinity of Slaterock Lake. Occurring in the same area are mixed beds of arkose and conglomerate, and minor greywacke. These occurrences are more fully described by Prest (1950, p.10-11).

Other Occurrences of Metasediments

Riley (1971, p.14) described minor occurrences of volcanogenic argillite in Rennie Township interbedded with medium-grained feldspathic greywacke.

Metasediments occur intercalated with felsic metavolcanics in the Belford-Strachan metavolcanic-metasedimentary belt. Bennett (1969, p. 5, 6) did not separate the two rock types because the metasediments are not very abundant and are easily mistaken for felsic tuffaceous rocks. They are largely arkose and quartzite.

Metasediments are scarce in the Fenton-Seaton Townships area (Saganash Lake metavolcanic-metasedimentary belt). McMurchy (1960, p. 9) noted the existence of quartzite, arkose, and "quartz-mica schist". Where observed during this survey, the quartzite is thin bedded (approximately ½ inch or 1.2 cm) with intercalations of arkose both of which are very fine grained. This occurrence of metasediments, east of Seaton Lake, is 30 to 50 feet (9 to 15 m) thick and forms a minor part of the sequence in an area dominated by iron formation and tuffaceous mafic metavolcanics.

FERRUGINOUS METASEDIMENTS AND IRON FORMATION

The term iron formation is used by Gross (1965, p.83) "to include all stratigraphic units of layered, bedded, or laminated rocks that contain 15 percent or more iron, in which the iron minerals are commonly interbedded with quartz,

TABLE 5 | IRON FORMATION WITHIN THE CHAPLEAU AREA (MODIFIED FROM SHKLANKA 1968).

Township	Facies	Width	Length	Associated Rocks[1]
Algoma District				
Maeck (5 E)	Magmatic	300 ft. (90 m) exposed	300 ft. (90 m) exposed	Mafic breccia of Seabrook L. complex
Timbrell (3 F) and Renwick (4 F)	Hydrothermal	10 in. (25 cm)	?	Near diabase dike in Early Precamb. granitic rocks
Wiseman (3 B)	Hydrothermal	100 ft. (30 m)	600 ft. (180 m) exposed	?
Sudbury District				
Benton (Wakami R. occur.)	Algoma type, sulphide facies	150 ft. (45 m)	?	Sed.
Benton (NE occur.)	Algoma type, non-magnetic	20 ft. (6 m)	?	Vol.
Benton (SE occur.)	Algoma type, sulphide facies	12 ft. (4 m)	?	Vol.
Cunningham	Algoma type, sulphide facies	50-800 ft. (15-240 m)	1-¾ mi. (2.8 km)	Vol. flows and tuffs
Cunningham (Peter L. occur.)	Algoma type, sulphide facies	300-600 ft. (90-180 m)	9,000 ft (2.8 km)	Vol.
Dore	Algoma type, oxide facies	10 ft. (3 m)	?	Intercalated with mafic vol. within felsic vol. unit
Garnet (Fawn Ck. occur.)	Algoma type	?	1 mi. (1.6 km)	Vol.
Garnet (SW occur.)	Algoma type	20-120 ft. (6-37 m)	1 mi. (1.6 km)	Vol.
Garnet (Yarwood L. occur.)	Algoma type, oxide and sulphide	200 ft. (60 m)	12,000 ft. (3.7 km)	Vol.
Genoa	Algoma type, oxide facies	Bands up to 200 ft. (60 m) thick	2 mi. (3.2 km)	Vol.

Greenlaw (N occur.)	Algoma type, oxide? facies	Up to 400 ft. (120 m)	Up to 1 mi. (1.6 km)	Vol. and sed.
Greenlaw (S occur.)	Algoma type, sulphide facies	60-100 ft. (18-30 m)	7,700 ft. (2.3 km)	Vol.
Halcrow	Algoma type, oxide facies	?	?	Vol.
Heenan (Woman R. Iron Formation)	Algoma type, oxide and sulphide facies	2-1400 ft. (0.6-430 m)	15 mi. (24 km) intermittent	Underlain by felsic vol., overlain by mafic to inter. vol.
Huffman (Little Rice L. occur.)	Algoma type, sulphide facies	15 ft. (4 m)	?	Vol.
Huffman (Little Rush River-Canoe L. occur.)	Algoma type, sulphide facies	600 ft. (180 m)	5 mi. (8 km)	Sed. in East, vol. in West
Keith (Groundhog R. pros.)	Algoma type, oxide facies	200 ft. (60 m)	?	Sed. within vol.
Keith (Mackeith L. pros.)	Algoma type, oxide facies	30-160 ft. (9-50 m) avg. 70 ft. (20 m)	?	Vol. invaded by mafic intrus.
Keith (Slaterock L. occur.)	Algoma type, oxide facies?	Small bands	?	Vol.
Kenogaming (Crawford L. occur.)	Algoma type, oxide facies	2 bands, 35 ft. (11 m) thick	¼ mi (400 m)	Vol.
Lackner (Falconbridge pros.)	Magmatic	Stringers or disseminated magnetite-apatite within area 2200 ft. (670 m) in diameter		In ring of alkalic silicate rocks within Lackner L. complex
Lackner (Hebden L. occur.)	Magmatic	1000 ft. (300 m)	2400 ft. (730 m)	Hebden (Portage) Complex
Lang	Algoma type, oxide facies	?	?	Early Precamb., hblde schist and gneiss
Mallard (Opeepeesway R. occur.)	Algoma type, sulphide-carbonate facies	lens 10 ft. (3 m) wide	?	Qtz.-sericite schist
Marion (Stackpool [East] pros.)	Algoma type, carbonate-sulphide facies	up to 100 ft. (30 m)	4-½ mi. (7 km)	Overlain by mafic vol.,underlain by felsic vol.

Marion (Stackpool [West] pros.)	Algoma, oxide facies	50-500 ft. (15-150 m) thick in W. In East 3 distinct bands 50 ft. (15 m) thick & 50-300 ft. (15-90 m) apart	2-½ mi (4 km)	do.
Moen[2]	Algoma type, oxide facies	Lenses up to 50 ft. (15 m)	1,800 ft (550 m)	Vol. Intruded by diabase dikes
Osway (misc. occur.)	Algoma type	Minor occurrences of lean cherty iron formation. Some with pyrite & pyrrhotite		Vol. & Sed.
Osway (Ramsay Ck. occur.)	Algoma type, sulphide facies	4 ft. (1.2 m) band of qtz. pyrite iron formation	?	Vol.
Osway (SW occur.)	Algoma type, sulphide facies	up to 600 ft. (180 m)	9,000 ft (2700 m)	Vol.
Penhorwood (Nat. R. pros.)	Algoma type, oxide, sulphide and silicate facies	150 ft. (45 m) lenses	lenses up to 5000 ft. (1500 m) long over strike length of 7 mi. (11 m)	Vol.
Penhorwood (Radio Hill Pros.)	Algoma type, oxide-carbonate facies	300-1500 ft. (90-460 m)	7000 ft. (2100 m)	Underlain by tuffaceous rocks, overlain by pyrite slate and tuff, within vol. sequence
Schembri[3]	Algoma type, oxide facies	25-85 ft. (8-26 m)	4,000 ft. (1.2 km)	mafic vol. to North, sed. and felsic vol. to South
Stover	Algoma type, oxide facies	Numerous bands up to 30 ft. (9 m) wide, most 1-10 ft. (0.3-3m)		Vol.

Swayze (Bayly L. occur.)	Algoma type, oxide & sulphide facies	?	?	Mafic vol.
Swayze (Cree L. occur.)	Algoma type, oxide & sulphide facies	200 ft. (60 m)	lenses 500 ft. (150 m) to ½ mi. (0.8 km)	Inter. to mafic vol.
Tooms	Algoma type	5 ft. (1.5 m)	?	Vol.
Yeo (Schist L. occur.)	Algoma type, sulphide facies	50-150 ft. (15-45 m)	3 mi. (5 km)	Sed.

[1]Abbreviations: vol. - Early Precambrian metavolcanics
sed. - Early Precambrian metasediments

[2]Formerly Tp. 23 R.16

[3]Formerly Tp. 23 R.15

chert, or carbonate, and where the banded structure of the ferruginous rocks conforms in pattern and attitude with the banded structure of the adjacent sedimentary, volcanic, or metasedimentary rocks..." Most major occurrences of iron formation in the map-area have had a long history of exploration and are discussed in the various detailed reports covering parts of the area; more recent exploration is discussed in the 'Economic Geology' section of this report.

Most iron formation occurrences within the map-area (listed in Table 5) are thin bands intercalated with metavolcanics and usually represent oxide facies conditions of sedimentation. These occurrences include: Nat River iron formation, Penhorwood Township (Milne 1972, p.16); Fenton Township (McMurchy 1960, p.8); Halcrow and Greenlaw Townships (Donovan 1968, p.17, 18); Dore Township, southern Swayze Township (Donovan 1965d, p. 10, 11); and parts of the Woman River Iron Formation, Heenan and Marion Townships (Goodwin 1965). Typically, oxide-facies iron formation consists of interbedded magnetite or magnetite-hematite layers and material variously described as chert (Donovan 1965d, p.10,11; 1968, p.17) and (or) pyritic, graphitic slate (Milne 1972, p.24). The individual layers vary from fractions of an inch to 4 or 6 inches (10 to 15 cm) in thickness; the layers are generally regular, but slump structures and brecciation (Emmons and Thomson 1929, p.25) are fairly common features. The weathered surface is occasionally rusty or discoloured but commonly displays grey to white bands of cherty material and black, blue-black, or grey bands of magnetite with or without hematite. Microscopic descriptions of occurrences of this facies can be found in Milne (1972, p.21-23) and Goodwin (1965, p.16,17).

Generally, oxide-facies iron formation seems to be associated with mafic and occasionally felsic flows and pyroclastic rocks, and more rarely with metasediments including other facies of iron formation. Accumulations are rarely thick where this facies occurs alone in the Swayze-Deloro belt; therefore, it would appear that accumulation occurred in local basins during brief lapses in volcanism.

Silicate-facies iron formation occurs as 30- to 250-foot (9 to 75 m) thick portions of iron formation units having total thicknesses of 130 to 750 feet (40 to 230 m) in the Radio Hill occurrence and in the Woman River Iron Formation. Milne (1972, p.19) briefly referred to the silicate-facies iron formation consisting of minnesotaite-bearing slaty material interbedded with sideritic, carbonate-facies iron formation. This type of material comprises only a minor thickness of the iron formation in this area. The presence of minnesotaite and (or) stilpnomelane indicates metamorphism under lower greenschist facies conditions. Goodwin (1965, p.16) described minor occurrences of magnetite-siderite and magnetite-grunerite-pyrrhotite layers intercalated with cherty material in the banded chert unit of the Woman River Iron Formation in the Stake Lake area of Marion Township. In the Northcott Bay section (Genoa Township) interbedded coarse-grained chert, siliceous magnetite, and "more or less dark-green, secondary silicates" are found in irregular layers ½ to 1 inch (1.2 to 2.5 cm) thick (Goodwin 1965, p.15).

Sulphide- and carbonate-facies iron formation are interbedded in the more extensive iron formation occurrences, as at Radio Hill (Penhorwood Township) and the Woman River Iron Formation. Milne (1972, p.22) described carbonate-facies material as "light and dark grey on fresh surfaces but weathers brick red and white and resembles banded hematite-chert". Occurrences of sulphide minerals (pyrite, pyrrhotite, and rare sphalerite), along with disseminated magne-

tite, are sporadic and not extensive in these two iron formations. The observed close association of silicate-facies iron formation with the predominantly carbonate-facies rocks of these two occurrences is suggested to have been caused by slight variations in the CO_2 partial pressure within the depositional basin, because upon depletion of CO_2, silicates would be the preferred iron-rich minerals (Gross 1965, p.88). Gross also suggested that the material later described by Milne (1972, p.20) as pyritic, graphitic slate is possibly silicate-facies iron formation. This would indicate that slightly more silicate-facies material is present than has been heretofore recognized. Milne (1972, p.22) has described the microscopic features of the carbonate-facies iron formation.

Sulphide-facies iron formation, found as a relatively minor constituent of the two extensive occurrences described above, is the only type found in the southeastern part of the Swayze-Deloro belt i.e. east of Garnet Township and south of Latitude 47°45′. Most of these occurrences are rather thin (4 to 120 feet or 1.2 to 35 m), discontinuous, and associated with metavolcanics (see Table 5). Commonly they consist of finely to coarsely interbedded chert or glassy quartz and pyrite and (or) pyrrhotite in layers from hair line thickness to 2 inches (5 cm). Rusty weathering and (or) limonitic cappings are common, but the fresh surface shows grey, black, or vitreous chert or quartz interbanded with the sulphides. As this rock type is rather restricted in extent it was not subjected to microscopic examination.

Basin Synthesis

Goodwin and Ridler (1970) in a synthesis of data on the Abitibi "orogen", analyzed the interconnecting metavolcanic-metasedimentary belts of the Abitibi Subprovince in terms of regional structure, tectonics, and paleoenvironment. Parts of that synthesis have application to this report in explaining the distribution through the Swayze-Deloro belt of: *(a)* felsic volcanic accumulations i.e. "volcanic centres" *(b)* distribution of the various clastic sedimentary rock types; and *(c)* distribution and significance of facies variation of iron formation. In addition, this type of analysis will help explain some of the other occurrences of volcanic rocks in the map-area, i.e. the Fenton-Seaton Townships area (Saganash Lake belt) and the Missinaibi Lake area (Michipicoten belt)

Iron formation has been used as an indicator of paleoenvironment with some success in Archean terrain (e.g. Goodwin and Shklanka 1967; Gross 1965). Goodwin and Shklanka (1967, p.789) suggested that in the Wawa-Goudreau area (Michipicoten belt), oxide-facies iron formation represents near-shore, shelf deposition and that dominantly carbonate-facies material represents an environment transitional from this to deep basin deposition, i.e. at a shelf margin, and that sulphide-facies deposition represents quiet deep water, reducing conditions of the central part of a volcanic-sedimentary basin (see also Goodwin and Ridler 1970, p.19). In the present map-area, oxide-facies deposition is associated largely with both mafic and felsic volcanic rocks (e.g. Penhorwood Township: Milne 1972; Swayze and Dore Townships: Donovan 1965d; Halcrow-Ridout Lakes area: Donovan 1968). As most of these occurrences are spatially associated with centres of felsic volcanism which are in part pyroclastic (both subaerial and subaqueous), shallow water deposition is assumed.

Carbonate-facies iron formation occurs in the Radio Hill and Nat River iron formations (Milne 1972) and in the Woman River Iron Formation (Goodwin 1965) in thick, laterally fairly extensive, units. These occurrences represent lengthy gaps in volcanic activity, during which exhalative activity could have altered the sulphur content of the local basin to the extent that short term sulphide-facies deposition took place in a shelf-margin environment which normally would favour carbonate deposition. Minor occurrences of sulphide-facies iron formation, particularly in association with volcanic rocks (as in southeastern Benton Township, Shklanka 1968, p.325) quite probably represent extremely small local basins in dominantly volcanic terrain, in which reducing conditions were locally intense. However, the many remaining sulphide-facies iron formation occurrences in the southeastern part of the Swayze-Deloro belt (see Table 5) are largely within Ridout metasediments and probably represent quiet-water, background sedimentation within a fairly large, relatively uniform, deep basin during intervals between high-energy clastic deposition. This interpretation (Figure 4) is reinforced by the fact that few felsic metavolcanics and almost no felsic pyroclastic rocks are found here.

Distribution of the various sedimentary rock types would also support this tentative reconstruction (see Figure 4). Conglomerate, arkose, arkosic greywacke, quartzite, and feldspathic quartzite are abundant in the Halcrow-Ridout Lakes area (Donovan 1968) and in the Swayze and Dore Townships area (Donovan 1965d). Donovan indicated, and the authors agree, that these metasediments are largely volcanogenic in origin, and in most cases, given the angular nature of larger clastic fragments and of individual grains, that transport distances were minimal. This would corroborate the hypothesis of shelf deposition for this area and perhaps for the Reeves-Kenogaming Townships part of the belt, wherein carbonate-facies iron formation also occurs.

Metasediments of the southeastern part of the belt (i.e. Osway, Benton, Mallard, and Huffman Townships) are dominantly a flyschoid facies with greywacke and conglomerate displaying graded bedding, crossbedding, scour structures, and rapid alternations of rock type, indicating deposition in relatively deep water by turbidity currents. These metasediments represent the high energy phase of deposition in the deep-water portion of the basin, in contrast to the sulphide-facies iron formation which represents the low energy phase of deposition in the same part of the basin.

The Belford-Strachan and Swayze-Deloro metavolcanic-metasedimentary belts, described as part of the Abitibi Subprovince in this report, can be divided into three major volcanic centres represented by accumulations of felsic metavolcanics:

(1) in the Belford-Strachan Townships area, part of the *Kamiskotia volcanic complex* of Goodwin and Ridler (1970, p. 12);

(2) in the northern parts of Keith and Penhorwood Townships, part of the *Deloro volcanic complex* of Goodwin and Ridler (1970, p.12);

(3) in the central part of the Swayze-Deloro belt, i.e. in the Halcrow-Marion Townships part of the *Swayze volcanic complex* of Goodwin and Ridler (1970, p.12).

Goodwin and Ridler postulated that each of these volcanic complexes was a separate entity, circular in plan and 60 to 100 miles (100 to 160 km) in diameter, elongated in an east-west direction by deformation. In addition, they suggested

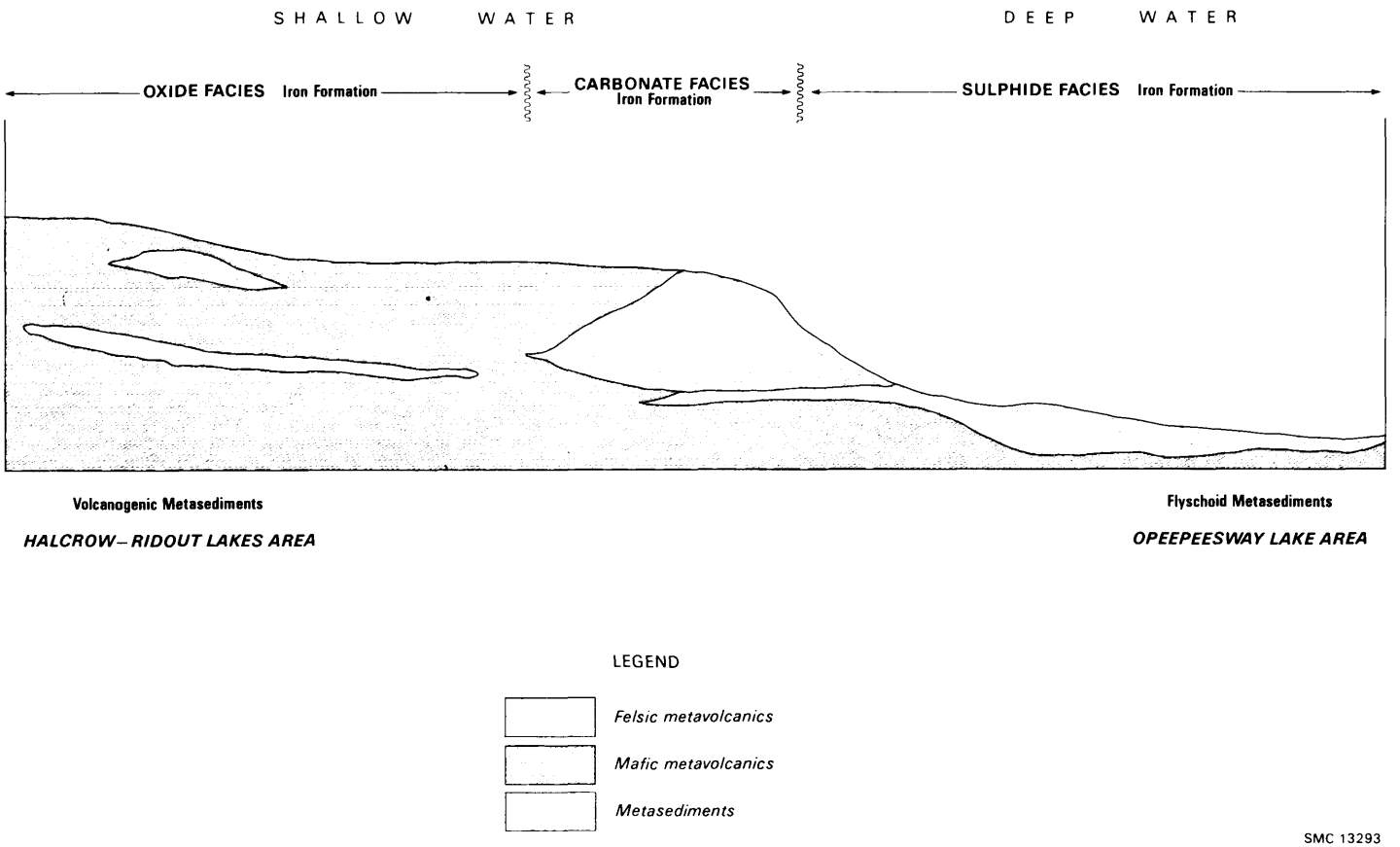


Figure 4–Tentative reconstruction of paleogeography of southern part of the Swayze-Deloro metavolcanic-metasedimentary belt.

that the volcanic complexes, toward the centre of the orogen (i.e. the Kamiskotia volcanic complex in this map-area), are younger than those bordering the orogen, partly on the basis of facies changes and stratigraphy of the iron formation within the Kamiskotia volcanic complex (Goodwin and Ridler 1970, p.21). The presence of Cu-Zn mineralization, mainly in the younger complexes, is also taken as an indication of the relative ages of the complexes. However, on the basis of the present survey, scattered occurrences of base-metal mineralization in the Swayze volcanic complex are an exception to this generalization.

The authors suggest that Goodwin and Ridler's (1970) designation of volcanic complexes as centres of Archean felsic volcanism within the eastern part of the map-area is valid, but any demonstration of contemporaneity or lack of it amongst these centres is premature. Much more detailed structural and stratigraphic work is needed. The authors would suggest, however, in a tentative fashion, that the part of the Deloro volcanic complex occurring within the map-area (i.e. in Penhorwood, Keith, and Muskego Townships) is younger perhaps than the Swayze volcanic complex, based, in part, on arguments used by Goodwin and Ridler (1970), and in part on the presence in the Deloro complex of a more cyclical volcanic pile and a greater assortment of rock types including a greater development of ultramafic intrusions.

The volcanic occurrences in the Fenton-Seaton Townships area (Saganash Lake belt) may have developed in a shallow-water environment, a conclusion based solely on the presence of oxide-facies iron formation and the limited occurrence of pillowed mafic metavolcanics. It is thought that this area is rather far from a volcanic centre.

The Glasgow[1], Meath[1], and Rennie Townships area (Michipicoten belt), with the extensive development of felsic tuff, pyroclastic rocks and possibly ignimbritic rocks (Riley 1971 and 1975, personal communication), is another volcanic centre. In view of the frequent occurrence of coarse breccia and only minor occurrences of oxide-facies iron formation, the paleobasin here was probably the scene of rapid, explosive felsic volcanism upon an earlier sequence of mafic metavolcanics, and little opportunity existed for sedimentation or sulphur-rich exhalative activity to take place.

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS

Rocks classed under this heading can be further subdivided into largely dioritic and gabbroic stocks and sill-like bodies of small size (map-unit *4a*) and serpentinized ultramafic rocks with minor associated gabbro occurring as sills and stocks (map-unit *4b*). Descriptions of these rocks are condensed from previous work and this discussion is largely a correlation of that work.

Virtually all the occurrences of dioritic and gabbroic rocks (map-unit *4a*) as sills and small stocks have been somewhat metamorphosed and appear to predate the granitic rocks, and furthermore, according to Milne (1972, p.28), in the Reeves-Kenogaming Townships area the dioritic rocks predate the serpentinite.

[1]Glasgow and Meath Townships are outside the map-area, west of Rennie Township.

The dioritic rocks are altered where they contact the serpentinite in a fashion similar to that in which the mafic metavolcanics in contact with serpentinite are altered (Milne 1972, p.28). Indirect evidence in the area of Napier Lake (Milne 1972, p.28) indicated that serpentinite truncates dikes of gabbroic rocks. Gabbroic rocks in the gabbro-ultramafic rock association (map-unit *4b*) are unmetamorphosed and generally show only minor deuteric alteration, perhaps serving to indicate that they are later than the dioritic-gabbroic rocks (map-unit *4a*). According to Gerald Bennett[1] (1972, personal communication) the metamorphism of the mafic rocks in the Belford-Strachan area is more intense to the west, indicating that these rocks may have been affected by the structural event emplacing the highly metamorphosed rocks of the Kapuskasing Structural Zone.

Diorite and Gabbro

The dioritic and gabbroic rocks are fine- to medium-grained, diabasic textured rocks which intrude the mafic and felsic metavolcanics and the metasediments in the 'greenstone' belts of the map-area. The principal occurrences are in *(1)* the northeastern part of the Swayze-Deloro metavolcanic-metasedimentary belt, in the Keith, Horwood, Muskego, Penhorwood, Reeves Townships area; *(2)* Newton Township; *(3)* Heenan and Marion Townships; and *(4)* the Cunningham-Garnet Townships area.

These rocks consist of 40 to 50 percent amphibole, the remainder being an aphanitic matrix of saussuritized plagioclase with occasional minor quartz. Trace amounts of pyrrhotite and pyrite are common. The rocks are grey to dark green and commonly coarser grained than the mafic metavolcanics. Compositionally these rocks include quartz diorite, diorite, quartz gabbro, and gabbro. They occur as roughly concordant bodies up to ½ mile (0.8 km) wide by 2½ miles (4 km) long in the midst of the metavolcanics of the belts (e.g. Milne 1972, p.26; Donovan 1965d, p.15; 1968, p.25). In a number of cases the coarse-grained centre of mafic flows could have been included in this unit on the map, in particular in Newton Township, Heenan and Marion Townships, and the Cunningham-Garnet Townships area. Petrographic descriptions of rocks of this map-unit in the Reeves-Kenogaming area are given by Milne (1972, p.26-27).

These rocks have in the past been classified as Haileyburian intrusions and in this area have been assigned pre-granite ages by Milne (1972), Meen (1942), Rickaby (1934), and Prest (1950). Goodwin (1965), Donovan (1965d; 1968), and Laird (1935a, on the basis of observations by Bannerman 1933) suggested a post-granite age. A post-granite age, however, is at variance with the metamorphosed nature of most of the bodies, and most of the age relationships observed in the field (e.g. Milne 1972, p.28).

[1]Geologist, Precambrian Geology Section, Geological Branch, Ontario Division of Mines, Sault Ste. Marie.

Ultramafic Intrusive Rocks and Associated Mafic Rocks

Partially and thoroughly serpentinized ultramafic rocks and associated mafic rocks are found as sills, dikes, and stocks in the map-area. The principal occurrences are in the Reeves-Kenogaming Townships area and the Keith-Muskego Townships area; minor occurrences are found in the Meath-Rennie Townships area and in the Garnet-Cunningham Townships area. An arcuate unit of predominantly gabbroic rocks, with associated ultramafic and dioritic rocks (Bennett 1969), in the Belford-Strachan belt is probably more closely allied with this map-unit(*4b*) than with the dioritic and gabbroic rocks (map-unit *4a*) described above, by virtue of its associated ultramafic rocks and its probable sill-like mode of intrusion. An aeromagnetic anomaly interpreted as an ultramafic intrusion is located in the Wakami-Shipley[1] Townships area.

The unit in the Belford-Strachan belt occurs as roughly concordant sheets from a few feet to 1,700 feet (520 m) wide and up to 2,500 feet (760 m) long. In Penhorwood Township, and in the Meath-Rennie Townships area, the bodies are irregular in shape, but in general the long axes of most bodies parallel the country rock foliation. In Reeves and Penhorwood Townships, part of one body trends at right angles to the regional foliation; this may reflect local folding (Milne 1972, p.29). Bennett (1969, p.8) suggested that intermediate to ultramafic intrusive rocks in the Belford-Strachan area may represent a number of closely-spaced sills, based in part on the interpretation of ground magnetic data.

The rocks in this unit vary from relatively unaltered gabbroic rocks with primary clinopyroxene and labradorite to serpentinized peridotite and pyroxenite. Bennett (1969) described slightly altered gabbroic rocks with labradorite (30 to 65 percent), clinopyroxene (15 to 45 percent), hornblende (15 to 35 percent), and magnetite-ilmenite (5 to 10 percent). Alteration, where present, appears to be deuteric in nature with development of uralite, zoisite, chlorite, biotite, and pyrite. Pyroxenite inclusions are prominent locally as lenses. Serpentinized dunite and peridotite found in the northwest corner of Strachan Township consist almost entirely of serpentine.

The ultramafic rocks found in the Reeves-Penhorwood Townships area contain little primary mineralogy and are thoroughly serpentinized. The weathered surface varies from white or green to black, red, and rusty orange, and has an equigranular texture. The fresh surface shows green to black, elongate polygonal areas surrounded by white, blue-green, or black aphanitic material forming a mesh-like texture. Grain size varies from 0.5 to 1 cm with individual prismatic relict grains outlined by antigorite and chrysotile serpentine, carbonate, and magnetite. The relict grains represent olivine which has been replaced by antigorite serpentine. Variations in colour are related to varying proportions of magnetite, carbonate, tremolite, chlorite, and serpentine.

Milne (1972, p.29) reported ultramafic rocks west of Horwood Lake Station (Penhorwood Township) having a texture described as "pine needle rock"(probably corresponding to the "spinifex" texture described by Eckstrand 1972, p.75). Milne (1972, personal communication) indicated that it is unlikely

[1]Formerly Township 19.

that this occurrence represents ultramafic flows. However, the existence of the quench texture, and the generally conformable nature of the ultramafic rocks in this part of the map-area, indicates that they were intruded into a high-level environment, probably before the onset of metamorphism.

Minor occurrences of serpentinized peridotite and pyroxenite are found in the larger metavolcanic-metasedimentary belts throughout the area. In the Meath-Rennie Townships area (Michipicoten belt) ultramafic rocks consist of serpentinized pyroxenite and partially serpentinized peridotite occurring as small lenses in the metavolcanic-metasedimentary belt. Riley (1971, p.24) related these occurrences to a large body of olivine gabbro at Glasgow Lake (outside the map-area), which is thought to be later than the diabase. Meen (1942, p.15) described a small body of partially serpentinized peridotite 2,000 feet (600 m) by 4,000 feet (1200 m) in Cunningham Township.

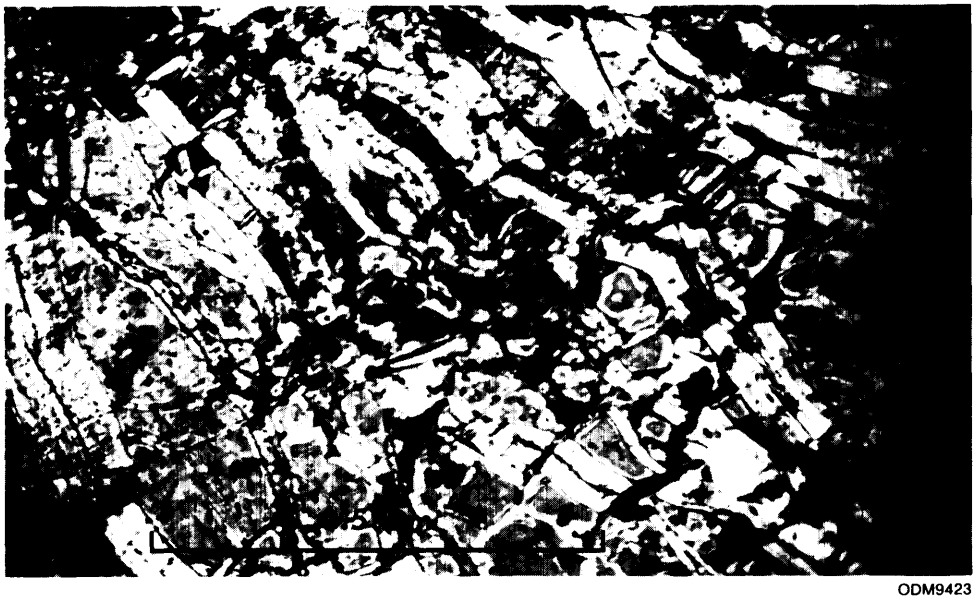
Prest (1950, p.14-19) described several thin, elongate sill-like bodies of serpentinized peridotite, pyroxene dunite, peridotite-picrite, and olivine gabbro with associated hornblendite and gabbroic phases, occurring in the Keith-Muskego Townships area (northern part of the Swayze-Deloro belt). He concluded that they are younger than the surrounding metavolcanics because they were emplaced as a series of sills and small stocks in the volcanic pile; according to Breaks (1973, p.48-50) the granitic rocks cut the ultramafic rocks in the Keith Township area.

A small occurrence of serpentinite in Walls Township (Kabinakagami Lake belt) was indicated in a single drill log submitted as assessment work by Sand River Gold Mining Company Limited (Regional Geologist's Files, Ministry of Natural Resources, Sault Ste. Marie, see also the description of "Sand River Gold Mining Company Limited [1957]" in the section "Asbestos").

A prominent circular aeromagnetic anomaly (see ODM-GSC 1963, Map 2245G) straddles the Wakami-Shipley[1] Townships common boundary west of the Canadian Pacific railway. This is approximately 5 miles (8 km) south-southeast of the townsite of Sultan on the Canadian Pacific railway. Attempts to locate outcrops by aerial reconnaissance within this magnetic expression proved fruitless but a large number of boulders of ultramafic rock were located close to the northeast shore of a small lake at approximately 47°30′45″N Latitude, 82°42′30″W Longitude. These boulders are located somewhat off the main magnetic expression but are thought to represent rocks from within it.

The boulders are angular and measure several feet in length and width and are considered to be close to their source. Thin sections cut from the fresher appearing material indicate that the rock is a peridotite in composition. Olivine within this rock is highly altered to serpentine (Photo 1). Remnant pyroxene is present but most has been altered to actinolite. Magnetite is present in amounts up to 5 percent and probably accounts for the aeromagnetic expression. A thin section of the more altered material displays a mixture of acicular actinolite with interstitial carbonate. From examination of the boulders on the lake shore, the rocks surrounding the peridotite intrusions are migmatitic in nature, but the relative age relationships are unknown.

[1]Formerly Township 19.



ODM9423

Photo 1–Photomicrograph of ultramafic rock, showing serpentinized olivine; thin section of a boulder from Wakami-Shipley Townships aeromagnetic anomaly.

Neither asbestos fibre nor sulphide mineralization was observed. There is no record of any exploration work having been done on this body.

FELSIC IGNEOUS AND METAMORPHIC ROCKS

Seventy-four percent of the map-area (i.e. 9,930 square miles or 25,700 km^2 out of 13,400 square miles or 34,700 km^2) is underlain by granitic and migmatitic rocks. These rock types have been separated into: *(a)* obviously intrusive batholithic rocks, on the basis of mineralogy, presence of igneous textures, intrusive relationships with the surrounding rock types, and aeromagnetic pattern; and *(b)* migmatitic rocks based on the presence of mixed rock types, one intrusive, the other a relict supracrustal rock. This separation into two map-units is based upon rather scattered observations of outcrop by helicopter in which a grid of observation points 2 to 4 miles (3 to 6 km) apart was generated. This was supplemented by a minor amount of roadside and lakeshore geological observations.

Individual outcrops of granitic rock (map-unit *6*) occur in places as large bodies of leucosome in migmatitic terrain, or conversely, in areas in which roof zones or marginal phases of batholiths are contaminated with older plutonic or supracrustal rocks.

The separation of dominantly igneous from dominantly migmatitic terrain was accomplished by outcrop observation supplemented by air-photo interpretation and interpretation of aeromagnetic maps reduced to base-map scale and su-

perposed on the outcrop pattern. Granitic batholiths in general produce an aeromagnetic pattern consisting of broad domical highs with a relatively smooth pattern of isomagnetic contours. The aeromagnetic character of the batholiths is smooth and massive with a distinct lack of "grain" or foliation to the isomagnetic lines. This smooth domical pattern is exemplified by the pattern of the batholith in Eric, Frater, Des Rosiers and Genoa Townships, and in the batholith centred on Bullbrook[1], Braithwaite[2], Eaton[3], and Dukszta[4] Townships (see ODM-GSC 1970). The aeromagnetic pattern of dominantly migmatitic areas is, in contrast, typified by a degree of linearity or foliation as seen in the pattern of aeromagnetic expression of the migmatitic zones east of Rennie Township and south of the Swayze-Deloro belt in Arbutus and Yeo Townships (see ODM-GSC 1972). This type of simplistic interpretation must take cognizance of the fact that any well foliated rock with units of varying magnetic susceptibility will produce the lineated pattern referred to above including, perhaps, metamorphosed granitic rocks, particularly if they are rich in inclusions of material such as amphibolite and (or) iron formation. The characterization of the area southwest of the highly metamorphosed portion of the Kapuskasing Structural Zone as migmatitic is a good example of this in that at least some of the rocks in this area represent recrystallized granitic rocks. However, given the scale of the survey and in particular, the amount of time available, this was the only means of interpreting the "interbelt" areas.

On the basis of the reconnaissance of scattered outcrop in parts of the area it is possible to state that several distinct areas of granitic rocks of relatively similar composition occur. However, it is not known whether these areas, termed *zones* for purposes of this report are equivalent to the more conventional usage *batholith.* All that is known is that the *zones* have a distinct aeromagnetic expression, are relatively similar texturally and mineralogically and could possibly, upon more detailed work, be termed composite batholiths such as described in other areas of the Superior Province.

It can be tentatively suggested that several ages of granitic rocks exist in the map-area:

(1) The leucosome or light-coloured, mobile, intrusive phase of the migmatitic rocks, generally granitic in composition. The leucosome could be in part coeval with the batholiths. (Evidence from northwestern Ontario would suggest that the migmatitic rocks are older than both metamorphosed and unmetamorphosed plutonic rocks, F.W. Breaks[5], personal communication, 1975).

(2) The main granitic batholiths with composition in the range quartz monzonite to granodiorite. The clarity of the aeromagnetic expression of these zones, the fact that they cross-cut the migmatites and their unmetamorphosed textures suggest that these rocks are relatively late, post-kinematic, and probably Kenoran in age (McLaren *et al.* 1968).

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[1]Formerly Township 9A.
[2]Formerly Township 9B.
[3]Formerly Township 8A.
[4]Formerly Township 8B.
[5]Geologist, Precambrian Geology Section, Geological Branch, Division of Mines, Toronto.

(*3*) Syenitic and granitic rocks associated with the Kapuskasing Structural Zone such as those in Halcrow Township (Donovan 1968, p.24,25) and in the Border Lake area where granite has been found to possibly post-date metasediments (map-unit *7*) in the Kapuskasing Structural Zone.

Migmatitic Rocks

Except for the nature of the xenoliths (e.g. metavolcanic, metasedimentary) the migmatitic outcrops are generally similar in appearance throughout the map-area. The appearance is that of a mixed rock in which fragments and inclusions of metamorphosed country rocks (paleosome) are embedded and engulfed in lighter coloured rock (neosome) which has intruded and partially assimilated the country rock. Within map-unit *5*, the identifying codes *5a* and *5b* refer to the mineralogic composition of the paleosome. In the metasedimentary migmatite the fragments of country rock (xenoliths) consist of brown-weathering gneiss in which biotite is generally the dominant mafic mineral. The metasedimentary xenoliths may vary in texture from fine-grained siltstone to conglomerate. The size, shape, orientation, and degree of assimilation of both metasedimentary and metavolcanic xenoliths varies greatly but the mineralogic composition of the metavolcanic xenoliths remains consistently close to an average 50 to 60 percent hornblende and 20 to 30 percent plagioclase, the balance being quartz. The neosome of metasedimentary and metavolcanic migmatites is medium- to coarse-grained, is generally grey on the fresh surface, and weathers to pinkish and buff colours, less frequently to white. Mineralogic composition and colour of the neosome varies with the degree of assimilation of the xenoliths. Dark colours are generally associated with relatively strong assimilation so that paleosome and neosome are no longer separated by sharp boundaries. Conversely, a lighter colour of the neosome is commonly observed in rocks with well-defined migmatitic fabrics. Nonetheless migmatitic outcrops may possess a complex fabric, and contrasting features such as the ones just mentioned may be present in the same outcrop at a short distance from one another.

A regional foliation is generally present in the migmatite and is defined by the subparallel arrangement of elongated xenoliths. A crude foliation of the rock as a whole, but at variance with the foliation of the xenoliths, was observed in a few places. This indicates that localized dynamic metamorphism (superimposed foliation) followed the metamorphic events during which the migmatite originated.

Close to the southwestern margin of zone 1 (described below under "Felsic Intrusive Rocks"); metavolcanic migmatite occurs in Wardle[1], Villeneuve[2], and Timbrell[3] Townships. The xenoliths consist of dark green to black, medium-grained, quartz-plagioclase-hornblende gneiss. In proximity of the western boundary of Villeneuve[2] Township the amount of paleosome increases and the metamorphic grade of the metavolcanic fragments decreases such that they become finely foliated, hornblende and chlorite-hornblende schists with concordant units of coarse-grained, leucocratic granodiorite a few inches in thickness.

[1]Formerly Township 3D.
[2]Formerly Township 3E.
[3]Formerly Township 3F.

In this area, foliation trends east and dips to the north. A similar foliation trend is found in the metavolcanic migmatite close to the eastern boundary of Villeneuve Township. From the limited evidence gathered in the field the setting of this area is similar to that of the Biscotasing area; the latter was proposed by Rogers (1962, p. 6) to be at the roof level of a granitic batholith, or at a low level of originally supracrustal rocks (i.e. metavolcanics and metasediments).

Felsic Intrusive Rocks

Granitic outcrop density is very poor in the northern part of the region. In the central part of the region granitic rocks are particularly well exposed west of Longitude 83°15′W and between Latitudes 47°50′N and 48°30′N. Farther south, in the approximately triangular area with vertices in the centres of Beilharts Township[1], Ceylon Township, and Topham Township, outcrops are scattered and scarce. Outcrops are virtually nonexistent in Cull[2], Delhaney[3], Dupuis[4], Green[5], Jeffries[6], Kalen[7], and Strom[8] Townships. Immediately south of Strom Township[8] very good granitic exposures occur at Wenebegon Lake. This relatively abrupt increase in outcrop density toward the south is emphasized by a change in topography from flat and swampy north of Wenebegon Lake, to relatively rugged and dissected south of it.

Owing to the reconnaissance nature of the present mapping, the felsic intrusive rocks could not be subdivided into mappable units. However, a large number of samples were collected over the entire map-area. The samples were cut and stained by the method of Engel and Hosking (*in* Reid 1969, p.11) to evaluate the potassium feldspar content of the nonmigmatic rocks. One hundred and twenty suitable slabbed samples were then point-counted using a transparent grid overlay; this data together with field observations yielded information about compositional trends of the granitic rocks on a regional scale. The nomenclature used for the felsic intrusive rocks is described under "Terminology". The number of thin sections of granitic rocks available to the authors was small relative to the size of the map-area; therefore, rocks referred to as granodiorite and trondhjemite may include quartz diorite.

The parts of the map-area underlain by granitic rocks are divided into a number of *zones* which outline areas within which the predominant felsic intrusive rocks are characterized by the features described below. The zone boundaries are not necessarily to be construed as boundaries of batholiths; evidence on this point is incomplete. The zone boundaries, do, however, indicate areas of relatively constant texture, degree of metamorphism, and composition.

The contacts between map-units *5* and *6* were derived primarily from in-

[1]Formerly Township 23, Range 19.
[2]Formerly Township 12G.
[3]Formerly Township 12F.
[4]Formerly Township 12E.
[5]Formerly Township 11G.
[6]Formerly Township 11F.
[7]Formerly Township 11E.
[8]Formerly Township 11C.

spection of the aeromagnetic maps. These contacts separate the "interbelt" areas into dominantly migmatic and dominantly intrusive felsic rocks. However, individual outcrop areas and larger lenses of felsic intrusive rocks occur in migmatitic areas, and roof zones of batholiths contain inclusions up to outcrop size of metasediments and metavolcanics. Therefore, areas of dominantly migmatic rock will contain areas of felsic intrusive rocks and *vice versa.*

REGIONAL VARIATION

Apart from relatively small occurrences of metavolcanics, metasediments, and migmatites, the entire southern part of the region is dominated by massive to crudely foliated, leucocratic, coarse-grained, quartz monzonite and granodiorite, pink and red in colour on the fresh surface. The granitic rocks of the southern part of the map-area are divided into three zones (zones 1, 2, and 3 on Figure 5, Chart A, back pocket), and are bounded on the north by an area in which little or no outcrop is found. The granitic rocks of the northern part of the area consist of a broad band of dominantly metamorphosed intrusions (zones 4 and 5) west of the south end of the Kapuskasing Structural Zone, and a weakly defined zone (zone 6) of trondhjemitic to granodioritic rocks.

Zone 1

Zone 1 in Figure 5 is a generalized outline of the outcrop area of the quartz monzonite-granodiorite complex. The type locality is the Rocky Island Lake area.

Rocks typical of zone 1 have a quartz content varying between 14 and 30 percent, and potassium feldspar to total feldspar ratios between 0.2 and 0.64 with slight predominance of values in the quartz monzonite compositional range (0.33 to 0.66). True granites (i.e. potassium feldspar ratio greater than 0.66) do not occur in the area. Quartz monzonite in this part of the region is typically pink or red on the fresh surface, and colours other than these are unusual in this compositional range. Granodiorite may be either pink or grey. Trondhjemites are scarce in this part of the region, but where they occur they are gneissic and grey in colour. Biotite is the major mafic mineral and constitutes between 1 and 5 percent of quartz monzonites and granodiorites, and up to 12 percent of the trondhjemites.

Thin sections of quartz monzonite show that plagioclase (albite-oligoclase) occurs as euhedral crystals of tabular habit and as numerous rounded inclusions in microcline. All the plagioclase, regardless of its mode of occurrence, is altered to some extent except for thin rims of unaltered plagioclase surrounding plagioclase inclusions within microcline. The widespread alteration of plagioclase contrasts markedly with the freshness of potassium feldspar which occurs as large phenocrysts of microcline, usually perthitic, and containing inclusions of plagioclase, biotite, and quartz. These features indicate that potassium feldspar has crystallized late. Quartz is anhedral and interstitial to the feldspar crystals; a weak to moderate undulatory extinction is almost invariably seen in this miner-

al. Brown biotite occurs as generally fresh, well defined, tabular crystals. Minor hornblende, apatite, sericite, saussurite, and iron oxides are the usual accessory minerals. The porphyritic character often observed in the quartz monzonite and granodiorite results from unusually large microcline phenocrysts 15 to 20 mm in size.

In general the large outcrops of quartz monzonite-granodiorite display complex intrusive relationships between different phases, development of pegmatite and quartz veins, evidence of several intersecting joint sets, and variations in grain size, colour, and texture. Pegmatitic phases ofter blend into the surrounding finer grained rock with ill-defined boundaries. These pegmatitic 'pods' consist of coarse-grained intergrowths of feldspars and quartz, containing 1 percent or less magnetite, and virtually no mafic minerals. Pegmatite occurs also in dikes and lensoid bodies a few feet in thickness, containing large biotite crystals and displaying a more or less defined internal zoning. Metamorphism of the quartz monzonite and granodiorite appears to have been restricted to an epizonal dynamic type which produced jointing, some shearing, and locally, a crude northwest-trending foliation.

East of zone 1, in the Mozhabong Lake-Lac aux Sables area, the granitic rocks are less complex in character. Sheeran (1952) described the general character of the Mozhabong Lake rocks as "very uniform in colour and texture" and Rogers (1962, p.22) showed that these rocks are quartz monzonite. Present data on the Mozhabong Lake area support Sheeran's and Rogers' observations. In view of the relative uniformity in mineralogic composition and general character, the Mozhabong Lake quartz monzonite may represent an intrusive episode separate from the emplacement of the Rocky Island Lake quartz monzonite-granodiorite complex; therefore it has not been included within the latter.

Outcrops of migmatite containing inclusions of gneissic amphibolite and hybrid granitic rocks delimit the southwestern margin of zone 1. The rocks occurring in this area were discussed in the section "Migmatitic Rocks".

Zone 2

Zone 2 is underlain by pink, massive to crudely foliated, medium- to coarse-grained, quartz monzonite which is locally porphyritic and pegmatitic. Mafic minerals consist of 1 to 3 percent biotite, often chloritized. Good exposures are found in the Wasasinka Lake area (Dukszta Township[1]), in the Ember Lake area (Burr Township[2]) and southeast of Kebskwasheshi Lake (Braithwaite[3] and Dukszta[1] Townships). To the northwest, the massive quartz monzonite grades into a gneissic phase containing amphibolite xenoliths. This rock is exposed at Kebskwasheshi Lake. Gneissic and hybrid phases occur also at White Pine Lake (Abney and Cortez Townships), and south of this lake, metavolcanics and metasediments occur in Fulton, Gladwin, and Ethel Townships. These rocks border the eastern side of the quartz monzonite massif of zone 2. On the basis of the presently available data, granodiorite appears to be of minor occurrence within

[1]Formerly Township 8B.
[2]Formerly Township 9Z.
[3]Formerly Township 9B.

zone 2, which is, therefore, distinguished from the quartz monzonite-granodiorite complex of zone 1.

Zone 3

Zone 3 is underlain by gneissic granodiorite and quartz monzonite, and migmatite with a neosome of granodioritic composition. Gneissic to crudely foliated granodiorite, pegmatitic granodiorite, metasedimentary gneiss, and metavolcanic migmatite containing amphibolite xenoliths several feet in length, are found at Wenebegon Lake. Gneissic and migmatitic granodiorite are exposed along Highway 129 in Langlois[1] and Hutcheon[2] Townships. Minor, massive quartz monzonite and gneissic trondhjemite occur in Fitzsimmons[3] and Engstrom[4] Townships respectively.

At Wenebegon Lake, along Highway 129, and in Havrot[5], Carruthers[6], and Beckett[7] Townships, the foliation trends southwest and dips to the north. This foliation could be related to the emplacement of a quartz monzonite batholith to the east (i.e. zone 2). However, as a whole, zone 3 may be interpreted as a relatively poorly exposed portion of the Kapuskasing Structural Zone (see Ayres *et al.* 1971a, 1971b).

Zone 4

Zone 4 is underlain by gneissic trondhjemite to quartz diorite, and substantial amounts of metasedimentary migmatite. The plagioclase, quartz, and potassium feldspar content of the gneissic rocks varies between 20 and 75 percent, 12 to 25 percent, and 2 to 20 percent respectively. The hornblende and biotite content varies between 2 and 15 percent. Under the microscope, these rocks are generally fresh in appearance owing to metamorphic recrystallization. Plagioclase (An_{20} to An_{52}) grains occur as equigranular aggregates showing interlocking texture and as large individual grains embedded in a finer grained plagioclase-microcline-quartz groundmass. Microcline is mostly restricted to the finer grained components. Quartz is found as phenocrysts, which may or may not show undulatory extinction, as interstitial material, and as small inclusions within plagioclase. Hornblende and biotite tend to form aggregates of fresh tabular crystals sub-parallel to foliation. Epidote, sericite, iron oxide, zircon, and in few examples, minor sulphides are the accessory minerals. Anhedral garnet crystals 1 to 3 mm in size occur as discrete disseminated individuals and also aggregated in thin bands bordering hornblende-rich areas or inclusions in gneiss and migmatite.

Gneissic to migmatitic trondhjemite and quartz diorite outcrop along Highway 101 in Gallagher Township, and in the Sideburned-Highbrush Lakes area.

[1]Formerly Township 10D.
[2]Formerly Township 10E.
[3]Formerly Township 22 - Range 18.
[4]Formerly Township 23 - Range 18.
[5]Formerly Township 6F.
[6]Formerly Township 8F.
[7]Formerly Township 9F.

Farther east, the sedimentary nature of some of these rocks becomes more evident, and migmatized metasediments (i.e. metasediments containing 10 to 25 percent intruded granitic material) and conglomerate are found in Borden Township at Borden Lake (largely outside zone 4).

Although the effects of various stages of assimilation (see the section "Migmatitic Rocks") are present in the migmatite of zone 4, the bulk of the rock is characterized by a relatively high degree of assimilation, and occurrences of grey, hornblende-rich, quartz diorite in which paleosome and neosome are almost indistinguishable are not uncommon. This feature, and the presence of garnet, would indicate a metamorphic grade higher than that of the migmatite and gneiss of zone 3, and possibly a relationship between the rocks of zone 4 and the garnet-pyroxene-plagioclase gneiss associated with the Kapuskasing Stuctural Zone.

In general, the rocks of zone 4 probably represent in large part metamorphosed granitic rocks associated with the Structural Zone.

Zone 5

Zone 5 is underlain essentially by weakly foliated quartz monzonite, light pink or buff in colour and migmatitic rocks with a quartz monzonite neosome. The plagioclase, potassium feldspar, and quartz contents of the quartz monzonite vary from 34 to 51 percent, 20 to 45 percent, and 15 to 26 percent, respectively. Mafic minerals consist of 1 to 4 percent biotite, or biotite plus hornblende. Under the microscope this rock is similar to the quartz monzonite of zone 1. However, plagioclase is not as altered, and where occurring as inclusions in microcline it lacks unaltered rims at the contact with the potassium feldspar. Biotite and hornblende occur as small interstitial flakes. Epidote and sericite are common accessory minerals. The quartz monzonite is exposed in D'Avaugour[1] Township and in Druillettes[2] Township. In Hornell, Delmage, and Buckland Townships the rock is migmatitic and contains plagioclase-hornblende gneiss xenoliths, perhaps representing in part metamorphosed granitic rocks cut by the body present in D'Avaugour[1] Township.

Zone 6

Zone 6 is underlain essentially by crudely foliated to migmatitic trondhjemite and granodiorite. Plagioclase, quartz, and potassium feldspar ratios are predominantly in the trondhjemitic compositional range. Mafic minerals consist of 2 to 12 percent green biotite and hornblende. Minor amounts of light green epidote are almost invariably present. In thin section plagioclase (albite-oligoclase) is generally seen as fresh equidimensional grains. Thoroughly altered plagioclase was observed in one place (Leeson Township). Microcline occurs as small crystals, often associated with and restricted to coarse-grained quartz injections par-

[1]Formerly Township 23 - Range 23.
[2]Formerly Township 37.

allel to foliation. Quartz occurs as large strained phenocrysts and as interstitial and fracture-filling material.

Biotite occurs as large tabular crystals, and to a lesser extent, as interstitial aggregates of small grains. Epidote and sericite are common accessory minerals. Good exposures of gneissic trondhjemite and granodiorite and metavolcanic migmatite are found along the shores of Missinaibi Lake. North of Lerwick and Kirkwall Townships, the outcrops are scarce and mostly trondhjemitic. Dikes of fine-grained massive red rock were seen at Baltic Bay of Missinaibi Lake (Brackin Township). They are described in the section "Alkalic Syenite Dike, Brackin Township" under "Carbonatite-Alkalic Complexes".

Other Areas

Scattered outcrops in Minnipuka, Mildred, and Walls Townships in the northwestern corner of the map-area are granodioritic in composition. In the northeastern part of the map-area, gneissic pink quartz monzonite occurs along the Nat River in Poulett Township. Further south, in Oswald, Melrose, Muskego, and Reeves Townships, biotite and biotite-hornblende trondhjemite and granodiorite appear to be the predominant felsic intrusive rocks. In bulk these rocks are similar to the trondhjemite and granodiorite of the Missinaibi Lake area. Possibly, the eastern and western trondhjemite and granodiorite were originally spatially related and were subsequently separated by the development of the Kapuskasing Structural Zone.

FELSIC INTRUSIVE ROCKS ASSOCIATED WITH THE KAPUSKASING STRUCTURAL ZONE

Granitic rocks spatially associated with the Structural Zone are thought to be linked to the uplift of the horst in that they are: *(i)* unmetamorphosed bodies, *(ii)* relatively small stocks found only in proximity to the Structural Zone.

A typical body is the small stock in Halcrow Township, described by Donovan (1968, p.24) as follows:

> The largest area of granite is in the western part of Halcrow Township, where a variety of textures and compositions are found. The main type is a pinkish fine- to medium-grained massive quartz monzonite. The main constituents are quartz, orthoclase, microcline, plagioclase (An_{20}) and hornblende; minor constituents are biotite, epidote, magnetite and pyrite, and secondary minerals are sericite, chlorite, and calcite. Although quartz monzonite is dominant, some granite, syenite, and monzonite are found. Compositional variations were gradational separate units that could not be mapped.

Other bodies, assigned to map-unit *11* in Fenton, Seaton, Sherlock, and Shenango Townships are also associated with the Structural Zone, but their form and intrusive relations allow them to be more definitely placed chronologically as post-uplift. On the other hand, the Halcrow Township body, described above, as well as small occurrences of syenite and diorite in Lougheed and Wadsworth Townships could be pre-uplift, and are, therefore, assigned to map-unit *6*. Both of the latter occurrences are too small to show on the map.

Two small bodies of granitic rocks occur within the mafic metavolcanics of the Swayze-Deloro belt in Cunningham and Dale Townships. These occurrences are described in reports by Meen (1942) and Bannerman (1933a, p.63d), respectively.

Gneissic to crudely foliated trondhjemite, light pink in colour, occurs along the western shore of Rush Lake (Genoa Township). The potassium feldspar, plagioclase, and quartz contents of this rock vary from traces to 6 percent, 67 to 70 percent, and 16 to 18 percent, respectively. Green biotite, hornblende, epidote, and magnetite represent 10 to 12 percent of the rock. The trondhjemite is fine to medium grained and porphyritic, owing to plagioclase phenocrysts 12 to 15 mm in size, and contains visible copper mineralization ("Economic Geology", "Parr Mines Limited").

KAPUSKASING STRUCTURAL ZONE ROCKS

The Kapuskasing Structural Zone (Figure 6, Chart A, back pocket, and Figure 7) is a NNE-trending zone of structural discordance extending from James Bay south to the Chapleau area where it gradually dies out. The zone is marked by structural trends nearly at right angles to the adjacent metavolcanic-metasedimentary belts, and by a sharp increase in metamorphic grade from predominantly greenschist and almandine-amphibolite facies assemblages in the metavolcanic-metasedimentary belts and surrounding granitic rocks to granulite facies assemblages (Winkler 1967, p.131). These changes in metamorphic grade are reflected by rather marked changes in lithology.

The zone forms an aeromagnetically distinct unit crossing the east-west trend in Superior Province structures (see Figures 2 and 3). The distinct boundaries reflect the magnetic susceptibility of the rocks underlying the zone. The susceptibility of the granulites is higher than that of the surrounding areas (see MacLaren *et al.* 1968, p.25, 30), and is caused in part by the presence of pseudotachylite and (or) ultramylonite. The ultramylonite is often highly magnetic, even in granitic rocks, and commonly deflects a compass needle.

The rocks of the Structural Zone were separated for purposes of field mapping in to five categories:

(1) meta-igneous rocks: gneissic gabbro and anorthositic gabbro, massive quartz diorite and syenite (map-unit *7a*); originally mafic to intermediate intrusive rocks;

(2) melanocratic granulite[1]: pyroxene-quartz-amphibole-plagioclase granulite, probably representing originally volcanic rocks (map-unit *7b*);

(3) pelitic and psammitic granulites: pyroxene-garnet-quartz-feldspar granulite (map-unit *7c*), probably representing originally sedimentary rocks;

[1]The term *granulite* is used here to denote rocks recrystallized under granulite metamorphic facies conditions and not in the European, textural sense.

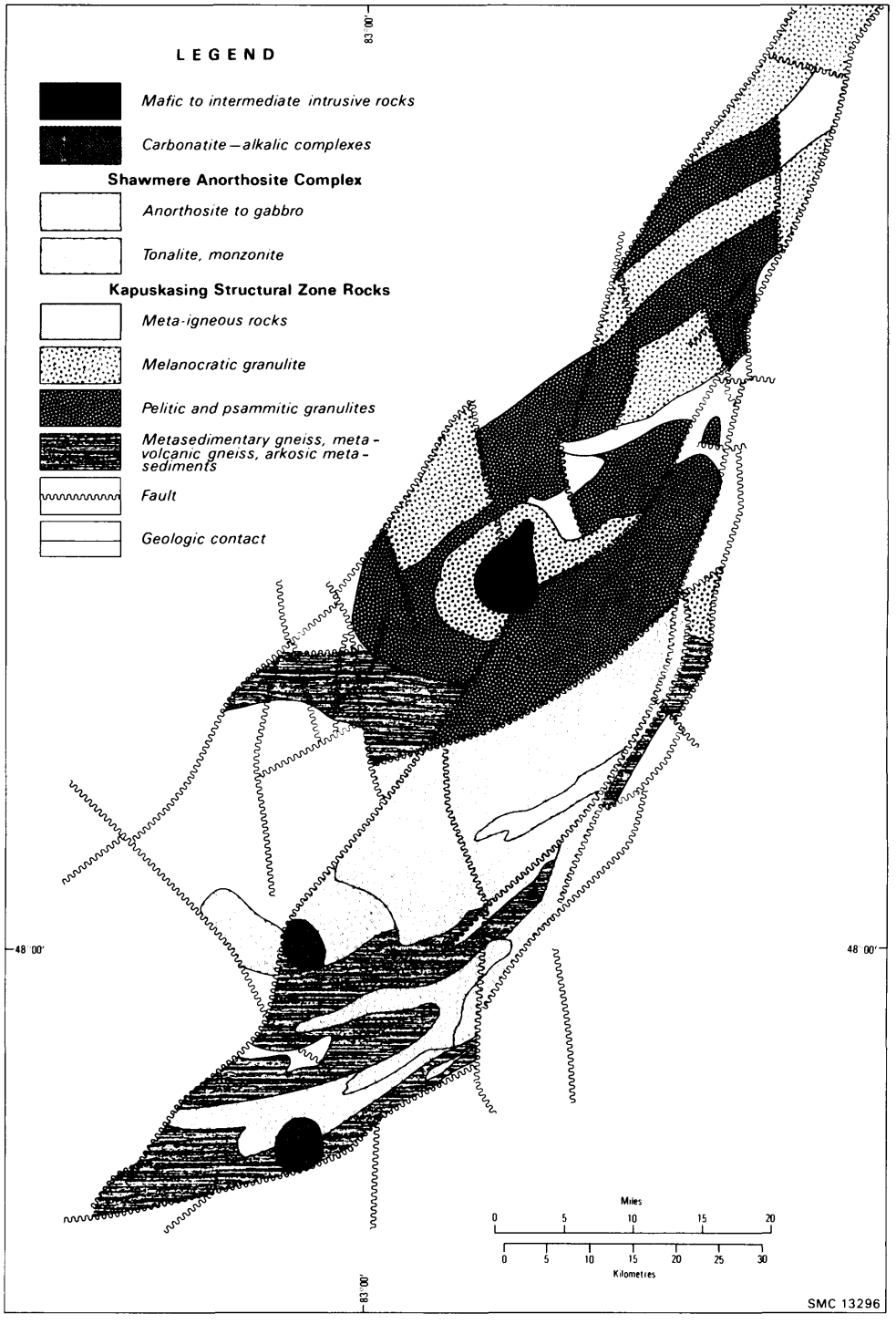


Figure 7–Geophysical interpretation of the Kapuskasing Structural Zone.

(4) metasedimentary gneiss and intercalated metavolcanic gneiss (map-unit *7d*), mostly having mineralogical assemblages characteristic of almandine-amphibolite facies;

(5) arkosic metasediments (map-unit *7e*) of uncertain metamorphic rank.

Outcrops in the area of the structure are generally small and widely scattered. Therefore, the continuity of individual units and contact relations between units are impossible to establish. Mylonitized zones up to 500 feet (150 m) wide have been found along the Goose Range fire tower road in Lemoine and Foleyet Townships and zones a few tens of feet wide on Highway 101. Bennett described extensive zones of 'mylonite' along the east side of the structure in Belford Township (Bennett 1969, p.10,11).

The rocks of the Structural Zone are characterized by mineral assemblages of the hornblende-clinopyroxene-almandine subfacies or the clinopyroxene-almandine subfacies of the granulite facies (Winkler 1967, p.135), corresponding to the hornblende-granulite subfacies of Fyfe *et al.* (1958, p.232). They are medium to coarse grained, generally granular, and exhibit gneissic banding.

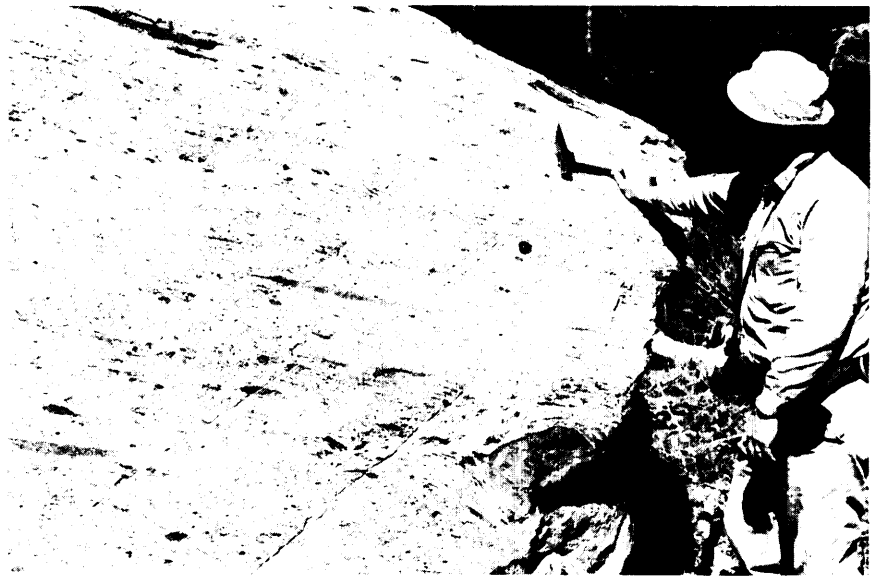
META-IGNEOUS ROCKS

The rocks mapped as unit *7a* represent scattered occurrences of mafic to intermediate igneous rocks which have been subjected to shearing and recrystallization. They are medium to coarse grained, massive to foliated, and vary in composition from diorite to anorthositic gabbro. The two occurrences of consequence are in Lougheed and Watson Townships.

In Lougheed Township scattered outcrops of gneissic gabbro and anorthositic gabbro form an elongated body 6 miles (10 km) east-west by 3 miles (5 km) north-south which is cut by a left lateral north-striking fault. No contact relations with the surrounding rocks were found in the course of mapping. The gabbroic rocks contain about 5 percent scattered garnet grains 0.5 cm in size. Amphibole occurs in bands and lenses up to 3 or 4 inches (8 to 10 cm) thick, containing scattered plagioclase grains. The amphibole-rich lenses are cut by feldspathic bands and veinlets (Photo 2). In Watson Township a large outcrop area consists of medium-grained massive hornblende quartz diorite with a mafic mineral content of 25 percent and about 10 percent quartz. This occurrence appears to be associated with the Structural Zone; it is megascopically fresh and unaltered in contrast to the older, Early Precambrian, mafic rocks ("Haileyburian") in Strachan and Belford Townships. In addition, an outcrop of unaltered syenitic rock was found in Lougheed Township.

MELANOCRATIC GRANULITES

The melanocratic granulites (map-unit *7b*) are medium- to coarse-grained rocks exhibiting a platy granoblastic or flaser structure. They display a foliated and rarely gneissic structure. The most abundant rock type is a (garnet)-pyrox-



ODM9424

Photo 2–Typical meta-igneous gneiss of map-unit 7a; anorthosite with garnet prominent among the mafic minerals. The obliteration of primary cumulate texture is typical.

ene-quartz-hornblende-andesine rock as indicated by the modal data in Table 6.

Commonly, the pyroxenes are slightly to severely altered. In all examples indicated below orthopyroxene is only slightly altered along some cleavage cracks and is never armoured by another mafic mineral phase. Flat-stage determinations of 2V indicate the orthopyroxene is hypersthene. Clinopyroxene, where present, is usually thoroughly armoured by, or altered to uralite and is probably

TABLE 6 | MODAL ANALYSES OF MELANOCRATIC GRANULITES FROM THE KAPUSKASING STRUCTURAL ZONE.

	1	2	3	4
Sample Number	AG19-1a	AG21-2	AI17-2	AI19-3
Plagioclase	54.8	66.2	69.0	64.2
Percent An	32	34	34	40?
Quartz	12.6	14.5	4.4	-
Hornblende	20.6	14.5	21.2	25.7
Orthopyroxene (hypersthene)	3.8	-	-	-
Clinopyroxene (uralitized)	0.7	2.5	-	-
Biotite	0.2	0.7	2.8	8.8
Opaque minerals	tr	0.7	0.4	-
Apatite	0.2	-	0.8	0.1
Garnet	6.6	0.3	-	-
Zircon	-	tr	0.4	-

an unstable component of the assemblage. Garnet occurs as large poikiloblastic grains with small irregular inclusions of quartz and feldspar, as small anhedral grains, or as large subhedral masses. Amphibole (probably hornblende) occurs as anhedral to subhedral, strongly oriented, pleochroic grains with Z brown-green and Y yellow-green. Quartz commonly shows undulatory extinction and consists of elongated aggregates which are composed of several individual grains. The predominant feldspar is plagioclase with straight to polygonal grain boundaries. Bent twin lamellae, strain shadows, and granulation are common. To the extent to which Michel-Levy determinations are reliable on deformed grains, the anorthite content of the plagioclase varies from An_{32} to An_{44} with a mean of An_{37}. Antiperthitic grains with beads, stringers, or blebs of exsolved potassium-feldspar are found frequently as minor constituents.

The rocks described contain mineral assemblages of the hornblende-orthopyroxene-plagioclase granulite subfacies or the hornblende-clinopyroxene-almandine granulite subfacies of the granulite facies (Winkler 1967, p.132,134,135). Granulite facies rocks are generally regarded as the product of polymetamorphism (Winkler 1967, p.132) and thus their present chemistry may quite possibly be different from their original chemistry. Furthermore, the outcrops found in the area are few in number so that they are not necessarily representative. Because of these limitations no attempt was made to use chemical data in suggesting a possible origin for these rocks. However, it is suggested on the basis of relict textures, structures, and mineralogy, that the above-mentioned rocks could represent metamorphosed mafic volcanic rocks. Coarser grained rocks with similar mineralogy are thought to represent metamorphosed gabbroic rocks.

PELITIC AND PSAMMITIC GRANULITES

The pelitic and psammitic granulites (map-unit *7c*) occur in zones up to 4 or 6 miles (6 or 10 km) wide trending northeast in the northern part of the Kapuskasing Structural Zone. This unit also forms the southern margin of the high grade portion of the structure, south of the Shenango intrusive complex. Here it is in gradational contact with interbedded metasediments and metavolcanics of lower metamorphic grade lying to the south. These, in turn, bound the Shawmere anorthosite complex on the north.

Contacts of this unit with the surrounding rock types were not observed. There is a good correlation of this unit with zones of relatively low aeromagnetic values on Map P.578 (ODM-GSC 1970) in part reproduced as Figure 3. The steep aeromagnetic gradient parallel to the structural trend of individual rock units within the structural zone indicates that in all probability the contact between map-units *7b* and *7c* is relatively sharp.

The pelitic and psammitic granulites weather rusty brown to red and are medium to coarse grained. Foliation or gneissosity is almost universally present and results from parallel arrangement of prismatic minerals such as pyroxene and (or) hornblende forming a fairly pronounced compositional banding. The compositional banding is due to bands, a fraction of an inch to 7 or 8 inches (17 or 20 cm) thick, which may be continuous for up to 75 feet (23 m); the bands

TABLE 7 MODAL ANALYSES OF PELITIC AND PSAMMITIC GRANULITES FROM THE KAPUSKASING STRUCTURAL ZONE.

	1	2	3	4	5	6	7
Sample Number	AE24-1	AE24-3	AF-20-1	AG22-3	AD26-1a	AD26-1d	AI22-6
Plagioclase	50.7	61.2	65.0	61.5	38.5	44.6	49.4
Percent An	40±	36	33	37	30	35	45
Quartz	15.0	32.8	12.3	31.1	28.8	29.7	16.4
Garnet	6.5	-	6.7	-	20.8	6.7	3.3
Biotite	12.7	2.6	9.3	3.5	9.4	10.9	25.0
Orthopyroxene	9.0	1.2	0.3	1.3	-	8.1	3.7
Clinopyroxene	-	1.2	-	-	-	-	-
Sillimanite	1.0	-	-	-	-	-	0.9
Chlorite	2.8	tr	-	-	-	-	-
Opaque	0.3	0.4	-	tr	-	-	-
Epidote	1.3	-	-	-	-	-	-
Carbonate	0.3	-	-	-	-	-	-
Apatite	0.5	-	-	-	-	tr	1.3
Sericite	-	0.2	3.7	0.1	-	-	-
Antiperthite	-	0.6	2.7	3.1	2.5	-	-
Pelitic/psammitic	pel.	psam.	pel.?	psam.	psam.	psam.	pel.

consist of mafic-rich material often weathering to a pervasive rusty red. Rocks from a relatively fresh part of an exposure, and which do not have an extremely granular texture, display the light green fresh surface characteristic of granulite facies rocks, but often this colour is seen only when the rock is sawed for sectioning. Garnetiferous bands ranging from ½ inch (1.2 cm) up to 3 inches (8 cm) in thickness with 5 to 25 percent garnet are found in quartzofeldspathic rocks in Lincoln and Shenango Townships.

At least two rock types are included in this unit: a psammitic type (the most abundant) and a pelitic type. Modes of the two types are given in Table 7.

From the modal data it can be seen that the assemblages present indicate metamorphism to the hornblende-orthopyroxene-plagioclase granulite subfacies (Winkler 1967, p.132) and the uppermost subfacies of the almandine amphibolite facies (sillimanite-almandine-orthoclase subfacies of Winkler 1967, p.106). It would appear that most of the material within the Structural Zone has been metamorphosed to granulite facies assemblages; the areas of amphibolite facies assemblages are of minor extent within the main part of the structure and are possibly related to retrograde metamorphism along faults. Chemical analyses (Table 8) of these rocks plot in the *Al-rich clays, shales* (pelitic), and *greywacke* (quartzofeldspathic) fields represented on an ACF diagram by Winkler (1967, p.56).

The quartzofeldspathic (psammitic) rock, represented in Table 7 by columns 2, 4, 5, and 6, displays a granoblastic polygonal or flaser texture and consists of 40 to 65 percent sodic andesine (An_{28-37}) as subhedral to anhedral grains, slightly sericitized, with occasionally granulated borders. Quartz has undulatory extinction and occurs as elongate phacoidal aggregates composed of individual subrounded grains (Photo 3). Garnet occurs as large (up to 2.7 mm) subhedral, poiki-

TABLE 8 CHEMICAL ANALYSES, IN WEIGHT PERCENT, OF PELITIC AND PSAMMITIC GRANULITES FROM THE KAPUSKASING STRUCTURAL ZONE. ANALYSES 1, 2 AND 3 BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	1	2	3	4	5
SiO_2	61.10	60.80	64.80	64.7	64.2
Al_2O_3	17.00	16.30	16.30	14.8	13.8
Fe_2O_3	4.26	1.57	5.12	1.5	3.4
FeO	3.91	5.35	1.66	3.9	2.0
MgO	4.04	4.02	2.90	2.2	1.7
CaO	3.52	4.30	2.29	3.1	2.5
Na_2O	3.18	3.43	3.06	3.1	1.5
K_2O	1.88	1.90	2.26	1.9	3.8
H_2O^+	0.59	0.46	0.74	2.4	3.6
H_2O^-	0.04	0.05	0.03	0.7	
CO_2	0.12	0.06	0.18	1.3	1.9
TiO_2	0.68	0.67	0.55	0.5	0.6
P_2O_5	0.18	0.18	0.06	0.2	0.2
S	0.03	0.01	0.14	0.2	-
MnO	0.10	0.10	0.09	0.1	-
Total	100.60	99.20	100.20	100.6	99.2
Specific Gravity	2.81	2.76	2.82		

1. Sample AD26-1d psammitic granulite, Watson Township.
2. Sample AI22-10 pelitic granulite, Shawmere Lake.
3. Sample AD26-la psammitic granulite, Watson Township.
4. Average of 23 greywackes (Pettijohn 1957, Table 52, p.307).
5. Average of 2 parts average shale and 1 part average arkose (Pettijohn 1957, Table 52, p.307).

loblastic grains with occasionally slightly embayed edges and rounded inclusions of quartz, plagioclase, and minor biotite. Orthopyroxene (variety hypersthene) has very slight pleochroism (X = red, Y = yellow, Z = clear to blue); it is often incompletely armoured by biotite and occurs as anhedral elongated grains (in amounts up to 8 percent) often associated with garnet in mafic-rich clusters distinct from the quartzofeldspathic matrix. The biotite is associated with pyroxene grains and also occurs as occasional small grains in the quartzofeldspathic matrix. Pleochroism is in shades of brown and red-brown.

The rocks north of the Shawmere anorthosite complex, in Oates, Lemoine, Shenango, Lincoln, and Copperfield Townships are tentatively classified as pelitic. Typical modes are tabulated in columns 1, 3 and 7 of Table 7. The rocks are foliated, have moderately well developed compositional banding, and contain occasional porphyroblasts of antiperthitic plagioclase. The rocks have a brown to grey weathered surface in which the plagioclase porphyroblasts are clearly visible as roughly equant greenish blebs up to 1.2 cm in size, or as elongated bands up to 4 cm long by 3 mm thick, apparently composed of one large grain. Quartz occurs as very elongated, thin (less than 1.5 mm) stringers parallel to foliation

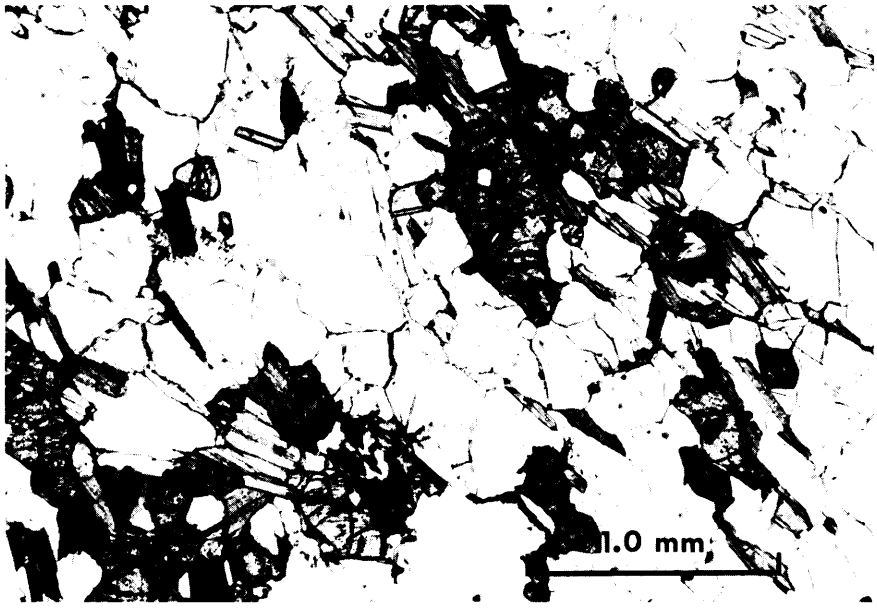


Photo 3–Photomicrograph of psammitic granulite, showing pyroxene grains rimmed with biotite in a quartzo-feldspathic matrix.

and is often found associated with feldspar grains. Biotite and occasional small garnet grains are visible in hand specimen.

The principal occurrence of the pelitic rocks is a band up to 2 miles (3 km) wide found in northwestern Lemoine Township immediately west of the anorthositic rocks east of Shawmere Lake. Outcrops are scarce, the best exposures are on Shawmere Lake. West of this, in Lincoln Township, there are good exposures of interbanded metasediments and metavolcanics of upper amphibolite facies rank. The Shawmere Lake exposures cover only a portion (i.e. an estimated 7,400 feet or 2300 m) of the probable stratigraphic thickness of the unit of pelitic rocks. It is, therefore, possible that some of the rocks in the Shawmere Lake area are volcanic in origin, just as a high proportion of the Lincoln Township amphibolite facies rocks, of which a greater section is exposed, are volcanic in origin. The modal data indicate that the eastern end of the pelitic rock band at Shawmere Lake has assemblages characteristic of the hornblende clinopyroxene-almandine granulite subfacies (Winkler 1967, p.135). The metamorphic grade, together with the structural trend of the rocks, indicates that the pelitic rocks are part of the Kapuskasing Structural Zone. The extrapolated continuation of this band to the west, in particular to Copperfield and Lipsett Townships, is based almost exclusively on interpretation of magnetic data (see Figure 3).

The most highly metamorphosed pelitic rocks are microgranoblastic polygonal in texture (Katz 1968, p.805). Irregular, subrounded, recrystallized plagioclase grains (approximately An_{45}) with well developed albite and Carlsbad twins, and grain boundaries commonly intersecting at 120-degree angles, make up

about half the rock. Quartz is present as irregular rounded grains and occasionally as ribbon-like composite grains, all having relatively sharp extinction. Scattered through the mosaic of quartz and feldspar are grains of brown to golden-yellow, anhedral to subhedral biotite, often closely associated with hypersthene grains. Hypersthene exhibiting poorly developed pleochroism and a poor basal parting, together with subsidiary clinopyroxene, probably augite, constitutes 3 to 15 percent of the rock. Antiperthitic plagioclase occurs as occasional porphyroblasts constituting no more than 4 or 5 percent of the rock. Accessory minerals are iron oxide (hematite-limonite), apatite, and sillimanite (?), found as separate anhedral grains and occasionally along cleavage cracks of the plagioclase.

METASEDIMENTARY AND METAVOLCANIC GNEISS

Map-unit *7d* includes both metasediments and metavolcanics, which, on the basis of structural trend and (or) metamorphic grade (upper almandine-amphibolite facies), appear to be associated with the Kapuskasing Structural Zone. These rocks occur in the southern and western tips of the Structural Zone, and their location is probably a domain of complex faulting as shown by the pattern of intersecting lineaments in this area.

ARKOSIC METASEDIMENTS

Arkosic metasediments consisting of rounded clastic grains of quartz and feldspar in sub-equal amounts with minor amounts of biotite and garnet are present as a unit of uncertain dimensions centred on the Foleyet-Chapleau Highway. The unit is thickly bedded; bedding is discernable with difficulty on the outcrops of the gently dipping units. The unit is intercalated with dioritic rocks south of the Shawmere anorthosite complex and appears on the basis of clastic to granoblastic textures to be a recrystallized metasediment of uncertain metamorphic rank.

Origin of the Structural Zone

Garland (1950), in the course of interpreting a gravity traverse across the Kapuskasing Structural Zone, suggested that the anomalously high zone was caused by a thinning of the granitic crustal layer due to orogenic forces. Innes (1960, p.319) suggested that the gravity high marks "a major tensional feature of the crust, a fracture zone extending to great depth, which has provided the channel for access to the surface of the basic material giving rise to the gravity anomaly". He also suggested that although not directly on strike, the "Kapuskasing-Fraserdale gravity high" may be the northeastern extension of the "Mid-continent gravity high".

Wilson and Brisbin (1965, p.186, 187) considered the Structural Zone to be an upwarp in the Conrad discontinuity, overlain by thinner than normal

granitic crust. The crust was presumed to be thicker to the east than the west, based on the fact that the axis of the gravity high is west of the exposed high grade rocks. They were the first to postulate faulting within the block (based on aeromagnetic evidence).

Carlson (1965d) indicated on his map that some of the rocks within the Structural Zone were sedimentary in origin. MacLaren (MacLaren *et al.* 1968, p.7) postulated that faulting uplifted the granulite facies rocks of the Structural Zone, whereas Skinner (MacLaren *et al.* 1968, p.5) suggested that either folding or faulting brought the highly metamorphosed rocks to their present surface position. Bennett *et al.* (1967, p.18) indicated that a sedimentary origin is possible for some of the rocks within the Structural Zone and that the remainder are mafic meta-intrusive rocks or metavolcanics, and that some charnockitic rocks of unknown origin are also present. Bennett (1969, p.8,9), in a more detailed report on the Belford-Strachan Townships area within this map-area, noted only that the rocks were metamorphosed under granulite facies conditions and did not suggest an origin.

Ayres (1971, personal communication) suggested that the Kapuskasing Structural Zone could represent a fracture along which large-scale, left-lateral movement and vertical movement took place. The proposed lateral movement shifted the Superior Province–Churchill Province boundary from its assumed position in the Sutton Inlier, west of the Structural Zone, northward to the Cape Smith–Wakeham Bay Belt in northern Quebec, east of the Structural Zone. The proposed vertical movement exposed, through upfaulting, a prevolcanic metasedimentary unit, i.e. older than the "greenstone" belts. He alternatively proposed that the Structural Zone could be a relatively recent feature that uplifted metasediments perhaps of Huronian age.

Any theory of origin of the Kapuskasing Structural Zone must explain the following facts:

(1) the Zone cuts, at varying degrees of obliqueness, both the metavolcanic-metasedimentary belts of the region and foliation in the granitic rocks;

(2) most units within the Zone dip at 20 to 40 degrees to the northwest whereas the surrounding rocks display predominantly vertical dip;

(3) extensive mylonitization is developed on the eastern side of the Zone;

(4) the western side of the Zone, particularly north of the map-area (Ayres 1971, personal communication), is not an abrupt boundary marked by mylonitization or steep metamorphic gradients;

(5) most rock-units of the Structural Zone within the map-area are probably of sedimentary origin (see Figure 7);

6) the granulitic rocks of the Structural Zone are probably cut by the Shawmere anorthosite complex, which has been dated radiometrically (K-Ar date on hornblende 2519 m.y., Watkinson *et al.* 1972) as Early Precambrian;

(7) the Shawmere anorthosite complex is well metamorphosed relative to Grenville Province anorthosites (Mason 1969; Lumbers 1971, personal communication);

(8) the Structural Zone underwent postmetamorphic igneous activity dated radiometrically at 1740 m.y. and several events dated at approximately 1000 m.y. (Gittins *et al.* 1967; see "Age of the Kapuskasing

Structural Zone" under "Structural Geology");
(9) the development of a rim of pargasitic hornblende with an outer rim of garnet ± spinel around an orthopyroxene core in the anorthosite indicates postemplacement metamorphic reactions (Griffin 1971);
(10) the axis of the gravity anomaly does not coincide with the linear magnetic anomaly marking the surface expression of the high grade rocks (see Figure 6).

The authors suggest that the Structural Zone represents a site of Early Precambrian (prevolcanism) sedimentation and intrusion of mafic igneous rocks, later intruded at a deep crustal level by the Shawmere anorthosite complex (this last postulation is based on relations in coronal mafic minerals in the anorthosite). This accumulation of rock was upfaulted either by simple rifting (Innes 1960) or by transform movement with both sides fault-bounded. The Zone is perhaps slightly wider than presently indicated; better exposure would perhaps show the western contact to be farther west.

Combined gravity and magnetic evidence indicates that the Zone may be a westward-dipping horst. A post-Early Precambrian age of granulitic rocks would be difficult to explain if the Early Precambrian age of the Shawmere anorthosite complex is correct.

SHAWMERE ANORTHOSITE COMPLEX

The Shawmere anorthosite complex (Figure 8), including the associated rock-types, has an areal extent of about 450 square miles (1200 km^2). The complex consists of a large, elliptical mass of anorthosite to anorthositic gabbro lying adjacent to and ESE of the Kapuskasing Structural Zone, with an area of 310 square miles (800 km^2), and a satellite Y-shaped mass with an area of 35 square miles (90 km^2). Between the two masses of anorthosite, strongly foliated quartz diorite (i.e. tonalite) and monzonite cover an area of 100 square miles (260 km^2). The complex has an overall length in an ENE direction of approximately 52 miles (84 km) and a maximum width of 15 miles (24 km).

Classification of the anorthositic rocks is loosely based on Buddington's classification (1939, p.19) as follows:

0–10% mafic minerals	Anorthosite
10–22.5% mafic minerals	Gabbroic anorthosite
22.5–35% mafic minerals	Anorthositic gabbro
>35% mafic minerals	Gabbro

The biotite- and hornblende-bearing rocks of the anorthosite kindred in which hypersthene is absent are classified according to de Waard's scheme (1968, p.77), which is in turn based on Johannsen (1931 *in* de Waard 1968). This terminology was used in the map-area to conform with previous work on anorthositic rocks (Hødal 1945; Philpotts 1966; etc.).

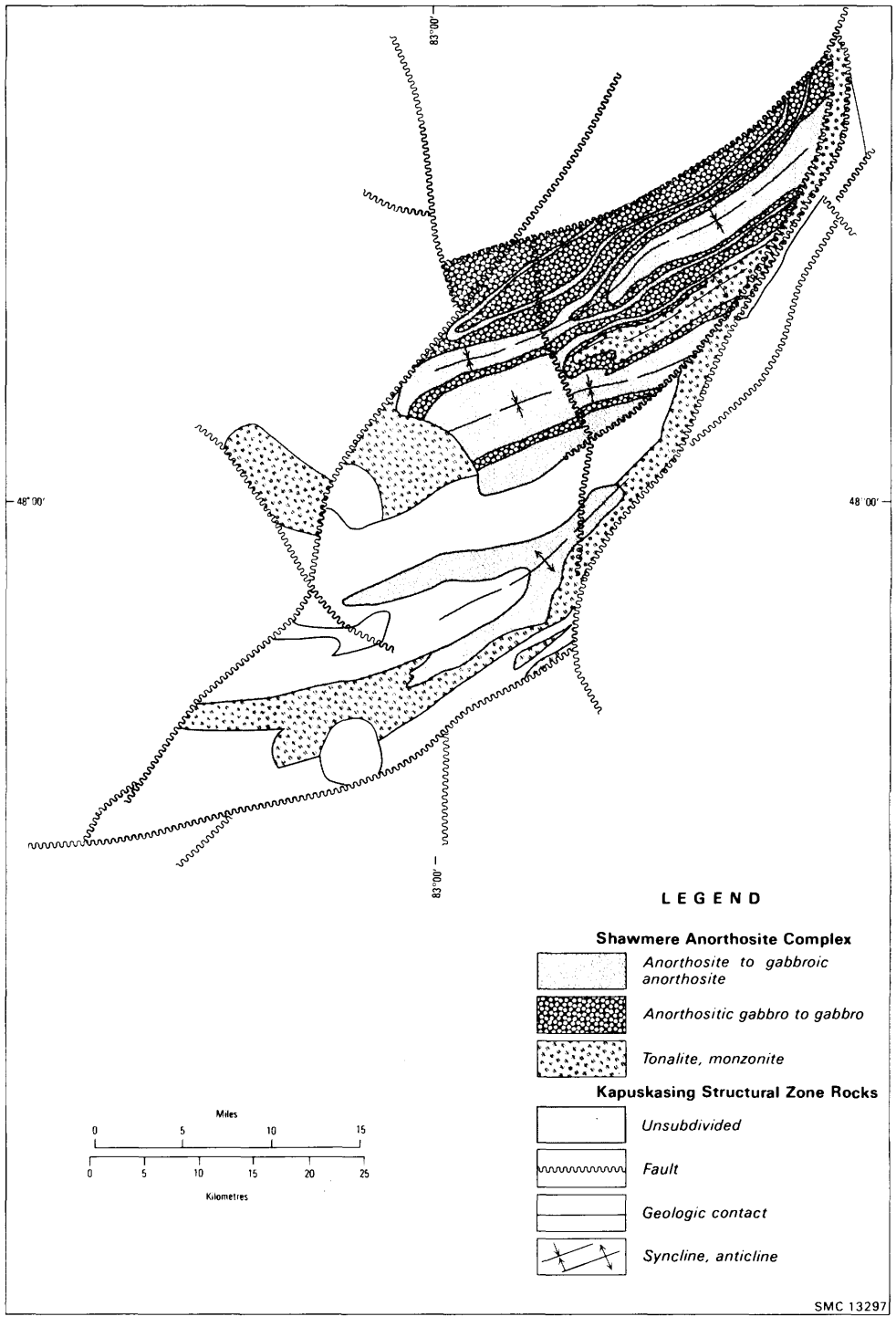


Figure 8–Geophysical interpretation of the Shawmere anorthosite complex.

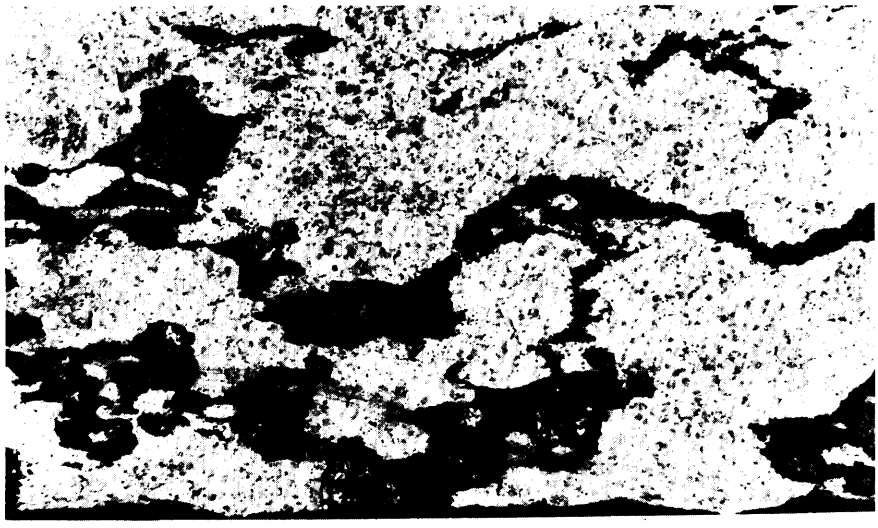
The largest mass, which lies just south and southeast of the granulites of the Kapuskasing Structural Zone, consists of anorthosite and gabbroic anorthosite with minor bands of gabbroic composition toward the southeastern margin (see Figure 8). Map-unit *8a* includes substantial amounts of gabbroic anorthosite and the actual anorthosite units are probably on the order of 1,000 feet (300 m) thick, where not tectonically thickened. The total amount of anorthosite possibly approaches 50 percent. The transition of gabbroic rocks to anorthosite is abrupt where observed. The abundance of plagioclase increases in the space of 6 inches (15 cm) to 2 feet (60 cm), and the mafic mineral content drops from 40 or 50 percent to 15 percent or less.

