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Geology of the Burchell Lake Area

District of Thunder Bay

By
P. E. GIBLIN

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ABSTRACT

This report describes the geology, structure, and mineral deposits of the Burchell Lake area, District of Thunder Bay. Ames township, the eastern quarter of Moss township, and unsurveyed territory east of these townships, are included in the map-area.

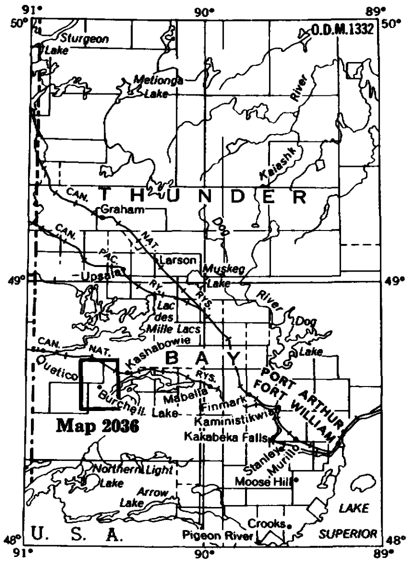


Figure 1 — Key map showing the location of the Burchell Lake map-area. Scale, 1 inch to 50 miles.

The area is underlain by Precambrian rocks, consisting of acid and basic metavolcanic rocks, greywacke and derived metamorphic schists, which have been intruded by gabbro, diorite, syenite, granite, and diabase.

The metavolcanic and metasedimentary rocks have been folded about northeast-trending axes. Potassium-argon dating indicates that metamorphism and granitic intrusion occurred about 2,500 million years ago.

Deposits of copper and iron exist in the area. North Coldstream Mines Limited is currently producing copper, together with minor quantities of gold and silver as by-products. To the end of 1961, total production from the deposit was 31,493,699 pounds of copper, 6,224 ounces of gold, and 139,505 ounces of silver; these had a total value of $9,337,132.

Geology of the Burchell Lake Area

By

P. E. Giblin[1]

INTRODUCTION

This report describes the geology and mineral deposits of the Burchell Lake area, about 65 miles west of the city of Port Arthur. The map-area represents about 140 square miles; it is bounded by latitudes 48°30′ and 48°42′ North and longitudes 90°30′ and 90°42′ West, and includes Ames township, the eastern quarter of Moss township, and unsurveyed territory lying to the east of these townships.

Headworks, North Coldstream Mines Limited.

The area is underlain by Precambrian rocks, consisting of metavolcanic and metasedimentary rocks, which have been intruded by gabbro, diorite, syenite, granite, and diabase. Copper, together with gold and silver as by-products, are currently produced by North Coldstream Mines Limited.

The village of Burchell Lake is situated in the geographic centre of the map-area, and serves as a townsite for employees of North Coldstream Mines Limited. A gravel road extends northeast from the village to join highway No. 11 just outside the east boundary of the map-area. Highway No. 11 is paved and extends east-west across the northern part of the map-area. The Fort William–Atikokan line of Canadian National Railways crosses the northeast corner of the map-area. The numerous lakes of the area permit ready access by canoe and aircraft.

[1]Geologist, Ontario Department of Mines.

Prospecting and Mining Activity

Copper and iron deposits exist in the report-area. Prospecting has been carried out mainly for copper deposits.

Copper was discovered at the present site of the North Coldstream mine during the 1870s, and the deposit subsequently became known as the Tip Top deposit. Small intermittent shipments of concentrates were made during the period 1903–1917. Coldstream Copper Mines Limited acquired the deposit and carried on production during 1957 and 1958. In 1959, the company was reorganized as North Coldstream Mines Limited, and production was resumed in 1960.

Considerable prospecting for copper was done during the 1950s. The Shield Development Company Limited carried out underground exploration in 1957, 1958, 1961, and 1962, from workings extended from the adjoining property of North Coldstream Mines Limited.

Present Geological Survey

The report-area was mapped during the summer of 1961 by the author and his geological field party, consisting of E. J. Rosenberger, senior assistant, and H. W. Kerr and G. W. Hawthorn, junior assistants. Geological mapping was carried out by the author and Mr. Rosenberger. Messrs. Kerr and Hawthorn ran pace-and-compass traverses. Traverses were run between points that were easily recognized on 1 inch to ¼ mile air photographs. All traverses were made at ¼-mile intervals, except in an area southeast of Watershed Lake where they were spaced at ½ mile intervals; the traverses were run mainly across the trend of structural features.