In outcrop, anorthosite weathers white and has a grey to pale mauve fresh surface. Mineralogical layering is evidenced by parallel arrangement of elongate plagioclase grains 10 by 2 mm in the coarse-grained phases. Commonly, the anorthosite consists of a fine-grained (about 1 to 2 mm) granoblastic textured rock in which all plagioclase is recrystallized. Typical mineral assemblages are: bytownite An_{70-74}, hornblende and rare grains of relict clinopyroxene and orthopyroxene. All textural gradations exist between primary, plagioclase laths and cataclastic or granoblastic grains.

In the centre of the mass, megacrysts of plagioclase up to 18 inches (45 cm) long by 3 to 5 inches (8 to 13 cm) across are found with interstitial hornblende and minor garnet. The cumulate nature of the plagioclase is obvious in many gabbroic anorthosite outcrops where megacrysts of plagioclase up to 8 inches (21 cm) by 4 inches (10 cm) are stacked one on top of another with interstitial clots up to 2 inches (5 cm) long of coronal intergrowths of mafic minerals. In addition, primary igneous layering is displayed by variation in mafic mineral content, with individual bands 3 to 4 feet (0.9 to 1.2 m) thick.

In the centre of the anorthosite body, the plagioclase grains do not appear to have been granulated. Toward the margin of the mass the intersertal texture is less apparent. Plagioclase grains decrease in size toward the southeastern margin of the body, where the average grain size is about 2.5 cm or less along the Goose Range fire-tower road (Foleyet Township). There, plagioclase has been thoroughly granulated and appears as granoblastic areas having the general form of megacrysts of plagioclase (Photo 4).

In addition to the granulation of the plagioclase, banding becomes apparent away from the relatively undisturbed centre of the mass. Toward the southern margin, relict interstitial hornblende and garnet (?) are still apparent but a banding consisting of mafic-rich and mafic-poor layers is apparent in some large exposures (Photo 5). In the northwestern part of the mass, granular textures are common and porphyritic textures occur in a few minor areas. Foliation is defined by an arrangement of individual hornblende grains roughly the same size as the plagioclase grains. Near Shawmere Lake and to the southeast, clots of hornblende, and occasional granules of brown pyroxene and garnet, are arranged in bands alternating with mafic-poor material. The clots are up to 1 foot (30 cm) in size and in places 18 inches (45 cm) by 1 to 3 inches (2.5 to 8 cm). The clots or bands are elongated parallel to the foliation and the bands are spaced a few feet apart.



ODM9426

Photo 4–Gabbroic anorthosite from near the Goose Range fire tower, Foleyet Township. Pyroxene grains rimmed with amphibole are present to the left of centre. Minor shear zones filled with alteration products are visible toward the bottom of the photo. The granulated nature of the plagioclase is well displayed.



ODM9427

Photo 5–Foliated anorthosite: mafic clots consist of pyroxene core rimmed with amphibole ± garnet. Foliation is defined by the concentration of mafic minerals in bands.



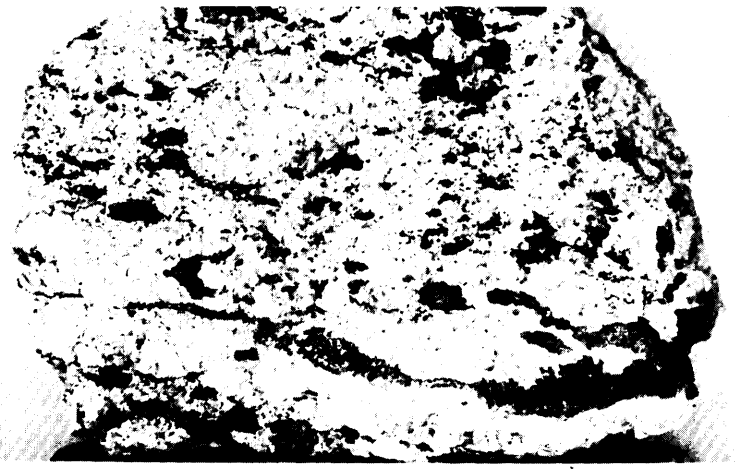
ODM9428

Photo 6–Contact between gabbroic anorthosite and gabbro (upper) along the Goose Range Fire Tower road, Foleyet Township.

The foliation is probably a metamorphic feature. It is better developed toward the margins of the anorthosite mass and parallels the northern contact with the rocks of the Kapuskasing Structural Zone. The foliation dips 30-50NW.

Primary igneous layering is found in a few localities toward the southern margin of the mass such as in Foleyet Township at the Goose Range fire tower (Photo 5) and along the fire-tower road (Photo 6). Photo 6 shows a band of hornblende gabbro about a foot (0.3 m) thick in granular-textured gabbroic anorthosite (note that the foliation is at a slight angle to the igneous banding). These bands range from fine-grained and fairly massive gabbroic material to coarse porphyritic anorthositic gabbro with plagioclase phenocrysts up to 1½ inches (4 cm) in length. They appear to be most abundant toward the southern contact, but information on this area is quite sketchy.

The available evidence indicates that the relatively undisturbed coarse-grained anorthositic core (e.g. Warren and Lemoine Townships) is succeeded by more granulated, foliated, gabbroic material (Photo 7) toward the margin of the mass (e.g. Carty Township). The eastern mafic-rich margin of the mass is interrupted by the occurrence of a lens of tonalite at Carty Lake (Carty Township). The tonalite is probably not related to the anorthosite in a direct genetic sense (see Simmons *et al.* 1974).



ODM9429

Photo 7–Typical hand specimen of gabbroic anorthosite from eastern margin of the Shawmere anorthosite complex.

Petrography

The anorthosite varies in texture from intersertal, with large plagioclase crystals and less than 15 percent interstitial hornblende and garnet, to a massive medium- to fine-grained hypidiormorphic granular rock (see Photos 9 and 10). Plagioclase occurs as subhedral to anhedral grains of varying sizes displaying hypidiomorphic granular textures in the less disturbed parts of the anorthosite complex. More intense granulation has resulted in mortar fabric, in which small plagioclase fragments rim large subhedral to anhedral grains (Photo 8). Scapolite (i.e. meionite, the uniaxial negative Ca-rich end-member of the scapolite series) and sericite have developed between feldspar grains.

The plagioclase varies from An_{53} to An_{74}; the mean of samples without exsolved K-feldspar is approximately An_{70}. Blebs and stringers of exsolved K-feldspar are present in some plagioclase grains but they are not abundant, constituting less than 1 percent of the rock. Normal zoning occurs, but rarely. In general, thin sections are too small to display well the intersertal texture seen in outcrop.

The hornblende is usually anhedral, but occasionally corroded basal sections are seen. The calcium-rich member of the hornblende series, pargasite, is most common and is associated in places with common hornblende. The pleochroism of pargasitic hornblende is light yellow-green to medium green whereas the common hornblende is usually pleochroic in dark grass-green to medium green. One sample from the central part of the anorthosite body has relatively fresh clinopyroxene (augite ?) and orthopyroxene. Clinopyroxene is present as relict grains surrounded by uralitic hornblende in a few specimens.

Coronas of 5 to 7 mm of hornblende mantling 10 mm hypersthene grains are common in less structurally disturbed areas (Photo 9); garnet may form a third

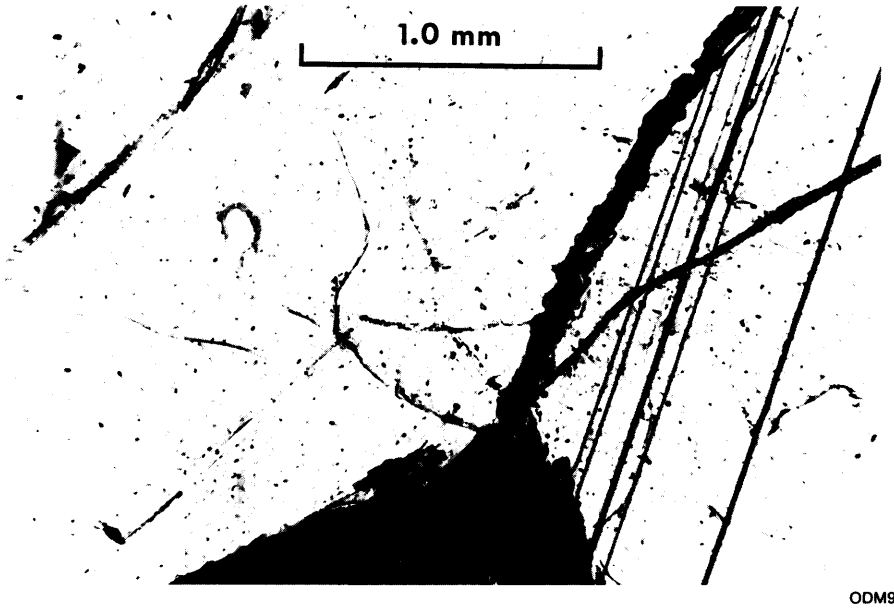


Photo 8–Photomicrograph of granulated grain boundaries of plagioclase grains in anorthosite. The intergranular material in this section is mostly fine-grained plagioclase, but scapolite, epidote, carbonate, and quartz have been observed.

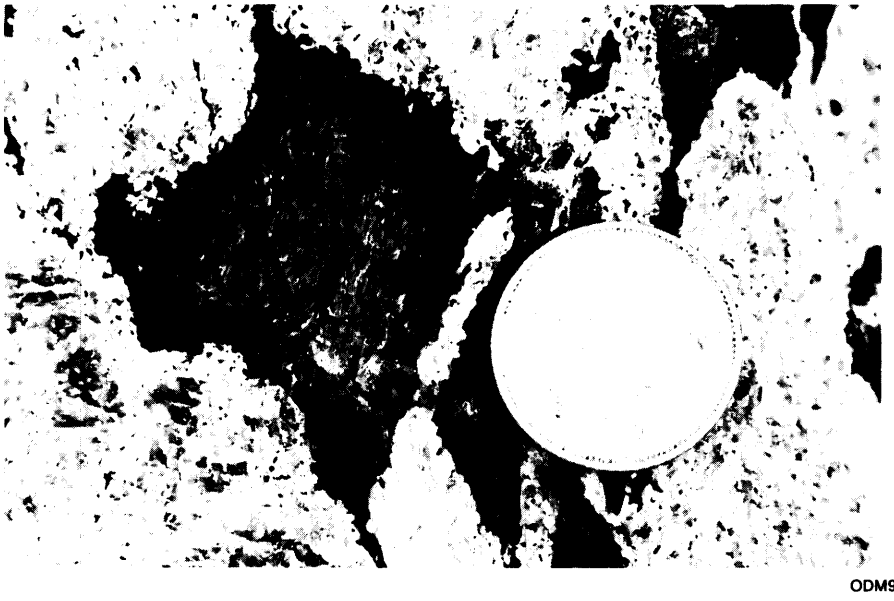
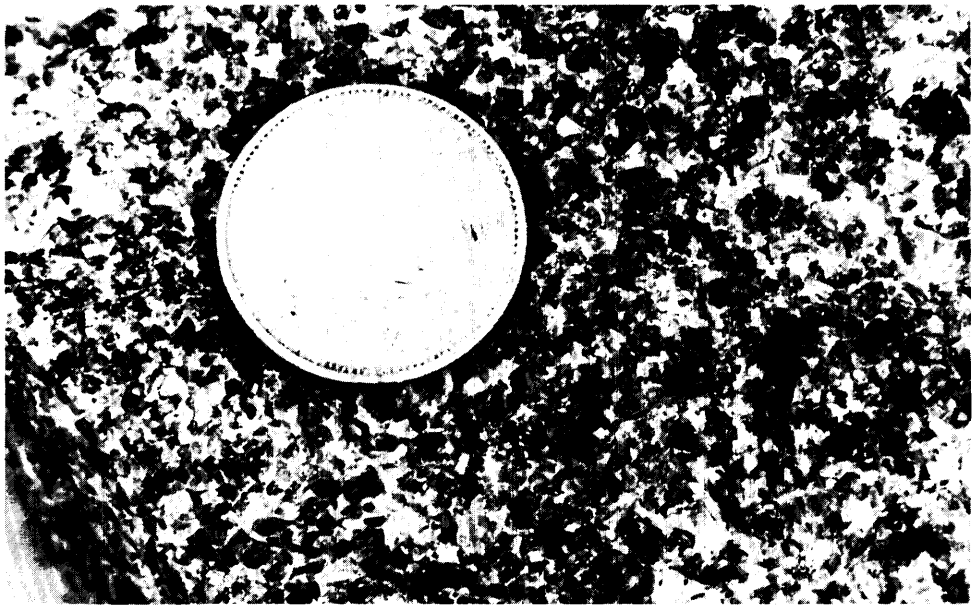


Photo 9–Hand specimen of anorthosite from central part of intrusion, showing orthopyroxene mantled with amphibole occupying intergranular spaces between cumulate plagioclase grains now well granulated.



ODM9432

Photo 10–Hand specimen of hypidiomorphic-granular anorthosite. This variety is very low in mafic minerals and purple to grey on the fresh surface.

phase of the corona. Griffin (1971) and Whitney and McLelland (1973) have demonstrated that the formation of these coronas is a common metamorphic effect in rocks of this composition.

Garnet is a common accessory mineral, constituting up to 1 percent of the anorthosite. A spectrographic analysis of a garnet concentrate by the Mineral Research Branch, Ontario Division of Mines, showed that it is high in Fe, has lesser amounts of Mg and Ca and minor amounts of Ti, Mn, and Cr. The garnet is probably rich in the almandine end-member of the series.

In the only specimen in which oxide minerals are abundant, they consist of exsolved grains of a light green, transparent-in-thin-section, isotropic spinel (hercynite ?) in pyroxene grains.

Toward the southeastern edge of the complex and in the area of Murdock Lake (Murdock Township), the anorthosite is cut by minor shear zones (usually subvertical) less than 1 inch (2.5 cm) wide. The zones are filled with scapolite, epidote (variety clinozoisite), carbonate, quartz, and minor hematite, along with crushed feldspar grains.

The southern body of anorthosite displays a hypidiomorphic-granular texture (Photo 10), and on the basis of the limited number of exposures, it appears to be similar to the rock found in the marginal areas of the main body. Interstitial mafic minerals, remnants of large phenocrysts, and mafic clots are absent. The mafic mineral is normal hornblende and the plagioclase is approximately An_{53}. Many grains show evidence of strain, such as bent twin lamellae and undulatory extinction.

ASSOCIATED ROCKS

Gabbro

Gabbro occurs in relatively thin units on the northern and southern fringes of the main mass of anorthosite, and stratigraphically low in the sequence. Typically it is a relatively coarse-grained rock. Plagioclase forms phenocrysts up to 2 to 5 cm in a matrix of hypersthene and augite, and in the least altered varieties, hornblende. Plagioclase is a cumulate phase, enmeshed in a matrix of mafic minerals.

The plagioclase has been almost completely recrystallized to a granoblastic mosaic of equant grains having smooth boundaries abutting at more or less perfect 120-degree junctions. Pericline and albite twins are common. A few grains have an unaltered, more calcic core with much finer, more regular twin lamellae and fine-grained inclusions. Compositions in thin section range from $An_{80}$to An_{83} based on examination of the most calcic parts of the grains; more altered grains are in the range An_{40-60}. Normative plagioclase composition is in the range An_{80}. The presence of some plagioclase grains with calcic cores and very uniform, less calcic exteriors indicates that metamorphism lowered the An content. The plagioclase compositions are consistent with the metamorphic rank of the surrounding metasediments.

The mafic minerals are interlocking granular masses of hornblende, pargasitic hornblende (calcic), orthopyroxene and clinopyroxene, and accessory garnet. The hornblende is the most abundant phase and has replaced the pyroxene. Relict, rounded blebs of pyroxene are found in masses of hornblende. The mafic mineral content ranges from nil to about 25 percent. The rocks low in mafics contain hornblende, whereas pyroxene is more common in the more mafic rocks.

Tonalite, Monzonite

Gneissic to flaser-textured monzonite and tonalite occur as lenses and bands within the main anorthosite mass and as marginal zones along the eastern edge of the main mass. The principal mafic minerals are hornblende, biotite, and garnet, and rare clinopyroxene. The mafic mineral content rarely exceede 35 percent and quartz, while noted in thin section, is not usually visible in the hand specimen.

The monzonitic and tonalitic rocks found within the anorthosite are strongly foliated and in some cases display a gneissosity (Photo 11) reflecting variations in the amounts of mafic minerals. The principal occurrence within the main anorthosite mass is at Carty Lake, where foliated to gneissic tonalitic rocks are cut by later semiconcordant sills up to 10 or 20 feet (3 or 6 m) thick of anorthosite to gabbroic anorthosite, developing locally an agmatitic appearance. The tonalitic rocks have a white to grey weathered surface and a hypidiomorphic-granular texture. They pass gradationally in most occurrences to monzonitic rocks but this transition was not mappable in the field. Tonalitic rocks also occur



ODM9433

Photo 11–Gneissic tonalitic rocks with amphibole-pyroxene inclusions.

south of the Goose Range fire tower on the shore of a small, unnamed lake in the southeast corner of Lemoine Township. Their extent here is unknown.

The rocks at the margins of the two anorthosite masses vary from monzonite to tonalite in composition and tonalite is the more abundant. The relations between the anorthosite and the surrounding tonalite are unknown. The contact was not mapped, and the contrast in the degree of deformation is not immediately explicable.

The tonalitic rocks contain hornblende, garnet, minor biotite, quartz (1 to 25 percent) and plagioclase (An_{30-60}) mostly in the sodic andesine range. The garnets form large (up to 5 mm) poikiloblastic grains with intrusions of quartz and feldspar. Some of the garnetiferous rocks are porphyroblastic, and individual garnet crystals attain a size of 10 to 15 mm. The most common mafic minerals are hornblende, minor biotite, and uralitized clinopyroxene. Opaque minerals (magnetite ?), apatite, zircon, epidote, and carbonate are accessory constituents. Potassium feldspar is present as beads, and patches in antiperthitic grains of plagioclase and occasionally as rims enclosing plagioclase grains.

These rocks bear a close spatial relation to the principal anorthosite mass. They form an aeromagnetically distinct unit whose trend is at variance with the surrounding granitic rocks (ODM-GSC 1963, Maps 2246G, 2247G, 2232G, 2233G). On the basis of limited data they are thought to be similar chemically to the pyroxene-bearing syenitic, dioritic, and gabbroic rocks of the anorthosite kindred (Philpotts 1966; de Waard 1968). Table 9 compares the chemistry of the gabbroic rocks of the Shawmere complex with rocks of the anorthosite kindred from the Adirondacks and other Grenville Province occurrences described by

TABLE 9 CHEMICAL ANALYSES, IN WEIGHT PERCENT, OF GABBROIC ROCKS OF THE SHAWMERE ANORTHOSITE COMPLEX IN COMPARISON TO OTHER ROCKS OF THE ANORTHOSITE KINDRED. ANALYSES 1 AND 2 BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	1	2	3	4	5	6
SiO_2	50.50	50.50	49.93	50.23	50.28	64.40
Al_2O_3	20.90	14.40	16.65	18.16	17.67	16.00
Fe_2O_3	1.50	4.45	1.15	1.66	1.30	1.16
FeO	3.04	4.98	5.36	7.09	7.46	4.77
MgO	9.23	9.62	10.26	9.38	9.27	0.76
CaO	13.20	10.70	13.65	9.17	9.72	2.63
Na_2O	1.43	1.87	1.75	2.35	1.96	3.79
K_2O	0.12	0.18	0.26	0.77	0.63	4.60
H_2O^+	0.59	0.64	0.36	0.70	0.47	0.40
H_2O^-	0.04	0.04	0.10	0.12	-	0.26
CO_2	0.16	0.22	-	-	-	0.32
TiO_2	0.19	0.25	0.49	1.00	0.89	0.73
P_2O_5	0.18	0.40	Nil	0.08	0.21	0.22
S	0.01	0.01	-	-	-	-
MnO	0.10	0.17	0.11	0.07	0.14	0.12
Total	101.20	98.40	100.07	100.78	100.00	100.16
Specific Gravity	2.88	2.98				

1. Sample AJ21-21 Shawmere anorthosite complex, Lemoine Township.
2. Sample AJ21-2b Shawmere anorthosite complex, Lemoine Township.
3. Gabbro from Morin anorthosite (Proterozoic) (Philpotts 1966, p.37).
4. Gabbro from Morin anorthosite (Proterozoic) (Philpotts 1966, p.37).
5. Average norite (Nockolds 1954, p.1020).
6. Average of six monzonitic rocks from the North Bay area (Lumbers 1971, p.37).

Lumbers (1971, p.34-39). The gabbroic rocks of the Shawmere complex are poorer in ferrous iron and lower in the ratio of ferrous to ferric iron and the ratio of ferrous iron to magnesia than rocks of comparable silica content and mineralogical composition such as Nockold's (1954) average norite or gabbro (see Column 3, Table 9).

Age and Metamorphism

The trend of foliation in the complex roughly parallels that of the Kapuskasing Structural Zone and cross cuts that of the metavolcanic-metasedimentary belts and the granitic batholiths and associated migmatites. The anorthosite complex is bounded by faults to the south and high grade metamorphic rocks of the Kapuskasing Structural Zone to the north, indicating that the Shawmere complex may be intrusive into the metasediments of the Structural Zone and, therefore, younger than the Structural Zone; the anorthosite complex may have been uplifted to its present crustal level by the development of the Structural



ODM9434

Photo 12–Folding in gabbroic anorthosite on road to Goose Range fire tower, Foleyet Township.

Zone. The Shawmere complex is cut by dikes 10 to 15 feet (3 to 4.5 m) wide of east-trending diabase and thin dikes of lamprophyre. These Middle Precambrian and younger dike rocks represent relatively near-surface phenomena. Therefore, the uplift of the complex was a Precambrian event.

A potassium-argon age of 2519 m.y. on hornblende from gabbroic anorthosite (Watkinson *et al.* 1972) is probably the age of uplift (metamorphism) because the age determination could not represent conditions before uplift (Moorbath 1967). Potassium-argon radiometric ages (2355 ± 65, 2235 ± 65, 2180 ± 60, and 2515 ± 80 m.y.) of rocks of the Kapuskasing Structural Zone to the north are Middle Precambrian (Wanless *et al.* 1968).

The textural evidence presented indicates that the anorthosite and the associated rocks have been metamorphosed. Undisturbed textures are present only toward the centre of the anorthosite mass. The foliation in one place can be seen to be later than the development of igneous layering (Photo 12). Primary mineralogy (e.g. pyroxene with exsolution textures) is not present; rather an assemblage consisting of garnet and hornblende with or without iron oxides is prevalent.

Chemistry

The chemistry of the rocks of the complex indicate that they are of the anorthosite kindred as defined by Philpotts (1966) and Hødal (1945). The rocks

TABLE 10 CHEMICAL ANALYSES, IN WEIGHT PERCENT, OF ANORTHOSITIC ROCKS FROM THE SHAWMERE ANORTHOSITE COMPLEX AND OTHER ANORTHOSITE COMPLEXES. ANALYSES 1 AND 2 BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	1	2	3	4	5	6
SiO_2	49.50	50.50	38.81	47.41	53.29	45.87
TiO_2	0.11	0.19	0.11	0.16	0.34	0.22
Al_2O_3	29.50	20.90	35.03	29.84	26.42	23.62
Fe_2O_3	0.17	1.50	1.24	0.84	0.86	1.05
FeO	1.12	3.04	1.52	1.60	1.67	2.65
MnO	0.02	0.10	0.06	0.01	0.03	0.06
MgO	1.38	9.23	1.79	1.54	1.09	3.36
CaO	14.75	13.20	19.26	15.07	10.26	14.43
Na_2O	2.26	1.43	0.48	2.21	4.32	1.80
K_2O	0.17	0.12	0.54	0.36	0.91	0.39
P_2O_5	0.01	0.18	0.07	0.08	0.10	0.02
Cr_2O_3		0.10				nd
H_2O^+	0.72	0.59	0.54	0.82	0.71	0.48
H_2O^-	0.07	0.04				0.05
CO_2	0.26	0.16				

1. Average of 3 anorthosites, Shawmere anorthosite complex.
2. Anorthositic gabbro, Shawmere anorthosite complex.
3. Average of 6 Sakeny-type anorthosites (Harpum *in* Windley 1973).
4. Average of 21 Bushveld-type anorthosites (Harpum *in* Windley 1973).
5. Average of 48 Adirondack-type anorthosites (Harpum *in* Windley 1973).
6. Average of 3 anorthositic rocks, Fiskenaesset (Windley 1973).

of the Shawmere anorthosite complex in columns 1 and 2 (Table 10) are compared with Archean anorthosites[1] in columns 3, 4, and 6. Silica is variable from complex to complex; alumina is high relative to some Middle Precambrian anorthosites such as in column 5; the variability in CaO and MgO between the Shawmere complex and other Archean anorthosites probably reflects local variations in chemistry. FeO/MgO ratios are similar in all Archean complexes, varying between 0.78 and 0.83 whereas the Middle Precambrian type (represented by the Adirondack massif in column 5) is higher at 0.96 and the Bushveld is 0.65. All the Archean anorthosites are uniformly low in total alkalis ($Na_2O + K_2O$), ranging between 1.02 and 2.43 percent.

The AFM plot in Figure 9 illustrates the differentiation trend of the Shawmere complex and the Fiskenaesset basement anorthosite (Windley 1973) (see the discussion below on Archean anorthosites). Some iron-rich phases of the Shawmere complex have been excluded because they are thought to be contaminated marginal phases. The complexes do not follow a trend of iron enrichment such as is displayed by some anorthosites of Middle Precambrian age (Philpotts 1968).

[1]The term *Archean anorthosite* is used rather than *Early Precambrian anorthosite* to conform with Windley's (1973) usage.

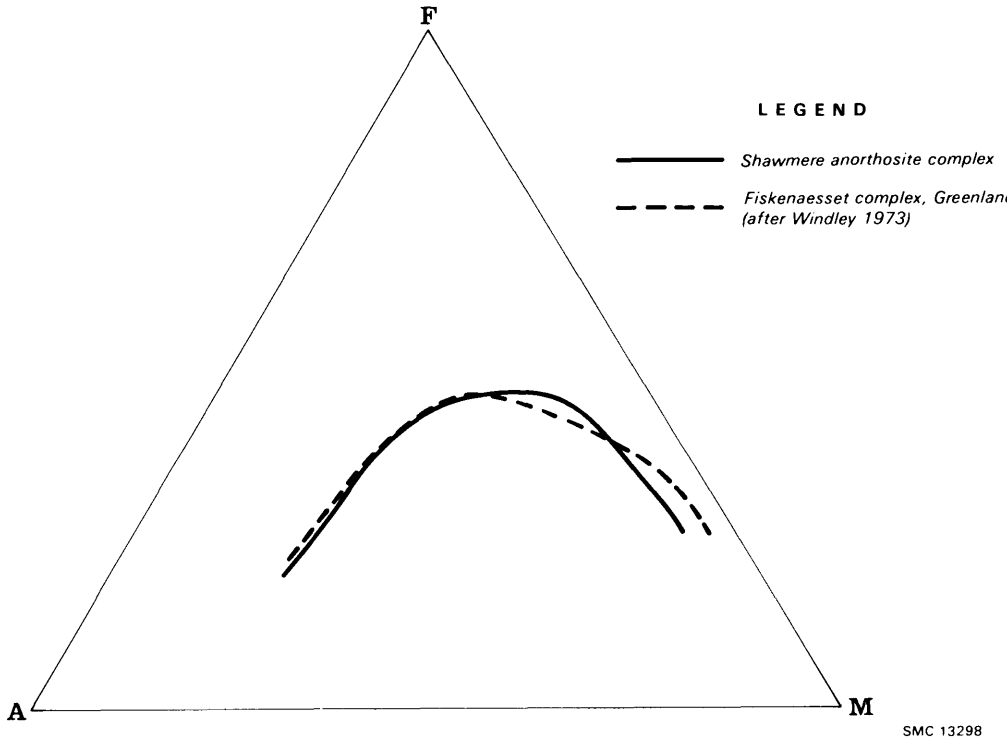
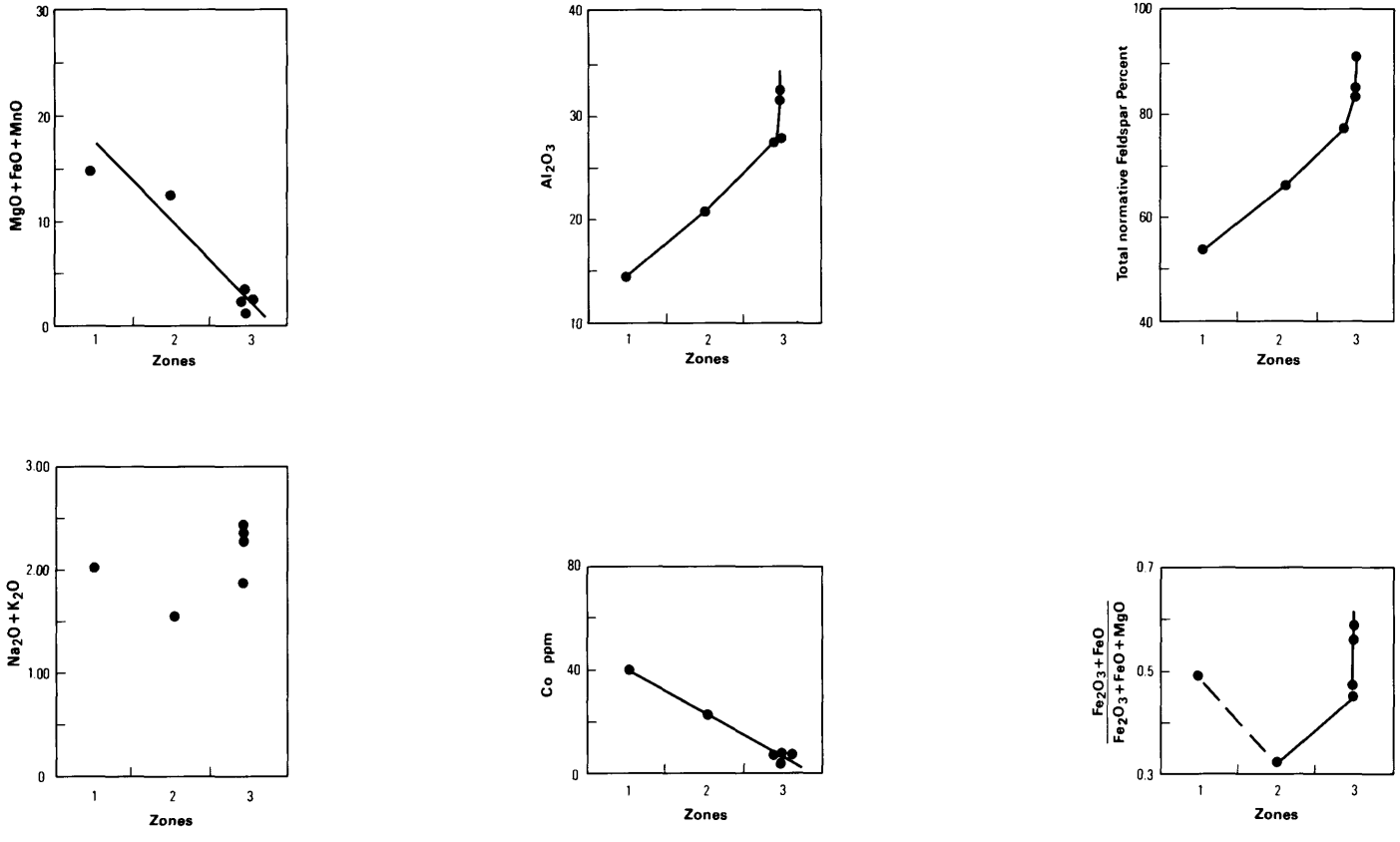


Figure 9–AFM diagram of the Shawmere anorthosite complex in comparison to the Fiskenaesset complex, an Archean basement-type anorthosite complex. $A = Na_2O + K_2O$; $F = FeO + Fe_2O_3$; $M = MgO$.

Plagioclase composition shows a regular and smooth variation from An_{80+} in the gabbroic phases of the lowest exposed part of the sequence (see the following section) through An_{70-74} in the upper gabbroic anorthosites. The lower values in the An_{50-58} range in the recrystallized anorthosites of the southern fold are thought to have resulted from relatively lower rank metamorphism. There is a regular variation with stratigraphic height in the following parameters (*cf.* Windley 1973, p.323), as shown in Figure 10:

(1) $(FeO + Fe_2O_3)/(FeO + Fe_2O_3 + MgO)$
(2) $MgO + FeO + MnO$
(3) Al_2O_3
(4) Normative feldspar content
(5) Cobalt content
(6) $Na_2O + K_2O$

The very calcic plagioclase (average An content 74 percent) and smooth variation of the An content of the plagioclase suggest an origin by fractional crystallization from a melt. The composition of the plagioclase, the occurrence of pargasitic hornblende, and the lack of abundant iron-bearing spinels suggest that the magma of the Shawmere anorthosite complex was calcic, iron poor and alumina rich.



SMC 13299

Figure 10–Variation diagrams for the Shawmere anorthosite complex. The zones represent a possible stratigraphic succession based on correlation with the Fiskenaesset complex in Greenland. Zone 1 consists of gabbro to anorthositic gabbro, Zone 2 anorthositic gabbro to gabbroic anorthosite, and Zone 3 anorthosite.

Structural Interpretation

No unequivocal top indicators were found in the Shawmere anorthosite complex; however they might be revealed by more detailed mapping. There are a few locations where the increase in size of cumulus plagioclase provides a very tentative top criterion based on an increase in number of cumulus plagioclase followed by an upward (?) decrease analogous to graded bedding in sedimentary rocks. However, the less disturbed nature of the large body of anorthosite centred on the northern synform (see Figure 8), indicated by the presence of cumulus plagioclase and abundant primary pyroxene, suggests that this area was preserved in the core of a synform in spite of the tight folding prevalent in the anorthosite complex.

The structural interpretation (Figure 8) is based on rather limited geological information and the extensive use of filtered aeromagnetic and magnetic susceptibility maps (prepared for the Ontario Division of Mines by Paterson, Grant and Watson Limited, Consulting Geophysicists, Toronto) to delineate structural trends and lithologic units. The interpretation is also based on the assumption that the complex is layered (see discussion below).

The main anorthosite mass is folded about a northeast-trending axis into two synforms and an intervening antiform. The northern synform extends from the eastern fault-boundary in Foleyet Township, WSW for 24 miles (39 km). The central part of the anorthosite core contains the best preserved igneous textures of the complex. The anorthosite has plagioclase with an anorthite content of 60 to 65 percent and contains orthopyroxene which is occasionally rimmed by clinopyroxene. The anorthosite is underlain by a thin unit of gabbro a few hundred feet thick with good cumulate texture and plagioclase with an anorthite content of 70-75 percent.

The southern synform extends from the eastern fault-boundary of the complex, in Carty Township, across the complex. The anorthosite core of this synform is predominantly granoblastic; the very little mafic material present consists of scattered disaggregated patches of relict interstitial hornblende in a matrix of granoblastic plagioclase grains with an An content of 54 to 58 percent.

Archean Anorthosites

Windley (1973) has distinguished two types of environments in which Archean anorthosites are found.

(1) Archean anorthosites have been recognized in the *"greenstone" belt* environment, for example at Dore Lake and Bell River, Quebec, where anorthosites intrude Early Precambrian volcanic sequences (Allard 1970; Freeman 1939). These bodies are characterized by a basal sequence of norite or anorthosite, coarse grain size (up to 30 cm in the anorthosite fraction at Dore Lake), and greenschist facies metamorphism.

(2) Within high grade gneiss terrains, Archean anorthosite occurs as conformable layers and lenses. These anorthosites differ from the "greenstone" belt type in that:

(i) they are of higher metamorphic rank;
(ii) they display a lack of iron enrichment during differentiation, compared to the "greenstone" type or some of the Middle Precambrian;
(iii) they have more calcic plagioclase.

These occurrences in high grade metamorphic terrains have been termed *basement type* anorthosites by Windley (1973) on the basis of stratigraphy, mineral chemistry, differentiation trend, and structure.

Origin of the Shawmere Anorthosite Complex

It is suggested that the regional setting of the Shawmere anorthosite complex is analogous to high grade gneiss terrains in which Archean basement type anorthosites are found, such as the Yilgarn Block of Australia, east and west Greenland, the Lewisian of Scotland, and the Limpopo Belt of Rhodesia and South Africa (Windley and Bridgwater 1971). On this basis, a tentative correlation has been made between a generalized stratigraphic section of a basement type anorthosite (the Fiskenaesset Complex) and equivalent lithologic units of the Shawmere anorthosite complex. The Shawmere anorthosite complex contains possible equivalents of Windley's (1973) units *2* (magnetite-rich ultramafics[1]), *3*(layered gabbro), *4*(mafic gabbro), *5*(ophitic gabbro), *6* (anorthosite), and *8* (garnet anorthosite) of the Fiskenaesset Complex. It should be noted that if the comparison is valid, there is a possibility that chromite (Windley's unit *1*) occurs in the upper parts of the Shawmere complex.

The main points in favour of this model are:

(1) the Shawmere anorthosite complex occurs within high grade metamorphic rocks;
(2) the Early Precambrian (Archean) minimum age of the complex;
(3) the lack of iron enrichment in the AFM plot and lack of magnetic highs over the complex;
(4) the very calcic composition of plagioclase with respect to massif type anorthosite.

Romey (1968), in a comparison of layered versus massif type anorthosites, made the point that *(a)* anorthite content of plagioclase increases as the degree of layering increases, and *(b)* a more even spread and greater range of An content occurs in the layered type than in the massif type. The spread of anorthite content in the metamorphosed basement anorthosites for any particular rock-unit is a function of the amount of low grade metamorphism the body has undergone. In gabbroic rocks of the Shawmere complex, calcic cores are preserved in some grains of plagioclase; metamorphism of the complex, at upper almandine amphibolite facies conditions, has lowered the average An content of plagioclase about 10 percent from the normative value.

Windley (1973) postulated that these basement type anorthosites were intrusive into supracrustal sequences at rather shallow depths, then deeply buried and metamorphosed under catazonal conditions. The cumulate textures and great lateral extent indicate that the basement anorthosites have been emplaced

[1]Not shown on map as a separate map-unit.

in a flat-lying position, either as stratiform or funnel shaped complexes. The great lateral extent of the Shawmere anorthosite complex suggests the former mode of intrusion. A basement anorthosite magma would have intruded either along a basement-supracrustal contact or into the flat-lying supracrustal rocks. The latter is considered more probable for the Shawmere complex.

Martignole and Schrijver (1970) suggested that the more sodic, less well-layered, Middle Precambrian massif-type anorthosite is the result of anorthositic magmas crystallizing under catazonal conditions in contrast to the nearer-to-surface environment of the basement type anorthosites. The latter conditions were a result of a thinner (10 to 15 km) Early Precambrian crust allowing direct access from the mantle for the anorthositic magmas which made their way to a near-surface environment where crystallization took place.

Windley *et al.* (1973) postulated a composition for the parental magma of the Fiskenaesset Complex in the high alumina basalt range. Very tenuous evidence (i.e. similarity to the Fiskenaesset model) suggests that the parental magma for the Shawmere Complex may have been a high-alumina basalt.

The absence of olivine and the abundance of armoured relict grains of clinopyroxene would suggest that crystallization took place under conditions of high P_{H_2O}(Griffin 1971). The survival of pyroxene relics in most rock types, together with the nearby presence of pyroxene-free assemblages suggests that primary hornblende may have crystallized from the Shawmere complex magma.

In summary, the Shawmere anorthosite complex is well layered and folded; chemically it is alumina and calcium rich, and iron-poor. It is Early Precambrian in age, associated with and probably intrusive into high grade metasediments of the Kapuskasing Structural Zone. On the basis of these characteristics it seems to fit the model developed by Windley (1973) for Archean basement type anorthosites. However, the evidence available is far from complete, and the final classification of this complex is dependent upon a more detailed study. From an economic standpoint, such detailed work may be justified by the alumina and chromium potential of the Shawmere complex.

Early to Middle Precambrian

MAFIC INTRUSIVE ROCKS

Diabase Dikes

Diabase dikes are found cutting all rock types in the region except the alkalic complexes (map-unit *10*), the late mafic intrusions (map-unit *11*), and lamprophyre dikes (map-unit *12*).

The dikes may be conveniently subdivided, on the basis of their strikes over a length of a few miles, into parallel to subparallel sets as identified on aeromagnetic maps. The sets, in order of abundance, strike:

Set 1–NNW;
Set 2–NW to WNW;
Set 3–ENE to NE;

Set 4–NE to NNE;
Set 5–N to (rarely) NNW.

The age relations of the dikes are rarely discernible in individual outcrops because the strike of individual dikes is subject to local variations related to contacts and the structural trend of foliated rocks in the metavolcanic-metasedimentary belts. Therefore, information on relative ages of the various dike sets is essentially restricted to interpretation of aeromagnetic maps (see ODM-GSC 1970, 1972) and scattered field observations: based on this information, the NE-striking set 4 is offset and cut by both NNW-trending dikes of set 1 and NW-trending dikes of set 2.

It was not possible during the field survey to separate most of the above dike sets on the basis of appearance in the field or petrography, because few thin sections were available. The only criteria available are the interpreted crosscutting relations and a few radiometric age determinations.

Table 11 is a geological summary of the dike sets, and gives the radiometric ages (Gates 1971) of the diabase dike swarms with which the dike sets in the map-area are correlated. Other radiometric age determinations are discussed in the text.

SET 1 (MACKENZIE III SWARM)

The NNW-striking and most abundant dike set is found only in that part of the map-area west and north of the Kapuskasing Structural Zone. Most of the dikes are found in the granitic area between Missinaibi Lake and the Kapuskasing Structural Zone. They are indicated by magnetic lineaments (usually higher than background) on aeromagnetic map P.578 (ODM-GSC 1970). Dikes of similar trend, far to the northwest, have been equated with the Mackenzie III swarm by Gates (1971). The rocks are usually black to red-brown on the weathered surface. Most of the dikes noted in the field are 100 to 250 feet (30 to 75 m) wide and commonly have a vertical dip. Aphanitic chill margins and a medium-grained, diabasic-textured interior are common. Thin section examination disclosed zoned, well-twinned laths of labradorite with interstitial augite, and substantial hornblende and opaque iron oxide (magnetite ?); accessory minerals include apatite, quartz, and biotite. Occasional sulphide grains were noted in some outcrops.

Radiometric age determinations were made on two dikes which probably represent this set in the Missinaibi Lake area. The results obtained were 1495 ± 125 m.y., and 1730 ± 150 m.y., by the K-Ar method on biotite, and pyroxene plus hornblende, respectively (Wanless *et al.* 1966, p.74-75). These age determinations, in conjunction with the strike of the dike set and its continuity (see ODM-GSC 1970, 1972), indicate that these dikes could be associated with the Mackenzie swarm. Gates (1971, p.39) suggested a tentative Rb-Sr age of 1660 m.y. for this swarm based on only a few determinations well outside the map-area. This fits with the geological observation that dikes of this swarm in places cut NE- to NNE-striking aeromagnetic anomalies reflecting the presence of diabase dikes (set 4) which may belong to the Abitibi Swarm.

TABLE 11 SUMMARY OF INFORMATION FOR DIABASE DIKE SWARMS. THE SWARMS ARE ARRANGED IN ORDER OF INCREASING AGE, AS INTERPRETED FROM CROSSCUTTING RELATIONS AND CORRELATION WITH RADIOMETRICALLY DATED SWARMS OUTSIDE THE MAP-AREA.

Set (relative abundance)		Strike	Crosscutting Relations	Petrography	Structure/ Magnetic Expression	Location in Map-area	Correlative Dike Swarm and Rb-Sr age[1]
youngest	2	NW-WNW	cuts set 4	Ophitic gabbro with fresh cpx[2]	emplaced along brecciated fault zones; distinct magnetic lineaments	S part	?Sudbury (1660±145 m.y.)
	1	NNW	cuts set 4	med. grained, quartz-bearing, diabase	moderate magnetic expression	NW part	Mackenzie III (1660?)
	3	ENE-NE	(?) cuts Kap. Struc. Zone & Shawmere anor. complex	very coarse grained, olivine-bearing diabase	distinct magnetic lineaments	central	Abitibi (2147±68)
	4	NE-NNE	cut by sets 1 and 2	very coarse grained diabase	distinct magnetic lineament	west half	?Abitibi (2147±68)
oldest	5	N-(rarely) NNW	do not cut Kap. Struc. Zone or Shawmere anor. complex	very coarse grained, quartz-bearing diabase, often glomero-porphyritic with green plagioclase	weak magnetic expression	E-central and NE parts	Matachewan (2690±93)

[1]Rb-Sr ages from Gates (1971); determined for dike swarms outside the map-area.

[2]A similar dike, just east of the map-area, described by Wanless *et al.* (1966, p.69).

SET 2

The next most abundant set of diabase dikes strikes roughly NW to WNW and appears to be confined in extent to that part of the map-area south of the Kapuskasing Structural Zone. In the field the diabase is texturally and petrographically identical to that of the MacKenzie III swarm. The dikes appear to have been emplaced in part along brecciated and recognizable fault zones, as distinct from the MacKenzie dikes, which appear to be more often associated with joints. The dikes are usually from 100 to 300 feet (30 to 90 m) wide and give rise to distinct magnetic lineaments on aeromagnetic maps 2243G, 2229G, and 2230G (ODM-GSC 1963). See also ODM-GSC (1970; 1972). Radiometric determinations on dikes from this swarm within the map-area gave the following dates: 1200 ± 130 m.y., 1035 ± 35 m.y., and 950 ± 75 m.y. (Wanless *et al.* 1966, p.69,71; 1968, p.96). Gates (1971, p.36) lists an age of 1660 m.y. using Rb-Sr techniques for Sudbury swarm dikes outside the map-area. Interpretation of the above-cited aeromagnetic maps indicates that the dikes of this swarm cut those of a swarm trending NE, (set 4, possibly related to the Abitibi swarm) making set 2 the youngest set in the map-area. This is based primarily on the K-Ar ages from within the map-area. If these are to be correlated with a particular swarm in Ontario this would be the Sudbury swarm (Fahrig *et al.* 1965, p.288) despite the fact that the set 2 dikes do not contain olivine. However, given the spread in radiometric ages, other swarms could be represented also.

SET 3 (ABITIBI SWARM)

The ENE-trending set is represented by a prominent dike extending through Hardiman, Horwood, and Coppell Townships southwestward to Rollo Lake. It produces a relatively steep magnetic lineament on aeromagnetic maps 2236G, 2262G, and 2263G (ODM-GSC 1963). This dike is 300 to 400 feet (90 to 120 m) wide and extends at least 136 miles (219 km) (see ODM-GSC 1970, 1972). Where the dike was examined the dip is vertical and the rock has a crumbly rusty red to orange weathered surface. The central part of the dike is very coarse grained and diabasic in texture; plagioclase grains are up to 4 cm by 0.5 cm. The contact was not observed, but toward the contact, the rock becomes medium grained. According to Milne (1972, p.50,51) this rock is made up of a felted mass of subhedral labradorite laths with interstitial titanaugite and olivine with accessory biotite, magnetite, and apatite; Milne correlates the dike with the Abitibi swarm, dated by Fahrig and Wanless (1964 *in* Fahrig *et al.* 1965) at 1230 m.y. by the K-Ar method. Gates (1971, p.41) indicates an age for the Abitibi swarm of 2147 ± 68 m.y. based on whole rock Rb-Sr methods.

SET 4

The NE- to NNE-striking dikes found in the southern part of the area, principally south of the Swayze-Deloro metavolcanic-metasedimentary belt, appear

to be older than the NW-striking dikes of set 2 in that they are cut by the latter and are often offset up to several thousand feet by faults trending NNW (based on aeromagnetic evidence, see ODM-GSC 1972). No petrographic descriptions are available for these dikes except a brief description by Rogers (1962, p.27) of their coarse-grained nature which, along with their aeromagnetic expression, would indicate that they also may be part of the Abitibi swarm. Although two radiometric dates are available for dikes of this trend (Wanless *et al.* 1966, p.67; 1967, p.87), the values of 1485 ± 120 m.y. and 1795 ± 190 m.y., based on the K-Ar method, do not agree with the age suggested for the Abitibi swarm by Fahrig *et al.* (1965, p.278) of 1230 m.y. or with Gates' (1971, p.36) age of 2147 ± 68 m.y. (based on the Rb-Sr method).

SET 5 (MATACHEWAN SWARM)

The only set of dikes in the map-area which is petrographically distinctive is a north- to (rarely) NNW-striking set. The dikes are found only in the east-central and northeastern part of the map-area to the east and south of the Kapuskasing Structural Zone. They are variable in width from a few inches up to 400 feet (120 m), and commonly are vertically dipping. They show up rather poorly as broad north-trending magnetic lineaments on aeromagnetic maps (ODM-GSC 1970) particularly in the northeastern part of the region. The dikes have chilled margins up to 12 inches (30 cm) thick and become very coarse grained where they are greater than 100 feet (30 m) wide. They are dark grey to black, weather black to red-brown, and have an equigranular diabasic texture. Clusters of white to green plagioclase, often of glomeroporphyritic habit, are sometimes found in these dikes. Milne (1972, p.50) described thin sections of the diabase of this dike set.

The dikes of this set are probably restricted to the eastern part of the map-region; they have certain petrographic similarities (i.e. glomeroporphyritic plagioclase) to the Matachewan diabase dikes of the Timmins-Kirkland Lake area, and are tentatively classified as Matachewan-type. This hypothesis is supported by the fact that these dikes are not found cutting the Kapuskasing Structural Zone rocks or the Shawmere anorthosite complex as do the diabase dikes of the other sets in the map-area. Bennett (1969, p.12) also maintained that Matchewan dikes are not found within rocks of the Kapuskasing Structural Zone. However, it is unknown whether their absence is the result of the depth of erosion of the rocks of the Structural Zone, the time of emplacement of the Zone, or the fact that exposure of the Structural Zone rocks is very poor.

Recent radiometric age determinations by the Rb-Sr whole rock method indicate that the age of the Matachewan swarm is 2690 ± 93 m.y. (Gates 1971, p.36) rather than the less reliable K-Ar age of 2485 m.y. (Fahrig and Wanless 1963 *in* Fahrig *et al.* 1965, p.292).

Late Precambrian

CARBONATITE-ALKALIC COMPLEXES

Within the map-area three carbonatite-alkalic complexes are known: they are the Lackner Lake, Nemegosenda Lake and Seabrook Lake complexes. The first two have been extensively explored for niobium and rare-earth mineralization.

Two magnetic anomalies, in Borden and Dupuis[1] Townships respectively, have been interpreted as possible carbonatite-alkalic complexes. However, outcrops could not be located within the anomalies which are discussed in more detail below.

The Shenango complex (see "Mafic to Intermediate Intrusive Rocks") has previously been interpreted from magnetic data as a carbonatite-alkalic complex from its prominent teardrop shaped magnetic expression (Satterly 1968). The intrusion is poorly exposed but preliminary investigation indicates that the intrusion is not a carbonatite-alkalic complex similar to those at Nemegosenda Lake or Lackner Lake but is more silica-saturated. Trace element studies show a high concentration of Sr, Ba, and Nb, however, and it may be related to the carbonatite-alkalic suite of rocks.

An alkali syenite dike was observed on Missinaibi Lake, cutting the granitic rocks.

The carbonatite-alkalic complexes are circular to elliptical in plan and consist of a series of concentric rings and partial rings of sövite, nepheline, syenite, malignite, fenite, and rocks of the urtite-melteigite series (ijolite). The Nemegosenda Lake, Lackner Lake, and Seabrook Lake complexes have been dated by the K-Ar method at 1010, 1090, and 1103 m.y. respectively (Gittens *et al.* 1967, p.653).

Brief visits were made to all the complexes but no attempt was made to remap the intrusions. Examinations were confined to visiting selected outcrops and collecting a limited number of samples for thin sectioning, assay, and whole rock analysis. Two days were spent examining the Lackner Lake complex, and three days and one day respectively at the Nemegosenda Lake and Seabrook Lake complexes. The following descriptions of these three complexes are largely a summary of reports by Parsons (1961) and Hødder (1961) and the reader is referred to these for more detailed descriptions: Lackner Lake Complex–Parsons (1961, p. 51, Map 2008), Hødder (1961); Nemegosenda Lake complex–Parsons (1961, p.33-50, Map 2007); and Seabrook Lake complex–Parsons (1961, p.11-22, Map 2005).

Rock terminology and descriptions are those used and defined by Parsons (see the section "Terminology"). Table 12 summarizes the K-Ar ages of the carbonatite-alkalic complexes within and close to the map-region. Chemical analyses by the Mineral Research Branch, Ontario Division of Mines, of samples from the various lithologic units of the carbonatite-alkalic complexes are given in Table 13; modal analyses are given in Table 14; the sample locations are given on

[1]Formerly Township 12E.

TABLE 12 | SUMMARY OF K-Ar RADIOMETRIC AGES FOR CARBONATITE-ALKALIC COMPLEXES WITHIN OR NEAR THE CHAPLEAU AREA, AND THE SHENANGO INTRUSIVE COMPLEX.

Complex	Mineral	Age m.y.
Firesand River[1]	Biotite	1087
	Biotite	1008
Lackner Lake[2]		1090
Nemegosenda[1]	Nepheline	988
	Nepheline	1036
Seabrook Lake[1]	Biotite	1109
	Biotite	1107
Shenango[3]	Biotite	1076 ± 42
		1082 ± 24
		1065 ± 24
Townships 107-108 (now Venturi and Tofflemire Townships)	Biotite[1]	1540
	Biotite[4]	1571 ± 84

[1]Gittens *et al.* 1967
[2]Lowdon and Wanless 1963
[3]Bell and Watkinson, unpublished data 1972
[4]Watkinson, D.K., unpublished data 1972

the geological maps of each complex (Figures 11b, 12b, and 13b).

Outside the map-area, the Firesand River complex[1] (Parsons 1961) was visited in conjunction with the examination of the complexes within the project area. A very brief visit was also made to the Township 107-108[2] carbonatite-alkalic complex[1], also outside the map-area, during preliminary reconnaissance of that area in preparation for regional reconnaissance mapping. The Firesand complex and the Township 107-108 complex are similar in that they appear to be composed predominantly of carbonate minerals in contrast to the predominantly silicate mineral assemblages of the Nemegosenda Lake and Lackner Lake complexes. Initial examination indicates that the silicate minerals in the carbonatite of the Firesand and Township 107-108 complexes are different from the silicate minerals in the carbonate-rich phases of the Lackner Lake complex. Calcic pyroxene, serpentine and serpentinized olivine were found in both the Firesand and Township 107-108 complexes whereas aegirine-augite and no olivine were noted in carbonatite samples collected at the Lackner Lake complex. Pyrochlore-bearing carbonatite samples collected at the Firesand River complex are texturally very similar to those observed in pyrochlore-bearing carbonatite core samples found at the former camp of Multi-Minerals Limited on the Lackner Lake complex.

[1]Described in Thurston *et al.* (1974, appendix).
[2]Townships 107 and 108 are now named Venturi and Tofflemire Townships respectively.

From their mineralogic assemblage and predominantly carbonate nature, the Firesand River and Township 107-108 complexes are considered to be more basic than the Lackner Lake and Nemegosenda Lake complexes which are characterized by a silica-undersaturated, alkali-rich, silicate mineral assemblage.

The carbonatite intrusions appear to be related to the Kapuskasing Structural Zone, which probably exerted some control on their emplacement. The Kapuskasing Structural Zone is thought to essentially represent a horst (see "Origin of the Structural Zone"). Intrusions emplaced along or into such a structure would be expected to be tabular rather than circular. If large concentrations of magnetic minerals are not present in the intrusions, they could be masked in magnetic surveys by the high magnetic susceptibility of the larger rock-units of the Kapuskasing Structural Zone. Puustinen (1970, p.89) reported a tabular carbonatite intrusion in Finland 14 000 m (46,000 feet) long and 1500 m (5,000 feet) wide controlled by north-striking fractures. Such elongate bodies could exist within the map-area and at other locations along the Structural Zone. Brown (1964, p.223,227) reported that in the Mbeya Range, Tanganyika (now Tanzania), a carbonatite intruded a fault zone over a distance of 12 miles (19 km) and has a width of 20 to 100 feet (6 to 30 m). Anomalously high niobium, thorium, and uranium values are associated with this body. In the Kapuskasing map-area, which adjoins the Chapleau map-area along its north boundary, Bennett *et al.* (1967, p.72) reported that carbonatites occur mainly as tabular bodies rather than circular pipes.

ORIGIN OF CARBONATITES

The origin of carbonatites is still a subject of controversy. A brief list of the processes proposed to explain magmatic-appearing carbonate-rich rocks includes (Heinrich 1966, p.272):

1. Rheomorphism or mobilization of limestone or marble.
2. Alkalic metasomatism or recrystallization of limestone or marble xenoliths or roof pendants, or both.
3. Hydrothermal replacement of various alkalic igneous rocks; fracture-filling and open-space deposition by hydrothermal solutions.
4. Magmatic.
   a. The carbonatitic fluid is primary and the associated alkalic rocks are derived by graded metasomatism of wall rocks.
   b. The carbonatitic magma is primary and juvenile. It may react at deep levels with crustal rocks to generate alkalic rock magmas.
   c. The carbonatitic fluid is a secondary magma formed as the ultimate fraction in the course of differentiation of one of several primary parent magmas (e.g. ijolitic, peridotitic); the CO_2 is juvenile.
   d. The carbonatitic fluid is a secondary magma formed as the ultimate fraction during the differentiation of alkalic magma contaminated by limestone syntexis.

The first two processes seem unlikely possibilities. The presence of limestone and (or) marble within the map-area in quantities sufficient to generate the volume of presently known carbonatites has not been observed in the course of field

TABLE 13 CHEMICAL ANALYSES AND NORMATIVE MINERALOGY OF SAMPLES FROM CARBONATITE-ALKALIC COMPLEXES WITHIN THE MAP-AREA (LACKNER LAKE, NEMEGOSENDA LAKE, AND SEABROOK LAKE COMPLEXES) AND NEAR THE MAP-AREA (FIRESAND RIVER COMPLEX NEAR WAWA, TOWNSHIPS 107-108 COMPLEX NORTH OF ESPANOLA). ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES; CIPW NORMATIVE MINERALOGY CALCULATED BY W.V. PEREDERY, GRADUATE STUDENT OF UNIVERSITY OF TORONTO; HIGHLY UNDERSATURATED ROCKS CALCULATED BY METHOD OF WAHLSTOM (1958, p.228-235).

	LACKNER LAKE COMPLEX		NEMEGOSENDA LAKE COMPLEX						SEABROOK LAKE COMPLEX	FIRESAND RIVER COMPLEX		TOWNSHIPS 107-108 COMPLEX	
Chemical Analysis (weight percent)	BC13-1C	BC13-5B[3]	AL14-6D[3]	BA13-2E[3]	BA13-6B[4]	BA13-8A1	BA13-9N[3]	BA13-10B[3]	BL4-2B2	FS-2A4[3]	FS-2D2	DK6-2E	DK6-3D2
SiO_2	26.60	55.90	48.70	47.30	44.00	52.00	48.20	52.30	0.71	17.40	45.40	58.20	43.90
Al_2O_3	8.40	21.00	16.00	24.10	12.50	18.50	18.00	19.40	0.30	9.24	13.40	19.70	16.00
Fe_2O_3	23.60	1.25	10.40	4.20	4.03	3.05	5.94	3.77	4.31	5.36	2.60	3.48	2.49
FeO	19.50	2.24	3.04	2.60	6.72	7.51	5.50	2.46	4.33	4.63	10.30	1.01	2.89
MgO	2.23	0.85	1.25	0.10	4.15	2.56	1.50	0.17	1.73	9.14	5.49	0.68	1.41
CaO	7.82	2.72	6.42	5.16	12.60	4.10	5.86	5.17	48.10	35.80	13.40	4.00	12.80
Na_2O	3.51	5.80	5.64	3.54	2.75	4.32	4.04	5.02	0.10	0.16	2.75	7.28	8.58
K_2O	1.43	8.73	3.71	7.47	5.14	4.97	6.15	6.50	0.14	0.37	0.63	0.14	3.72
H_2O^+	0.30	0.20	3.25	0.83	0.49	1.46	2.43	0.57	0.15	0.37	0.90	1.17	1.30
H_2O^-	0.03	0.04	0.32	0.14	0.04	0.32	0.28	0.15	0.07	0.10	0.10	0.05	0.06
CO_2	0.18	0.18	1.12	0.46	5.38	0.36	2.52	3.10	39.20	15.60	2.92	2.86	5.20
TiO_2	3.88	0.17	0.24	0.34	0.73	0.92	0.51	0.16	0.07	0.81	0.74	0.40	0.70
P_2O_5	0.20	0.02	0.18	3.81	1.55	0.70	0.53	0.40	0.25	0.69	0.18	0.08	0.78
S	0.01	0.01	0.01	0.01	0.13	0.02	0.04	0.01	0.33	0.09	0.46	0.05	0.16
MnO	1.06	0.21	0.44	0.08	0.35	0.23	0.14	0.15	1.05	0.85	0.24	0.05	0.10
Total	98.70	99.80	100.70	100.00	100.60	101.00	101.90	99.30	100.80	100.60	99.50	99.20	100.10
Specific Gravity	3.60	2.68	2.81	2.68	2.93	2.78	2.84	2.68	2.86	3.08	3.03	2.66	2.75
Trace Elements[1] (ppm)	BC13-1C	BC13-5B[3]	AL14-6D[3]	BA13-2E	BA13-6B[4]	BA13-8A1	BA13-9M[3]	BA13-10B[3]	BL4-2B2	FS-2A4[3]	FS-2D2	DK6-2E	DK6-3D2
Ag	-	-	-	-	-	-	-	-	-	-	1	-	-
As	1	1	1	1	1	1	1	2	1	1	50	1	1
Ba	-	3000	500	3000	1500	2000	500	1500	1500	400	1000	250	1000
Be	5	8	15	3	3	3	3	5	3	-	3	6	5
Co	30	6	10	6	30	20	10	6	20	25	80	6	8
Cr	15	10	10	10	500	10	10	10	15	10	30	10	10
Cu	6	3	30	6	60	20	15	8	10	20	270	10	10
Ga	10	10	5	5	5	10	5	10	-	5	20	15	10
Ni	20	5	10	-	150	10	-	5	10	15	40	-	5
Pb	10	-	10	-	10	10	10	10	230	10	10	-	-
Sc	20	-	-	-	20	-	-	-	20	-	40	-	-
Sn	10	-	-	-	-	-	-	-	10	-	-	-	-
Sr	200	500	2000	1500	1500	1000	1000	1000	5000	1500	500	400	1000
V	150	10	15	15	150	30	10	10	40	100	250	60	100
Y	-	-	50	40	40	40	20	20	600	500	30	-	20
Zn	1040	100	130	70	90	150	150	60	420	130	110	30	50
Zr	600	250	300	30	300	400	300	400	80	150	150	250	250
Nb	1000	200	500	200	300	300	300	100	700	500	100	100	100

Normative Mineralogy in Wt. Percent[2]	BC13-1C	BC13-5B[3]	AL14-6D[3]	BA13-2E	BA13-6B[4]	BA13-8A1	BA13-9N[3]	BA13-10B[3]	BL4-2B2	FS-2A4[3]	FS-2D2	DK6-2E	DK6-3D2
Quartz	-	-	-	-	-	-	-	-	-	-	-	13.78	-
Orthoclase	-	51.59	21.93	43.91	30.38	29.48	36.35	38.41	-	-	3.72	0.83	21.70
Albite	-	11.84	32.77	6.28	15.97	21.49	22.63	34.39	-	-	23.26	61.59	10.48
Leucite	6.54	-	-	-	-	-	-	-	-	-	-	-	-
Nepheline	16.18	20.15	8.09	12.95	3.95	8.24	6.25	4.38	-	-	-	-	-
Anorthite	2.78	5.47	7.38	20.57	6.57	16.02	9.68	3.44	-	-	22.35	1.24	27.25
Corundum	-	-	-	2.65	-	-	1.15	2.84	0.20	8.78	-	7.12	-
Ca Clinopyroxene	13.11	2.83	3.60	-	4.95	0.58	-	-	-	-	10.27	-	5.91
Mg Clinopyroxene	4.21	1.22	3.11	-	2.63	0.20	-	-	-	-	4.68	-	3.52
Fe Clinopyroxene	9.41	1.60	-	-	2.15	0.40	-	-	-	-	5.47	-	2.11
Enstatite	-	-	-	-	-	-	-	-	-	-	2.97	1.69	9.16
Ferrosilite	-	-	-	-	-	-	-	-	-	-	3.47	-	-
Forsterite	0.94	0.63	-	1.41	5.40	4.36	2.62	0.30	0.56	15.99	4.22	-	-
Fayalite	1.96	0.91	-	0.74	4.87	7.54	3.94	1.09	0.81	3.36	5.44	-	-
Wollastonite	-	-	3.18	-	-	-	-	-	-	-	-	-	-
Magnetite	34.25	2.54	10.52	6.03	5.84	4.39	8.61	5.47	6.26	7.87	3.77	2.26	3.71
Hematite	-	-	3.14	-	-	-	-	-	-	-	-	1.92	-
Ilmenite	7.43	0.32	0.46	0.60	1.39	1.69	0.97	0.30	0.15	1.52	1.41	0.76	1.37
Apatite	-	0.05	0.43	4.29	3.71	0.82	1.27	0.96	0.28	0.82	0.43	0.19	0.82
Calcite	0.40	0.41	2.55	1.00	12.23	0.80	5.73	7.05	82.30	35.36	6.64	6.50	-
Cancrinite	-	-	-	-	-	-	-	-	-	-	-	-	12.51
Calcium Orthosilicate	1.09	-	-	-	-	-	-	-	-	24.26	-	-	-
Kaliophilite	-	-	-	-	-	-	-	-	0.32	1.27	-	-	-
Sodium Metasilicate	-	-	-	-	-	-	-	-	0.24	0.36	-	-	-
Siderite	-	-	-	-	-	-	-	-	3.94	-	-	-	-
Dolomite	-	-	-	-	-	-	-	-	2.91	-	-	-	-
Pyrite	-	-	-	-	-	-	-	-	1.03	-	-	-	-
Total Normative Minerals	97.30	99.57	97.15	100.26	100.03	96.01	99.19	98.62	99.00	99.59	98.10	97.88	98.54

[1] Li, Mo, Sb not detected

[2] Acmite, rutile, chromite not present

[3] The following samples are equivalent (see also Table 17):
BA13-2A and BA13-2E
BA13-9N and BA13-9M
BA13-10B and BA13-10D
AL14-6C and AL14-6D
FS-2A5 and FS-2A4
BC13-5A and BC13-5B

[4] Matrix of nepheline syenite breccia

Samples:

BC13-1C -	Ijolite-malignite
BC13-5B -	Mafic syenite
AL14-6D -	Malignite-nepheline syenite (fenite?)
BA13-2E -	Nepheline syenite
BA13-6B -	Malignite-mafic syenite
BA13-8A1 -	Mafic syenite
BA13-9N -	Malignite
BA13-10B -	Nepheline syenite
BL4-2B2 -	Sovite
FS-2A4 -	Ijolite-sovite
FS-2D2 -	Ijolite
DK6-2E -	Quartz syenite
DK6-3D2 -	Ijolite-malignite

Sample locations for Lackner Lake, Nemegosenda Lake, and Seabrook Lake complexes are given on Figs. 11b, 12b, and 13b, respectively. Other sample locations are given in Thurston *et al.* (1974, Figs. 30 and 32).

TABLE 14 MODAL ANALYSES OF SAMPLES FROM CARBONATITE-ALKALIC COMPLEXES WITHIN THE MAP-AREA (LACKNER LAKE, NEMEGOSENDA LAKE, AND SEABROOK LAKE COMPLEXES) AND NEAR THE MAP-AREA (FIRESAND RIVER COMPLEX NEAR WAWA, TOWNSHIPS 107-108 COMPLEX NORTH OF ESPANOLA). MODAL ANALYSES BY W.R. TROUP, GEOLOGICAL ASSISTANT, ONTARIO DIVISION OF MINES; VOLUME PERCENTAGES DETERMINED FROM 1000 POINT COUNTS PER THIN SECTION.

LACKNER LAKE CARBONATITE-ALKALIC COMPLEX

Sample	BA13 -1B	BC13 -1C	BC13 -1D	BC13 -3A	BC13 -5A[1]	BC13 -6	BC13 -7A	BC13 -A	BC15 -1	BC15 -3A	BC15 -5	BC15 -7	BC15 -8
Mineralogy													
Nepheline	23.7	27.4	26.6	35.9	47.2	34.0	53.3	-	26.0	58.1	40.2	25.6	35.6
Orthoclase + Perth.	30.4	15.0	1.4	2.0	41.3	52.3	37.1	-	60.5	23.0	1.8	2.0	51.6
Plagioclase	-	-	-	-	-	-	-	-	0.5	-	-	-	-
Carbonate (Calcite)	-	-	-	-	-	-	-	54.6	0.1	-	-	0.1	-
Aegirine Augite	45.9	57.5	47.3	42.0	8.4	12.3	-	11.3	6.3	15.8	39.2	30.1	11.3
Aegirine	-	-	-	-	-	-	2.3	-	-	-	-	-	-
Biotite	-	-	3.0	0.1	0.5	-	0.6	0.2	3.4	-	7.2	23.2	-
Hydronephelite	-	-	-	-	-	-	0.9	-	-	-	-	-	-
Chlorite	-	-	-	-	-	-	-	-	1.3	-	-	-	-
Apatite	-	1.0	0.3	-	0.5	0.4	-	18.9	0.2	0.2	4.8	7.3	0.4
Zircon	-	-	-	-	-	-	1.1	-	-	-	-	-	-
Magnetite	traces	-	21.4	20.0	2.2	1.0	-	14.8	1.1	2.9	5.6	2.5	1.1
Hematite	-	-	-	-	-	-	-	-	-	-	-	9.5	-
Pyrochlore	-	-	-	-	-	-	-	0.2	-	-	-	-	-
Sodalite	-	-	-	-	-	-	-	-	0.2	-	-	-	-
Cancrinite	-	-	-	-	-	-	-	-	0.4	-	-	-	-
Brown F.G. Alt. Product of Neph.	-	-	-	-	-	-	3.0	-	-	-	1.2	-	-

[1]The following samples are equivalent: BC13-5A and BC13-5B (see Table 13).

Samples (locations given on Figure 11b):

BA13-1B - Malignite
BC13-1C - Ijolite-malignite
BC13-1D - Ijolite
BC13-3A - Ijolite
BC13-5A - Mafic syenite, containing ovoid clots of nepheline and K-feldspar, presumably pseudoleucite
BC13-6 - Nepheline syenite
BC13-7A - Mafic syenite (juvite)
BC13-A - Sovite
BC15-1 - Nepheline syenite
BC15-3A - Nepheline syenite
BC15-5 - Ijolite
BC15-7 - Ijolite
BC15-8 - Porphyritic nepheline syenite

NEMEGOSENDA LAKE CARBONATITE-ALKALIC COMPLEX

Sample	AL14 -4	AL14 -6C**	BA13 -2A	BA13 -6B	BA13 -6C4	BA13 -6D	BA13 -7A5	BA13 -7B1	BA13 -8A2	BA13 -8B4	BA13 -9G1	BA13 -9I	BA13 -9J1	BA13 -9M[1]	BA13 -10D[1]
Mineralogy															
Plagioclase(An2-8)	-	0.1	-	-	-	-	10.0	39.2	4.3	0.2	-	-	-	-	0.3
Alkali Feldspar	-	-	-	12.0	-	-	-	-	39.0	-	-	-	-	-	-
Orthoclase	-	-	45.1	-	15.2	23.2	-	32.4	-	41.3	66.6	20.2	15.9	19.9	46.0
Microcline	-	10.7	-	-	-	-	-	-	-	-	-	-	1.2	-	-
Aegirine	-	-	-	-	-	-	-	-	-	5.6	-	-	-	-	-
Augite	64.3	-	-	1.2	35.7	1.4	-	0.3	-	0.9	-	-	-	-	tr
Aegirine Augite	-	28.5	-	14.8	2.4	-	-	-	12.3	-	24.4	61.3	40.2	26.0	14.0
Nepheline	25.0	53.0	42.2	3.0	-	71.0	-	20.6	21.5	16.0	1.1	5.5	-	36.2	28.4
Biotite	3.6	0.6	1.6	52.6	35.7	-	-	-	21.2	29.0	0.6	1.8	-	13.2	3.1
Carbonate (Calcite)	3.3	2.4	-	14.8	7.8	-	78.8	2.2	-	2.4	1.8	2.1	19.0	1.9	4.3
Cancrinite	-	1.0	0.9	-	-	1.2	-	-	-	4.1	-	-	-	-	-
Sericite	-	-	0.3	0.4	2.0	2.2	1.1	3.0	-	-	-	5.3	15.6	-	-
Epidote	-	-	-	-	-	-	0.3	1.9	-	-	-	-	-	-	-
Actinolite	-	-	-	-	-	-	-	-	-	-	-	-	5.3	-	-
Hornblende	-	-	-	-	-	-	-	-	-	-	-	-	1.9	-	-
Wollastonite	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-
Sodalite	2.0	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-
Apatite	0.2	-	7.3	0.8	0.2	-	9.3	0.4	1.7	0.5	-	-	-	-	-
Magnetite	1.6	2.0	2.4	0.4	1.0	0.2	0.5	-	-	-	4.7	2.4	0.2	2.8	3.9
Pyrochlore	-	-	-	-	-	0.4	-	-	-	-	0.8	1.2	0.7	-	-
Pyrite	-	0.8	-	-	-	-	-	-	-	-	-	0.2	-	-	-
Brown Alteration	-	-	0.2	-	-	-	-	-	-	-	-	-	-	-	-
Fluorite	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-

[1]The following samples are equivalent: BA13-6C and BA13-6D; BA13-9M and BA13-9N; BA13-10D and BA13-10B (see Table 13).

Samples (locations given on Figure 12b):

AL14-4 - Ijolite
AL14-6C - Malignite-nepheline syenite (fenite?)
BA13-2A - Nepheline syenite (juvite)
BA13-6B - Malignite-mafic syenite
BA13-6C4 - Mafic breccia (cement)
BA13-6D - Nepheline syenite (juvite)
BA13-7A5 - Sovite
BA13-7B1 - Albitized nepheline syenite
BA13-8A2 - Malignite-mafic syenite
BA13-8B4 - Mafic dike
BA13-9G1 - Nepheline syenite
BA13-9I - Malignite
BA13-9J1 - Malignite
BA13-9M - Malignite
BA13-10D - Nepheline syenite

SEABROOK LAKE CARBONATITE-ALKALIC COMPLEX

Sample	BL4-2A4	BL4-2B2	BL4-3A	BL4-3B1	BL4-6B	BL4-8	BL4-10	BL4-12	BL4-13
Mineralogy									
Plagioclase An_{34-64}	6.0	-	-	-	-	-	36.2	13.2	32.7
Alakli Feldspar	-	-	-	-	-	-	18.7	-	12.7
Amphibole	0.6	-	-	-	-	0.6	16.8	-	-
Arfvedsonite	-	-	-	-	0.7	-	-	-	1.4
Carbonate	88.0	93.4	35.3	42.8	28.9	85.0	6.4	25.5	0.2
Quartz	1.67	-	-	-	-	-	12.8	-	24.0
Biotite	-	1.1	25.3	-	55.6	3.0	-	25.6	0.0
Antiperthite	-	-	-	-	-	-	8.5	-	-
Perthite	-	-	-	-	-	-	-	-	21.5
Aegerine-Augite	-	-	-	-	-	-	-	14.5	6.4
Sericite	-	-	-	-	-	-	-	9.0	-
Actinolite	-	-	-	-	4.3	-	-	-	-
Apatite	-	-	1.5	-	-	8.3	-	3.3	-
Sphene	-	-	-	-	-	-	-	1.0	-
Chlorite	-	-	-	-	-	0.1	-	-	-
Olivine	-	-	3.0	-	-	-	-	-	-
Limonite	3.6	-	-	-	0.6	2.4	-	-	-
Magnetite	0.1	3.4	12.0	-	9.9	0.6	0.3	3.8	-
Pyrite	0.1	-	-	-	-	-	-	-	-
Pyrochlore	-	1.0	-	-	-	-	-	-	-
Hematite	-	1.1	-	57.2	-	-	0.3	-	1.1
Fragments	-	-	7.8	-	-	-	-	-	-
F.G. Dusty Material Alteration Product	-	-	15.1	-	-	-	-	4.1	-

Samples (locations given on Figure 13b):

BL4-2A4 - Sovite
BL4-2B2 - Sovite
BL4-3A - Mafic breccia
BL4-3B1 - Hematitic sovite
BL4-6B - Mafic breccia
BL4-8 - Sovite (dike)
BL4-10 - Fenite
BL4-12 - Mafic breccia
BL4-13 - Fenite

FIRESAND RIVER CARBONATITE-ALKALIC COMPLEX

Sample	FS-2A5[1]	FS-2C1	FS-2D1	FS-4A3	FS-4B2	FS-5A3
Mineralogy						
Plagioclase (An_{10-30}) sericitized	-	-	-	-	-	10.2
Alkali Feldspar	-	-	3.0	-	-	-
Biotite	4.4	19.0	3.0	-	1.4	0.1
Apatite	10.4	8.9	-	-	2.2	0.4
Diopside	8.4	2.2	-	-	-	-
Olivine	19.9	2.4	-	-	0.5	-
Serpentine	0.2	0.2	-	-	0.3	-
Actinolite-tremolite	5.8	13.4	82.0	-	1.5	-
Carbonate	28.0	28.3	7.0	100.0	89.2	85.4
Limonite	-	-	-	-	-	2.9
Hematite	-	-	-	-	-	0.3
Perovskite	-	0.9	-	-	-	-
Magnetite	7.8	24.7	4.0	-	4.4	0.5
Pyrrhotite	-	-	1.0	-	-	-
Pyrite	-	-	-	-	-	0.2
Pyrochlore	-	-	-	-	0.5	-
Sericite + F.G. Material	7.4	-	-	-	-	-
Brown Mineral (alteration product of olivine)	7.7	-	-	-	-	-

[1]The following samples are equivalent FS-2A5 and FS-2A4 (see Table 13).

Samples (locations given in Thurston *et al.* 1974, Figure 30):

FS-2A5 - Ijolite-sovite
FS-2C1 - Ijolite-sovite
FS-2D1 - Mafic metavolcanic (Early Precambrian)
FS-4A3 - Sovite
FS-4B2 - Sovite
FS-5A3 - Sovite

TOWNSHIPS 107-108 CARBONATITE-ALKALIC COMPLEX

Sample	DK6-1	DK6-2A1	DK6-2B	DK6-2C	DK6-3B1	DK6-3D1	DK6-3D2
Mineralogy							
Plagioclase An_{4-37}	32.2	-	-	77.9	-	-	-
Microcline	10.4	-	-	-	-	-	25.6
Aegirine	-	-	27.0	8.1	-	-	-
Augite	-	traces	-	-	-	-	-
Hornblende	-	-	-	-	-	-	22.0
Barkevikite	4.4	-	-	-	-	-	-
Microperthite	18.6	-	-	-	-	-	-
Actinolite-Tremolite	-	-	-	-	1.2	-	-
Olivine	-	-	-	-	-	2.5	-
Serpentine	-	-	-	-	8.1	0.5	-
Sodalite	-	-	-	2.0	-	-	-
Nepheline	-	-	-	5.7	-	-	-
Cancrinite	-	-	-	2.5	-	-	46.4
Zircon		-	1.1	0.2	-	-	-
Biotite	-	-	-	-	2.8	3.8	0.5
Carbonate	-	99.5	22.9	3.1	66.6	80.8	3.8
Apatite	-	0.3	1.2	-	12.3	9.6	1.3
Chlorite	0.5	-	-	-	-	-	-
Quartz	32.9	-	-	-	-	-	-
Thomsonite	-	-	47.8	-	-	-	-
Magnetite	-	0.2	-	0.1	8.0	0.2	-
Pyrrhotite	-	-	-	0.4	1.0	1.8	0.4

Samples (locations given in Thurston *et al.* 1974, Figure 32):

DK6-1 - Fenite
DK6-2A1 - Sovite
DK6-2B - Ijolite
DK6-2C - Syenite-nepheline syenite
DK6-3B1 - Sovite
DK6-3D1 - Sovite
DK6-3D2 - Ijolite-malignite

mapping. Only one occurrence of marble was found during the mapping program and this occurs as relatively thin bands, not exceeding 2 feet (0.6 m) in width, in a metavolcanic migmatite sequence (map-unit *5a*) in southeastern Lloyd Township. This small occurrence, associated with sulphide mineralization, is approximately 20 miles (32 km) northwest of the nearest known carbonatite-alkalic complex at Nemegosenda Lake.

Process number 3 is not considered probable. If the carbonatites observed were a product of hydrothermal activity their restriction in association to alkali-rich, silica-undersaturated rocks would seem more than fortuitous.

A magmatic origin, process number 4, seems most probable with all or some of mechanisms 4a through 4c being operable. Process 4d has been recently discredited by experimental investigations completed by Wyllie and Watkinson (1970). In addition, the lack of carbonate-rich rocks within the map-area discredits the proposed genetic link between carbonate syntexis and carbonatite magma.

Heinrich (1966, p.280) summed up the experimental work in the following statement:

> Mobile carbonatitic magmas can exist. Their temperatures, 683 to 450°C, and the pressures, 1000 to 10 bars, are in accord with pressure-temperature environments deduced from geological data. Further chemical complication of these simplified synthetic magmas would doubtless lower their temperatures still more, and the minimum pressure may be as little as 1 bar.

In summary, carbonatite magmas are considered to be a low temperature phenomenon.

Heinrich (1966, p.316, 317) did not believe that carbonatitic magma was primary, but strongly favoured the derivation of a carbonatitic magma by a process of differentiation from mantle material.

Heinrich (1966, p.317, 318) gave the following reason for his belief:

> A consideration of various lines of evidence indicates strongly that the second hypothesis is to be favoured: most carbonatite magmas are secondary magmas. This is in opposition to von Eckermann's interpretation...of the origin of the Alnö complex and to similar ideas that have been advanced by Dawson...and by Temple and Grogan...
>
> Arguments for the derivative origin of carbonatite magmas are:
>
> 1. The volume of even the largest carbonatite bodies are trivial when compared with the volumes of nephelinitic lavas and tuffs in genetic association in volcanoes of the Mt. Elgon type. For Napak King...estimates that "even if the central complex extends downward for 5 miles [8 km], its volume would amount to no more than 3 percent of the nephelinites... of the original cone, while the carbonatite accounts for little more than 1 percent of the mass of the central complex."
> 2. Both their mineralogy and the stability fields of their synthetic counterparts indicate that carbonatites are low-temperature assemblages, whereas many of the associated silicate rocks represent higher-temperature systems.
> 3. Silicate species in carbonatites include those minerals that characterize the later members of the silicate rock series (aegirine, alkali-feldspar, biotite). Inclusions of silicate rocks in carbonatites are reworked to aggregates of phases that are in stable association with the carbonates. "The continuity between the mineralogy of the carbonatites and that of the silicate rocks supports the suggestion that they have been derived from the latter" (King...).
> 4. The presence of a typical sequence of rocks that begins with alkalic silicate types (e.g., nepheline syenites) containing late, primary calcite as an accessory species progresses through carbonate-rich silicate types to silico carbonatites and ends with carbonatites containing silicate species only in accessory amounts.
> 5. The exomorphic effect of carbonates upon some of their associated silicate rocks, which may be strongly carbonatized.

6. Petrologically simple sövites and rauhaugites displaying intrusive characteristics may grade in a single complex or district into mineralogically complex carbonatites characterized by mineral assemblages with "hydrothermal" characteristics (fluorite, barite, sulphides) and by some structures that characterize true veins.
7. Many alkalic rock complexes, even miascitic ones, have no associated carbonatites, but only very exceptionally do carbonatites occur without comagmatic alkalic rocks, and some of these carbonatites may actually be recycled (e.g. Kaluwe).

Other authors have recently proposed the following methods of carbonatite magma generation.

1. Franz and Wyllie (1967, p.323-326) proposed a magmatic origin of carbonatites based on experimental evidence but do not state whether the magma is primary or secondary (i.e. differentiated).
2. Upton (1967, p.281-288) considered a carbonatite magma as a late stage derivative of alkaline pyroxenite and related ultrabasic magmas.
3. Gold (1967, p.288-302) concluded that the magmas for the Monteregion Hills of Quebec, which include the Oka carbonatite, resulted from the differentiation of an alkali basalt magma.
4. Wyllie (1966a, p.350-351) proposed that a carbonatite magma would be derived from an alkalic peridotite magma possibly as an immissible liquid fraction.
5. Gittens (1966, p.379) summarized Russian thinking on the carbonatite problems and stated the following:

The Russian position differs markedly from that of most petrologists in North America and Europe in favouring an extreme metasomatic origin whereby most of the rocks of a carbonatite complex are formed by a series of metasomatic transformations in zones surrounding an ultrabasic plug; it appears to have been influenced strongly by the number of ultrabasic alkalic-carbonatite complexes found in the Kola Peninsula, northern Siberia and Tuva (southern Siberia) and is based on Korzhinsky's theories of the differential mobility of the elements.

In summary, most investigators consider alkali-rich basic to ultrabasic magmas to be the source of the carbonatite magma and (or) the metasomatizing fluids.

CARBONATITE-KIMBERLITE RELATIONSHIP

Of particular interest is the possibility of a genetic relationship between carbonatites and kimberlites.

Heinrich (1966, p.319) summarized Janse: "Janse...concludes that kimberlites are formed by zone refining[1] of a magma, derived from a deep source in the mantle in places beneath very stable parts of the crust and that kimberlitic magmas so formed may develop a volatile-rich carbonatitic top fraction."

This suggests the carbonatites could be the upper expression of kimberlite intrusions. Von Eckermann (1967) and Watson (1967) discussed the relationship between alkalic ultrabasic rocks, kimberlites, and carbonatites. Dawson (1967,

[1]Zone refining, the process by which a magma locally formed at depth could move upward under the influence of gravity by a process of simultaneously melting of the roof and crystallization at the bottom of the magma chamber (Turner and Verhoogen 1960, p.249).

p.269-278) proposed an intimate but somewhat uncertain relationship between carbonatites, their associated alkalic rocks, kimberlites and similar potassic ultrabasic rocks. The reader is referred to this discussion which summarizes the ideas of the possible interrelation of these two rock types, and which is too lengthy to reproduce here.

Mitchell (1970, p.697-698) listed the following ten criteria pointing to a possible relationship between these rock types.

1. Kimberlites are closely associated in time and space with carbonatites or with rock types found in carbonatite complexes....
2. A complete chemical gradation is said to exist between kimberlite and carbonatite....
3. Kimberlites and carbonatites are similar geochemically, being enriched in Nb, Ba, Sr, Zr, rare earth elements, etc.
4. Kimberlites are found within some carbonatite complexes, for example, Alnö..., Fen..., Ngualla..., Tundulu....
5. Kimberlites are rich in calcite and dolomite, and experimental studies have shown that these minerals need not be alteration products....Thus, the calcite in kimberlite is thought to be magmatic calcite and to be similar to the carbonatite calcite.
6. De Sousa Machado...has shown that the carbonatite activity along the Lucapa graben in Angola is replaced to the northeast by kimberlite activity of the same age at Bakwanga (Congo).
7. Late-stage carbonate dikes cut the Premier kimberlite....
8. Dawson...has reported carbonatite tuff cones in northern Tanzania which contain xenoliths of lherzolite, harzburgite, and garnet-mica-peridotite. The garnet-mica-peridotite xenoliths contain chrome diopside and pyrope. The xenolith suite is identical to that found in kimberlites.
9. Allen and Deans...have described alnöite and ankaratrite from the Solomon Islands containing ultrabasic inclusions, pyrope, chrome diopside, and magnesian ilmenite.
10. Moissanite (SiC) has been found to occur rarely in both kimberlite and carbonatite....

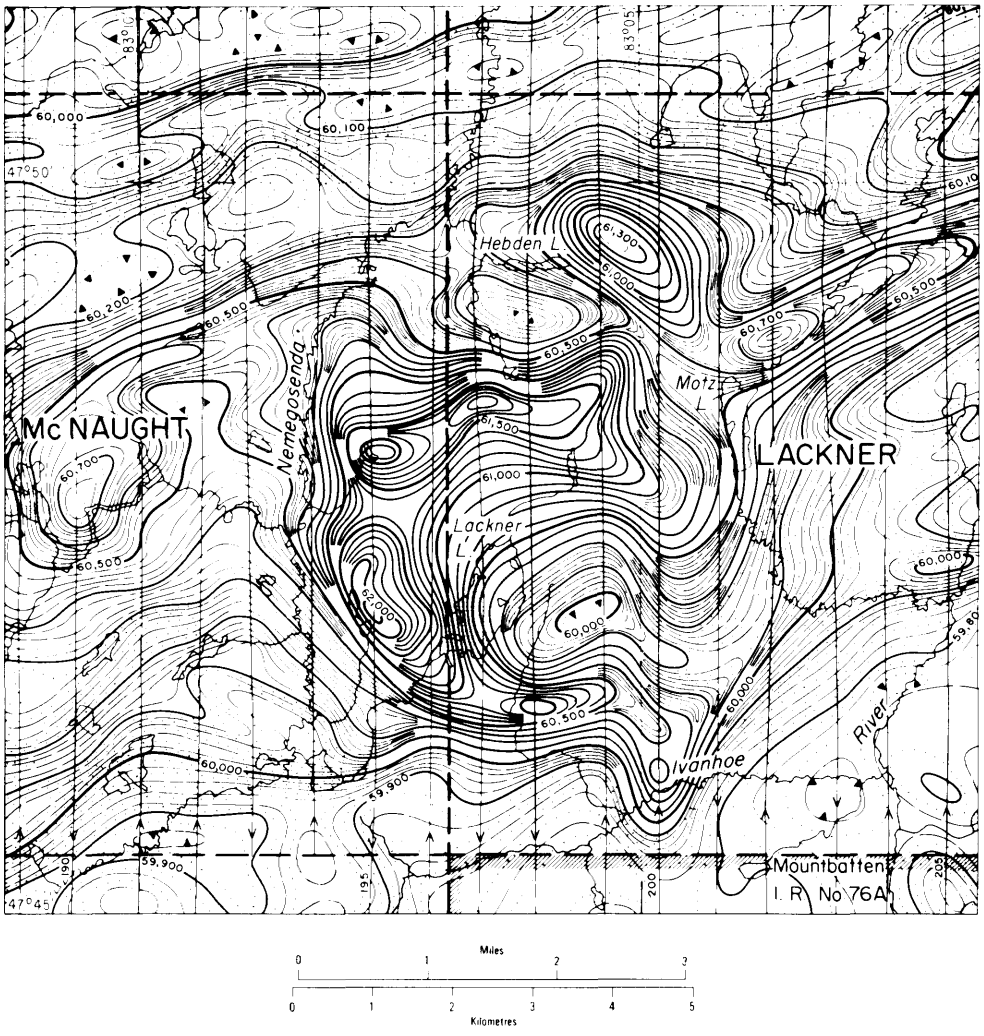
Mitchell (1970, p.697-699) presented the above ten reasons suggesting a carbonatite-kimberlite link, then critically reviewed the kimberlite-carbonatite problem and pointed out that the relationship between carbonatite and kimberlite is still unproven and may not exist. The reader should refer to the original papers of Mitchell (1970) and Dawson (1967) for opinions concerning this controversial subject.

If the relation between kimberlites and carbonatites is valid as suggested by some investigators, then the Kapuskasing Structural Zone, along which are found a number of carbonatite-alkalic complexes, presents an exploration target for kimberlitic rocks and perhaps diamonds. At present, kimberlite and kimberlitic rocks are known at only two places in Ontario: the Upper Canada Mine in the Kirkland Lake region and Coral Rapids northeast of Kapuskasing (Lee and Lawrence 1968, p.1,2).

The reader may find the report by Satterly (1971) of further interest with regard to the possible occurrence of diamonds in Ontario.

Lackner Lake Carbonatite-Alkalic Complex

The Lackner Lake complex straddles the Lackner-McNaught Township boundary and comprises a roughly circular intrusion of just over 9 square miles (23 km^2) in area (Figures 11a, b). The intrusion is composed of a number of arcuate rock units of nepheline syenite, carbonatite, malignite, and ijolite, and a cen-

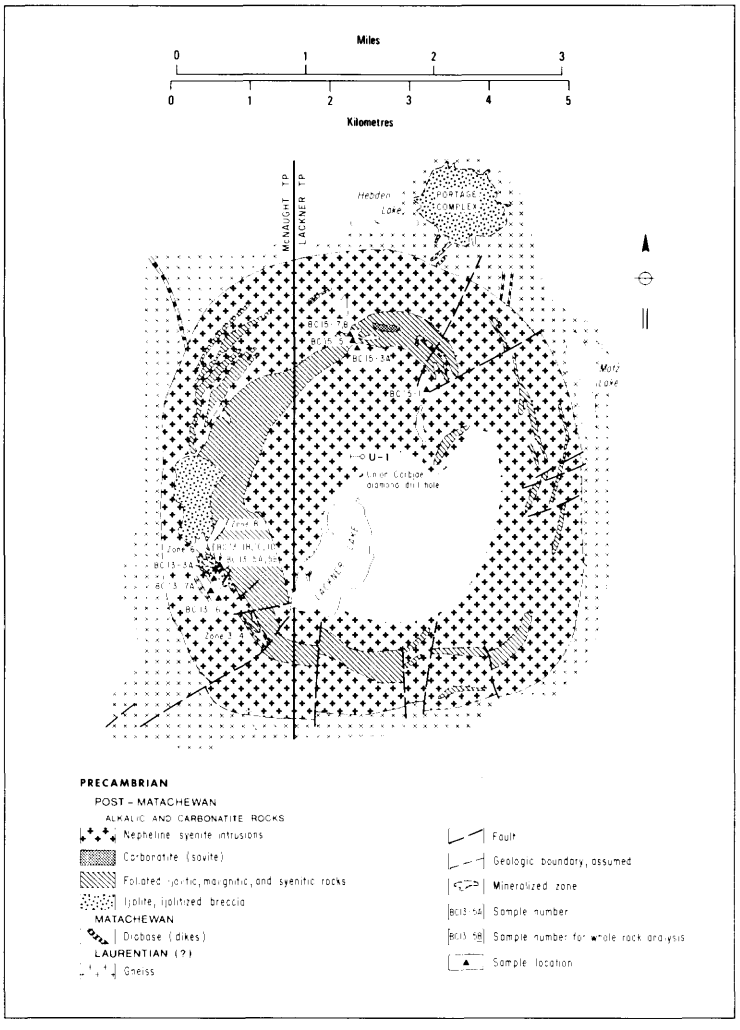


SMC 13300

Figure 11a–Aeromagnetic map of the Lackner Lake complex. After ODM-GSC Map 2232G (1963).

tral plug of nepheline syenite. Lowden and Wanless (1963, p.83-84) reported a K-Ar radiometric age of 1090 m.y. on biotite taken from nepheline syenite within this complex.

The complex can be reached by driving 15 miles (24 km) along a gravel road east from Highway 129, or by driving approximately 7 miles (11 km) along the same gravel road from the railway siding of Nemegos on the Canadian Pacific railway. The arcuate hills of the Lackner Lake complex, rising several hundred



SMC 13301

Figure 11b–Geological map of the Lackner Lake complex. Modified from Parsons (1961, Map 2008).

feet above the surrounding landscape, form a prominent landmark in the area.

The complex consists of a series of concentric semicircular arcuate units of nepheline syenite and related rocks intruded into gneisses which have been fenitized along their contact with the outer edge of the complex. The outer nepheline syenite is a coarse-grained, leucocratic rock composed of roughly equal parts nepheline and potassium feldspar. The mafic minerals are predominantly aegirine-augite, with minor biotite, and generally make up less than 10 percent of the rock. The nepheline often displays alteration to sericite, hydronephelite, and

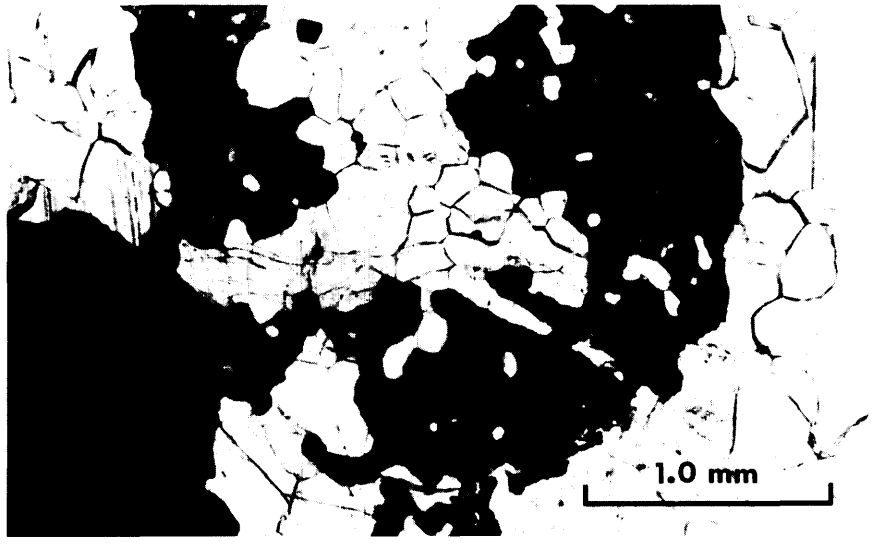


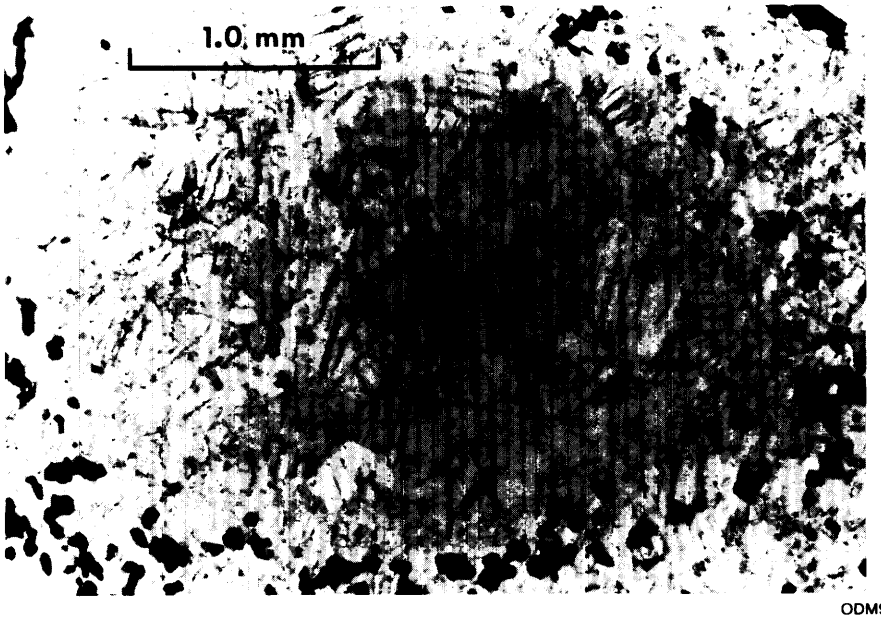
Photo 13–Photomicrograph of sövite showing small grains of pyrochlore (centre of photograph) with aegerine-augite, apatite, magnetite, and calcite, Lackner Lake complex.

traces of carbonate. Locally, a fine-grained, porphyritic, well-foliated phase of nepheline syenite is present. This phase often contains angular to subrounded fragments of malignite.

The outer nepheline syenite is separated from the inner nepheline syenite core by a semicircular arcuate unit of more melanocratic, fine-grained rocks, malignite and ijolite. The ijolite is located on the western flank of the complex and is composed of aegirine-augite and nepheline, and minor apatite, biotite and potassium feldspar. Magnetite is a common major accessory mineral. Thin section examination indicated there may be two ages of ijolite: one, comprising fragments, is a medium-grained, homogenous magnetite-rich variety; the other is a finer grained, magnetite-poor variety comprising the groundmass. The malignite is a melanocratic fine- to medium-grained nepheline syenite which comprises the bulk of the mafic arcuate unit separating the inner and outer nepheline syenites. The malignite is composed of 30 to 50 percent aegirine-augite, and potassium feldspar and nepheline in approximately equal amounts. Biotite and magnetite are common accessory minerals. Foliations in the ijolite and malignite appears to be defined by the alignment of biotite grains, foliation in the nepheline syenite by the orientation of the feldspar crystals.

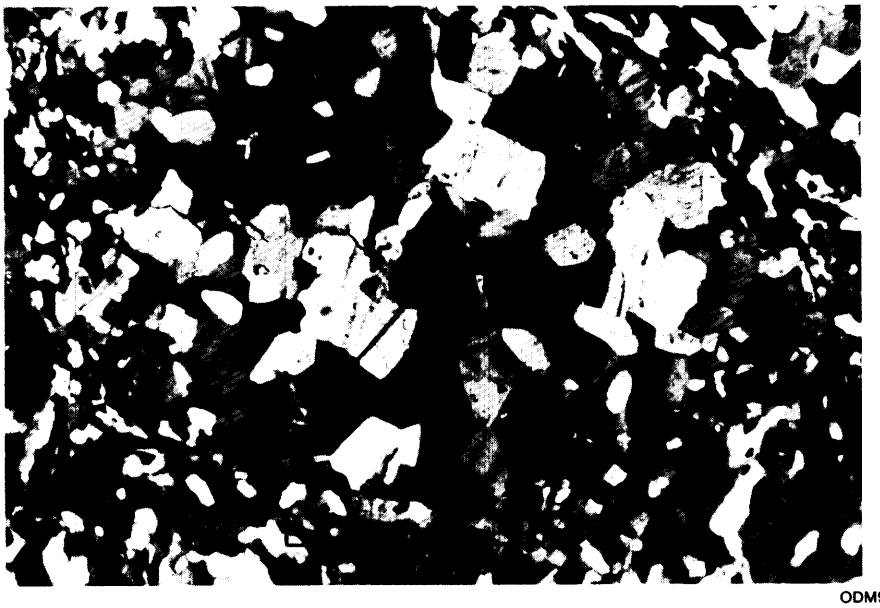
The inner-core nepheline syenite appears to be very similar to the outer nepheline syenite in composition and appearance.

On the Multi-Minerals Limited property and within Multi-Minerals zone 8 are located dikes of sövite, containing aegirine-augite, magnetite, and apatite, which cut the ijolite and malignite (Parsons 1961, Map 2008). Minor biotite is present in the sövite along with tiny grains of pyrochlore. The pyrochlore appears to be concentrated along edges of magnetite grains, between carbonate grains, and along edges of aegirine-augite grains (Photo 13). Scattered pyroch-



ODM9436

Photo 14–Photomicrograph of nepheline syenite showing oblate clot of fine-grained nepheline (colourless) and potassium feldspar (light grey) surrounded by finer grained nepheline, potassium feldspar, and aegerine augite. Lackner Lake complex.



ODM9437

Photo 15–Same as Photo 14, with crossed nicols.

lore grains were noted, enclosed within carbonate grains, and these often display a set of fractures radiating out from the pyrochlore grain. In reflected light the pyrochlore occurs as tiny euhedral to subhedral reddish brown grains. A second occurrence of sövite is reported in the northeast corner of the intrusion (Parsons 1961, Map 2008).

Located in the southwest corner of the complex and on the Multi-Minerals Limited property are exposures of several dike-like bodies of magnetite and one of magnetite-apatite. The magnetite-apatite body (Multi-Minerals zone 6) consists of massive angular fragments of magnetite, displaying a subconchoidal fracture, cemented in a matrix of fine- to medium-grained, granular magnetite and light green vitreous apatite. Along the southern boundary of Multi-Minerals zone 6, a nepheline syenite occurs in which circular to ellipsoidal clots of nepheline and potassium feldspar comprise over 50 percent of the rocks. It has been suggested by D. Watkinson (personal communication) that these clots could represent psuedoleucite (Photos 14, 15). Approximately 200 feet (60 m) west of the magnetite-apatite body, which has been exposed by extensive pitting, a 2- to 3-foot (0.6 to 0.9 m) wide vein and numerous smaller veins of massive magnetite cut nephleine syenite. Pits on all these exposures were water filled at the time of visiting which prevented close examination.

To the west and northwest of the Lackner Lake complex two satellite bodies are indicated on the aeromagnetic map of the area (ODM-GSC 1963, Map 2232) and are discussed here because of their proximity to the Lackner Lake complex and their circular magnetic expression. No outcrops of these bodies are known to exist.

Drill logs, submitted for assessment work credit by Multi-Minerals Limited for diamond drilling within the aeromagnetic expression east of Lower Cachege Lake, describe the rocks as hornblende syenite cut by diabase and lamprophyre dikes.

Drill logs, submitted by Multiwin Exploration Limited for diamond drilling on a small circular aeromagnetic anomaly northwest of the main Lackner Lake complex, report mixed gabbro and syenite in all of three holes with one hole also reporting pegmatite and gneiss.

Nemegosenda Lake Carbonatite-Alkalic Complex

The Nemegosenda Lake Complex (Figures 12a, 12b) covers approximately 9 square miles (23 km^2) and is elliptical in plan view with its long axis striking north. The complex underlies parts of Pattinson, Collins, McGee and Chewett Townships, and can be easily reached by float-equipped aircraft from Chapleau to Nemegosenda Lake. The complex is composed of incomplete arcuate rings of various alkalic syenites intruded into a sequence of tonalitic and monzonitic rocks of the Shawmere anorthosite complex. The Nemegosenda Lake complex has sparse outcrop and is covered largely by Nemegosenda Lake. Gittens *et al.* (1967, p.652) reported K-Ar dates of 988 and 1036 m.y., obtained from nephelines collected from the complex.

Parsons (1961, p.36-39) indicated that three fenite zones occur from the outer perimeter inward: ijolitic fenite; red alkalic fenite; and pyroxenitic fenite.

The ijolitic fenite occurs locally along the northern flank of the intrusion and consists of nepheline, biotite, and pyroxene and minor amounts of magnetite, calcite, and apatite. The red alkalic fenite occurs along the northeast side of the complex and along its western flank, and is reported to consist of about 40 percent aegirine-augite, 20 percent fresh feldspar, and about 35 percent hydrated material, mostly pseudomorphic after feldspar, probably originally albite. Minor amounts of carbonate, biotite, apatite, wollastonite, and altered nepheline occur in the fenite; scapolite and fluorite were also reported by Parsons (1961, p.36) to be present. The red alkalic fenite is reported to be consistently radioactive and generally contains Nb_2O_5 content greater than 0.2 percent (Parsons 1961, p.36). The pyroxenitic fenite occurs inside the red alkalic fenite along the eastern margin of the complex. The pyroxenitic fenite consists of aegirine-augite, nepheline, and potassium feldspar. The rock is massive to highly foliated and brecciated.

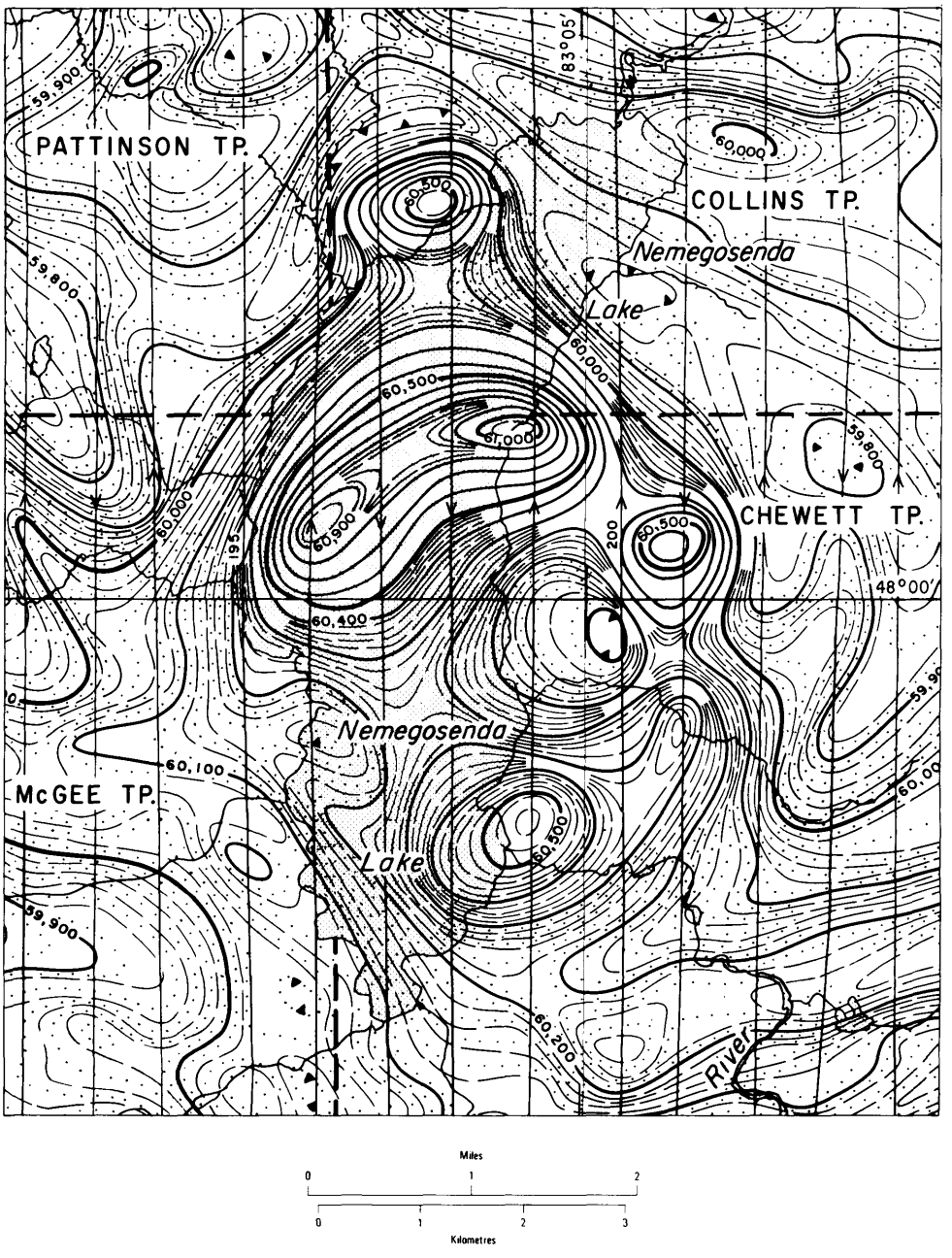
In the northeast corner of the complex, within the fenite ring, are various mafic to ultramafic rocks in lenses and irregular masses. These rocks consist of malignite, biotite-feldspar pegmatite, and jacupirangite. They are massive to brecciated and consist mainly of biotite, orthoclase, anorthoclase, and varying quantities of magnetite, pyroxene, apatite, and calcite. Minor accessory minerals are sulphide, graphite, pyrochlore, and zircon. These rock units parallel the rim of the complex, dip inward towards the centre, and vary in width from a few feet to a few hundred feet. They comprise the host of the main zone of niobium mineralization which has been delineated by diamond drilling by the Dominion Gulf Company.

Carbonate rocks make up only a small part of the complex and consist of sövite and pyroxene-biotite sövite. These rock units range from intrusive dike-like bodies to replacement bodies in breccia zones. Apatite and albite are locally present as abundant accessory minerals. One type of carbonate rock, consisting of patches of biotite and fine-grained calcite in a matrix of coarse-grained white calcite, is reported to contain niobium mineralization (Parsons 1961, p.40).

Syenitic contact rocks between the fenites and the alkalic syenites of the complex have been described as varying from uniform-textured syenitic rocks to breccias and pseudobreccias. These rocks vary in composition from malignite to leucocratic alkalic syenite, and are transitional between the fenite contact rocks and intrusive rocks of the core.

The core of the complex thus has two zones, the outer zone consisting of syenitic breccia and an inner zone of nepheline-bearing rocks. Coarse-grained juvite occurs on islands in Nemegosenda Lake in the southwest corner of the complex while pulaskite, foyaite, and nepheline-bearing biotite syenite make up the remaining nepheline syenite rocks of the inner core. The change from fenite to the syenitic rocks is marked by the occurrence of magnetite and biotite, and also by an increase in nepheline and orthoclase toward the intrusive syenitic rocks.

Traversing in the northwest corner of the complex disclosed outcrops of medium- to coarse-grained ijolite with radiating groups of light green vitreous apatite crystals up to 1½ inches (4 cm) in length. Altered nepheline, carbonate, and sodalite also constitute a significant part of the rock. These outcrops are thought to represent the ijolitic fenite of Parsons (1961, p.36). One outcrop of red alkalic fenite on the west side of the complex was examined, and from the igneous-appearing (inequigranular-hypidiomorphic) textures observed in the outcrops of these rocks a magmatic or a rheomorphic origin seems as likely as the metaso-



SMC 13302

Figure 12a–Aeromagnetic map of the Nemegosenda Lake complex. After ODM-GSC Maps 2232G and 2233G (1963).

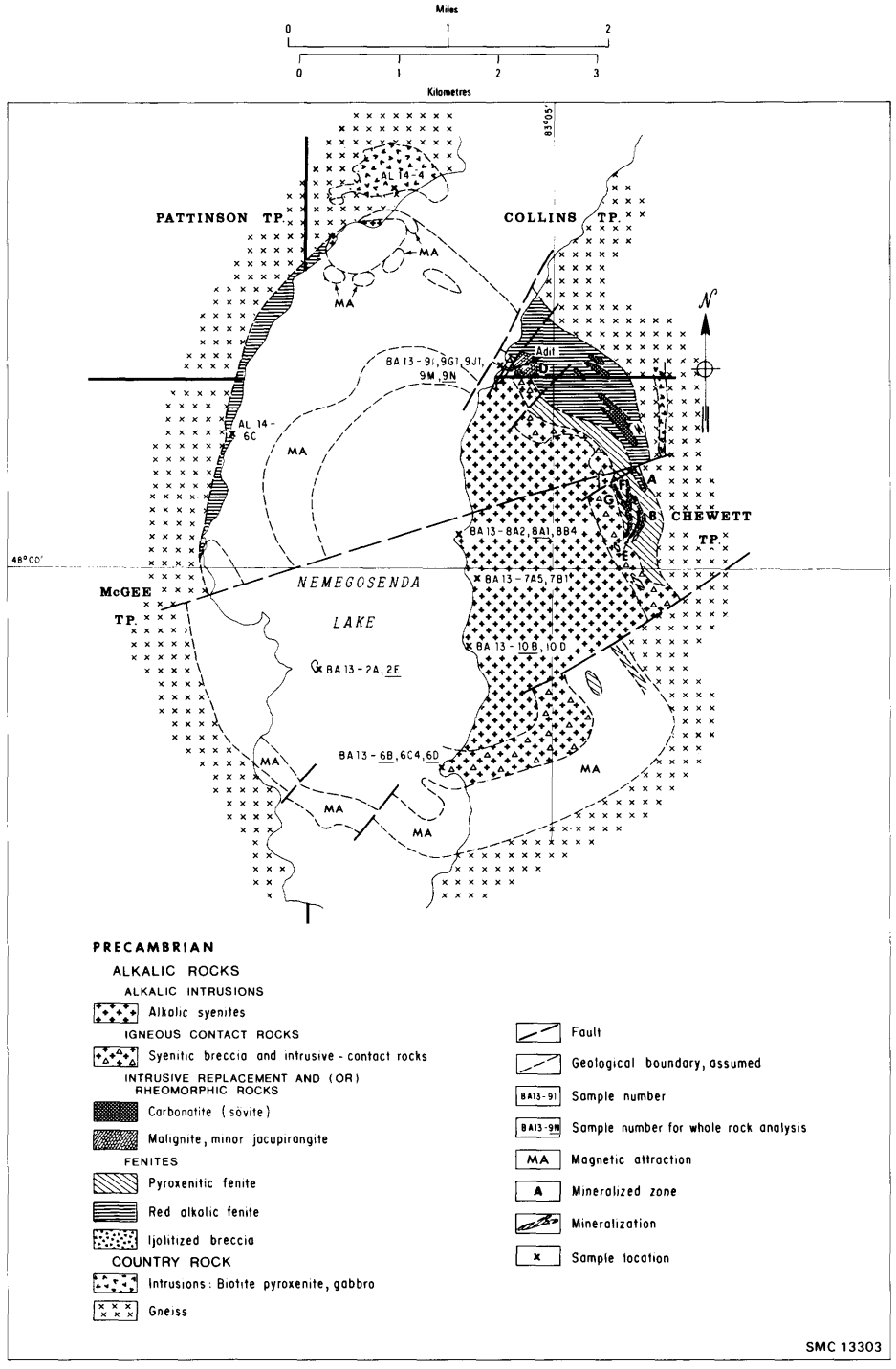


Figure 12b–Geological map of the Nemegosenda Lake complex. Modified from Parsons (1961, Map 2007).

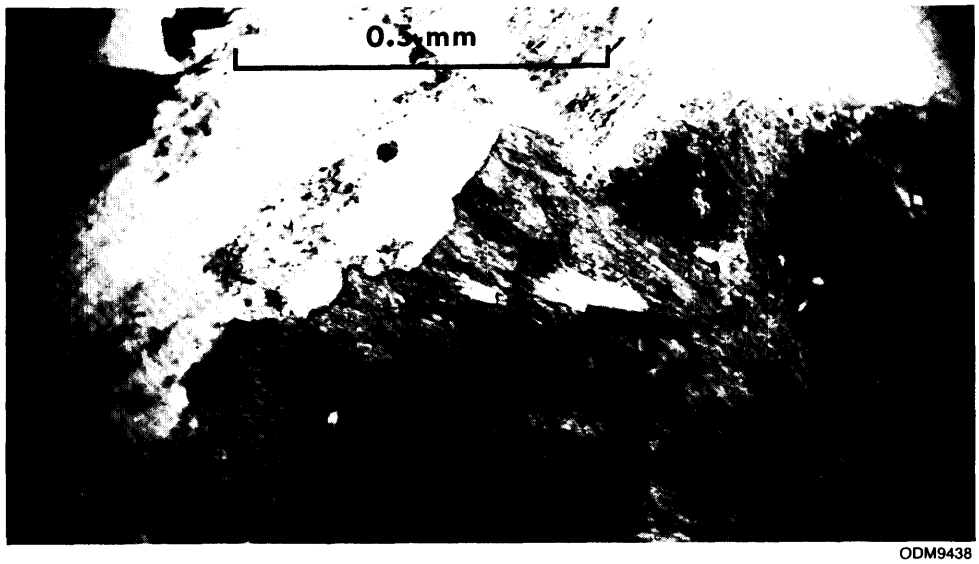


Photo 16–Photomicrograph of malignite, showing small crystals of pyrochlore (centre of photograph) in aegerine-augite rimmed with soda amphibole, with calcite and potassium feldspar; Dominion Gulf Company zone D, Nemegosenda Lake complex.

matic one of fenitization.

Examination of outcrops along the southeast shore of Nemegosenda Lake indicated a nepheline syenite breccia with a black matrix composed of calcite, pyroxene, biotite, potassium feldspar and their alteration products. The nepheline syenite fragments are up to several feet in diameter and probably belong to Parsons' map-unit 8 (Parsons 1961, Map 2007). This unit likely extends across the southeastern corner of the intrusion (see Figure 12b).

A sövite dike cutting nepheline syenite on the east side of the complex was examined. The nepheline syenite enclosing the dike is bleached grey and has undergone considerable alteration along the contact with the sövite dike. The altered rock appears to consist largely of fine-grained albite, potassium feldspar and nepheline which is turbid or clouded and appears to have undergone alteration. The sövite contains minor apatite, albite, sericite, and epidote.

Thin sections cut from pyrochlore-bearing samples collected at the adit and site of the former workings of Dominion Gulf Company indicated that the pyrochlore occurs as small yellow-brown to honey-yellow, subhedral to euhedral crystals located principally along the margins of acicular aegirine-augite crystals in rocks generally of the malignite type (Photo 16). The margins of the aegirine-augite crystals appear to be partly altered to amphibole and carbonate. Well-developed amphibole overgrowths with euhedral crystal boundaries occur locally next to these marginal altered zones. Calcite, potassium feldspar and nepheline are the other major constituents of the pyrochlore-bearing samples. Minor magnetite and pyrite are common.

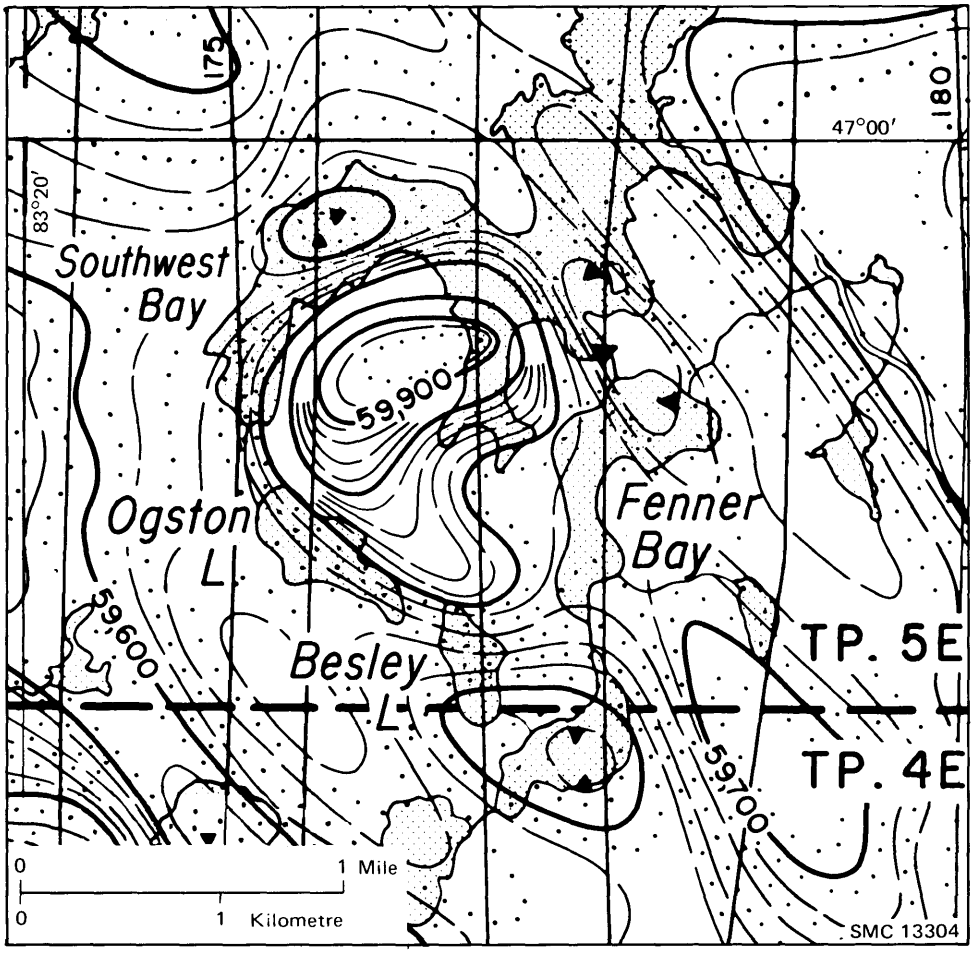


Figure 13a–Aeromagnetic map of Seabrook Lake complex. After ODM-GSC Maps 2228G and 2229G (1963).

Seabrook Lake Carbonatite-Alkalic Complex

The Seabrook Lake complex is located in Rollins and Maeck Townships[1], on the south end of Seabrook Lake, and can be reached by a gravel road leading northwest from Aubrey Falls on Highway 129. The complex is about 1¾ miles (2.8 km) long in a north-south direction, and is up to ¾ miles (1.2 km) wide at its northern end. It is covered by a thick growth of brush but outcrops can be examined along the shore of Seabrook Lake (Figures 13a, b).

The Seabrook Lake complex has been dated by the K-Ar method on biotites

[1]Formerly Townships 4E and 5E respectively.

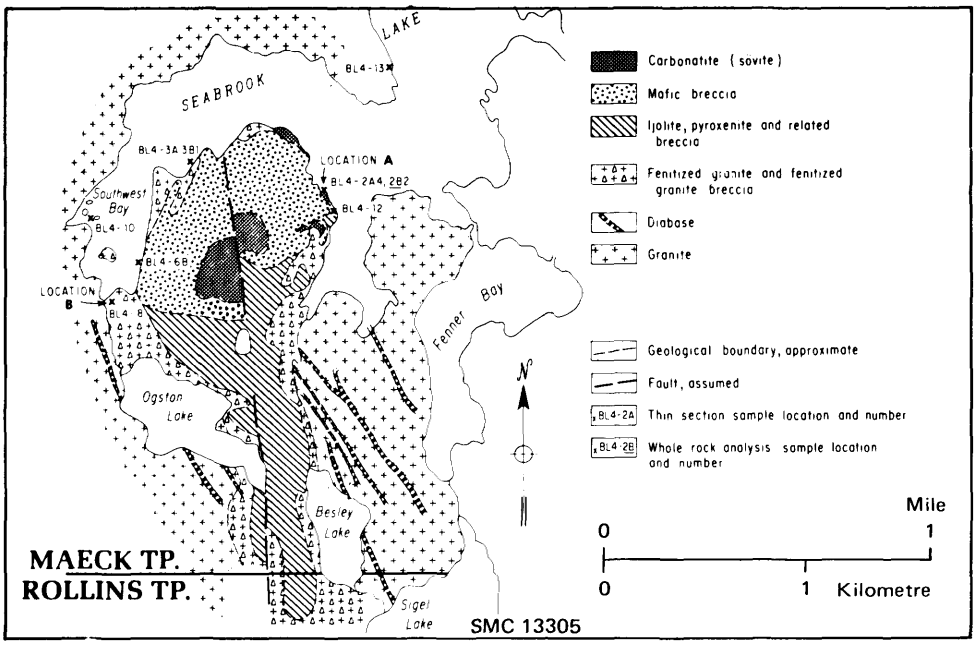


Figure 13b–Geological map of Seabrook Lake complex. Modified from Parsons (1961, Map 2005).

obtained from the complex. These dates are 1109 and 1107 m.y. (Gittens *et al.* 1967, p.652). The Seabrook Lake intrusion consists of a predominantly mafic breccia core (Photo 17) containing minor carbonatite (Photo 18), surrounded by a fenite halo varying from several hundred to nearly 1,000 feet (300 m) in width. The complex and northwest-trending diabase dike set are cut by a fault. The diabase dike set has not been observed to cut the carbonatite-alkalic sequence of the complex and is thus most likely older than the complex. Mafic to ultramafic rocks which comprise the southern end of the complex and the central part of the northern half of the complex are characterized by an inward-grading sequence of granitic rocks ("country rocks" of Figure 13b) granite fenite, fenitized granitic breccia, mafic breccia, and carbonatite (Parsons 1961, Map 2005). The mafic breccias are characterized by carbonate, biotite, and pyroxene, and the absence of nepheline and feldspar; Parsons (1961, p.18) considered the ijolite within the mafic breccia to have resulted in part from a replacement of granitic breccia.

The carbonatite examined at Parsons' locations "A" and "B" is chiefly calcite and displays a distinct foliation due to variation in accessory mineral content. The foliation is enhanced by weathering and closely spaced jointing. The carbonatite forms dikes which cut fenetized granite south of the southwestern bay of Seabrook Lake and along the east shore of the main peninsula on Seabrook Lake, and forms a dike on the west shore of the lake approximately 3,000 feet (900 m) north of the main alkalic core (Parsons 1961, p.19).

The mafic rocks at the southern end of the complex are pyroxenite and ijolite bounded by fenitized granitic breccia.



ODM9439

Photo 17–Mafic breccia on the shore of Seabrook Lake. Seabrook Lake complex.



ODM9440

Photo 18–Foliated and jointed sövite. Seabrook Lake complex.



ODM9441

Photo 19–Photomicrograph of fenitized granite, showing sodic amphibole fibres. Seabrook Lake Complex.

The better-developed fenites, such as those occurring on some of the islands in the southwestern bay of Seabrook Lake display a well-developed acicular fibrous amphibole which has been tentatively identified optically as arfvedsonite (Photo 19). An X-ray powder pattern of blue-green fibers from the fenite indicated an amphibole structure.

Nepheline was not observed in the thin sections prepared from the samples collected from the complex but was visually identified in hand samples collected at the southern end of the complex.

A thin section of carbonatite from an outcrop at Parsons' location "A" on the northeast side of the main peninsula into Seabrook Lake, disclosed up to 8 percent fine-grained intergranular quartz displaying a mottled extinction, and associated with minor feldspar. This is thought to be, in part, secondary in origin and not an original component of the carbonatite. The carbonatite is very close to a mafic breccia (3 to 4 feet or 0.9 to 1.2 m wide) which contains fragments derived from both the complex and the wall-rocks; some of the quartz in the carbonatite may have been derived from the milling of fragments broken from the enclosing wall-rocks at the time of breccia formation and emplacement.

Borden Township Magnetic Anomaly

A prominent circular magnetic anomaly (Figure 14) in Borden Township is thought to represent a carbonatite intrusion (Gittens 1966b, p.522).

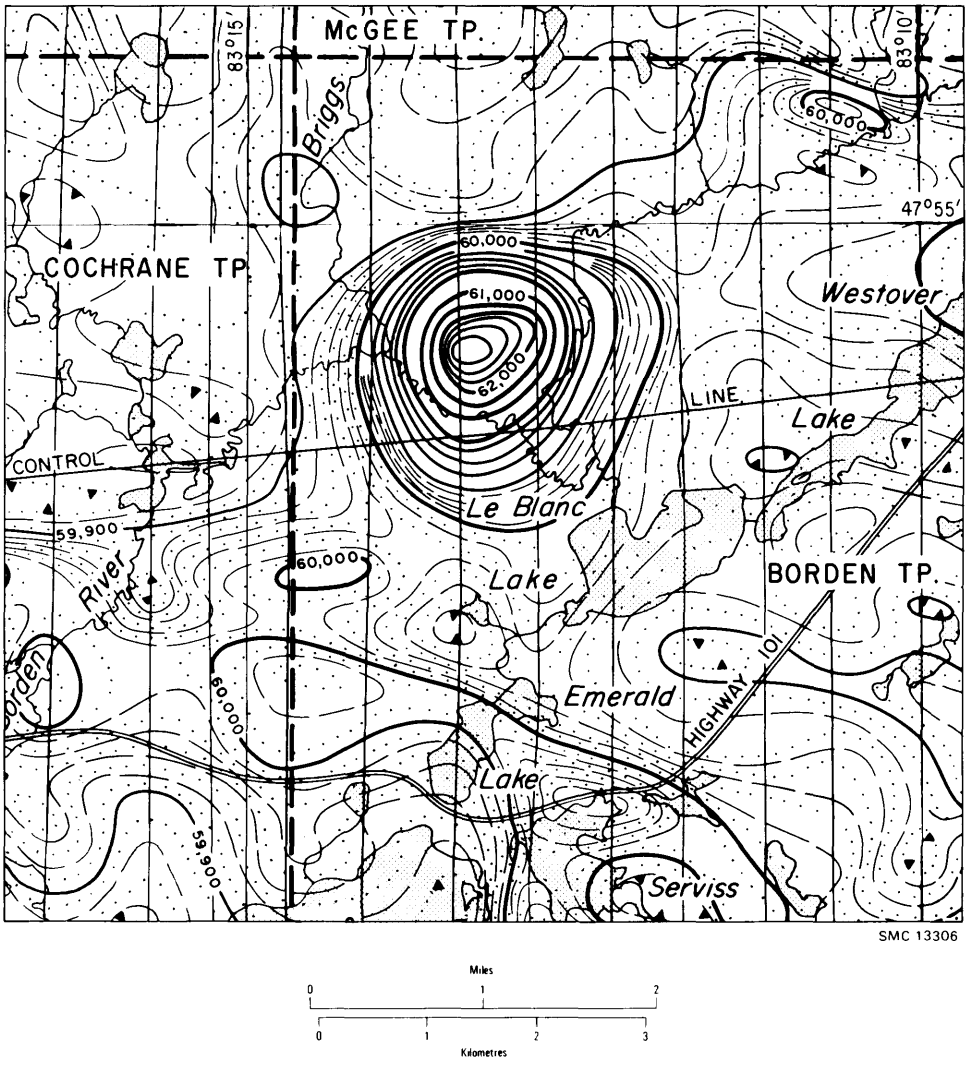


Figure 14–Aeromagnetic map showing Borden Township magnetic anomaly. After ODM-GSC Map 2232G (1963).

A search of the assessment work files failed to disclose that any work had been done on this anomaly. Attempts by members of the field party to locate outcrop within the magnetic contours defining the anomaly failed.

Dupuis[1] Township Magnetic Anomaly

A prominent anomaly on aeromagnetic map 2231G (ODM-GSC 1963) in Township 12E (Dupuis Township), District of Algoma, has been interpreted by Ayres *et al.* (1971b) as a possible alkalic rock complex. Ground traverses within the magnetic anomaly failed to disclose outcrop. Two outcrops of foliated quartz diorite and granodiorite cut by red quartz-feldspar pegmatite were located along the southern margin of the magnetic expression. An examination of the boulders along a lumber road which passes close to the southern boundary of the magnetic anomaly failed to disclose rocks of a composition that would give rise to the magnetic anomaly. Two boulders of nepheline syenite, as well as abundant boulders of anorthosite, were observed. The nepheline syenite is typical of those found in the Lackner Lake carbonatite-alkalic complex and are considered to be glacial erratics derived from this body; the Shawmere anorthosite lies just northeast of the Lackner Lake complex. The cause of this anomaly awaits further investigation. There is no record of any work having been done to test this anomaly.

Alkalic Syenite Dike, Brackin Township

On Red Granite Point located on the west shore of Missinaibi Lake is a brick-red, fine- to medium-grained, massive to porphyritic, alkalic syenite dike. The dike cuts gneissic biotite quartz diorite and trondhjemite which strike at N70W and dip 60S. By averaging the attitudes of the east and west contacts the dike strikes N30E and dips 80N, and appears to be approximately 70 feet (20 m) wide.

The dike has a well developed, fine-grained, porphyritic chilled margin which grades into an equigranular medium-grained core. The rock is composed of 80 to 85 percent subhedral to euhedral, brownish, clouded alkalic feldspar, generally with colourless albite rims where the feldspar crystals are separated by the mafic components of the rock. The cloudy nature of the feldspar is probably due to very fine grained disseminated hematite in the crystal lattice. The phenocrysts of the chilled margin appear to be of the same composition as the feldspar of the groundmass, but the cloudy appearance of the feldspar makes identification difficult. The feldspar generally appears to be a single phase; zoning and perthitic intergrowths were not detected by optical examination.

Biotite is the most common mafic mineral and comprises up to 10 percent of the rock. Brown hornblende comprises 3 to 4 percent of the rock and commonly

[1]Formerly named Township 12E.

TABLE 15 | CHEMICAL ANALYSIS (MAJOR AND TRACE ELEMENTS) OF ALKALIC SYENITE DIKE, BRACKIN TOWNSHIP. ANALYSIS BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

SiO_2	56.20[1]	Ag	-
Al_2O_3	16.60	As	-
Fe_2O_3	1.67	Ba	2500[2]
FeO	6.62	Be	3
MgO	0.98	Co	4
CaO	3.52	Cr	-
Na_2O	6.26	Cu	10
K_2O	3.31	Ga	30
H_2O^+	1.11	Li	-
H_2O^-	0.20	Mo	-
CO_2	0.68	Ni	20
TiO_2	1.22	Pb	10
P_2O_5	0.04	Sb	-
S	0.28	Sc	30
MnO	0.22	Sn	-
		Sr	400
		V	10
		Y	30
		Zn	140
		Zr	300

[1]Weight percent
[2]Parts per million

occurs as an alteration product of pyroxene. Minor euhedral to subhedral calcic pyroxene crystals comprise 1 to 2 percent of the rock. The subhedral grains of the pyroxene commonly display a fine-grained brownish alteration product along their rims, possibly biotite. Fine-grained, acicular, blue-green amphibole occurs rarely as an alteration of the pyroxene. Accessory zircon, calcite, magnetite, and apatite were noted. A total rock analysis of a sample taken from the centre of the dike and analyzed by the Mineral Research Branch, Ontario Division of Mines, is given in Table 15.

MAFIC TO INTERMEDIATE INTRUSIVE ROCKS

The rocks grouped here are all spatially associated with the Kapuskasing Structural Zone. The principal occurrences are: *(1)* dioritic and gabbroic rocks in Fenton and Seaton Townships; *(2)* the Shenango intrusive complex, centred on Shenango Township; and *(3)* scattered, ill-defined occurrences (too small to show on the map) within and adjacent to the Kapuskasing Structural Zone. They are all unaltered and cut the rocks of the metavolcanic-metasedimentary belts, the granitic rocks, and the granulites of the Kapuskasing Structural Zone. Some of these unaltered rocks are spatially associated with the anorthosite, which has

been metamorphosed, and because of this they are thought to be later than the anorthosite.

Fenton-Seaton Townships Area

In the Fenton-Seaton Townships area, the most abundant rock type is a grey to black weathering, medium- to coarse-grained hornblende diorite with plagioclase phenocrysts, up to 1 cm long, forming 40 to 65 percent of the rock. Quartz was not observed in hand specimens. Scattered outcrops of this rock type, with minor compositional variation (quartz diorite and hornblende gabbro), are found over an area of 9 miles (14 km) by 3 miles (5 km) in central Seaton Township. West of this area are mafic metavolcanics extending 6 miles (10 km) in a north-south direction and having a maximum width of about 2 miles (3 km). McMurchy (1960, p.9) indicated the hornblende diorite to be equivalent to the metavolcanics to the north. This is considered a possibility, but on the present map these rocks (McMurchy's unit 2) were included with the mafic to intermediate intrusive rocks, because in the outcrops visited no distinction could be made between these intrusive rocks and the other rocks mapped as hornblende diorite.

Shenango Intrusive Complex

The Shenango complex (Figure 15a, b) is a roughly elliptical intrusion straddling the Sherlock-Shenango Townships boundary; its area, interpreted from aeromagnetic map 2248G (ODM-GSC 1963), is approximately 27 square miles (70 km^2). The complex is composed of a monzonitic core containing several arcuate, mafic hornfels units, and on the east side, a peripheral unit of syenodiorite and diorite.

Rock exposures on the complex are not abundant and are largely confined to its central core and the northern and eastern flanks. It is estimated that less than 1 percent of the area of the complex occurs as outcrop. Outcrop areas were located by helicopter, and these were checked on the ground as much as possible. Approximately two days reconnaissance mapping by the author [Sage] and four days by senior assistants were spent on the complex.

Chemical analyses (by Mineral Research Branch, Ontario Division of Mines) of samples from the various lithologic units of the Shenango complex are given in Table 16; modal analyses are given in Table 17; the sample locations are given on the geological map of the complex (Figure 15b).

The various rock-units are considered to be comagmatic and probably grade gradually into each other (Figure 15b). A Peacock variation diagram (Figure 16) based on four analyses (analyses by the Mineral Research Branch) of rocks collected from the Shenango complex shows that the Shenango rock suite is alkali-calcic based on the Peacock alkali-lime index (Barth 1962, p. 171-172).

Rocks characteristic of a carbonatite-alkalic suite, such as nepheline syenite, sövite, malignite, and the urtite-melteigite series were not found. The actual con-

tact between the intrusion and its wall-rocks was not observed, but outcrops of wall-rocks within 1,000 feet (300 m) of the body do not show development of a fenitic halo around the body. The rock suite appears to represent an alkali-poor, silica-saturated series rather than one of significant undersaturation and alkali enrichment. The only rock of definite alkalic affinity is the small dike found in the rock cut on the Canadian National railway. The relationship of this dike to the Shenango complex is unknown.

Trace elements determinations (see Table 16) of the Shenango rock suite by the Mineral Research Branch, show that the monzonitic to dioritic rocks contain abnormal quantities of Ba, Sr, and Nb. Barium varies from 3000 to 4000 ppm, strontium from 800 to 1000 ppm, and niobium from 100 to 300 ppm. The mafic hornfels varies from 150 to 200 ppm Ba, and contains about 200 ppm Sr but no Nb. These lower concentrations of Ba, Sr, and Nb in the hornfels indicate that the hornfels may have a different origin than the other rocks of the complex. The high concentrations of Ba, Sr, and Nb in the Shenango complex is indicative of a link with rocks of a more alkalic nature.

Biotite taken from diamond drill hole number K-1 at 496 feet (151.2 m), drilled by Kennco Explorations (Canada) Limited, gave K-Ar radiometric ages of 1076 ± 42 m.y. and 1082 ± 24 m.y.; biotite taken from 306 feet (93.3 m), Kennco Explorations (Canada) Limited diamond drill hole number K-2, gave a K-Ar age of 1065 ± 24 m.y. (K. Bell and D.H. Watkinson, Carleton University, unpublished data 1972). These ages are similar to those reported by Gittens *et al.* (1967) for the Nemegosenda Lake and Lackner Lake carbonatite-alkalic complexes (see the section "Carbonatite-Alkalic Complexes").

Whole rock Rb-Sr age determinations by L. Owen[1], of samples collected from the Shenango complex, gave an isochron age of 1099.7 ± 184.6 m.y. The Sr^{87}/Sr^{86} ratio of 0.70303 ± 0.00064 for the complex is primitive and indicates that the rocks may have crystallized from a magma derived from the mantle. A sample of the syenodiorite-diorite border zone collected on Long Lake had a significantly higher Sr^{87}/Sr^{86} ratio than the other samples and points to the possibility that this unit is not comagmatic with the others.

MONZONITE

The core of the Shenango complex consists of a fine- to medium-grained, massive, equigranular to inequigranular, red to red-brown rock containing approximately 20 to 25 percent mafic minerals. The feldspar is antiperthite, constituting 40 to 70 percent of the rock, in part surrounded by smaller grains of sodic andesine feldspar (Photo 20). The potassium feldspar generally constitutes between one-third and half of the total feldspar. The mafic minerals consist of 10 to 40 percent hornblende, trace to 12 percent augite, and trace to 5 percent biotite. Locally, near the contact with mafic hornfels, magnetite may constitute up to 10 percent of the rock. A trace of interstitial quartz was noted. One thin sec-

[1]Graduate student (supervisor, Dr. Gunter Faure), Laboratory for Isotope Geology and Geochemistry, Ohio State University.

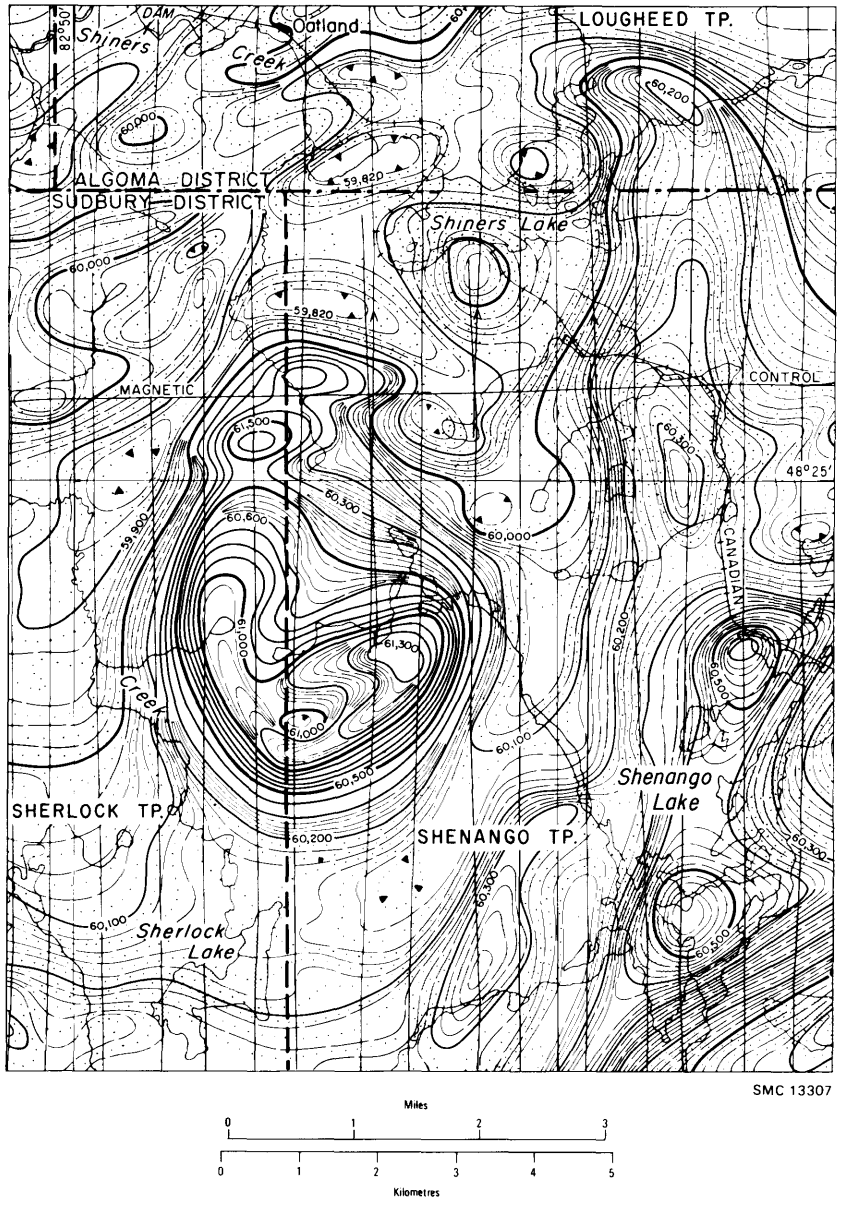


Figure 15a–Aeromagnetic map of Shenango complex. After ODM-GSC Map 2248G (1963).

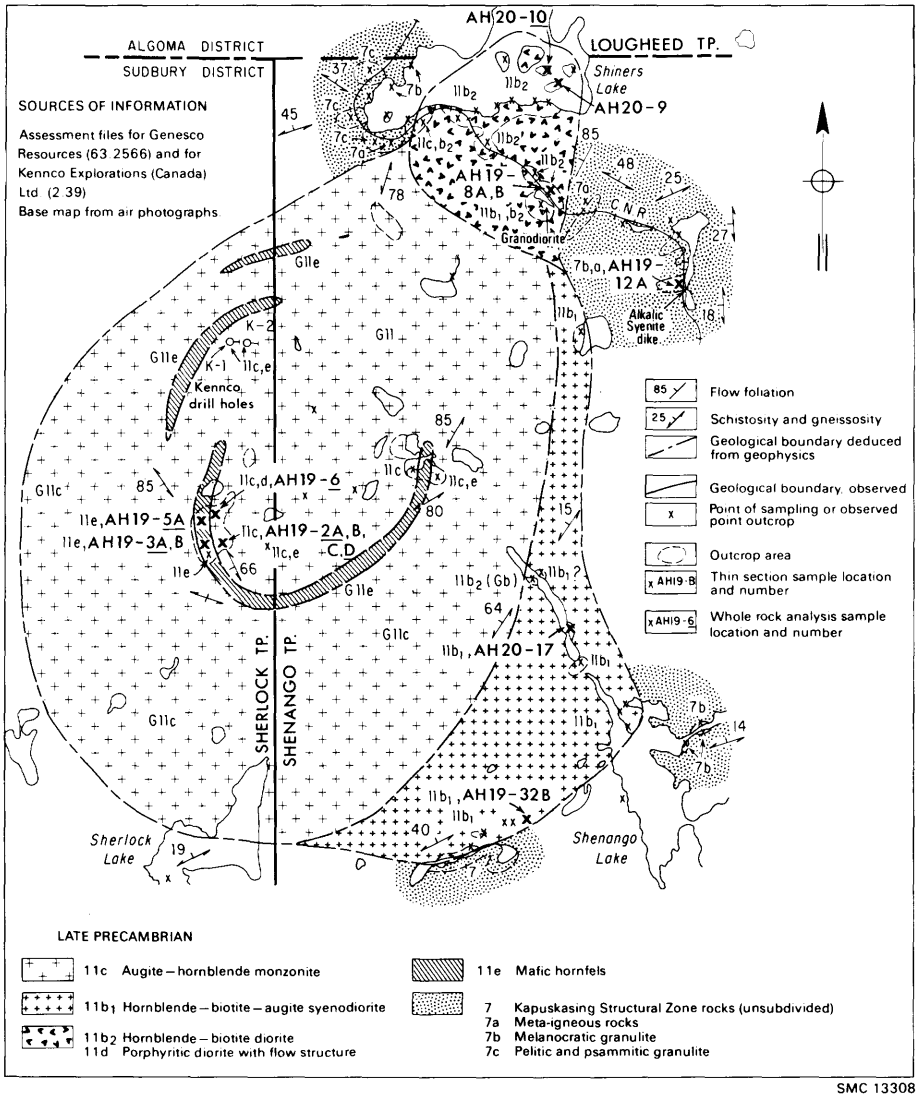


Figure 15b–Geological map of Shenango complex.

TABLE 16 | CHEMICAL ANALYSES AND NORMATIVE MINERALOGY OF SAMPLES FROM THE SHENANGO INTRUSIVE COMPLEX. ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES; CIPW NORMS CALCULATED BY W.V. PEREDERY, GRADUATE STUDENT, UNIVERSITY OF TORONTO.

Chemical Analysis (weight percent)	AH19-2A	AH19-2D	AH19-3A	AH19-5A	AH19-6	AG20-10
SiO_2	51.60	60.40	53.20	52.90	58.60	52.60
Al_2O_3	19.50	18.70	14.60	15.00	16.40	21.50
Fe_2O_3	4.74	3.00	3.71	4.84	2.37	0.98
FeO	4.48	6.07	6.65	8.24	5.78	5.35
MgO	1.95	0.93	5.89	3.18	1.32	1.90
CaO	8.90	2.35	9.95	10.40	3.86	7.30
Na_2O	3.91	4.56	2.04	1.24	5.04	4.18
K_2O	2.23	4.28	0.58	0.31	5.06	2.51
H_2O^+	0.06	0.52	1.48	0.61	0.53	0.70
H_2O^-	0.06	0.04	0.03	0.05	0.12	0.04
CO_2	0.25	0.22	0.14	0.16	0.21	0.16
TiO_2	0.93	0.40	0.99	1.21	0.62	0.90
P_2O_5	0.73	0.11	0.08	0.05	0.32	0.41
S	0.02	0.01	0.01	0.01	0.01	0.01
MnO	0.17	0.29	0.20	0.22	0.22	0.12
Total	99.50	101.90	99.50	98.40	100.50	98.70
Specific Gravity	2.85	2.76	2.93	2.98	2.72	2.80
Trace Elements[1] (ppm)						
Ag	-	-	1	1	-	-
As	1	1	4	1	1	1
Ba	3000	3000	200	150	3000	4000
Be	3	3	-	-	3	3
Co	25	10	50	50	20	20
Cr	15	10	100	80	10	10
Cu	50	15	30	100	30	40
Ga	10	10	15	15	10	15
Ni	20	10	80	100	15	50
Pb	10	10	10	10	10	10
Sc	20	-	20	30	-	20
Sr	800	1000	200	200	1000	1000
V	150	10	250	300	30	50
Y	20	40	20	30	30	20
Zn	110	130	110	120	130	70
Zr	250	300	200	250	250	150
Nb	100	300	-	-	300	100
Normative Mineralogy (weight percent)						
Quartz	1.57	8.10	10.14	17.13	-	-
Orthoclase	13.18	25.29	3.43	1.83	29.90	14.83
Albite	33.08	38.58	17.26	10.49	42.64	35.36
Anorthite	29.06	9.55	28.96	34.43	7.17	32.47
Corundum	-	3.06	-	-	-	-
Ca Clinopyroxene	3.67	-	7.97	6.64	3.59	0.02
Mg Clinopyroxene	2.13	-	4.87	2.98	1.08	0.01
Fe Clinopyroxene	1.35	-	2.61	3.59	2.64	0.01
Enstatite	2.73	2.32	9.80	4.94	1.45	2.17
Ferrosilite	1.73	8.54	5.26	5.95	3.54	3.56
Forsterite	-	-	-	-	0.53	1.79
Fayalite	-	-	-	-	1.45	3.23
Magnetite	6.87	4.35	5.38	7.02	3.44	1.42
Ilmenite	1.77	0.76	1.88	2.30	1.18	1.71
Apatite	1.75	0.26	0.19	0.12	0.77	0.98
Calcite	0.57	0.50	0.32	0.36	0.48	0.36
Total Normative Minerals	99.46	101.32	98.07	97.78	99.84	97.94
Total Wt. Oxides	99.39	101.31	98.03	97.75	99.80	97.91

[1] Li, Mo, Sb, and Sn not detected in any samples

Samples (locations given on Figure 15b):
AH19-2A - Mafic hornfels
AH19-2D - Syenodiorite-monzonite
AH19-3A - Mafic hornfels
AH19-5A - Mafic hornfels
AH19-6 - Monzonite
AG20-10 - Diorite

TABLE 17 MODAL ANALYSES OF SAMPLES FROM THE SHENANGO INTRUSIVE COMPLEX. ANALYSES BY W.R. TROUP, GEOLOGICAL ASSISTANT, ONTARIO DIVISION OF MINES; VOLUME PERCENTAGES DETERMINED FROM 1000 POINT COUNTS PER THIN SECTION.

Sample	AH19 -2A	AH19 -2B	AH19 -2C	AH19 -2D	AH19 -3A	AH19 -3B	AH19 -5A	AH19 -6	AH19 -8A	AH19 -8B	AH19 -12A	AH19 -32B	AG20 -9	AG20 -10	AH20 -17
Mineralogy															
Plagioclase An_{20-56}															
" Phenocrysts	68.9	-	37.0	57.2	34.3	41.7	33.0	4.9	60.5	70.6	-	50.7	77.2	86.3	45.0
" Groundmass	-	26.0	-	-	-	-	-	-	-	-	-	-	-	-	-
Alkali Feldspar	-	-	-	-	-	-	-	-	0.5	-	75.3	6.6	-	-	14.1
Pyroxene (undif.)	-	-	-	0.1	-	-	-	-	-	0.6	-	-	-	-	-
Augite	8.3	4.6	-	-	-	-	-	5.5	-	-	-	15.2	11.2	1.0	7.3
Aegirine Augite	-	-	-	-	-	-	57.2	-	-	-	-	-	-	-	-
Amphibole	-	-	-	-	-	-	-	-	0.9	-	-	-	-	-	-
Hornblende	15.7	1.0	22.9	22.6	50.9	47.0	tr	13.8	-	9.0	-	2.9	1.0	2.7	21.4
Arfvedsonite	-	-	-	-	-	-	-	-	-	-	18.0	-	-	-	-
Quartz	-	-	-	-	10.8	8.6	7.2	-	16.8	4.7	-	-	0.1	0.3	-
Biotite	4.6	-	0.8	0.9	1.5	0.1	-	-	3.7	7.2	0.4	22.6	8.3	9.5	11.7
Carbonate	-	-	-	-	-	-	-	-	-	-	-	-	-	0.1	-
Apatite	0.2	-	-	-	-	0.4	-	0.1	-	0.7	-	0.1	1.3	0.1	0.5
Fluorite	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-
Sericite	-	-	-	-	-	-	-	-	-	6.6	0.2	1.6	-	-	-
Natrolite	-	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-
Antiperthite	-	68.4	37.9	19.2	-	-	-	75.6	15.8	-	-	-	-	-	-
Epidote	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
Chlorite	-	-	-	-	-	-	-	-	0.7	-	-	-	-	-	-
F.G. Alt. Prod.	-	-	-	-	-	-	-	-	-	-	2.8	-	-	-	-
Magnetite	2.3	-	1.4	-	2.4	2.2	2.6	0.1	-	0.6	1.6	-	0.4	-	-
Pyrite	-	-	-	-	-	-	-	-	0.8	-	1.2	-	-	-	-
Hematite	-	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-

Samples (locations given on Figure 15b):

AH19-2A - Mafic hornfels
AH19-2B - Monzonite
AH19-2C - Monzonite
AH19-2D - Syenodiorite-monzonite
AH19-3A - Mafic hornfels
AH19-3B - Mafic hornfels
AH19-5A - Mafic hornfels
AH19-6 - Monzonite
AH19-8A - Diorite
AH19-8B - Diorite
AH19-12A - Alkalic syenite (dike)
AH19-32B - Diorite-syenodiorite
AG20-9 - Diorite
AG20-10 - Diorite
AH20-17 - Syenodiorite

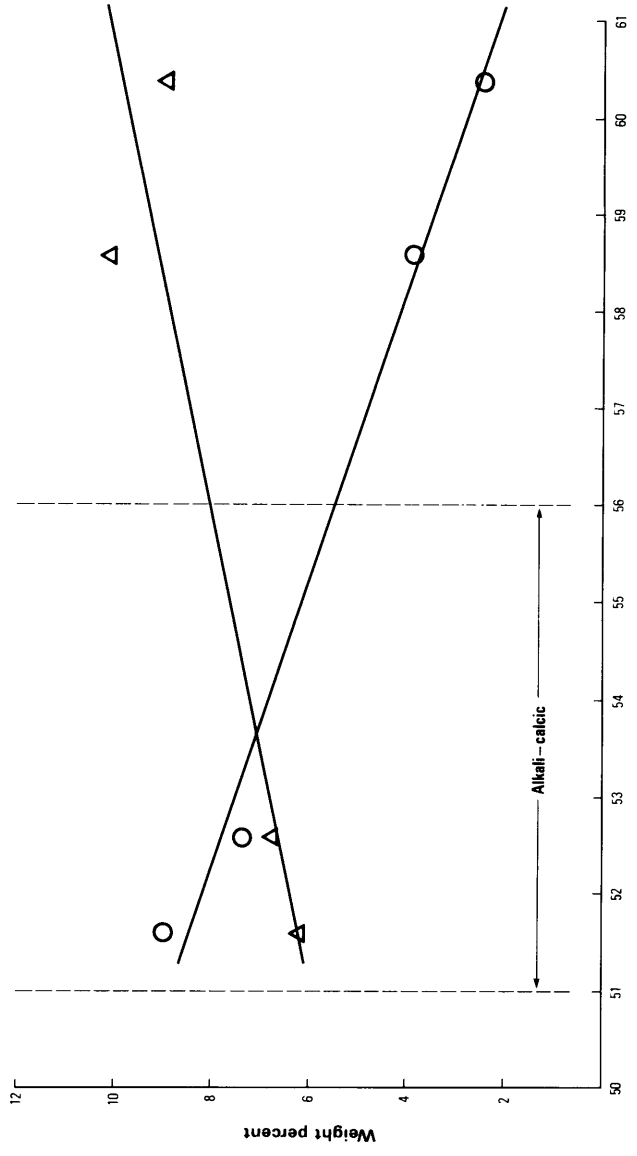


Figure 16–Alkali-lime variation diagram, showing that the Shenango complex is alkali-calcic.



ODM9442

Photo 20–Photomicrograph of monzonite-syenodiorite, showing antiperthitic feldspar. Shenango Complex.

tion displayed a good foliation, and examination indicates that the rock may have undergone some mild cataclasis; sutured feldspar grain boundaries indicated some recrystallization. The foliated specimen lacks pyroxene. Pyroxene often displays some alteration to amphibole and some minor sericite alteration of the feldspar was noticed. Otherwise, the rock is relatively fresh.

SYENODIORITE-DIORITE

A syenodiorite border zone is finer grained, more mafic; and contains a lower percentage of potassium feldspar than the monzonitic core. The syenodiorite is a fine- to almost medium-grained, massive, equigranular, pale pink rock containing 30 to 45 percent mafic minerals. The plagioclase is calcic andesine and makes up 45 to 55 percent of the rock. The potassium feldspar forms less than one-third of the total feldspar, and occurs as antiperthite.

The mafic minerals are pyroxene, 10 to 15 percent, hornblende, trace to 10 percent; and biotite, 10 to 15 percent. Minor apatite and magnetite occur as accessory minerals. The pyroxene shows local alteration to amphibole and the feldspar displays minor spotty alteration to sericite, otherwise the rock is relatively fresh. Stringers of aplite consisting of quartz and potassium feldspar were noted cutting the syenodiorite.

Along the northwest corner of Long Lake, which is the local name for the long linear bay extending northwest from the west side of Shenango Lake, an isolated outcrop of dark brown gabbroic rock occurs. The continuity of this body is unknown and for purposes of simplicity of mapping has been included with the syenodiorite border zone.

DIORITE

Along the northeast flank of the intrusion a medium- to slightly coarse-grained, massive, equigranular to inequigranular grey diorite can be found in railway rock cuts and along the shore of Shiners Lake (Figure 15b). The feldspar is plagioclase of calcic andesine composition and constitutes 60 to 70 percent of the rock. The mafic minerals consist of trace to 15 percent augite, 10 to 15 percent biotite, and trace to 8 percent hornblende.

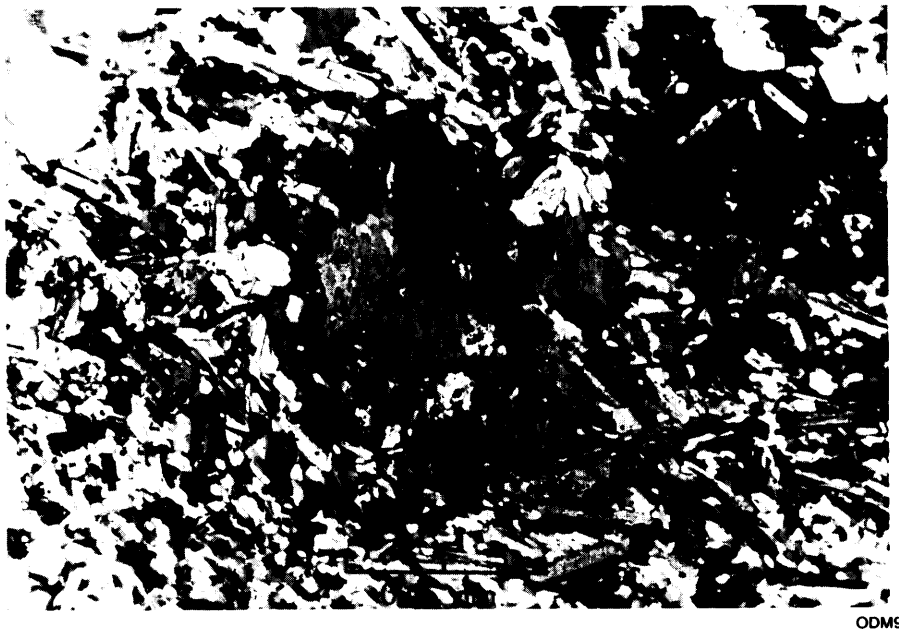
Minor apatite and magnetite are accessory minerals. A trace of quartz is present as a granophyric intergrowth along the edges of a few scattered plagioclase grains. The pyroxene displays alteration to hornblende and some sericitic alteration of the feldspar is present. The rock is generally fresh in appearance. In the field the diorite was observed to be cut by red-brown, coarse-grained dikes of monzonite pegmatite.

DIORITE PORPHYRY

In the centre of the Shenango intrusion a diorite porphyry of apparently limited extent and erratic distribution occurs between the monzonite and mafic hornfels. The rock is massive and displays a good trachytic texture on outcrops and in hand samples. The phenocrysts are of calcic andesine composition and constitute about 20 percent of the rock. The plagioclase of the groundmass makes up another 30 percent. Hornblende comprises about 25 percent, augite 15 percent, and magnetite 10 percent. Minor apatite and biotite were noted. Some of the hornblende crystals enclose plagioclase grains, forming a poikilitic texture.

MAFIC HORNFELS

A fine-grained, massive to foliated, black mafic hornfels occurs as blocks, linear and curvilinear bands, and as isolated inclusions within the monzonitic core of the Shenango complex. The rock is composed of 30 to 40 percent sodic labradorite, 40 to 60 percent pale green to pale brown hornblende, 10 to 15 percent quartz, 5 percent magnetite and a trace of biotite and epidote. The quartz commonly occurs as wispy elongated granular-textured segregations. In thin section, good poikiloblastic textures are displayed; plagioclase is enclosed by hornblende and hornblende by plagioclase (Photo 21). Outcrops commonly display amygdaloid-like clots, which are composed of epidote, quartz, hornblende, and chlorite, and which weather in relief. The curvilinear band of magnetite-bearing hornfels



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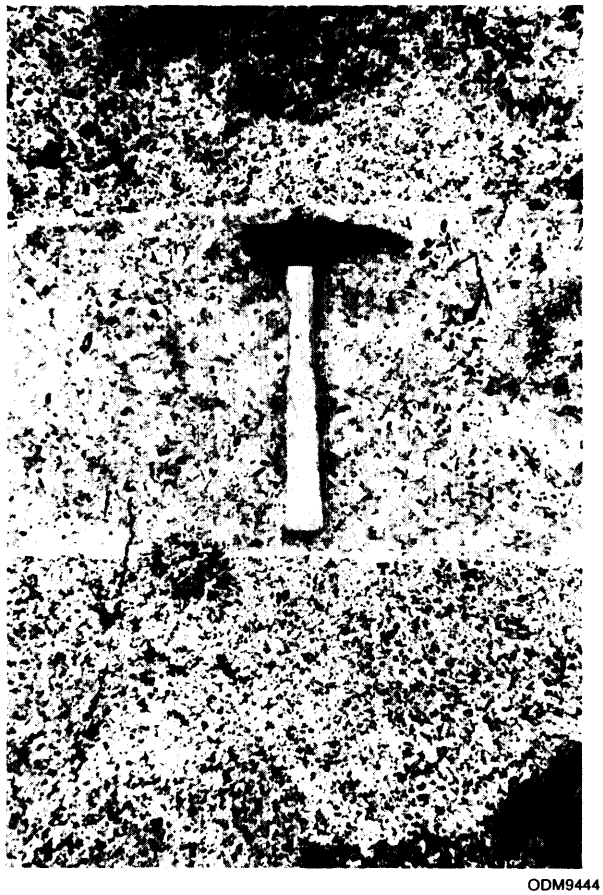
Photo 21–Photomicrograph of mafic hornfels, showing poikiloblastic texture in hornblende. Shenango complex.

in the central part of the intrusion, combined with the irregular concentration of magnetite in the monzonite core near the mafic hornfels contact, appears to be the cause of the prominent magnetic expression of the centre of the intrusion displayed on aeromagnetic map 2248G (ODM-GSC 1963).

The hornfels is believed to represent mafic volcanic blocks and roof pendants that have been metamorphosed under hornblende hornfels facies conditions. These blocks and roof pendants may be remnants of the Belford-Strachan metavolcanic-metasedimentary belt which may possibly have extended across this area at the time of the intrusion of the Shenango complex.

GRANODIORITE

In a rock cut along the Canadian National railway a fine- to medium-grained, red-brown granodiorite was observed to cut the coarser grained, grey diorite. This rock-unit is too small to be shown on Map 2351 but is shown on Figure 15b. The granodiorite contains 20 to 30 percent interstitial quartz. The texture is somewhat aplitic, and the diorite forming the wall-rocks has small amounts of granophyre between the feldspar grains. Even though a number of the feldspar grains appear homogeneous under low magnification, high magnification shows a fine perthitic intergrowth of potassium feldspar and plagioclase.



ODM9444

Photo 22–Coarse-grained dike of red monzonite cutting hornblende-biotite diorite. Shiners Lake, Shenango complex.

The alkali-silica-rich, late-stage pegmatitic and aplitic dikes sharply crosscut the monzonitic to dioritic rocks (Photo 22). An X-ray diffraction pattern of the feldspar taken from a bright red, coarse-grained hornblende-feldspar pegmatite, in a railroad cut on the south shore of Shiners Lake (northwest corner of Shenango Township), disclosed both plagioclase and potassium feldspar. The ratio of plagioclase to potassium feldspar is 2:1. The pegmatite is in turn cut by a fine-grained, quartz-feldspar aplite dike.

ALKALIC SYENITE

In a rock cut along the Canadian National railway a small, bright red to reddish brown, 2-foot (0.6 m) wide dike of alkalic syenite porphyry, striking N85W

and dipping 22N, cuts granulites of the Kapuskasing Structural Zone. The dike is too small to be shown on Map 2351 but is shown on Figure 15b. The rock consists of 5 percent phenocrysts of microcline in a groundmass made up of smaller grains of alkali feldspar and having a weak trachytic texture. The alkali feldspar groundmass constitutes nearly 80 percent of the rock. Small acicular crystals of amphibole, questionably identified as arfvedsonite, make up 10 to 15 percent of the rock. Purple fluorite constituting up to 1 percent of the rock, occurs as very small grains in the groundmass; disseminated pyrite makes up approximately another 5 percent. Magnetite, biotite, and sphene occur as accessory minerals.

Minor sericite and kaolinite alteration of the potassium feldspar is common. The bright red-brown colour of the rock may be due to fine-grained dusty hematite in the feldspar crystal lattices. The relationship of the dike to the nearby Shenango intrusive complex is unknown.

Occurrences Within the Kapuskasing Structural Zone

Small occurrences (too small to be shown on Map 2351) of hornblende diorite are found within the Kapuskasing Structural Zone (i.e. south of Otapingshewee River adjacent to the eastern boundary of the one in Watson Township). The hornblende diorite is unaltered and is thought to be younger than the granulites of the Kapuskasing Structural Zone. It contains 25 percent hornblende, 10 percent quartz, and the remainder is plagioclase. Where examined it is medium to coarse grained, massive to porphyritic, and contains occasional flecks of biotite.

Fresh, unaltered syenitic rocks (not shown on map) were found within the Kapuskasing Structural Zone in the Lougheed Lake area of Lougheed Township. They contain 10 to 20 percent hornblende, pink feldspar and no visible quartz. It is not possible to estimate the size of the syenitic bodies, because of poor exposure and the scale of mapping. No megascopically visible alteration was noted, and these occurrences were assigned to the Late Precambrian, mafic to intermediate intrusive rocks, as were syenitic dikes found cutting all rock types in the area (except diabase dikes).

Mesozoic

(?)LATE JURASSIC TO EARLY CRETACEOUS

Lamprophyre Dikes

Porphyritic, mafic to ultramafic dike rocks are found cutting all rock types in the area except map-units *10* and *11*. Lamprophyres have been described by Laird (1935a, p.19), Donovan (1965d, p.15; 1968, p.26), Prest (1950, p.25), and Rickaby (1934, p. 19), mostly cutting quartz-feldspar porphyry and felsic meta-

volcanics in general. The largest occurrence is a 20 foot (6 m) wide dike in Keith Township, described by Prest (1950) as being almost 1 mile (1.6 km) in length. It does not outcrop, but was encountered frequently by diamond drilling and magnetometer traverses. Rickaby (1934) described a 75-foot (23 m) wide dike exposed along the Denyes-Swayze Townships boundary.

Several rock types including camptonite, minette, and possibly alnoite, have been described by the above-mentioned previous workers. Other lamprophyric rocks have been found associated with the Kapuskasing Structural Zone within the map-region. Bennett (1969, p.14) reported a monchiquite dike along the metavolcanic-gabbro contact on the Paypeeshek River in Belford Township. On the basis of its similarity to a dike found at Sextant Rapids on the Abitibi River, he suggested it may be of post-Middle Devonian age. A lamprophyre dike near Coral Rapids, north of the map-area was recently dated by K-Ar methods at 128 ± 18 m.y. (Wanless *et al.* 1973, p.60, 61).

Bennett (1969, p.13-14) also reported a mafic carbonatite dike cutting gabbro on the Groundhog River in Montcalm Township. The dike is brecciated and is composed of carbonate (43 percent), phlogopite (26 percent), talc-antigorite (18 percent) and magnetite-ilmenite (13 percent). He assigned the dike tentatively to the Proterozoic.

During the present survey lamprophyre dikes were observed along the Foleyet-Chapleau highway in tonalitic rocks of the Kapuskasing Structural Zone and one occurrence in granitic rocks east of Foleyet. Two or three thin mafic dikes were encountered north of the Kapuskasing Structural Zone in Lloyd Township. The strike of these dikes is variable. Easterly strikes perhaps predominate along the Foleyet-Chapleau highway, but north-striking dikes were also found. The dikes vary in width from 4 or 6 inches (10 or 15 cm) up to 2 feet (60 cm). Contacts with the surrounding rock types are generally sharp, and commonly have a narrow (less than 5 mm) dark, aphanitic chilled margin. Brecciation of the wall-rocks into angular and subangular fragments a few inches on a side is found along about 25 percent of the dikes. Weathered surfaces vary from rusty red through red-brown to grey, greenish grey and black. All dike rocks are characterized by a crumbly mafic-rich weathered surface. The fresh surface usually displays a fine-grained to aphanitic matrix containing phenocrysts of biotite, and (or) other mafic minerals. Several varieties of dikes were noted in the course of the field work, but due to its reconnaissance nature only two dikes were examined in detail.

A peculiar inclusion-bearing type was noted along the Foleyet-Chapleau highway where it crosses the Borden River and at the west boundary of Chewett Township. The rock forms an east-trending dike a maximum of 15 to 18 inches (40 to 45 cm) wide over a length of about 75 feet (23 m). The weathered surface is crumbly and grey-green in colour and shows 1 to 3 inch (3 to 8 cm) subangular to rounded green inclusions with white, 5 mm thick fringes, constituting 10 to 20 percent of the rock. The inclusions appear to be calcite, and are mottled by numerous thin serpentine veinlets running through them in a random fashion. The serpentine is intermixed with talc and chlorite and makes up 35 to 45 percent of the inclusions. The 5 mm wide margins of the inclusions consist of relatively pure carbonate. Toward the edges of the margins, disseminated anhedral grains of magnetite become abundant, constituting 5 percent of the inclusion margins. The inclusions are also found as 1 cm angular bodies constituting a sizeable part

TABLE 18 | CHEMICAL ANALYSES IN WEIGHT PERCENT OF LAMPROPHYRIC ROCKS. ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

	1	AJ22-16
SiO_2	39.80	35.00
Al_2O_3	5.00	6.00
Fe_2O_3	4.07	8.70
FeO	6.06	5.85
MgO	20.20	19.10
CaO	11.30	13.40
Na_2O	0.35	0.47
K_2O	0.44	1.21
H_2O^+	3.63	3.18
H_2O^-	0.25	0.13
CO_2	7.52	2.84
TiO_2	1.69	2.42
P_2O_5	0.30	0.96
S	0.60	0.02
MnO	0.18	0.31
Total	100.80	99.60
Specific Gravity	2.84	2.97

1. Inclusion bearing spessartitic dike on Highway 101, northeast of Borden Lake.

AJ22-16 Lamprophyre dike located east of Foleyet on Highway 101, referred to in text as a ouachitite.

of the rock. The bulk of the inclusion-bearing rock has a slightly porphyritic texture; phenocrysts of intensely pleochroic, red-brown to clear brown amphibole (basaltic hornblende) form 20 percent of the rock and phenocrysts of olivine and talc with magnetite-ilmenite inclusions (determined by X-ray diffraction) constitute 15 to 20 percent of the rock. Serpentine (10 percent), magnetite-ilmenite (20 percent), biotite (5 percent), chlorite (15 percent), carbonate grains and small inclusions (5 to 10 percent), and occasional feldspar laths found in the groundmass, account for the balance. On the basis of the modal data above and the chemistry (Table 18) this rock appears to have spessartitic affinities (see Williams *et al.* 1954, p.88).

The other sample which was examined was obtained from a brown-weathering outcrop with 3 mm biotite phenocrysts. The few dikes of this type observed are usually only a few inches thick, random in strike, and found along the Foleyet-Chapleau highway. Microscopic examination indicated that the rock is composed of phenocrysts of biotite (25 to 30 percent) and calcite plus talc (20 percent) in a finer grained matrix of magnetite, fine-grained acicular amphibole, pyroxene, and biotite, and accessory apatite. By the classification of Williams *et al.* (1954, p.85,91), the rock is probably an ouachitite.

Most of the lamprophyre dikes, except perhaps those in the Swayze-Deloro belt, may be spatially related to the Kapuskasing Structural Zone. Whether they are as young in age as suggested is unknown and awaits radiometric investigation. They are known to be at least as young as the metasediments of the Kapuskasing Structural Zone or the anorthositic rocks. None were found cutting the Late Precambrian alkalic rocks or the mafic to intermediate rocks and their present position in the legend is based solely on the age of a similar lamprophyre dike north of the map-area.

Cenozoic

PLEISTOCENE

The Pleistocene geology of the map-region has been previously mapped on a reconnaissance scale by A.N. Boissonneau (1965a; 1965b). In addition to these Pleistocene geology maps there are two reports supplementary to these maps: Boissonneau (1966; 1968). A.P. Coleman (1909) did some early work outlining the extent of glacial Lake Ojibway. V.K. Prest, in the course of compiling the glacial map of Canada, did additional field work in the general area (Prest 1966, p.202,203). This work has been supplemented by a re-interpretation of 1 inch to 1 mile (1:63,360) air photos by W.R. Troup[1] to provide the Pleistocene geology shown on Preliminary Maps P.672-675 (Thurston *et al.* 1971a; 1971b; 1971c; 1971d), and by field observations consisting of scattered altimeter readings on eskers and moraine topography, and numerous determinations of glacial striae directions. Figure 17 (Chart A, back pocket) is a generalization of this data.

[1]Senior geological assistant, Geological Branch, Ontario Division of Mines, Toronto.

The discussion that follows is largely a summary of Boissonneau's work in the map-area (Boissonneau 1966, 1968), with additional radiometric data.

Glacial History

A few scattered glacial striae trend at right angles to the dominant southerly trend, particularly in the area just to the north of the map-area. They are earlier than the southerly set (based on crosscutting relationships) and were thought by Boissonneau (1966, p.567) to represent a glaciation before the late or classical Wisconsin advance. There is, however, no till which can be correlated with this earlier Quaternary glaciation.

During late Wisconsin time, another glacial advance moved in a southerly direction, as indicated by striae and chatter marks. This sheet commenced retreating at a later date, and its front reached the southern boundary of the map-area between 10,700 and 11,500 years B.P.[1] (Prest 1969). This position is marked by the Cartier I recessional moraine, remnants of which closely follow the southern boundary of the map-area in Monestime[2], Landriault[3], and Lefebvre[4] Townships. At this stage the deltaic deposits from the glacial Mississagi River would have been accumulated south of the map-area. The glacier continued to retreat, leaving in its wake the Cartier II moraine belt which consists of an east-trending series of elongated moraine remnants extending from Timbrell Township[5] on the west through to Foucault Township[6]. North of this are traces of the Cartier III moraine in Assad Township[7] and of the Obatika Lake moraine in Parrott Township[8].

The continued northward withdrawal of the Cartier II ice front was probably marked by low water levels in the post-Algonquin lake (Boissonneau 1968, p.106). When the Mattawa outlet opened during this time, Lake Barlow-Ojibway became independent of the lake in the Upper Great Lakes basin. The ice front continued retreating northward to the Chapleau I position, at which time glacial Lake Sultan (see Figure 17), postulated by Boissonneau (1968, p.100,107), existed for a short period of time, presumably, before the formation of Lake Barlow-Ojibway within the map-area. The outlet for this lake was the Wenebegon spillway along the present-day Wenebegon and Mississagi Rivers. Lake Sultan was partially overridden by a local re-advance of the ice-front. This is indicated by minor moraines overlying Lake Sultan lacustrine deposits. This re-advance formed the Chapleau II moraines in Daoust[9], Nimitz, de Gaulle, Edith, and Arbutus Townships and eventually the Chapleau III moraine, poorly preserved to the east just outside the map-area. Patches of moraine in Whigham, Ivanhoe,

[1] B.P. is "Before Present", using year 1950 as a datum.
[2] Formerly Township J.
[3] Formerly Township R.
[4] Formerly Township N.
[5] Formerly Township 3F.
[6] Formerly Township K.
[7] Formerly Township T.
[8] Formerly Township Y.
[9] Formerly Township 28.

and Pinogami Townships probably represent further retreat of this ice sheet. Patches of outwash in Winget and Rennie Townships are thought to represent the ice position during a post-Minong stage of the Lake Superior basin (Boissonneau 1966, p.568). Zoltai and Herrington (1966) reported an age of 9380 ± 150 years B.P. for the post-Minong stage of Lake Superior.

After the ice sheet had retreated north of the present map-area, Lake Barlow-Ojibway expanded into the map-area, dammed up by the high topography to the south and the margin of the ice sheet to the north. The maximum extent of the lake within the map-area is indicated on Figure 17. Boissonneau (1966) indicated that this maximum extent would correspond to a high water level at the outlet of about 800 feet (250 m) before isostatic adjustment. According to Prest (1970, p.721) Lake Barlow-Ojibway first inundated parts of the map-area about 9500 years B.P., and overflowed into a southeastern spillway on the site of the present-day Lake Temiskaming. As the ice front retreated northward, so did the lake, passing out of the map-area *circa* 8700 years B.P.

Prest (1969) indicated an approximate age of 9500 years B.P. for the probable ice front position while Lake Barlow-Ojibway existed. Antevs (1953) indicated that Lake Barlow-Ojibway was not present in the map-area before the Cochrane readvance which has a minimum age of 6380 ± 350 years B.P. (Karlstrom 1956, p.314). More recent data presented by Prest (1970, p.723) indicated that the Cochrane I advance occurred at about 8200 years B.P., certainly before the draining of Lake Ojibway II.

The Cochrane I advance produced southeast-trending striae, drumlins, and eskers in the northern part of the map-area. This advance left two terminal moraine remnants in the northern part of the map-area in Lisgar, Griffin, Slack, Fenton, and Seaton Townships.

Most of the ice of the Cochrane I advance essentially melted in place, leaving a large ice block in the northern part of the map-area. This ice block preserved some of the southeast-trending striae, eskers, and drumlins during the Cochrane II advance, but east and north of this area, southwest-trending striae, eskers, and drumlins marking the second Cochrane advance, partially obliterated the southeast-trending set (see Boissonneau 1966, p.563, 575). This second advance at its maximum extent reached a position just within the northeast corner of the map-area. The time gap between the two Cochrane advances was probably minimal in order for the ice block, referred to above, to remain.

The second phase of the Cochrane advance almost completely overrode Lake Ojibway and is dated by Prest (1970, p.724) as *circa* 8100 years B.P.

Direction of Ice Movement

Orientation of eskers, drumlins, and glacial striae are the principal means of determining direction of ice movement. The generalized compilation of this data presented in Figure 17 indicates that in the northern part of the map-area movement of the main, late Wisconsin ice sheet was almost due south. Boissonneau (1966, p.563, 567) reported a few older southeast-trending striae in areas not overridden by the Cochrane advance. These lie north of the present map-area. Other divergences in striae directions (e.g. those trending southeast in the Missi-

naibi Lake area) are probably local topographically induced features. The southerly trend in ice movement directional features persists in the southern part of the map-region, with minor deviations east of Sultan in the Biskotasi Lake area. This trend represents the advance of the Laurentide ice sheet during the late Wisconsin.

In the north-central part of the map-area, glacial striae and drumlins are oriented in a southeasterly direction. This area includes parts of the following townships north of the lacustrine deposits of Lake Barlow-Ojibway: Cromlech, Usnac, Oscar, Concobar, Radisson, and Allenby. These features, which crosscut and post-date those mentioned above, are suggested by Boissonneau (1966, p.575) to be the result of the Cochrane I advance.

Glacial Deposits

MORAINES

Moraines representing the main phases of glaciation are not found north of Latitude 48°N. South of this latitude, in the western part of the map-region, two wave-washed patches of sand and gravel in Rennie and Winget Townships represent outwash deposits formed during the Post-Minong stage of deglaciation. Scattered, generally east-trending moraine deposits marking the Chapleau I and II and the Cartier I, II, and III phases are found in the southern part of the map-area. Most of these moraines have minor fan-shaped areas of outwash associated with them, extending southward up to ½ mile (0.8 km).

The moraines consist of elongate ridges of bouldery till, with heights of about 100 to 150 feet (30 to 45 m) and widths of ½ to 1 mile (0.8 to 1.6 km); one section of the Chapleau I moraine in Dore, Coppell, and Garnet Townships is about 8 miles (13 km) wide. The Chapleau I moraine is not a particularly conspicuous topographic feature. Where it traverses the Swayze-Deloro metavolcanic-metasedimentary belt, it is often found as a broad plain of cobble- and boulder-filled sandy till no more than 30 to 75 feet (9 to 23 m) high. None of the moraines in the southern part of the area form high ridges, i.e. all are under 100 feet (30 m) for the most part. The moraines of the Chapleau I phase have been overridden and those of the Chapleau II phase show evidence of reworking by lake action (Boissonneau 1968, p.101).

DRUMLINS

Drumlins are found scattered over the northern part of the map-area as low (50 to 75 feet or 15 to 23 m) elongated hills of sandy till, 1,000 to 2,000 feet (300 to 600 m) long by 200 to 300 feet (60 to 90 m) wide, oriented in a southeasterly direction. These features are extremely scarce south of the lacustrine deposits of Lake Barlow-Ojibway.

Glaciofluvial Deposits

ESKERS

These are depositional features of proglacial and subglacial streams active during the recession of the ice sheet. Not all eskers have been plotted on Figure 17; only those forming major systems are shown.

A fairly extensive but somewhat discontinuous esker extends southwards from the eastern end of Missinaibi Lake to Busby Township. A major esker that rises up to 100 feet (30 m) above the surrounding area extends from north of Ivanhoe Lake to central Silk Township. A major esker complex extends from McGee Township north of Westover Lake down the east side of Borden Lake to its southern end (Boissonneau 1965b). Further information is to be found on Boissonneau's maps (1965a, 1965b). In general it can be stated that the eskers are dominantly sand with occasional gravel beds which make good road building material.