Geological data were plotted in the field on acetate (Perfatrace) sheets fitted over air photographs (scale, 1 inch to ¼ mile). The data were transferred to a basemap (scale, 1 inch to ¼ mile) prepared by the Cartography Unit of the Ontario Department of Mines from maps of the Forest Resources Inventory of the Ontario Department of Lands and Forests. Prospect plans and diamond-drill logs, obtained from property owners and from assessment work reports filed with the Ontario Department of Mines, were also used in plotting geological data.

Preliminary uncoloured geological maps of the north and south halves of the area (maps P-126 and P-127, on the scale of 1 inch to ¼ mile) were released for distribution in December 1961. The final map, No. 2036 (back pocket), is reproduced on a scale of 1 inch to ½ mile.

Acknowledgments

The author was assisted in the field by E. J. Rosenberger, H. W. Kerr, and G. W. Hawthorn. As senior assistant, Mr. Rosenberger carried out independent geological mapping. The author is indebted to these men for their willing and competent assistance.

Field discussions with M. E. Hurst, J. E. Thomson, and E. G. Pye of the Ontario Department of Mines were most helpful. W. S. Row, president of North Coldstream Mines Limited and Shield Development Company Limited, authorized publication of certain data concerning the properties of these companies. L. R. Redford, manager for North Coldstream Mines Limited, permitted use of accommodations and office facilities of the mine. G. H. Montgomery, manager for Shield Development Company Limited, provided data regarding the property of this company. R. C. Heim, chief geologist, and Allen Sheito, formerly geologist,

North Coldstream Mines Limited, contributed information and valuable discussion concerning the mine. R. D. Bell, assistant secretary-treasurer of Andover Mining and Exploration Limited, permitted publication of data from company reports.

Assessment Work Reports

Several geological and geophysical reports, as well as numerous logs of diamond-drillholes, have been submitted to the Ontario Department of Mines to be recorded as assessment work. Reports only are on file at Toronto; reports and drill logs are on file with the resident geologist in Port Arthur. The company names, type of information reported, and file numbers are tabulated below.

Company Name	Type of Information	File No.
Arcadia Nickel Corp. Ltd.	geophysical drill logs	63.880 ———
Burchell Lake Mines Ltd.	drill logs	———
Coldstream Copper Mines Ltd.	geological geophysical geophysical drill logs	63A.186 63.379 63.776 ———
De Ville Copper Mines Ltd.	geophysical	63.839
Galloway Chibougamau Mines Ltd.	geological	63A.318
Goldale Mines Ltd.	geophysical	63.920
Goldora Mines Ltd.	geophysical	63.706
Greatlakes Copper Mines Ltd.	geophysical geophysical drill logs	63.479 63.480 ———
Hermes Mines Ltd.	geological	63A.162
Jack Lake Mines Ltd.	drill logs	———
Jellicoe Mines (1939) Ltd.	geological, geophysical	63.937
Kinasco Exploration and Mining Ltd.	drill logs	———
MacLeod-Cockshutt Gold Mines Ltd.	geological, geophysical	63.838
Martin-McNeely Mines Ltd.	geological, geophysical	63.939
Moffat property	geological	63A.84
New Alger Mines Ltd.	geophysical geological, geophysical	63.820 63.926
New Jack Lake Uranium Mines Ltd.	geophysical drill logs	63.826 ———
North Coldstream Mines Ltd.	geological geophysical drill logs	63A.406 63.1106 ———
Parry property (Rio Tinto Canadian Exploration Ltd., option)	geological, geophysical drill logs	63.718 ———
Trudev property (The Mining Corp. of Canada Ltd., option)	drill logs	———

Previous Geological Work

The general geology has been described briefly by Coleman (1895, pp. 74–76), McInnes (1897, pp. 16H, 43H–45H), Watson (1928, pp. 109–119), Tanton (1938a, 1938b), and Perdue (1938). Most of these reports contain brief descriptions of the Tip Top (now North Coldstream) copper deposit. Additional descriptions of this deposit by government geologists have been provided by Miller (1903, pp. 101, 102), Goodwin (1904, pp. 55, 56), Moore (1911, pp. 209–213), Parsons (1918, pp. 170–172), and Thomson *et al* (1957, pp. 47–49).