Glaciolacustrine Deposits

VARVED CLAY, CLAY, SAND, AND SILT

These deposits are particularly well exposed along the valleys of the Groundhog, Ivanhoe, and Kapuskasing Rivers. Banks up to 20 or 30 feet high are commonly observed in the area once covered by Lake Barlow-Ojibway, which includes the above rivers and the shores of Brunswick Lake and the Missinaibi River. They consist typically of clay and silt beds up to ½ inch (1.2 cm) thick. Exposures were not examined in detail.

Silt and sand are more abundant than clay in the Lake Barlow-Ojibway deposits which lie in the northwestern part of the map-area. Extensive sand deposits with very little coarse material are seen along the Canadian National railway between Fire River and Minnipuka, and in the area south of Peterbell. A flat and extensive sand plain of unknown thickness occurs northwest of Shawmere Lake and extends northward across the Canadian National railway to the Oates Lake area

Lake Sultan appears to have deposited mostly sandy material in the central part of the map-area. Exposures of this material are abundant along the Woman River where it crosses the Canadian Pacific railway, along the shore of Wakami Lake and in the vicinity of Five Mile Lake Provincial Park. The material appears to consist of fine sand with little if any coarse detritus or clay.

Spillways

The channels through which proglacial Lake Sultan debouched into Lake Huron, i.e. glacial Lake Stanley (Prest 1970, p.721), formed the only major spillway within the map-area. It consists of a broad (up to 2 miles or 3 km) dissected plain of mixed sand, gravel, and boulders, extending from the Kebskwasheshi Lake area southward to a point east of Rocky Island Lake, where it turns sharply westward to enter the Mississagi River valley, at which point it resumes its southerly course. Boissonneau (1968, p.102) has termed this the Wenebegon spillway. Its upper reaches at an approximate elevation of 1,800 feet (550 m), mark the height of the highest water level of Lake Sultan. Within the map-area the spillway descends from 1,800 feet (550 m) to 1,400 feet (425 m) near the Cartier II moraine, on its course toward glacial Lake Stanley (Boissonneau 1968, p.102).

STRUCTURAL GEOLOGY

Foliation, Schistosity, and Gneissosity

The rocks of the metavolcanic-metasedimentary belts generally have foliation parallel or at a low angle to bedding, flow banding, or compositional banding in iron formation. The foliation is defined by the planar orientation of platy or acicular minerals such as biotite, chlorite, white mica, and amphibole, and by flattening of clasts, pyroclastic fragments, or clots of mafic minerals. Foliation is poorly developed in scattered areas toward the centre of the metavolcanic-metasedimentary belts such as Coppell, Newton, and southern Horwood Townships. Foliation is not always discernable in the early mafic and ultramafic rocks, Milne (1969, p.56) reported that a foliation in the early gabbro of the Reeves-Kenogaming area is well developed only immediately adjacent to the contacts with granitic rocks. The ultramafic rocks in the same area show mineralogical layering and banding which consists of alternate layers of "honeycomb" and "pine needle texture" (currently referred to as "spinifex" texture) serpentinite, which according to Eckstrand (1972) and Pyke *et al.* (1973), are probably primary features due to quenching.

Foliation and (or) gneissosity is present in the migmatitic and granitic rocks. Certainly in the southern part of the map-area, where the quartz monzonitic rocks are of magmatic origin and are uncontaminated, the foliation observed towards the edges of "zones" (see section "Felsic Intrusive Rocks") is probably a variety of primary flow structure. Planar structures in migmatitic rocks consist of *lit-par-lit* banding or gneissosity, developed particularly in metasedimentary migmatites. In many places, for example in the Biscotasing area, the foliation in the migmatitic rocks appears to follow with some degree of fidelity the primary lithologic banding of the more weakly metamorphosed volcanic and sedimentary rocks.

Planar structure in rocks of the Kapuskasing Structural Zone consists largely of gneissosity defined by small to major differences in the mineralogical

composition of individual bands on a scale ranging from ½ inch (1 cm) to 2 or 3 feet (0.6 or 0.9 m). In the garnetiferous metasediments (map-unit *7c*) of the Kapuskasing Structural Zone, individual bands 6 to 12 inches (15 to 30 cm) thick may contain up to 10 percent garnet, whereas adjacent bands of approximately equal thickness may be free of garnet. Gneissosity is defined on a less dramatic scale in map-unit *7b* "melanocratic granulites". In this map-unit, flaser-like elongated blebs of granulated plagioclase and trains of garnet grains define a gneissosity which is, in turn, emphasized by the elongate nature of the mafic minerals. It is not possible to determine whether the gneissosity in rocks of the Kapuskasing Structural Zone parallels or is at some angle to original compositional banding, except perhaps for the pelitic and psammitic granulites, in which gneissosity may parallel original compositional banding or bedding.

Within the Shawmere anorthosite complex, both primary mineralogical layering and later metamorphic foliation can be discerned. In the central part of the complex west of the Goose Range fire-tower, flattened mafic clots can be seen in places to parallel mineralogical banding (defined on the basis of 6-inch (15 cm) to 3-foot (0.9 m) mafic-rich and mafic-poor bands), and in other places to cut this banding at a low angle (up to 20 degrees). On the Goose Range fire-tower road an outcrop of anorthositic gabbro shows a clear example of 6-inch (15 cm) to 1-foot (30 cm) bands of mafic-rich material being cut by a foliation, defined by the elongation of amphibole grains at nearly 30 degrees to the primary layering. Foliation, definitely metamorphic in origin, is found fairly commonly in the tonalitic rocks which border the main anorthosite body on the east, i.e. along the Foley-et-Chapleau highway.

Schistosity is found occasionally in the more weakly metamorphosed volcanic and sedimentary rocks of the map-area, for example in the Opeepeesway Lake area, where slaty cleavage is common in the argillitic rocks.

Lineation

Secondary lineations are relatively common in the metavolcanic-metasedimentary belts of the map-area. In general, secondary lineations consist of elongated clasts in detrital rocks, elongated pyroclastic fragments, small scale crenulations, parasitic fold axes, elongated mafic minerals in the metavolcanic-metasedimentary blebs, and elongated blebs in the granulitic gneisses.

Lineations plunge steeply in the eastern part of the Swayze-Deloro belt (Heenan and Marion Townships) but a shallower plunge (20 to 60 degrees) is common further west in the belt (Halcrow-Ridout Lakes area). Shallow-plunging lineations are present in the Kapuskasing Structural Zone. West of the Structural Zone lineations in the Wawa Subprovince generally plunge at angles greater than 60 degrees (Riley 1971, p.31).

Joints

Joints are present throughout the map-area, forming a prominent feature of the massive granitic rocks. The major sets in the southern part of the map-area,

i.e., south of the Kapuskasing Structural Zone, trend northeast and NNW to northwest, and some subhorizontal jointing is present. Within the Structural Zone jointing is not as well developed but in general trends in about the same directions, and perhaps the subhorizontal set is more strongly developed.

North of the Kapuskasing Structural Zone, joint trends remain much the same although both major sets have a slightly more northerly trend. Joints served as the locus of intrusion of the diabase dikes and major sets are indicated by dike trends and spacing. Joint planes have localized late stage hydrothermal mineralization consisting of quartz, quartz-carbonate, hematite, and epidote veins. In addition, pegmatite bodies in the granitic rocks, particularly in the southern part of the region, are localized by joints. Jointing provided a channelway for the intrusion of alkalic dikes (not described in "General Geology") in the southern part of the anorthosite in Chewett Township, and for minor dikes associated directly with the carbonatite-alkalic complexes, particularly at Nemegosenda Lake and Lackner Lake. Throughout the Kapuskasing Structural Zone and for a considerable distance on either side, jointing appears to have controlled the emplacement of lamprophyric dikes of uncertain age.

Faulting and Shearing

Becuase of irregular, poorly distributed outcrop throughout most of the map-area it is difficult to define faulting with any degree of certainity other than on a large scale.

Criteria used for evidence of faulting are as follows:

(i) air-photo and topographic lineaments;
(ii) aeromagnetic lineaments;
(iii) presence of shearing, brecciation or ultramylonites;
(iv) structural offset or discontinuity in layered rocks, in particular, sudden changes in attitude;
(v) abrupt discontinuities in metamorphic grade;
(vi) presence of zones of hydrothermal alteration, e.g. carbonatization, hematitization, etc.

Strike-slip faults exist in the map-area but evidence for these is only revealed by detailed mapping, because the only sign of movement is usually the presence of shear zones of relatively limited extent. The principal example of this type of movement in the Swayze-Deloro metavolcanic-metasedimentary belt is an east-trending shear zone along the north shore of Ridout Lake in Greenlaw Township (Donovan 1968, p.30).

East- to ENE-striking faults are prominent in the Reeves-Kenogaming Townships area (Milne 1972, p.58) where several strike-slip faults have been mapped. An equivalent level of detail in mapping should reveal many more strike-slip faults elsewhere in the map-area.

Major NNW- to northwest-striking faults are conspicuous in the metavolcanic-metasedimentary belts. In the Swayze-Deloro belt, this faulting is indicated by abrupt discontinuities in the felsic metavolcanic unit in Swayze Township and the major metasedimentary unit in Cunningham Township. This fault extends from central Fawn Township northwestwards nearly to Rollo Lake in

Rollo Township, a distance of 16 miles (26 km). A part of this fault is described by Donovan (1965d, p.17) as follows:

> The fault is characterized by highly sheared volcanic rocks in zones up to 200 feet [60 m] wide. Within the shear zones the acid volcanic rocks have been altered to sericite-quartz-feldspar schists while the intermediate to basic volcanic rocks have been altered to chlorite-hornblende-feldspar schists. The fault has left-lateral mevement, and fault displacement ranges from 500 feet [150 m] to ½ mile [800 m].

Faults with similar strike and displacement are found to the east in Dore Township, and at Crossley Lake and to the west of the lake. Several northwest-trending faults are located in the area of Greenlaw, Cunningham, and Garnet Townships. Northwest-trending faults are important in the Missinaibi Lake area where Riley (1971, p.33) indicated several major faults with this trend.

Within the Swayze-Deloro belt, faults having a northwest-trend become quite rare to the north. Here the dominant trend is NNE but displacements are at most a few hundred feet. Along the southern fringe of the Swayze-Deloro belt, faults varying in length from 9 miles (14 km) to only a few thousand feet are found offsetting the metasedimentary unit which constitutes the best horizon marker. In Esther Township, the metavolcanic-granite contact is offset about 2,500 feet (760 m) by a northeast-trending fault which extends about 4 miles (6 km) northwards from the contact.

Large scale faulting associated with the horst of high-grade metamorphic rocks along the Kapuskasing Structural Zone is a most prominent feature of the map-area. The western boundary of the Structural Zone is assumed to be a fault almost solely on the basis of the abrupt change in aeromagnetic expression from known granulite facies rocks in the Structural Zone to the granitic rocks to the west, e.g. see aeromagnetic map 2266G (ODM-GSC 1963). This fault extends about 44 miles (71 km) from the northern boundary of the map-area in Slack Township (see Map 2351, back pocket) to Lisgar Township where it is shifted south by a north-striking fault. From here it continues on for 15 miles (24 km) to Lougheed Township where it is shifted north 2 miles (3 km) to the northeast corner of Kapuskasing Township from whence it continues southwest to Lipsett Township. From this point it continues 28 miles (45 km) to the southwest. Similarly the east side of the Structural Zone is fault-bounded from Stringer Township at the north boundary of the map-area southwestward to Oates Township, where the fault appears to bound, not the granulitic rocks, but the Shawmere anorthosite complex. The southern end of this fault is difficult to define owing to poor exposure. For most of its length, where exposed, it is marked by an ultramylonite zone up to 20 or 30 feet (6 or 9 m) wide, and evidence of extensive shearing and recrystallization is found in the adjacent anorthosite suite rocks. The fault passes through Pinogami and Hellyer Townships, eventually splaying out into a series of southwest-striking faults, which terminate the Swayze-Deloro belt at its western end and which possibly controlled the emplacement of granitic rocks in the upper Ivanhoe River valley (Crockett and Raney Townships). An extension of this fault system takes on an approximately ENE-strike in Lackner Township and continues for 30 miles (50 km) to the eastern boundary of Dalmas Township.

Movement on this fault system is interpreted to have been largely vertical, based solely on the abrupt change in metamorphic grade from lower and middle

greenschist facies in the metavolcanic-metasedimentary belts to granulite facies in the Kapuskasing Structural Zone. A rough estimate of the vertical movement would be on the order of several thousand feet.

Several ages of faulting can be deduced from the available evidence, which is essentially the trend of aeromagnetic anomalies associated with diabase dikes, which are fault- and joint-controlled. Displacement of major dikes can readily be observed on the aeromagnetic map (see Figure 3) of the map-area. Dividing the map-area along the Kapuskasing Structural Zone, two patterns emerge:

i) north of the Structural Zone, the northeast-trending joints are displaced by movement along NNW-trending faults;

ii) south of the Structural Zone, northeast-trending dikes are cut and displaced by dikes along northwest-trending faults.

Southwest-striking major fault zones bounding the Structural Zone have been previously described. They predate a northeast-striking fault which cuts the Structural Zone in Lincoln Township, continuing southwest to Gallagher Township. This fault bears an unknown age relationship to a northwest-striking fault which passes through McGee Township to Clifton Township and which intersects and offsets the the fault zone bounding the north side of the Kapuskasing Structural Zone.

Cataclastic Rocks

Cataclastic textures in rocks of the Kapuskasing Structural Zone have been referred to earlier in this report. In addition, textures indicative of cataclasis are commonly found along the eastern margin of the Kapuskasing Structural Zone in granitic rocks and anorthosite suite rocks. Mylonitized zones up to 30 feet (9 m) wide are found along Highway 101; mylonite zones were also reported in Belford Township (Bennett 1969, p.10, 11), as well as to the north of the map-area (Bennett *et al.* 1967). The zones along Highway 101 consist of 15- to 20-foot (4.5 to 6 m) wide areas of mylonitized rock in which dark, cherty- or flinty-looking aphanitic material occurs as streaks, dikelets, or delicate coatings around individual grains or cementing individual grains. In Foleyet Township, along the Goose Range fire-tower road, a dike of this cherty rock was found (Photos 23, 24) cutting the foliation of flaser-textured tonalitic rocks of the anorthosite suite at an angle of about 40 degrees.

Thin section (Photo 25) examination disclosed that the cherty rock consists of angular grains, somewhat corroded along grain boundaries; these grains of severely strained feldspar and occasionally quartz, constitute up to 20 percent of the rock, and are suspended in what appears to be a devitrified glass now composed of small granules of epidote and thin needles of opaque iron oxide (magnetite?) in albite plagioclase. The feldspar grains or fragments form about 90 percent of the fragmental material and are usually larger than those of quartz. The feldspar shows irregular extinction, bent twin lamallae and on occasion corroded and embayed outlines. The quartz displays very irregular extinction.

In his review of the pseudotachylite problem, Philpotts (1964) concluded that although many varieties of mylonitized rocks might have similar textures



ODM9445

Photo 23–Closeup of ultramylonite veinlet cutting tonalite. Note sharpness of contact. Goose Range fire tower road, Foleyet Township.



ODM9446

Photo 24–Closeup of fragments of feldspar in ultramylonite matrix.

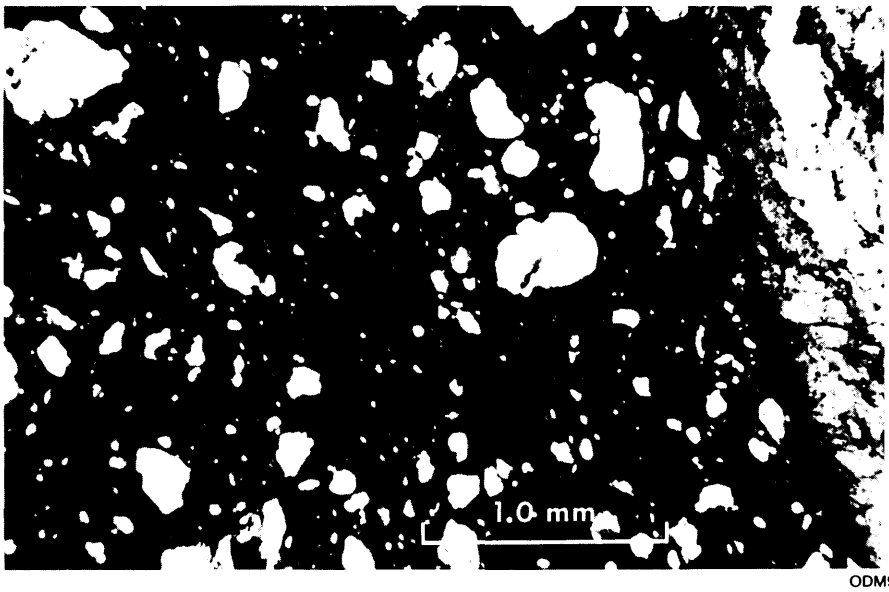


Photo 25–Photomicrograph of ultramylonite under crossed nicols. Tonalite is to the right. Most fragments here are feldspar, in a very fine grained matrix.

and structures, the presence of fusion products e.g. glass, was essential to the definition of pseudotachylite. Ermanovics *et al.* (1972, p.257), in view of the difficulty involved in establishing whether glass is present in hand specimens, defined pseudotachylite as follows: "...the term pseudotachylite as used in this report includes veins of crushed rock some of which contain glass."

As the unequivocal presence of (devitrified) glass was not observed in this area, the veins or dikelets described above are perhaps best referred to as ultramylonite.

The reaction rims around the fragments, a phenomenon discussed by Ermanovics *et al.* (1972, p.259), is thought to be marked in these devitrified examples by slight variations in the relative amounts of epidote and magnetite forming the matrix. It is not possible to postulate any sort of chemical variation within the veins.

The veins of ultramylonite are widespread in their occurrence along the Kapuskasing Structural Zone. Bennett *et al.* (1967) described examples in the Operation Kapuskasing map-area. McMurchy (1960) described "diabase" occurrences that could be ultramylonite, in Griffin Township, 3.2 miles (5.1 km) south of Griffin Lake in granulite facies rocks of his "granite complex". Bennett (1969, p.11) described similar occurrences of ultramylonite which resemble chilled diabase in the Belford-Strachan Townships area.

The west side of the Kapuskasing Structural Zone does not appear to be as well marked by cataclasis as the east side.

Folding

Doubly plunging isoclinal folds with moderate to steep plunges are characteristic of the metavolcanic-metasedimentary belts. Some of the folds are more open than others, e.g. the anticline passing through Heenan, Marion, and Dore Townships, but the majority are tight isoclinal folds. Steeply plunging, closely-spaced folds occur in the northern part of the Swayze-Deloro metavolcanic-metasedimentary belt in Keith and Muskego Townships (Prest 1950, p.26-28). Breaks (1973, p.70) stated that the folds to the south, in Horwood Township, are open and gently plunging, reflecting a change in structural style.

In the central part of the belt, an anticlinal axis extends ENE from Coppell Township through to the Great Pike Lake area in Horwood Township. This feature is defined primarily by pillow top determinations. The secondary lineations indicate a 20 degree westward plunge. South of this anticline lies the major fold of the belt, a syncline defined by primary structures in metavolcanics and metasediments such as pillows, graded bedding, and cross bedding. At its west end the syncline is overturned; the north limb dips vertically or steeply north (Donovan 1968, p.24), and the south limb dips north at 60 to 90 degrees. It appears that the fold is doubly plunging, at angles of 30 to 50 degrees west in the Halcrow-Denyes Townships area. The plunge steepens radically at the western edge of the belt, possibly reflecting the diapiric nature of the granite intrusions in the Ivanhoe River valley. In the southern part of the belt, a cross-folded anticline named the Woman River anticline (Goodwin 1965, p.32), extends from Cunningham Township eastward to Marion Township. The facing data is based on grain gradations and pillow top determinations, chiefly in Marion Township. According to Goodwin (1965, p.33), the fold plunges nearly vertically. In the Opeepeesway Lake area, a major synclinal structure extends from Benton Township eastwards beyond the eastern boundary of the map-area. The trace of the axial plane follows approximately the middle of the metasedimentary unit which passes through Osway Township. Reliable top determinations are found only on the south limb of the fold and they indicate tops to the north. Moorhouse (1949, p.13) suggested that the fold plunges east at some unspecified angle; the authors suggest a shallow plunge because of the great size of the structure.

In the Fenton-Seaton Townships area along the north boundary of the map-area, the metavolcanics appear to be folded about a south-plunging, slightly overturned synclinal axis. A syncline is indicated by the stratigraphic repetition of iron formation and an east-facing pillow.

The metavolcanics in the Rennie Township area are folded about an anticlinal axis, possibly plunging east as indicated mainly by the attitudes of pillows. South of Rennie Township, in the Lang Township area, neither the authors nor Bennett (1971, p.54) were able to postulate a definitive model for the folding of the metavolcanics.

Several ages of folding are present in the map-region and they can be categorized as follows in order of age:

*(i)*isoclinal, upright to slightly overturned, closely spaced folds generally following the main east to northeast stratigraphic trends;

(ii) a later series of cross-folds which deflected the trace of the axial plane of the folds in *(i)*;

(iii) some warping of the above, brought about by the diapiric mode of intrusion of post-tectonic granitic rocks.

Examples of type *(ii)* are found in the northern and central part of the Swayze-Deloro belt, where axial traces are generally concave northward. In Horwood Township, Breaks (1973, p.70,71) suggested that this type of folding could have been brought about by compression from the southeast and northwest due to the forceful mode of intrusion of the granitic rocks on either side of the metavolcanic-metasedimentary belt. The intrusion of the batholith centred in Edith and Fawn Townships, the inclusion-rich zone of which is exposed, was possibly the cause of the type *(iii)* arching of the axial trace of the Woman River anticline and its flanking folds. Compression from the batholith to the west of the Swayze-Deloro belt could also have been a factor in the arching, but the arching is perhaps allied with event *(iii)* rather than *(ii)* because the arching of the major folds is apparently quite late, based on the fact that the post-tectonic granites appear to intrude the older granitic rocks.

AGE OF THE KAPUSKASING STRUCTURAL ZONE

The fault zones bounding the Kapuskasing Structural Zone appear to separate two structurally distinct areas which have slightly different joint and fault trends: the difference in trends may indicate a possible clockwise rotation of the crustal block north of the Structural Zone with respect to the crustal block south of the Structural Zone.

Another characteristic of the Structural Zone is the rarity of diabase dikes. The single outcrop identified as diabase in the northern part of the map-area, within the Structural Zone, by McMurchy in Griffin Township (1960, Map 1960a), may be a mylonitic rock of some sort. Although this outcrop was not examined during the present mapping survey, the authors believe that this rock is ultramylonite rather than diabase on the basis of the following evidence: (i) if the rock is diabase with the northerly trend shown (McMurchy 1960), it should belong to the Matachewan swarm (set 5) which typically has a glomeroporphyritic habit, but this was not observed by McMurchy; (ii) if the rock is diabase, more outcrops of diabase dikes, which are relatively resistant to erosion, with the same trend and habit should be found in the map-area; (iii) if the "diabase" belongs to the NNW-trending Mackenzie III swarm (set 1), the trend is sufficiently oblique to the Structural Zone that it should have an aeromagnetic expression, which is not present.

It is therefore tentatively suggested that possible rotation of the crustal blocks on either side of the Kapuskasing Structural Zone post-dated the intrusion of the Matachewan diabase dikes within the map-area, and that upthrusting of the high-grade metamorphic rocks of the Structural Zone also probably post-dates Matachewan diabase dikes which have been dated by Rb-Sr methods at 2690 ± 93 m.y. (Gates 1971, p.36). However, representatives (too small to show on the map) of the Abitibi diabase dike swarm (set 3) dated by Rb-Sr methods at 2147 ± 68 m.y., cut rocks of the Structural Zone, thereby defining a minimum age for the upthrusting event.

Igneous activity along the Zone was continuous over the interval 1740 m.y.

to 128 m.y.; these radiometric ages represent the intrusion into the Zone of the Cargill carbonatite-alkalic complex (Gittins *et al.* 1967) and a lamprophyre dike at Coral Rapids (Wanless *et al.* 1973, p.60) respectively; both of these intrusions are north of the map-area.

ECONOMIC GEOLOGY

Summary Statement

Economic interest in the map-area has included investigations for gold, iron, asbestos, niobium, and base metals. Prospecting has been largely concentrated in the Swayze-Deloro and Michipicoten metavolcanic-metasedimentary belts. Occurrences of iron, copper, asbestos, gold, lead, zinc, molybdenum, antimony, uranium, niobium, and rare earths are known to occur within the map-area.

Initial mineral exploration for iron in the region was conducted prior to 1910. This early activity was concentrated in Heenan, Marion, and Genoa Townships along the Woman River Iron Range and was done by the C.K. Leith interests and the Jefferson Mining Corporation. This activity failed to indicate an iron deposit of economic importance, but some base-metal mineralization was uncovered along the eastern extremity of the Woman River Iron Formation. Exploration for iron along this belt remained dormant until the early 1960s when Stackpool Mining Company Limited investigated the economic potential of the iron occurrences by diamond drilling. Investigations by Stackpool Mining Company Limited in the 1960s and earlier observations by Moore in 1926, indicated about 5,000,000 tons of concentrating ore grading nearly 40 percent iron (Goodwin 1965, p.39; Moore 1926, p.91)

The Woman River Iron Formation consists of banded chert, magnetite, pyrite, pyrrhotite, and siderite. Oxide-facies iron formation predominates in the west and sulphide facies iron formation predominates to the east.

Iron deposits along the Groundhog River in Keith and Penhorwood Townships were known from work in the early part of this century, but investigations of these deposits were not undertaken until the late 1950s and early 1960s when Kukatush Mining Corporation (Ontario) Limited undertook considerable diamond drilling and trenching of the Radio Hill iron formation. The Radio Hill iron formation consists of banded chert, magnetite, carbonate, iron silicates, pyrite, and pyrrhotite bounded by graphitic-pyritic slates and is associated with felsic metavolcanics of the greenschist facies. The iron formation occurs between pyroclastic metavolcanics and highly carbonatized, altered ultramafic rock (Milne 1972, p.20). Exploration by Kukatush Mining Corporation (Ontario) Limited has indicated approximately 158,000,000 tons of magnetic iron ore grading 27.8 percent acid-soluble iron which can be concentrated to 67 percent iron (Canadian Mines Handbook 1970-1971, p.205; Milne 1972, p.99).

During the 1930s and then again after World War II and into the early 1950s a great deal of prospecting energy was expended looking for economic gold deposits. This activity resulted in substantial production from the Renabie mine and the Jerome mine, minor production from the Tionaga mine and the Hal-

crow-Swayze mine, and the development of a zone of large, low grade tonnage potential at the Nudulama Mines Limited property.

The Renabie mine located in Leeson Township ceased operations during the summer of 1970 after a productive life of 23 years. The Renabie ore consisted of gold-bearing quartz which was mined from veins, chimneys, and lenticular bodies within the marginal zone of a large granite batholith (Frohberg 1948, p.1). Mining operations reached a depth of 3,455 feet (1053 m) with development on 20 levels. Reserves as of December 31, 1968 were 157,704 tons grading 0.211 ounces per ton (Canadian Mines Handbook, 1969-1970, p.304).

The Jerome mine in Osway Township produced 56,878 ounces of gold and 15,104 ounces of silver from 335,060 tons of ore before operations were terminated in 1945 (Brown 1948, p.438). The Jerome orebody consists of a vein zone lying along the contact between metasediments and a feldspar porphyry. The vein structure is curvilinear and dips steeply north (Moorhouse 1949, p.18-22). The Jerome mine was developed by a shaft 1,138 feet (347 m) deep with six levels (files, Mineral Resources Branch, Department of Energy, Mines and Resources, Canada). Reserves are estimated at 345,000 tons grading 0.19 ounces gold per ton after dilution (Moorhouse 1949, p. 22).

Nudulama Mines Limited, formerly Ladulama Gold Mines Limited, formerly Dulama Gold Mines Limited has done extensive development work on their gold prospect in Leeson Township. The deposit outlined on this property is an extension of the Renabie ore zone and has been developed by a shaft 1,065 feet (324 m) deep with seven levels. The property has been maintained in good standing by the company since underground operations terminated in 1951. Proven reserves are 579,325 tons grading 0.194 ounces per ton, and 1,000,000 tons are suggested (files, Mineral Resources Branch, Department of Energy, Mines and Resources, Canada).

Asbestos fibre in commercial quantity occurs in Reeves Township and at the time of writing was being mined by Canadian Johns Manville Company Limited. The asbestos mineralization occupies a wedge shaped area 2,100 feet (640 m) long and varying in width from 750 feet (230 m) on the west to about 200 feet (60 m) on the east (Milne 1972, p.68). The host rock is a serpentinized ultramafic body whose composition was originally dunitic to peridotitic (Milne 1972, p.69). As of 1967, ore reserves were estimated to be 20 million tons, with a total fibre content of between 3 and 3.5 percent (Milne 1972, p.68). The mining plant is designed to handle 5,000 tons of ore per day but has been running at a rate of 4,000 tons per day (Canadian Mines Handbook 1969-1970, p.71).

Within the map-area five carbonatite-alkalic complexes are known, or thought to exist. Of these five complexes, two have possible economic potential.

In the late 1950s the Dominion Gulf Company explored a niobium-bearing zone of the Nemegosenda Lake carbonatite-alkalic complex in Chewett, McGee, Pattinson, and Collins Townships. Parsons indicated, by his mapping and from work performed by Dominion Gulf Company, that a nearly circular pyrochlore-bearing body of malignite and malignite breccia occurs between red alkalic fenite and syenite breccia in the northeast corner of the complex (Parsons 1961, Map 2007). This body has been explored by diamond drilling and a 580-foot (177 m) adit, and represents a potential ore zone of 20,000,000 tons grading 0.47 percent Nb_2O_5 (Parsons 1961, p.46). By-product production of uranium, thorium, rare earth, zirconium, apatite, and magnetite may be possible from this deposit (Par-

sons 1961, p.46).

In Lackner and McNaught Townships Multi-Minerals Limited did extensive diamond drilling in the late 1950s on the Lackner Lake carbonatite-alkalic complex for iron, apatite, niobium, rare earths, and thorium. Three zones of potential economic interest were partially delineated. Development work on the property has indicated 5,000,000 tons of titaniferous magnetite-apatite-rare earth ore available for open pit mining in the Number 6 zone, averaging 70 percent titaniferous magnetite and 22 percent apatite (Parsons 1961, p.63). Additional tonnages are indicated in other zones.

Even though base metal production has not occured within the region, several interesting base metal occurrences are known. Consolidated Shunsby Mines Limited has a copper-zinc prospect in brecciated cherty iron formation in Cunningham Township. Diamond drilling by Consolidated Shunsby Mines Limited indicated a zone of 310,095 tons grading 1.2 percent copper and 1.3 percent zinc (F.R. Joubin[1] 1970, personal communication). Westfield Minerals Limited has evaluated a zinc-silver prospect in a shear zone cutting pyroclastic metavolcanics in Rennie Township. Work by Westfield Minerals Limited has indicated a 350-foot (107 m) section grading 14.8 percent zinc and 10.6 ounces silver per ton over a width of 4.3 feet (1.3 m) (Riley 1971, p.49).

Exploration activity in the summer of 1970 by Parr Mines Limited initiated a staking rush in the Rush Lake area, Genoa and Marion Townships, after the announcement of the discovery (The Northern Miner, July 23, 1970, p.1) of disseminated chalcopyrite mineralization in a quartz-bearing diorite in association with sheared mafic inclusions. Also near the close of the 1970 field season prospectors uncovered a copper occurrence in Muskego Township which was subsequently optioned to Kam-Kotia Mines Limited (The Northern Miner, Sept. 10, 1970, p.1). United Macfie Mines Limited, 43.5 percent owned by Kam-Kotia Mines Limited, was reported to be undertaking a drilling program on the Muskego Township showing (The Northern Miner, Nov. 26, 1970, p.107).

Texore Mines Limited, Royal Agassiz Mines Limited with Gold Hawk Exploration Limited, and Noranda Mines Limited, also made copper discoveries in Marion Township (The Northern Miner, October 8, 1970; March 11, 1971).

Description of Mineral Deposits and Exploration Activity

The map-area has been prospected for over 60 years and much information has been recorded. Approximately 400 documents, comprising assessment files, government reports and maps, were collected and examined by the authors. The large volume of information examined prevented in-depth studies of properties, and resulted in the omission of several mineral deposits which could not be quickly located, and prevented tracing the complex histories of deposits which had been investigated by several companies.

Table 19 is a summary of assessment work and other information regarding the mineral deposits of the map-area. All mineral deposits are numbered and

[1]President, Consolidated Shunsby Mines Limited.

shown by the appropriate symbols on Maps 2351 and 2352 (back pocket). Any one symbol on the map may represent more than one mineral deposit, if the deposits were too close together to separate at the scale of mapping.

The more important mineral deposits and properties, including all those visited by the author [Sage] are described in the text. Numbers in parentheses following the titles of mineral deposits, properties, and areas of exploration correspond to those on Maps 2351 and 2352 and Table 19.

Properties are titled in this report according to ownership as of December 1970. Names in parentheses, following titles, refer to previous owners or names by which the property is otherwise known, e.g. Belcher Mining Corporation Limited (Halcrow-Swayze Mine).

Mineral deposits open to staking as of December 1970 are titled as mines, prospects, or occurrences according to the amount of work previously done on them (see "Terminology").

Areas of exploration on which no mineral deposit has been discovered are titled according to the company that performed the work. Dates in square brackets following titles indicate date of last major work on parcels of land open to staking as of December 1970, e.g. Canadian Nickel Company [1967].

In the text, the mineral deposits are grouped under the headings: gold, asbestos, base metals and sulphides, iron, molybdenum, uranium-thorium, and niobium on the basis of the principal commodity sought by the investigators. An attempt was made to avoid duplicate classification of a deposit as it passed through several examinations by different companies.

During the search of assessment data the mode of occurrence of the various types of mineralization was recorded in the hope that some trends could be established. For each occurrence, a notation was made of the host rock, wall rocks, associated rocks, and alterations. The quality and detail of the available data is quite variable. Therefore, the reader should consider the conclusions as tentative. The results are discussed briefly in the sections of the report describing the different mineral-deposit groups.

An effort has been made to make the data complete up to May 1, 1970. Where pertinent, some additional information was added after that date. When possible, the number of claims contained within a given property were taken from the Canadian Mines Handbook, 1970-1971. An in-depth research of property ownerships and claim status could not be made because of the magnitude of the project and time limitations.

TABLE 19 | SUMMARY OF ASSESSMENT WORK AND OTHER INFORMATION FOR

Abbreviations and explanation

No.	Number on map and in text
Minerals	See map for abbreviations
Type of Work	
AEM	Airborne electromagnetic
AMG	Airborne magnetic
ARA	Airborne radioactivity
DN	Dip needle
EM	Electromagnetic (ground)
GC	Geochemical
GL	Geological
GR	Gravity
IP	Induced polarization
mag	Magnetic (ground)
RA	Radioactivity
RES	Resistivity
SP	Self potential

Township	Name	No.	Minerals, commodity	Latitude	Longitud
ARBUTUS	Best-Ore Mines Ltd.	-			
	Bi-Ore Mines Ltd.	7	cp,py	47°35.05′	82°10.85
BEHMANN (T24R19)	Algoma Central Railway	-			
BELFORD	Area Mines Ltd.	8	gf	48°38.10′	82°19.90
	Area Mines Ltd.	9	po,py,gf	48°35.3′	82°24.05
	Area Mines Ltd.	10		48°35.35′	82°16.05
	(2 locations)	11	po,py,cp,sp,gf	48°35.00′	82°18.00
	Area Mines Ltd.	12	cp,py,po,gf	48°37.1′	82°23.45
	Butler, R.M. (Keevil Mining Group Ltd.) prop 7	138	py,po,gf	48°43.1′ (see Lisgar Tp.)	82°27.25
	Butler, R.M. (Keevil Mining Group Ltd.) prop 1	13	cp,py,po,gf	48°38.55′	82°18.55
	Butler, R.M. (Keevil Mining Group Ltd.) prop 12	-			
	Butler, R.M. (Keevil Mining Group Ltd.) prop 2	14	py,sp,cp,gf,po	48°39.70′	82°22.10
	Huston, C.C.	-			
	McIntyre Porcupine Mines Ltd.	-			
	McIntyre Porcupine Mines Ltd.	-			
BENTON	Blackstein-Kamovsky Claims	-			
	NE Benton Tp. IF	-	IF		
	SE Benton Tp. IF	-	IF,py		
	Wakami River IF	15	IF,py	47°42.30′	82°26.75

DDH's	Diamond drill holes
8(2027')	Number of holes (Total footage drilled)
Toronto file	File number in Assessment Files Research Office, Ontario Division of Mines, Whitney Block, Parliament Buildings, Queen's Park, Toronto
Other files	
Sudbury	Filed in Resident Geologist's Office, Ontario Ministry of Natural Resources, Sudbury
SSM -	Filed in Regional Geologist's Office, Ontario Ministry of Natural Resources, Sault Ste. Marie
T -	Filed in Regional Geologist's Office, Ontario Ministry of Natural Resources, Timmins

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
	15(6563')	1949		Sudbury	
	9(4596')	1947		Sudbury	
GL		1961		SSM-915	
EM	1(300')	1965	63.1420,Rept 12		Bennett 1969, p.21
EM	1(470')	1965	63.1421		Bennett 1969, p.21
EM, mag		1966	63.1680, Rept 10		Bennett 1969, p.21
mag	1(358')	1966	63.1896, Rept 13		Bennett 1969, p.21
EM, mag, GC, GL		1965	63.1436	T-1044	
EM, mag	8(3246')	1966	63.1412, Rept 11		Bennett 1969,p.23
EM, mag		1965	63.1540		Bennett 1969
	1(523')	1966	Rept 14		Bennett 1969,p.23
mag	4(1643')	1957	63.778, Rept 4-10		Bennett 1969,p.23
GL		1958	63A-345		Bennett 1969,p.24
EM		1958	69.934		Bennett 1969,p.24
	38(4808')	1948		Sudbury	Shklanka 1968,p.325; Laird 1935, p.11 Shklanka 1968,p.325 Shklanka 1968,p.326 Laird 1935,p.15

Township	Name	No.	Minerals, commodity	Latitude	Longitude
BLAMEY	Canadian Nickel Co.	-			
	Canadian Nickel Co.	16	py,po,gf	47°39.10′	82°38.95′
	Canadian Nickel Co.	-			
	Canadian Nickel Co.	17	py,po	47°40.00′	82°39.30′
	Kirkland Minerals Corp. Ltd.	18	py,mag	47°40.20′	82°41.30′
BORDEN	Borden Tp. sulphide occurrence	19	py,po	47°55.55′	83°07.75′
BRACKIN	Baltic Mines Ltd.	20	Au,py,gn,cp, mo,po	48°21.05′ (Location Approx.)	83°50.0′
	Camex Mines Ltd.	-	Au,py		
	Campbell, R. Group	-			
	Campbell, R.	-			
	Low, J.H. (Burt prop.)	-			
	Macabie Mines Ltd.	21		48°19.70′	83°49.95′
		22	py,gn,Au	48°20.50′	83°50.55′
	Macassa Mines Ltd.	21	Au	48°19.70′	83°49.95′
	Renabie Mines Ltd.	5	Au	42°23.00′ (see Leeson Tp.)	83°52.00′
	Unknown				
BUSBY	Martel, J.M.	23	py,cp	48°19.65′	83°25.00′
CARTY	Butler, R.M.	24		48°07.40′	82°36.65′
	(Keevil Mining Group Ltd.	25	py,po,cp,mag	48°07.25′	82°37.25′
	Prop.)	26		48°07.50′	82°36.10′
CASSIDY (8E)	Canadian Lencourt Mines Ltd.	-			
	Coulee Lead and Zinc Mines Ltd.	27	U	47°15.85′ (Location Approx.)	83°18.30′
	Leon, Marcil	-			
CAOUETTE (32)	Alarie, Leo & Sons	-			
CHAPLEAU	Collings, W.H.	-			
CHEWETT	Borden River Hydro Reserve	-			
	Chewett Tp. Sulphide occurrence	28	po,py	47°56.00′	83°05.75′
	Dominion Gulf Co.	29	Nb,RE,U,Th,	48°00.15′	83°04.40′
		31	mag,ap	48°01.20′ (see Collins Tp.)	83°05.10′
COCHRANE	Borden Lake pyrite occurrence	30	po,py	47°52.15′	83°18.00′
COLLINS	Dominion Gulf Co.	31	Nb,RE,U,Th,	48°01.20′	83°05.10′
		29	mag,ap	48°00.15′	83°04.40′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
	1(550′)	1966	Rept 1-10		
	1(146′)	1968	Rept 10		
	1(175′)	1968	Rept 11		
	1(110′)	1968	Rept 12		
EM, mag, GL		1956	63.734		
		1970			Visited
GL	7(1810′)	1948	63A.36,Rept 5-4-37 5-4-36		
		1947	63A.21	SSM-957	
GL		1950	63A.90	SSM-960	
GL	4(216′)	1954	63A.201		
GL		1948	63A.56		
GL	17(4526′)	1965	Rept 26-10	SSM-660	
GL		1948	63A.33	SSM-523	
		1942 (present)			Bruce 1942,p.15-23; Bruce 1948,p.436-438; Frohberg, 1948; MRB files, Ottawa
	6(350′)		5-6-35		
					Pers. commun.
EM, mag, GL	4(1222′)	1965	63.1438 Rept 1-10, 1-11, 12 Rept 1-13 (Ivanhoe Tp.)		
		1969		SSM-1450	
		1970			Pers. commun.
		1969		SSM-1451	
		1968		SSM-1300	Quarry Permit Sand and Gravel
		1967-70		SSM-1064	Quarry Permit Sand and Gravel
		1970			Visited
mag, GL	41(21,624′)	1956	63.681	Sudbury	Robertson 1968b, p.68
		1970			Visited
mag, GL	41(21,624′)	1956	63.681	Sudbury	Robertson 1968b, p.68

Township	Name	No.	Minerals commodity	Latitude	Longitude
COPPELL	Algoma Eastern Railway Co., Northern Ontario Lands Corp.Ltd.		Au		
	Radiant Explorations Ltd. (Algoma-Talisman) Sylvanite G.M.L. Talisman Mines Ltd.	32	Au	47°53.60′	82°30.00′
	United States Smelting Refining and Mining Co.	33	py,gf,sp,cp	47°50.80′	82°35.55′
	United States Smelting Refining and Mining Co.	34	py,po,gf	47°55.00′	82°33.20′
	United States Smelting Refining and Mining Co.	35	py,po,gf	47°54.30′	82°35.10′
CROCKETT	Butler, R.M. (Keevil Mining Group Ltd. Prop. 27)	213	po	47°56.05′ (Sandy Tp.)	82°53.55′
CUNNINGHAM	Acadia Uranium Mines Ltd.	-			
	American Metal Co.Ltd.,The	36	cp,py,po,sp	47°42.50′	82°39.15′
	American Metal Co.Ltd.,The	37	cp,sp,bn,py,	47°43.25′	82°40.30′
		38	po,gn,gf	47°43.40′	82°40.00′
	Anaconda Co. (Canada) Ltd., The	230		47°43.60′ (Tooms Tp.)	82°55.75′
		75	py,mag,gf	47°41.50′ (Greenlaw Tp.)	82°47.25′
		39		47°41.00′	82°44.00′
	Anglo-Sudbury Mines Prop.	40	sp,gn,cp,py	47°42.55′	82°42.35′
	Aumacho River Mines Ltd.	-	py		
	Bussin, J.J.	-			
	Canadian Nickel Co.	41	po,py,gf	47°42.60′	82°36.25′
	Canadian Nickel Co.	42	py	47°42.00′	82°36.75′
	Clement, T.	-			
	Consolidated Mining & Smelting Co. of Canada Ltd., The	-			
	Consolidated Shunsby Mines Ltd.	37	po,py,cp,gn,	47°43.25′	82°40.30′
		43	sp	47°43.00′	82°39.60′
	Consolidated Shunsby Mines Ltd.	37	cp,sp,py	47°43.25′	82°40.30′
		43		47°42.50′	82°39.60′
	Consolidated Shunsby Mines Ltd.	-			
	Consolidated Shunsby Mines Ltd.	37	po,py,cp,	47°43.25′	82°40.30′
		43	sp,gn	47°43.00′	82°39.60′
	Consolidated Shunsby Mines Ltd.	37	Pb,Zn,Cu	47°43.25′	82°40.30′
		43		47°43.00′	82°39.60′
	Consolidated Shunsby Mines Ltd.	37		47°43.25′	82°40.30′
	Copper-Chief Mines Ltd.	44	sp,gn,cp,gf	47°41.55′	82°43.50′
	Derraugh, J.E.	37	gf,sp,cp,	47°43.25′	82°40.30′
		45	py,po,gn	47°43.65′	82°41.50′
	Geo-Scientific Prospectors Ltd.	-			
	Gold Chief Mines Ltd.	44	py,sp	47°41.55′	82°43.50′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
		1936			Harding 1937,p.20
GL		1950		Sudbury	
		1948		Sudbury	
		1970			Pers. commun.
	1(304')	1970			Pers. commun.
	1(234')	1970			Pers. commun.
	1(244')	1970			Pers. commun.
EM, mag	1(395')	1965	63.1748		
mag		1956	63.748		
GL		1954	63A.191		
EM, GL	5(2000')	1954	63.443, Rept 11, 13		
EM, GL		1960	63.1048		
		1929			Bannerman 1930, p.12-13; Shklanka 1969,p.238,232; Meen 1942,p.19-20
mag, GL		1956	63.762		
mag		1956	63.759		
	1(153')	1965	Rept 22		
	1(577')	1966	Rept 21		
AEM, AMG		1957	63.859		
EM		1954	63.426		Shklanka 1969, p.237-238; Shklanka 1968,p.331
GL	1(1480')	1958	63A.336, Rept 12		Shklanka 1969, p.237-238;Shklanka 1968,p.331
EM, mag, GL	5(1494')		63A.412, Rept 20		
EM, mag		1965	63.1763		
mag, GC	6(792')	1966	63.185, Rept 16		
GC, GL		1969	63A.560		
GC, GL		1970	2.36		
		1929			Bannerman 1930, p.13;Meen 1942,p.20
	5(1423')	1952	Rept 18		
SP		1958	63.936		
		1937			Meen 1942,p.20; Shklanka 1968,p.332

Township	Name	No.	Minerals commodity	Latitude	Longitude
CUNNINGHAM (cont.)	Kirkland Minerals Corp.Ltd.	18	py	47°40.20′ (see Blamey Tp.)	82°41.30′
	MacIntosh, J.M.	-			
	Maneast Uranium Corp. Ltd.	43	cp,py,po,gf, sp,gn	47°43.00′	82°39.60′
	Maneast Uranium Corp. Ltd. (same as Derraugh)	45	gf,sp,cp,py, po,gn	47°43.65′	82°41.50′
	McLaren claims	-	IF		
	Mid-North Engineering Services Ltd.	-			
	Olive Gold Mines Ltd. (formerly Swayze-Huycke Gold Mines Ltd.)	46	Au	47°44.80′	82°37.70′
	Page-Harley Mines Ltd. (same as Derraugh)	37	po,cp,gn	47°43.25′	82°40.30′
	Ridout-Cunningham Mines Ltd.	37	py,po,cp,sp	47°43.25′	82°40.30′
	Rio Tinto Canadian Explor. Ltd.	47	cp,gf,po,py, sp	47°41.35′	82°38.25′
	Swayze-Huycke Gold Mines Ltd.	46	Au	47°44.80′	82°37.70′
DALE	Rundle Gold Mines Ltd.	165	Au,py	47°51.25′ (Newton Tp.)	82°21.20′
	Talisman Mines Ltd.	-			
	U.S. Smelting Mining and Refining Corp.	-			
DE GAULLE	Pyrite	-	py		
DENYES	Brown, Arthur	-			
	Derraugh, J.E.	48	Au,py,cp,gn	47°49.00′	82°43.75′
	Dyment Mining and Investments Ltd.	49	Au,gn,hem, sp	47°48.25′	82°47.30′
	Erie Canadian Mines Ltd.	-			
	Goldstar Explorations Ltd.	50	py,gf	47°48.35′	82°50.30′
	Please, Mike	-			
	Sylvanite Gold Mines Ltd.	51	py, Au	47°48.80′	82°49.75′
	Sylvanite Claims (Erie Canadian Mines Ltd.)	51	Au	47°48.80′	82°49.75′
	Tyche Long Lac Gold Mines Ltd.	-			
DESROSIERS	Anaconda American Brass Ltd.	52	po,py,mag	47°49.00′	82°06.60′
	Jonsmith Mines Ltd.	53	mo,py,Bi	47°48.55′	82°02.60′
	Noranda Mines Ltd.	54	mo	47°48.55′	82°01.65′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
		1956	63.734		
	12(509')	1956	Rept 17		
	8(1541')	1956	Rept 14		
	4(1626')	1956	Rept 18		Shklanka 1969,p.72
		1917			Lindeman and Bolton 1917,p.92-93
	8(360')	1956	Rept 15		
		1934			Meen 1942,p.22,23
	9(2976')	1953	Rept 18		Shklanka 1969,p.238-239
		1929			Bannerman 1930, p.6-11; Meen 1942, p.20-22; Shklanka 1969, p.238-239
	2(817')	1959	Rept 19		
		1934			Laird 1935c,p.38-39; MRB files, Ottawa
GL		1950		Sudbury	
		1970			Pers. commun.
		1970			Pers. commun.
		1950			Harding 1950
		1969		Sudbury	
	11(2000')	1934			Rickaby 1934,p.27-29; Donovan 1968,p.39; MRB files, Ottawa
	(1000')	1934			Rickaby 1934,p.29-31; Donovan 1968,p.40 ; MRB files, Ottawa
GL		1932		Sudbury	
EM, mag, GL	4(1167')	1964	63.1304, Rept 1-10, 1-11,1-12,1-13		
		1969		Sudbury	
		1934			Rickaby 1934,p.31; Donovan 1968,p.42; MRB files, Ottawa
GL		1935		Sudbury	
					MRB files, Ottawa
GL		1962			Pers. commun.
	18(4389')	1960	Rept 10		Johnston 1968,p.67
		1970			Pers. commun.

Township	Name	No.	Minerals commodity	Latitude	Longitude
DORE	Dore Township Occurrence	-	IF		
	Miner Kenty (Cyril Knight Prospecting Co. Ltd.)	55	Au	47°50.10′	82°35.80′
EISENHOWER	Canadian Nickel Co.	56	gf,py,po	47°39.90′	82°52.55′
	Korpela Sulphide Occurrence	57	po,py,cp	47°38.95′	82°57.60′
EMIRY (T24 R18)	Algoma Central Railway	-			
ESTHER	Northern Aerial Canada Golds Ltd.	58	py,asp,Ag	47°39.50′	82°21.80′
EVANS	Butler, R.M. (Keevil Mining Group Ltd. prop. 36)	-	py		
	Butler, R.M. (Keevil Mining Group Ltd. prop. 37)	-			
FENTON	Allison, A.K.	-			
FOLEYET	Butler, R.M. (Keevil Mining Group Ltd. prop. 11)	59	py,cp,sp,po	48°13.05′	82°27.85′
	Butler, R.M. (Keevil Mining Group Ltd. prop.14)	161	py,cp,sp,po	48°11.35′	82°22.45′ (see Muskego Tp.)
	Butler, R.M. (Keevil Mining Group Ltd. prop.15)	60	po,py,cp	48°11.35′	82°26.55′
	Butler, R.M. (Keevil Mining Group Ltd. prop.16)	61	po,cp,py,sp	48°12.65′	82°26.20′
	Butler, R.M. (Keevil Mining Group Ltd. prop.34)	62	py,cp,po,sp	48°13.50′	82°28.70′
	Canadian Nickel Co.	63	po	48°13.10′	82°24.85′
		61		48°12.65′	82°26.20′
FORTUNE	Mespi Mines Ltd.	-			
GALLAGHER	Borden Lake radioactivity anomaly	64	U, Th	47°48.70′	83°19.15′
GARNET	C.M.S. Syndicate	-			
	Canadian Nickel Co.	65	gf	47°43.45′	82°30.25′
	Canadian Nickel Co.	66	py,po,gf	47°42.05′	82°34.25′
	Canadian Nickel Co.	-			
	Canadian Nickel Co.	67	gf	47°43.10′	82°30.00′
	Canadian Nickel Co.	68	gf	47°43.50′	82°30.90′
	Canadian Nickel Co.	69	IF,mag,hem,gf	47°44.45′	82°33.80′
	Canadian Nickel Co.	70	gf	47°42.35′	82°30.50′
	Canadian Nickel Co.	-			
	Canadian Nickel Co.	71	gf	47°41.25′	82°33.00′
	Drummond-Dobie Claims	-	IF	could not locate	

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
					Shklanka 1968,p.332; Donovan 1965d,p.10; Rickaby 1934,p.36; MRB files, Ottawa; Donovan 1965,p.20
	?(1000')	1932			
	3(545')	1967		Sudbury	
		1970			Visited
GL		1961		SSM-907	
					Laird 1935a,p.23 MRB files, Ottawa
EM, mag, SP, GL		1965	63.1781		
EM, mag, SP, GL		1965	63.1783		
	1(203')	1965	Rept 10		
EM, mag, GL	2(981')	1965	Rept 17		
EM, mag, GL	3(1191')	1965	63.1527, Rept 10	T-1119	
EM, mag, GL	2(1130')	1966	Rept 15, 63.1526		
EM, mag	2(1050')	1966	Rept 14, 63.1793		
EM, mag, GL	4(1302')	1965	Rept 10,16,63.1440		
	6(1922')	1964	Rept 11,12,13		
AEM, AMG		1964	63.1287		
		1970			Pers. commun. (Earl Sootheran Chapleau, Ontario)
	3(215')		Rept 12		
	1(453')	1966		Sudbury	
	1(146')	1965	Rept 14		
	1(402')	1966	Rept 13		
	1(480')	1966	Rept 16		
	1(437')	1966	Rept 17		
	2(950')	1966	Rept 18		
	1(395')	1968	Rept 11		
	1(404')	1968	Rept 10		
	2(695')	1968	Rept 15		
		1917			Lindeman & Bolton 1917,p.92

Township	Name	No.	Minerals commodity	Latitude	Longitude
GARNET (cont.)	Fawn Creek Occurrence	-	IF		
	SW Garnet Township Occurrence	71	py,po	47°41.25′	82°33.00′
	Yarwood Lake Occurrence	69	py,po,mag,cp	47°44.45′	82°33.80′
GAUNT (7D)	Samco Const. Ltd.				
GENOA	Central Sudbury Lead-Zinc Mines Ltd.	72	cp,po,gn,sp,	47°50.10′	82°11.80′
		147	mag,gf,py	47°49.60′ (see Marion Tp.)	82°15.20′
	Jefferson Mining Corp.	72	cp,py,po, sp,gn,mag	47°50.10′	82°11.80′
	Jessop Property	73	gn,cp,sp,py, mag,Au,Ag	47°50.05′	82°09.05′
	Jowsey, R.J. (Mining,Corp. of Canada Ltd., The	72	gn,py,sp, cp,po,mag	47°50.10′	82°11.80′
	Lucky Creek Mining Co.Ltd.	72	gn,cp,sp	47°50.10′	82°11.80′
	McAree Mines Ltd.	-			
	Parr Mines Ltd.	74	cp,bn,py	47°46.50′	82°11.20′
	Smith Claims (Jefferson Lead-Zinc occurrence)	72	gn,sp,cp, mag,po,py	47°50.10′	82°11.80′
	Woman River Iron Formation	72	py,cp,gn, sp,IF	47°50.10′	82°11.80′
GREENLAW	Anaconda Co. (Canada) Ltd., The	230		47°43.60′ (Tooms Tp.)	82°55.75′
		75	py,po,mag,gf	47°41.50′	82°47.25′
		39		47°41.00′ (Cunningham Tp.)	82°44.00′
	Canadian Nickel Co.	76	gf	47°43.65′	82°48.80′
	Canadian Nickel Co.	77	gf	47°44.85′	82°48.30′
	Clement, T.	-			
	Greenlaw Gold Mines Ltd.	78	py,cp	47°44.75′	82°49.25′
	Hotstone Minerals Ltd.	-			
	Hotstone Minerals Ltd., (Newbec Mines Ltd.)	79	Au,py	47°43.00′	82°48.50′
	Lee Gold Mines Ltd.	80	py,cp,Au	47°45.50′	82°49.95′
	New Athona Mines Ltd. (formerly Lee G.M.L.)	80		47°45.50′	82°49.95′
	Newbec Mines Ltd. (see Hotstone Minerals Ltd.)	79	Au,py	47°43.00′	82°48.50′
	North Greenlaw Tp.IF	-	IF		
	South Greenlaw Tp.IF	-	IF		
GRIFFIN	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 21	-	py,po,cp, gf, mag		

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
					Shklanka 1968,p.334
					Shklanka 1968,p.334
					Shklanka 1968,p.334-335
Sand and Gravel Quarry Permit				SSM-1301	
	7(1734')	1947	Rept 5-5-159		Goodwin 1965,p.35-46; Shklanka 1969, p.245
	10	1929			Bannerman 1930,p.2-6; Moore 1926b,p.94-96
		1929			Bannerman 1930,p.6; Kindle 1936,p.160
EM, mag, GC, GL	7(1394')	1963	Rept 5-5-159 63.1225		Goodwin 1965,p.35-46; Shklanka 1969, p.244-45
		1957		Sudbury	
		1964		Sudbury	
		1970			The Northern Miner July 23, 1970
		1918			Robinson 1918,p.25-27
		1965			Moore 1926b,p.86-96; Goodwin 1965,p.46-55; Furse 1932,p.48-51
EM, GL		1960	63.1048		
	1(199')	1967	Rept 11		
	1(211')	1967	Rept 10		
AEM, AMG		1957	63.859		
		1934			Rickaby 1934,p.34; Donovan 1968,p.41; MRB files, Ottawa
		1956		Sudbury	
		1968			Donovan 1968,p.41
		1934			Rickaby 1934,p.33-34
		1968			Donovan 1968,p.42
		1934			Rickaby 1934,p.34; MRB files, Ottawa
					Shklanka 1968,p.336
					Shklanka 1968,p.336
EM, mag	1(399')	1964	Rept 10,63.1594		

Township	Name	No.	Minerals commodity	Latitude	Longitude
HALCROW	Bastarache, Gerard	81	py,po	47°50.00′	82°56.00′
	Belcher Mining Corp. Ltd. (formerly Halcrow Swayze Mines Ltd.)	3	Au,py,cp	47°48.00′	87°56.50′
	Dalhousie Oil Co.Ltd.	81	py,po	47°50.00′	82°56.00′
	Halcrow Swayze Mines Ltd.	3	Au	47°48.00′	82°56.50′
	Halcrow Township IF	-	IF		
	Lyall-Beidelman	81	Au,py,asp	47°50.00′	82°56.00′
	Shunsby Gold Mines Ltd.	82	RA	47°50.00′	82°58.00′
HALSEY	Caral Mining Co.Ltd.	-			
	Gaff Mines Ltd.	-			
	Naneek Mines Ltd.	-			
HAYWARD	Continental Mining Exploration Ltd.	-			
	Granwick Mines Ltd.	-			
	Martin, H.E. (Colomac Yellowknife Mines Ltd.)	-			
HEENAN	Anaconda American Brass Ltd.	83	cp,gf	47°49.50′	82°23.75′
		84		47°49.80′	82°25.95′
	Fisher, M.D.	-	py,Au,sp, trace of gn	cannot locate	
	Fummerton Mining & Development Co.Ltd.	-			
	Joburke Gold Mines Ltd.	85	Au	47°48.00′	82°22.00′
				Location approx.	
	Leith, C.K. (Estate)	-		47°47.60′	82°19.75′
				47°46.40′	82°22.20′
	United States Smelting Refining and Mining Co.	84	py,gf	47°49.80′	82°25.95′
	United States Smelting Refining and Mining Co.	86	py,gf	47°47.55′	82°25.45′
	United States Smelting Refining and Mining Co.	87	py,gf	47°48.60′	82°24.20′
	United States Smelting Refining and Mining Co.	88	py,gf	47°49.25′	82°21.80′
	Woman River Iron Formation				
	Zeidal Claims	-			
HELLYER	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 38	89	py,mag	48°00.15′	82°46.80′
		90		47°59.85′	82°49.25′′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 37	-			

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
	6(220')	1966		Sudbury	
		1965			Donovan 1968,p.38-39
	6(400')	1966	Rept 10		
	?(2000')	1934			Rickaby 1934,p.31-33; Laird 1935c,p.39; MRB files, Ottawa
		1968			Shklanka 1968,p.337
		1934			Rickaby 1934,p.33; Donovan 1968,p.41-42; MRB files, Ottawa
		1955			Donovan 1968,p.42
mag	5(2003')	1955	63.579, Rept 5-4-169		
mag		1955	63.551		
		1951	63.244		
EM, mag		1956-57	63.845	SSM-1466	
		1957	63A-330		
EM, mag		1956-57	63.741		
		1962			Pers. commun.
		1929			Bannerman 1930,p. 13-14; Kindle 1936, p.160
mag, GL		1946	63.59		Goodwin 1965,p.55
		1947			MRB files, Ottawa
		1906-07			Goodwin 1965,p.46-51
	3(1469')	1970			Pers. commun.
	1(615')	1970			Pers. commun.
	2(737')	1970			Pers. commun.
	1(184')	1970			Pers. commun.
		1965			Goodwin 1965,p.46-55; Furse 1932,p.44-51; Moore 1926b,p. 86-96; Shklanka 1968, p.338-339
	3(200')	1949		Sudbury	
EM, mag, SP, GL		1965	63.1780		
EM, mag, SP, GL		1965	63.1783		

Township	Name	No.	Minerals commodity	Latitude	Longitude
HOLLINGER (12)	Tp.12 Sulphide Occurrence	91	po,py	47°19.65′	82°13.00′
HORWOOD	Ajax Minerals Ltd.	-			
	Bachmann-Campbell-Reany	92	py,Au	47°56.00′	82°17.50′
	Camback Syndicate	92	py,cp,Au	47°56.00′	82°17.30′
	Deburmac Gold Mines Ltd.	93	py,Au,gn	47°58.00′	82°17.50′
	Desco Gold Mining and Exploration Syndicate	-		cannot locate	
	Desourdy Property	-			
	Donalda Mines Ltd.	94	py,po,sp, gn,Au,cp	47°56.50′	82°19.80′
	Gifford, C.S.	94	py,po,cp, sp,gn,Au	47°56.50′	82°19.50′
	Gilbert	-			
	Gould-Dunn	95	py	47°59.00′	82°17.00′
	Groundhog Gold Mines Ltd.	96	Au	48°00.00′	82°20.00′
	Groundhog Gold Mines Ltd.	96	Au	48°00.00′	82°20.00′
	Groundhog Gold Mines Ltd.	96	Au	48°00.00′	82°20.00′
	Hardiman Bay Mines Ltd.	97	Au	47°56.00′	82°23.00′
	Hardiman Bay Mines Ltd.	97		47°56.00′	82°23.00′
	Hardiman Bay Mines Ltd.	97	Au	47°56.00′	82°23.00′
	Hollinger Cons. Gold Mines Ltd.	98	py,po,cp	48°01.20′	82°16.50′
	Horlac Mines Ltd.	-			
	Horwood Explor. Syndicate	99	py,po,cp,gn,Au	47°59.00′	82°16.00′
	Jacobs, W.A.	99	cp,gn,py	47°59.00′	82°16.00′
	Labbe, W.	100	py,cp,gn,Au	48°01.50′	82°15.00′
	Lafontaine Group	-			
	Landry, H.	97	py,cp,Au	47°56.00′	82°23.00′
	Lefevre, J.A.	101	cp,sp,po,py	47°58.85′ location approx.	82°20.30′
	Lefever & Anderson	-		47°57.30′ location not accurate	82°19.00′
	Lefever-Desourdy-Silams	-	py,cp,Au,po	cannot locate	
	Lefever, J.E.	-			
	Lefever, J.E.	102	Au,po,cp	48°01.80′	82°19.50′
	Lefever, J.E.	-	py,po		
	Lefever Prop. (Kerr Addison Gold Mines Ltd.)	102	py,po,cp, Au,Ag	48°01.80′	82°19.50′
	Macassa Mines Ltd., Hollinger Cons. Gold Mines Ltd., Lafontaine Gp.	-			
	Monte Carlo Explor. Gold Mines Ltd.	-	py		
	Moramo Gold Syndicate	94	py,cp,po,Au	47°56.50′	82°19.80′
	Mosher Long Lac Gold Mines Ltd.	94	po,py,cp,Au	47°56.50′	82°19.80′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
		1962			Rogers 1962,p.31
GL		1961	63A.402		
		1932-34			Harding 1937,p.25
		1932			Laird 1935b, p.37
	16(7090')	1946		Sudbury	MRB files, Ottawa
		1935			Harding 1937,p.24-25
	4(357')	1950		Sudbury	
EM, mag		1965	63.1828		
		1933			Harding 1937,p.21-22
		1933-36			Harding 1937,p.30
		1933			Harding 1937,p.23; MRB files, Ottawa
GL	?(8000')	1947	63A.25		
		1934-36			Laird 1935b,p.36; Harding 1937,p.27; MRB files, Ottawa
mag	?(8000')	1948	63.143		MRB files, Ottawa
mag	10(2196')	1963	63.1226		MRB files, Ottawa
	12(2400')	1963	Rept 5-11-188		
GL		1966	63.1817		
	1(429')	1946	Rept 5-1-182		
	29(1638')	1950		Sudbury	
		1935-36			Harding 1937,p.22
		1935-36			Harding 1937,p.22 MRB files, Ottawa
		1936			Harding 1937,p.27-29 MRB files, Ottawa
GL	3(1501')	1947		Sudbury	
		1933			Harding 1937,p.23 MRB files, Ottawa
		1929			Bannerman 1930,p.15
		1934			Laird 1935,p.36-37; Harding 1937,p.30; MRB files, Ottawa
		1935-36			Harding 1937,p.26-27 MRB files, Ottawa
	13(947')	1948-49	Rept 5-13-181		
	44(3295')	1948-49	Rept 5-35-185		
	5(281')	1955	Rept 5-3-184		
AMG	3(240')	1948-60	Rept 5-6-180		
GL		1950		Sudbury	
		1935-36			Harding 1937,p.24
		1933			Laird 1935b,p.35-36
GL		1948	63A.60		

Township	Name	No.	Minerals commodity	Latitude	Longitude
HORWOOD (cont.)	O'Neil Gold Prospecting Syndicate	96	py,cp	48°00.00′	82°20.00′
	Orofino Mines Ltd.	216	Au,py,po, cp,gn	47°56.40′ (Silk Tp.)	82°24.50′
	Queensway Mines Ltd. (Horlak Mines Ltd.)	100	py,Au	48°01.50′	82°15.00′
	Radiant Explor. Ltd.	-	py		
	Siegel Group	103	py	48°03.35′	82°12.95′
	Silans, P.H.	104	Au,py	48°00.50′	82°18.00′
	Smith, A.H.	105	py,cp,Au	47°57.65′	82°15.20′
	Tionaga Gold Mines (Smith-Thorne Mine)	6	Au,cp,gn, sp,py,po	47°57.20′	82°19.20′
HUFFMAN	Best-Ore Mines Ltd.	-			
	Bi-Ore Mines Ltd.	106	py,asp,Au	47°35.85′	82°13.05′
	Denison Mines Ltd.	107	mo,py,cp	47°35.80′	82°07.00′
	Falconbridge Nickel Mines Ltd.	108	po,gf,py	47°35.70′	82°10.65′
	Gaffney, M.J.	109	py,Au	47°37.00′	82°10.40′
	Gaffney, T.J.	110	cp	47°36.80′	82°09.35′
	Jerome Gold Mines Ltd.	4	Au	47°37.45′	82°14.50′
	Jess-Mac Gold Mines Ltd.	109	Au,Ag,gn,	47°37.00′	82°10.40′
		111	sp,cp	47°36.35′	82°10.00′
	Little Rice Lake IF	-	IF		
	Little Rush River-Canoe Lake IF	-	IF		
	Mining Corp. of Canada Ltd.	-			
	O'Neil-Jessop Claims	112	py,cp,gn,hem	47°37.10′	82°12.75′
	Rio Tinto Canadian	109	Au,Ag,cp,	47°37.00′	82°10.40′
	Explor. Ltd.	111	gn,sp	47°36.35′	82°10.00′
	Swed Prospecting	-			
	Sylvanite Gold Mines Ltd.	-			
IVANHOE	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 17	-			
	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 14	161	py,po,cp,sp	48°11.35′ (Muskego Tp.)	82°22.45′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 17	113	py,po,cp, sp,gf	48°09.35′	82°26.00′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 31	26	py,po,cp,mag	48°07.50′ (Carty Tp.)	82°36.10′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 15	62	po,py,cp	48°13.50′ (Foleyet Tp.)	82°28.70′
JESSIMAN (6E)	Bussineau Stone Property	-	Au,Cu	cannot locate	
	Taman Uranium Mines Ltd.	114	cc,bn,Ag	47°07.75′ Location approx.	83°17.90′
JOFFRE	Joffre Sulphide Occurrence	115	py	47°23.30′	82°17.75′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
		1933-35			Harding 1937,p.29-30 MRB files, Ottawa
GL		1950		Sudbury	Harding 1937,p.20-23 Laird 1935b,p.34-35 MRB files, Ottawa
	41(5579')	1952	Rept 5-17-187		MRB files, Ottawa
		1963	Rept 5-2-186		
	5(2534')	1947	Rept 5-6-183		
	17(2134')	1949	Rept 5-17-189		
					Harding 1937,p.25; MRB files, Ottawa
		1933-35			Harding 1937,p.24; MRB files, Ottawa
		1933-37			Harding 1937,p.17-20; MRB files, Ottawa
	3(1862')	?	Rept 5-2-190		
		1949?			Moorhouse 1949,p. 15-17
EM, mag, GL		1964	63.1260		
	2(804')	1966	Rept 10		Shklanka 1969,p.249- 250
	5(1446')	1961	Rept 11		
	3(1294')	1961	Rept 12		
		1938			Moorhouse 1949,p. 18-22; Brown 1948, p.438-441
	10(1998')	1951	Rept 5-2-192		Shklanka 1969,p.249
					Shklanka 1968,p.341
					Shklanka 1968,p.341
	1(100')		Rept 5-1-193		
		1933			Laird 1935a,p.28-29
EM, mag		1966	63.1902		Shklanka 1969,p.249
	5(2185')	1950	Rept 5-5-191		
		1936		Sudbury	
EM, mag		1964	63.1546		
EM, mag, GL	3(1191')	1965	63.1527, Rept 10	T-1119	
EM, mag	3(1498')	1965	63.1811, Rept 10		
	1(206')	1965	Rept 1-13		
EM, mag, GL	2(1130')	1965	63.1526		
		1963		SSM-772	
		1970		SSM-1503	
		1962			Rogers 1962,p.31

Township	Name	No.	Minerals commodity	Latitude	Longitude
KEITH	Aladdin-Groundhog Mines Ltd.	-			
	Algoma Ore Properties	116	IF	48°09.00′	82°14.70′
	Butler, R.M. (Keevil Mining	117	py,po,gf,	48°09.90′	82°22.25′
	Group Ltd.) Prop. 26 & 40	118	(trace cp)	48°09.85′	82°19.55′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop. 14	161	py,po,sp,cp	48°11.35′ (see Muskego Tp.)	82°22.45′
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Nickel Co.	117		48°09.90′	82°22.25′
		118	po, py	48°09.85′	82°19.55′
	Canadian Nickel Co.	117		48°09.90′	82°22.25′
		118	po,py,gf	48°09.85′	82°17.55′
		119		48°09.85′	82°15.70′
	Canadian Pacific Railway	-			
	Concord Mines Ltd.	-	(trace Au) dis.py		
	Cons. Mining and Smelting Co. of Canada Ltd., The				
	Continental D.D. Rouyn	-			
	Continental D.D. Rouyn	-			
	Cook, S.	120	py,po,asp, sp,gn	48°08.20′	82°13.75′
	Dulama Gold Mines Ltd.	-			
	Duncan W.J. (Wejack Property)	-	trace py		
	Dunvegan Mines Ltd. (formerly Hoodoo Lake Mines Ltd.)	121	Au,py,po, cp,gn,sp	48°08.40′	82°15.60′
	Garnet Gold Mines Ltd.	122	py,mo,gf	48°08.85′	82°19.00′
	Groundhog Mining Corp.	122	mag,py,po	48°08.85′	82°19.00′
		116	hem	48°09.00′	82°14.70′
	Groundhog River IF	-	IF,py,po,cp		
	Holliston property	121	py,cp	48°08.40′	82°15.60′
	Hoodoo Lake Mines Ltd.	121	py,cp,Au,po	48°08.40′	82°15.60′
	Keith Tp IF	-	IF		
	Keith Tp IF	-	IF		
	Joburke Gold Mines Ltd.	123	Au,cp,po	48°08.80′	82°17.00′
	Keithgold Mines Ltd.	-			
	K.M. Ontario Explor.Ltd.	-	gf,py,IF		
	K.M. Ontario Explor.Ltd.	-			
	Kukatush Mining Corp.Ltd.	124	py,po,mag,gf	48°09.35′	82°16.30′
	Kukatush Mining Corp.Ltd.	118	py,IF,po	48°09.85′	82°19.55′
	Kukatush Mining Corp.Ltd. (1960)	117	py	48°09.90′	82°22.25′
	MacKeith Lake Prospect	-	IF		
	MacLeod-Cockshutt Gold Mines Ltd.	-			
	Mining Oriented Invest.Ltd.	-			
	Nib Yellowknife Mines Ltd.	125	py	48°07.35′	82°16.65′
	Nudulama Mines Ltd.	-			
	Palomar Gold Mines Ltd.	-			
	Purdy Mica Mines Ltd.	-			
	Radio Hill Mines Co.Ltd.	126	gf,py	48°10.35′	82°14.05′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
	3(2267')	1946-47		T-3	Prest 1950,p.39
	2(400')	1960	Rept 5-2-205		
EM, mag, GL		1966	63.1963		
	3(1191')	1965	63.1527, Rept 10	T-1119	
EM, mag		1957	63.2102		
	2(406')	1964	Rept 5-1-205A 5-1-206A		
	4(806')	1964	Rept 5-2-207A 5-2-205B 5-2-206B		
mag		1961	63.1102		
	3(2265')	1947		T-207	Prest 1950,p.41
GL		1946		T-32	
	1(361')	1966	Rept 5-1-207		
	1(83')	1966	Rept 5-1-208A		
		1926			Bannerman 1930, p.15-16
GL		1947	63A.10		Prest 1950, p.39
GL	20(7569')	1947	63A.8		Prest 1950, p.40
GL	20(7569')	1946		T-62	
GL	14(9795')	1946-47		T-41	Prest 1950, p.40
mag		1960	63.1035		Shklanka 1968,p.343
	3(926')	1959	Rept 5-3-204		
GL		1946-47		T-68	
		1946			Prest 1950,p.37; MRB files, Ottawa
		1917			Lindeman and Bolton 1917,p.93
		1916			Tanton 1916,p.182
	13(6971')	1947		T-70	Prest 1950,p.34-37
					Hogg 1946b,p.1109, 1112
	4(3318')	1946-47			Prest 1950,p.38
	1(260')	1966	Rept 14		
	1(201')	1966	Rept 15		
	1(430')	1960	Rept 5-1-208		
	2(994')	1960	Rept 20		
	2(1264')	1962	Rept 12		
					Shklanka 1968,p.344
GL		1947	63A.6		Prest 1950,p.41
	2(205')	1969	Rept 1		
GL		1947	63A.12		Prest 1950,p.39-40
GL		1947		T-172	Prest 1950,p.39
GL	9(5093')	1946-47		T-100	Prest 1950,p.37-38
GL	12(5735')	1947		T-83	Prest 1950,p.38-39
	3(1247')	1967	Rept 13		

Township	Name	No.	Minerals commodity	Latitude	Longitude
KEITH (cont.)	Robertson, D.S.	-			
	Slate Rock Lake IF	-	IF		
	Smith Claims	-			
	Wejack Mines Ltd.	122	py,po,gf,cp	48°08.85′	82°19.00′
	Wiltsey Claims	-			
KENOGAMING	Canadian Johns-Manville Co.Ltd.	127	py,po,Fe	48°10.00′	82°00.90′
	Canadian Johns-Manville Co.Ltd.	128	IF,po,py,asb	48°08.45′	82°00.40′
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	128	IF,asb,po,py	48°08.45′	82°00.40′
	Canadian Johns-Manville Co.Ltd.	128	mag,asb	48°08.45′	82°00.40′
	Crawford Lake Occurrence	-	Fe		
	Fallmac Nickel Mines Ltd.	-	S		
	Jade Oil & Gas Co.Ltd.	-			
	Kalbrook Mining Co.Ltd.	-			
	Kukatush Mining Corp.	127	mag	48°10.00′	82°00.90′
	Penko Gold Mines Ltd.	190	py,Au	48°11.70′ (Reeves Tp.)	82°02.20′
LACKNER	Apamag Mines Ltd.	-	mag,py,cp	(see 129,130)	
	Beaulieu Yellowknife Mines Ltd.	-			
	Beaulieu Yellowknife Mines Ltd.	-			
	Canadian Nickel Co.	129	gf	47°48.55′	83°02.25′
	Chyka Mines Ltd.	-	mag,ap,cp,po	(see 129)	
	Chyka Mines Ltd.	-		(see 129)	
	Claymac Mines Ltd.	-			
	Dominion Gulf Co.	-	mag,ap	(see 129)	
	Falconbridge Nickel Mines Ltd.	-	mag,ap	(see 129)	
	MacDonnell-Labrasseur-Derraugh	-	Fe,Cu,RE	(see 129)	
	Multi-Minerals Ltd.	156	mag,ap,po,Nb, cp,U,Th,RE	47°47.20′ (McNaught Tp.)	83°07.75′
	Nemegos Uranium Corp.	-	mag,U	(see 129)	
	Silverman Property	-	py,cp,mag	(see 129)	
	Union Carbide Canada Mining Ltd.	-			
LANG	Algoma Ore Properties Ltd.	130	il,mag	48°15.15′	83°56.75′
LANGLOIS (10D)	Dusdal, Otto	-			
	Kram, K. & Glowacki, J.	131	py,po,sp,U	47°24.45′	83°12.30′
LEESON	Camabie Mines Ltd.	-			
	Camex Mines Ltd.	-			

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
EM, mag		1966	63.2025		
					Shklanka 1968,p.345
		1917		T-117	
GL	9(6781')	1946-47		T-130	Prest 1950,p.40
		1947			Prest 1950,p.40
mag, GL		1957	63.826		Milne 1972
mag, GL		1958	63.946		Milne 1972
AMG		1964	63.1326		Milne 1972
EM, mag		1964	63.1707		Milne 1972
	10(2525')	1965	Rept 10		Milne 1972
					Shklanka 1968,p.345
					Milne 1972
EM, mag		1955	63.653		Milne 1972
EM, mag, GR		1965	63.1739		Milne 1972
	13(?)	1946		T-145	Milne 1972
mag		1960	63.1052		Milne 1972
GL		1946		T-145	
	5(2130')	1955	Rept 5-5-223		
mag		1955	63.599		
mag		1955	63.625		
	1(180')	1967	Rept 1-12		
mag	32(11,730')	1952	63.330, Rept 5-7-220		Shklanka 1968,p.346
		1954			
		1955	63.552		
	9(2722')	1955	63.553		
mag, GL	2(1263')	1952	63.333, Rept 10		Hodder 1961
GL		1959	63.1016		Shklanka 1968,p.346
mag		1952	63.315		
GL		1954	63A.195		Shklanka 1968,p.351
					Robertson 1968,p.77
mag	4(720')	1950-51	63.192 Rept 5-3-258		
	27(5869')	1957	Rept 5-7-221, 5-13-221, 5-11-222, 5-7-259, 63.518		
	1(801')	1969	Rept 27		
	4(1005')		Rept 5-3-225		Shklanka 1968,p.347
	1(11')	1955	Rept 6-1-256	SSM-474	
					Robertson 1968,p.84
					Harding 1950
GL		1947	63A.27	SSM-958	
GL		1947	63A.21	SSM-957	

Township	Name	No.	Minerals commodity	Latitude	Longitude
LEESON (cont.)	Campbell, R.Group	-			
	Campbell, R.Group	-			
	Canbrae Exploration Co.Ltd.	132	Au,py,gn,cp	48°26.85′ (location approx.)	83°51.15′
	Coniagas Mines Ltd.,The	-			
	Nudulama Mines Ltd. (formerly Ladulama Gold Mines Ltd.)(formerly Dulama Gold Mines Ltd.)	133	py,gn,cp,Au	48°23.00′	83°49.00′
	Frontenac Group	-	gn,py,cp,mo, Au	cannot locate	
	Hard Rock Gold Mines Ltd.	134	Au,py	48°24.45′	83°50.70′
	Ken-Bay Gold Mines Ltd.	-	py		
	Leeson 1940 Group (Macassa Mines, Ltd.)	135	Au,gn,cp, py	48°24.25′	83°50.20′
	Leeson Tp. 1941 Group (Macassa Mines, Ltd.)	-	py		
	Macabie Mines Ltd.	136	py,gn,Au	48°24.25′	83°52.00′
		137		48°23.30′	83°51.70′
	Macassa Mines Ltd.	135	py,gn,Au	48°24.25′	83°50.20′
	Renabie Mines Ltd.	5	Au,py,cp,gn	48°23.00′	83°52.00′
LISGAR	Butler, R.M. (Keevil Mining Group Ltd. Prop.7)	138	py,po,gf	48°43.10′	82°27.25′
LLOYD	Martel, J.M. Claims	139	py,po,cp	48°19.60′	83°12.00′
MAECK (5E)	Bussineau, W.	140	Nb,hem	46°59.25′	83°19.25′
		141		46°59.60′	83°18.45′
	Joubin, F.R.	140		46°59.25′	83°19.25′
		141		46°59.60′	83°18.45′
	Nagel, H.F.	-			
	Taylor, L.M.	-			
	Seabrook Lake Occurrence	140	hem	46°59.25′	83°19.25′
		141		46°59.60′	83°18.45′
	Tarbutt Mines Ltd.	140	Nb	46°59.25′	83°19.25′
		141		46°59.60′	83°18.45′
MALLARD	Anaconda American Brass Ltd.	142	gf,py,po, sp,gn,cp	47°41.25′	82°17.75′
	Ferlund-Gauldie-Mogridge Claims	143	py,Au,cp,Ag	47°42.70′	82°16.40′
	Hermiston Claims	143	py,Au	47°42.70′	82°16.40′
	Maltby Claims	144	py,cp	47°41.65′ Location Approx.	82°15.50′
	Mogridge Claims	143	py,cp,Au	47°42.70′	82°16.40′
	Opeepeesway River Occ.	-	IF		
	Woman River Gold Mines Ltd.	145	Au,cp,py	47°43.65′	82°19.50′
	Woman River Gold Syndicate	145	Au,py	47°43.65′	82°19.50′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
GL		1950	63A.90	SSM-960	
GL	4(216′)	1954	63A.207		
		1942			Bruce 1942,p.24
		1942			Bruce 1942,p.23-24
	26(7466′)	1947	Rept 5-26-231		MRB files, Ottawa
		1942			Bruce 1942,p.24
		1951	63A.128	SSM-954	
	9(3000′)	1947	Rept 5-9-228		
GL	6(1516′)	1947-48	Rept 5-9-230 63A.18	SSM-1459	
GL	3(519′)	1947	Rept 5-31-229 File 63A.18		
	18(4905′)	1965	Rept 10	SSM-660	
		1947	63A.55	SSM-959	
		1942			MRB files, Ottawa Bruce 1942,p.15-23 Bruce 1948,p.436-438
EM, mag, GC, GL		1965	63.1436	T-1044	
		1969-70			Pers. commun.
	4(576′)	1955	Rept 6-1-249	SSM-224 SSM-1207	Parsons 1961,p.21-22
mag, GC		1957 & 1964	63E.1, 63.799	SSM-652	
		1950			Harding 1950
	3(627′)	1957	Rept 6-2-254 6-1-250	SSM-227	
		1968			Shklanka 1968,p.41
mag	6(207′)	1957	63.799, Rept 6-3-251, 6-2-252, 6-1-253	SSM-226, 225	Parsons 1961,p.21-22
	11(4101′)	1963	Rept 10		
		1933			Laird 1935a,p.23-25 MRB files, Ottawa
		1934			Rickaby 1934,p.36 Laird 1935a,p.28 MRB files, Ottawa
		1933			Laird 1935a,p.28
		1934			Rickaby 1934,p.36 Shklanka 1968,p.348
		1933			Laird 1935a,p.25 MRB files, Ottawa
		1933			Rickaby 1934,p.36

Township	Name	No.	Minerals commodity	Latitude	Longitude
MARGARET	Margaret Tp. Sulphide Occ.	146	py,mag	47°26.60′	82°09.00′
MARION	Anaconda American Brass Ltd.	147	sp,gn,cp	47°50.00′	82°15.05′
	Central Sudbury Lead-Zinc	147	py	47°49.60′	82°15.20′
	Mines Ltd.	72	cp,po,gn, sp,mag,gf	47°50.10′ (see Genoa Tp.)	82°11.80′
	Joburke Gold Mines Ltd.	85	Au	47°48.00′ location approx.	82°22.00′
	R.J. Jowsey Mining Co.	72	gn,py,sp, cp,po,mag	47°50.10′ (Genoa Tp.)	82°11.80′
	Leith, C.K. (Estate)	148		47°47.60′	82°19.75′
		149		47°46.40′	82°22.20′
	Lucky Creek Mining Co.Ltd.	72	gn,cp,sp	47°50.10′ (Genoa Tp.)	82°11.80′
	McAree Mines Ltd.	-			
	Parr Mines Ltd.	74	cp,bn,py	47°46.50′ (Genoa Tp.)	82°12.20′
	Royal Agassiz Mines Ltd. & Gold Hawk Explor.Ltd.	150	cp,Au	47°46.05′	82°16.55′
	Noranda Mines Ltd.	151	cp,Ag	47°47.95′	82°15.55′
	Stackpool Mining Co.Ltd.	72	cp,py,gn, sp,mag	47°50.10′ (Genoa Tp.)	82°11.80′
		152		47°49.60′	82°15.20′
	Texore Mines Ltd.	153	Cu	47°45.70′	82°16.90′
	Wendmar Gold Mines Ltd.	154	py	47°49.10′	82°17.50′
	Woman River Iron Formation	-	IF		
MARSH (44)	Charlebois, Cristakos	155	Au,py,po, cp,cu	48°16.30′	83°56.05′
McGEE	Dominion Gulf Co.	31	Nb,RE,U, Th,mag,ap	48°01.20′ (Collins Tp.)	83°05.10′
		29		48°00.15′ (Chewitt Tp.)	83°04.40′
McILVEEN (5G)	Ranger Lake Uranium Co.Ltd.	-			
McNAMARA	McNamara Tp. Occurrence	-	IF		
McNAUGHT	Claymac Mines Ltd.	-			
	Falconbridge Nickel Mines Ltd.	-	mag,ap	(see 156)	
	Multi-Minerals Ltd.	156	mag,ap,po,Nb, cp,py,U,Th,RE	47°47.20′	83°07.75′
	Multi-Minerals Ltd.	156	Nb, mag	47°47.20′	83°07.75′
	Multiwin Explor. Ltd.	-	py,po,cp		
	Naneek Mines Ltd.	-			

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
		1962			Rogers 1962,p.31
		1962			Pers. commun.
	7(1734')	1947	Rept 5-5-159		Goodwin 1965,p.35-46; Shklanka 1969, p.245
		1947			MRB files, Ottawa
EM, mag, GC, GL	7(1394')	1963	63-1225, Rept 5-7-248		Goodwin 1965,p.35-46; Shklanka 1969, p.244-245
		1906-1907			Lindeman & Bolton 1917,p.91-92; Goodwin 1965,p.46-51
		1957		Sudbury	
		1964		Sudbury	
		1970			The Northern Miner July 23, 1970
		1970			Pers.commun.; The Northern Miner March 3,1971,p.3
		1970			Pers.commun.; The Northern Miner Oct.8,1970,p.3
mag	14(1926')	1960	63.1074, Rept 5-14-247		Goodwin 1965,p.35-46; Shklanka 1968, p.349
		1970			Pers. commun.; The Northern Miner Oct.8,1970,p.3
mag, GL		1946	63.43		Goodwin 1965,p.56
		1965			Goodwin 1965,p.46-55; Furse 1932,p.48-51; Moore 1926b, p.86-96
		1934			Burwash 1935,p.38
mag, GL	41(21624')	1956	63.681		
	2(755')	1955	Rept 6-2-255	SSM-228	
					Shklanka 1968,p.351
mag	9(2722')	1955	63.553, Rept 5-0-224		
mag		1959	63.1016		
GL		1954	63A.195		Robertson 1968b,p.77; Shklanka 1968, p.351
mag	2(1000')	1965	63.1791, Rept 10,11		Hodder 1961
AMG	7(1450')	1954	63.487, Rept 5-7-260		
mag		1951	63.244		

Township	Name	No.	Minerals commodity	Latitude	Longitude
McNAUGHT (cont.)	Nemegos Uranium Corp.	-	mag,U	(see 150)	
	Ontario Rare Metals Mines Ltd.	-	py,po,mo	(see 150)	
	Silverman Property	-	py,cp,mag,Nb	(see 150)	
	Titaniferous Magnetite Occ.	-			
McPHAIL	McClasky, J.A.	157	py,cp,gn, hem,Au	47°09.70′	82°13.05′
MILDRED	Algoma Central Railway (Franc. R. Joubin & Assoc.)	-			
	Algoma Central Railway (Algoma Ore Prop. Ltd.)	-			
MONTCALM	Area Mines Ltd.	158	po,py,cp	48°41.35′	82°07.60′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop.28	-			
	Huston, C.C. & Associates (Area Mines Ltd.)	-			
	Teck Exploration Co.Ltd. (Brand Option)	159	py,po	48°40.00′	82°07.60′
MOUNTBATTEN	I.R. 76 Occurrence	160	py	47°42.45′	83°01.85′
MUSKEGO	Butler, R.M. (Keevil Mining Group Ltd.) Prop 14	161	py,po,cp,sp	48°11.35′	82°22.45′
	Chalcopyrite Occurrence	162	cp	48°21.70′	82°20.30′
	Kam-Kotia Mines Ltd.	163	cp,po,py	48°13.40′	82°17.50′
	Scorch Creek Occurrence	164	po,py	48°13.50′	82°19.30′
NEELANDS (11B)	Ontario Dept. of Public Works	-			
NEWTON	Algoma Eastern Railway Co., Northern Ont. Lands Corp.Ltd.	-	Au		
	Rundle Gold Mines Ltd.	165	Au,py	47°51.25′	82°21.20′
	Talisman Mines Ltd.	-			
	Miquelon Showing	166	Au,py	47°54.60′	82°26.10′
	Rundle-Fredrickson Vein and Rundle-Hanna Vein	167	Au,py	47°54.80′	82°27.65′
	Rundle Gold Showing	-	Au	47°55.25′	82°25.10′
	United States Smelting Refining and Mining Co.	168	py,gf,po	47°50.65′	82°24.70′
NOVA	Area Mines Ltd. (Keevil Mining Group Ltd.) Prop.17	169	po,py,cp	48°28.50′	82°23.25′
	Butler, R.M. (Keevil Mining Group Ltd.) Komak Creek Group	170	py,po,sp, mag,gf	48°33.60′	82°22.45′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
mag	4(720′)	1950-51	63.192, Rept 5-3-258		
mag	5(2332′)	1954	63.483, Rept 5-5-261		
mag, GL	7(1229′)	1954	63.518		
		1959	Rept 5-7-259		
		1917			Lindeman & Bolton 1917,p.89-90
		1955			Rogers 1962,p.32 MRB files, Ottawa
GL		1963		SSM-514	
AEM, AMG		1957-58		SSM-646	
EM, mag	6(2402′)	1965	63.1418, Rept 5-1-555, 10,11,12		Bennett 1969,p.22
AEM, AMG, EM, mag		1966	63.1683		
mag				T-629, T-878	
EM, mag	2(917′)	1958		T-692	Bennett 1969,p.24
		1970			Visited
EM, mag, GL	3(1191′)	1965	63.1527, Rept 10	T-1119	
		1917			GSC Map 1697
		1970	2.207, Rept 11		The Northern Miner Sept.10,1970,p.1; Visited
		1970			Visited
		1968		Sudbury Quarry Permit. NE of Emmons Lake	
		1936			Harding 1937,p.20
GL		1950		Sudbury	
		1970			Pers. commun.
		1950		T-375	
		1950		T-375	
		1970			Unpublished geol. map, courtesy Hollinger Mines Ltd.
	2(324′)	1970			Pers. commun.
EM		1965	63.1442		Bennett 1969,p.22-23
	1(272′)	1964	Rept 10		

Township	Name	No.	Minerals commodity	Latitude	Longitude
NOVA (cont.)	Butler, R.M. (Keevil Mining Group Ltd.) Prop.29	171	sp,gf,po, cp,py	48°34.60′	82°22.35′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop.28	-			
	Huston, C.C.	-			
	McIntyre Porcupine Mines Ltd.	-			
	McIntyre Porcupine Mines Ltd.	-			
OATES	Area Mines Ltd.	-	py	cannot locate	
OKE	Estate Projects Ltd. (Westfield Minerals Ltd.)	172	po,py,gf	48°55.15′	82°01.75′
OSSIN	McIntyre Porcupine Mines Ltd.	-			
	McIntyre Porcupine Mines Ltd.	-			
OSWAY	Bi-Ore Mines Ltd.	106	asp,py	47°35.85′ (see Huffman)	82°13.05′
	Burton, M.	-			
	Chipway Gold Mines Ltd.	173	py,cp,asp, Au,mag	47°38.25′	82°18.70′
	Jerome Gold Mines Ltd.	4	Au,tet,sp,py, cp,mo,gn	47°37.45′	82°14.50′
	Osway Gold Mines Ltd.	174	py,cp	47°38.80′	82°17.95′
	Rumsey Creek Occurrence	-	py		
	Skye Property	175	Au,asp,py,Ag	47°36.05′	82°15.05′
	Southwest Osway Tp.IF	-	IF		
PATTINSON	Dominion Gulf Co.	31	Nb,RE,U,Th, mag,ap,Zr	48°01.20′ (Collins Tp.)	83°05.10′
		29		48° 00.15′ (Chewett Tp.)	83°04.40′
PENHORWOOD	Arnott, B.L.	-			
	Brewis and White	-			
	Burtho Gold Mines Ltd.	-	Au,py,cp	cannot locate	
	Canadian Johns-Manville Co.Ltd.	176	asb	48°10.90′	82°04.90′
	Canadian Johns-Manville Co.Ltd.	177	py,po,mag,asb	48°07.45′	82°03.00′
	Canadian Johns-Manville Co.Ltd.		asb		
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	178	IF, py	48°09.35′	82°10.60′
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	-			

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
EM, mag	6(2036')	1965	63.1419	T-857	Bennett 1969,p.24
AEM, EM, mag, GL		1966	63.1683		Bennett 1969
mag		1957	63.778		Bennett 1969,p.23
GL		1958	63A.345		Bennett 1969,p.24
EM		1958	63.934		Bennett 1969,p.24
EM		1965	63.1457		
EM, GL	3(1238')	1961	Rept 5-3-299		
GL		1958	63A.345		
EM		1958	63.934		
	?(15,000')	1949			Moorhouse 1949,p. 15-17; MRB files, Ottawa
	8(2,663')	1966	Rept 10		
		1947			Moorhouse 1949,p. 17-18; MRB files, Ottawa
		1938			Moorhouse 1949,p. 18-22; Brown 1948, p.438-441;MRB files, Ottawa
		1949 (?)			Moorhouse 1949, p.23 Shklanka 1968,p.354
		1949 (?)			Moorhouse 1949,p. 23-24; MRB files, Ottawa Shklanka 1968,p.354
mag, GL	41(21,624')	1956	63.681	Sudbury	Parsons 1961
	4(161')	?		T-495	
GL	2(1100')	1946		T-154	Milne 1972
GL		1947	63A.13		
	16(6471')	1953	Rept 10		Milne 1972
		1963			
	7(2875')	1955	Rept 17		Milne 1972
mag, DN, GL		1956-58	63.469		Milne 1972
mag, GL		1957	63.805		Milne 1972
mag, GL		1957	63.843		Milne 1972
GL		1960	63A.373		Milne 1972
mag, GL		1964	63.1320		Milne 1972

Township	Name	No.	Minerals commodity	Latitude	Longitude
PENHORWOOD (cont.)	Canadian Johns-Manville Co.Ltd.	179	asb,Au,asp	48°10.70′	82°06.80′
	Canadian Johns-Manville Co.Ltd.	180	asb	48°08.85′	82°05.20′
	Canadian Johns-Manville Co.Ltd.	-	minor py	cannot locate	
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	176	py,cp,po,gf	48°10.90′	82°09.90′
	Canadian Nickel Co.	181	po	48°07.85′	82°04.00′
	Canadian Nickel Co.	182	po,gf,mag	48°09.00′	82°03.45′
	Canadian Nickel Co.	-			
	Falconbridge Nickel Mines Ltd.	183	ba	48°05.25′	82°08.95′
	Horwood Mining Ltd.	184	quartz	48°04.90′	82°09.50′
	Kalbrook Mining Co.Ltd.	-			
	Kukatush Mining Corp.Ltd.	185	mag,po,py	48°09.25′	82°02.75′
	Kukatush Mining Corp.Ltd.	178	mag,po,py,cp	48°09.35′	82°10.60′
	McCarthey Garnet C. (Transhorwood Mines Ltd.)	178	IF, mag	48°09.35′	82°10.60′
	McIntyre Porcupine Mines Ltd.	-	py	cannot locate	
	Mining Endeavours Ltd.	176	py,asp,Au	48°10.90′	82°09.90′
	Mosher Claims	-			
	Nib Yellowknife Mines Ltd.	-			
	Nib Yellowknife Mines Ltd.	176	Au,py,asp	48°10.90′	82°09.90′
	Nib Yellowknife Mines Ltd.	-			
	Nat River Prospect	185	IF	48°09.25′	82°02.75′
	Penko Gold Mines Ltd.	190	py,Au	48°11.70′ (Reeves Tp.)	82°02.20′
	Pen-More Prospecting Syn.	-	py,mag		
	Pen Star Pros. Syndicate	-	py,mag		
	Penwood Gold Mines Ltd.	-			
	Purdy Mica Mines Ltd.	-			
	Pyrite occurrence	-		cannot locate accurately	
	Radio Hill Prospect	178	IF	48°09.35′	82°10.60′
	Texas Gulf Sulphur Co.Inc.	186	py,gf	48°09.75′	82°06.60′
	Transhorwood Mines Ltd.	178	mag,IF	48°09.35′	82°10.60′
PINOGAMI	Butler, R.M. (Keevil Mining Group Ltd.) Prop 23	-	py,cp,mag, po,sp		
POTIER	Central Manitoba Mines Ltd. (W. Gerrie)	238	po,cp,gf,py asp,Au	47°34.50′ (Yeo Tp.)	82°00.25′
		239		47°34.75′ (Yeo Tp.)	82°01.75′
	Three Ducks Lake Syndicate	238	gf,py,cp	47°34.50′ (Yeo Tp.)	82°00.25′
		239		47°34.75′ (Yeo Tp.)	82°01.75′
POULETT	Area Mines Ltd.	-			
PUSKUTA	Continental Mining Explor.Ltd.	-			

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
mag, GL		1966	63.898		Milne 1972
mag		1966	63.1669		Milne 1972
EM, mag	1(408')	1966	63.1857, Rept 12		Milne 1972
EM, mag		1966	63.1878		Milne 1972
	4(2241')	1966	Rept 11		Milne 1972
	2(1076')	1964	Rept 13	T-862	Milne 1972
	1(394')	1964	Rept 14	T-862	Milne 1972
	1(495')	1969	Rept 15	T-862	Milne 1972
		1963			Guillet 1963,p.18-20
					Milne 1972
		1966			Milne 1972
	13(?)	1946		T-145	Milne 1972
	5(3912')	1960	63.1052, Rept 16	T-669	Milne 1972
mag		1963	63.1234	T-669	Milne 1972
mag, GL		1966	63.147		
mag, GL, SP		1946-47	63.107		Milne 1972
GL		1947	63A.9	T-191	
	1(499')	1947		T-144	
GL		1948	63A.9	T-191	
GL		1948	63A.11, 63A.23		Milne 1972
GL		1948	63A.23, 63A.11		
					Shklanka 1968,p.355
GL		1946		T-145	
mag		1948	63.145		Milne 1972
mag		1948	63.146		Milne 1972
	4(3083')	1950		T-669	Milne 1972
	1(499')	1947			Prest 1950,p.38-39
					Milne 1972
		1924			Todd 1924,p.17
					Shklanka 1968,p.356
	1(79')	1960		T-506	Milne 1972
mag, GC			63.147 see McCarthey		
EM, mag, GR, GL	3(1391')	1965	63.1786 Rept 1-10 1-11, 1-12	Sudbury	
GL		1950	63A.95,Rept 5-2-390, 5-2-389		Laird 1932,p.31
	2(617')	1958	Rept 5-2-312		Laird 1932,p.28-30
	1(375')	1965	Rept 1-10		
EM, mag		1956-57	63.845	SSM-1466	

Township	Name	No.	Minerals commodity	Latitude	Longitude
RANEY	Raney Lake Prospecting Syndicate	187	Au,py,cp,gn	47°52.25′	82°48.10′
RECOLLET (T24 R22)	Algoma Central Railway	-			
	Molybdenite Occurrence	188	mo	47°53.25′	83°59.75′
REEVES	Arkel, E.	214	Au	48°13.00′ (Sewell Tp.)	82°00.45′
	Brewis & White	-			
	Canadian Johns-Manville Co.Ltd.	1	asb	48°12.10′	82°05.20′
	Canadian Johns-Manville Co.Ltd.	-	py,po (minor)		
	Canadian Johns-Manville Co.Ltd.	189	py (trace cp)	48°12.60′	82°02.70′
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	190	py,gf	48°11.70′	82°02.20′
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	190	py,po,gn	48°11.70′	82°02.20′
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	191	py	48°12.90′	82°05.50′
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Johns-Manville Co.Ltd.	-			
	Canadian Nickel Co.	192	gf	48°13.35′	82°10.80′
	Canadian Nickel Co.	193	gf,py	48°11.90′	82°10.25′
		194		48°11.25′	82°12.25′
	Kalbrook Mining Co.Ltd.	-			
	McIntyre Porcupine Mines Ltd.	195	py	48°11.45′	82°09.75′
	Penko Gold Mines Ltd.	190	Au,py	48°11.70′	82°02.20′
REILLY (4G)	Evans, Harry	-	cp,py,RA	Could not locate	
	Ranger Lake Uranium Co.Ltd.	-			
RENNIE	Cambre Mines Ltd.	-			
	Carmichel, D.H.	-			
	Cobalt Products Ltd.	196	asb	48°25.45′	83°55.00′
	Coulee Lead & Zinc Mines Ltd.	197		48°25.00′	83°56.25′
	Duvex Oils and Mines Ltd.	217	Au,py	48°21.40′ (Stover Tp.)	83°55.05′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
		1934			Rickaby 1934,p.35 MRB files, Ottawa
GL		1961		SSM-881, 818	
					Giblin 1967
		1916			Tanton 1916,p.181 Todd 1924, p.14-15 Milne 1972
GL	2(1100′)			T-154	
		1953-present			Hewitt and Satterly 1953,p.13, Milne 1972
EM, GL		1954	63.440		
EM	3(1151′)	1957	63.774, Rept 5-2-481		
EM, GL		1957	63.833		
EM, GC		1957	63.897		
	3(712′)	1957	Rept 5-3-442		
mag, GL		1964	63.1320		
	2(1001′)	1964	Rept 5-2-441A		
	1(501′)	1964	Rept 5-1-442A		
mag	2(696′)	1965	Rept 11, 63.1299		
	2(908′)	1965	Rept 10		
EM, mag		1966	63.1878		
	1(326′)	1964	Rept 12		
	3(1169′)	1964	Rept 5-1-441B, 5-1-442B, 5-1-441C		
	13(?)	1946		T-145	Milne 1972
mag, SP, GL		1946-47	63.107		
GL		1946		T-145	
		1949		SSM-1069 (C-14)	
ARA	5(2240′)	1955	63.649, Rept 6-2-637, 6-4-638	SSM-223	
		1939			Riley 1971
		1939			Riley 1971
mag	2(1500′)	1953	63.357	SSM-962	Riley 1971
(see Westfield Minerals Ltd.)		1953			
GL	8(2027′)	1948-1952	63A.148,63A.64	SSM-567	

Township	Name	No.	Minerals commodity	Latitude	Longitude
RENNIE (cont.)	Martin, W.L.	197		48°25.00′	83°56.25′
	Lysander Gold Mines Ltd.	198	py,po	48°22.10′	83°54.60′
	Northabie Mines Ltd.	-	py		
	Pyrite Occurrences	199		48°24.55′	83°56.75′
		200	py	48°22.00′	83°55.55′
		201		48°22.00′	83°58.50′
		202		48°24.75′	83°55.20′
	Renabie Mines Ltd.	-			
	Wesson Mines Ltd.	203		48°22.60′	83°54.45′
		204	py,po,sp	48°23.55′	83°55.65′
		205		48°24.30′	83°55.25′
	Westfield Minerals Ltd.	197	py,sp,cp,Ag, gf,Au,gn	48°25.00′	83°56.25′
RENWICK (4F)	Chalcopyrite Occurrence	-	py,cp,hem	cannot locate	
RIOUX (2E)	Huston, C.C. & Associates	206		46°45.85′	83°19.25′
	(McClasky Prospect)	207	cp	46°46.10′	83°18.70′
		208		46°46.35′	83°18.10′
	Lambert, G.F.	-			
	Taylor, K.R. & Allen, M.	-			
ROLLINS (4E)	Ahearn, R. or Taylor Oil & Mines	-			
	Bonnin, I.	-			
	Ontario Hydro	-			
	Preston East Dome Mines, Ltd.	209	Th,U	46°54.80′	83°12.70′
	Sanco Construction	-			
	Tarbutt Mines Ltd.	-			
	Taylor, R.J.	-			
ROLLO	Agaura Explorations Ltd.	210	py,gn,Au	47°52.30′	82°42.70′
	Canadian Nickel Co.	-			
	Canadian Nickel Co.	211	gf	47°50.80′	82°38.55′
	Cyril Knight Prospecting Co.Ltd.	212	Au,py	47°52.80′	82°42.75′
	Jarvis, A.	-			
	Sunorca Exploration Co.Ltd.	-			
ROOT (4D)	Ontario Hydro	-			
	Preston East Dome Mines, Ltd.	209	Th,U	46°54.80′ (Rollins Tp.)	83°12.70′
SANDY	Butler, R.M. (Keevil Mining Group Ltd.) Prop.27	213	po	47°56.05′	82°53.55′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
(see Westfield Minerals Ltd.)		1965			
mag, GL	4(856′)	1947	63.131, Rept 5-1-444, 5-2-443, 5-2-445	SSM-528	Riley 1971
RES	2(932′)	1954	63.404	SSM-568	Riley 1971
					Riley 1971
		1946			Riley 1971,p.44
mag, GL	10(1147′)	1947-48	63.124	SSM-492	Shklanka 1969 Riley 1971,p.44
AEM, AMG, EM, mag, RA, RES	28(5189′)	1953 1965 1969	63.1646, 63.2525 Rept 10,11,12, 5-7-451	SSM-842	Shklanka 1969,p.261 Riley 1971
		1968			Shklanka 1968,p.40 ODM 1923,p.200
	6(973′)			SSM-606	Shklanka 1969,p.72
		1966-67		SSM-1151	
	1(416′)	1956	Rept 6-1-246	SSM-217	
	6(694′)	1957	Rept 6-5-299		
	6(694′)	1957		SSM-220	
Sand and Gravel Quarry Permit		1967-69		SSM-1058	
GL	5(798′)	1949	Rept 6-4-259	SSM-607	Robertson 1968b,p. 14; Harding 1950
Sand & Gravel Quarry Permit		1968		SSM-1297	
	5(164′)	1957	63.799,Rept 6-5-300	SSM-225 SSM-221	
	3(266′)	1956	Rept 6-3-301	SSM-222	
		1934			Rickaby 1934,p.35
	1(433′)	1966	Rept 1-10		
	(1413′)	1966	Rept 1-11		
		1934			Rickaby 1934,p.35 MRB files, Ottawa
	3(150′)	1957		Sudbury	
	?(2500′)	1933			Kindle 1936,p.125
Sand & Gravel Quarry Permit		1968-69		SSM-1294	
	5(798′)	1950	Rept 6-4-259	SSM-607	Harding 1950 Robertson 1968b, p.14
EM, mag	1(395′)	1965	63.1748, Rept 1-10		

Township	Name	No.	Minerals commodity	Latitude	Longitude
SEWELL	Arkell, E.	214	Au	48°13.00′	82°00.75′
	Card Lake Copper Mines Ltd.	214	Sb,As,Cu,Ni	48°13.00′	82°00.75′
	Canadian Johns-Manville Co.Ltd.	-			
	Fawcett Claims	-	py		
	Gosselin Claims	214	Au,cp,py,po	48°13.00′	82°00.75′
	Kalbrook Mining Co.Ltd.	-			
	Penko Gold Mines Ltd.	190	Au,py	48°11.70′ (Reeves Tp.)	82°02.20′
SHAWKENCE (T24 R21)	Algoma Central Railway	-			
SHENANGO	Genesco Resources Property	-			
	Kennco Explorations (Canada) Ltd.	-			
SHERLOCK	Genesco Resources Property	-			
	Kennco Explorations (Canada) Ltd.	-			
SHIPLEY (19)	Canadian Nickel Co.	-			
SILK	Ansara, E.E.	-			
	Eclipse Airways	215	Au,cp,py	47°55.95′	82°25.25′
	McVittie Cryderman Option	-			
	Orofino Mines Ltd.	216	Au,py,po, cp,gn	47°56.40′	82°24.50′
	Thorne, G.A.	215	Au,py	47°55.95′	82°25.25′
SLIEVERT (2C)	Canadian Johns-Manville Co.Ltd.	-			
STRACHAN	Butler, R.M. (Keevil Mining Group Ltd.) Prop.28	-			
	Huston and Assoc.	-			
STOVER	Duvex Oils and Mines Ltd.	217	Au,py,asp	48°21.40′	83°55.05′
	Gilbert Option (Sylvanite Gold Mines Ltd.)	-			
	Guarnaccio Gold Mines Ltd.	-		48°20.30′	84°01.30′
	Kaksonen, J.	218	py	48°20.80′	83°58.85′
	Laird & Carmichael	-			
	Lysander Gold Mines Ltd.	198	py,po	48°22.10′ (Rennie)	83°54.60′

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
		1916			Tanton 1916,p.181 Todd 1924,p.14-15
		1969 1971			Milne, 1968a; The Northern Miner 1971,Oct.7,p.19; Oct.14,p.13;Oct.28, p.2
EM, mag		1966	63.1895		
	8(647')	?		T-288	
		1916			Todd 1924,p.14-15 Tanton 1916,p.181
	13(?)	1946		T-145	Milne 1972,p.91
GL		1946		T-145	Milne 1972,p.91
GL		1961		SSM-880	
EM, mag, GL		1968	63.2566		
mag, IP	2(1006')	1970	2.39		
EM, mag, GL		1968	63.2566, Rept 10		
mag, IP	2(1006')	1970	2.39		
	1(402')	1966	Rept 1-10		
	2(996')	1964	Rept 10		
		1934			Rickaby 1934,p.36
	2(655')	1947		Sudbury	
GL		1950		Sudbury	Harding 1937,p.20-23 Laird 1935b,p.34,35 MRB files, Ottawa
		1935			Harding 1937,p.20 Laird 1935b,p.34,35
AMG, ARA, GL		1969	63.2517	SSM-1442	
AEM, EM, mag, GL		1966	63.1683		Bennett 1969
mag	4(1643')	1957	63.778, Rept 4-10		Bennett 1969
GL	8(2027')	1948- 1952	63A.148 63A.64	SSM-567	
		1942		SSM-491	
AMG		1954	63.516	SSM-470	MRB files, Ottawa
GL		1948	63A.51		
	3(1153')	1955 1961		SSM-587	
mag, GL	4(856')	1947	63.131, Rept 5-1-444, 5-2-443, 5-2-445	SSM-528	Riley 1971,p.42

Township	Name	No.	Minerals, commodity	Latitude	Longitude
STOVER (cont.)	McMillan Group (Renabie Mine Ltd.)	-			
	Milmar-Island Mines Ltd.	-			
	Noranda Exploration Co.Ltd.	-			
	Pileggi Prospecting Syn. (Sylvanite Gold Mines Ltd., Garvey Property)	218	py,asp,Au	48°21.15′	83°58.20′
	Pileggi Prospecting Syn.	219		48°20.95′	83°56.90′
	NW, Central, SE groups	220	py,asp,Au,cp	48°20.60′	84°00.00′
	(Sylvanite Gold Mines Ltd.)	221		48°20.45′	83°55.30′
	Renabie Mines Ltd.	-	Au		
	Seaboard Oils & Mines Ltd.	222	py	48°20.25′	83°56.25′
	Stover Gold Mines Ltd.	220	py,cp,Au	48°20.95′	83°56.90′
	(same as Pileggi Prospecting Syndicate)			48°20.60′	84°00.00′
	Stover Tp. IF	-	IF		
	Thompson-Kaksomen Property	-			
	Turzone Explorations Ltd.	219	py	48°20.95′	83°56.90′
SWAYZE	Bayly Lake IF	-	IF		
	Buffalo Canadian Gold Mines Ltd.	223	Au	47°47.00′	82°40.00′
	Canadian Nickel Co.	224	gf	47°46.50′	82°36.50′
	Canadian Nickel Co.	225	gf	47°46.10′	82°42.70′
	Canadian Nickel Co.	-	IF		
	Collins, J.H.	-			
	Cree Lake IF	-	IF		
	Denyes Explor. Syn.Ltd.	48	Au	47°49.00′ (Denyes Tp.)	82°43.75′
	Flint Rock Mines Ltd.	-			
	Flint Rock Mines Ltd.	226	py,cp,po, Au,Ag	47°46.55′	82°41.25′
	Jarvis, A. Claims	-			
	Kenty Gold Mines Ltd. (W.G. Akins)	227	Au,py,gn, hem,gf,cp	47°50.20′	82°36.75′
	McNeely-McCullough	228	py,Au	47°50.00′	82°37.70′
	Montgomery-Ackerman	229	Au	47°49.75′	82°36.55′
TIMBRELL (3F)	Chalcopyrite occurrence	-	py,cp,hem	cannot locate	
TOOMS	Anaconda Co. (Can.) Ltd.	230		47°43.60′	82°55.75′
		75	cp,po,mag,gf	47°41.50′ (Greenlaw Tp.)	82°47.25′
		39		47°41.00′ (Cunningham Tp.)	82°44.00′
	Armac Securities Ltd. (Tooms Nickel Syndicate)	231	Cu,Ni,Zn	47°43.10′	82°52.30′
	Betty Lake IF	-	IF		

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
	3(504')	1949		SSM-540	
See Guarnaccio		1959-60			MRB files, Ottawa
EM, mag		1969	63.2584	SSM-1487	
	5(998')	1944		SSM-489	MRB files, Ottawa
				SSM-490	Horwood 1942,p.35-39
GL		1943		SSM-489	
				SSM-490	
	1(496')	1951	Rept 5-1-347	SSM-1377	
				SSM-501	
GL		1949	63A.74		
	13(1169')	1948	Rept 10		Horwood 1942,p.35-39; MRB files, Ottawa
					Shklanka 1968,p.360
GL		1948	63A.50		
	2(1001')	1961	Rept 5-2-348	SSM-563	
		1968			Shklanka 1968,p.361
		1934			Rickaby 1934,p.26
					Laird 1935c,p.38
					MRB files, Ottawa
	1(545')	1966	Rept 12		
	1(609')	1966	Rept 13		
	2(693')	1966	Rept 14		
		1933			MRB files, Ottawa
		1968			Shklanka 1968,p.361
		1934			Rickaby 1934,p.29
	10(1243')	1962	Rept 10		
	23(3056')	1962	Rept 11		Donovan 1965d,p.22
	3(150')	1957		Sudbury	
		1931			Rickaby 1934,p.21-25
					Furse 1932,p.51-53
					Donovan 1965d,p.20-21; MRB files, Ottawa
	?(5000')	1934			Rickaby 1934,p.25-26
					MRB files, Ottawa
		1934			Rickaby 1934,p.26
					MRB files, Ottawa
		1968			Shklanka 1968,p.40
					ODM 1923,p.200
	6(1431')	1960	63.1048, Rept 5-6-350		
	9(3014')	1967	Rept 10		Shklanka 1969,p.269
					Shklanka 1968,p.362

Township	Name	No.	Minerals, commodity	Latitude	Longitude
TOOMS (cont.)	Canadian Nickel Co.	-			
VILLENEUVE (3E)	Ontario Hydro	-			
WADSWORTH	Butler, R.M. (Keevil Mining Group Ltd.) Prop.7	138	py,po,gf	48°43.10′ (Lisgar Tp.)	82°27.25′
	McIntyre Porcupine Mines Ltd.	-			
WALLS	Culbert-Peterson	232	Au,cp,py,po	48°59.00′	83°59.70′
	Mitchell, D.	-	py		
	Neswoba Gold Mining Syndicate Option (Erie Canadian Mines Ltd.)	-	py,cp, Au, gn,po	cannot locate	
	Sand River Gold Mining Co.Ltd.	233	mag,po	48°59.75′	83°53.25′
WATSON	Butler, R.M. (Keevil Mining Group Ltd.) Prop.6	234	py,po,cp	48°42.80′	82°20.10′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop.7	140	py,po,gf	48°43.10′ (Lisgar Tp.)	82°27.25′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop.8	235	py,po	48°45.15′	82°22.75′
	Butler, R.M. (Keevil Mining Group Ltd.) Prop.20	236	py,po,gf	48°49.00′	82°23.25′
	Geophysical Engineering & Surveys Ltd. (Keevil Mining Group Ltd.) Prop.21	237	py,po,gf	48°49.90′	82°18.10′
WISEMAN (3B)	Briscoe-Kokdtow Occurrence	-	hem,cp,py	cannot locate	
WISNER	Wisner Tp. Occurrence	-	mag,py		
YEO	Central Manitoba Mines Ltd.	238	po,cp,gf,	47°34.50′	82°00.25′
		239	py,asp,Au	47°34.75′	82°01.75′
	Cryderman, R. (Moore Lake Grp) (Schist Lake Group)	238	py,po,cp,	47°34.50′	82°00.75′
		239	asp,Au	47°34.75′	82°01.75′
	Porcupine-Helca Mining Co.Ltd.	-			
	Schist Lake Occurrence	239	py	47°34.75′	82°01.75′
	Yeoman Mining Syndicate Ltd.	-			

Type of Work	DDH's	Approx. date	Toronto file	Other files	References
	1(401')	1968		Sudbury	
Quarry permit, Sand and gravel		1968		SSM-1290	
EM, mag, GC, GL		1965	63.1436	T-1044	
GL		1958	63A.345		
		1926			Gledhill 1927,p.86 Maynard 1929,p.122-123; MRB files, Ottawa
	2(68')	1957	Rept 6-2-234	T-1477	
	13(1501')	1934		SSM-197	
mag, DN	1(1106')	1957		SSM-633	
	1(551')	1966	Rept 11		
EM, mag, GC, GL		1965	63.1436	T-1044	
EM, mag, GC, GL		1965	63.1435		
EM, mag, GL		1965 1966	63.1590		
EM, mag	2(702')	1965	63.1592, Rept 10		
		1968			Shklanka 1968,p.40
					Shklanka 1968,p.363
	4(714')	1950	63A.95, Rept 5-2-389 5-2-390		
		1932			Laird 1932,p.30-31 MRB files, Ottawa Laird 1932,p.34 MRB files, Ottawa Shklanka 1968,p.364
		1941		Sudbury	

GOLD

A review of the assessment files and old geological reports indicates that at least half of the previous work in the map-area was done in evaluating gold showings. Because almost all of this work was done prior to the early 1950s and old trenches, pits and stripped areas are now overgrown, it was decided that property examinations would be confined to those on which underground work had been done. It was hoped that this limited number of properties would give a representative cross section of the gold deposits of the area.

Tables 20, 21, 22, are based in part on a search of assessment files and geological reports and are only as reliable as their sources. The reader is reminded that in Table 20, any one deposit may have more than one host rock, wall rock, etc. The heading "Host Rock" describes the rock within which the mineralization occurs; "Wall Rocks" the rock bounding the mineralized zone; and "Associated Rocks" those rocks whose relationship to the mineralization is uncertain.

Examinations of the various gold deposits indicate that silicification and carbonatization in association with shearing may be of more importance as an indicator to the localization of gold deposits than assessment literature would suggest. On nearly all the deposits visited, evidence of silicification and (or) carbonatization was found. There also appears to be a strong correlation between gold mineralization and felsic porphyritic intrusions. The ubiquitous occurrence of pyrite with gold mineralization suggests that pyrite occurrences should always be checked for their gold content.

The mineralogy of the gold deposits is given in Table 21 which records the reported frequency of occurrence of various minerals associated with gold mineralization.

W.G.Akins (227)
(Kenty Prospect)
Swayze Township
District of Sudbury

The former property of Kenty Gold Mines Limited is located just over ½ mile (0.8 km) northeast of the east end of Brett Lake, Swayze Township. Access to the property is by float-equipped aircraft to Brett Lake and a short walk from the former townsite of Swayze. A foot-trail, 21 miles (34 km) long, leads to the mine site from Sultan on the Canadian Pacific railway.

In 1946, the property was acquired by Erndale Mines Limited and 1,250 tons of ore were removed from the second level and 1,634 feet (498 m) of diamond drilling completed. There is no record of the amount of gold recovered from the mined ore. Work by Erndale Mines Limited ceased in 1950 (files, Mineral Resources Branch, Department of Energy, Mines and Resources, Canada).

TABLE 20 | LITHOLOGIC ENVIRONMENT FOR GOLD MINERALIZATION WITHIN THE CHAPLEAU AREA.

Host Rock

Number of occurrences reporting - 99

Rock Type	Percent of Total
Quartz veins	76%
Mafic metavolcanics	10%
Other	14%

Wall Rock

Number of occurrences reporting - 79

Rock Type	Percent of Total
Mafic metavolcanics	48%
Granitic rocks	15%
Sediments	15%
Other	22%

Associated Rocks

Number of occurrences reporting - 24

Rock Type	Percent of Total
Porphyry	62%
Diorite	20%
Mafic metavolcanics	18%

Structure

Number of occurrences reporting - 30

Structural Type	Percent of Total
Shearing	100%

Alteration

Number of occurrences reporting - 13

Alteration Type	Percent of Total
Silicification	69%
Carbonatization	23%
Sericitization	7%

TABLE 21 | MINERALOGY OF 86 GOLD OCCURRENCES WITHIN THE CHAPLEAU AREA, AS TAKEN FROM ASSESSMENT FILES AND GOVERNMENT REPORTS.

Mineral	Number of reported occurrences
Gold (native)	86
Pyrite	62
Chalcopyrite	38
Galena	25
Pyrrhotite	16
Sphalerite	10
Arsenopyrite	9
Molybdenite	5
Silver	2
Magnetite	1

This former gold property is now controlled by W. Akins. In 1970, surface workings were overgrown or partially filled in. Buildings at the mine site were in an advanced state of decay.

The first description of the property was by Rickaby in a special report quoted by Furse (1932, p.51-53):

The Kenty group comprises 15 claims, being 3 claims wide and 5 claims long, in an east-west direction, and tying on to the east boundary of Swayze township. Five showings had been uncovered at the time of the writer's visit, disclosing quartz veins occurring along fractures in greenstone. The veins, which have been stripped for lengths of up to 135 feet [41 m] show strong fractures with widths from 3 to 10 feet [0.9 to 3 m] striking from N.50°E. to N.70°E., and dipping 60° to 70°S.E. Along the fractures the basalts have been silicified and heavily mineralized with pyrite. Very minor amounts of chalcopyrite, galena, sphalerite, and molybdenite were noted. The quartz occurs as small stringers and veins up to 2 feet [0.6 m] in width parallel to the fracturing.

No. 1 showing occurs at the east end of a small lake near the west boundary of claim No. 20,709. The vein had been stripped for a distance of 120 feet [36 m] showing widths up to 5 feet [1.5 m]. It strikes N.55°E. and dips 65°S.E. It appears to have been faulted in two places, the fault planes being approximately at right angles to the vein. Coarse native gold was visible in one place. Grab samples from this vein assayed as follows:-

Quartz ..... $0.40[1]

Pyrite schist 7.80

No.2 showing occurs in the southern part of claim No.20,710, about 300 feet [90 m] west of No.2 post. It has a northeast strike and dips to the southeast, but insufficient work had been done to determine its attitude accurately. The fracturing extends over a width of 8 feet [2.5 m] in one place.

[1]In 1932 the price of gold was $20.67 per ounce.

Grab samples assayed as follows:-

Quartz $2.80

Pyrite schist 5.00

No.3 showing occurs near the west boundary of claim No. 20,713, about 600 feet [180 m] north of No.3 post. The vein has been stripped for a distance of 135 feet [41 m] and some shallow trenches have been blasted out. It shows a width of from 5 to 8 feet [1.5 to 2.5 m] at the east end, where it passes into low ground. The strike is N.70°E., and the dip 65°S. Assays of samples were as follows:-

1– Chip sample across 8 feet at east end of vein $0.60

2– Chip sample across 5 feet 35 feet west 1.00

3– Grab sample of quartz at east end ..... Nil

4– Grab sample of pyrite schist east end 5.40

5– Grab sample of pyrite schist near west end 9.00

No.4 showing occurs on the south boundary of claim No.20,713, about 450 feet [137 m] east of No. 3 post. The vein had been stripped for a distance of 100 feet [30 m] showing a width of 10 feet [3 m] in places. It strikes N.50°E. and dips 60°S.E. Small dikes of felsite intrude the fracture in this showing. A grab sample of pyrite with some quartz assayed $2.40.

No.5 showing occurs on claim No.20,716, about 300 feet [90 m] east of No.3 post, and shows a quartz vein from 2 to 2½ feet [0.6 to 0.8 m] wide, striking N.55°E. and dipping 70°S.E. It had been stripped for a distance of 75 feet [23 m] but no blasting had been done and no samples were taken.

It is not possible to form an estimate of the importance of this discovery at this early stage of its development. A favourable feature however, is the strength of the fractures and the heavy pyritization. The samples assayed above point to a close connection between the pyrite and the gold values. As a prospect, this property would appear to have more than ordinary merit.

The property of Kenty Gold Mines Limited was further described in considerable detail by Rickaby (1934, p.22-25) as follows:

Vein Characteristics.–The Kenty veins belong to the lode type of deposits, consisting of a series of parallel veins, each having a main quartz leader with subsidiary parallel veinlets and altered country rock intervening. They may occur in the lavas, sediments, or intrusive rocks. The average strike of the veins is approximately N.60°E., and they dip to the southeast at angles varying from 40 to 80 degrees. The veins occur in fractures in the country rock with practically no schisting. The average width of vein material is from 4 to 5 feet [1.2 to 1.5 m] with a maximum of 10 feet [3 m]. The wall rocks show considerable replacement by carbonates, chiefly ankerites, and pyrite. The quartz contains some pyrite and tourmaline; other gangue minerals noted are calcite, galena, specularite, graphite, chalcopyrite, and a little feldspar. Coarse native gold is visible in fractures in the main quartz or in the narrow quartz veinlets. Almost every vein shows some visible gold, and in places on the surface it is present in spectacular amount, the most notable veins being Nos. 1, 3, 11, 16, and 21. Veins Nos. 9, 11, and 16 are probably faulted portions of the same vein; and in No. 16 over a length of 90 feet [27 m] between two faults, coarse native gold is to be seen in fractures in the quartz for the full length.

Faulting.–A series of post-mineral faults intersect the veins, causing displacements from a few feet up to 350 feet [107 m] or more. Vein No. 1, for example, in a length of 200 feet [60 m] has three parallel faults striking N.10°W., with a maximum displacement of 30 feet [9 m]. At the east end of the surface showing it has been faulted to the northwest and has been recently picked up by crosscutting, proving a displacement of 360 feet [110 m]. This condition of faulting adds somewhat to the problem of following the veins underground, but much information has already been obtained to assist in connecting various sections of the veins.

Underground Development.–Shafts Nos. 1 and 2 have been sunk to depths of 500 feet and 525 feet [150 m and 160 m] respectively. Up to the end of April, 1934, approximately 5,000 feet [1500 m] of lateral work, including 3,000 feet [900 m] of drifting, had been done. Since the beginning of 1934 a campaign of diamond-drilling has been carried on to obtain further information on the geology, faulting, and vein structures. Up to the present the underground work has been concentrated on veins Nos. 1, 3, and 9, but there are many other veins indicated on the surface, in the drilling, and underground with possibilities worthy of investigation. In the vicinity of the two shafts and eastward the greenstones and sediments are intruded by the lamprophyric rocks, and the veins lying to the north and dipping southward pass into these lamprophyres.

TABLE 22 | FORMER GOLD PRODUCERS AND PROSPECTS IN THE CHAPLEAU AREA

Name	Ownership in 1970	Township	Latitude	Longitude	Development	Production (ounces) Au	Ag	Reserves
Halcrow-Swayze mine	Belcher Mining Corp. Ltd.	Halcrow	47°48.00′	87°56.50′	One 371′ shaft; three levels at 200′,270′ & 354′	38.733	15.0	127,500 tons @ 0.11 oz/T
Jerome mine	The E.B. Eddy Co. Ltd.	Osway	47°37.45′	82°14.50′	One 1138′ shaft; six levels at 200′, 350′,500′,650′, 800′ and 1,100′	56,878	15,104	345,000 tons @ 0.19 oz/T
Kenty prospect	W.G. Akins	Swayze	47°50.20′	82°36.75′	Two shafts; No.1 is 510′ deep with three levels at 250′, 375′, and 500′; No. 2 is 534′ deep with 2 levels at 290′ and 525′			
Lee prospect		Greenlaw	47°45.50′	82°49.95′	One 250′ shaft; two levels at 125′, and 250′			
Joburke prospect[1]	New Joburke Explor. Ltd.	Keith	48°08.80′	82°17.00′	One 425′ shaft; three levels at 125′, 250′, and 375′			
Nudulama prospect	Nudulama Mines Ltd.	Leeson	48°23.00′	83°49.00′	One 1065′ shaft; seven levels at 150′, 275′,425′,575′,725′ and 1025′			579,325 tons @ 0.194 oz/T.possible additional 1,000,000 tons (no grade est.)
Orofino prospect	Orofino Mines Ltd.	Silk & Horwood	47°58.00′	82°24.00′	One 306′ shaft; two levels at 150′ and275′			

Renabie mine	Renabie Mines Ltd.	Leeson	48°23.00′	83°52.00′	Two shafts: one 281′ with two levels at 125′ and 250′; one 3455′ with twenty levels	776,191 (to July, 1970)	245,146	101,025 tons @ 0.204 oz/T. (Dec. 31, 1969)
Rundle prospect	Rundle Gold Mines Ltd. (Hollinger Mines Ltd.)	Newton	47°51.25′	82°21.20′	One 374′ shaft; two levels at 150′ and 300′			100,000 tons @ 0.29 oz/T (portion)
Swayze-Huycke prospect		Cunningham	47°44.80′	82°37.70′	One 150′ shaft; one level at 125′			
Tionaga mine/ Smith-Thorne mine	F. Lefever and J. Lefever	Horwood	47°57.20′	82°19.20′	One 731′ shaft; five levels at 200′, 325′, 450′, 570′ and 700′	2299	404	

[1]The Joburke prospect was brought into production in 1973 by Noranda Explor. Co. Ltd.

No. 1 Shaft.–Shaft No. 1, which was sunk on No. 1 vein, has been drifted on at three levels, 250, 375, and 500 feet [76, 114, and 152 m]. The vein, which is in basalt on the surface, dips about 58°S. and passes into the sediments above the 500-foot level [152 m]. The vein is strong and has good widths with good mineralization down to and including the 375-foot [114 m] level, but is narrow on the 500-foot [152 m] level. On this level, however, another vein was encountered just north of the shaft and approximately 100 feet [30 m] north of No.1. One hundred and fifty feet [45 m] east of the shaft both these veins are faulted to the north, and a crosscut run out to the north on the 375-foot [114 m] level has picked up the eastward extension of No.1 vein, showing a displacement of 360 feet [110 m] to the north. The fault strikes approximately N.10°W., and it would appear that the vein encountered on the 500-foot [152 m] level north of the shaft is the westward extension of what is known on the surface as No.19 vein.

No.2 Shaft.–At No.2 shaft, which lies approximately 1800 feet [550 m] east of No.1 and was put down to examine veins No. 9 and No.3, drifting has been done at two levels, 290 and 525 feet [88 and 160 m]. The veins have the usual complications due to minor faulting, but the fractures are strong and have good widths of quartz. Much of the wall rock of these two veins in this section of the underground work consists of the lamprophyric dikes, alternating with basalts, with the former type predominating. The west drift on the No.9 vein at the 290-foot [88 m] level and the intersection of this vein at the 525-foot [160 m] level show considerable porphyry. A drill-hole to the south from the end of the south crosscut at the 525-foot [160 m] level passed through more than 300 feet [90 m] of basalt showing two strong-looking veins that are not represented on the surface. This band of basalt would appear from surface work to widen out toward the east.

Gold Values in the Veins.–Surface and underground work so far indicate that the best ore values are present where the veins occur in the greenstones as opposed to the lamprophyres or sediments. The only difference noted in the appearance of the veins in the different types of rocks lies in the amount of mineralization of the altered wall rock, particularly with regard to the amount of pyrite present. The fractures may be just as strong and the quartz may have just as good widths in the lamprophyres as in the greenstones, but the pyritization is more marked in the latter, and better values occur in general where the pyritization is strongest. The veins show low or erratic values in the lamprophyre, and, as a result, the development of ore shoots up to date has been only moderately encouraging, owing possibly to the extent of these lamprophyres in the vicinity of the underground work. Considerable further exploration is now being carried out, particularly in the area to the south of No.2 shaft, where a large body of greenstone is indicated and into which the veins outcropping on the surface north of the shaft would appear to dip below the 500-foot [152 m] level.

Observations by the author [Sage], during a brief visit, agree with Donovan's (1965d, p.21) interpretation that the "lamprophyric dikes" of Rickaby may be a dioritic phase of the intermediate to mafic metavolcanics.

Three grab samples were taken for assay by the author, two from the muck pile close to the west side of the shaft, and one from an apparently barren quartz vein outcropping north of the shaft. Both samples from the muck pile are moderately mineralized with up to 5 percent pyrite and both are breccias of silicified, carbonatized, and pyritized metavolcanics cemented with barren, milky quartz and yellow-brown carbonate. The two grab samples taken from the muck pile assayed 0.16 and 0.19 ounces gold per ton respectively (assays by Mineral Research Branch, Ontario Division of Mines). The sample of milky quartz taken from the vein north of the shaft assayed trace of gold.

Two additional outcrop samples for thin sectioning were taken approximately 30 feet (9 m) NE and 310 feet (95 m) NW of the shaft respectively. The two samples are very fine grained, massive, silicified and carbonatized, mafic metavolcanics. The second sample contains approximately 15 percent pyrite, and limonite after pyrite, and is much more altered than the first sample. In thin section, the quartz and calcite are seen to occur as microcrystalline grains, the quartz having the typical mosaic pattern of fine-grained chert. Other minerals identified were altered pyroxenes, altered plagioclase, chlorite, and possibly fine-grained needle-like actinolite. Only a brief visit was made to the No.2 shaft site

located just over ¼ mile (0.4 km) northeast of the No.1 shaft, and no samples were collected.

Belcher Mining Corporation Limited (3)
(Halcrow-Swayze Mine)
Halcrow Township
District of Sudbury

Belcher Mining Corporation Limited currently controls 19 patented claims encompassing the former Halcrow-Swayze Mines Limited property in central Halcrow Township. The patented claims covering this property are registered to James H. Guerin, Roger Downey and Walter Hill. The former mine site is located on claim P.22151, registered to Roger Downey.

The mine site is located approximately ¾ mile (1.2 km) due west of the north end of Halcrow Lake and can be reached from either Halcrow or Shunsby Lakes where float-equipped aircraft can land.

Rickaby (1934, p.31-33) described the work in 1932 and 1933 as follows:

The principal showing occurs on claims S.22,151, 22,158, and 22,146, and consists of a shear zone in an impure quartzite or greywacke, striking S.60°E. and dipping 80°N.E. The south limit of the shearing is represented by a fault with greenstone tuffs on the footwall side. The north limit is represented by a dike of quartz diorite 100 feet [30 m] or more in width, which parallels the shear zone and has been traced for half a mile [0.8 km]. The width of the zone between the diorite dike and the fault varies, with a maximum of 200 feet [60 m], and the shearing varies in intensity across this width. In the zones of more pronounced shearing the quartzite and diorite have been mineralized, chiefly with pyrite and carbonates, and the gold values are associated with this mineralization. Definite quartz veins do not occur except in cross-fractures in the main zone.

The mineralization of this deposit seems to be genetically connected with the quartz diorite dike. Besides the main dike a number of small offshoots from it may be seen in some of the pits. Several narrow mica lamprophyre dikes, usually not over a foot [0.3 m] wide, occur along the shear zone. One of these dikes has been traced continuously for a distance of 500 feet [150 m], commencing east of the shaft and following westward along the footwall.

All the mineralized schist across the zone is reported to carry low values in gold, from 0.01 to 0.03 ounces per ton, and some zones show medium to moderately low values. One of these zones along the footwall side is reported from underground sampling to show over a width of 4 feet [1.2 m] an average of 0.20 ounces of gold per ton for a length of 100 feet [30 m] or 0.15 ounces per ton for a length of 235 feet [72 m] and in addition at the west end of the drift an average of 0.20 ounces over 8 feet [2.5 m] for a length of 50 feet [15 m]. On the surface some quartz veins occurring in the cross-fractures with considerable pyrite and some chalcopyrite showed values considerably higher than this. One of these, known as No.1 vein, is reported to have shown 0.70 ounces per ton across a width of 44 inches [112 cm]. Surface trenching and test-pitting have indicated a zone with a length of approximately 1,500 feet [460 m] containing low gold values over considerable widths with possibilities of finding enrichments that might afford ore bodies of medium to low grade.

During 1932 and 1933 a great deal of surface trenching and test-pitting was done, followed by 2,000 feet [600 m] of diamond-drilling. Following this a shaft was sunk to a depth of 200 feet [60 m] and approximately 1,200 feet [360 m] of lateral work has been completed. The main drifting was done along the zone at the south side of the shearing with a crosscut run out to the northwest toward the quartz diorite dike. The management proposes to continue the drifting to the west and at the same time to carry on drilling from the 200-foot [60 m] level to encounter the mineralized zone at a depth of 500 feet[150 m]. During the winter a small pilot mill of 25 tons capacity with crusher, ball mill, Diesel engine, and cyanide equipment was taken into the property to be used in sampling the ore.

Laird (1935c, p.39) stated:

Development at the property of the Halcrow-Swayze Mines, Limited, in Halcrow township, proceeded steadily during 1934. It consisted mainly of surface exploration, underground development, diamond-drilling, and the operation of a 25-ton test mill, all of which was carried on under the direction of Horace Strong.

The testing of the three main veins as exposed on the surface are reported to have given the following results:

Vein	Length	Width	Gold content
	feet	inches	ounces per ton
No.1	100	16	0.235
No.2	900	84	.120
No.4	30	12	.857

A shaft was sunk on No.2 vein to a depth of 371 feet [113.1 m] with levels at 200 and 354 feet [60 and 108 m] and a sublevel at 270 feet [82 m]. Most of the underground development has had to do with No.2 vein at the 200-foot [60 m] level, where it has been drifted on for a length of 1,138 feet [347 m] and shows widths ranging from 4 to 7 feet [1.2 to 2.1 m]. On the bottom level No. 2 vein was opened for a length of 200 feet [60 m] and showed an average width of 4 feet [1.2 m]. Diamond-drill intersections below the bottom level indicate the continuity of No.2 vein, as well as low gold values to a depth of 500 feet [150 m].

Mr. Strong, president of the company, estimates in No.2 vein 82,500 tons of ore above the 200-foot [60 m] level, with a grade of 0.11 ounces gold per ton, and a further 45,000 tons of the same grade ore between this and the bottom level. By a process of selective mining it is stated that 35,000 tons of ore with a grade of 0.171 ounces per ton could be extracted down to the 354-foot [108 m] level.

The author [Sage] concurs with the most recent geological mapping of the area by Donovan (1968). During a brief visit to the property one thin, fine-grained bed of possible greywacke was noted on some stripped outcrop north of the shaft.

The author collected four grab samples for assay and two outcrop samples for thin sections. One grab sample assaying 0.68 percent copper, 0.03 ounces gold per ton, and 0.27 ounces silver per ton (assays by Mineral Research Branch, Ontario Division of Mines), is a sheared quartz-veined, carbonatized, sericite schist containing medium-grained (less than 2 mm), disseminated chalcopyrite. The rock is either a highly-altered, felsic metavolcanic or a phase of the quartz porphyry outcropping just east of the shaft. This specimen was collected from the muck pile about 80 feet (24 m) north of the shaft, but the rock is not common in the muck pile.

A second grab sample, assaying 0.43 ounces of gold per ton (Mineral Research Branch, Ontario Division of Mines), consists of sheared, carbonatized, vein quartz with up to 50 percent granular to crystallized pyrite (less than 2 mm diameter). This sample was taken from the muck pile just north of the shaft.

Examination of two thin sections of the country rock indicate that both samples are probably crystal tuff, and consist of a fine-grained, inequigranular groundmass of sericite and potassium feldspar enclosing irregular anhedral crystals (2 to 3 mm) of potassium feldspar which make up approximately 50 percent of the rock. Quartz, calcite, limonite and plagioclase are generally present in amounts of 5 percent or less. The potassium feldspar grains commonly have irregular sutured edges probably caused by minor recrystallization of the feldspar. The potassium feldspar is untwinned and has the appearance of quartz but good right-angle cleavage can be observed. Plagioclase probably composed a much larger proportion of the rock before undergoing alteration to sericite and calcite. Relict albite twinning is present in some highly altered plagioclase grains.

The E.B. Eddy Company Limited (4)
(Jerome Mine)
Osway Township
District of Sudbury

The operations of Jerome Gold Mines Limited were located on a point of land jutting northward into Opeepeesway Lake. This former mine site was not visited by members of the field party. Access to the property is by motor road from the town of Ramsey on the Canadian Pacific railway. The patented claims which encompass the mine site are currently owned by The E.B. Eddy Company Limited. The mine has been idle since 1945.

This property was described by Moorhouse (1949, p.18-22) as follows:

The vein zone on which most of the work has been done was discovered by Bert Jerome in 1938 while prospecting for the Mining Corporation of Canada. The find was drilled and underground exploration was begun in 1939.

The property is provided with a complete mining plant and a 500-ton mill. The 3-compartment shaft reaches a depth of 1,138 feet [347 m] and levels have been established at 200, 350, 500, 650, 800, and 1,100 feet [60, 105, 150, 200, 245, and 335 m]. Most of the work to date has been carried out on the 200-, 350-, and 500-foot [60, 105, 150 m] levels, with drifts extending 1,200 feet [370 m] or more east of the shaft and 1,500 feet [460 m] or more to the west.

Many of the claims are covered by water, as is obvious from an examination of the map. For the most part the exposed rock is greywacke with some conglomerate, the latter being especially prominent in the southeastern part of the property. These sediments have been extensively intruded by dikes and bodies of porphyry. The most characteristic phase is a feldspar or syenite porphyry, which in its less altered condition is red in colour but which in many places, as in the large outcrops southeast of the shaft, has been highly carbonatized and altered so that it weathers to a grey colour. In the vicinity of these intrusions the sediments have been highly altered and porphyritized, so much so that the distinction between them and the porphyry is very difficult to make. Small amounts of lamprophyric material also outcrop, the best exposures being on the small island just north of the dock on Jerome point. Diabase dikes were noted in the southeastern part of the property near the Osway-Huffman boundary and were intersected by diamond-drilling in other parts of the property.

At the time of the writer's visit, the mine was flooded, and it was not possible, therefore, to make an underground examination. The staff kept a very complete record of the underground geology while the mine was in operation. A study of their maps and the surface map indicates that the vein zone lies at or near the contact of the sediments with a tongue of porphyry or highly porphyritized sediments. The keel of the porphyry tongue lies near surface at the west end of the workings, but pitches irregularly east to a depth of more than 1,000 feet [300 m] near the east end.

In the eastern part of the mine the vein zone strikes N.50°W., curving gradually to strike N.80°W. at the west end. The average dip is 72°N. W.L. Brown [1948, p.439-440] says:-

"The gradual arc in the shear zone may be an important structural control on the emplacement of the ore. Fractures or stringer zones diverge tangentially both east and west of the centre of the arc in the main vein. These subsidiary zones consist of a number of rudely parallel, bluish quartz stringers in sufficient number to make ore zones."

Numerous faults, which seem to fall into two main sets, were encountered underground. One set strikes N.10° to 25°W. and dips east at angles varying from 20 to 40 degrees. These are thrust faults with a predominant vertical movement, which is shown by striae and mullion structure, and a right hand horizontal displacement of from 1 to 50 feet [0.3 to 15 m]. The faults of the second set strike N.65° to 75°W., usually at a small angle to the strike of the vein zone, and dip nearly vertical. They intersect the thrust planes already described and have displaced them from 1 to 30 feet [0.3 to 9 m]. The horizontal shift produced by these faults is left-handed, i.e., north side west. Tension fractures associated with these faults strike N.45° to 65°E. and dip 75°W. Brown reports:-

"These tensions fractures cut across the early vein material as well as the earlier thrust faults. They are filled with milky quartz carrying coarse pyrite, tetrahedrite, and native gold. Thus, it is ob-

vious that at least one stage of gold mineralization is later than the post-vein thrust faults. This is further borne out by the assay plans, which show a concentration of higher grade ore under the east dipping faults. That hydrothermal solutions have been active along the thrust fault planes is shown by bleached wall-rock and the development of sericite and tourmaline for 3 feet [0.9 m] or more on either side.

"Another longitudinal fault in the eastern section of the mine strikes east-west and dips 72°N. This fault has a right-hand horizontal movement of approximately 100 feet [30 m]....The relative age of this latter fault with respect to the longitudinal faults of left-hand movement is not known."

The mineralized zone is complex in structure and composition. It comprises a zone of cherty bluish-grey quartz from 3 to 4 feet [0.9 to 1.2 m] wide on the north wall, a central section of glassy quartz and white carbonate, and on the south wall a discontinuous vein zone, in places consisting of stringers, of bluish quartz. The main vein is fairly persistent but varies considerably in width and is locally interrupted. In addition, there are local thick sections, some of which are wider portions of the main vein, while others appear to be more or less isolated pods. In addition to the lenticular nature, which is a primary feature of the vein structure, the mineralized zone is further broken up by the faults described in the preceding paragraph.

The vein material is well exposed on surface at only one place, a small pit just northwest of the open cut, which is located about 250 feet [76 m] northeast of the shaft. On the southeast wall of this pit, a detailed section from the northeast to the southwest is as follows: 2 feet [0.6 m] of schist with pods of silicified material; a 2½-foot [0.8 m] lens of silicified country rock; 8 inches [20 cm] of schist; a horizontal lens of typical blue-gray, cherty quartz, with carbonate, 32 inches [81 cm] wide and from 12 to 14 inches [30 to 36 cm] thick; 12 inches [30 cm] of schist with lenses of quartz; 20 to 22 inches [50 to 56 cm] of cherty blue quartz containing inclusions of country rock and cut by carbonate veinlets, both quartz and carbonate being intersected by lenses of glassy quartz; 2½ feet [0.8 m] of barren glassy quartz and carbonate; greywacke on the southwest wall. The total width of the mineralized zone here exposed is thus about 13 feet [4 m]. In the outcrop between this pit and the open cut to the southeast, the mineralized zone is represented by a silicified, carbonatized greywacke. The sediments and porphyry along the vein zone are red in colour owing to alteration, a feature often shown by porphyritized sediments in the area.

As already indicated, the veins consist of blue-grey to black cherty quartz, cut by later carbonate and glassy quartz. The former is mineralized with very fine grained metallics which cannot be determined from visual examination, and carries most of the values. Examination of polished sections from the surface exposure described revealed only pyrite, a little native gold, and an exceedingly fine grained silvery metallic, which has not been determined. The blue colour of the quartz is caused, at least in part, by this mineral. Chalcopyrite, tetrahedrite, galena, sphalerite, and molybdenite are also mentioned by Brown. Visible gold is rare. Sericite is associated with it. The cherty-looking quartz probably has formed, at least in part, by silicification of the country rock. Chalcopyrite and tourmaline were noted in the glassy quartz. Visible gold is reported to occur in it occasionally. Values are said to be generally lower and more erratic than in the dark-coloured quartz.

According to Brown, "The vein material varies from 5 to 75 feet [1.5 to 23 m] wide." Ore shoots have been found, to date, over a strike length of 3,000 feet [900 m].

Not all the mineralization consititues ore. The ore shoots in the zone show a steep rake to the west and are found to bottom in a zone of quartz and carbonate which carries no values. The values extend to a greater depth in the eastern part of the mine than in the western part. This is considered by Brown to be connected with the eastward pitch of the porphyry tongue, since values do not tend to persist below the bottom of the porphyry.

Ore reserves were officially estimated in 1945 to be 345,000 tons averaging 0.19 ounces gold per ton after dilution. Milling began onAugust 25, 1941, and was suspended owing to labour shortages on August 31, 1943. Underground work was suspended in 1945. Up to the time milling was stopped, total production was 335,060 tons, which yielded gold to the value of $2,189,822 and silver to the value of $5,829.

A second mineralized zone has been indicated by surface work and diamond-drilling some 400 feet [120 m] south of the main vein. Company plans indicate that this mineralization also is located along a porphyry-sediments contact. It has been indicated by drilling for a length of about 1,400 feet [430 m] and has a maximum width of 60 feet [18 m] according to mine plans. Only the north wall of this zone is exposed. It is highly carbonatized, silicified, sheared, and locally brecciated. Stringers of glassy quartz with tourmaline and chalcopyrite cut this zone. Carbonate stringers are also present.

Lee Prospect (80)
Greenlaw Township
District of Sudbury

The former property of Lee Gold Mines Limited is located close to the northwest shore of a small bay on the west side of Lee Lake in the northwest corner of Greenlaw Township. In 1970 the mine site was heavily overgrown and most of the surface workings covered, filled in, or water filled. The patented claims formerly covering this property have been surrendered. Rickaby (1934, p.33-34) described the property as follows:

> The principal showings occur...on the west side of Lee Lake. The country rock consists of diorite, which intrudes the Keewatin greenstones and sediments of the Ridout series approximately along the contact. The diorite is cut by a dike of quartz porphyry from 10 to 20 feet [3 to 6 m] wide, striking S.60°E., which has been traced by trenching for 800 feet [240 m]. The porphyry and the diorite for a width of 5 to 10 feet [1.5 to 3 m] on either side of the porphyry have been sheared and replaced by quartz and carbonates heavily mineralized with pyrite and showing narrow streaks of chalcopyrite. This condition is seen in a series of seven deep trenches extending over a length of 300 feet [90 m]. The mineralization is confined to the highly schisted rock, which dips about 80°N., and this mineralized schist is reported to show good values in gold. Four grab samples of this material gave a gold content of up to 0.10 ounces per ton. A series of 11 shallow diamond-drill holes have been put down to intersect the mineralized zone over a length of 800 feet [240 m]. Four of these holes are reported to have shown values in gold from 0.25 to 0.64 ounces per ton.

Laird (1935c, p.39) stated:

> During 1934, Lee Gold Mines, Limited, was engaged in underground development of their property at Lee lake, Greenlaw Township. A shaft was sunk to a depth of 250 feet [76 m] and considerable lateral work was performed on levels established at 125 and 250 feet [38 and 76 m]. The mineralized shear zone, as exposed on surface, is reported to have been intersected on both levels. Disappointing gold values, however, together with a faulting problem led to the suspension of operations in January, 1935.

Donovan (1968, p.42) stated that the ground formerly held by Lee Gold Mines Limited was under control of New Athona Mines Limited. There is no record of any recent work having been done by this company on the property.

During a brief visit to the mine site the author located a pit approximately 60 feet (18 m) east of the shaft in highly sheared grey-green quartz feldspar porphyry in which irregular disseminations of pyrite, pyrrhotite, and chalcopyrite occur with quartz and carbonate along foliation planes. The best mineralization occurs over a width of about 4 feet (1.2 m) near the south end of the trench and from 5 to 6 feet (1.5 to 1.8 m) south of a contact with a slightly sheared, white quartz feldspar porphyry. Sulphide content is variable, and ranges from 1 to 3 percent. The shearing which is represented by a well developed foliation strikes N75W and dips 60N. Grab samples of the more heavily mineralized, chalcopyrite-bearing material taken from the pit by the author assayed 0.47 percent copper and 0.04 ounces of gold per ton (assay by Mineral Research Branch, Ontario Division of Mines). The mineralization was not observed in a deep pit and a trench approximately 20 and 70 feet (6 and 20 m) respectively farther east along strike of the contact. A deep pit which was located near the trench with the chalcopyrite mineralization, was water-filled and could not be examined.

Outcrops of metavolcanics examined in proximity to the mine site appear to

be intermediate to felsic in composition. A sample from an outcrop southeast of the shaft, appears to be an altered, highly sheared intermediate metavolcanic, possibly a cyrstal tuff or a sheared feldspar porphyry. Two other samples are representative of the grey-green and white quartz-feldspar porphyry respectively, which are associated with minor chalcopyrite mineralization. The first of these was taken from a prospect trench approximately 150 feet (45 m) east of the shaft. The rock is grey-green, highly sheared and carbonatized, quartz-feldspar porphyry or crystal tuff with carbonate composing almost 50 percent of the rock. The second was taken from the same prospect trench about 150 feet (45 m) northeast of the shaft site. This rock is a carbonatized, slightly sheared, quartz-feldspar porphyry. The two apparently different rock types could be one and the same, with chlorite in the more highly sheared sample causing darker colouration. Sericite and carbonate are common in all the thin sections. Other minerals identified in one or more thin sections were limonite, chlorite, pyrite, and epidote. The feldspar in all thin sections is plagioclase of sodic andesine composition. Some fine-grained material displaying a granophyric texture exists between and along the edges of some plagioclase grains.

F. Lefever and J. Lefever Jr. (6)
(Tionaga Mine/Smith-Thorne Mine)
Horwood Township
District of Sudbury

The former Tionaga gold mine, also known as the Smith-Thorne mine or property, is located on the east side of Horwood Lake at the north end of a long narrow bay that projects south from Horwood Lake into Dale Township. The property has been inactive since 1939 and the trenches, pits, and shafts are now inaccessible. The patented claims covering the mine site are presently held by Florence Lefever and John Lefever Jr.

This property was first described by Laird (1935b, p.36) as follows:

> The Smith group consists of 26 claims on the east side of Horwood Lake near the junction of the South and Northeast [Hardiman Bay] arms. In October, 1933, Wm. Smith discovered a massive quartz vein in pillowed andesite on the shore of the lake on what is now claim S.25,339. It strikes N.83°E. and dips 45°N. It has an average width of 30 inches [75 cm] and has been exposed for about 60 feet [18 m]. To the west it passes into the lake and eastward it is heavily drift-covered. The quartz is a dark smoky variety containing tourmaline and moderate quantities of pyrite, sphalerite, galena, and chalcopyrite, and some visible gold. Channel samples are reported to have yielded 0.75 ounces gold per ton over vein width.

Harding (1937, p.17-18) described this property as follows:

> The rocks here consist mostly of dark-weathering Keewatin lavas, which include ellipsoidal and amygdaloidal types of andesites and basalts. They strike northeast and dip from 45° to 50°N.W. They are cut by masses of Algoman quartz-feldspar porphyry, most of which are linear in shape and strike parallel to the lavas. A few cut across the strike of the lavas at small angles.
>
> Shaft-sinking was commenced in the fall of 1935 for the purpose of exploring a gold-bearing quartz vein, which dips about 45°N. and strikes N.80°E. from the east shore of Horwood lake. By August 15, 1936, a 45-degree shaft, the upper part of which followed the vein, had been completed to an inclined depth of 599 feet (434 feet vertical) [183 m; 132 m], levels had been opened at 200, 325, and 570 feet [60, 100, and 175 m] (on the incline), and 722 feet [220 m] of lateral work had been com-

pleted, most of it on the 570-foot [175 m] level. By October 5, 1936, drifting on this level had disclosed the vein for a distance of 100 feet [30 m] both east and west of the shaft. Vein widths varied from 2½ to 6 feet [0.8 to 1.8 m], and visible gold was exposed both in the shaft and on the 570-foot [175 m] level. A vein section 75 feet [23 m] in length on this level west of the shaft was reported to be of good grade over a mineable width.

In addition to gold the vein minerals include pyrite, chalcopyrite, pyrrhotite, galena, and zinc blende. Small grains and veinlets of an unidentified grey mineral of metallic lustre when subjected to qualitative tests yielded antimony and arsenic, which suggested the presence of stibnite. Tourmaline and calcite are also present. During the early part of October, 1936, the drift west of the shaft had reached a fault, where the vein was lost, and exploration for a time was confined to drifting on the vein in the porphyry to the east. Later in 1936, underground diamond-drilling was commenced with the object of locating the vein beyond the fault.

A well-defined gold quartz vein containing sulphides is exposed on the surface about 800 feet [240 m] east of the shaft. Drag folds in this vein suggest that the rocks north of the vein moved relatively to the west. The strike and dip of this vein conform roughly to the strike and dip of the vein at the shaft. Additional work, however will be necessary before their exact relationships can be established.

Late in 1937 this property underwent further development and the following is taken from files of the Mineral Resources Branch, Department of Energy, Mines and Resources, Canada.

Late in 1937 the property was examined by H.C. Dudley, who along with W.E. Smith, was instrumental in organizing Tionaga Gold Mines, Limited, incorporated in November 1937, to develop the property. Work began in February, 1938. The shaft was dewatered and deepened an additional 132 feet [40 m] to a total inclined depth of 731 feet [223 m], and new levels were established at 450 and 700 feet [135 and 215 m].

During the summer and fall of 1938 a 50-ton amalgamation mill, which commenced operation on November 10, was installed. Milling continued to May 18, 1939, when all work on the property ceased.

The following table is a summary of underground development:

	Drifting			Crosscutting			Raising		
Level	1935	1938-39	Total	1935	1938-39	Total	1935	1938-39	Total
200′	539′	111′	650′	46′	44′	90′		95′	95′
325′	136′		136′	75′		75′			
450′		284′	284′		40′	40′		125′	125′
570′	713′	114′	827′	360′	20′	380′		63′	63′
700′		272′	272′		169′	169′		141′	141′

Two grab samples were collected by the author [Sage] from the muck pile next to the shaft. These samples returned low gold values. Mapping by members of this field party indicated that the rocks in the area around the mine shaft are mainly intermediate to mafic metavolcanics intruded by small concordant bodies of quartz-feldspar porphyry. The muck pile at the mine indicated that quartz-feldspar porphyry was encountered in the workings. The mafic metavolcanics contain poorly developed pillows south of the mine site along the shore of Horwood Lake.

Two samples were taken from outcrop for thin sectioning near the shore of Horwood Lake at 155 feet and 130 feet (47 m; 40 m) respectively southeast of the shaft. The first is a fine-grained highly altered feldspar porphyry. The phenocrysts are highly altered, zoned and unzoned, euhedral to subhedral crystals of plagioclase with an anorthite content of at least 36 percent. Some fragments of plagioclase crystals were noted. The rock contains chlorite, carbonate, limonite, and sericite, with the carbonate and sericite being derived largely from altered feldspars. The fine-grained groundmass is composed dominantly of fine-grained carbonate and untwinned plagioclase. The second sample is a fine-grained,

massive, intermediate to mafic metavolcanic which may be a metamorphosed tuff. The rock contains nearly 10 percent angular quartz grains. Actinolite, biotite, carbonate, limonite, pyrite, and chlorite, are the other mineral constituents.

New Joburke Explorations Limited (2,123)
Keith Township
District of Sudbury

New Joburke Explorations Limited, formerly Joburke Gold Mines Limited, holds 23 claims (Canadian Mines Handbook 1970-1971, p.253) in north-central Keith Township. The property is located southwest of the southwest end of MacKeith Lake. Access is by gravel road, south from Highway 101 where it crosses the Canadian National railway and then west about 1 mile (1.6 km) by a short, rough road to the mine site.

The general geology of the area was described by Hogg (1946b, p.1110-1111):

> The area is underlain by a tightly folded series of Keewatin volcanics with some interbedded sediments, which outcrop to the west of Keith lake, roughly 2½ miles [4 km] from the site of the present gold discovery.
>
> In the immediate vicinity of the discovery of the Rush Lake property, the rocks are almost entirely Keewatin volcanics. A very continuous band of iron formation, which has been traced for more than 6 miles [10 km] outlines the regional strike of the volcanics.
>
> South of the iron formation lies a series of basic flows, which have been sheared in a direction parallel to the iron formation. It is this series of flows that contains the gold bearing veins on the Rush Lake property.

In more detail, Hogg (1946b, p.1111) described the geology near the mine site:

> The entire area mapped...lies within a strong shear zone. Similar sheared lavas were observed north of Mackeith lake and south of the map-area, indicating a zone of shearing at least half a mile [0.8 km] wide at this point. The intensity of shearing and thermal metamorphism increases toward the centre, and in the area of the present discoveries, the rock is in places converted into a quartz-carbonate schist. To the west the strike is about N.85°E., whereas near the east end of the map area it is closer to S.70°E., an indication that the regional shearing conforms to the warp in the iron formation to the north. The dip ranges from 80°N. to 90°N.
>
> The sheared rocks are almost entirely andesitic lavas. They are so highly carbonatized, that they react quite violently with dilute hydrochloric acid. Where shearing and thermal metamorphism have been extreme, they have the banded appearance of sedimentary rocks. As no evidence was seen of any fragmental material to suggest the presence of either tuffs or sediments, it has been assumed that this banding is due to the injection of carbonates along the shear planes.
>
> On outcrops where shearing is less intense, the rock weathers with a pitted surface owing to the presence of calcite-filled amygdules.
>
> Drag-folding and minor crenulations in the sheared lavas are common throughout the area mapped.
>
> Several outcroppings of a light, yellow-weathering sheared rock were found. This rock contains a large number of quartz eyes, which stand out on the weathered surface, and in view of its distribution it has been mapped tentatively as a quartz porphyry. It is extremely sheared and shows little sign of original texture, but near the edges it was found fingering out along shear planes in the andesitic lavas.
>
> A dike of unsheared quartz diabase strikes northwest through the centre of lot 12 and appears to be later than the veins exposed near No.1 post of claim No.43256. Gold values have been reported from nine different showings on the Rush Lake property.

Hogg (1946b, p.1111-1112) described the vein at the surface as follows:

The various showings are distributed over a length of 3,100 feet [940 m] within the shear zone. In view of the small amount of evidence now available, it is necessary to consider each exposure independently, though there are certain features that they have in common. For one thing, most of them occur along the same general strike in the shear zone. Outside this central zone, several minor occurrences of quartz in stringers and lenses were encountered, usually associated with drag folds in the shearing, but these isolated occurrences are not mineralized.

The veins exposed on the various showings are quite similar in appearance. A typical cross-section includes bands of quartz, quartz-carbonate, and sheared, carbonatized lava mineralized with pyrite and minor amounts of chalcopyrite.

At least two ages of quartz are present in the veins. Most common is a white to yellow variety, which is mineralized with pyrite in coarse cubes and disseminated grains having a distinct greenish-yellow colour. It is in this type of vein material, where the pyrite cubes have weathered out, that visible gold was found. A specimen of this type...was assayed and returned 0.08 ounces of gold per ton.

Another common type of quartz is a blue translucent variety. This quartz is highly fractured, and the fractures are filled with a very fine, dark material, which forms a network through the quartz. Yellow pyrite in seams and tiny grains is abundantly distributed throughout this fracture system. Chalcopyrite is also present in minor quantities. Hand specimens of this type...returned 0.02 ounces per ton.

The quartz-carbonate type of vein material comprises more than 60 percent of the veins. The carbonate is a tough, brown ankerite or ferrodolomite, which occurs in irregular masses throughout the quartz. Pyrite occurs in fine granular form and in occasional cubes concentrated along the edges of the carbonate masses. A specimen...assayed 0.16 ounces of gold per ton.

Lenses of banded, carbonatized andesite are found enclosed in the veins, and they are also mineralized with fine disseminated pyrite and with coarse pyrite concentrated in narrow stringers of quartz.

The ore zone was described further by Prest (1950, p.34-36) as follows (Figure 18 and Figure 19, Chart B, back pocket).

A vertical, 2-compartment shaft was begun on July 2, 1947, and was completed to a depth of 425 feet [130 m] on October 28, with stations established at the 125-, 250-, and 375-foot [40, 75, and 115 m] levels. Drifting on the 250- and 375-foot [75 and 115 m] levels followed. Some 3,590 feet [1090 m] of drilling was completed before operations were stopped in August, 1948, pending the financial arrangements necessary to develop two more levels. A considerable amount of ore-grade material has been stock-piled, and the workable ore shoots above the 375-foot [115 m] level have been outlined.

McIntyre Porcupine Gold Mines, Limited, took up an option on the property on September 23, 1949. The mine was dewatered and both levels were resampled. The option was dropped on December 2, 1949.

The ore zone consists of an intricate network of quartz stringers and veins in variously silicified, albitized, and carbonated andesitic and dacitic volcanics. The vein material itself is largely quartz, albite, carbonate, and pyrite, with a minor amount of chalcopyrite and, rarely, visible gold. The presence of chalcopyrite is a good indicator of gold values, but the better values are usually found where there are marked concentrations of pyrite. Indeed, narrow pyrite "leads" may readily be followed through some of the better ore-grade sections. There are clearly at least two ages of both quartz and carbonate. Zones of strong carbonatization are fairly numerous but seldom make ore-grade material unless cut by the later pyritiferous quartz veins. Yet occasionally the carbonated rocks make ore without any noticeable quartz being present. As already stated, the gold usually accompanies the more pyritiferous quartz veins. Other quartz veins with little or no pyrite are widespread through the vein zone.

Drag-folding is evident in the volcanics of the vein zone underground, and almost always these show a south side up movement and plunge westward from near horizontal up to angles of 45 degrees and, rarely, as much as 60 degrees. In plan these drags form a reverse "S", as is commonly seen on the surface. The quartz veins, however, usually occur in "S" drag folds, and the ore shoots rake to the east. Numerous minor faults are also apparent underground. These displace the veins a few feet, with an east side north movement. The ore shoots are arranged *en échelon* to the north, going eastward. The writer believes that the two types of drag movements seen in the mine and on the surface

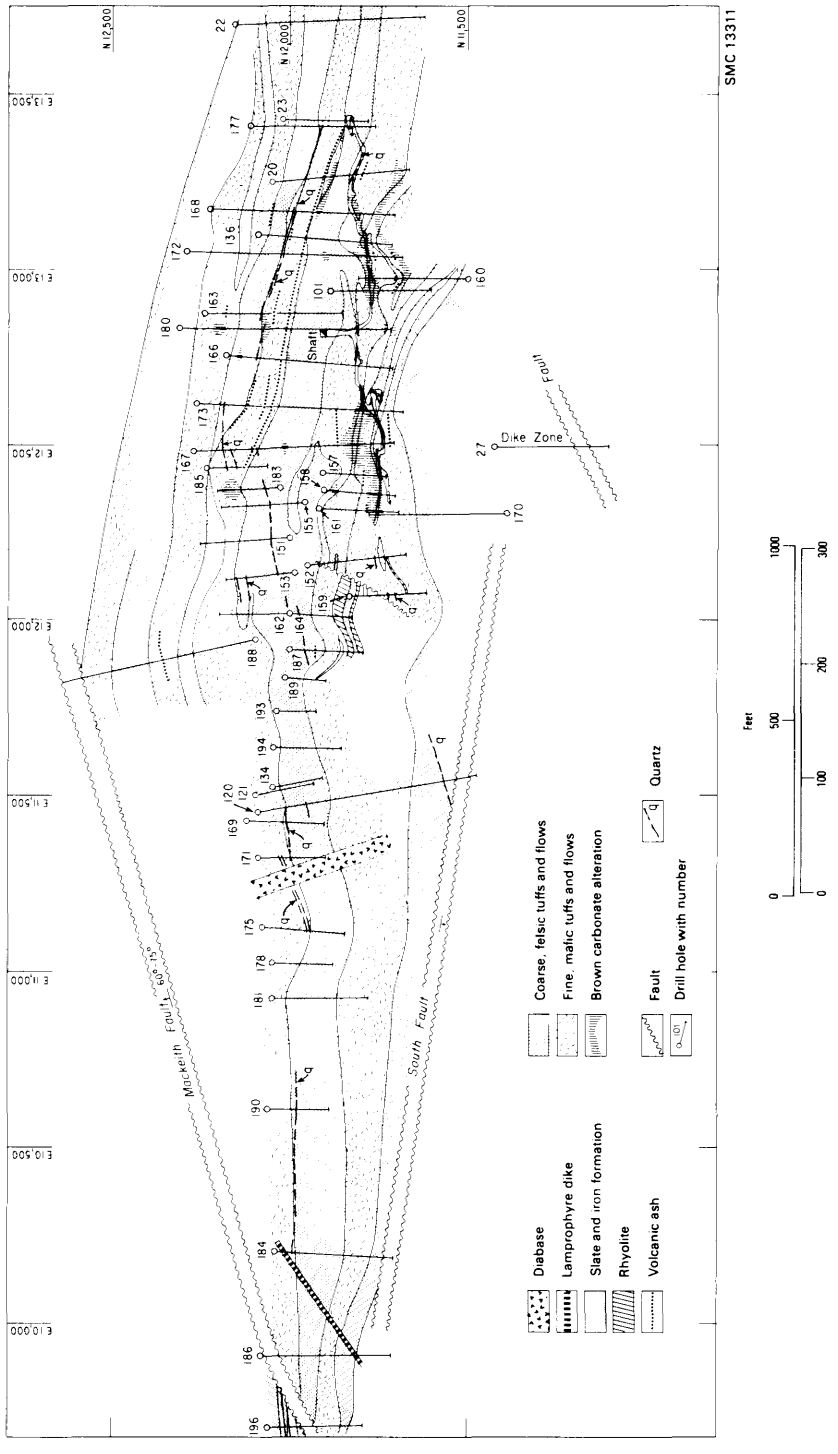


Figure 18–Joburke Gold Mines Limited, (now New Joburke Explorations Limited). Keith Township; generalized geological plan at 250-foot (76 m) level; modified from a company plan, 1949.

are related to folding in the one case and faulting or shearing movements in the other. The south side up movement with the frequent tops-south determinations observed to the south of the mine indicate the south limb of an anticline plunging west. The more usual occurrence of the quartz veins in "s" drag folds, the rake of the ore shoots to the east, and their *en échelon* arrangement with an east side north movement may be a result of the dragging movements along the Joburke fault to the north. This dragging movement along the strike fault, so at variance with the fold structures in the greenstone block to the east, is believed to have "opened" the rocks and provided the channels for the vein-forming solutions.

This picture is further illustrated on the surface at the No.3 vein, where the main part of the quartz vein shows an open "S", elongated in the north-south direction and with a steep dip to the east, which cuts directly across the schistosity and the drags in the greenstone. The shear in the greenstone strikes at N.75°E. and dips vertically, whereas the axis of the drag folds, which are the reverse "S" type, trend at N.50°E. and plunge 40 degrees to the southwest. Minor offshoots of quartz follow the greenstone schistosity for short distances and hence may occur in the fold or the fault-drags.

The main vein zone may owe its position to the occurrence of more massive and competent dacitic volcanics interbedded with schistose and streaky-banded andesitic volcanics, with fractures developing as these heterogeneous rocks were dragged by the folding and faulting movements. No tuffs could be positively identified near the shaft site owing to the intense shearing, but thin-section studies do indicate their presence. There are also numerous rusty-weathering, carbonated rocks in this vicinity, which are known as "old dikes". These both parallel and crosscut the volcanic formations.

At the time of the author's [Sage] visit the surface trenches were partially filled and overgrown. Examination and sampling were carried out near the shaft. Three grab samples were taken by the author from the muck pile for assay; one of these returned an anomalous assay of 12.88 ounces of gold per ton, 1.37 ounces of silver per ton, and 0.23 percent copper (assay by Mineral Research Branch, Ontario Division of Mines). This high-grade specimen was collected from the south side of the muck pile at the shaft site. Gold is not visible to the unaided eye in the specimen. The sample consists of milky vein quartz with approximately 50 percent medium- to coarse-grained, granular pyrite. A polished section was prepared from the remainder of the assay sample, disclosing irregular fine-grained, disseminated, native gold in the pyrite (Photo 26). Chalcopyrite was also observed, as irregular blebs within the pyrite and as thin irregular wisps, possibly filling cracks within the pyrite. This sample may be the unweathered equivalent of the occurrence, described by Hogg (1946b, p.1109), of quartz containing visible gold associated with weathered crystals of pyrite. One of the other samples taken by the author from the muck pile returned a gold assay of 1.79 ounces per ton (assay by Mineral Research Branch, Ontario Division of Mines) and represents a similar mineral assemblage.

Two thin sections were prepared from samples collected from outcrop about 210 feet (64 m) northwest of the shaft and about 310 feet (94 m) west of the shaft respectively. The samples exhibit good microscopic foliation. The first sample is composed of very fine-grained carbonate, quartz, chlorite, and sericite, in order of decreasing abundance. The second sample in order of decreasing abundance, consists of very fine grained carbonate, quartz, plagioclase, and minor pyrite. The rocks are sheared, silicified, and carbonatized to the extent that the original character is difficult to determine. Based on observations of less altered rocks collected from the surrounding area, these rock samples are probably of volcanic origin.

It is reported that the original development work on this property disclosed a vein on the 250-foot (75 m) level (Figure 19) that for a distance of 835 feet (255 m) averaged 0.25 ounces gold per ton across 6.3 feet (1.9 m) (files, Mineral Re-

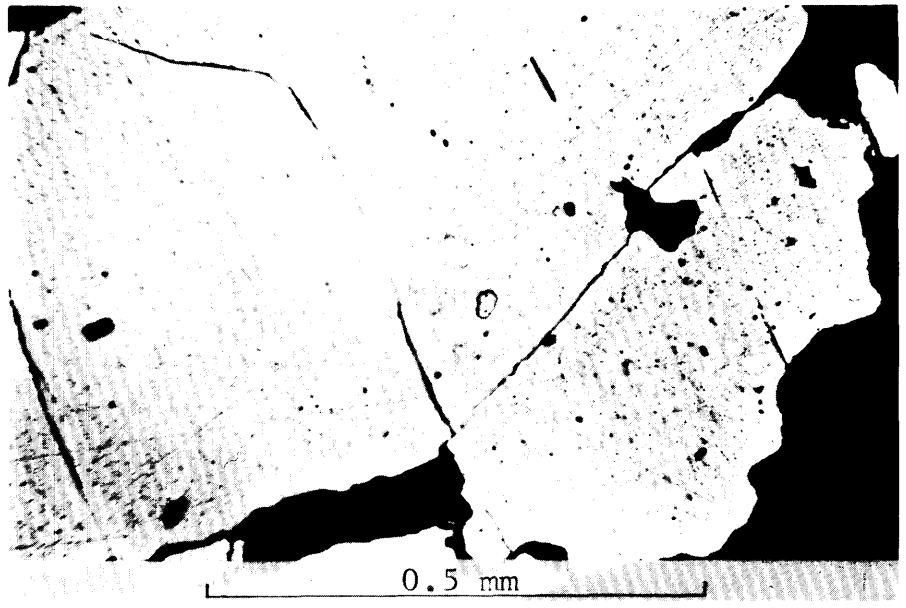


Photo 26–Photomicrograph of polished section displaying native gold (high relief in centre of photo) in pyrite (light grey area) surrounded by quartz (black). Prepared from a sample assaying 12.88 ounces gold per ton. New Joburke Explorations Limited gold prospect.

search Branch, Department Energy, Mines and Resources, Canada). The most recent work reported at the time of writing[1] is 5,000 feet (1500 m) of diamond drilling carried out in 1964 under agreement with Denison Mines Limited (files, Mineral Resources Branch, Department Energy, Mines and Resources, Canada). The results of this work are unknown.

Nudulama Mines Limited (127)
Leeson Township
District of Sudbury

A 15-patented-claim property in Leeson Township, Sault Ste. Marie Mining Division, is currently held in good standing by Nudulama Mines Limited, formerly Ladulama Gold Mines Limited, formerly Dulama Gold Mines Limited. The property may be reached by motor road through the Renabie mine site. The property was not visited.

[1]The New Joburke Explorations Limited property was brought into production in 1973 by Noranda Exploration Company Limited, and is shown on Map 2351 as a producing mine.

The gold deposit is described in the files of the Mineral Resources Branch, Department of Energy, Mines and Resources, Canada, as follows:

The gold occurrences at Nudulama are presumably similar to those of the adjoining Renabie Mine. The main Nudulama vein is considered to be an extension of the "C" vein at Renabie. Quartz veins, carrying pyrite, galena, and chalcopyrite, occur in the gneissic border facies of a granite batholith. The veins are localized in minor shear zones, and are highly irregular in extent and persistence. Gold is rarely visible, and is apparently associated with the sulphides.

Proven ore reserves of 579,325 tons grading 0.194 ounces gold per ton, and suggested reserves of 1,000,000 tons of ore are based upon development work which consists of a shaft 1,065 feet (325 m) in depth with seven levels (files, Mineral Resources Branch, Department of Energy, Mines and Resources, Canada). The reader is also referred to the marginal notes on ODM Map P.492 (Ferguson 1968a) for additional information concerning this property.

Orofino Mines Limited (216)
Silk and Horwood Townships
District of Sudbury

A gold prospect held by Orofino Mines Limited is located in the southeast corner of Silk Township close to the Silk-Horwood Township line and is accessible by winter road from the south end of Horwood Lake. The property consists of 32 claims (Canadian Mines Handbook 1970-1971, p.274) which straddle the Township boundary. At the time of the author's [Sage] visit, few workings remained exposed and most of the buildings had been destroyed by a bush fire which passed through the area in 1948.

Initial prospecting for gold on this property was described by Laird (1935b, p.34-35) when it was under control of Thorne interests. He described the showings as follows:

The country rock is mainly greenstone, which has been extensively intruded by feldspar porphyry dikes and bosses of quartz diorite. In all, 14 different quartz leads have been uncovered, 6 of which show visible gold.

The main showing occurs on the east slope of a prominent north-south ridge on claim S.24,974. In two of the test pits here, visible gold occurs in spectacular quantities. The greenstone has been thrown into well-defined folds, probably as the result of the pressure exerted by the intruding diorite masses, and a bedded appearance has developed. Narrow quartz stringers carrying visible gold and some pyrite follow the bedding-planes but occur mainly on the flanks of the folds. It follows that the veins dip at low angles to the north and to the south and that they are erratic in their occurrence.

Harding (1937, p.20) described the occurrences as follows:

In October, 1935, the group was acquired under option by the Hollinger Consolidated Gold Mines, Limited.

The rocks consist largely of Keewatin lavas and sediments, which have been intruded first by diorite and later by Algoman quartz porphyry. Visible gold has been discovered in several scattered locations both in quartz veins which cut the diorite and disseminated in the diorite...[Thinly]bedded, steeply dipping Keewatin sediments, which strike approximately northeast, are flanked on the east by massive diorites and lavas. The diorite is cut by numerous highly folded veins and lenses of quartz of irregular widths and lengths. Many of them narrow down to small stringers and disappear. Pyrite appears to be the chief sulphide associated with the gold. In general, the gold values appear to be er-

ratic, both in the diorite and in the veins. Diamond-drilling, consisting of several shallow holes completed during the early part of 1936, failed to locate a sizeable ore body.

A geological report by Nelson Hogg (1950b) described the Orofino prospect as follows:

Geology

Most of the workings are in diorite, which is the host rock for the ore [Figure 20, Chart B, back pocket]. Both diorite and ore are cut by feldspar porphyry and "lamprophyre dykes". The porphyry is a reddish type with white phenocrysts, and it occurs in steep-walled dykes, which generally strike about N.70°E., parallel to the veins, but less frequently strike in a more northerly direction. The 150 South Vein is cut in the east drift by a dyke of porphyry, angling obliquely across the vein in a northeasterly direction.

The lamprophyre is a reddish, felsitic rock, which, judging by its appearance, is probably related to the porphyry. One prominent sheet of lamprophyre has been cut underground in the South drift. It is flat lying, and occupies the back of the drift over much of its length. In the main cross-cut, the lamprophyre forms the back of the drift, and toward the east end it dips gently downward, until, in the east face, it occupies the upper half of the drift. Since it is later than the veins, it complicates development and renders back sampling unpractical.

The sequence of events is constructed as follows:

6– Porphyry Dykes
5– Lamprophyre dykes
4– Faulting
3– Emplacement of Veins
2– Faulting
1– Diorite Intrusion

Description of Veins

No. 1 Bonus Vein

This vein is a north-dipping vein with a dip of about 40 degrees. It outcrops 125 feet [38 m] southwest of the shaft, but was not picked up in a long trench just east of the shaft. A vein considered to be No.1 Bonus Vein was intersected in the shaft at a depth of 50 feet [15 m] below the collar, and has a reported width of 11 feet [3.4 m], of vein quartz and brecciated, mineralized diorite. Sampling gave results varying from 0.04 to 0.48 ounces per ton, but most samples were below 0.06 ounces per ton.

The north cross-cut on the 50-foot [15 m] level should have exposed the Bonus Vein, but did not. A porphyry dyke was intersected at the point where the vein projects and it is possible that the porphyry interrupts the vein at this point.

No. 1 North Vein

No surface outcroppings of this vein were exposed in trenching, but it was intersected in diamond drill holes, which suggest that it may be converging with No.1 South Vein toward surface. The station at 150 feet [45 m] exposes the vein, which cuts through the shaft about 15 feet [4.5 m] below the level. It is a zone of quartz-filled fractures in diorite, and lacks the strong faulting which marks the No.1 South Vein. The walls locally are bounded by slips and clean-cut quartz veins, but more often the vein is a stockwork. The quartz stringers carry a little pyrite but most sulphide mineralization is in the form of coarse cubes and grains of pyrite disseminated throughout the diorite. In the shaft, the vein is exposed for a vertical distance of 15 feet [4.5 m] and consists of a fracture zone with quartz stringers, most of which have an almost horizontal attitude. Channel sampling in vertical cuts at 3-foot [0.9 m] intervals give an arithmetic average of 0.23 ounces per ton.

Drifting both east and west have exposed No.1 North Vein for 150 feet [45 m]. It has a northerly dip of about 40 degrees, and a variable strike, trending slightly south of east. The east end, at the time of examination, was bending toward the south, and approaching No.1 South Vein. It seems probable that these two veins will converge on strike to the east and upward on dip.

No. 1 South Vein

Underground work has been concentrated on this vein, which showed most promise of continuity

in drilling and surface work [Figure 21 and 22]. It strikes N.70°E., and dips north at about 40 degrees. Drifting has borne out the promise of continuity, and at the time of examination, the vein had been followed for about 500 feet [150 m] on the 150-foot [45 m] level. It follows a persistent, well-defined fault, which generally forms the footwall of the vein. Quartz veining crosses the fault at one point, and indicates that the fault is pre-quartz. At the same time values are concentrated in a narrow band of reddish, feldspathic alteration which follows the fault, indicating that sulphides and gold were in part at least, later than the fault movement. However, the fault is often marked by an open fracture, and pyrite close to it is crushed and powdery white in the centre of the vein zone. It is coarse and cubic, indicating that some sulphides were present prior to the last movement on the fault.

Where No.1 South Vein is intersected in the crosscut, south of the shaft, the footwall fault has split into two parts with the intervening diorite fractured and intersected by a stockwork of quartz stringers. This condition has resulted in an elliptical expansion of ore, which at this point is 20 feet [6 m] wide normal to the dip. Both footwall and hanging wall are marked by a strong slip carrying an inch or two [2.5 or 5 cm] of red felspathic alteration. This is bordered on both walls by one to three feet [0.3 to 0.9 m] of white quartz characterized by ribbon structure and angular fragments of chloritic wall rock. Ribbons in two directions were observed, one parallel to the vein, and one vertical. The diorite between these veins is highly fractured and mineralized with disseminated pyrite in relatively coarse cubes and grains. This stockwork in the centre of the vein zone carries low values in gold. The white quartz carries a little pyrite, which is concentrated in the ribbons and inclusions, and carries low to moderate gold values. The few inches of red alteration along the persistent fault, is well mineralized with fine, crushed pyrite, and carries high gold values, often in ounces. Visible gold is not common, but has been observed. Galena is rarely present, and is accompanied by high gold values. A specimen carrying a few specks of galena each with visible gold, was obtained from No.1 South Vein.

West of the cross-cut, the ore zone narrows and for most of its length the width between the two fault fractures is two to three feet [0.6 to 0.9 m]. Red alteration marks the walls and the intervening vein is quartz with a little white calcite, and inclusion and ribbons of chloritic wall rock. Sulphide mineralization and values are best where inclusions and ribbons are most numerous. For a length of 85 feet [26 m] in the west drift, the vein is a barren, white quartz-calcite vein. Values in this section are low and the vein is not of ore grade. In the west face, 285 feet [87 m] west of the cross-cut, the vein has regained its fragmental, ribboned character, and values have improved.

In the east drift, the vein contracts to a single quartz-calcite vein about three inches to thirty-six inches [7.6 to 91 cm] wide, with a fault along one wall only. The fault fracture is characterized by red feldspathic alteration. It lies along the footwall of the vein near the cross-cut, but at a point where the quartz vein narrows to less than six inches [15 cm], it crosses the pink alteration and fault, which forms the hanging wall of the vein beyond that point. Where the vein crosses the fault, an open slip lined with carbonate cuts the vein but does not displace it.

The vein in the east drift is cut by a porphyry dyke, which strikes east of north and dips at 45 to 50 degrees to the west. The vein is also displaced by a northeasterly striking fault, which moves the vein twelve feet [3.7 m] north on the east side.

A flat lying sheet of lamprophyre forms the back throughout most of the east drift, occupying the upper half of the east face (April 4, 1950). This renders back sampling impracticable.

No. 5 Vein

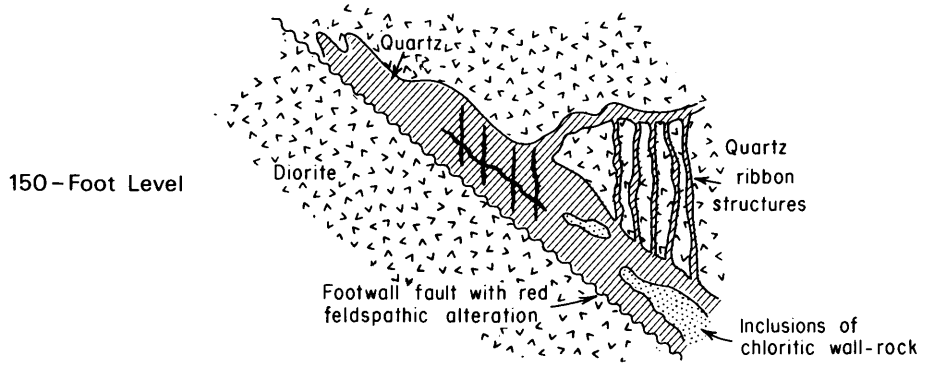
One hundred and seventy feet [52 m] north of the shaft, a sheared, fractured zone striking south of east, and dipping north, was encountered in the main cross-cut. This zone is made up of several closely spaced, weak fractures, with little quartz. The intervening diorite is well mineralized with disseminated pyrite, and several specimens containing visible gold in small quantities were seen. This zone was not predicted by surface drilling. Only one round had been taken on it, east of the cross-cut, at the time of examination.

Wall Rock Alteration

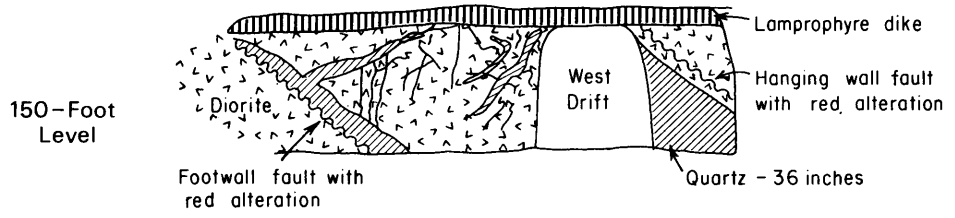
Diorite is the only pre-ore wall rock. It is fine textured and somewhat chloritic near the veins. Inclusions and ribbons of diorite show various stages of silicification, from chloritic diorite cut by a few stringers of quartz, to greenish quartz with a few remaining patches of chloritic material.

Carbonatization was not observed in the vein walls.

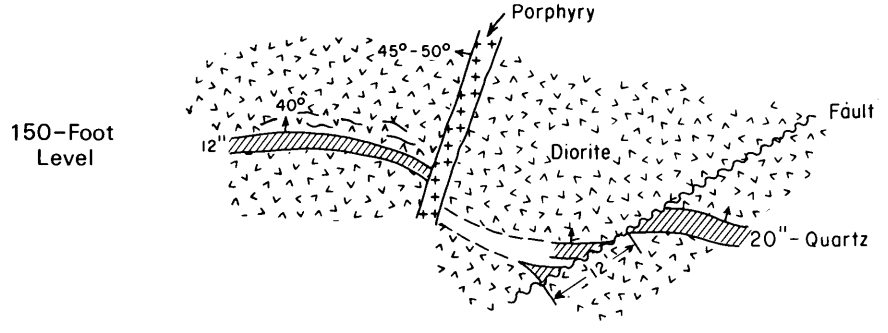
The reddish feldspathic material which occupies the fault along the footwall of No. 1 South Vein appears to be of hydrothermal origin, but it has clean cut contacts, and its effect on the walls is not noticeable.



No.1 South Vein, Main Crosscut South, West Wall



No.1 South Vein, Main Crosscut South, West Wall



No.1 South Vein, East Drift

SMC 13314

Figure 21–Orofino Mines Limited, Silk Township; geological sketches of vein structure by Hogg (1950b).

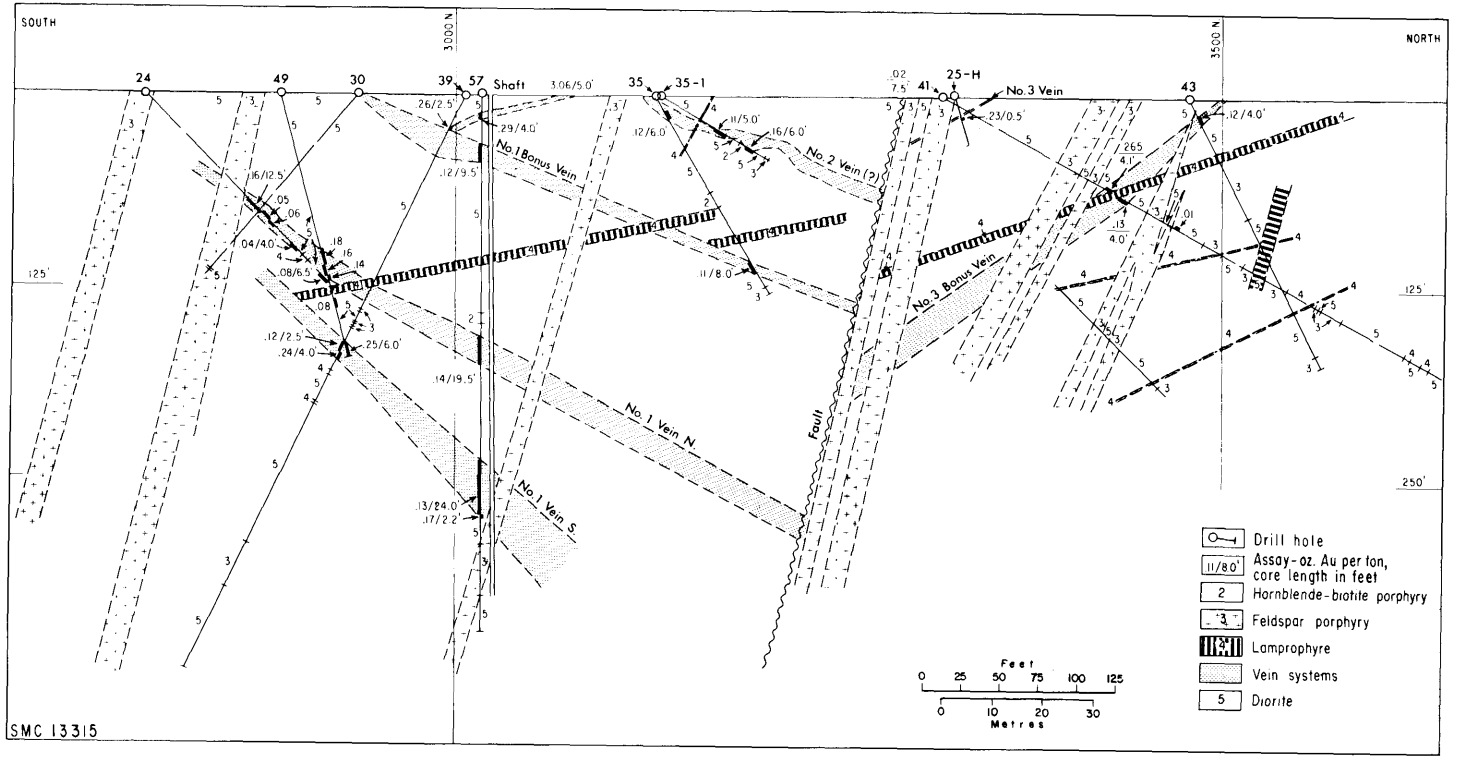


Figure 22–Orofino Mines Limited, Silk Township; geological cross-section along 20+40E, east side of shaft; modified from section by Mining Research Corporation Limited, 1949.

Sulphide Mineralization

Pyrite is the predominant sulphide, but arsenopyrite is present in small amount. Sphalerite and galena have also been observed, the latter being an indicator of gold values.

Hogg (1951) examined thin sections of the dikes and concluded in a supplementary report that the youngest dikes were biotite lamprophyre, the next youngest were feldspar porphyry and that the oldest were aplite.

It seems probable that the aplite sheet and dikes are closely related genetically to the porphyry, and closely preceded it. There is evidence underground that the sheet of aplite exposed in the east drift has been re-opened and later fractures filled with a fine grained phase of porphyry.

A supplementary report by Hogg (1950c) adds the following information for the advance in drifting and crosscutting for September 1st to 15th, 1950:

275 Foot [85 m] Level

Drifting on the No.1 South Vein has been extended 185 feet [115 m] west from the shaft. The first 100 feet [30 m] gave a cut average of 0.80 over an average width of 3 feet [0.9 m]. The average values over the balance of the drift are not available yet.

Drifting on this No.1 South Vein to the east has been extended 116 feet [35.4 m] from the north crosscut, that is, approximately 166 feet [50.6 m] east of the shaft. Values so far obtained average approximately 0.30 (uncut).

The north crosscut follows a north-trending fault, along which the lateral displacement is about 20 feet [6 m].

At a point 150 feet [46 m] north of the No.1 South Vein the No.1 North Vein has been intersected on the west side of the fault, and should be again intersected within 20 feet [6 m] on the east side.

In the south crosscut mineralization extends for a distance of over 80 feet [24 m]. Average of 200 car samples gave 0.10, and channel samples gave from 0.06 to 0.83. As this is something new, the potentialities of this wide zone of mineralization will not be known until further work has been carried out.

150 Foot [45 m] Level

The No.1 North Vein has been located east of the fault (same fault as on 275-foot [85 m] level north crosscut), and drifting started. Muck samples of 26 cars (2 tons each), gave average value of 1.01 ounce. Slashing on the west side of the fault shows the ore to be approximately 12 feet [3.7 m] wide at this point.

General

The north crosscut on the 275-foot [85 m] level is to be extended to the northeast to intersect the downward continuation of No.5 vein from the 150-foot [45 m] level, and continue into an area where other veins exposed on the surface should be located in the underground.

A geological report dated September 30, 1950, prepared by J.A. Reid, Consulting Mining Engineer, for Sylvanite Gold Mines Limited, is in the assessment files of the Resident Geologist, Ontario Ministry of Natural Resources, Sudbury; the reader may find this of additional interest. The following description of the ore vein is taken from the files of the Mineral Resources Branch, Department of Energy, Mines and Resources, Canada:

In sinking the shaft a number of veins were intersected, 2 of which, No.1 North Vein, and No.1 South Vein, have been developed to some extent. On the 150-foot [45 m] level No.1 vein, which has an indicated width at depth of 10 feet [3 m], has been drifted on for 270 feet [82 m]. Grade was found to average 0.30 oz/ton gold (cut) over a width of 6.1 feet [1.9 m]. No.1 South vein on this level has been drifted on for 700 feet [210 m]. Of this length, 300 feet [90 m] averaged 0.30 oz/ton gold (cut) over an average width of 4 feet [1.2 m]. At the west end of the No.1 South drift another vein, drifted

on for over 100 feet [30 m], averaged 1 oz/ton gold (cut), for a length of 90 feet [27 m] over an average width of 2.7 feet [0.8 m]. On the 275-foot [85 m] level No. 1 South vein was drifted on for about 500 feet [150 m]. The vein in the first 100 feet [30 m] west of the shaft averaged 0.80 oz/ton gold (cut) over a width of 3 feet [0.9 m]. An unusual number of porphyry dykes – all post ore – were encountered on this level.

In 1962, the deposit was explored at greater depth by 800- to 1,000-foot (240 to 300 m) diamond drill holes and some additional claims were staked by Orofino Mines Limited to protect the structure. There is no record of more recent activity.

Four grab samples were collected by the author from the muck pile, and two thin sections prepared from outcrop samples. The grab sample which returned the best assay of 1.17 ounces of gold per ton and 0.33 ounces of silver per ton (assays by Mineral Research Branch, Ontario Division of Mines) consists of silicified, pyritized, quartz diorite breccia with minor carbonate. The fragments were cemented with milky vein quartz and contain approximately 40 percent pyrite. The pyrite is concentrated in the altered diorite fragments and commonly occurs as euhedral crystals up to 3 mm in diameter. Another of the four samples consists of altered, massive, medium-grained quartz diorite with 15 percent euhedral pyrite, and assayed 0.25 ounces gold per ton (assay by Mineral Research Branch, Ontario Division of Mines). The other two samples, consisting of altered, massive, fine- to medium-grained quartz diorite with up to 5 percent euhedral pyrite, assayed 0.04 and 0.10 ounces gold per ton respectively (assays by Mineral Research Branch, Ontario Division of Mines). From the assays, it appears that the higher gold values are associated with quartz veining and abundant pyrite.

Approximately 260 feet (80 m) SE of the shaft, massive altered quartz diorite has been intruded by fine-grained, light to dark grey porphyry. In thin section, the quartz diorite is seen to be highly altered and composed of plagioclase, chlorite, sericite, pyrite, carbonate, quartz, hornblende and epidote. Fine-grained quartz and plagioclase form granophyric intergrowths which often surround grains of what appears to be highly altered plagioclase (Photo 27). The altered grains appear to consist of a fine-grained mixture of sericite, carbonate, chlorite, epidote and some limonite. The porphyry intrusion is also altered, principally to sericite, but it is fresher in appearance than the diorite. Plagioclase phenocrysts with an anorthite content of at least 42 percent make up approximately 30 percent of the rock. The phenocrysts are extensively altered to sericite but some have unaltered remnant cores which occasionally are well twinned. Several scattered quartz phenocrysts were noted. Chlorite and carbonate are present in the fine-grained groundmass which appears to be largely a mixture of quartz and altered plagioclase.

Renabie Mines Limited (5)
Leeson and Rennie Townships
District of Sudbury

Renabie Mines Limited presently owns 32 claims straddling the Leeson-Rennie Townships line. The Renabie mine site is in Leeson Township and can be reached by automobile from Missanabie which is on Highway 651. The prop-



ODM9449

Photo 27–Photomicrograph of quartz diorite, showing granophyric intergrowths surrounding altered plagioclase. Orofino Mines Limited gold prospect.

erty is developed by two shafts, the deepest of which reaches a depth of 3,455 feet (1053 m). The mine was in continuous production from July 1947, but operations were terminated during the summer of 1970. The property was not visited.

The geology of the Renabie mine area was described by Bruce (1942 p.15-16) as follows:

Basic lavas cross the central part of the claims; the eastern part of them is underlain by batholithic rocks consisting of granite and granite gneiss and tonalite and tonalite gneiss. These rocks are cut by some narrow dikes of diabase...and by several small lamprophyre dikes, most of which strike north; but one, which is nearly flat, is followed for some distance by the workings on the 250-foot [75 m] level and caused considerable difficulty in mining. The lamprophyre dikes in places include fragments of auriferous quartz, apparently torn from the quartz veins during the intrusion of the dike. The western part of the property lies in the large mass of quartz porphyry extending northwestward from Campbell lake. Somewhat genissic tonalite outcrops immediately north of the "C" ore zone. The "A", "B" and "D" zones lie in gneissic granite. The [No.1] Shaft is located on claim S.34,318, midway between the "B" and "C" ore bodies, a short distance in the footwall should the two known bodies be connected.

Underground the drifts in both directions from the shaft on both levels penetrate a complex of massive and gneissic granite. It was thought that these might represent different periods of intrusion, but under the microscope massive and gneissic granites appear very similar and the massive variety instead of being less altered than the gneissic one actually contains a larger proportion of secondary minerals. Furthermore, in some places one appears to grade into the other. There are, however, certain contacts that are sharp, as if the massive type may be slightly later than the gneissic one, but nowhere was it found cutting across the gneissic structure. Since the gneissic granite

shows evidence of movement during its crystallization, it seems likely that the massive granite represents merely a slightly later stage of consolidation occurring after the emplacement of the igneous rock. Thus in places where the rock had become partially crystallized before movements ceased, some of the early minerals were fractured and granulated and a gneissic structure developed. In other places the magma crystallized quietly and formed a massive rock. Along the "B" ore body the gneissic structure is nearly east-west in strike, at a large angle to the contact between the granite and greenstone 500 feet [150 m] to the west.

Bruce (1948, p.436) elaborated further:

Immediately west of the main orebodies of the mine a small blunt projection of volcanics extends eastward into the gneisses. The gneissic structure of the igneous rock curves with the contact and takes on a strike nearly at right angles to the normal east-west direction and a dip of approximately 45° to the west beneath the greenstone. Apparently the gneissic structure is due to flowage of the granitic rock during consolidation, and the slight change in direction of the greenstone-gneiss contact was sufficient to produce an eddy in the moving magma. The gneiss is believed to have moved upward and probably northward in the last stages of consolidation, stretching into the shallow embayment northwest of the Renabie mine.

Bruce (1942, p.16-20) continued:

All four areas of gold-bearing quartz exposed by trenching and stripping...are in granite and granite gneiss. The "A" ore body lies in the southeast corner of claim S.34,317, not far from the contact of the gneiss with the volcanics. A ridge of tonalite is less than 100 feet [30 m] north of the "C" area, but drift covers the northern edge of the quartz body and the wall rock is not exposed.

The "A" area...is the original discovery. It is apparently a pipe-shaped body with a broadly elliptical cross-section; the longer axis of the ellipse is nearly east-west. On the surface the length exposed by stripping is 82½ feet [25.1 m] and the maximum width is 21½ feet [6.5 m]. From the surface to the 125-foot [40 m] level the pipe rakes westward at an angle of 42 degrees. The longer axis of the elliptical cross-section on the 125-foot [40 m] level is 60 feet [18 m], and the shorter 20 feet [6 m].

The "B-D" area lies northeast of the "A"....The part designated "B" has irregular lenses of quartz, from a few inches to more than two feet [0.6 m] in width, lying in a zone approximately 9 feet [3 m] wide. The long directions of the lenses are parallel to the gneissic structure of the enclosing gneiss....The length of the area containing quartz, as exposed by stripping, is at least 125 feet [40 m]. On the 125-foot [40 m] level a body of quartz, roughly Z-shaped in cross-section, was encountered 600 feet [180 m] west of the shaft. This, however, does not seem to be the main body of quartz that outcrops. The "B" body proper was entered at 720 feet [220 m] west of the shaft, and from that point quartz lenses were encountered in a zone 160 feet [50 m] in length, striking somewhat north of west....On the 250-foot [75 m] level the series of quartz lenses is considerably shorter....The eastern extremity of the zone rakes westward very steeply, and the dip is to the south at 65 to 70 degrees. Raises from the 250-foot [75 m] level to the 125-foot [40 m] level and from the 125-foot [40 m] level to the surface penetrated several separate masses. Hence the quartz bodies are discontinuous vertically as well as horizontally and the quartz has the form of lenses rather than pipes.

At the west end of the "B" zone the quartz lenses bend sharply to the south, and a rather continuous mass of quartz extends southward. This is the "D" body. On the surface it extends southward a distance of 110 feet [34 m] to a swampy valley that hides the southern end. At the point where it disappears beneath overburden it is 175 feet [53 m] northeast of the east end of the "A" ore body. On the 125-foot [40 m] level the "D" body has a length of 235 feet [72 m], with the continuity of quartz broken only by a narrow lamprophyric dike....At the north end the horizontal width of quartz exposed in the workings is approximately 35 feet [11 m]. The width decreases to 10 feet [3 m] immediately north of the lamprophyre dike and increases to a maximum of 45 feet [14 m] at the south end of the body. On the 250-foot [75 m] level the north end shows two separate tongues of quartz; the south end is wider than it is on the level above....Raises have been put up from the 250-foot [75 m] level to the 125-foot [40 m] level and from the 125-foot [40 m] level to the surface. Both of these are altogether in quartz. The lens thus is continuous for a depth of more than 250 feet [75 m]. The dip of the lens follows the gneissic structure of the granite...which is approximately 45 degrees. The variation in width of the body makes accurate determination of dip impossible. It seems to be slightly flatter than 45 degrees from the 125-foot [40 m] level to the surface. Assuming a dip of 45 degrees, the maximum thickness of the lens would be 32 feet [10 m] and the minimum 7 feet [2.1 m] and the

dip length from the surface to the 250-foot [75 m] level would be slightly over 350 feet [105 m] Diamond-drilling downward from the 250-foot [75 m] level shows that the ore body continues an additional 250 feet [75 m] below the present workings.

The distribution of the quartz lenses on the surface seemed to indicate that the "D" body and the "A" body should join a few feet east of the most easterly limits exposed by stripping of the "A" body. Underground work, however, shows no connection between the two on the levels now opened. The "A" body on the 125-foot [40 m] level ends 60 feet [18 m] west of the"D" body, and drill holes intersecting the block of ground between the two have not shown any connecting quartz masses.

The "C" area is in the southwestern part of claim S.34,794, some 1,600 feet [490 m] east of the east end of the "B" ore body. On the surface it appeared to be a thick lens, narrowing sharply to the east and consisting almost entirely of quartz. It is found to be a number of rather closely spaced veins of quartz separated by sheets of wall rock. The body on the 125-foot [40 m] level is 100 feet by 70 feet [30 m by 21 m] which is less than on the surface. On the 250-foot [75 m] level it is 60 feet by 40 feet [18 m by 12 m]. Both walls and the rock masses between the quartz veins are tonalite. A dike of diabase cuts through the quartz as well as the tonalite.

Most of the quartz of the "A", "B", and "D" bodies is a granular white variety with numerous brownish streaks. Veins of a younger white quartz of fine grain cut this type. The proportion of metallic minerals in the older quartz is very small; the younger has practically none. Gold rarely occurs in sufficiently large grains to be visible to the naked eye, and in many samples that contain more than an ounce of gold per ton no gold can be found even under the microscope. The most abundant metallic mineral is pyrite, which occurs in tiny cubes or irregular grains. Galena is sparingly present and erratically distributed. The gold content is higher where galena is present.

Bruce (1942, p.20-23) continued with a discussion of wall rock alteration and the results of polished section work. For this information the reader is referred to the original paper.

Frohberg (1948, p.16-20) described the gold deposits after more work had been completed and his description is as follows:

The Gold Deposits

Although some gold has been found in the older formations west and south of the Renabie mine, the known discoveries of economic significance lie within the border of the batholith. The majority occur in the outer shell of granite gneiss, a few like the Renabie "C" orebody and the Dulama No.1 Vein are in tonalite gneiss. All the deposits have been found at distances of less than one mile [1.6 km] from the granite-greenstone contact....Quartz veins, in appearance and mineralization similar to the auriferous type, are known to occur farther inward, but carry little if any gold.

Mineralogy–Mineralogically the gold deposits of the Renabie area consist largely of glassy, milk-white to greyish quartz. Other, rare gangue minerals include carbonate and black tourmaline, both of which occur in negligible quantities. The metallic mineralization consists mainly of pyrite and small amounts of galena and chalcopyrite. No tellurides have been recognized. The total sulphide content in most veins averages less than 2%, but may locally exceed 10%.

Pyrite is found as more or less well developed crystals and in small, irregular aggregates. Cubes up to 1 inch [2.5 cm] size have been noted in the Renabie "C" orebody. Some pyrite occurs in exceedingly small particles which escape detection in the hand specimen but show during panning. Galena, chalcopyrite, and, rarely, sphalerite accompany the pyrite in well mineralized vein sections. Galena and chalcopyrite are observed filling cracks in the pyrite thus indicating their later age. Both minerals are probably contemporaneous.

The gold rarely occurs in particles large enough to be seen with the naked eye. In spite of the fine size of the gold, most ores pan surprisingly well though roasting may be necessary. Under the microscope, the gold is seen as light-coloured specks and flakes clustering around the sulphides. In some sections it occurs in faint cracks in the other vein minerals. The occurrence of galena is generally regarded as indicative of higher gold values, but this empirical rule is not without exceptions.

The Quartz Bodies–The auriferous quartz bodies have the form of lenses, chimneys, and fissure veins. Some are so irregular in shape as to make classification difficult. Their lengths range from a few score feet to almost 700 feet [210 m]. Widths vary from a few inches to over 100 feet [30 m]. Rel-

atively little information is available as regards the vertical extent of the deposits. Some of the Renabie orebodies have been opened up to a vertical depth of 375 feet [115 m]. The downward continuity of the Renabie "D" Orebody has been ascertained by diamond drilling to a depth of slightly over 500 feet [150 m]. No exploration has been carried out beyond that depth.

In detail, the relationship between the quartz bodies and their host rocks is quite erratic. Wide quartz bodies have been found to terminate rather abruptly without evidence of fracturing or shearing continuing beyond their ends. In some cases joint planes have been factors controlling the shape of the smaller bodies. Chimney-like quartz masses show structural relations to intersections or junctions of two or more sets of fracturing.

The variability of the shape and dimensions of the quartz bodies is well illustrated by the Renabie "B" and "D" deposits. On the surface, these two structures consist of one continuous, curved quartz body over 250 feet [75 m] long, the north portion of which strikes nearly west and dips 60° south while the south portion strikes almost south and dips 55° west. Underground both ore zones consist of separate quartz bodies with an intervening gap of more than 100 feet [30 m]....

Wall-rock Alteration–Some deposits consist almost entirely of quartz with only traces of wall-rock inclusions. Others, like the large Renabie "C" orebody, contain numerous sheet-like inclusions of altered country rock. In most cases, the sheared host rock close to the quartz bodies has been sericitized and impregnated with varying amounts of pyrite. As a rule, the mineralized wall-rock carries low gold values, though not invariably so.

A different type of wall-rock alteration was observed in the east portion of the Renabie "C" orebody. Here the tonalitic wall-rock is altered to a fine-grained, slightly schistose rock which under the microscope consists of densely packed biotite and epidote, and minor amounts of chloride [chlorite?] and quartz. In the west portion of the same orebody, a partial sericitization appears to have been superimposed upon the earlier biotization.

Ore Shoots–The gold content of the different quartz bodies varies within wide margins. Assays range from traces to more than 10 oz. p.t. The gold tenor seems to vary with the sulphide content although this is no infallible criterion. As mentioned previously, higher gold values are commonly associated with the galena.

Some quartz bodies like the Renabie "D" have a sufficiently uniform gold content to be mined as a whole. In others, gold values are concentrated in certain portions of the quartz masses. It is interesting to note that in the Renabie "A", "B", "C" and the Dulama No. 1 bodies, all of which strike nearly west and dip steeply south, higher assay values occur nearly exclusively in the western halves of the quartz masses. A steeply westerly rake is discernible in the case of the Renabie "A" and "B" orebodies.

For additional information the reader is referred to the marginal notes on ODM Map P.492 (Ferguson 1968a).

Rundle Gold Mines Limited (165)
Newton and Dale Townships
District of Sudbury

Rundle Gold Mines Limited, a subsidiary of Hollinger Mines Limited, currently controls 4,555 acres (18.43 km^2) in Newton and Dale Townships. The property has been inactive since 1942 and most exposures are presently overgrown, filled or otherwise inaccessible. Surface facilities were destroyed in a bush fire which originated at the Orofino prospect in 1948. The shaft is located in the southeast corner of Newton Township about 1½ miles (2.4 km) south of Cinqisle Lake and on a hill 500 feet (150 m) from the northeast shore of Parallel Lake [local name].

Information regarding this prospect is relatively scarce. A brief report by Hogg (1950a, p.1-3) based on a brief visit in the presence of Hollinger Mines Limited officials is available from the Regional Geologist's Files, Ontario Minis-

try of Natural Resources, Timmins.

Hogg (1950a) described the geology as follows:

Developments

The property has been extensively explored by surface trenching and diamond drilling. A shaft has been sunk to 350 feet [107 m] with levels at 150 feet [45 m], and 300 feet [90 m]. A limited amount of drifting was done on both levels.

Work was discontinued on July 1, 1942, and a watchman was kept on the property until 1948 when the surface buildings were destroyed by fire.

On the hill south of the shaft, there are numerous other gold 'showings', which have been opened up by surface trenching and stripping.

Geology

The rocks in the immediate vicinity of the mine are principally Keewatin-type volcanics intruded by feldspar porphyry and other acid intrusives. The volcanics include lavas of andesitic and rhyolitic composition, bedded tuffs, and some iron formation.

The hill south of the shaft is largely pink feldspar porphyry, with large included remnants of partly digested lavas. Both porphyry and altered lavas are cut by quartz stringers and mineralized with disseminated pyrite.

Veins

The surface showing of the main vein, on which the shaft is sunk, is almost entirely covered with broken rock. According to Mr. Rundle, most of the vein is in pink porphyry with quartz stringers mineralized with disseminated pyrite. Much of the broken ore on the dump is white quartz, with inclusions of pink syenitic material. The quartz carries pyrite and some chalcopyrite in irregular masses. Visible gold was observed in several specimens, in minute fractures around pyrite grains.

Where the vein is exposed west of the shaft, it consists of highly silicified, altered lava, well mineralized with disseminated pyrite.

In developing the vein underground considerable difficulty was encountered with cross faulting.

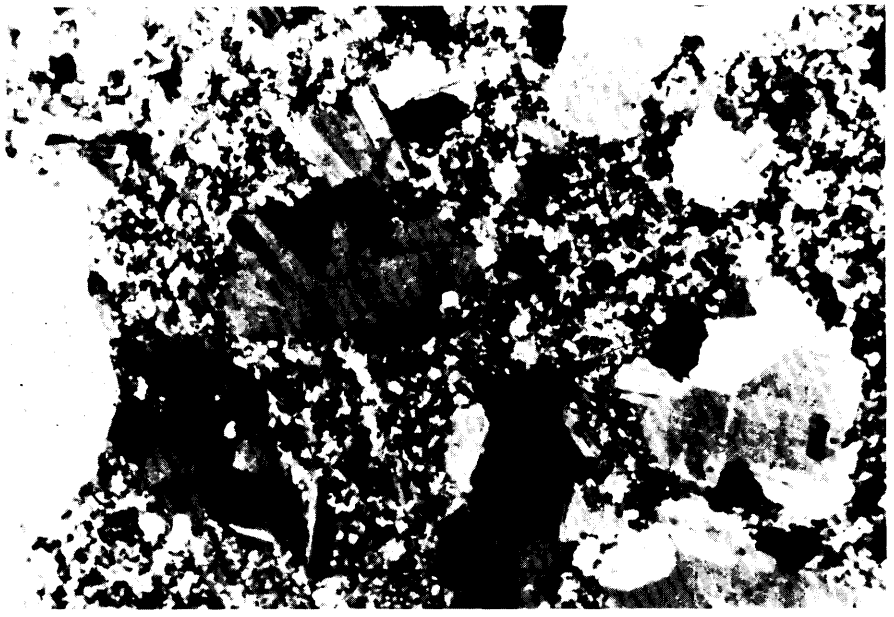
Numerous other showings are exposed on the hill south of the shaft. Some are mineralized remnants of lava in the porphyry, some are narrow quartz veins, and some are quartz stockworks in porphyry.

Ore reserves

Mr. W.R. Dunbar, Chief Geologist for Hollinger, estimates that underground work has outlined 100,000 tons of ore with an average grade of 0.29 ounces per ton.

Four grab samples were taken for analysis by the author [Sage] from the muck pile and outcrops. Two of these returned good gold assays. One sample assayed 1.09 ounces gold per ton (assay by Mineral Research Branch, Ontario Division of Mines) and consists of dull-grey to milky vein quartz with about ¼ percent pyrite occurring as euhedral crystals up to 1 mm in diameter. A second sample, collected from outcrop in a partially filled trench about 200 feet (60 m) west of the main shaft, assayed 1.95 ounces gold per ton (assay by Mineral Research Branch, Ontario Division of Mines). The sample contains about 15 to 20 percent pyrite and is cut by small white carbonate stringers. The pyrite occurs as small euhedral crystals generally less than ½ mm in diameter. The rock may originally have been an intermediate to mafic volcanic rock, or a phase of the feldspar porphyry. Approximately 40 percent of the muck pile is composed of weathered, red-brown feldspar porphyry with 2 to 3 percent finely disseminated pyrite. The third and fourth samples, representative of this rock type, returned 0.11 and 0.10 ounces gold per ton respectively (assays by Mineral Research Branch, Ontario Division of Mines).

Three samples were selected for thin sectioning. One sample was taken from the muck pile 90 feet (30 m) west of the shaft and is part of the same specimen that assayed 0.11 ounces gold per ton. The sample is a relatively fresh, fine- to



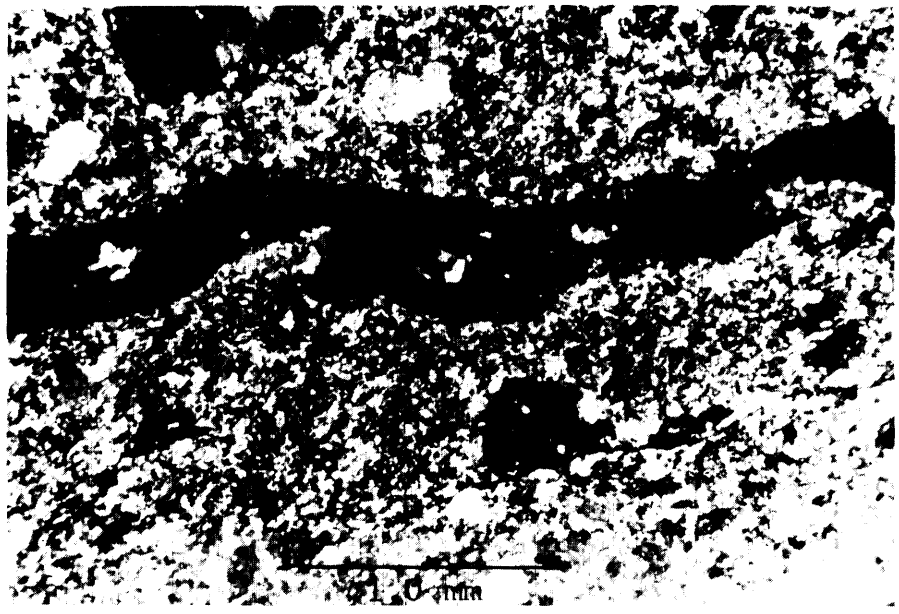
ODM9450

Photo 28–Photomicrograph of feldspar porphyry assaying 0.11 ounce gold per ton, showing bent and broken feldspar phenocrysts. Rundle Gold Mines Limited prospect.

medium-grained, inequigranular, plagioclase porphyry. The phenocrysts exhibit pericline and albite twinning. The phenocrysts are slightly altered to sericite and carbonate and some grains have a protoclastic or cataclastic texture (Photo 28). This rock is possibly an intrusive breccia unit. The sample contains abundant carbonate in the groundmass and fracture filling of the plagioclase grains. Weathering turns the surface reddish brown from the iron contained within the carbonates.

Two samples, collected from outcrops about 70 feet (21 m) northeast, and 160 feet (49 m) southeast of the shaft respectively, represent the rock units occurring north and south of the shaft. Both specimens are considered to be altered, fine-grained, intermediate to felsic pyroclastics (Photo 29). Abundant, highly-altered, plagioclase grains show good relict albite twinning and are largely altered to carbonate and sericite. The first sample contains what appear to be irregular collapsed fragments of more mafic material, now largely altered to chlorite and limonite. Both specimens are rich in carbonate, and display euhedral crystals and anhedral crystal fragments of plagioclase. Minor quartz and pyrite are present in both samples. The second sample contains 3 to 4 percent biotite which exhibits bending of the 001 cleavage planes. Thin section study therefore, suggests that the feldspar porphyry intrusion associated with gold mineralization occurs within highly-altered intermediate pyroclastics.

Surface geological maps made available through the courtesy of Hollinger Mines Limited indicate that the rocks within the vicinity of the mine site are



ODM9451

Photo 29–Photomicrograph of felsic to intermediate, pyroclastic rock, showing collapsed pumice fragments. Outcrop sample collected approximately 75 feet (23 m) northeast of shaft of Rundle Gold Mines Limited prospect.

predominantly mafic metavolcanics with interdigitating porphyry intrusions (Figure 23). In cross-section, the mineralized zone is steeply dipping and variable in width (Figure 24).

The presence of low but interesting gold values within feldspar porphyry samples collected from the muck pile near the shaft indicates that porphyry bodies of the area should be examined for their low-grade, gold potential.

Swayze-Huycke Prospect (46)
Cunningham Township
District of Sudbury

The former property of Swayze-Huycke Gold Mines Limited is located on the east shore of Allen Lake in the northeast corner of Cunningham Township. The former mine site is presently overgrown and little can be seen of the workings. The ground covering the prospect is currently open for staking. The prospect can be reached with float-equipped aircraft to Allen Lake. Meen (1942, p.23) described the occurrence as follows:

Because operations have been suspended for some years and considerable regrowth of the underbrush has taken place, it is not certain that the writer saw all the surface work. A few old strippings

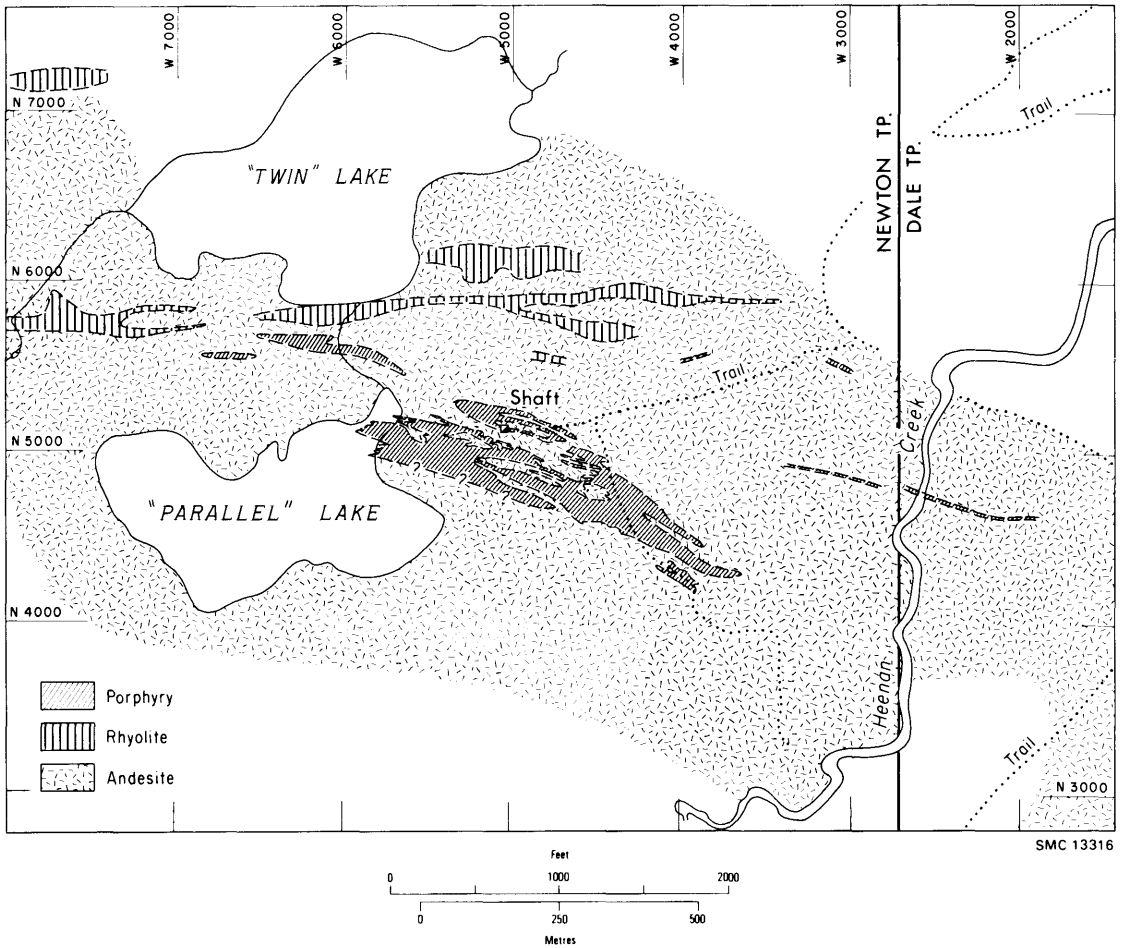
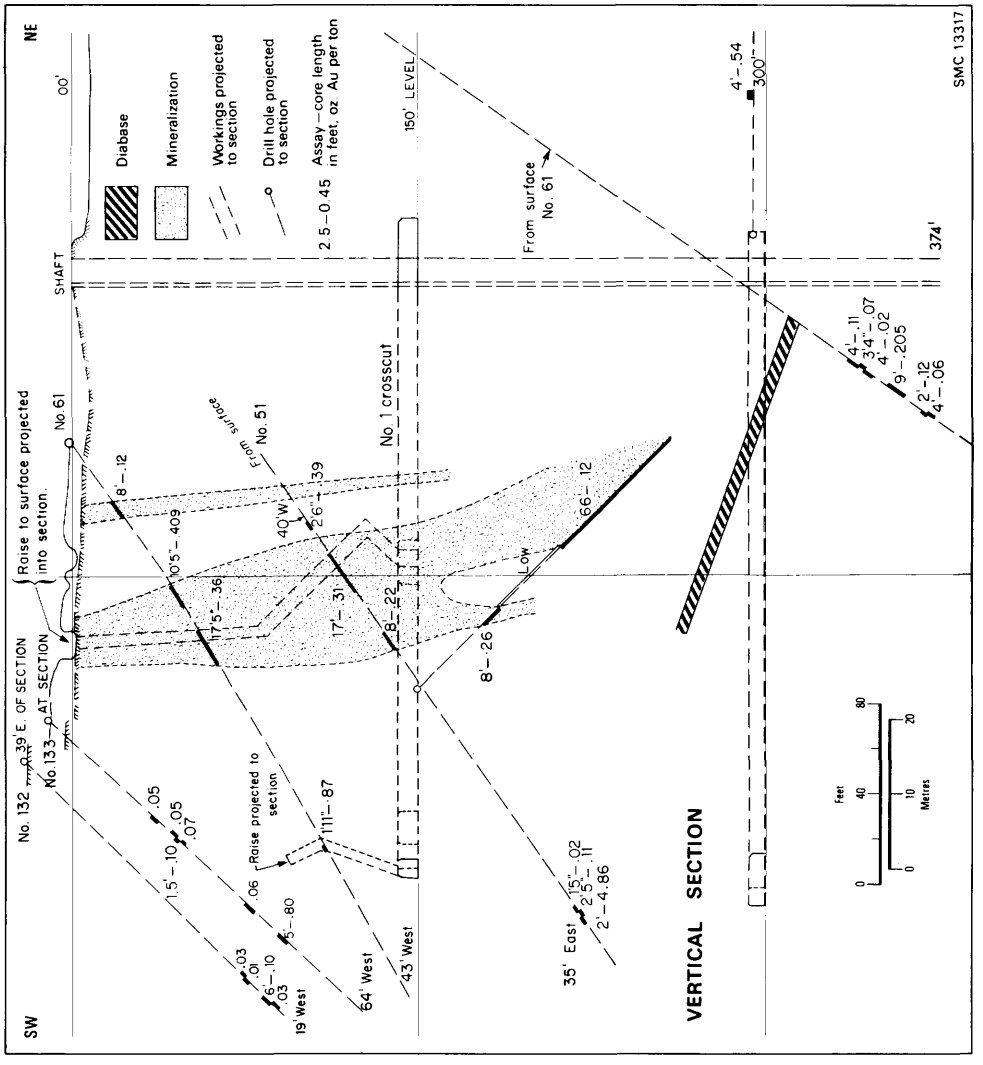


Figure 23–Rundle Gold Mines Limited, Newton and Dale Townships; geological map modified from a plan by J. Armstrong, and published with the permission of Hollinger Mines Limited. Lake names are local names (i.e. unofficial).


SW
NE
No. 132
No. 133
E. OF SECTION
AT SECTION
Raise to surface projected into section.
No. 61
SHAFT
00'
Diabase
Mineralization
Workings projected to section
Drill hole projected to section
Assay — core length in feet, oz Au per ton
2 5 — 0 45
150' LEVEL
From surface
No. 61
From surface
No. 51
No. 1 crosscut
Raise projected to section
.8' — .12
10'5' — .409
17'5' — .36
40' W
26' — .39
17' — .31
8' — .22
8' — .26
66' — .12
Low
111' — .87
1.5' — .10
.05
.05
.07
.06
5' — .80
.03
.01
6' — .10
.03
19' West
64' West
43' West
35' East
15' — .02
2.5' — .11
2' — 4.86
4' — .54
300'
374'
4' — .11
3.4' — .07
4' — .02
9' — .205
2' — .12
4' — .06
VERTICAL SECTION
Feet
Metres
SMC 13317

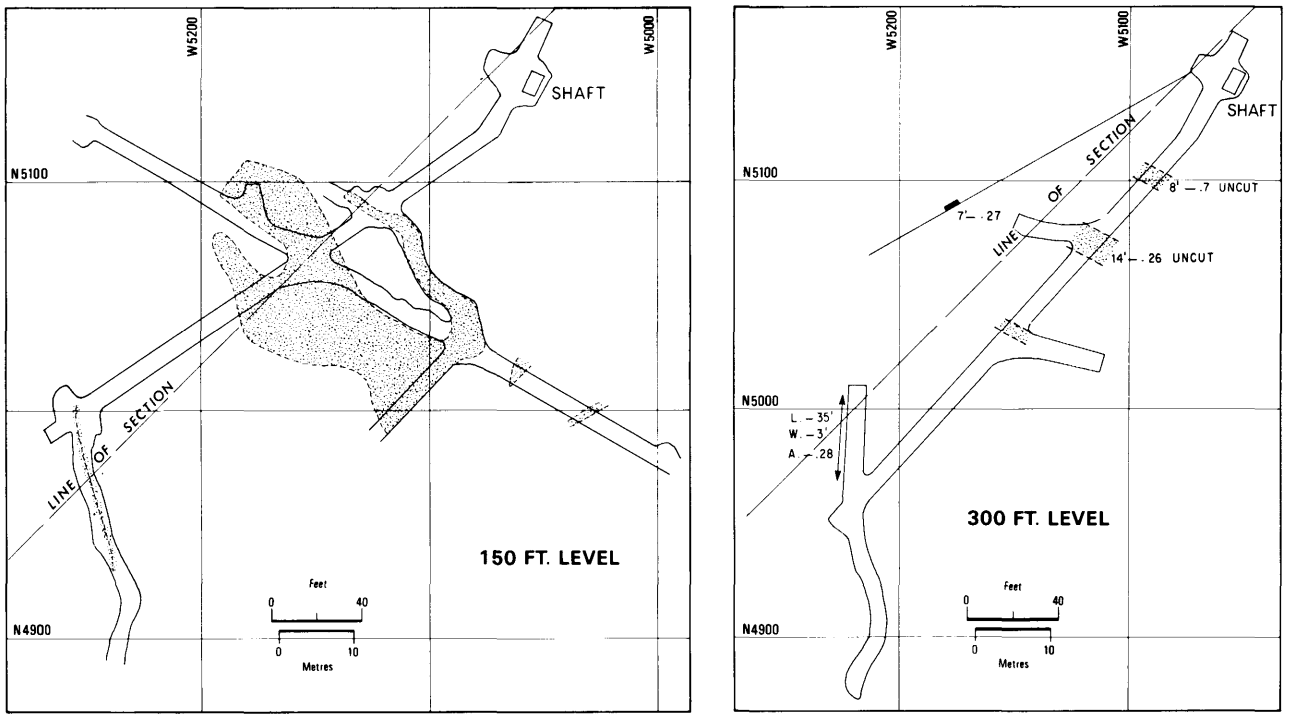


Figure 24–Rundle Gold Mines Limited, Newton Township; geological vertical section and level plans, modified from company plans; published with the permission of Hollinger Mines Limited.

ing to the log the drill hole cut 110.5 feet (33.7 m) of asbestos-bearing material with a weighted grade of 0.708 percent asbestos. For a more complete description of this occurrence the reader is referred to the report by Riley (1971, p.40).

Canadian Johns-Manville Company Limited (1)
Reeves, Penhorwood, and Kenogaming Townships
District of Sudbury

The asbestos deposits on the Reeves mine property of Canadian Johns-Manville Company Limited consist of five mineralized zones containing asbestos fibre. The Canadian Johns-Manville Company Limited investigated this area for asbestos fibre starting in the early 1950s, and have developed a producing mine (the Reeves mine) near the southern edge of Reeves Township. Several other zones of asbestos fibre were delineated south of the mine site in Penhorwood Township. The main ore zone of Canadian Johns-Manville Company Limited has been described by Milne (1972, p.68) as a large, mineralogically layered ultramafic mass, of originally dunitic to peridotitic composition, which has been almost completely serpentinized. The mineralized zone has a strike length of 2,100 feet (640 m) in a northwest direction and a width of 750 feet (230 m) at the west end and 200 feet (60 m) at the east end (Milne 1972, p.68). Ore reserves are estimated to be 20 million tons grading between 3 and 3.5 percent total fibre (Milne 1972, p.68). The other occurrences of asbestos fibre are known as the "75", Jehann, Dupont, and Nat River fibre zones.

Other occurrences of asbestos fibre are known in Penhorwood Township, and just east of the map-area in Kenogaming Township (Milne 1972).

For a complete description of these deposits the reader is referred to the report by Milne (1972, p.60-63, p.67-74).

Sand River Gold Mining Company Limited [1957] (233)
Walls Township
District of Algoma

In 1957 Sand River Gold Mining Company Limited drilled a 1,106 foot (337.1 m) hole on claim SSM 55817 on the west side of the Pichogen River at Latitude 48°59.75′ and Longitude 83°53.25′. The drill log was obtained from assessment file SSM 1473 (Regional Geologist's Files, Ontario Ministry of Natural Resources, Sault Ste. Marie); it reports that the entire hole was drilled in magnetite-bearing serpentinite with trace amounts of sulphide, and possibly some fibre.

BASE METALS AND SULPHIDES

Within the map-area approximately 115 base-metal and sulphide occurrences have been noted in previous reports and assessment files. Even though

sulphide occurrences are numerous throughout the metavolcanic-metasedimentary belts and exploration activity has been sporadic within these belts for nearly 70 years, a producing base-metal mine has yet to be developed. Exploration activity by several major mining firms is continuing at the present time.

As a means of illustrating the base-metal and sulphide occurrences a table similar to the one that was prepared for gold deposits was assembled from assessment data and reports.

Table 23 shows that most sulphide occurrences within the map-region have a sedimentary environment. If iron formation is considered a sedimentary rock, a total of 47 percent of the occurrences are hosted by metasediments. Among those formations referred to as wall rocks, sedimentary rocks again predominate in a total of 41 percent of the described cases. In both categories mafic metavolcanics are the next to most frequent rock type. Under the heading of "Associated Rocks", porphyries of various types and granites are dominant.

Described structural controls of mineralization are largely confined to shearing and brecciation. Minor mineralization occurs along diabase dike – granitic rock contacts in the southern part of the map-area.

From field work and a search of the assessment literature, it was determined that the metasediments and particularly the iron formations appear to contain the most abundant sulphide mineralization, and perhaps offer the most promising exploration target.

Within the Woman River Iron Formation, sulphides of economic interest appear to be at least in part later than the pyrite-pyrrhotite mineralization of the iron formation.

Goodwin (1965, p.16-17) described sulphides in the banded chert member of the Woman River Iron Formation as follows:

> Dark-grey to black, carbonaceous zones up to 2 feet [0.6 m] thick, composed of fine-grained chert, carbonaceous matter, and sulphides (generally pyrite and pyrrhotite), are locally present within the banded chert or at the contact of the chert with the immediately underlying sulphide-carbonate zone....The sulphide components of the carbonaceous zones commonly form small spherical to ellipsoidal concretions up to ¼ inch [6 mm] in diameter distributed in the carbonaceous matter. Tiny flecks of chalcopyrite, galena, and sphalerite are locally associated....Minor traces of copper-lead-zinc mineralization are locally present in the banded chert. Typically, traces of one or more of sphalerite, galena, and chalcopyrite, in that general order of abundance, occur either in narrow crosscutting, quartz-calcite stringers less than ¼ inch [6 mm] wide, or, more rarely, as tiny, irregular clusters of grains within the carbonaceous chert as mentioned above.

Goodwin (1965, p.19-20) further described the occurrence of base metal sulphide minerals in the sulphide-carbonate member as follows:

> Lead-zinc-copper mineralization is locally present in the sulphide-carbonate member in the form of small quartz-carbonate veinlets and lenticles generally less than ¼ inch [6 mm] thick and a few inches long, containing sphalerite, galena, and chalcopyrite, in that general order of abundance.

For a complete description of the Woman River Iron Formation and associated base metal mineralization the reader is referred to Goodwin (1965).

Even though base metal mineralization has been known since 1910 to exist in the Woman River Iron Formation, and the area has been prospected for base metals many times since, an economic concentration has not been found. The widespread occurrence of base metal sulphides reflects a favourable environment for base metal sulphide deposition, but the delineation of an economic deposit

TABLE 23 | LITHOLOGIC ENVIRONMENT FOR BASE METAL AND SULPHIDE MINERALIZATION WITHIN THE CHAPLEAU AREA.

Host Rock

Number of occurrences reporting - 137[1]

Rock Type	Percent of Total
Metasediments	27%
Quartz veins	22%
Iron Formation	20%
Mafic Metavolcanics	15%
Felsic Metavolcanics	9%
Diorite	2%
Sericite Schist	2%
Other	3%

Wall Rock

Number of occurrences reporting - 100

Rock Type	Percent of Total
Metasediments	41%
Mafic Metavolcanics	32%
Porphyry and Granite	15%
Felsic Metavolcanics	6%
Diorite	5%
Other	1%

Associated Rocks

Number of occurrences reporting - 15

Rock Type	Percent of Total
Porphyry and Granite	67%
Diorite	13%
Other	20%

Structure

Number of occurrences reporting - 20

Structural Type	Percent of Total
Shearing	75%
Breccia	15%
Contact	10%

Alteration

Number of occurrences reporting - 9

Alteration Type	Percent of Total
Silicification	44%
Carbonatization	33%
Chloritization	23%

[1]note: some occurrences report more than one host rock

TABLE 24 MINERALOGY OF 115 BASE METAL AND SULPHIDE OCCURRENCES WITHIN THE CHAPLEAU AREA, AS TAKEN FROM ASSESSMENT FILES AND GOVERNMENT REPORTS.

Mineral	Percentage of reported occurrences
Pyrite	96%
Pyrrhotite	65%
Chalcopyrite	62%
Sphalerite	31%
Graphite	30%
Galena	18%
Magnetite	14%
Gold (minor component)	10%
Hematite	6%
Arsenopyrite	4%
Molybdenite	3%
Silver	3%
Bornite	1%

will probably require considerable patience and an indepth study of the area.

Minerals of economic interest occurring within the cherty iron formations and argillaceous-greywacke bands located on the property of Consolidated Shunsby Mines Limited in Cunningham Township indicate that crosscutting relationships of base metal sulphide mineralization is also common in these iron formations. The economically important sulphides at this occurrence commonly occur along with barren sulphides as cementing material in a light grey chert breccia. The chert fragments themselves appear to be barren. Within the greywacke bands minor disseminated pyrite can be seen paralleling the bedding; however, the galena, sphalerite, and minor chalcopyrite occur predominantly as crosscutting stringers, veinlets, and fracture fillings.

It is recommended that during exploration for base metals within the map-area, particular attention should be given to sulphide-bearing iron formations particularly if the unit has been brecciated. Outcrops of barren sulphides should be examined along strike for areas of brecciation and possible economic mineralization.

Table 24 lists the frequency of occurrence of individual mineral species within the base metal sulphide occurrences of the map-area. The deposits are fundamentally pyrite-pyrrhotite-chalcopyrite assemblages and a significant proportion have associated graphite and sphalerite.

P. Barry
Shenango and Sherlock Townships
District of Sudbury

In 1969, Geneseco Resources did geological mapping and a ground magnetometer survey over claims registered to Peter Barry, covering the central por-

tion of the Shenango complex. Other than traces of chalcopyrite, nothing of economic interest was reported to have been found.

Borden Lake Pyrite Occurrence (30)
Cochrane Township
District of Sudbury

Minor disseminated sulphides, predominantly pyrite with minor pyrrhotite, were observed along Highway 101 in Cochrane Township.

This occurrence contains irregular concentrations of sulphide forming up to 5 percent of the rock, and is similar to the Scorch Creek occurrence. Two grab samples, taken by the author [Sage] and assayed by the Mineral Research Branch, Ontario Division of Mines, assayed 0.02 percent copper, 0.03 percent nickel and 0.07 percent copper, 0.01 percent nickel respectively. Disseminated sulphides in quantities from trace to nearly 1 percent are common in these rock types.

The erratic distribution, low assay values, and low total sulphide content suggest that this occurrence is of little economic interest.

Card Lake Copper Mines Limited (214)
Sewell Township
District of Sudbury

In the southwest corner of Sewell Township an occurrence of antimony was recently mapped by Milne (1972, Map 2230). The deposit can be reached by a logging road south of Highway 101.

A brief visit was made to the showing. The antimony mineralization is associated with silicification and sericitization along a zone of shearing which cuts mafic pillow lavas. The zone strikes S25E and dips from vertical at the northern end, to 27SW at its southernmost exposure. Mineralization has been exposed by intermittent stripping and several pop holes over a length of 180 feet (55 m). The mineralized zone averages between 4 and 5 feet (1.2 to 1.5 m) in width. The shearing is parallel to the elongation of the pillows in mafic metavolcanics located on the north side of the shear zone. The metavolcanics are silicified and altered on both sides of the zone of shearing.

The antimony mineralization is very fine to medium grained and banded, with the high-grade material appearing as narrow lensoid stringers. The pit located at the southern extremity of the exposure shows the richest concentration. Two grab samples were taken by the author [Sage] for assay. The first, from a pit at the southern end of the exposure, assayed 14.2 percent antimony, 3.05 percent arsenic and 0.02 percent copper. The second, from the north end of the exposure, assayed 0.55 percent antimony, 1.10 percent arsenic and 0.02 ounces gold per ton. A 30 element spectrographic analysis disclosed nothing of further interest. X-ray diffraction analysis of the metallic minerals indicated that the antimony-bearing mineral is berthierite and that the arsenic is contained in fine-

grained arsenopyrite (assays and analyses by Mineral Research Branch, Ontario Division of Mines). A polished section prepared from a high-grade sample containing berthierite showed fine- to medium-grained berthierite occurring as irregular grains in quartz. This is the third reported occurrence of this mineral in the Province of Ontario. Berthierite in association with gold mineralization, has also been reported from the Little Long Lac mine and Talsmora mine, Errington Township, District of Thunder Bay (Pye 1951, p.57) and from the Cochenour Willans mine, Dome Township, District of Kenora (Traill 1970, p.73).

Drilling by Card Lake Copper Mines Limited (The Northern Miner 1971, Oct. 7, p.19; Oct. 14, p.13; Oct 28, p.2) on two anomalies designated "A" and "B", has disclosed copper, nickel, and antimony mineralization. Two holes on anomaly "B" disclosed copper and nickel values and two holes on anomaly "A" disclosed antimony mineralization with a width of 30 feet (9 m).

Consolidated Shunsby Mines Limited (37, 43)
Cunningham Township
District of Sudbury

The property of Consolidated Shunsby Mines Limited is located in the centre of Cunningham Township and can be reached by float-equipped aircraft to Peter Lake and a 3-mile (5 km) hike east along a tote road to the property. A second means of access would be by helicopter to the Ministry of Natural Resources fire-tower in central Cunningham Township and a 1 mile (1.6 km) walk, along a trail leading south to the Consolidated Shunsby Mines Limited camp. The property is located about 14 miles (23 km) north of Sultan on the Canadian Pacific railway. The old Kenty wagon road from Sultan is now impassable for vehicles over most of its length but one could walk along the road bed until meeting the trail leading from Peter Lake to the Shunsby camp. The walk into the property from Sultan would take the better part of a day.

The company was originally known as Shunsby Gold Mines Limited, and was renamed Shunsby Mines Limited in 1955. In 1965 the name was changed to Consolidated Shunsby Mines Limited.

In 1955, Shunsby Gold Mines Limited acquired 20 mining claims from H.J. Paul and E.N. Sootheran of Chapleau. During succeeding years the company has added and dropped claims. Currently the company controls 10 non-patented claims, 20 patented claims, 10 mining leases, and one license of occupation in Cunningham Township (F.R. Joubin [1] 1970, personal communication). Work on the property included 39,000 feet (12 000 m) of diamond drilling. The company has completed considerable trenching and stripping of mineralized showings. Geophysical and goechemical surveys have been run over various portions of the property.

Work by Consolidated Shunsby Mines Limited on their main showing 1 mile (1.6 km) southeast of the Ministry of Natural Resources camp has delineated a zone approximately 350 feet (105 m) along strike, 1,000 feet (300 m)

[1]President, Consolidated Shunsby Mines Limited.

down dip, and 30 feet (9 m) thick with a drill-indicated grade of 1.2 percent copper and 1.3 percent zinc for 310,095 tons (F.R. Joubin 1970, personal communication). Joubin reported that the mineralization is still open at depth and that this block of ground is bounded to both the north and south by faulting.

Diamond drilling by Consolidated Shunsby Mines Limited has also indicated mineralization 1,550 feet (470 m) south of the main showing and approximately 500 feet (150 m) north (F.R. Joubin 1970, personal communication). In the southeast corner of the property some high grade copper float has been located but its source remains yet to be discovered. The mineralized areas located in the northwest corner of the area have undergone only limited testing.

The Consolidated Shunsby property is particularly interesting in that base metal mineralization occurs over a broad area in lean, brecciated, siliceous iron formation with minor associated greywacke. Ore-grade intersections, some relatively high grade, have been made both within and south of the main showing. Generally, however, the higher grade intersections are separated by lower grade intersections. The most important metals present are copper and zinc but there appear to be values in lead, silver, and cadmium, of potential secondary interest. Consolidated Shunsby Mines Limited is continuing its evaluations of the economic potential of this area.

During the 1970 field season the author [Sage] spent a day and a half on the property in the company of William Heshka, company geologist, examining the mineralized showings. F.R. Joubin made available to the author maps, cross-sections, and reports concerning the property. The following descriptions of the various rock-units (slightly modified by the author with regard to rock type after examination of drill core from Consolidated Shunsby Mines Limited hole number 68-16) are based on personal communications with Heshka and Joubin, and geological reports by Archibald (1962) and Mudford (1956).

The rocks of the area are mafic metavolcanics, chert with carbonaceous argillite (greywacke) bands, fine- to medium-grained diorite, and feldspar porphyry.

The sequence dips 20 to 30 degrees west and generally strikes north in the central part of the area; farther north within the property the strike is northeast. The lowest unit of the sequence is a massive, relatively homogeneous, fresh, fine- to medium-grained diorite which may represent an intrusion or very thick flow. This unit is referred to as the "Footwall Diorite" by Consolidated Shunsby Mines Limited. Drilling by Consolidated Shunsby Mines Limited has penetrated several hundred feet of this unit without encountering a lower contact. Overlying the "Footwall Diorite" are argillite, graphitic phyllite and some sericite schist. These rock units are thought to be in fault contact with the lower diorite; diamond drilling has indicated this contact to be highly altered. One or two porphyry sills, 1½ to 3 feet (0.5 to 0.9 m) thick, locally intrude the diorite-metasediment contact. Overlying the argillite, phyllite and sericite schist is a fine-grained, brecciated, light grey to dark grey chert, referred to as "Basal Chert" by Consolidated Shunsby Mines Limited. The "Basal Chert" is the locus of the main copper-zinc mineralized zone. Above the "Basal Chert" lies a fine-grained, massive light to dark green, variolitic mafic metavolcanic unit. The next stratigraphic unit, above the variolitic metavolcanic, is a light grey to dark grey, fine-grained, chert breccia. This upper chert breccia is referred to as "Middle Chert" by Consolidated Shunsby Mines Limited, and is the locus of predominantly zinc mineralization.

These units are in conformable contact and are cut by a younger diorite dike or dikes which are highly altered and dip steeply eastward. The younger diorite is reported to have highly altered feldspars and mafic minerals; and small bluish quartz grains are scattered sparsely throughout. It is post-ore and remobilization of the sulphide may have occurred on both sides of the dike. The sequence was then intruded by feldspar porphyry, possibly along faults. The porphyry does not occur in large masses and rarely cuts the "Footwall Diorite".

Faulting of the area is complex. A series of roughly east-trending faults with left lateral displacement occur within the area. These faults are thought to be dipping south. A second series of north-trending faults with little displacement is also present and they are commonly filled with feldspar porphyry. The sphalerite mineralization is possibly spatially related to the feldspar porphyry intrusions.

The author examined two thin sections of the argillite horizons, prepared from core samples taken from Hole 68-16 of Consolidated Shunsby Mines Limited at depths of 174.0 feet and 311.8 feet (53.0 and 95.0 m) (Figure 26). The rock appears to be a very fine grained greywacke composed of 15 to 20 percent angular to subrounded clastic quartz grains, 10 to 15 percent anhedral to euhedral pyrite, 0 to 5 percent graphite, 20 to 25 percent carbonate, and 55 to 60 percent angular to subrounded chert grains. The drill core is finely bedded at 45 degrees to the core axis and a tiny stringer of pyrite crosscuts the bedding in the 311.8 foot (95.0 m) sample. Contacts between the fine-grained, black greywacke horizons and the chert breccia appear to be gradational.

The following descriptions refer to mineral occurrences on the property of Consolidated Shunsby Mines Limited, shown on Figure 25 (Chart B, back pocket).

LOCATION 1

Approximately 400 feet (120 m) east and slightly south of the Consolidated Shunsby Mines Limited base camp at the edge of a small stream, an outcrop of brecciated chert cemented with pyrite, chalcopyrite and minor sphalerite has been exposed by trenching.

The sulphides occur as thin, discontinuous massive to banded fillings between breccia fragments, as disseminated grains, and as breccia cement, over a width of 30 to 40 feet (9 to 12 m). The formation appears to strike approximately N40E and dips 64W. Scattered inclusions of chlorite schist were noted in the outcrop. The breccia fragments are light grey, sugary textured, and consist of angular, unmineralized, chert fragments.

Heshka (1970, personal communication) reported that this occurrence is an isolated block pinching out into "greenstone" to the north, and cut off by faulting to the south. Heshka reported that work on this fault block indicated an average sulphide content of 10 to 15 percent, of which about half is chalcopyrite. Heshka reported assays between 1 and 2 percent copper with an average of about 1.8 percent. A grab sample of better-than-average material was taken by the author for assay. This sample assayed 5.00 percent copper, 0.73 percent zinc, and 0.60 ounces silver per ton (assay by Mineral Research Branch, Ontario

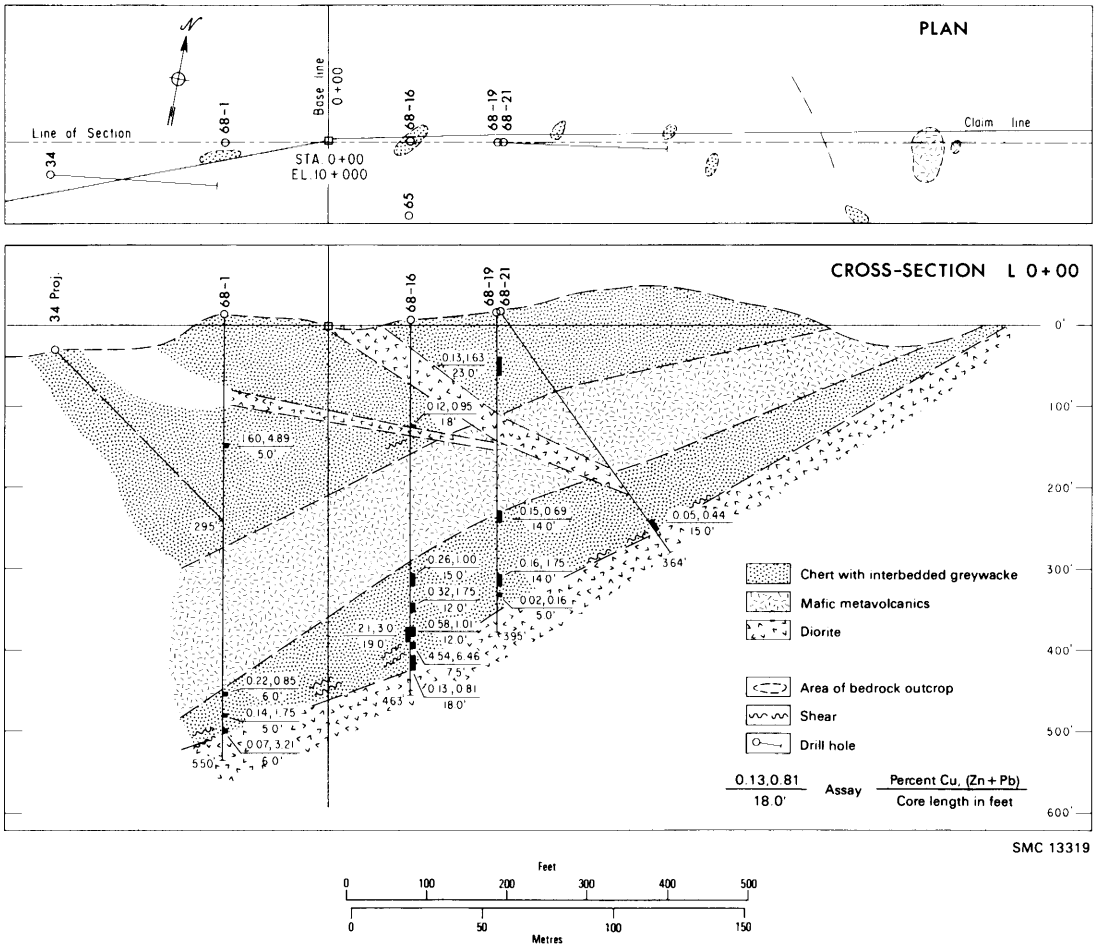


Figure 26–Consolidated Shunsby Mines Limited, Cunningham Township; generalized geological cross-section, modified from a company section, 1969.

Division of Mines). A 30 element spectrographic analysis did not indicate anything else of interest.

LOCATION 2

Approximately 800 feet (240 m) north of location 1, a ridge of interbedded chert, greywacke and chlorite schist has been extensively trenched and prospected for a length of 65 to 70 feet (20 to 21 m) parallel to strike. The chlorite schist is probably of mafic volcanic derivation. The rock-units strike N45E and dip 57N, parallel to a stream valley along the south side of the ridge. Extensive trenching perpendicular to strike has disclosed veinlets and stringers of sulphides both parallel to, and crosscutting the bedding over widths of 10 to 20 feet (3 to 6 m). The sulphides in order of decreasing abundance are sphalerite, galena, pyrite, and chalcopyrite. The sulphides vary in quantity from 0 to 20 percent of the total rock and the surface shows abundant iron staining with splashes of blue-green azurite and malachite.

The outcrop exhibits minor brecciation and some slickenside development along joint planes. Brecciation does not appear to be nearly as intense as that at location 1. Two grab samples were collected by the author for assay. The first assayed 0.18 ounces silver per ton, 0.07 percent copper, 1.58 percent lead, 0.25 percent zinc and 0.04 percent cadmium. The second sample assayed 0.36 percent copper, 0.32 percent lead and 4.66 percent zinc. A 30 element spectrographic analysis disclosed nothing else of interest in either sample (assays by Mineral Research Branch, Ontario Division of Mines).

LOCATION 3

Approximately 500 feet (150 m) NNW of location 2 is a rounded, iron-stained outcrop approximately 50 by 50 feet (15 by 15 m) in surface area, containing 0 to 15 percent pyrite. The chert appears to be brecciated but its stratigraphic position relative to the other base metal showings is unknown. A grab sample taken from this outcrop by the author assayed 0.02 percent copper. A 30 element spectrographic analysis returned nothing else of interest (assays by Mineral Research Branch, Ontario Division of Mines).

LOCATION 4

Three closely spaced parallel trenches have been blasted across banded iron formation and thin beds of greywacke, in the northwest corner of the Consolidated Shunsby Mines Limited property, on the Tower Group of claims. The showing is approximately 1,600 feet (490 m) southwest of the Ministry of Natural Resources cabins on a small lake and approximately 1 mile (1.6 km) northwest of the Shunsby camp and principal showings. The banding within the iron

formation consists of alternating layers of chert and magnetite, and is best observed in the most westerly trench. The trenches are perpendicular to the strike of the iron formation and expose roughly 50 to 60 feet (15 to 18 m) of the cherty iron formation with thin beds of greywacke, but the trenching does not completely cross the intercalated iron formation and greywacke unit. Mild to strong brecciation was noted at the south end of the trenches. Magnetic attraction prevented an accurate strike determination but it is estimated to be between N65E and N75E with variable dips of 45 to 80N. The total sulphide content is variable from 0 to 15 percent. The sulphides were observed along bedding planes, as stringers crosscutting the bedding, as breccia matrix, and as disseminations. Several irregular thin stringers of massive pyrrhotite were noted. Some graphitic bands occur parallel to the bedding. At the north end of the middle trench highly iron-stained gossan occurs.

Mineralization consists of pyrite, pyrrhotite, galena, chalcopyrite and sphalerite with an uneven, irregular distribution. Overall base-metal sulphides generally do not exceed 1 or 2 percent of the total rock. The more heavily mineralized iron formation and metasediments are exposed for a width of approximately 30 feet (9 m) in the middle trench but sparse mineralization is present throughout most of the length of the trench.

Three grab samples were collected by the author from this occurrence for assay and spectrographic analysis. The first from the westernmost trench returned 0.21 ounces silver per ton, 0.10 percent copper, 0.25 percent lead, and 2.10 percent zinc. The second sample from the centre of the easternmost trench returned 0.45 ounces silver per ton, 0.14 percent copper, 5.05 percent lead, and 15.7 percent zinc. The third sample from the same trench and location returned 0.22 ounces silver per ton, 0.12 percent copper, 2.20 percent lead, 11.1 percent zinc and 0.05 percent cadmium. The first and third samples were examined by 30 element spectrographic analysis and nothing of additional interest was detected (assays and analyses by Mineral Research Branch, Ontario Division of Mines). Heshka and Joubin (1969, p.3) reported that random chip samples from these trenches assayed 1.2 to 5.7 percent zinc over widths of 10 to 24 feet (3 to 7 m).

LOCATION 5

A fifth mineralized showing in brecciated, cherty iron formation is located approximately 300 feet (90 m) southwest of the Ministry of Natural Resources cabin on the opposite shore of the lake and roughly northwest of occurrence 4. This occurrence has been exposed by trenching along the north side of the hill facing the lake and 40 to 50 feet (12 to 15 m) from the edge of the lake. The trenching may parallel the strike of the cherty iron formation. There is some evidence of shearing striking at N70W with possibly a vertical dip. The mineralization occurs within the matrix of the breccia fragments. Sphalerite and galena mineralization cements light grey to dark grey, saccharoidal, angular chert fragments over an exposed length of 14 feet (4 m) and 2- to 3-foot (0.6 to 0.9 m) width. Mild iron-staining is present and minor, coarse crystalline calcite was noted. Mapping by Consolidated Shunsby Mines Limited indicated that this occurrence is not within the same formation as location 4. Heshka and Joubin (1969,

p.3) reported that seven drill holes averaging 250 feet (75 m) in length were drilled near this showing, three of which returned zinc-bearing sections averaging 2.5 to 3.7 percent zinc, sparse lead, and trace of copper.

A grab sample taken from this showing by the author assayed 3.35 percent lead, 8.45 percent zinc, and 0.05 percent cadmium. A 30 element spectrographic analysis disclosed nothing else of interest (assay and analysis by Mineral Research Branch, Ontario Division of Mines).

Indian Reserve 76A Pyrite Occurrence (160)
Mountbatten Township
District of Sudbury

Located approximately 2,000 feet (600 m) west of Whitney Lake in Mountbatten Township are four prospect pits 3½ by 5 feet (1.1 by 1.5 m) in area and 4 to 5 feet (1.2 to 1.5 m) in depth. Three of these pits are in sand and gravel bordering outcrop area of approximately 600 square feet (56 m^2). The fourth pit exposes a subvertical quartz lens marginal to the outcrop area. This lens is 5 to 8 inches (13 to 20 cm) in width and visible over a length of 3 feet (0.9 m).

The contact zone of the lens with the metavolcanics is sheared, chloritized, and contains 8 to 12 percent massive pyrite as stringers 1 to 12 mm in thickness and concordant to the foliation. Pyrite disseminations and stringers occur also as a fracture filling material within the quartz lens. A grab sample of the massive pyrite material taken by the author [Siragusa] assayed 0.11 percent copper. A 30 element spectrographic analysis disclosed nothing of further interest (assay and analysis by Mineral Research Branch, Ontario Division of Mines). The area may warrant further evaluation.

Jefferson Lead-Zinc Occurrence (72)
Genoa Township
District of Sudbury

An occurrence of lead and zinc within the sulphide facies of the Woman River Iron Formation was examined by the author [Sage] during the 1970 field season. The occurrence, located in northwestern Genoa Township, was formerly held by Jefferson Mining Corporation (ca. 1910), and more recently by Stackpool Mining Company (ca. 1950-1962). The deposit may be reached by walking approximately 2 miles (3 km) west along a vaguely discernible drill-road from the north end of Rush Lake (Goodwin 1965, Map 2067). Rush Lake may be reached by float-equipped aircraft from Sudbury, Timmins, or Chapleau or by motor road from the hamlet of Jerome.

Moore (1926a, p. 374-375) described the occurrence as follows:

> This zone did not consist of solid ore but was made up of parallel streaks of sphalerite and galena. The 8-foot [2.5 m] shaft lies 360 feet [110 m] eastward from these drill-holes, along the strike of the iron formation. In the bottom of this shaft, towards the west side, there is a lens of nearly solid galena 34 inches [86 cm] wide with 4 inches [10 cm] more or less pure ore. An analysis of the solid galena vein, made by the Provincial Assayer, gave: lead, 73.44 percent; zinc, 6.01 percent; silver, none.

TABLE 25 | ASSAYS OF SAMPLES FROM JEFFERSON LEAD-ZINC OCCURRENCE IN GENOA TOWNSHIP, DISTRICT OF SUDBURY.

Sample*	Au oz/T	Ag oz/T	Pb%	Zn%	Cu%	Cd%
BB30-1A2 (High-grade material from muck pile)	0.02	0.70	45.30	0.26		
BB30-1B2	0.01	0.22	3.15	10.50		0.10
BB30-1C2	tr	0.18	0.37	0.68		
BB20-1D2*	tr	tr	-	0.25		
VV30-1E2*	tr	tr	-	-		
BB30-1F2	tr	tr	0.63	3.24		
BB30-1G2	0.01	1.12	19.50	26.10	0.71	0.07
BB30-1H2	tr	tr	-	0.10		

*All samples were taken from an outcrop along the side of a trench except BB20-1D2 and VV30-1E2 which were taken from a stripped area perpendicular to the trench; assays by Mineral Research Branch, Ontario Division of Mines.

At the surface the vein, on the west side of the shaft, is only 6 inches [15 cm] wide and on the east side 18 inches [46 cm] wide with a high proportion of sphalerite, especially along the margins, with depth the vein widens on the east side of the shaft to three feet [0.9 m], although it is not as solid as on the west side at the bottom of the shaft.

At 50 feet [15 m] east of the shaft, there is an irregular band of sphalerite, galena and chalcopyrite in the iron formation and another irregular band in the same formation 25 feet [7.5 m] northward across the strike.

The initial discovery of base metal mineralization was made in 1910 from diamond drilling on claim WD717 and two years later a pit was put down on the best galena showing (Goodwin 1965, p.36, 51-55). This showing consisted in 1970 of a waterfilled pit, stripping, and a 6-foot by 70-foot (2 m by 21 m) trench parallel to the strike of the formation. This work has exposed an area 70 feet (21 m) long and 21 feet (6.4 m) wide of magnetic, sulphide-facies iron formation striking approximately east.

Grab samples were taken by the author from the 70-foot (21 m) long trench to determine if metals other than lead, zinc or copper were present. One sample of high-grade material was taken from the muck pile next to a small pit in the trench. The assay results are given in Table 25.

The principal metals present are lead and zinc, with lesser amounts of copper, cadmium, and silver. Grab samples taken by the author from the muck pile near a filled trench approximately 100 feet (30 m) east of this showing assayed 2.88 percent lead and 6.70 percent lead. The mineralization occurs as high-grade, irregular lenses in sulphide-facies iron formation which is exposed for a width of 21 feet (6.4 m). The mineralization consists of massive pyrrhotite and minor pyrite in association with minor quartz-carbonate gangue. The pyrrhotite is medium- to fine-grained and the pyrite was locally observed to occur in crude crystals up to ½ inch (1.3 cm) in diameter. All samples were examined by emission spectroscopy, but nothing of additional interest was disclosed (analyses and assays by Mineral Research Branch, Ontario Division of Mines).

E. Korpela (57)
Eisenhower Township
District of Sudbury

An occurrence of sulphide-facies iron formation can be reached by driving 2.2 miles (3.5 km) by road east and north of Kormak to where a logging road branches off to the north. At 0.2 miles (0.3 km) along the logging road, stripping and pitting can be found on the west side.

The exposure consists of five pits and intermittent stripping. Stripping has exposed a zone approximately 350 feet (105 m) long and from 20 to 30 feet (6 to 9 m) wide, of magnetic, banded, sulphide-facies iron formation. The bands consist of quartz, amphibolite, massive to disseminated pyrrhotite, with minor accessory garnet, pyrite, and chalcopyrite. The sulphide content appears to diminish perpendicular to strike, toward the edges of the exposure but the complete width of the formation is not exposed. The formation also extends beyond the stripping, along strike at both ends. Korpela reported assays up to 0.14 percent copper and 0.14 percent nickel, and that one 60-foot (18 m) diamond drill hole was drilled which did not completely penetrate the formation.

Three grab samples were taken by the author [Sage] for assay. The first was collected from the northernmost pit and assayed 0.11 percent copper and 0.03 percent nickel; the second from the central pit assayed 0.06 percent copper, 0.03 percent nickel, and 0.29 percent zinc; and the third from the southernmost pit assayed 0.05 percent copper, and 0.03 percent nickel. A 30 element spectrographic analysis of the three samples disclosed nothing of further interest (assays and analyses by Mineral Research Branch, Ontario Division of Mines).

The general area appears to warrant further investigation for mineralization of greater economic interest.

J.M. Martel (23)
Busby Township
District of Sudbury

A chalcopyrite occurrence in Busby Township is reached by walking approximately 5,400 feet (1650 m) west along an old tote road, off the gravel road leading north from Chapleau to Missinaibi Lake. The tote road meets the Missinaibi Lake road approximately 3.6 miles (5.8 km) northwest of the turn-off to the Ministry of Natural Resources camp on Wrong Lake.

The mineralization consists of a 6-inch (15 cm) wide, irregular, discontinuous, quartz vein with up to 2 percent disseminated chalcopyrite in a mylonite zone. The vein material fills part of the breccia-mylonite zone cutting a pink, medium-grained, hornblende quartz diorite. The breccia consists of angular fragments of quartz diorite cemented in a dark grey-black mylonite which is locally weakly magnetic.

Thin section examination reveals a mortar texture of fresh rock material derived from the surrounding quartz diorite. The plagioclase is possibly andesine in composition. Both quartz and plagioclase exhibit undulatory extinction and twin lamellae of the plagioclase are commonly bent. Minor tufts of radiating biotite

occur between some rock fragments and mineral grains. Minor hematite was noted, some of which occurs as tiny needle-like crystals. Some magnetite is indicated by the local attraction of a magnet. Minor specular hematite occurs as streaks and around some breccia fragments. On the outcrop surface the breccia fragments are angular and appear to have been bleached to a grey-white.

The main mylonite zone is 12 inches (0.3 m) wide and consists of dark grey mylonite, and bleached quartz diorite fragments. The quartz diorite appears bleached with decreasing intensity away from the mylonite zone for approximately 3 feet (0.9 m) on both sides. The bleaching of the breccia fragments appears to be largely due to a decrease in the mafic mineral content with respect to the unbrecciated host rock from which the fragments were derived. The chalcopyrite-bearing quartz vein is made up of discontinuous and irregular bodies within the main mylonite zone; occasionally, angular fragments of mylonite are completely surrounded by vein quartz. The zone strikes N45W, dips vertically and is exposed over a length of 12 feet (3.7 m).

Work on this occurrence is of particular note since several mylonite and pseudotachylyte zones were observed within the Kapuskasing Structural Zone (see the section "Cataclastic Rocks" in "Structural Geology"). This chalcopyrite occurrence in association with a mylonite zone is the first reported from the area and suggests that mylonitization may be followed by later veining and sulphide mineralization.

A grab sample of the vein material taken by the author [Sage] assayed 0.08 percent copper and a 30 element spectrographic analysis disclosed nothing of further interest (assay and analysis by Mineral Research Branch, Ontario Division of Mines).

J. M. Martel (139)
Lloyd Township
District of Sudbury

A sulphide showing in Lloyd Township can be reached by driving 45 miles (72 km) north on the Missinaibi Lake Road, then turning right to the Ministry of Natural Resources camp on Wrong Lake, then continuing east and then south along the east side of Makonie Lake into the southeast corner of Lloyd Township. At a distance of 16.65 miles (26.79 km) from the turn off at Wrong Lake, a logging trail branches off to the south for 1.45 miles (2.33 km) to the sulphide occurrence.

The outcrop consists of interbanded amphibolite, metasedimentary biotite-hornblende-quartz-plagioclase gneiss and quartz-biotite-hornblende-pyroxene marble. The marble appears to be the least abundant rock type and biotite-hornblende-quartz-plagioclase gneiss is the most common. The quartz within the marble weathers into sharp relief giving an irregular, jagged ridge-like appearance to the mixed carbonate-quartz rock. The various bands are up to several feet in width, gradational into each other, and the author believes they represent a metasedimentary-metavolcanic sequence. The banding strikes N55E and dips from 22 to 43S; the shallower dips predominate.

The sulphide mineralization consists predominantly of disseminated to mas-

sive pyrite and pyrrhotite and a trace of chalcopyrite. The amphibolites display the highest sulphide content, and some samples contain 50 percent or more total sulphide. The biotite-hornblende-quartz-plagioclase gneiss may contain up to 15 percent total sulphide and the marble usually less than 1 percent.

The occurrence has been prospected by stripping and scattered test pits. The pits disclose sulphides for a distance of over 300 feet (90 m) perpendicular to the strike but the exposure is not continuous. The sulphides are erratic in distribution over this distance, being concentrated in the amphibolite bands. Since most of the exposures were covered by mud and water at the time of examination, it is uncertain how many sulphide bands exist and what their total cumulative width is. A total of five grab samples were submitted by the author for assay and 30 element spectrographic analysis by the Mineral Research Branch, Ontario Division of Mines. All samples returned negligible values.

This occurrence is unique in the map-area, for it contains the only known occurrence of marble within the mapped area. The occurrence of quartz and calcite in contact with each other also indicates that the metamorphic conditions were not sufficiently severe for the formation of wollastonite of the granulite facies.

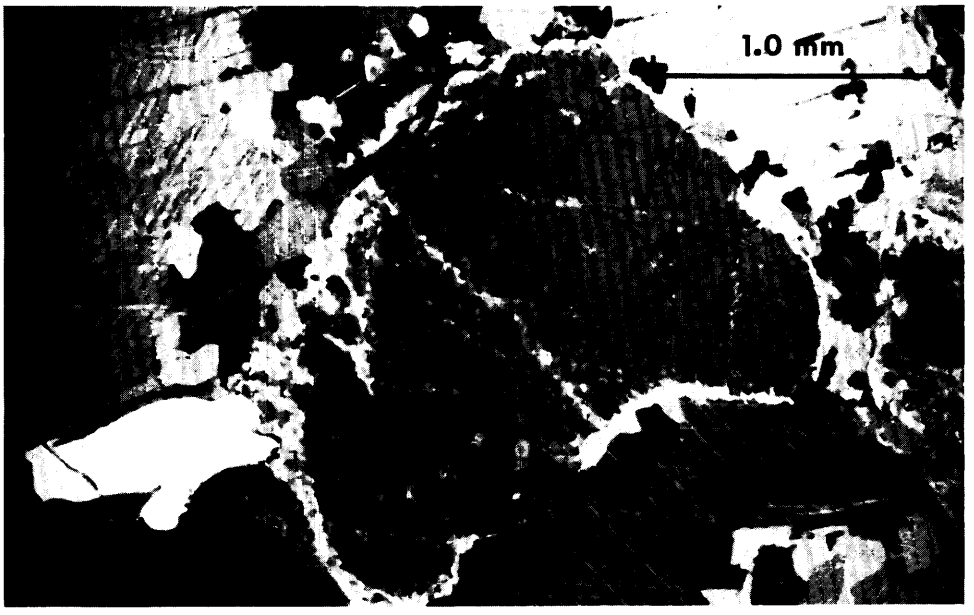
Three thin sections were prepared from the three different rock types found within this occurrence. The amphibolite, possibly a mafic metavolcanic, consists of 40 to 45 percent green hornblende, 10 to 15 percent plagioclase, and 45 to 50 percent pyrrhotite. Some quartz and a trace of pyroxene are also present.

The metasedimentary gneiss consists of 20 to 25 percent biotite, 20 to 25 percent hornblende, 30 to 35 percent quartz and 30 to 35 percent plagioclase of sodic andesine composition. The rock is medium grained and exhibits a foliation due to the preferred orientation of the mafic minerals.

The marble is composed of 70 to 75 percent calcite, and pyroxene and hornblende make up most of the remainder (Photo 30). In thin section pyrrhotite, biotite, quartz, and garnet were also identified. An X-ray scan was made of the acid-insoluble residue remaining after HCl treatment: pyroxene, amphibole, quartz, epidote, garnet, sphene and pyrrhotite were identified. The pyroxene was tentatively identified as hedenbergite, and the garnet as grossularite-andradite. The carbonate was identified as calcite. A qualitative spectrographic analysis for Zr, Nb, La, Ce, Sr, and Ba was made; only Sr, about 1,000 ppm, was detected. All rock types are medium grained, and all except the marble exhibit a well developed foliation due to the preferred orientation of the mafic minerals. All gradations between these three fundamental rock types are present. From the mineralogy as determined by optics and X-ray, the rock could be classed as a marble of the almandine-amphibolite facies (Turner and Verhoogen 1960, p.544-553).

A second sulphide occurrence lies within granitic rocks, approximately ¼ mile (0.4 km) northwest of the first occurrence, on a deeply weathered knoll 45 by 75 feet (14 by 23 m). The sulphide showing appears to be a pyrrhotite-bearing, hornblende-plagioclase-quartz gneiss. The outcrop is cut by some small irregular quartz veins and granitic pegmatites. The sulphides appear to be concentrated in the more mafic portion of the gneiss. Deep weathering and heavy iron-staining prevented a good examination. The formation appears to dip shallowly to the east. Several small, spherical, pyrite balls were noted. A grab sample of the more mineralized though deeply weathered material, was submitted for assay but returned negliglible values.

Work on the outcrop consisted of stripping and a couple of shallow test pits.



ODM9452

Photo 30–Photomicrograph of marble, showing calcic pyroxene in calcite. Martel property, Lloyd Township.

These two sulphide occurrences are worth noting since they occur on the west flank of the Kapuskasing Structural Zone. Further prospecting in this region, and within these rock types may disclose sulphides of greater economic interest.

R. Nabigon
Shenango and Sherlock Townships
District of Sudbury

In 1970, Kennco Explorations (Canada) Limited worked on a claim block registered to R. Nabigon which adjoins Geneseco Resources' claim group on the north side. Kennco Explorations (Canada) Limited did a ground induced polarization and magnetometer survey, and two diamond drill holes totalling 1,006 feet (306.6 m) were drilled on the best indicated induced polarization anomaly. Examination of the core indicated considerable mixing of monzonite to syenodiorite and mafic hornfels. The monzonite-syenodiorite crosscuts and intrudes the hornfels; the contacts exhibit both sharp and gradational aspects suggesting that locally assimilation of the mafic hornfels by the monzonite-syenodiorite intrusion has taken place. Several small quartz-potassium feldspar-muscovite pegmatite clots were observed. No evidence of mineralization was revealed other than some disseminated pyrite in hole number 1 at a depth of 148 feet (45.1 m).

The pyrite content visually did not exceed 5 percent and a 30 element spectrographic analysis by the Mineral Research Branch, Ontario Division of Mines of a core chip from 148 feet (45.1 m) returned nothing of interest.

Noranda Exploration Company Limited (151)
Marion Township
District of Sudbury

G.J. LaFleche, prospector for Noranda Exploration Company Limited, made a copper discovery in central Marion Township during the 1970 field season (The Northern Miner, October 8, 1970, p.3).

R.S. Woolverton (personal communication) of Noranda Exploration Company Limited reported that the showing occurs at the corner of claims S-256044, S-256043, and S-256042. The chalcopyrite and pyrite mineralization occurs in rhyolite quartz porphyry over a width of 40 feet (12 m). Channel samples across the zone are reported (Woolverton, personal communication) to have averaged 0.36 percent copper with 0.15 ounce silver per ton.

The sulphide mineralization is 90 percent chalcopyrite and 10 percent pyrite and is associated with fracturing and shearing.

Opeepeesway River Copper Occurrence (153)
Marion Township
District of Sudbury

Texore Mines Limited discovered copper mineralization in Marion Township during 1970 (The Northern Miner, October 8, 1970, p.3). The discovery is located in the southeastern corner of claim S-282058. A.A. Koffman (personal communication), consulting geologist for Texore Mines Limited, reported that the mineralization is associated with quartz in andesite. Three trenches were excavated, and a ground magnetic and electromagnetic survey completed. Upon completion of a ground electromagnetic survey and ground magnetic survey no anomalies were found and further work was not recommended. The claims were allowed to lapse.

Parr Mines Limited (74)
Marion Township
District of Sudbury

Disseminated, chalcopyrite mineralization was discovered by Parr Mines Limited on the west shore of Rush Lake. The showing occurs near the water's edge on the end of a peninsula jutting into Rush Lake from its western shore. The occurrence is close to the Genoa Township–Marion Township boundary. Rush Lake can be reached by float-equipped aircraft from Timmins, Sudbury, or Chapleau or by motor road from the hamlet of Jerome.

Development consists of two trenches perpendicular to the shoreline of Rush Lake, about 35 and 50 feet (11 and 15 m) long and about 45 feet (14 m) apart. Disseminated chalcopyrite mineralization is exposed over a width of 6 to 10 feet (2 to 3 m) within the trenches, and is unevenly and erratically distributed in pink diorite. The mafic component of the diorite appears to be largely altered to chlorite and probably was originally hornblende. The feldspars appear to be relatively fresh in hand sample. Sulphides appear to be slightly more abundant in the more leucocratic phases of the diorite. Sheared, well foliated, locally mineralized, chlorite schist striking parallel to the direction of trenching is exposed in both trenches. The schist appears to be large xenolithic blocks or lenses within the diorite mass. The xenoliths may represent remnants of mafic volcanic rocks or diabase dikes. Trace amounts of epidote were noted in some samples of the chlorite schist. Sheared chlorite schist in the eastern trench contains up to 10 percent sulphides, predominantly chalcopyrite near the contact with the diorite; the sulphides decrease in quantity eastward and away from the contact. The foliation of this body strikes N10E, and dips vertically; the contact between the diorite and chlorite schist appears undulatory, vertical and conformable to the foliation in the chlorite schist. The chlorite schist in the western trench appeared to be largely barren.

Within the diorite several short, discontinuous slightly vuggy milky quartz stringers, less than 1 inch (2.5 cm) in width, contain chalcopyrite mineralization within their centres. The sulphides in the diorite in order of decreasing abundance are chalcopyrite, pyrite, and bornite, their total abundance not exceeding 2 or 3 percent of the total rock mass.

Two grab samples of the pink diorite were taken by the author [Sage] from the western trench and assayed by the Mineral Research Branch of the Ontario Division of Mines. The first was collected near the south end of the trench and assayed 0.47 percent copper; the second was collected from near the north end and assayed 0.79 percent copper and a trace of nickel.

In the eastern trench sampling was confined to the sheared chlorite schist which at its southern extremity near the shore of Rush Lake contains disseminated sulphides over a width of 6 feet (2 m). Trenching had not progressed sufficiently to expose this occurrence for any significant distance along strike. The diorite near this sulphide rich zone did not appear to contain any appreciable amount of sulphide. A grab sample of chlorite schist taken 1½ feet (0.5 m) perpendicularly from the western contact of the diorite and chlorite schist assayed 3.09 percent copper and 0.02 percent nickel. Another sample taken 5½ feet (1.7 m) from the contact assayed 0.71 percent copper and 0.02 percent nickel. The chlorite schist was barren at 8 feet (2.4 m) from the western contact and trenching had not exposed the eastern contact. Chalcopyrite mineralization in the diorite exposed near the northern end of this trench and locally along its western flank appeared to be the same as that in the western trench. Three of the above mentioned samples were also examined by 30 element spectrographic analysis and nothing of additional interest was found (analyses by Mineral Research Branch, Ontario Division of Mines). Within the area of the trenches malachite staining can be observed along fresh joint surfaces but is uncommon on the weathered outcrop surfaces.

A thin section prepared from a specimen containing approximately 1 percent chalcopyrite mineralization showed that the rock is composed of an estimated 80

to 85 percent relatively fresh plagioclase of sodic andesine composition, 10 to 15 percent chlorite and calcite after amphibole, and about 5 percent epidote and sericite from the alteration of feldspar (Photo 31).

Approximately 300 feet (90 m) back from the shore of Rush lake several 'pop holes' in medium-grained, pink, quartz diorite were examined, but no mineralization was observed.

Approximately 150 feet (45 m) west of the main showing a 'pop hole' in medium-grained, pink, quartz diorite was placed along a fracture striking N60W and dipping 65N, along which disseminated to massive pyrite mineralization and iron staining occur. The width of mineralization does not exceed 6 inches (15 cm). Mafics within the quartz diorite appear to be chloritized and the feldspars somewhat clouded. A grab sample was taken for assay and returned a trace of copper.

Another 'pop hole' 50 feet (15 m) further west contains a trace of pyrite in a similar host rock. This occurrence was not sampled.

Royal Agassiz Mines Limited and Gold Hawk Exploration Limited (150) Marion Township District of Sudbury

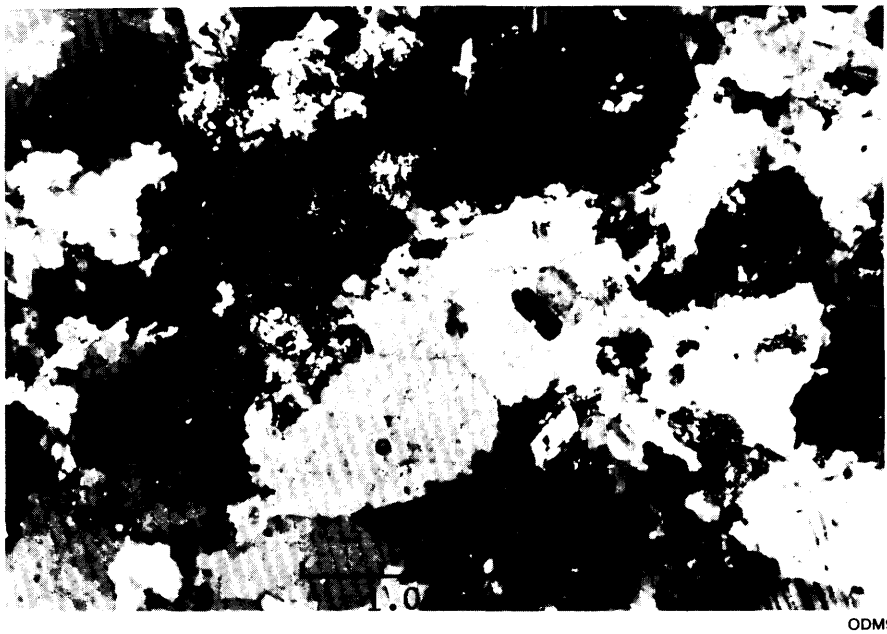
Royal Agassiz Mines Limited and Gold Hawk Exploration Limited made a copper discovery in Marion Township (The Northern Miner, March 3, 1971, p.3). C.D. Robbins (personal communication), of Royal Agassiz Mines Limited reported that the main showing occurs near the centre of claim S-282052, 200 to 300 feet (60 to 90 m) east of the western boundary of the claim. Three or four other showings were reported in the area. Chalcopyrite is the copper-bearing mineral and the host rock is described as rhyolite.

Robbins also reported that, on the same claim, a chalcopyrite-bearing quartz vein 1 to 2 feet (0.3 to 0.6m) wide and dipping shallowly to the east has been exposed for 100 feet (30 m) and assayed from 0.02 to 0.70 ounces gold per ton.

Scorch Creek Sulphide Occurrence (164) Muskego Township District of Sudbury

Two small prospect pits in migmatized mafic metavolcanics are located about 1,000 feet (300 m) north of Highway 101 on the west side of Scorch Creek. The pits lie approximately 100 feet (30 m) west of the river's edge.

Sulphides, predominantly pyrite, occur as small grains and irregular blebs in amphibolite and irregular, discontinuous, injections of medium-grained, blue-grey, quartz diorite. The total sulphide content rarely exceeds two percent. Minor pyrrhotite was noted and several small grains were tentatively identified as chalcopyrite. A grab sample taken by the author [Sage] from the most sulphide-



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Photo 31–Photomicrograph of diorite with minor sericite and epidote alteration. Parr Mines Limited copper showing.

rich material assayed 0.08 percent copper (assay by Mineral Research Branch, Ontario Division of Mines). The discontinuous and erratic distribution, combined with low values would indicate the occurrence to be of little economic interest.

United Macfie Mines Limited (163)
Muskego Township
District of Sudbury

An occurrence of banded, sulphide-facies iron formation is located approximately 1 mile (1.6 km) north of Highway 101 and 1½ miles (2.4 km) east of Scorch Creek. The exposure can be reached by walking north along an old logging road and foot trail from Highway 101 at a point 1½ miles (2.4 km) east of Scorch Creek.

This discovery was optioned by Kam Kotia Mines Limited from prospectors who made the discovery (The Northern Miner, 1970, Sept. 10, p.1). In November of 1970 United Macfie Mines Limited, which is 43.5 percent owned by Kam Kotia Mines Limited, was awarded a contract for diamond drilling (The Northern Miner, 1970, Nov. 26, p.107).

During the later part of 1970 and early part of 1971, Mid-North Engineering Services Limited completed a ground magnetometer and electromagnetic survey for United Macfie Mines Limited over claim group 279191-279206 inclusive

which encompasses the above copper showing (Assessment File 2.207, Rept. 11, Assessment Files Research Office, Ontario Division of Mines, Toronto). Sampling of the previously described trenches by United Macfie Mines Limited disclosed a weighted average of 0.30 percent copper over a width of 27 feet (8.2 m). The host rocks were described as volcanic xenoliths.

Three holes totalling 1,289 feet (392.9 m) in length were drilled by the company and encountered disseminated sulphides and stringers over varying widths. The sulphides are pyrite and pyrrhotite and minor chalcopyrite and sphalerite.

Examination of this occurrence by the author [Sage] showed that the sulphide content is variable from trace to 60 percent, and the sulphides are pyrrhotite and pyrite and minor chalcopyrite. The chalcopyrite generally varies from trace to about 1 percent in the samples collected by the author. The pyrite-pyrrhotite appears to be concentrated along the margins of the more siliceous iron formation layers, and the chalcopyrite is closer to the centre of the pyrrhotite-pyrite stringers. The chalcopyrite occurs as disseminated grains, and irregular and discontinuous splashes. Minor, poorly crystallized garnet was noted in one above-average sample which contained 1 to 2 percent chalcopyrite. A polished section was prepared from a pyrrhotite and chalcopyrite stringer which showed that the chalcopyrite is intergranular to the quartz and occurs in grains composed in part of pyrrhotite. The chalcopyrite and pyrrhotite are joined along curved, irregular, cuspate boundaries. Several grains of chalcopyrite enclose grains of quartz.

The formation is generally very well banded, becoming coarser grained to the north, perpendicular to strike. The iron formation consists of alternating bands of colourless to smokey saccharoidal quartz, sulphides, magnetite, and amphibole, and contains minor intercalations of what may be fine-grained, lithic sandstone. The unit has been concordantly intruded by pink, medium-grained, porphyritic granite and blue-grey quartz diorite. Sixty feet (18 m) north of the mineralized exposure lies a fine- to medium-grained, schistose amphibolite unit which probably represents a mafic metavolcanic. This unit has been intruded by the same felsic material as the iron formation. At the north end of this 2-foot by 3-foot (0.6 by 0.9 m) outcrop a small area of pink, granitic rock is in contact with a poorly exposed 1 by 1 foot (0.3 by 0.3 m) area of sulphide-facies iron formation. Pyrite and pyrrhotite make up 25 percent of this rock but only one or two grains of possible chalcopyrite were noted. This may be a second band of sulphide-facies iron formation parallel to the first, or just an inclusion.

Owing to magnetic attraction, the strike was difficult to determine but is approximately N30W with a dip of 60W. Two overlapping trenches, perpendicular to strike, expose a 35-foot (11 m) width of mineralization of which the richer portion is near the centre to the west. Three grab samples taken from the trench by the author assayed 0.06, 0.44, and 0.17 percent copper respectively. A composite sample was collected by the author by taking a chip sample every 1 foot (0.3 m) perpendicular to the strike, omitting the felsic intrusions, and this returned an overall assay of 0.34 percent copper (assays by Mineral Research Branch, Ontario Division of Mines).

A 30 element spectrographic analysis of the composite sample and two of the grab samples failed to turn up other metals of interest. The occurrence is located in an area of low relief and attempts to trace it along strike failed.

United States Smelting Refining and Mining Company [1970] (Sulphide Occurrences) (33, 34, 35, 84, 86, 87, 88, 168) Heenan, Newton and Coppell Townships District of Sudbury

During the summer of 1970 United States Smelting Refining and Mining Company did follow-up work on airborne geophysical anomalies. The survey covered all or parts of Heenan, Newton and Coppell Townships. Three holes totalling 682 feet (208 m) were drilled on three conductors in Coppell Township, one hole of 324 feet (98.8 m) in Newton Township and seven holes totalling 3,005 feet (915.9 m) in four locations were drilled in Heenan Township. All holes encountered graphite, pyrite, and (or) pyrrhotite except hole NS-2 in the southwest corner of Coppell Township which encountered minor amounts of zinc and trace amounts of copper. The claims and exploration concessions have been dropped.

Westfield Minerals Limited (197) Rennie Township District of Sudbury

Westfield Minerals Limited controls a zinc-silver prospect at the south end of Conboy Lake (Riley 1971, p.45) which can be reached by float-equipped aircraft from either Wawa or White River.

This showing was located in 1939 by Jack Tremblay and underwent limited stripping and trenching. In 1953, Coulee Lead & Zinc Limited drilled nine diamond drill holes totalling 3,213 feet (979.3 m) on the showing and in 1962 Gunnex Limited examined the property and completed magnetic and electromagnetic surveys (Riley 1971, p.45). Beginning in 1963 and continuing into 1967 Westfield Minerals Limited completed airborne magnetic and electromagnetic surveys, ground electromagnetic surveys, and an induced polarization survey (Riley 1971, p.45, 46). During this time 19 diamond drill holes were completed.

The zinc-silver mineralization occurs in a metamorphosed felsic tuff horizon which is bordered on both sides by mafic metavolcanics and gabbro sills (Riley 1971, p.46). Two narrow units of iron formation are reported to occur at the eastern end of the mineralized zone (Riley 1971, p.46).

The mineralization consists of massive dark brown sphalerite, coarse pyrite, and minor amounts of disseminated galena and chalcopyrite (Riley 1971, p.48). The shear zone is reported to be at least 900 feet (270 m) long, of which 550 feet (170 m) are mineralized (Riley 1971, p.48). Mineralization occurs over widths of 14 feet (4 m), however the best mineralization occurs in a west-raking zone 350 feet (105 m) long and over a width of approximately 4.3 feet (1.3 m) (Riley 1971, p.48). Riley (1971, p.49) reported that this zone has a drill indicated grade of 14.8 percent zinc and 10.6 ounces silver per ton over an average thickness of 4.3 feet (1.3 m). For additional descriptive and assay data the reader should refer to the report of Riley (1971, p.45-49).

IRON

Within the map-area 51 occurrences of iron have been reported in the literature and government reports. Of these 51 occurrences, 46 are the banded Algoma-type and 5 are of magmatic affinity. Of the five magmatic bodies one is associated with the carbonatite-alkalic complex at Lackner Lake, three are in serpentinized ultramafic rocks, and one is thought to represent a differentiated sill or flow because of its high TiO_2 content, great strike length and massive appearance. Of these 51 occurrences, the wall rocks of 28 are described as mafic metavolcanics, 11 as felsic metavolcanics, five as metasediments, three as mafic intrusives, two as granite and one as migmatite. There seems to be a definite preference for iron deposits to occur in association with mafic volcanic rocks. Magnetite appears to be the most common iron oxide, it being reported 23 times versus 3 times for hematite. Pyrite is the most common accessory sulphide present, being reported in 21 instances. This is followed by pyrrhotite with 12 reported occurrences. Iron carbonate occurs in the Woman River and Radio Hill iron formations and in places constitutes a significant proportion of these units (Goodwin 1965, p.17; Milne 1972).

Within the map-area only two iron formation units have received much attention. These units are located in Penhorwood-Kenogaming-Keith Townships and Genoa-Heenan-Marion Townships. A third iron deposit on which a limited amount of work has been done is located in Lang Township on the south end of Missinaibi Lake.

Kukatush Mining Corporation (Ontario) Limited (117, 118, 124, 127, 178, 185)
Penhorwood, Keith and Kenogaming Townships
District of Sudbury

Occurrences of iron formation on the Groundhog River were known shortly after 1900, however, evaluation of these occurrences was not attempted until nearly 50 years later.

The Radio Hill iron formation has been extensively investigated by Kukatush Mining Corporation (Ontario) Limited who control 95 claims in Penhorwood, Keith and Kenogaming Townships. In the late 1950s and early 1960s Kukatush Mining Corporation (Ontario) Limited did considerable diamond drilling, trenching, and some bulk sampling. The iron formation consists of banded chert, magnetite, iron silicates, iron carbonate, pyrite and pyrrhotite which are bounded by graphitic pyritic slates. The iron formation lies along the contact between felsic pyroclastic rocks and highly carbonatized ultramafic rocks. The work of Kukatush Mining Corporation (Ontario) Limited has delineated 158,000,000 tons of iron ore grading 27.8 percent acid-soluble iron which can be concentrated to 67 percent iron (Canadian Mines Handbook 1969-1970, p.202, Milne 1972, p.99). The company is seeking financing to place the Penhorwood Township property into production (Canadian Mines Handbook 1970-1971, p.205). For a more complete and detailed description of these deposits, the reader is referred to the report by Milne (1972, p.16-26, p.92-102).



ODM9454

Photo 32–Outcrop of massive ilmenite and magnetite. Missinaibi Lake occurrence.

Missinaibi Lake Ilmenite-Magnetite Occurrence (130)
Lang Township
District of Sudbury

A rather unique occurrence of titaniferous magnetite (Photo 32) is located 700 to 1,000 feet (210 to 300 m) west of the south end of Missinaibi Lake, Lang Township. The occurrence consists of fine- to medium-grained massive ilmenite and magnetite in a metavolcanic-metasedimentary sequence. This iron occurrence was investigated by Algoma Ore Properties in 1958-1959 by four diamond drill holes totalling 1,005 feet (306.3 m). The formation has been shown by geophysical and geological mapping to have an (intermittent) strike length of approximately 9,800 feet (3000 m) (Figure 27). The formation strikes roughly at N33W and dips approximately 85W. The main mineralized zone lies between lines 20+00S and 34+00S on the Algoma Ore Properties Limited grid. Within this area, the mineralized zone is reported to be 250 feet (75 m) wide at its widest point and contains three high grade bands of mineralization separated by zones of disseminated mineralization (Figure 28). At line 26+00S from east to west, these high grade zones are approximately 40, 85, and 15 feet (12, 26, and 4.5 m) thick (see Figure 28). Minor folding which plunges south is reported to be present (Venn 1959, p.5). Faulting may be present between lines 16+00S and 20+00S (Venn 1959, p.5).

Geological mapping by Algoma Ore Properties Limited indicated that the ore occurs in hornblende gneiss possibly of gabbroic origin, between gneiss to the

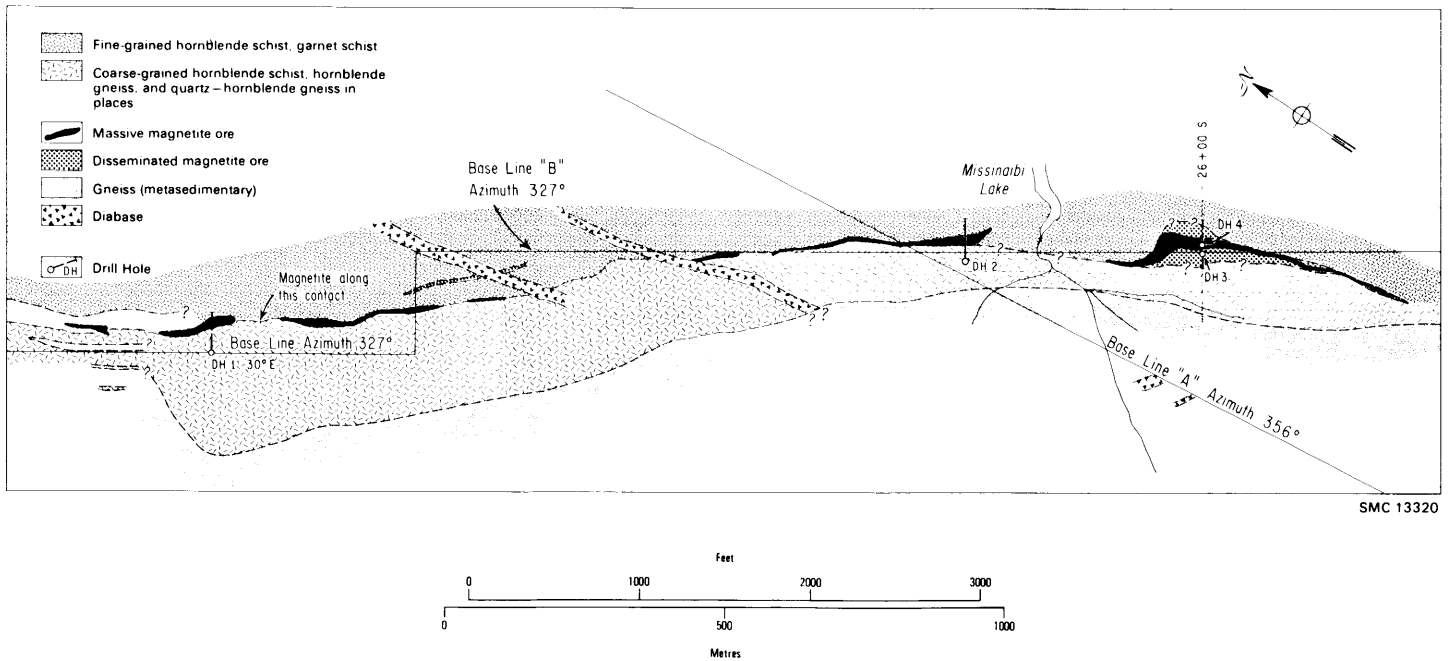


Figure 27–Missinaibi Lake ilmenite-magnetite occurrence; geological map modified from an Algoma Ore Properties Limited map by V.R. Venn (1959).

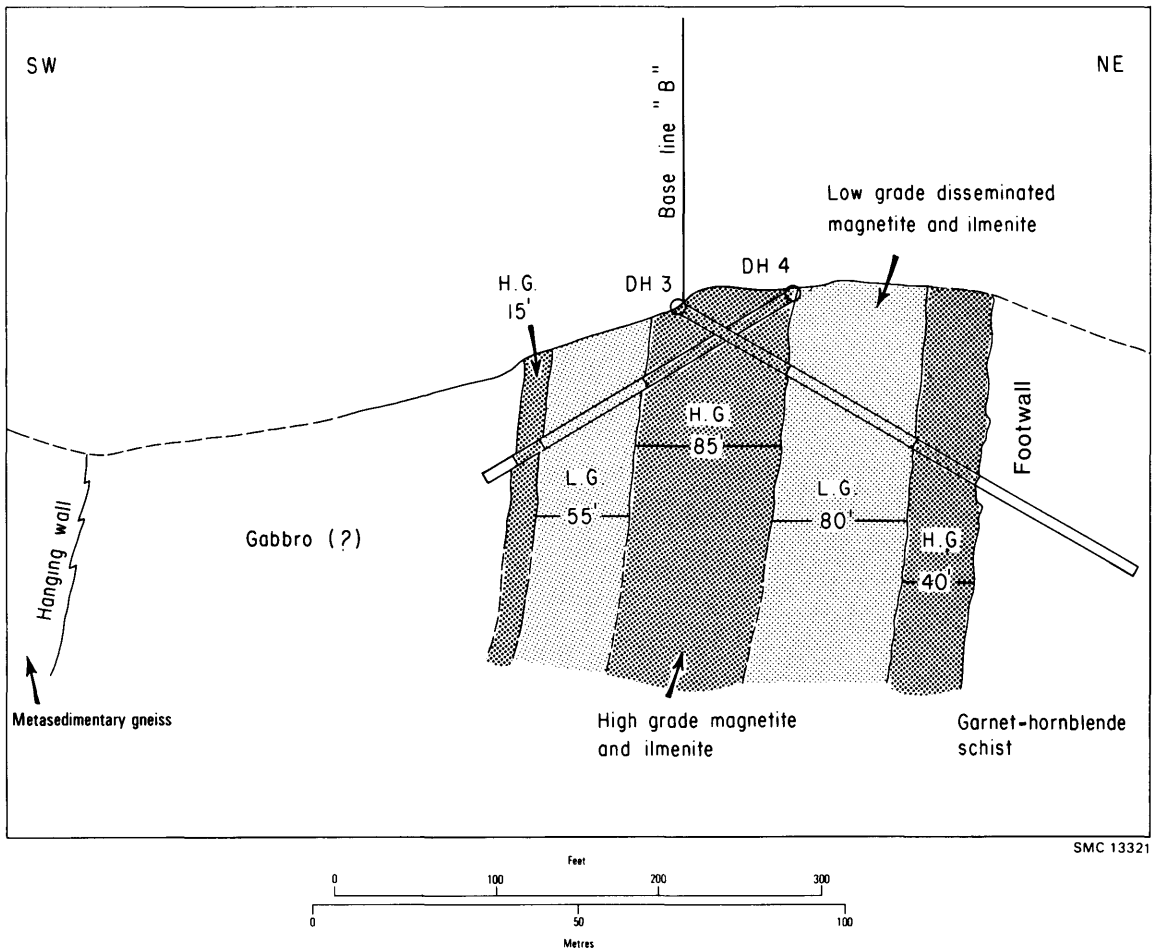


Figure 28–Missinaibi Lake ilmenite-magnetite occurrence; geological cross-section on 26+00S; modified from an Algoma Ore Properties Limited section by V.R. Venn (1959).

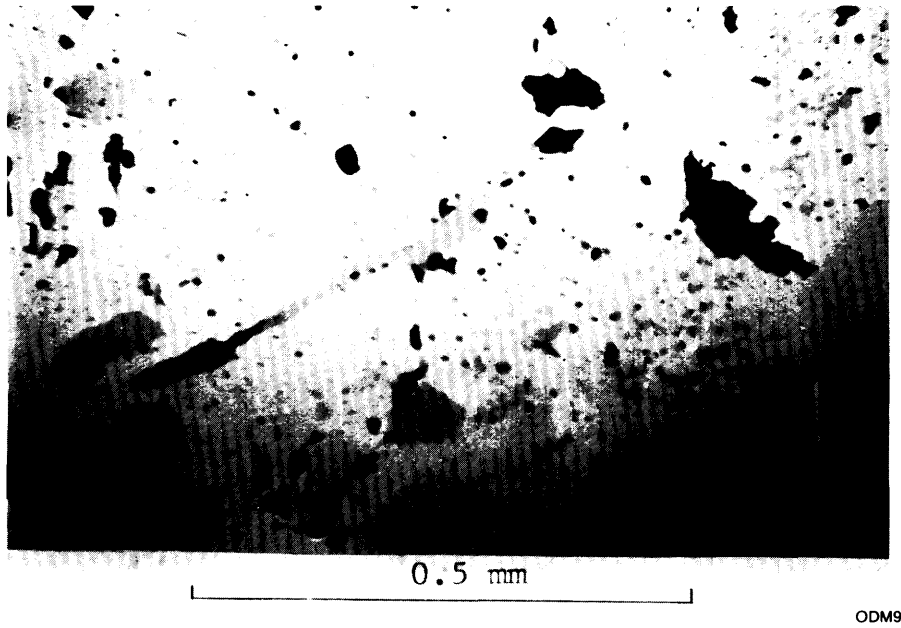


Photo 33–Photomicrograph of polished section showing ilmenite (dark grey) in magnetite (light grey) with minor gangue. Missinaibi Lake ilmenite-magnetite occurrence.

west, possibly of metasedimentary origin, and hornblende schists to the east, possibly of metavolcanic origin (Venn 1959, p.2-3). Diabase dikes are reported to cut all formations including the mineralized zones (Venn 1959, p.4).

A very brief visit was made by members of the field party to the occurrence. The rocks both immediately above and below the mineralized horizons were tentatively identified as fine- to medium-grained, very schistose to gneissic metavolcanics.

The thin sections cut from samples collected by the author [Sage] from above and below the magnetite-ilmenite horizon contain approximately 45 to 50 percent pale brown to pale green hornblende; twinned and untwinned plagioclase make up the remainder of the rock. Chlorite and sericite were noted as minor alterations of the hornblende and plagioclase respectively. Less than 1 percent magnetite was present. A few scattered small grains of red garnet were observed in outcrop but not in thin section. Gneiss outcropping 1,000 feet (300 m) west of the iron formation is composed of approximately 10 percent hornblende, 5 percent muscovite, 5 percent sericite, 20 percent quartz, 5 percent magnetite, and 55 percent twinned and untwinned plagioclase. The rock is probably a metamorphosed sedimentary rock, derived in part from the enclosing volcanic rocks.

A polished section and X-ray diffraction analysis of the mineralization disclosed the presence of magnetite, ilmenite, and chlorite, and minor talc and pyrite. The polished section displays two small apatite crystals and indicates that the magnetite and ilmenite occur in roughly equal proportions (Photo 33).

TABLE 26 | ANALYSES OF SAMPLES FROM MISSINAIBI LAKE ILMENITE-MAGNETITE OCCURRENCE, LANG TOWNSHIP, DISTRICT OF SUDBURY. ANALYSES BY MINERAL RESEARCH BRANCH, ONTARIO DIVISION OF MINES.

Sample Location[1]	Sample Number	Fe	TiO_2	SiO_2	P_2O_5	S	Cu	Ni
26+00S	AJ3-3D2	51.4%	14.2%	12.8%	0.02%	0.52%		
30+00S	AJ3-3R2	52.9%	18.2%					
24+00S	AJ3-3V2	48.2%	18.3%	14.2%	0.01%	0.53%	0.02%	0.01%

[1]Sample locations from grid lines established by Algoma Ore Properties Limited.

Three grab samples were taken by the author for analysis (Table 26). All three samples were tested for platinum group metals but none were detected. The first two samples were checked by 30 element spectrographic analysis for other possible metal concentrations and returned nothing of additional interest (analyses by Mineral Research Branch, Ontario Division of Mines).

Assuming a mineable width of 80 feet (24 m) and a depth of 1,000 feet (300 m), Venn (1959, p.9) estimated an approximate tonnage of 16,000,000 tons of ore grade material assaying approximately 35 percent soluble iron.

This deposit appears to be unique in the map-area and its true genesis will probably be resolved only by more detailed geological mapping and petrographic studies. The author tentatively proposes that this occurrence may be either a differentiated mafic flow or sill. Venn (1959, p.7-8) proposed that the occurrence is a differentiated sill. In either case, the occurrence probably is part of the volcanic cycle that generated the enclosing wallrock.

Woman River Iron Formation (72, 73, 148, 149, 152)
Genoa, Marion and Heenan Townships
District of Sudbury

The iron formation of Genoa, Heenan and Marion Townships has been intermittently examined for iron and base metals since shortly after 1900. This formation consists of two or more parallel bands composed of magnetite, siderite, chert, pyrite, and pyrrhotite, and contains local concentrations of base-metal sulphides.

There is a change in the iron formation facies from west to east. Oxide facies predominates in the west and sulphide facies in the east (Goodwin 1965, p.24-25). A vertical transition is also present; the iron formation gradually changes from siliceous magnetite-siderite at the base, through jaspery chert and grey banded chert to a light grey banded chert having negligible iron content at the top of the formation (Goodwin 1965, p. 23).

In the early 1960s Stackpool Mining Company Limited extensively diamond drilled and tested this iron formation. Goodwin (1965, p.39) stated that work done by Stackpool Mining Company Limited, and earlier estimates by Moore (1926b, p.91) indicated that 5,100,000 tons of iron ore containing 40 percent iron are present.

For a complete description of this occurrence the reader is referred to the report by Goodwin (1965).

MOLYBDENUM

Within the map-area molybdenum was noted to occur sparingly in granitic pegmatites as isolated grains of molybdenite. Only one occurrence of molybdenite has been tested for its economic potential within the map-area; this occurrence was examined by Jonsmith Mines Limited, and is located in DesRosiers Township.

Jonsmith Mines Limited (53)
DesRosiers Township
District of Sudbury

In 1959 Jonsmith Mines Limited investigated an occurrence of molybdenite mineralization on the west side of Alike Lake in DesRosiers Township. The company completed geological mapping, extensive stripping, trenching, test pitting, bulk sampling and diamond drilling totalling 4,452 feet (1357 m).

The bedrock of the area consists of a sequence of generally thin-bedded, intermediate to felsic metavolcanics with local thin agglomeratic horizons. Folding and contortion of the bedding is locally pronounced. This sequence was then both concordantly and disconcordantly intruded with quartz-potassium feldspar-plagioclase pegmatites usually containing minor amounts of molybdenite. Jonsmith Mines Limited worked on two of the larger, more molybdenite-rich pegmatites which may or may not be one and the same since they occur along strike about 200 feet (60 m) apart. They were referred to as the "North" and "South" showings by Jonsmith Mines Limited. A brief visit to the property was made during the 1970 field season and an examination made of what is thought to be the "North" showing.

Molybdenite was observed as radiating clusters of euhedral crystals averaging ½ inch (13 mm) in diameter, in the massive, milky quartz core and the quartz-feldspar margin of the pegmatite vein. Molybdenite is also concentrated along joints in the biotite-quartz-feldspar pegmatite of the outer margins of the pegmatite veins. The greater concentration of molybdenite appears to be in the coarse-grained, biotite-quartz-feldspar marginal phase of the pegmatites. There is a decrease in molybdenite concentration in the quartz core of the vein, where the molybdenite occurs as disseminated crystal clusters. Smaller molybdenite-bearing pegmatites exposed in the vicinity of the "North" showing display the molybdenite concentrated at the core. In most of the smaller pegmatites, zoning from a quartz feldspar margin to a quartz core was not observed.

The potassium feldspar ranges from pale pink to white in colour, and is exceeded by plagioclase feldspar by a ratio of approximately 3 to 1. The plagioclase locally shows the platey nature of cleavelandite, a variety of albite.

Weathering of the molybdenite has produced a thin yellow coating of ferrimolybdite along some joint fractures and molybdenite cleavage surfaces. Two specimens were collected which contained a silver-white cleavable mineral identified by X-ray powder diffractions as a mixture of cosalite (lead-bismuth sulphide) and galena.

Three samples of country rock range in composition from felsic to mafic and are thought to be metamorphosed volcanic rocks. The felsic metavolcanic contains up to 30 percent quartz, 20 percent biotite, and 50 percent plagioclase. The mafic metavolcanic contains approximately 55 percent yellow-brown hornblende, 40 percent plagioclase, and 5 percent epidote. The third thin section represents a slightly more intermediate composition of approximately 50 percent biotite, 44 percent plagioclase, 5 percent epidote and minor hornblende. All three specimens are fine to very fine grained and exhibit a well developed foliation caused by the preferred orientation of the mafic minerals. The foliation is parallel to a nearby agglomeratic horizon as well as to the compositional variation of the formations themselves, and therefore, it is assumed that the foliation and bedding are essentially parallel.

No mineralization was observed outside the pegmatites. One selected grab sample taken by the author [Sage] from the "North" showing assayed 11.3 percent molybdenum and 0.44 percent bismuth; no evidence of tungsten mineralization was noted. A 30 element spectrographic analysis disclosed nothing of additional interest (assays and analyses by Mineral Research Branch, Ontario Division of Mines).

Johnston (1968, p.67) reported that Jonsmith Mines Limited removed a 50 ton bulk sample from pit No.1 which assayed 1.0 percent MoS_2 and a 165 ton bulk sample from pit No. 2 which assayed 2.25 percent MoS_2. The "North" showing may have been pit No.2 and the "South" showing pit No. 1.

URANIUM-THORIUM

A review of the assessment files and old reports indicated that there are seven occurrences of uranium and thorium in the map-area. Of these seven occurrences three are related to carbonatite-alkalic complexes, one is related to metasediments, two to granites and one to diabase dikes. The known occurrences appear to be of minor importance but uranium and thorium may be recovered as a by-product if the carbonatite-alkalic complexes are mined for their niobium content. In addition to the previously reported radioactive occurrences the party visited one new radioactive occurrence during the 1970 field season and one was reported to the survey party by a representative of Gunnar Mining Limited.

Uranium mineralization was located by Preston East Dome Gold Mines Limited in Root[1] and Rollins[2] Townships in fractured contact zones of diabase dikes with the granitic rocks (Harding 1950; Robertson 1968b). During the present mapping, over 300 samples from the southern part of the region were unsuc-

[1]Formerly Township 4D.
[2]Formerly Township 4E.

cessfully tested by the authors for radioactivity. However, as hundreds of diabase dikes occur in the area, the extent of diabase-granitic rock contacts is on the order of several hundred miles and the uranium potential could not be evaluated at the reconnaissance scale of the present mapping.

Aubinadong River Pitchblende Occurrence (27)
Cassidy Township[1]
District of Sudbury

The Cassidy Township occurrence was not visited by members of the survey party. A verbal description of this property was provided by Albert Zeemel of Gunnar Mining Limited. The occurrence is located in a cliff face on the east side of the Aubinadong River in Cassidy Township at approximately Latitude 47°15.85'N and Longitude 83°18.30'W. Zeemel described the occurrence as pitchblende mineralization occurring as fracture fillings ⅜ to ½ inch (9.5 to 13 mm) wide and striking NE. The granite is a pink, medium-grained rock exhibiting some yellow secondary uranium oxides along tiny fractures close to the main pitchblende-bearing fractures. The granite itself does not show radioactivity beyond normal background.

In samples supplied by Zeemel the granite appeared to be composed of 25 to 35 percent quartz and 65 to 75 percent bright red, potassium feldspar. A trace of possible chloritic material may represent the alteration of a minor, mafic component. It is reported that Coulee Lead & Zinc Mines Limited have done a limited amount of work on this occurrence.

Aubrey Falls Uranium Occurrence (209)
Root[2] and Rollins[3] Townships
District of Algoma

This occurrence was not visited by members of the survey party. The deposit was described by Robertson (1968b, p.14) as follows:

Location: No.1; Aubrey Falls, Township 4D. No.2; 1 mile [1.6 km] northwest of No.1, Township 4E.
Development: Trenching, drilling (1949-1950).
Geology: A gossan occurs along a fractured zone at the contact of a diabase dike and Archean granitic rocks.
Dimensions and Grade: Zone 2-5 feet [0.6 to 1.5 m] wide traced over 800 feet [240 m]. Gossan contains 0.54 %U_3O_8 (RE)[4], fresh material 1.59% U_3O_8 (RE). This on analysis gave 0.10% U_3O_8 (Chem.), 1.5% ThO_2 (estimated). Later surface samples ranged from 0.03 to 0.79% U_3O_8 (RE). 15 core samples: 8 less that 0.005% U_3O_8 (RE), others range from 0.006 to 0.01% U_3O_8.

[1]Formerly Township 8E.
[2]Formerly Township 4D.
[3]Formerly Township 4E.
[4]RE = radiometric equivalent.

In assessment file SSM607, mention is made of intense, reddish, hematite alteration along the diabase-granite contact in association with the uranium mineralization.

There is no record of work being done after 1949-1950.

Borden Lake Radioactivity Anomaly (64)
Gallagher Township
District of Sudbury

On a small point of land jutting from the west shore of Borden Lake at Latitude 47°48.70'N and Longitude 83°19.15'W, radioactivity is 4 to 5 times background. This occurrence was pointed out to a member of the survey party by Earle Soothern, veteran prospector of the Chapleau area.

The host rock is fine- to medium-grained pink biotite granite which weathers to a grey-white. The rock is visually estimated to contain 10 to 15 percent quartz, 1 to 10 percent biotite, and the remainder pink potassium feldspar. The mafic minerals are commonly segregated into wispy streaks. The radioacitivty appears to be associated with reddening, possibly by hematite along joints striking S33E and dipping 10E. The zone of reddening and the radioactivity disappear rapidly within 1 foot (0.3 m) of the joint. No uranium- or thorium-bearing mineral was recognized. A grab sample taken by the author assayed 0.001 percent U_3O_8 and 0.07 percent ThO_2 (assay by Mineral Research Branch, Ontario Division of Mines). The radioactivity is apparently largely due to the thorium content.

NIOBIUM

Within the map-area, three carbonatite-alkalic complexes are known, and two magnetic anomalies have been interpreted as carbonatite-alkalic complexes. Two of these bodies have been extensively explored for niobium and rare-earth mineralization. The geology of the complexes is described in "Carbonatite-Alkalic Complexes" in "General Geology".

Niobium mineralization is known to occur as pyrochlore within the three carbonatite-alkalic complexes examined within the map-area. Pyrochlore-bearing carbonatite samples collected at the Firesand River complex, outside the map-area, are texturally very similar to those observed in pyrochlore-bearing carbonatite core samples found at the former Multi-Minerals Limited camp on the Lackner Lake complex. Pyrochlore mineralization was not found at the Township 107-108 complex, also outside the map-area (described in Thurston *et al.* 1974, appendix).

Within the map-area, proven niobium mineralization which is potentially economic is concentrated in the more mafic silicate phases of the Lackner Lake and Nemegosenda Lake complexes. However, within Canada, current niobium production from the Oka complex in Quebec is largely from pyrochlore-bearing sövite (Heinrich 1966, p.375-376). Niobium mineralization within the St. Honoré

complex which is being considered for production (The Northern Miner, Jan. 4, 1971), occurs largely in carbonate of dolomitic and calcitic compositions (Vallee and Dubuc 1970, p.349-350). Currently it appears that economic concentrations of niobium occur in those complexes and (or) rock types that are carbonate-rich and more basic than those composed almost totally of silicate mineralogy. This indicates that the predominantly carbonate intrusions are more likely to have the higher grade concentrations of niobium than the alkalic rock intrusions.

Within the map-area, geological reports and maps of the alkalic syenite-carbonatite complexes indicate that the pyrochlore mineralization is associated with magnetite and (or) mafic silicate rocks in preference to the carbonate-rich rocks. Even though of lower grade than Oka or St. Honoré, the large indicated tonnage of niobium mineralization of the Nemegosenda Lake and Lackner Lake complexes have potential economic significance.

Multi-Minerals Limited has delineated in excess of 122,000,000 tons of low grade niobium mineralization in three zones on the Lackner Lake complex and Dominion Gulf Company has outlined 20,000,000 tons of low grade niobium mineralization at the Nemegosenda complex (Canadian Mines Handbook 1969-1970, p.241; Parsons 1961, p.46).

Minor amounts of sulphide minerals were observed in the Nemegosenda Lake complex, the Firesand River complex, and the Township 107-108 complex. While analyses by the Mineral Research Branch, Ontario Division of Mines failed to disclose anything of interest in selected samples from these complexes, the presence of zinc and molybdenum in anomalously high but uneconomic quantities within the St. Honoré complex emphasizes the fact that these bodies should be carefully checked for base metal mineralization as well as for rare earths, uranium, thorium, and niobium (Vallee and Dubuc 1970, p.356). Lumbers (1971, p.69,79,81) also reported uneconomic but interesting amounts of copper, nickel, and tin along with niobium and uranium in the Iron Island complex, in the North Bay area.

Prospecting for carbonatite intrusions within the map-region has largely consisted of investigating circular to elliptical magnetic anomalies indicated by ODM-GSC airborne magnetometer surveys (Parsons 1961, p.3; Heinrich 1966, p.8,9). The possibility of undiscovered carbonatite intrusions is still thought to be good.

The carbonatite-alkalic complexes appear to be spatially associated with the Kapuskasing Structural Zone (see "Carbonatite-Alkalic Complexes" in "General Geology"). Intrusions emplaced along such a structure would be expected to be tabular rather than circular; however, if large concentrations of magnetic minerals are not present, tabular intrusions could be masked in magnetic surveys by the rocks of the Kapuskasing Structural Zone.

North of the map-area, Bennett *et al.* (1967, p.72) reported that carbonatites occur mainly as tabular bodies rather than circular pipes. Since the carbonatite-alkalic complexes are commonly more radioactive than the surrounding wall-rocks, an airborne radiometric survey might disclose further areas of interest along the Kapuskasing Structural Zone. It must be considered, however, that the existing airborne radiometric techniques have little ability to penetrate overburden and that extensive Pleistocene deposits cover large areas of the Kapuskasing Structural Zone.

Care should be taken while ground-prospecting for carbonatite complexes,

because those bodies that consist predominantly of carbonate are easily eroded and may be poorly exposed. Carbonatite-alkalic complexes, whose mineralogy is predominantly silicate would be better exposed. Examination of the soil cover over the carbonate-rich Firesand River and Township 107-108 complexes indicated dark brown soils rich in carbonate rhombs, biotite flakes, and other more resistant silicate and oxide minerals derived from rock weathering. Soils, therefore, should be examined carefully over suspected carbonatite areas. Panning of the soil taken from the surface of a suspected carbonatite should disclose a heavy mineral assemblage such as magnetite, biotite, apatite, zircon, perovskite, and pyrochlore, characteristic of a carbonatite intrusion. This assemblage however, would be expected to vary in relative amounts of the minerals present, away from the site of the intrusion, because of the breakdown of the less resistant minerals by weathering.

A carbonatite intrusion within the map-area is most likely to have been intruded into a sequence of rocks that is more resistant to erosion. Thus relatively abundant outcrops of the wall-rocks may occur about the margins of a low area underlain by carbonatites. Such outcrops should be checked for the presence of sodic amphiboles and sodic pyroxenes along cracks and joint surfaces. The development of these minerals is indicative of the process of fenitization which often accompanies a carbonatite intrusion.

Reconnaissance traverses over five complexes during the field season indicated that the vegetation may be more lush and vigorous than in the surrounding areas. This may be caused by the presence of phosphorous and other plant nutrients that have been released by weathering of the phosphorous-rich rocks of these bodies. Some form of infra-red, aerial photography thus may offer potential as an exploration tool.

Lackner Lake Carbonatite-Alkalic Complex
McNaught and Lackner Townships
District of Sudbury

Parsons (1961, p.60-68) gave a detailed account of exploration and development up to that time and the reader is referred to his report for this information. Exploratory work other than described by Parsons is as follows.

CANADIAN NICKEL COMPANY [1967] (129)
LACKNER TOWNSHIP

The Canadian Nickel Company drilled a 180-foot (55 m) hole on claim S135090 northeast of the Lackner Lake complex. The log records biotite gneiss, biotite hornblende gneiss, and graphitic hornblende biotite gneiss. No further work is reported.

FALCONBRIDGE NICKEL MINES LIMITED [1959]
LACKNER AND MCNAUGHT TOWNSHIPS

Falconbridge Nickel Mines Limited completed a magnetometer and geological survey over claims S110164-66, S108080-86, and S108541-47, covering a portion of the southwest corner of the complex. No further work is reported.

MULTI-MINERALS LIMITED
MCNAUGHT AND LACKNER TOWNSHIPS

Multi-Minerals Limited holds 51 patented claims covering most of the west flank of the complex. The prospect is described in Parsons (1961, p.61-68).

In the late 1950s Multi-Minerals Limited did extensive trenching and diamond drilling in the southwest corner of the complex. This work has disclosed three zones of niobium mineralization. The ore zones occur in ijolitic, malignitic and syenitic rocks (Photos 34 and 35) between the nepheline syenites of the inner core and outer rim (Parsons 1961, Map 2008).

Multi-Minerals Limited zones 3 and 4 consist of pyrochlore-bearing ijolite which carries some concentrations of magnetite and apatite. The Canadian Mines Handbook (1969-1970, p.241) reported that the zone contains an estimated 37,000,000 tons grading 21.3 percent apatite, 13.7 percent magnetite and 0.198 percent niobium oxide. Zone number 6 is a massive magnetite-apatite zone estimated to contain 5,024,250 tons to a depth of 500 feet (150 m) grading 69.6 percent magnetite, 21.9 percent apatite, and 0.173 percent niobium oxide. The Canadian Mines Handbook also reported that subsequent work in 1966 indicated 2.72 percent rare earth-thorium-yttrium oxides in zone 6. Multi-Minerals Limited zone number 8 lies in malignite and ijolitic malignite and contains two carbonatite dikes which are also pyrochlore bearing. This zone is estimated to contain potentially 80,000,000 tons grading 0.25 percent niobium oxide over a length of 1,400 feet (420 m) and to a depth of 800 feet (240 m) (Canadian Mines Handbook 1969-1970, p.241). These zones are all reported to be still open to further extension.

In 1970 Multi-Minerals Limited leased the Number 6 zone to Fetio Industrial Development Limited for the production of titaniferous magnetite concentrate. Multi-Minerals Limited planned to recover phosphoric acid and rare earths from the non-magnetic tailings.

MULTIWIN EXPLORATIONS LIMITED [1954]
MCNAUGHT TOWNSHIP

Multiwin Explorations Limited completed an aeromagnetic survey and drilled seven holes totalling 1,450 feet (442 m) on claims S62700 to S62753 inclusive and claims S62557 to S62562 inclusive, which lie along the western boundary of the complex. Nothing of economic interest was encountered.



ODM9456

Photo 34–Nepheline syenite with magnetite and ijolite fragments near Multi-Minerals zone number 6. Lackner Lake complex.



ODM9457

Photo 35–Intermixed nepheline syenite (light) and ijolite (dark), near Multi-Minerals zone number 6. Lackner Lake complex.

NANEEK MINES LIMITED [1950]
MCNAUGHT TOWNSHIP

Naneek Mines Limited completed a magnetometer survey over claims S56527 to S56344 inclusive located along the southwestern boundary of the complex. No further work is reported.

UNION CARBIDE CANADA MINING LIMITED [1969]
LACKNER TOWNSHIP

Union Carbide Canada Mining Limited drilled one 801-foot (244.1 m) hole on claim S155436 located approximately 2,300 feet (700 m) north of the north end of Lackner Lake. The core is reported to have consisted of coarse-grained nepheline syenite cut by two lamprophyre dikes from 222 to 228 feet (68 to 69 m) and 490 to 493 feet (149.4 to 150.3 m). No further work is reported.

Nemegosenda Lake Carbonatite-Alkalic Complex (29, 31)
McGee, Pattinson, Collins and Chewett Townships
District of Sudbury
Dominion Gulf Company

Exploratory work on this complex by Dominion Gulf Company was done principally along their zone D on the Chewett and Collins Townships boundary. The Assessment Files Research Office (Ontario Division of Mines, Toronto) contains records of 41 holes totalling 21,624 feet (6591.0 m) that were drilled during 1957-1958 by the company. Drilling by Dominion Gulf Company delineated a mineralized zone with an indicated 20,000,000 tons grading 0.47 percent Nb_2O_5 in a block 600 by 800 feet (180 by 240 m) and to depths of 600 feet (180 m) (Parsons 1961, p.46). A 580-foot (175 m) adit which cut 235 feet (72 m) of mineralization was driven into this zone and bulk samples taken. Pilot plant research indicates a 90 percent niobium recovery is possible direct from raw ore (Canadian Mines Handbook 1970-1971, p.128).

Parsons (1961, p.46) reported that uranium, thorium, rare earths, zirconium, apatite, and magnetite could be of interest as by-products of a niobium operation. Fluorite, barite, galena, sphalerite, chalcopyrite, and graphite are reported to be present but of academic interest only. Samples of malignite collected by the author [Sage] from the muck pile at the mouth of the Dominion Gulf Company adit and containing 15 to 20 percent pyrite were checked by 30 element spectrographic analysis for base metals but returned nothing of interest. Samples of niobium ore collected by the author from the muck pile at the adit site of Dominion Gulf Company assayed 0.33 to 0.61 percent Nb_2O_5 (assays and analysis by Mineral Research Branch, Ontario Division of Mines).

Several niobium-bearing zones have been indicated from work by Dominion Gulf Company occurring along the eastern rim of the complex in the pyroxenitic fenite zone. The results of diamond drilling by Dominion Gulf Company as de-

TABLE 27 | ASSAYS OF DIAMOND DRILL CORE FROM THE NEMEGOSENDA LAKE CARBONATITE-ALKALIC COMPLEX BY DOMINION GULF COMPANY (FROM PARSONS 1961, p.50).

Zone	Number of Holes	Drilled Strike-Length of Zone in Feet	Assay Nb_2O_5	Length of Mineralized Core in Feet
A	3	300	0.45%	116
B	6	1700	0.43%	101
E	4		0.43%	43
F	3	1500	0.37%	169
G	3	400		

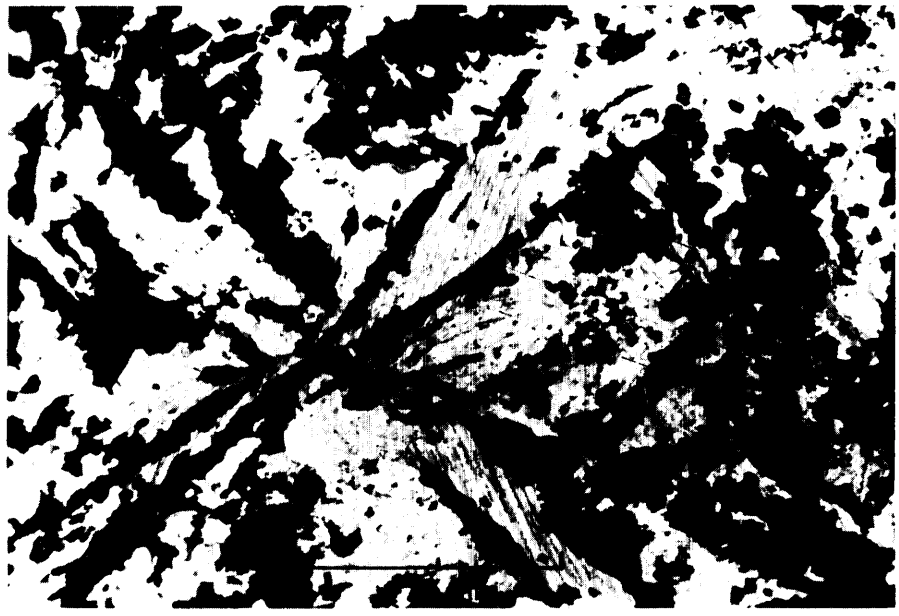
scribed by Parsons (1961) are summarized in Table 27. For additional detail on this property, see Parsons (1961, p.46-50.).

Seabrook Lake Carbonatite-Alkalic Complex (140, 141)
Maeck Township[1]
District of Algoma

Niobium values ranging from 0.01 to 0.33 percent Nb_2O_5 were reported by Parsons (1961, p.20) from samples collected from the Seabrook complex, but mineral concentrations of economic interest have not been delineated. The 0.33 percent Nb_2O_5 analysis was obtained on a fenitized granite (Parsons location "B") at the south end of the southwestern bay of Seabrook Lake. A sample of the carbonatite from this location collected by members of the field party returned 0.01 percent Nb_2O_5 upon analysis by the Mineral Research Branch, Ontario Division of Mines. The granitic fenite was not submitted for analysis.

Other samples collected by members of this field party along Seabrook Lake returned, upon analysis by the Mineral Research Branch, Ontario Division of Mines, 0.01 to 0.03 percent niobium, 0.07 to 0.47 percent cerium oxide, and 0.04 to 0.22 percent lanthanum oxide. U_3O_8 equivalent is 0.003 to 0.005 percent. The best analysis returned 0.47 percent cerium oxide and 0.22 percent lanthanum oxide and was from a hematite-bearing carbonatite collected from the northwest corner of the main peninsula projecting into Seabrook Lake. The sample is bright red and in thin section (Photo 36) displays large, somewhat euhedral crystals of carbonate with hematite concentrated along grain boundaries. The carbonate reacts vigorously to hydrochloric acid and is most likely calcite. The rock is medium grained, and on the slabbed surface the hematite gives a distinctive "bird track" pattern. This hematite-rich rock is likely similar to those found in a 300 by 300-foot (90 by 90 m) hematite-bearing area described by Parsons (1961, p.19-20) in the western part of the complex.

[1]Formerly Township 5E.



ODM9458

Photo 36–Photomicrograph of hematite-bearing carbonatite, showing hematite and calcite. This sample assays 0.47 percent cerium oxide and 0.22 percent lanthanium oxide. Seabrook Lake complex.

An investigation of the rare earth potential of this area appears to be warranted.

Parsons (1961, p.20) reported showings of fluorite, magnetite, hematite, and pyrochlore with an unidentified radioactive mineral. Time prevented the party from relocating these showings.

A brief review of work submitted for assessment credit in addition to that described by Parsons (1961, p.20-22) is as follows:

F.R. JOUBIN [1957] (147)

A geochemical soil survey was completed and samples tested for heavy metals and niobium concentrations. A limited amount of trenching was done in testing anomalous areas. Work was concentrated on the main peninsula jutting into Seabrook Lake and is covered by claims SSM67142, SSM67141, SSM67151, SSM67143, and SSM67140. The higher niobium values in the soil are reported to occur in association with magnetite concentrations. No additional work was reported and the claims have been dropped.

Four diamond drill holes totalling 576 feet (175 m) were drilled on claims SSM27730 and SSM29271 located on the south shore of the southwestern bay of Seabrook Lake. No further work was reported. Minor niobium values were encountered and higher niobium values were reported to occur with areas of abnormal radioactivity and concentration of magnetite. The claims have been dropped.

Recommendations for Prospectors

It is recommended that the search for gold deposits within the metavolcanic-metasedimentary belts be concentrated along zones of shearing which display silicification and carbonatization. The common occurrence of quartz-feldspar and feldspar porphyry intrusions near known gold occurrences further suggests that their presence in association with shearing, silicification, and carbonatization represents a particularly good environment for gold mineralization.

The granitic rocks offer some promise for gold deposits particularly where pipes and lenses of quartz are found similar to those occurring at the Renabie mine in Leeson Township.

Base metal mineralization appears to be most commonly associated with various types of iron formation where it occurs as crosscutting veinlets, massive lenses, and breccia cement. Conventional airborne geophysical surveys with ground follow up on the anomalies appear to offer the best possibility for discovery of this type of deposit. Particular attention should be paid to brecciated iron formation and the possibility of base metal sulphide mineralization in association with massive pyrite-pyrrhotite bodies.

Exploration for carbonatite-alkalic complexes would have the best possibility of success along the Kapuskasing Structural Zone. It is expected that the future discoveries of carbonatite-alkalic complexes will consist of lenticular rather than circular bodies. Care should be taken while prospecting for such intrusions because exposure is very poor and dark brown soils rich in carbonate rhombs, biotite flakes, magnetite, and pyroxene grains which are found over weathered carbonatite are easily missed by the casual observer. Outcrops within an area of suspected carbonatite emplacement should be checked for the occurrence of the sodic amphiboles and pyroxenes along cracks and joint surfaces. The presence of these minerals is indicative of the process of fenitization which commonly accompanies carbonatite intrusion.

Since the rocks of the carbonatite-alkalic rock suite are commonly more radioactive than the surrounding wall rocks, airborne radiometric surveys may offer some promise as an exploration tool for those bodies that outcrop. Vegetative cover is apparently more lush over carbonatite-alkalic complexes; therefore, airborne photographic techniques may offer promise as an exploration tool for bodies close to the surface but covered by surficial deposits.

If the carbonatite-kimberlite relationship is real then the Kapuskasing Structural Zone offers good potential for the occurrence of kimberlite rocks. Pos-

sible exploration methods for kimberlite are soil sampling, and searching for the kimberlite indicator minerals.

Economic deposits of asbestos fibre in serpentized ultramafic rocks occur along the eastern edge of the map-area and therefore, ultramafic rocks should be checked for economic concentrations of this mineral. Even though no indications of asbestos fibre have been found, the Wakami-Shipley Townships aeromagnetic anomaly which is interpreted as an ultramafic intrusion (see the section "Ultramafic Intrusive Rocks and Associated Mafic Rocks" in "General Geology") warrants a closer examination.

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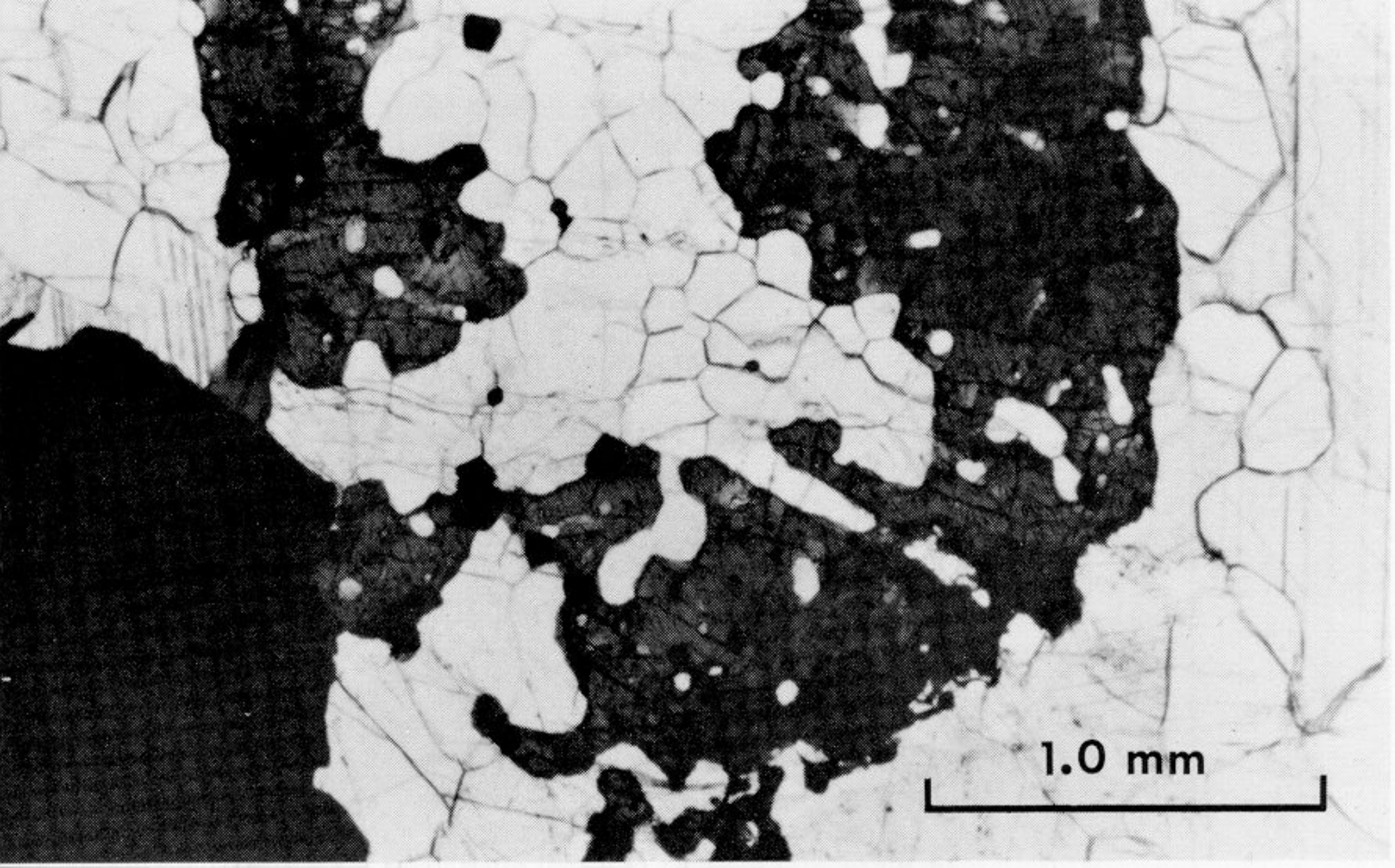
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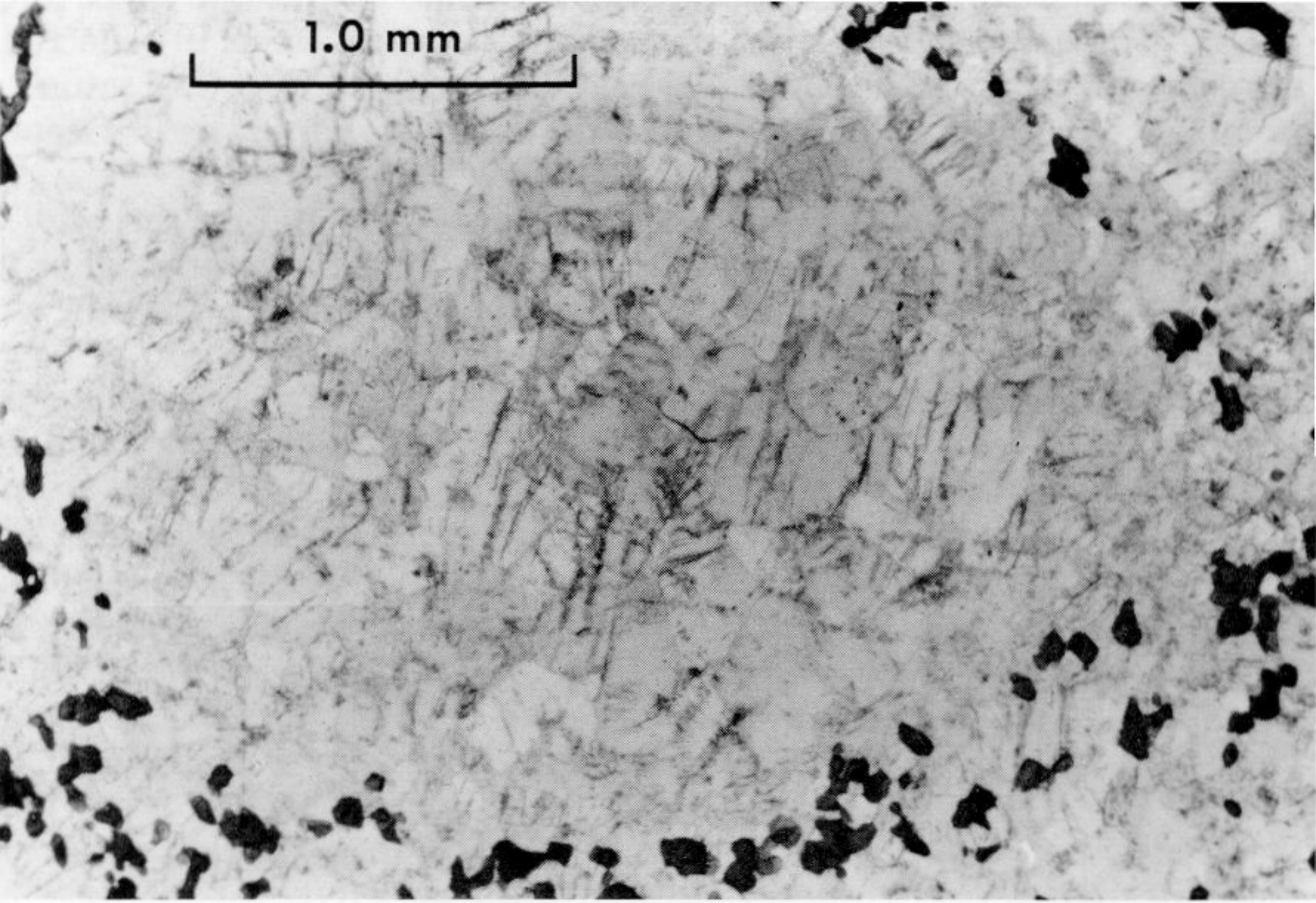
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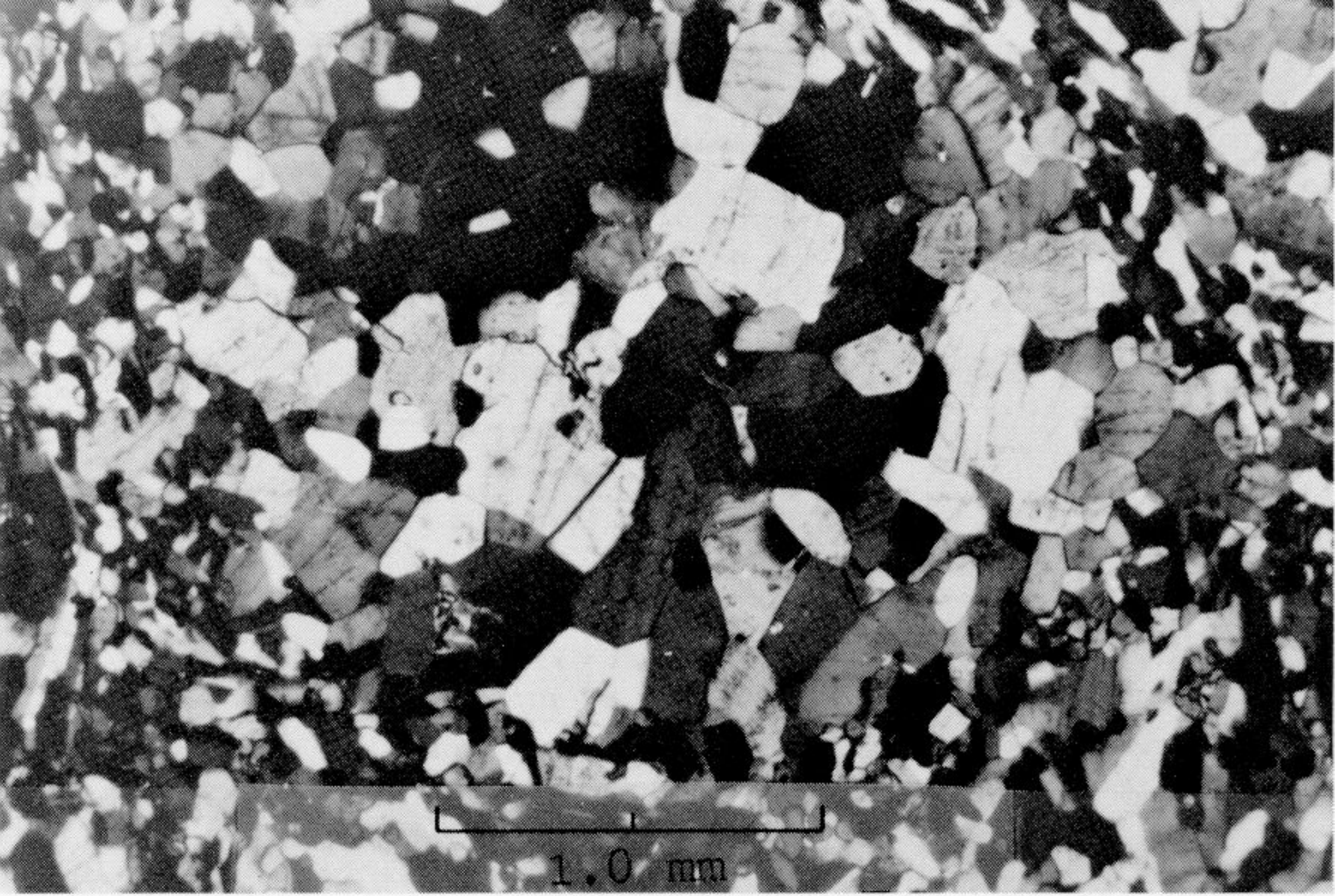
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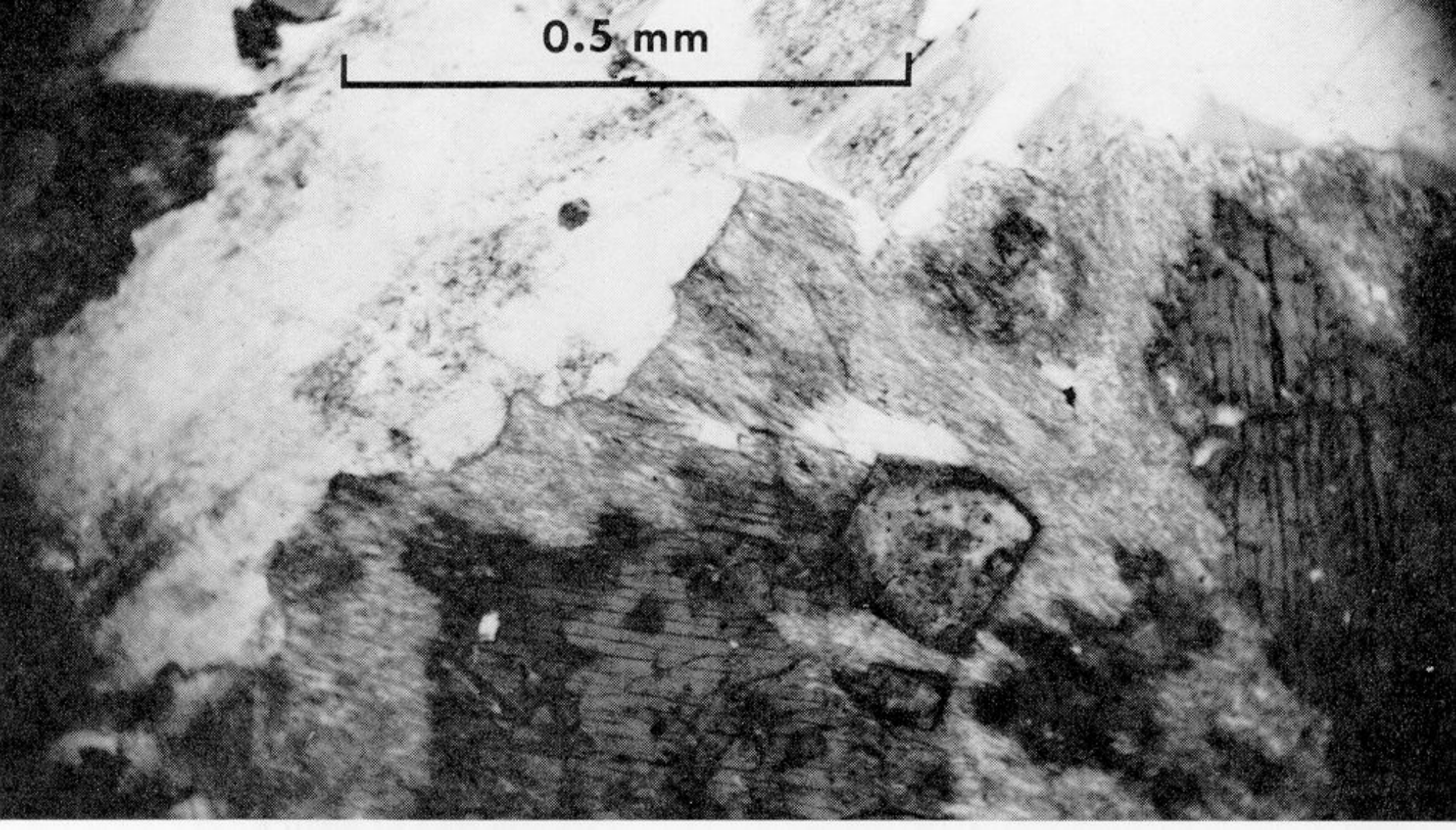
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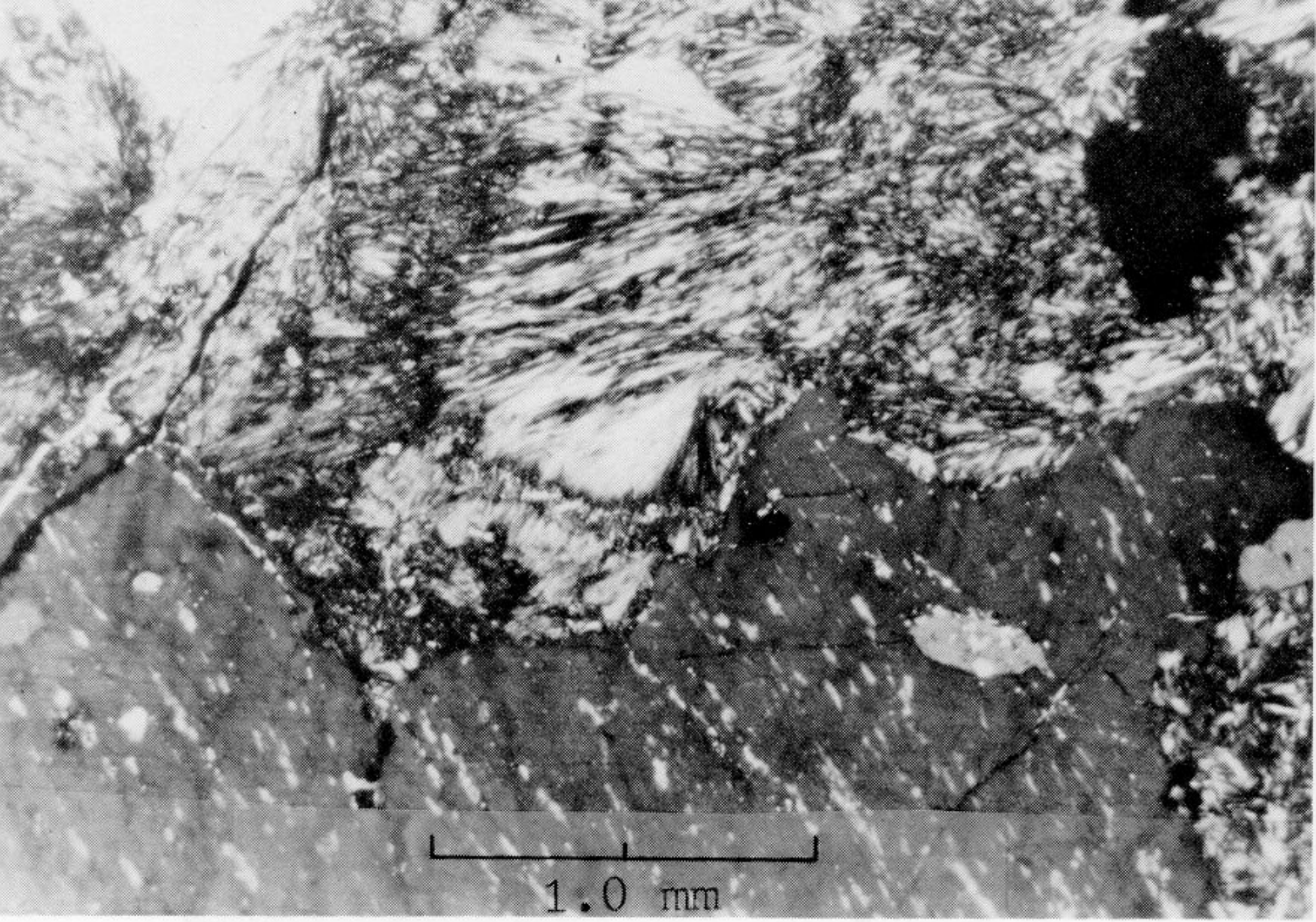

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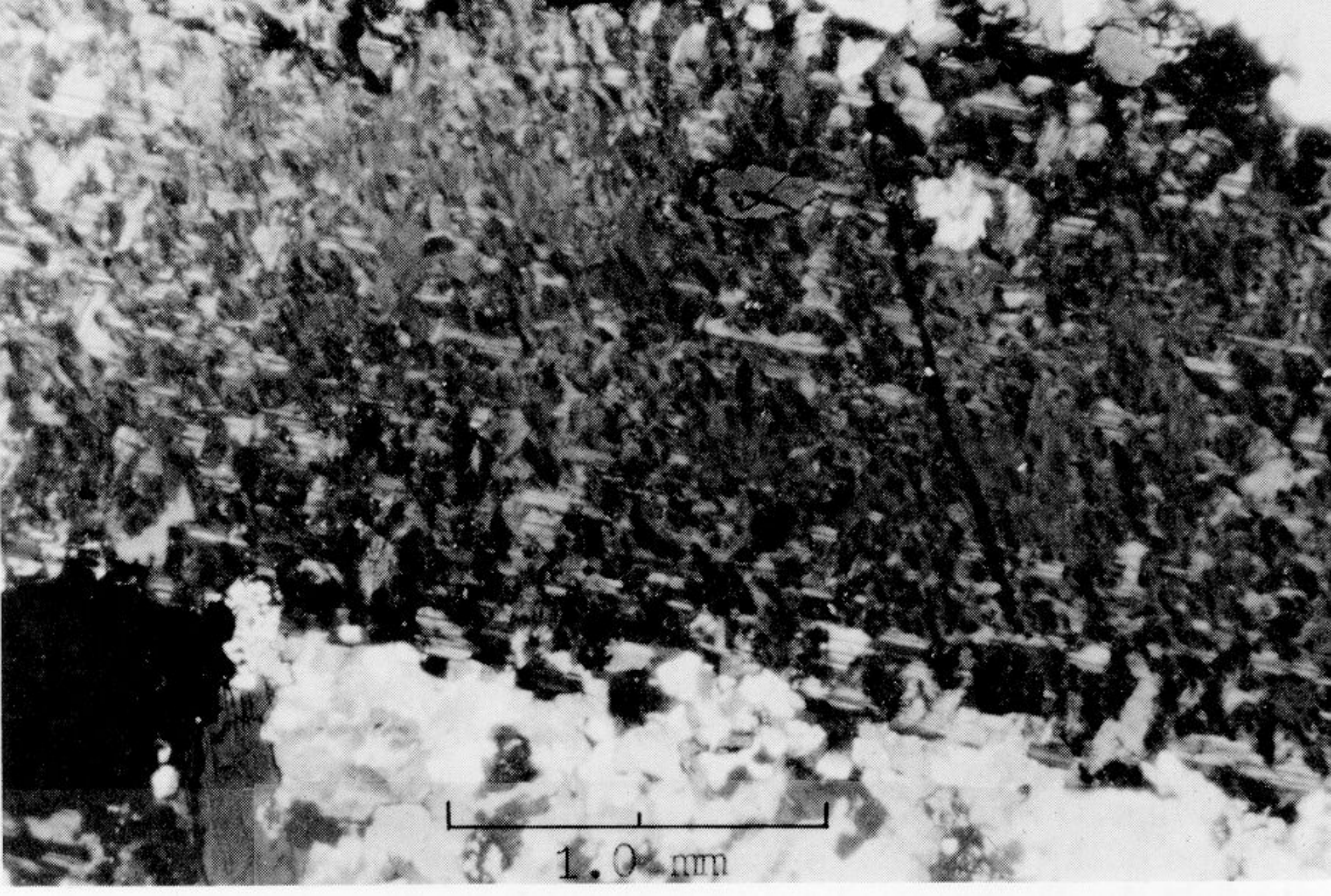

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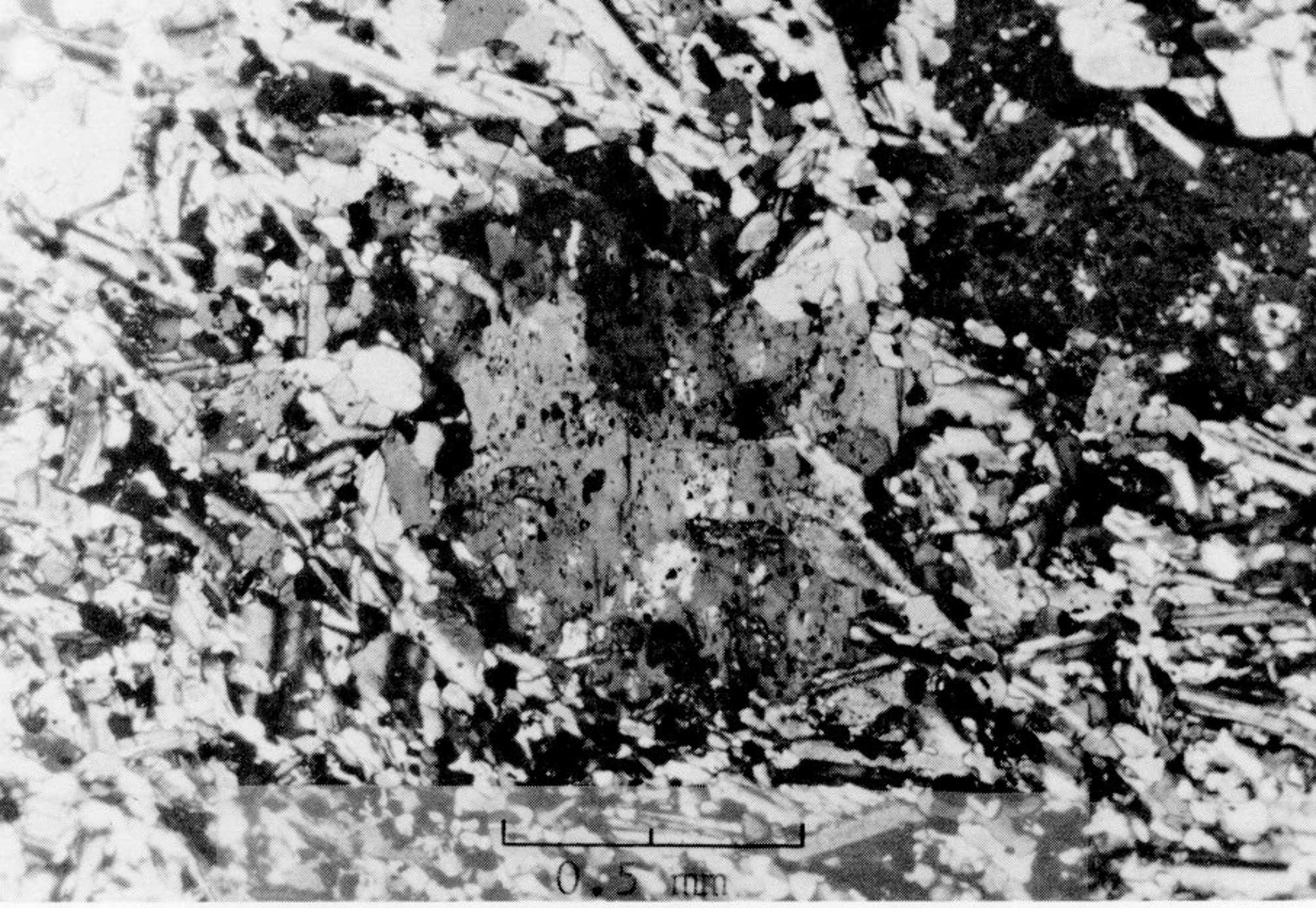

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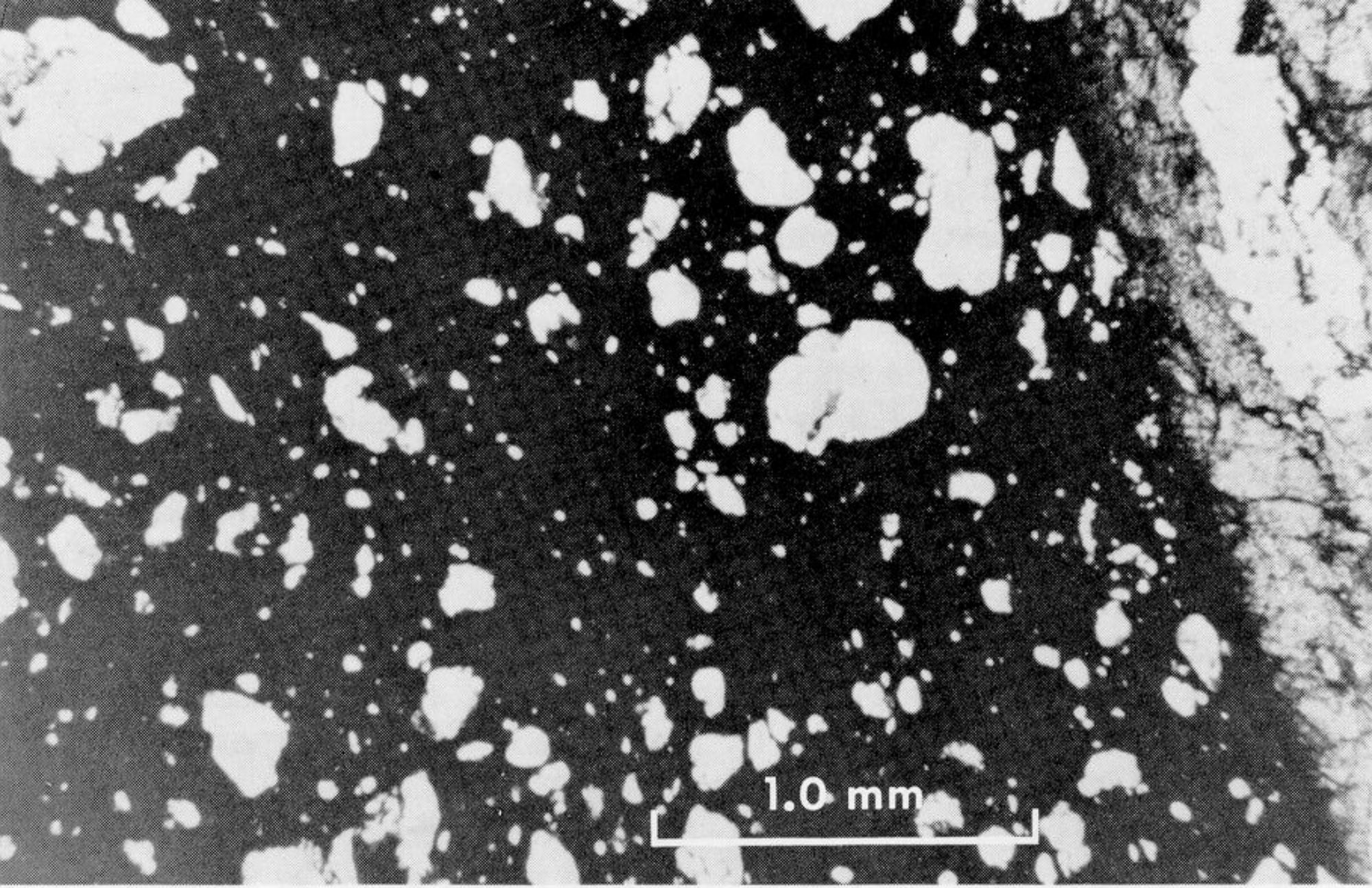

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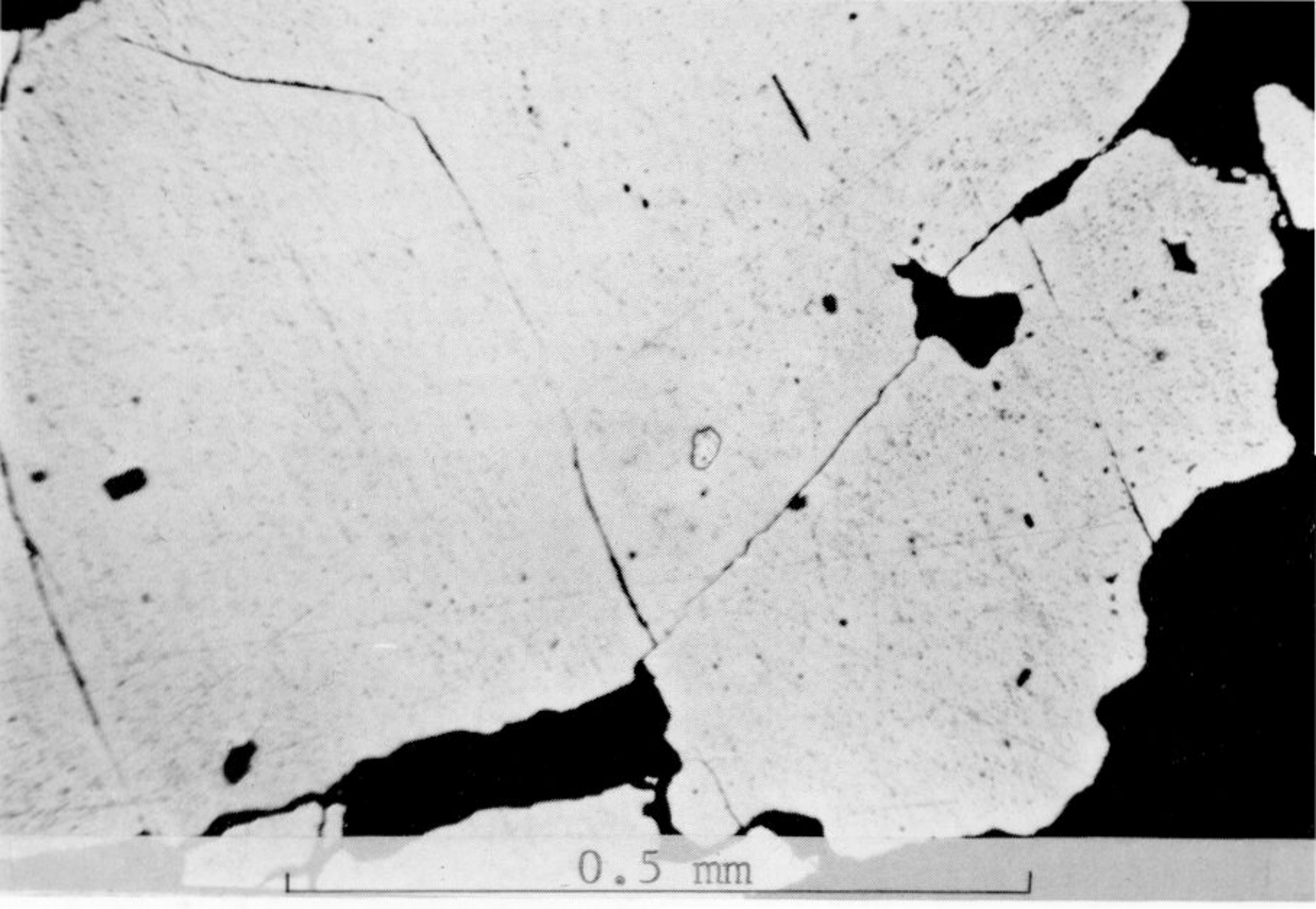

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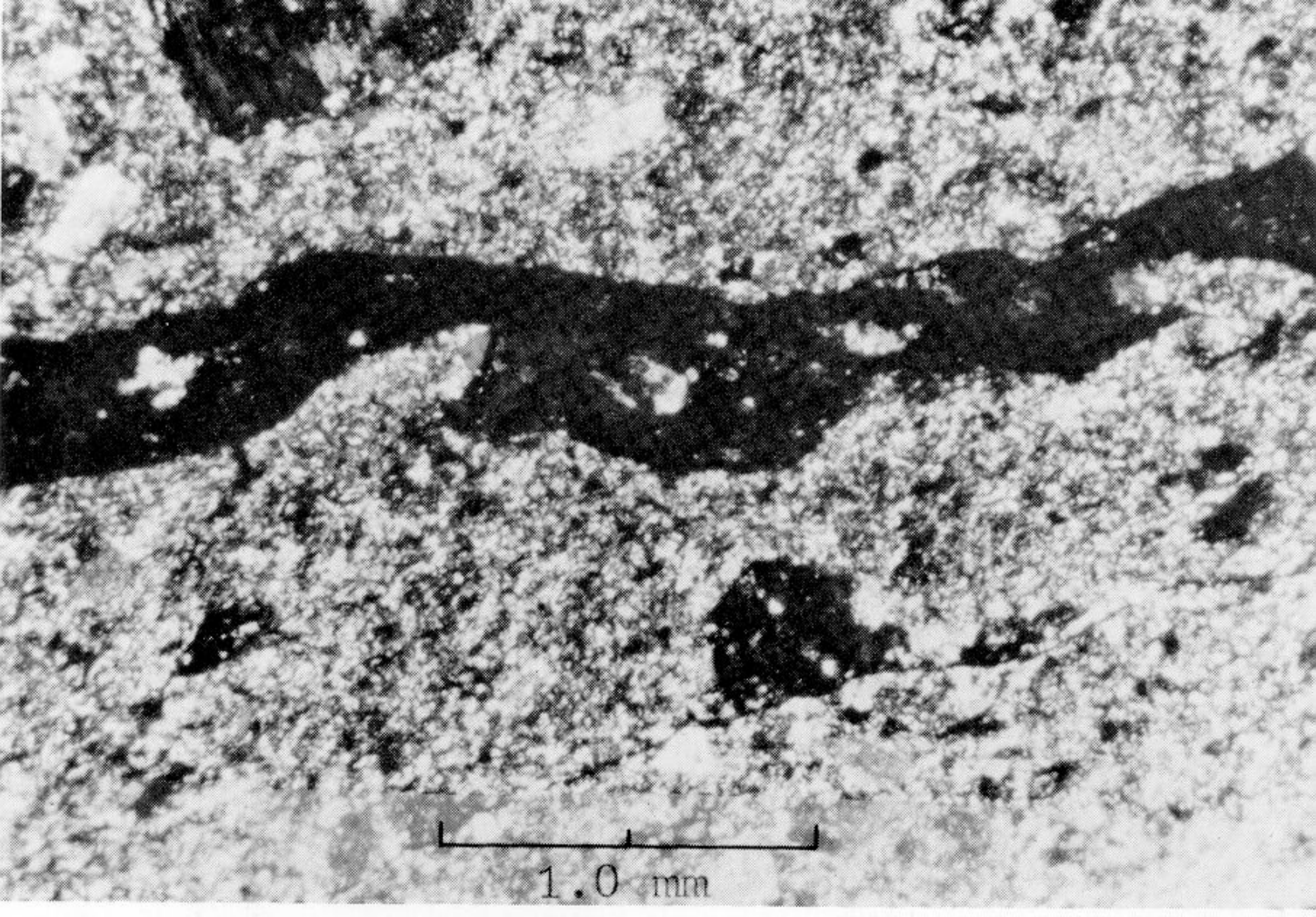


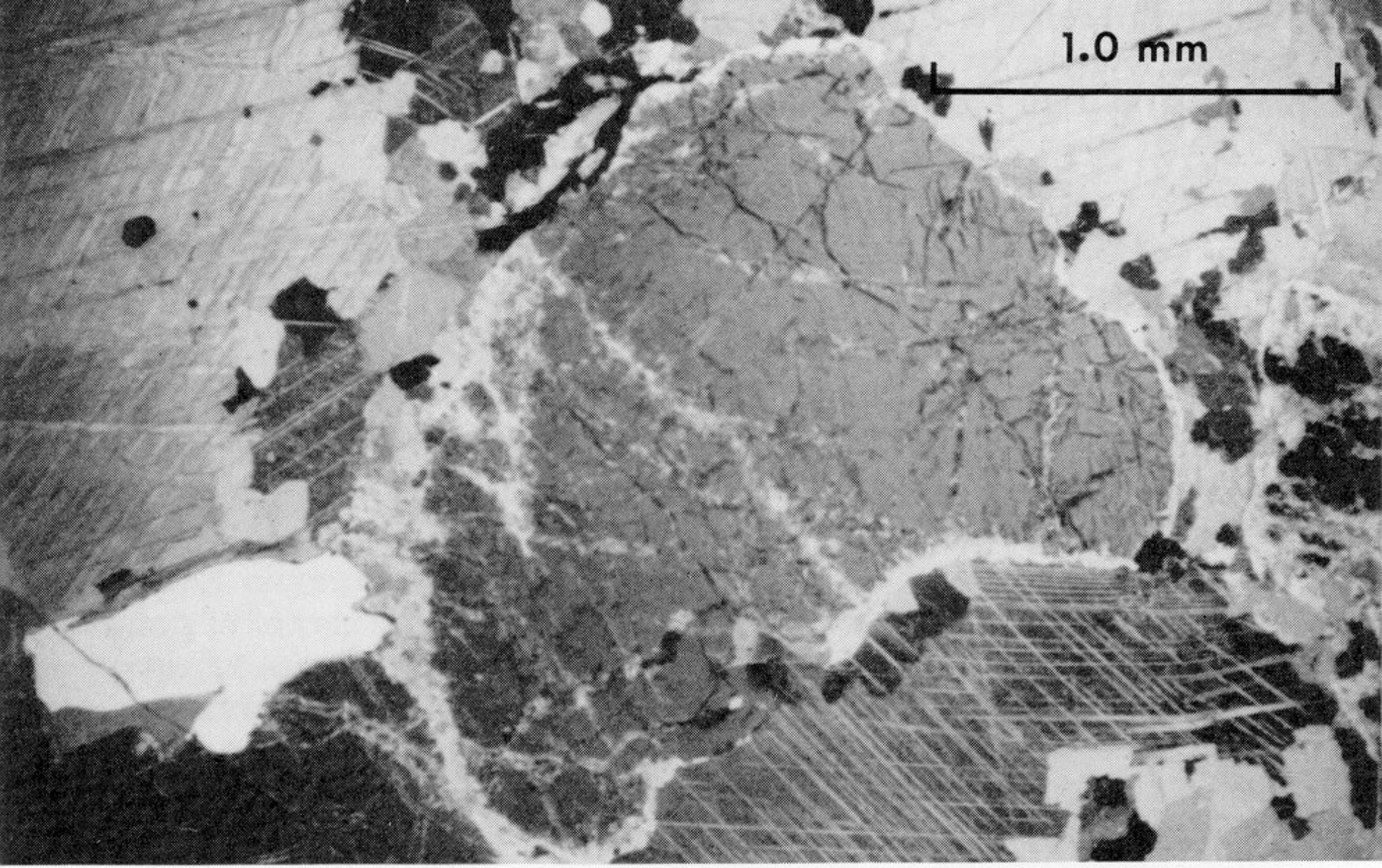


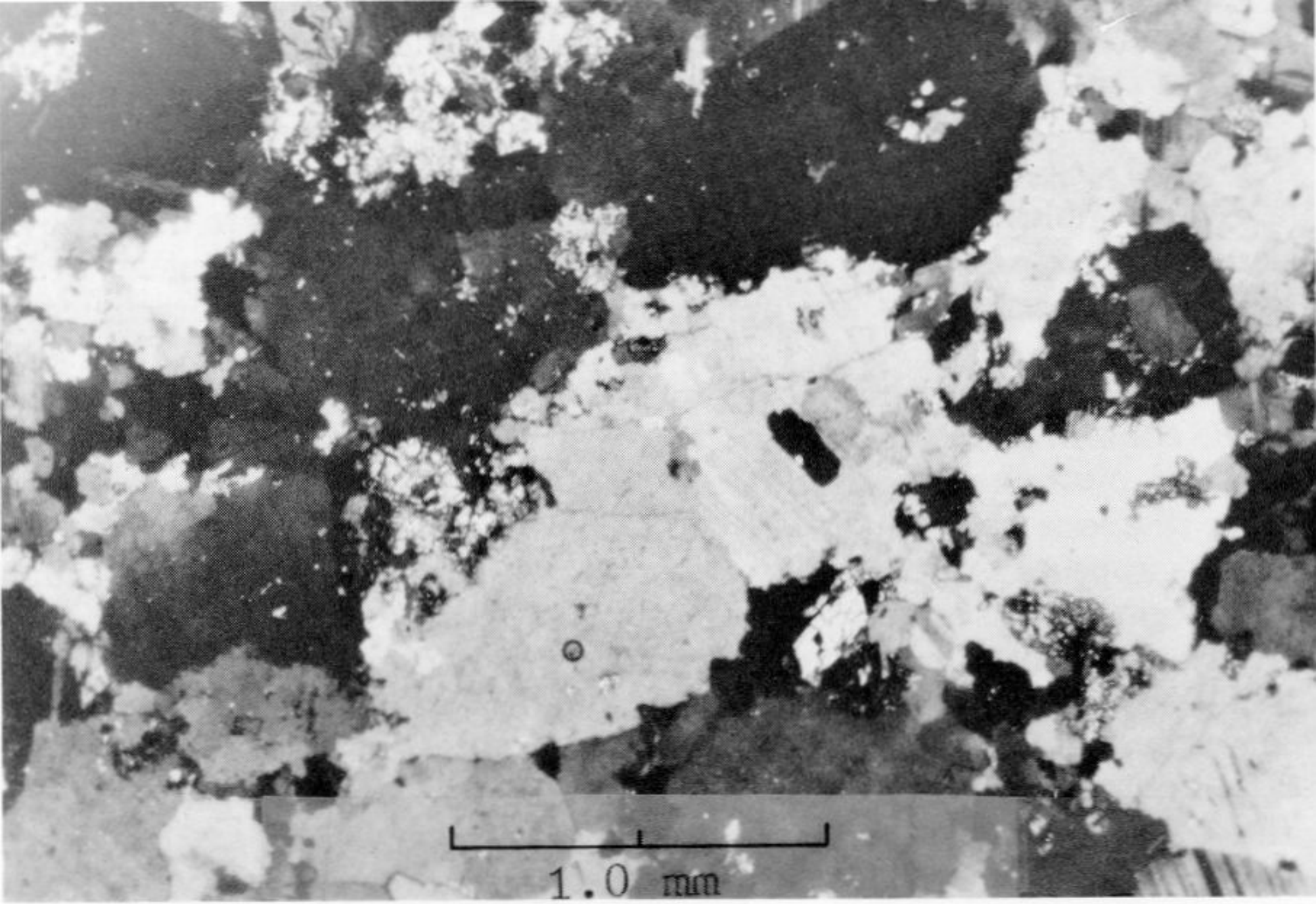

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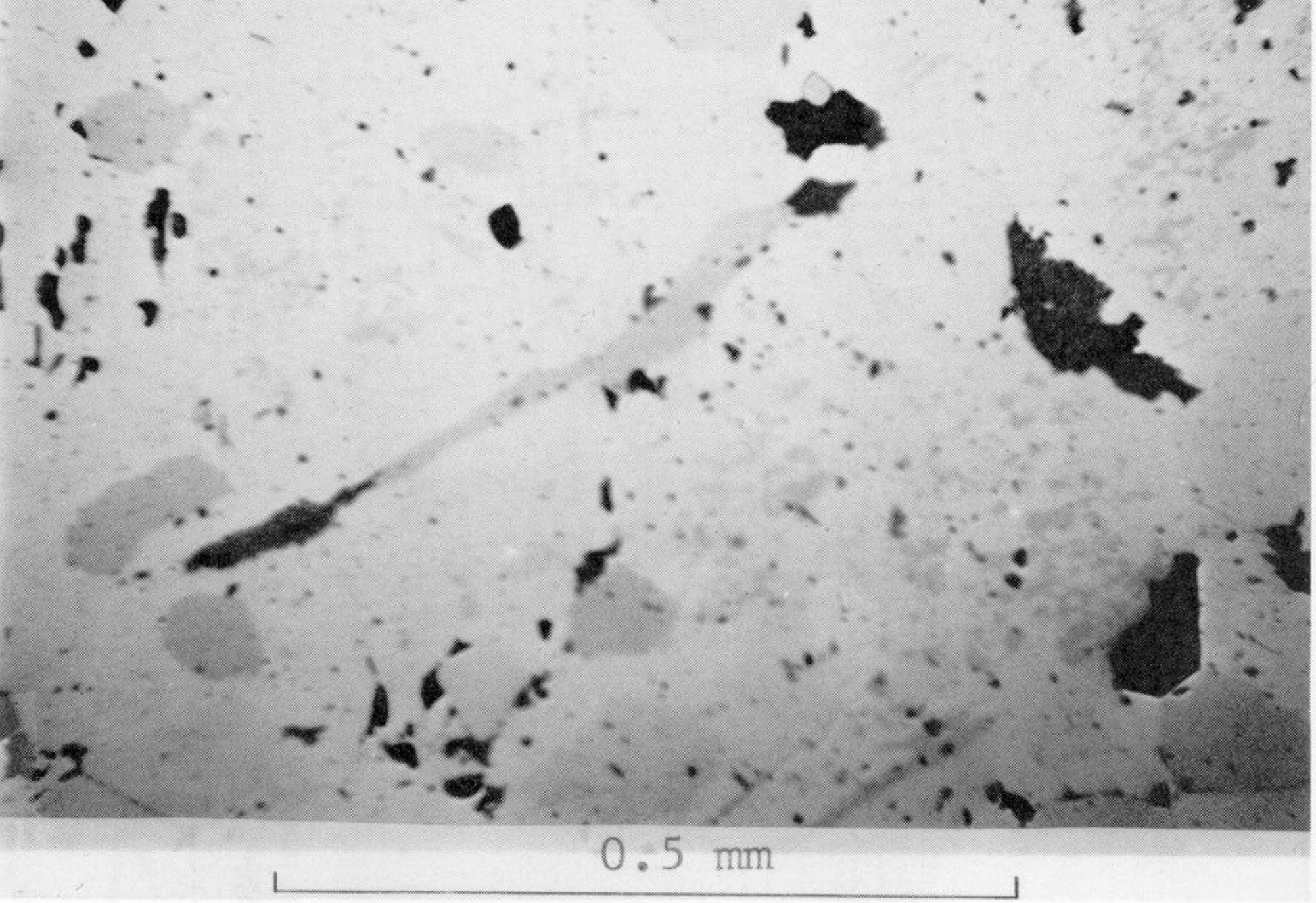

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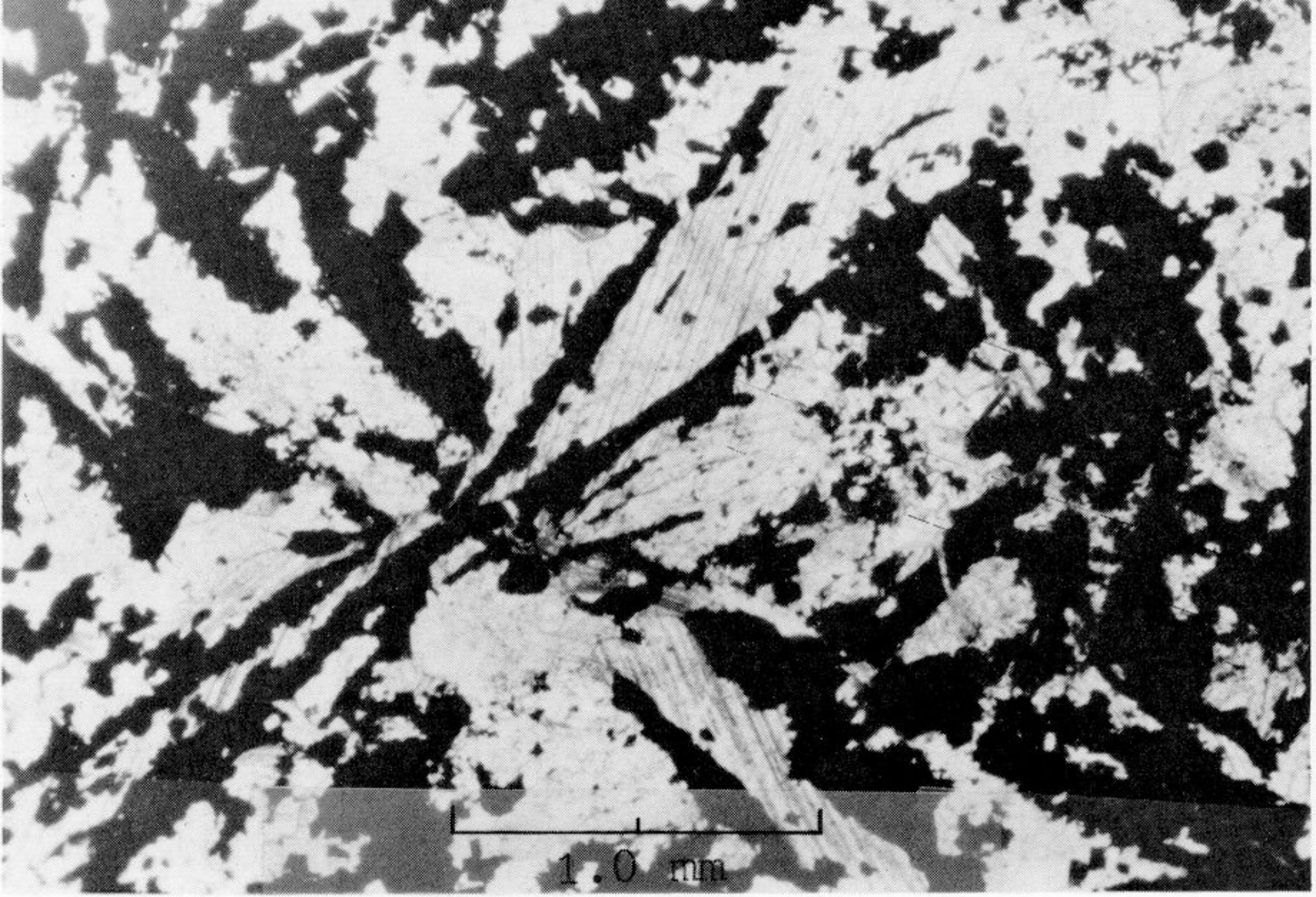

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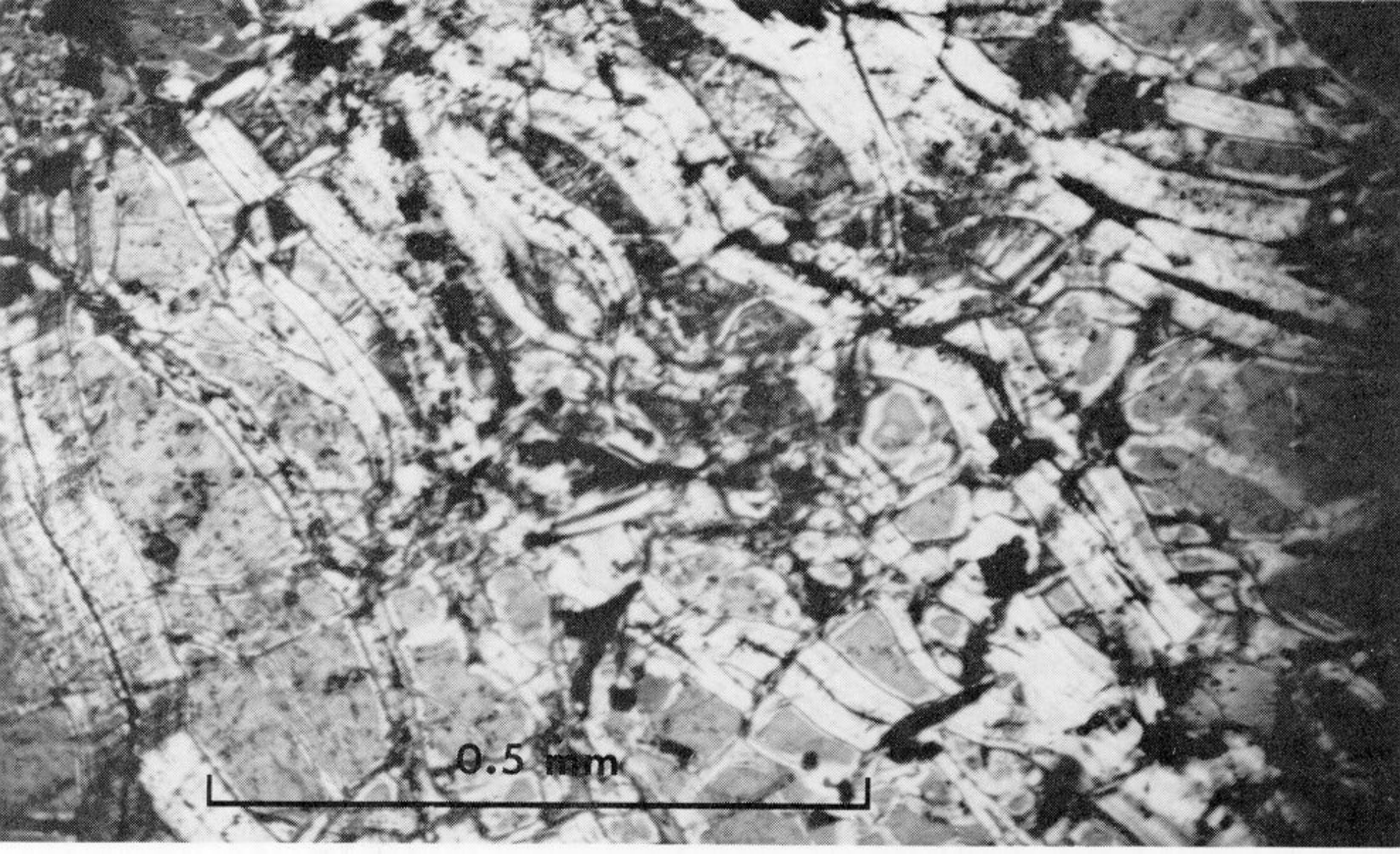

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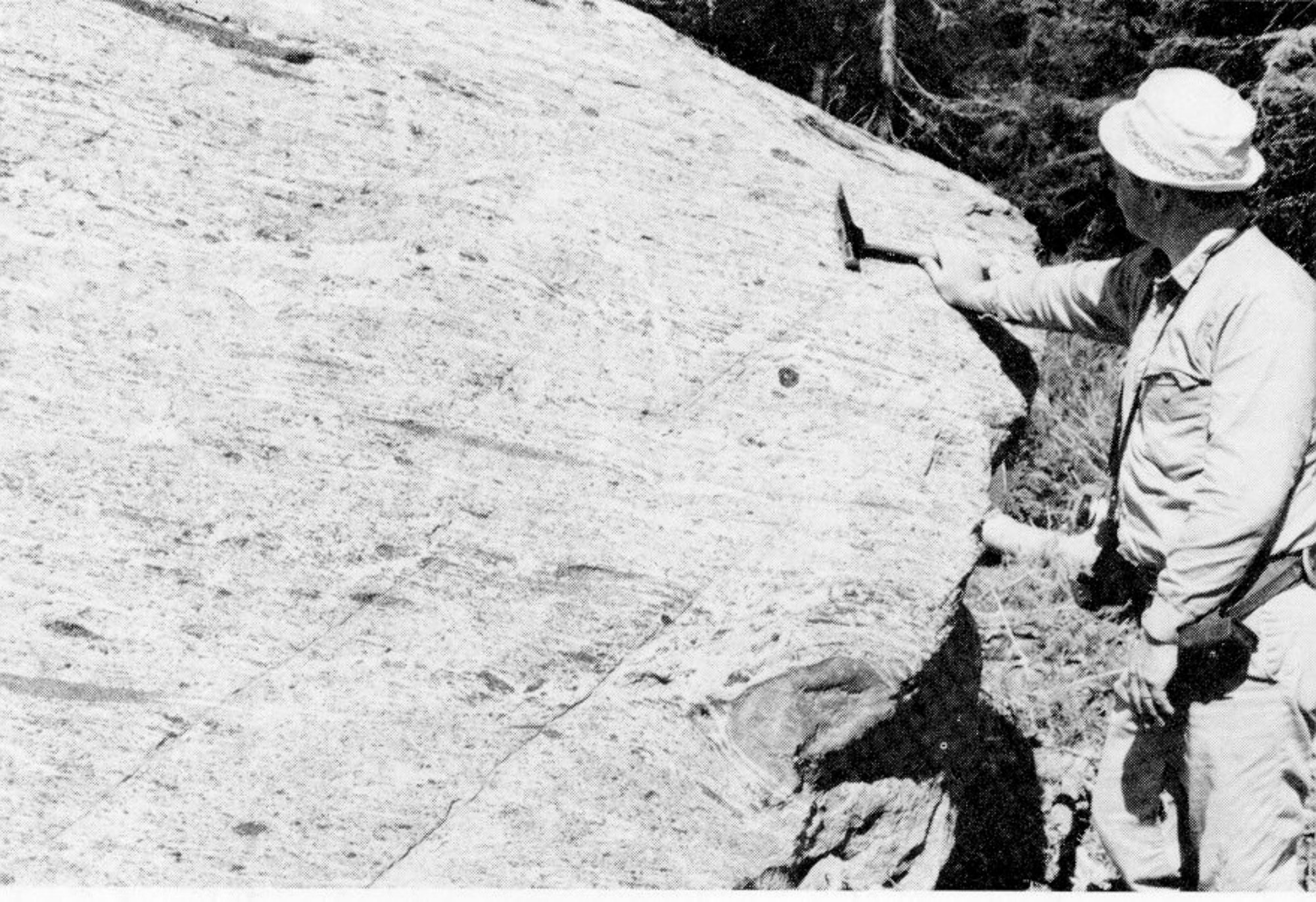


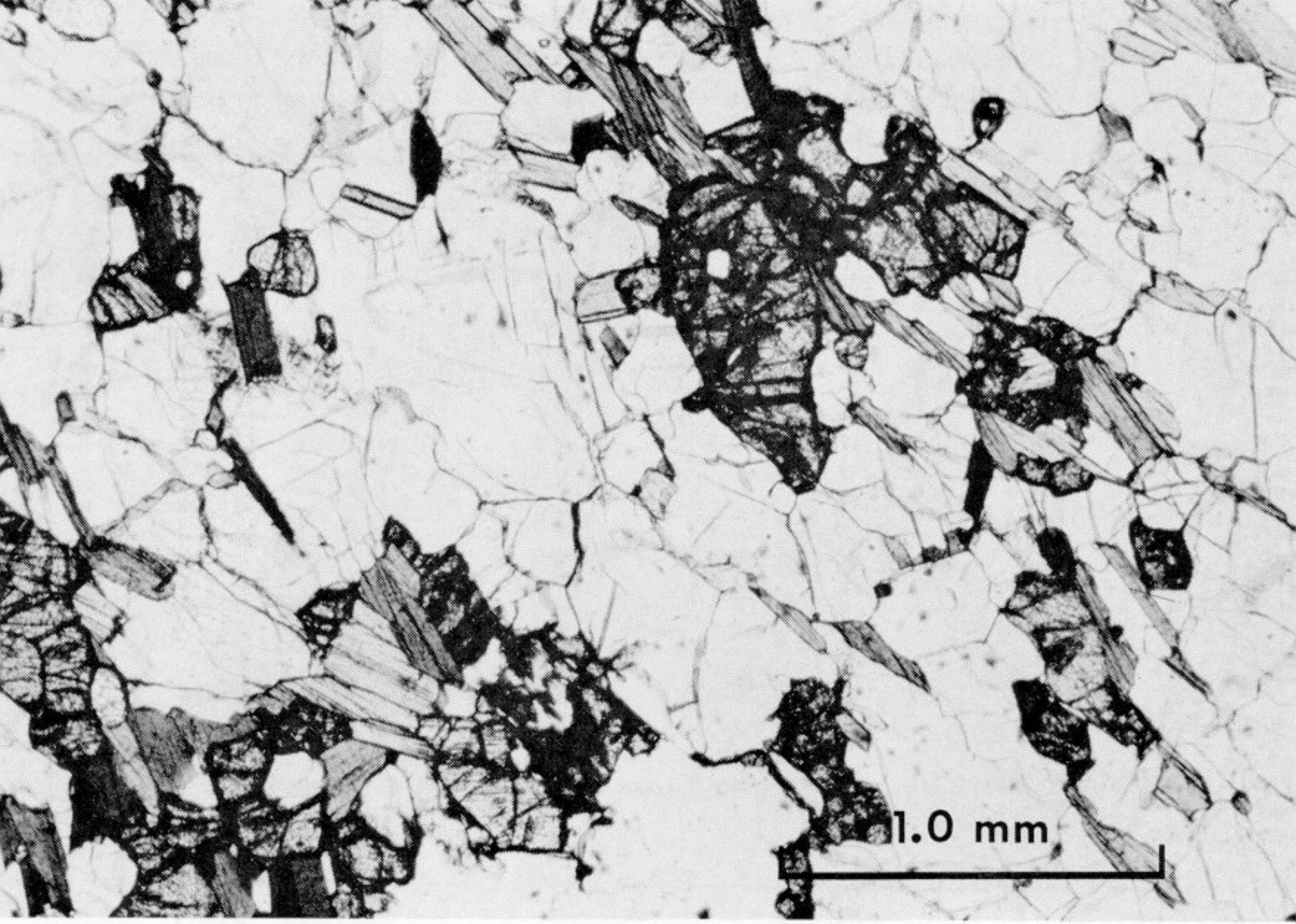

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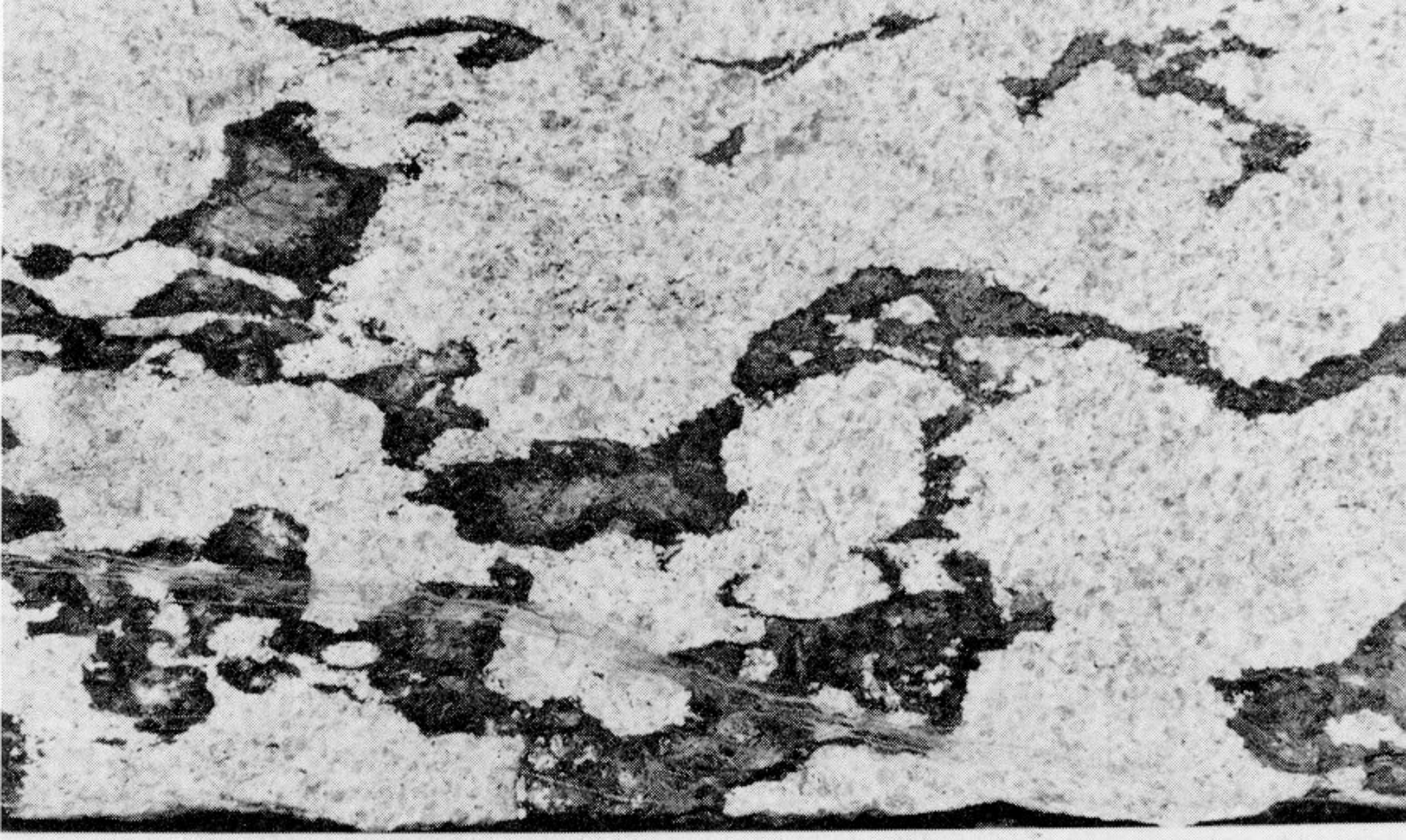



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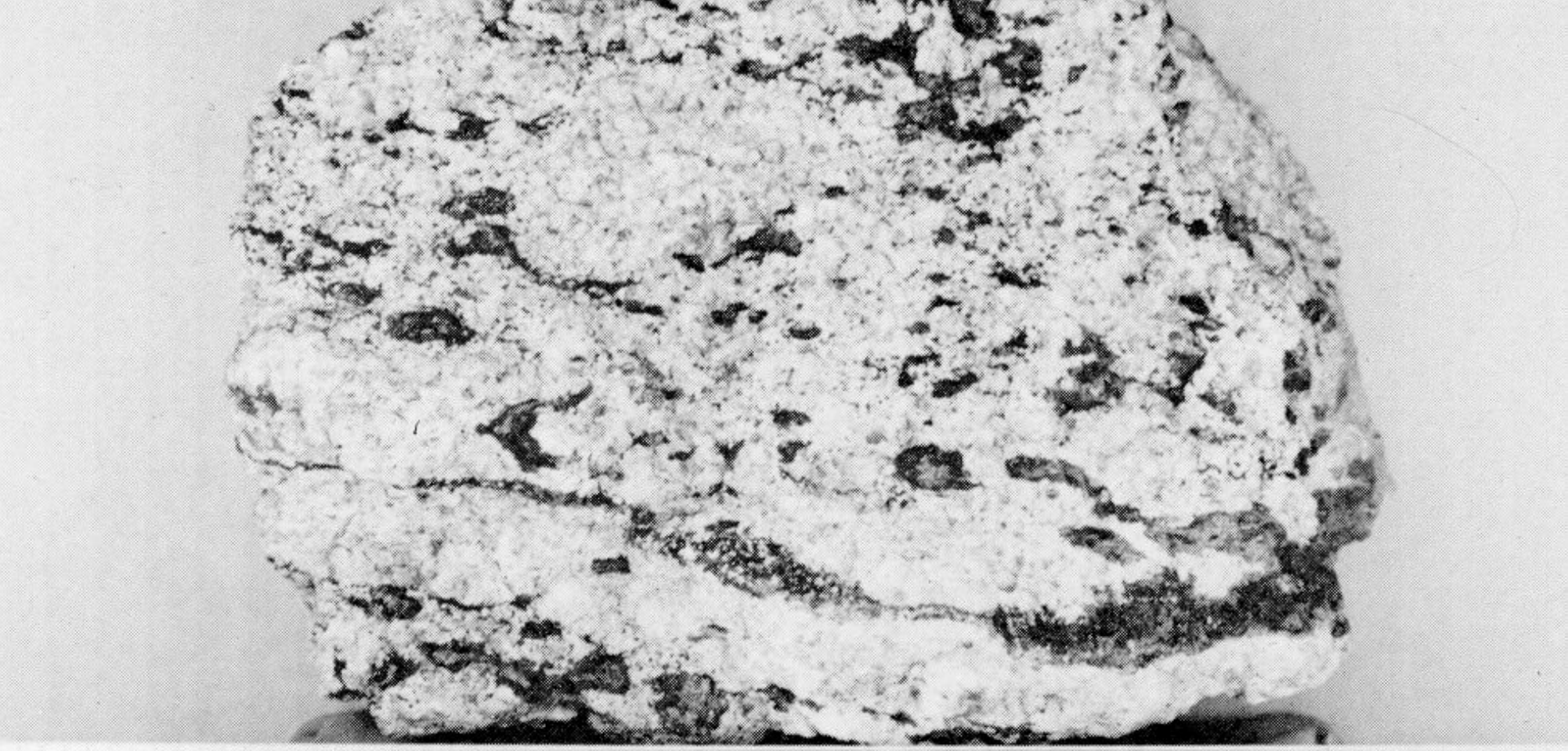

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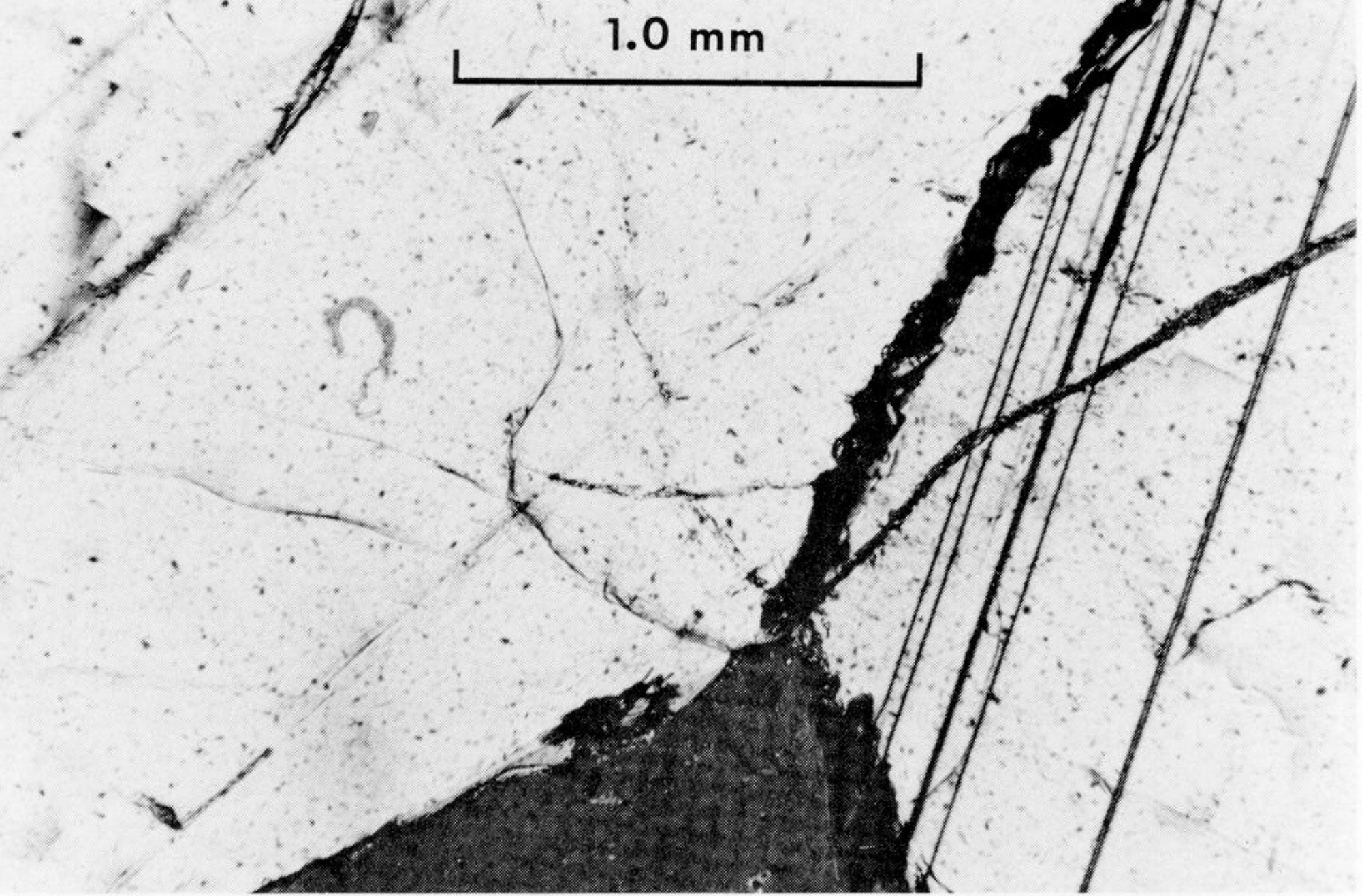


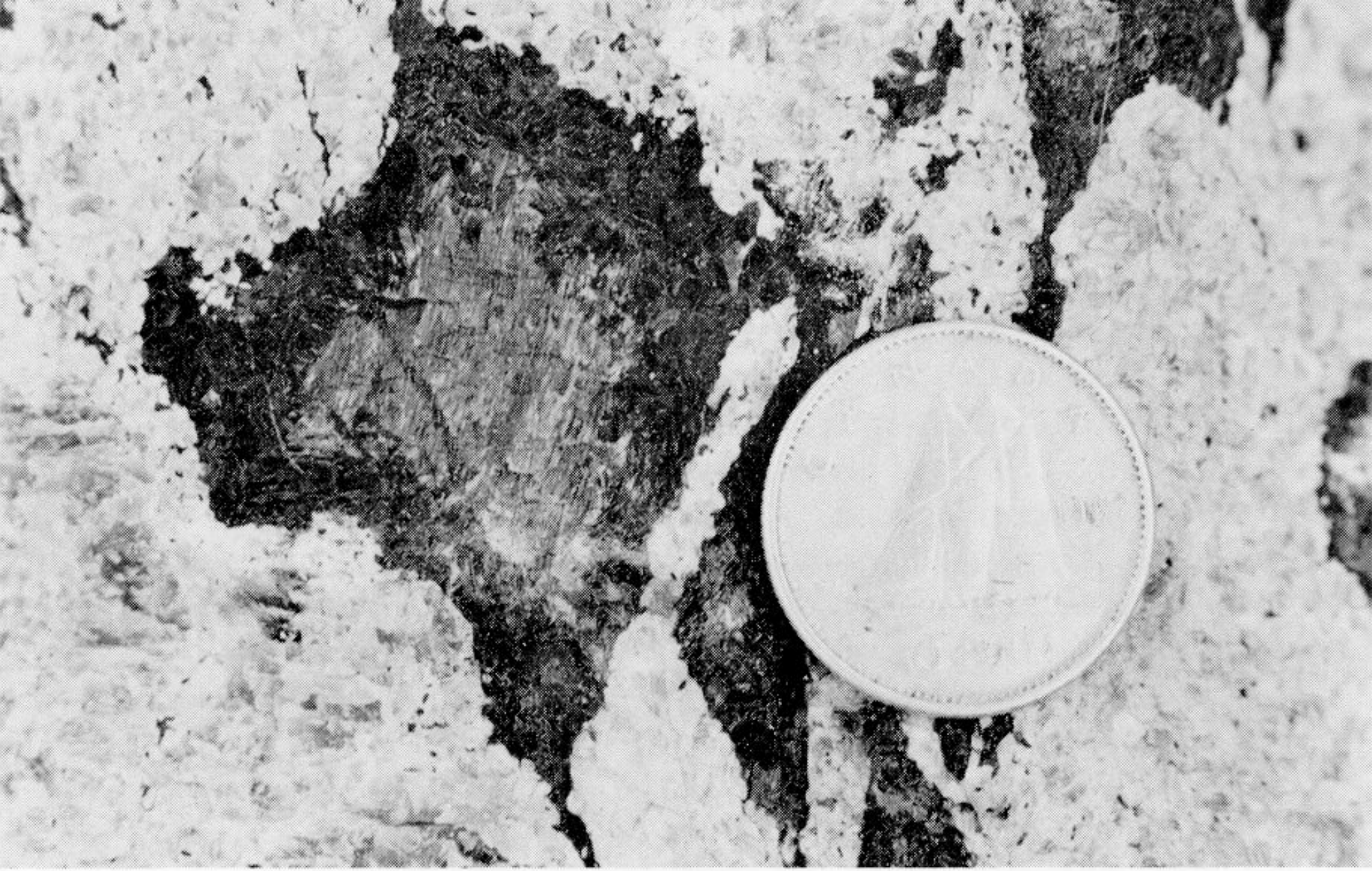

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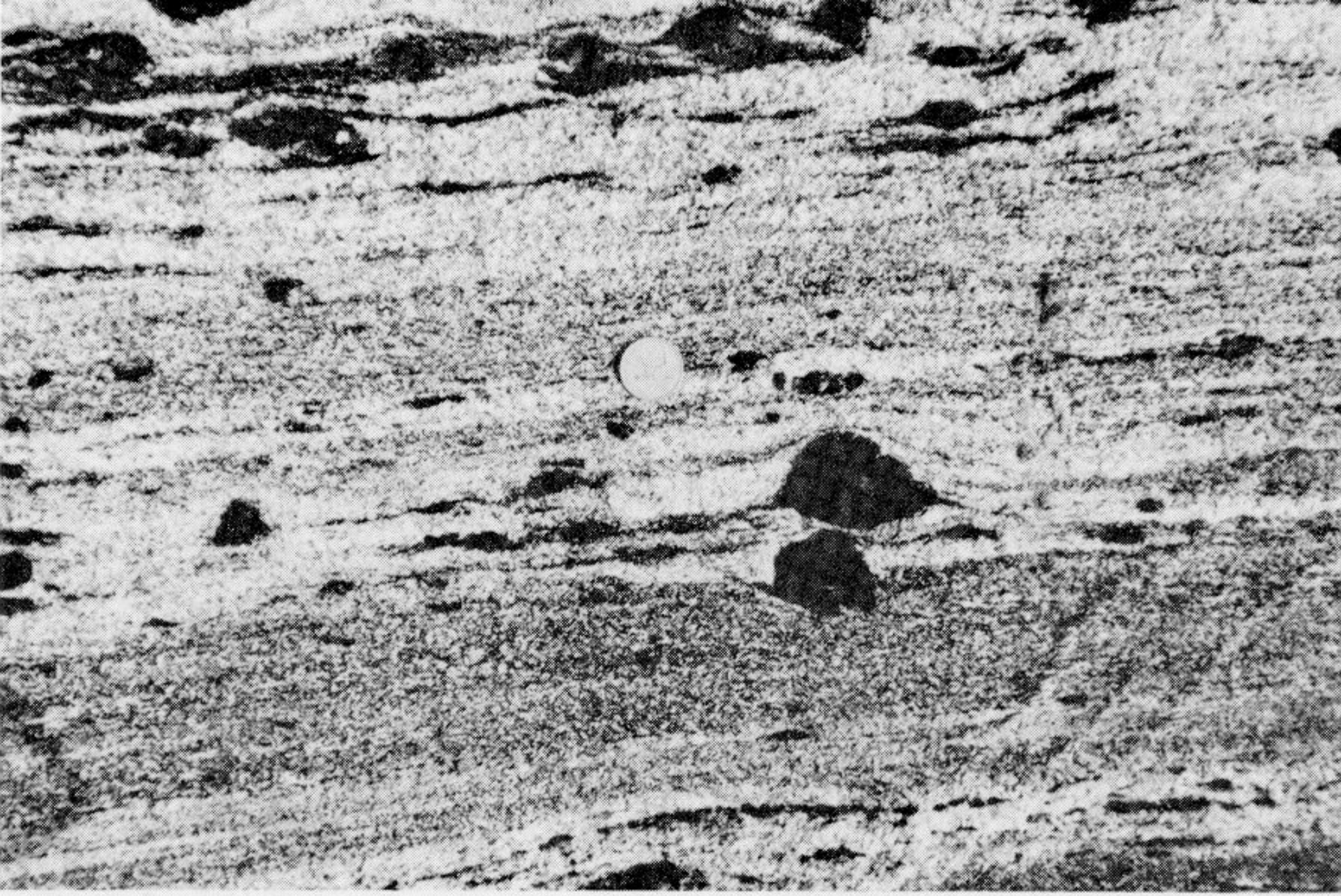





1.0 mm









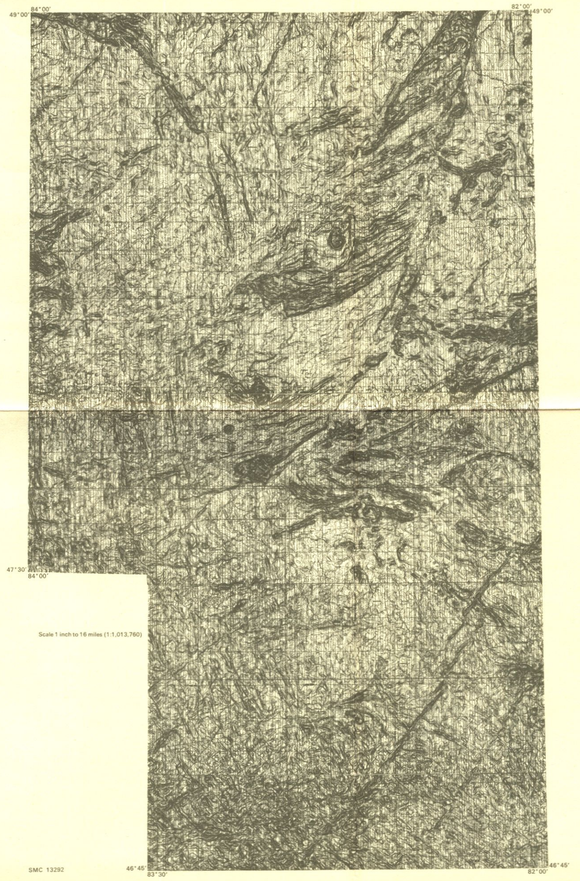


Figure 3. Aeromagnetic map of the Chapleau Area (from ODM — GSC maps P.578 and P.800; 1970, 1972).



Figure 6. Aeromagnetic map showing Bouguer gravity contours (values in milligals). Gravity contours from Earth Physics Branch Gravity Map 21 (1970).

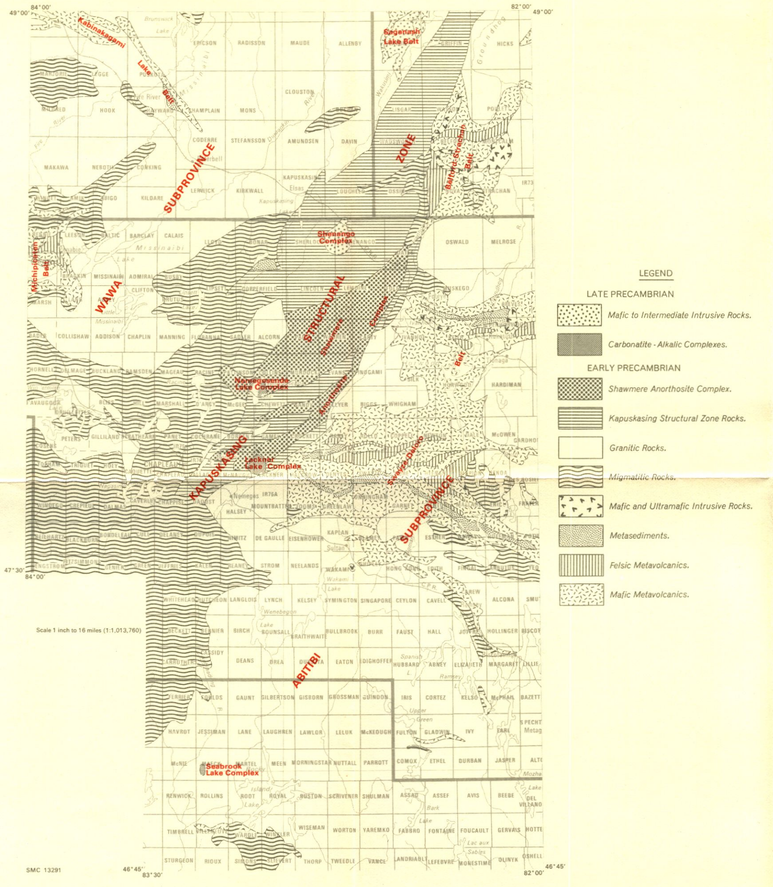


Figure 2. Generalized geology of the Chapleau Area.

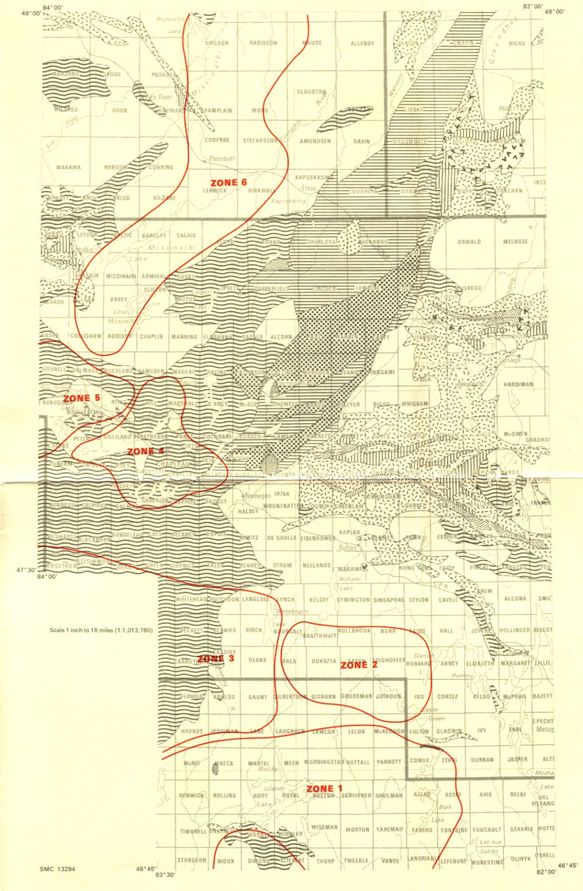


Figure 5. Regional variation of granitic rocks including the leucosome of migmatitic rocks.

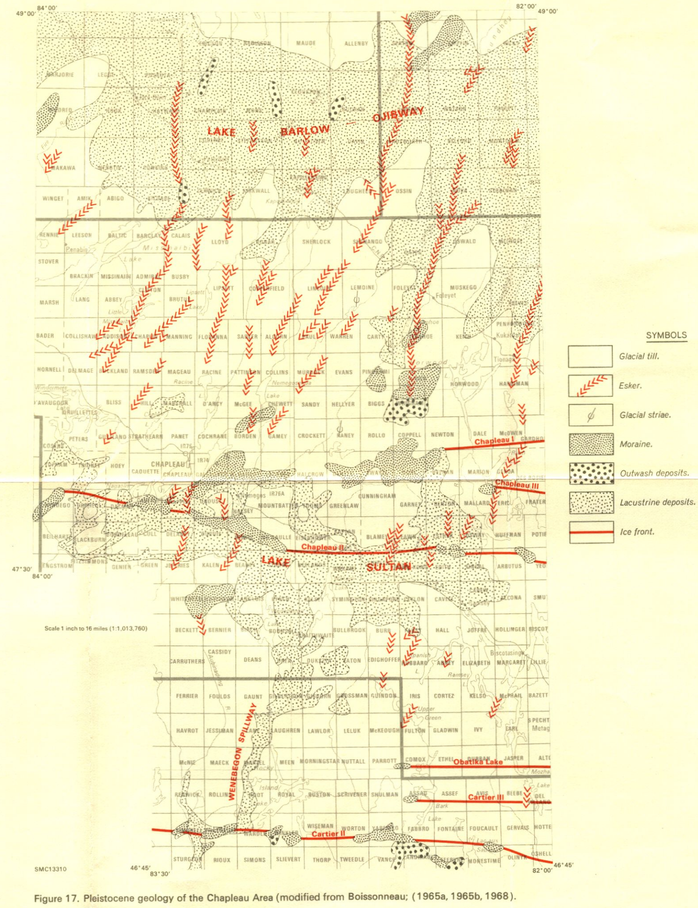
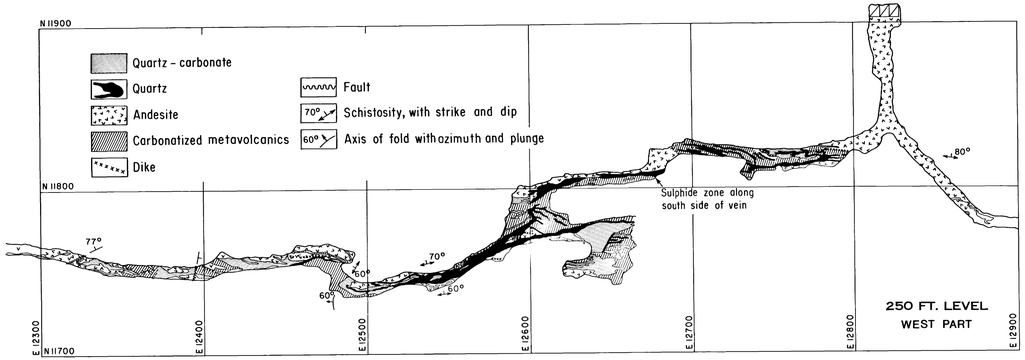


Figure 17. Pleistocene geology of the Chapleau Area (modified from Boissonneau; (1965a, 1965b, 1968).



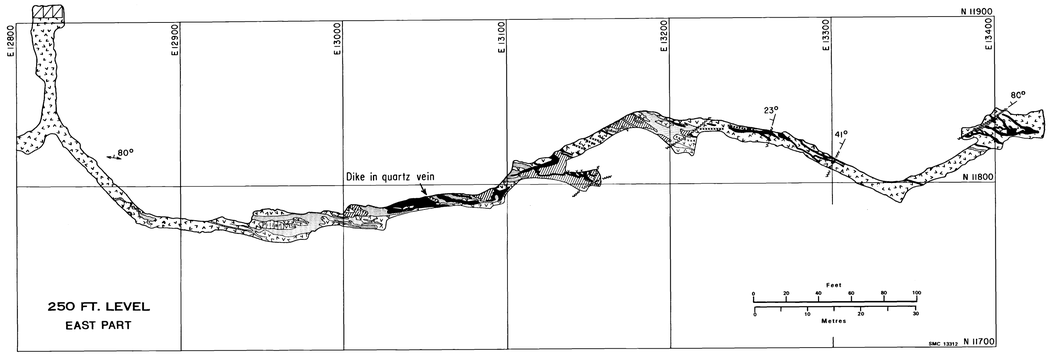


Figure 19. Joburke Gold Mines Ltd. Geological plan of the 250 foot level; modified from a company plan by Prest, 1950.

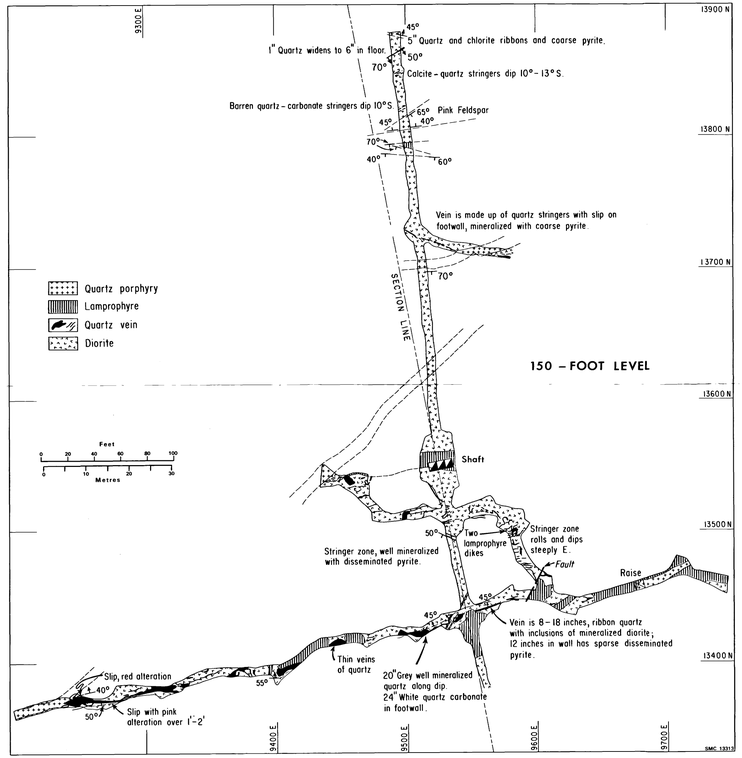


Figure 20. Orofino Mines Ltd. Geological plan of the 150 foot level; modified from a geological plan by Nelson Hogg, 1950b.

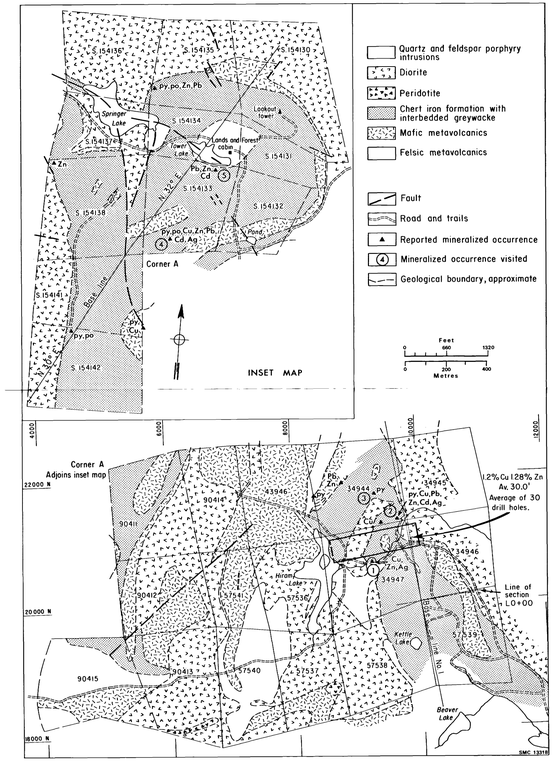


Figure 25. Consolidated Shunsby Mines Ltd. Geological plan of Main Showing and Tower Group; modified from a company plan by C. W. Archibald, R. Mudford and W. Heshka, 1970.

Map 2221
Chapleau-Foleyet
Geological Compilation Series

PRODUCING MINES

1 Canadian Johns-Manville Co. Ltd.—Reeves mine (0b 9b).....asb
2 Noranda Exploration Co. Ltd./New Joburke Explorations Ltd.
New Joburke mine (0b 9d).....Au

PAST PRODUCING MINES

3 Halcrow-Swayze mine (0a 10a).....Au, Ag
4 Jerome mine (0b 10b).....Au, Ag
5 Renable mine (Na 9c).....Au, Ag
6 Smith-Thorne mine/Tionaga mine (0b 10a).....Au, Ag

THE MAP INDEX

The red letters and numbers in the borders provide a location reference system based on that of Map 2310, Ontario Mineral Map, 1974.

MINERAL PRODUCTION AND RESOURCES

The area contains deposits of antimony, apatite, asbestos, barite, copper, gold, iron, lead, molybdenum, niobium and other rare earths, talc, thorium, uranium, and zinc. Production at the end of 1970 was solely of asbestos, but by 1973 gold was being produced at the New Joburke Explorations Ltd. property by Noranda Exploration Co. Ltd.

Early exploration included work on the Woman River iron formation in 1910. By the 1960's Stackpool Mining Company Limited indicated reserves of 5,100,000 tons of iron ore grading 40% iron and Kukatush Mining Corporation (Ontario) Limited indicated reserves of 158,000,000 tons of 27.6% acid soluble iron in the Radio Hill iron formation in Penhorwood Township.

The Renable mine in Leeson Township produced 776,191 oz. Au, 245,146 oz. Ag over the period 1947 to July, 1970. Reserves as of 1970 were 157,704 tons grading 0.211 oz./ton Au. The Jerome mine of Jerome Gold Mines Limited in Osway Township produced 56,978 oz. Au and 15,104 oz. Ag between 1941 and 1943. In 1968 when production started at the Canadian Johns-Manville Company Limited, Reeves mine ore reserves were established at 20,000,000 tons with an asbestos fibre content of 3 to 3.5%.

Dominion Gulf Company holds claims covering the Nemegosenda Lake carbonatite-alkalic complex, which contains a mineralized zone of 20,000,000 tons grading 0.47% Nb_2O_5. By-product production of U, Th, rare earths, zirconium, apatite and magnetite would be possible upon development.

Multi-Minerals Limited holds ground on the Lackner Lake carbonatite-alkalic complex, which has three mineralized zones grading as follows: zones No. 3 and 4 -37,200,000 tons of 0.198% Nb_2O_5, 41.3% apatite and 13.77% magnetite; zone 6 - 5,024,250 tons grading 69.6% magnetite, 21.9% apatite and 0.173% Nb_2O_5; and zone 8 - 80,000,000 tons grading 0.25% Nb_2O_5.

Several base metal occurrences are known. The Consolidated Shunsby Mines Limited deposit in Cunningham Township comprises a mineralized zone of 310,095 tons grading 1.2% Cu, and 1.3% Zn.

HOW TO OBTAIN ADDITIONAL INFORMATION

Published geological maps used as reference material during the preparation of this map are indicated on Index Maps 2079, 2080 and 2081 of the Division of Mines, Ministry of Natural Resources, Toronto and on Index Sheets 41 and 42. Geological Survey of Canada, Department of Energy, Mines and Resources, Ottawa.

Four uncoloured preliminary geological maps at scale of one inch to two miles were produced following Operation Chapleau, a helicopter supported reconnaissance mapping project covering the map sheet. These are: P.672 Missinaibi Lake Sheet, P.673 Horwood Lake Sheet, P.674 Chapleau Sheet and P.765 Opeepeesway-Rocky Island Lakes Sheet.

Published geological reports covering this sheet are listed in Bulletin 28 and Supplements, Division of Mines, Ministry of Natural Resources and in the Index of Publications, Geological Survey of Canada.

Aeromagnetic maps covering this sheet may be obtained from the Director, Geological Survey of Canada, Ottawa, or Mines Publications Office, Ministry of Natural Resources, Parliament Buildings, Toronto M7A 1W3.

Topographic maps of the area are available at a scale of one inch to two miles, 1:250,000 and 1:50,000 from the Lands Publications Office, Ministry of Natural Resources and the Topographic Survey, Department of Energy, Mines and Resources, Ottawa.

Air photographs at a scale of one inch to one quarter mile are available from: Photo Library, Administrative Services Branch, Ministry of Natural Resources, Toronto. Air photographs at a scale of one inch to one mile are available from National Air Photographic Library, Department of Energy, Mines and Resources, Ottawa.

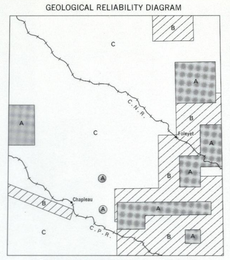
The name and ownership of many mineral occurrences shown on this sheet are given on Map 2310, Ontario Mineral Map, 1974.

Information on geology and mineral occurrences may be obtained at the offices of the Regional Geologists at Timmins and Sault Ste. Marie and at the office of the Resident Geologist in Sudbury.

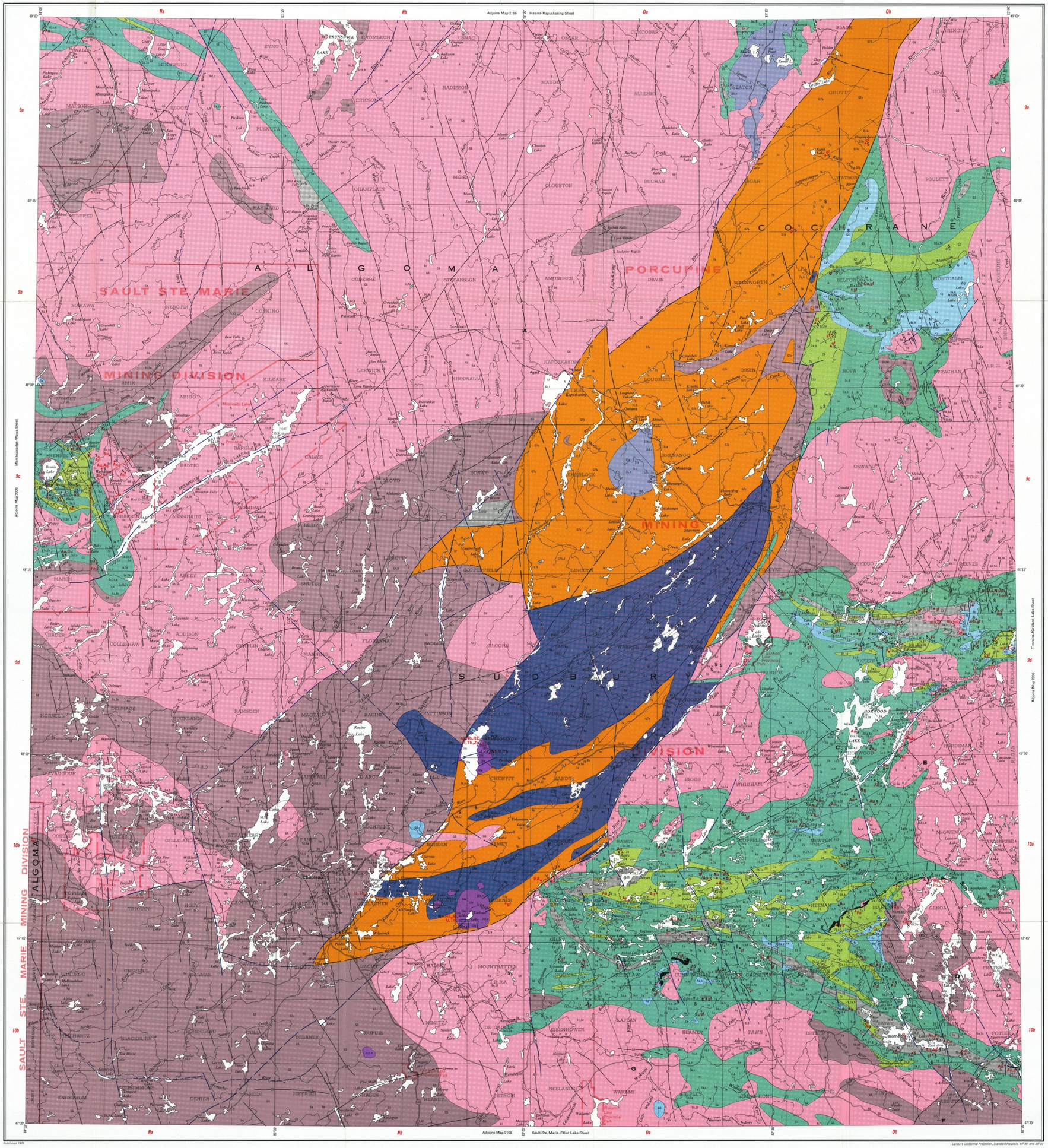
Mining claim maps and general information on properties may be obtained at the offices of the Mining Recorders at Timmins, Sault Ste. Marie and Sudbury or at the Ministry of Natural Resources, Toronto.

Up-to-date information on current developments may be obtained from the annual review of the Division of Mines and the Annual Report of Regional and Resident Geologists at Timmins, Sault Ste. Marie and Sudbury, published annually.

GEOLOGICAL RELIABILITY DIAGRAM

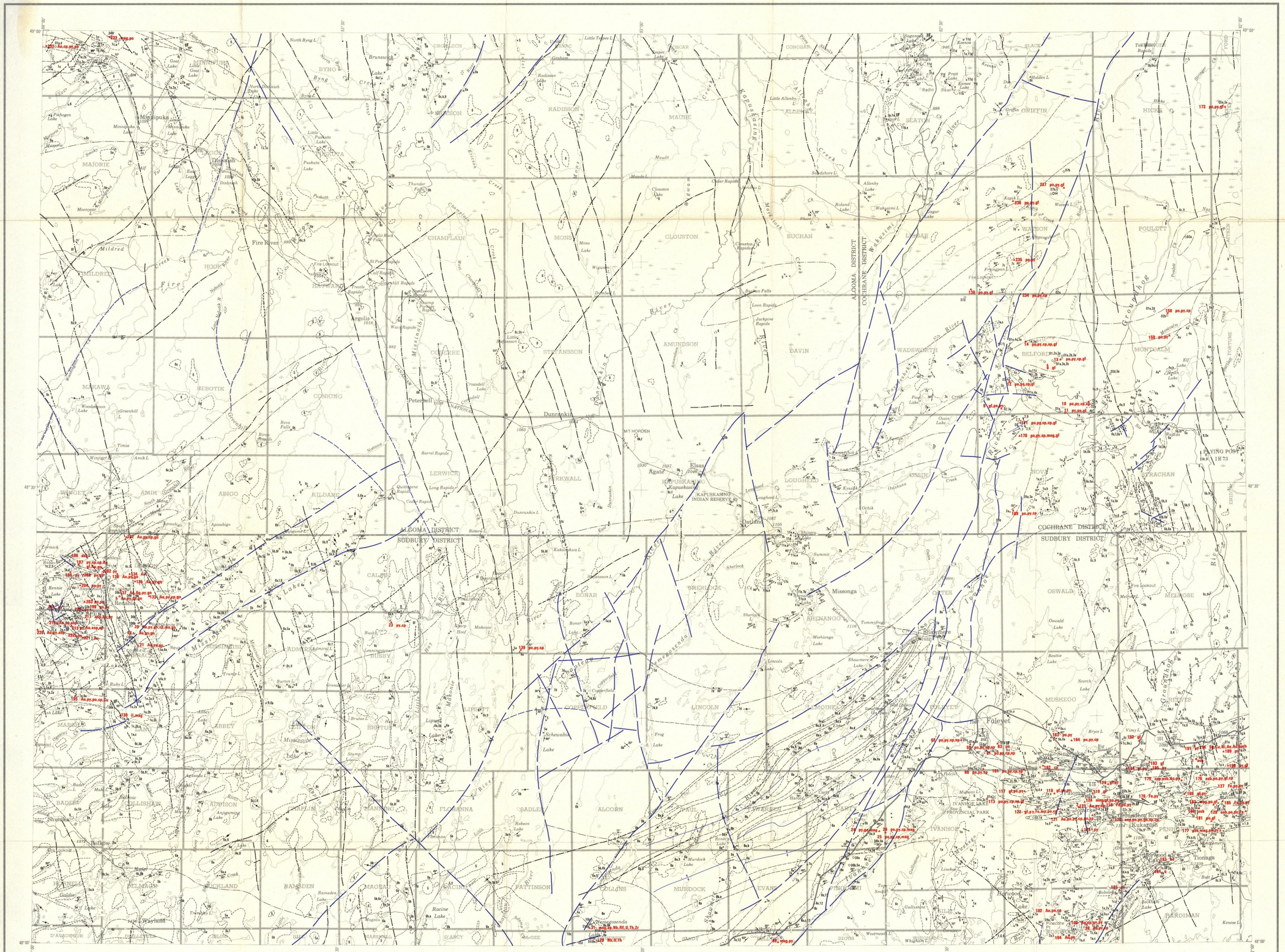


A Detailed mapping; scales greater than 1" to ¼ mile.
B Semi-detailed mapping; scales less than 1" to 1 mile.
C Mostly unmapped, but some airborne reconnaissance.


Adjoins Map 2166 Hearst-Kapuskasing Sheet
Adjoins Map 2079 Manitouwadge-Wawa Sheet
Adjoins Map 2080 Timmins-Kirkland Lake Sheet
Adjoins Map 2081 Sault Ste. Marie-Elliot Lake Sheet
ALGOMA MINING DIVISION
PORCUPINE MINING DIVISION
SUDBURY MINING DIVISION
SAULT STE. MARIE MINING DIVISION
COCHRANE
SAULT STE. MARIE
Chapleau
Foleyet
Missinaibi Lake
Lackner Lake
Nemegosenda Lake
Dominion Gulf Co. Ltd. Nb,Ta,Zr
Dominion Gulf Co. Ltd. Nb,Ta,Zr
Dominion Gulf Co. Ltd. Nb,Ta,Zr

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

Map 2351
Foleyet



Map 2351

FOLEYET

ALGOMA, COCHRANE, SUDBURY DISTRICTS

Scale 1:250,000

Metres 5000 0 5 10 15 20 25 30 35 Kilometres

Chains 400 200 0 5 10 15 Miles

LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Till, clay, sand, gravel.

UNCONFORMITY

MESOZOIC

LATE JURASSIC TO EARLY CRETACEOUS[a]

12 *Lamprophyre dikes.*

INTRUSIVE CONTACT

PRECAMBRIAN

LATE PRECAMBRIAN

MAFIC TO INTERMEDIATE INTRUSIVE ROCKS[b]

11 — *11a Hornblende syenite.*
11b Syenodiorite and diorite.
11c Hornblende monzonite.
11d Porphyritic hornblende diorite, quartz diorite, and gabbro (plagioclase porphyry).
11e Mafic hornfels.

CARBONATITE-ALKALIC COMPLEXES[b]

10 — *10a Alkalic syenite, pulaskite.*
10b Brecciated alkalic syenite and related rock types.
10c Fenitized rocks.
10d Massive mafic nepheline syenite (malignite).
10e Massive to foliated nepheline syenite and related rocks.
10f Sövite (calcite-rich carbonatite).
10g Magnetite-apatite rock.†
10h Urtite, ijolite, melteigite (nepheline-pyroxene rocks).†

INTRUSIVE CONTACT

EARLY TO MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

9 *Diabase dikes.*

INTRUSIVE CONTACT

EARLY PRECAMBRIAN

SHAWMERE ANORTHOSITE COMPLEX

8 — *8a Anorthosite to gabbroic anorthosite.*
8b Anorthosite gabbro.
8c Gabbro.
8d Brecciated anorthositic to gabbroic rocks.
8e Gneissic to flaser-textured tonalite and monzonite.

INTRUSIVE CONTACT

KAPUSKASING STRUCTURAL ZONE ROCKS

7 — *7a Meta-igneous rocks (metamorphosed mafic to intermediate intrusive rocks).*
7b Melanocratic granulite (pyroxene-quartz-hornblende-plagioclase granulite).
7c Pelitic and psammitic granulites (pyroxene-garnet-quartz-feldspar granulite).
7d Metasedimentary gneiss, including intercalations of metavolcanic gneiss (metamorphosed to upper amphibolite facies).
7e Arkosic metasediments.

FAULT CONTACT

FELSIC IGNEOUS AND METAMORPHIC ROCKS[e]

Felsic Intrusive and Hybrid Rocks[c]

6 — *6 Unsubdivided.[d]*
6a Massive to weakly foliated, biotite and hornblende trondhjemite, granodiorite, and minor quartz diorite.
6b Gneissic, biotite and hornblende trondhjemite, granodiorite, and minor quartz diorite.
6c Massive to weakly foliated biotite and hornblende-biotite quartz monzonite.
6d Gneissic biotite and hornblende quartz-monzonite.†
6e Syenitic rocks.
6f Pegmatite, aplite.
6g Augen gneiss.
6h Hornblende granodiorite to diorite (in part hybrid rocks).
6j Porphyritic granitic rocks.

INTRUSIVE OR GRADATIONAL CONTACT

Migmatitic Rocks[c]

5 — *5 Unsubdivided.[d]*
5a Migmatite with metavolcanic paleosome[g] of quartz-feldspar-hornblende gneiss; veined with more than 25% granitic material (neosome[f]).
5b Migmatite with metasedimentary paleosome[g] of biotite-quartz-feldspar gneiss; veined with more than 25% granitic material (neosome[f]).

INTRUSIVE CONTACT

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS

4 — *4 Unsubdivided[d].*
4a Diorite and gabbro.
4b Ultramafic rocks and their serpentinized equivalents, minor gabbro.

INTRUSIVE CONTACT

METASEDIMENTS[g]

3 — *3 Unsubdivided[d].*
3a Greywacke, arkose, quartzite.
3b Conglomerate.
3c Argillaceous, fine-grained metasediments.
3d Biotite-quartz-feldspar schist and gneiss.†
3e Migmatized metasediments (10-25% granitic material).†

METAVOLCANICS[g]

Felsic to Intermediate Metavolcanics

2 — *2 Unsubdivided[d].*
2a Rhyolite to dacite flows and fragmental rocks.
2b Tuff, banded tuff; and lapilli-tuff.
2c Agglomerate, breccia.
2d Porphyritic flows, quartz-feldspar porphyry.

Mafic to Intermediate Metavolcanics

1 — *1 Unsubdivided[d].*
1a Basalt to andesite flows and porphyritic flows, massive to foliated.
1b Basalt to andesite pillow lava.
1c Mafic pyroclastic rocks.
1d Layered amphibolite.
1e Diorite, gabbro (coarse-grained flows or intrusions).
1g Migmatized mafic metavolcanics (10-25% granitic material).

IF *Iron formation (associated with 1, 2 and 3 map units).*

Ag Silver.
ap Apatite.
As Arsenic.
asb Asbestos.
asp Arsenopyrite.
Au Gold.
ba Barite.
berh Berthierite.
Bi Bismuth.†
bn Bornite.†
cc Chalcocite.†
cp Chalcopyrite.
Cu Copper.
Fe Iron.
gf Graphite.
gn Galena.
hem Hematite.†
il Ilmenite.
mag Magnetite.
mo Molybdenite.
Nb Niobium.
Ni Nickel.
po Pyrrhotite.
py Pyrite.
q Quartz.
RA Radioactive minerals.†
RE Rare Earths.
Sb Antimony.
sp Sphalerite.
Th Thorium.
U Uranium.
Zn Zinc.†
Zr Zirconium.

[a] Based on correlation with radiometrically dated lamprophyres at Coral Rapids on the Abitibi River.

[b] Relative ages unknown, radiometric ages equivalent; these rock map units appear to be spatially associated with the Kapuskasing Structural Zone.

[c] Units 5 and 6 distinguished in part on the basis of aeromagnetic data; therefore, outcrops of unit 5 will occur in areas of unit 6 and vice versa.

[d] Rock identification based on airborne observation.

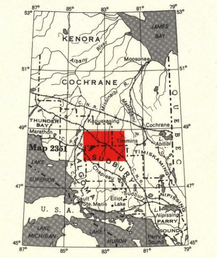
[e] Melanocratic portions of migmatite, consisting of fragments and inclusions of country rock.

[f] Leucocratic portion of migmatite.

[g] Age relationships between units 1, 2 and 3 unknown.

The letter "D" preceding a rock unit number, for example "D5", indicates identification from diamond drill core.

†Occurs only on companion sheet.



Scale, 1 inch to 200 miles

SYMBOLS

- Small bedrock outcrop.
- Area of bedrock outcrop.
- Bedding, top unknown; (inclined, vertical).
- Bedding, top indicated by arrow; (inclined, vertical, overturned).
- Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).
- Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).
- Lava flow; top (arrow) from pillows shape and packing.
- Gneissosity; (horizontal, inclined, vertical).
- Foliation; (horizontal, inclined, vertical).
- Mineral layering; (horizontal, inclined, vertical).
- Lineation with plunge.
- Geological boundary, position interpreted.
- Geological boundary, deduced from geophysics.
- Fault; (observed, assumed).
- Lineament.
- Jointing; (horizontal, inclined, vertical).
- Drag folds with plunge.
- Anticline, syncline.
- DH Drill hole.
- Producer.
- Past-producer.
- Mineral occurrence.

For other conventional signs refer to 1:250,000 National Topographic System.

PRODUCERS

1. Canadian Johns-Manville Co. Ltd.—Reeves mine.
2. Noranda Exploration Co. Ltd./New Joburke Explorations Ltd.—New Joburke mine.

PAST PRODUCERS

3. Halcrow-Swayze mine.†
4. Jerome mine.†
5. Renable mine.
6. Smith-Thorne mine/Tionaga mine.†

For occurrences numbered 7 to 239 see report.

†Occurs only on companion sheet.

SOURCES OF INFORMATION

Geology by P. C. Thurston, G. M. Siragusa, R. P. Sage and assistants. Geological Branch, 1970. Geology is not tied to surveyed lines.

Published and unpublished maps of the Ontario Division of Mines, Geological Survey of Canada, and mining companies.

Aeromagnetic map 7086G, Geological Survey of Canada.

Preliminary maps (ODM) P672, Missinaibi Lake Sheet, P673 Horwood Lake Sheet, scale 1 inch to 2 miles, issued 1971.

Cartography by P. A. Wisbey and assistants, Surveys and Mapping Branch, 1975.

Map base from Map 42B of the National Topographic System.

Adjoins Map 2351

Map 2352
Chapleau

LEGEND

PHANEROZOIC

CENOZOIC

QUATERNARY

PLEISTOCENE AND RECENT

Till, clay, sand, gravel.

UNCONFORMITY

MESOZOIC

LATE JURASSIC TO EARLY CRETACEOUS[a]

12 *Lamprophyre dikes.*

INTRUSIVE CONTACT

PRECAMBRIAN

LATE PRECAMBRIAN

MAFIC TO INTERMEDIATE INTRUSIVE ROCKS[b]

11 *11a Hornblende syenite.*
11b Syenodiorite and diorite.
11c Hornblende monzonite.
11d Porphyritic hornblende diorite, quartz diorite, and gabbro (plagioclase porphyry).
11e Mafic hornfels.

CARBONATITE-ALKALIC COMPLEXES[b]

10 *10a Alkalic syenite, pulaskite.*
10b Brecciated alkalic syenite and related rock types.
10c Fenitized rocks.
10d Massive mafic nepheline syenite (malignite).
10e Massive to foliated nepheline syenite and related rocks.
10f Silvite (sylvite-rich carbonatite).
10g Magnetite-apatite rock.
10h Urtite, jolite, melteigite (nepheline-pyroxene rocks).

INTRUSIVE CONTACT

EARLY TO MIDDLE PRECAMBRIAN

MAFIC INTRUSIVE ROCKS

9 *Diabase dikes.*

INTRUSIVE CONTACT

EARLY PRECAMBRIAN

SHAWMERE ANORTHOSITE COMPLEX

8 *8a Anorthosite to gabbroic anorthosite.*
8b Anorthosite gabbro.
8c Gabbro.[f]
8d Brecciated anorthositic to gabbroic rocks.
8e Gneissic to flaser-textured tonalite and monzonite.

INTRUSIVE CONTACT

KAPUSKASING STRUCTURAL ZONE ROCKS

7 *7a Meta-igneous rocks (metamorphosed mafic to intermediate intrusive rocks).[f]*
7b Melanocratic granulite (pyroxene-quartz-hornblende-plagioclase granulite).
7c Pelitic and psammitic granulites (pyroxene-garnet-quartz-feldspar granulite).
7d Metasedimentary gneiss, including intercalations of metavolcanic gneiss (metamorphosed to upper amphibolite facies).
7e Arkosic metasediments.

FAULT CONTACT

FELSIC IGNEOUS AND METAMORPHIC ROCKS[c]

Felsic Intrusive and Hybrid Rocks[c]

6 *6 Unsubdivided.[d]*
6a Massive to weakly foliated, biotite and hornblende trondhjemite, granodiorite, and minor quartz diorite.
6b Gneissic, biotite and hornblende trondhjemite, granodiorite, and minor quartz diorite.
6c Massive to weakly foliated biotite and hornblende-biotite quartz monzonite.
6d Gneissic biotite and hornblende quartz-monzonite.[f]
6e Syenitic rocks.
6f Pegmatite, aplite.
6g Augen gneiss.
6h Hornblende granodiorite to diorite (in part hybrid rocks).
6j Porphyritic granitic rocks.

INTRUSIVE OR GRADATIONAL CONTACT

Migmatitic Rocks[c]

5 *5 Unsubdivided.[d]*
5a Migmatite with metavolcanic paleosome[e] of quartz-feldspar-hornblende gneiss; veined with more than 25% granitic material (neosome[f]).
5b Migmatite with metasedimentary paleosome[e] of biotite-quartz-feldspar gneiss; veined with more than 25% granitic material (neosome[f]).

INTRUSIVE CONTACT

MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS

4 *4 Unsubdivided.[d]*
4a Diorite and gabbro.
4b Ultramafic rocks and their serpentinized equivalents, minor gabbro.

INTRUSIVE CONTACT

METASEDIMENTS[g]

3 *3 Unsubdivided.[d]*
3a Greywacke, arkose, quartzite.
3b Conglomerate.
3c Argillaceous, fine-grained metasediments.
3d Biotite-quartz-feldspar schist and gneiss.
3e Migmatized metasediments (10-25% granitic material).

METAVOLCANICS[g]

Felsic to Intermediate Metavolcanics

2 *2 Unsubdivided.[d]*
2a Rhyolite to dacite flows and fragmental rocks.
2b Tuff, banded tuff, and lapilli-tuff.
2c Agglomerate, breccia.
2d Porphyritic flows, quartz-feldspar porphyry.

Mafic to Intermediate Metavolcanics

1 *1 Unsubdivided.[d]*
1a Basalt to andesite flows and porphyritic flows, massive to foliated.
1b Basalt to andesite pillow lava.
1c Mafic pyroclastic rocks.
1d Layered amphibolite.
1e Diorite, gabbro (coarse-grained flows or intrusions).
1g Migmatized mafic metavolcanics (10-25% granitic material).

IF *Iron formation (associated with 1, 2 and 3 map units).*

Ag	Silver.
ap	Apatite.
As	Arsenic.[f]
asb	Asbestos.[f]
asp	Arsenopyrite.
Au	Gold.
ba	Barite.[f]
berh	Berthierite.[f]
Bi	Bismuth.
bn	Bornite.
cc	Chalcocite.
cp	Chalcopyrite.
Cu	Copper.
Fe	Iron.
gf	Graphite.
gn	Galena.
hem	Hematite.
il	Ilmenite.[f]
mag	Magnetite.
mo	Molybdenite.
Nb	Niobium.
Ni	Nickel.
po	Pyrrhotite.
py	Pyrite.
q	Quartz.[f]
RA	Radioactive minerals.
RE	Rare Earths.
Sb	Antimony.[f]
sp	Sphalerite.
Th	Thorium.
U	Uranium.
Zn	Zinc.
Zr	Zircorlium.[f]

[a] *Based on correlation with radiometrically dated lamprophyres at Coral Rapids on the Abitibi River.*

[b] *Relative ages unknown, radiometric ages equivalent; these rock map units appear to be spatially associated with the Kapuskasing Structural Zone.*

[c] *Units 5 and 6 distinguished in part on the basis of aeromagnetic data; therefore, outcrops of unit 5 will occur in areas of unit 6 and vice versa.*

[d] *Rock identification based on airborne observation.*

[e] *Melanocratic portions of migmatite, consisting of fragments and inclusions of country rock.*

[f] *Leucocratic portion of migmatite.*

[g] *Age relationships between units 1, 2 and 3 unknown.*

The letter "D" preceding a rock unit number, for example "D1", indicates identification from diamond drill core.

†Occurs only on companion sheet.

SYMBOLS

- *Small bedrock outcrop.*
- *Area of bedrock outcrop.*
- *Bedding, top unknown; (inclined, vertical).*
- *Bedding, top indicated by arrow; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from grain gradation; (inclined, vertical, overturned).*
- *Bedding, top (arrow) from cross bedding; (inclined, vertical, overturned).*
- *Lava flow; top (arrow) from pillows shape and packing.*
- *Gneissosity; (horizontal, inclined, vertical).*
- *Foliation: (horizontal, inclined, vertical).*
- *Mineral layering; (horizontal, inclined, vertical).*
- *Lineation with plunge.*
- *Geological boundary, position interpreted.*
- *Geological boundary, deduced from geophysics.*
- *Fault; (observed, assumed).*
- *Lineament.*
- *Jointing; (horizontal, inclined, vertical).*
- *Drag folds with plunge.*
- *Anticline, syncline.*
- *Drill hole.*
- *Producer.*
- *Past-producer.*
- *Mineral occurrence.*

For other conventional signs refer to 1:250,000 National Topographic System.

PRODUCERS

1. *Canadian Johns-Manville Co. Ltd.—Reeves mine.†*
2. *Noranda Exploration Co. Ltd./New Joburke Explorations Ltd.—New Joburke mine.†*

PAST PRODUCERS

3. *Halcrow-Swayze mine.*
4. *Jerome mine.†*
5. *Renable mine.†*
6. *Smith-Thorne mine/Tionaga mine.*

For occurrences numbered 7 to 239 see report.

†Occurs only on companion sheet.

SOURCES OF INFORMATION

Geology by P. C. Thurston, G. M. Siragusa, R. P. Sage and assistants, Geological Branch, 1970. Geology is not tied to surveyed lines.

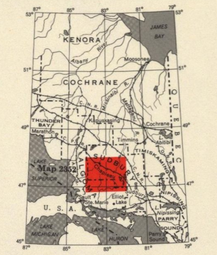
Published and unpublished maps of the Ontario Division of Mines, Geological Survey of Canada, and mining companies.

Aeromagnetic maps 7068G, 7077G, Geological Survey of Canada.

Preliminary maps (ODM) P672, Missinaibi Lake Sheet, P673 Horwood Lake Sheet, P674 Chapleau Sheet, P675 Opeepeesway-Rocky Island Lake Sheet, scale 1 inch to 2 miles, issued 1971.

Cartography by P. A. Wisbey and assistants. Surveys and Mapping Branch, 1975.

Map base from Maps 41J and 41O of the National Topographic System.



Scale, 1 inch to 200 miles

Scale 1:250,000

Metres 5000 0 5 10 15 20 25 30 35 Kilometres

Chains 400 200 0 5 10 15 Miles

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ONTARIO
DIVISION OF MINES

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Map 2352

CHAPLEAU

ALGOMA, SUDBURY DISTRICTS