The North Coldstream and Shield copper deposits have been described in theses by Taylor (1957) and Carson (1958), respectively.

Geophysics Paper 1112 (O.D.M. and G.S.C., 1961) provides aeromagnetic data for the area.

Physiography

The report-area is on the watershed between the Pigeon River and Kaministikwia River drainage systems. The height-of-land passes south of Stetham and Crayfish lakes in the northern part of the report-area, and passes west of Upper Shebandowan and Firefly lakes in the eastern part of the report-area. These lakes drain a small part of the report-area eastward into the Shebandowan lakes and the Shebandowan River. The greater part of the report-area is drained to the southwest, into the Pigeon River system, by the Wawiag River.

The area is a peneplane with a maximum relief of 100–200 feet. The topography reflects, in part, the bedrock lithology and structure. Those parts of the area underlain by bedded or foliated rocks are characterized by elongated ridges, lakes, and swamps, all of which trend parallel to the bedrock structure. Irregular-shaped hills characterize those parts of the area underlain by massive intrusive rocks. Outcrops of gabbro and diorite tend to form steep hills with numerous small cliffs; granite and syenite generally appear in low rounded outcrops.

Some elevations within the map-area are:

	ELEVATION[1] feet
Keego Siding (C.N.R.)	1,540
Crayfish Lake	1,535
Upper Shebandowan Lake	1,474

(1)From Tanton (1938b).

Natural Resources and Development

The area is densely wooded with a generally immature forest-cover consisting mostly of spruce, balsam, poplar, birch, cedar, willow, and alder.

Moose, deer, and bear inhabit the area. Beaver are very common, and their dams have caused flooding of extensive areas. Pike, pickerel, and lake trout inhabit the larger lakes.

The village of Burchell Lake, which serves as a townsite for employees of North Coldstream Mines Limited, is the only settlement within the map-area.

GENERAL GEOLOGY

The consolidated rocks, all of which are of Precambrian age, consist of metamorphosed volcanic and sedimentary rocks that have been intruded by gabbro, diorite, syenite, granite, and diabase. The rocks are folded about northeast-trending axes. Potassium-argon dating indicates that metamorphism and granitic intrusion occurred about 2,500 million years ago.

Pleistocene deposits of sand and gravel are widespread but, in general, bedrock is well exposed throughout the area.

TABLE OF FORMATIONS

CENOZOIC	
RECENT:	Swamp and stream deposits.
PLEISTOCENE:	Sand and gravel.
	Great Unconformity
PRECAMBRIAN	
PLUTONIC ROCKS	
Late Basic Intrusive Rocks:	Diabase (dikes).
	Intrusive Contact
Granitic Rocks:	Leucogranite; biotite granite; porphyritic biotite granite; hornblende granite; porphyritic hornblende granite; muscovite granite; granite pegmatite.
Syenitic Rocks:	Leucosyenite; biotite syenite; porphyritic biotite syenite; hornblende syenite; porphyritic hornblende syenite.
	Intrusive Contact
Early Basic Intrusive Rocks:	Gabbro; diorite; lamprophyre.
	Intrusive Contact
METASEDIMENTS AND METAVOLCANICS	
Metasediments:	Greywacke, biotite-feldspar-quartz schist.
	Possible Fault Contact
Basic Metavolcanics:	Amphibolite, amphibolite schist; chlorite schist; coarse gabbroic flows and intrusions; agglomerate; pillow lava; tuff and basic sedimentary rocks; iron formation.
Acid Metavolcanics:	Rhyolite; rhyolite breccia; sericite schist; porphyritic rhyolite; rhyolite tuff.

DEFINITION OF GEOLOGICAL TERMS

Some of the common geological terms have several meanings and may not have the same significance to different readers. In following the practice recommended (Shaw 1957) by a subcommittee of the National Advisory Committee on Research in the Geological Sciences (Ottawa, Canada), a few of the more important definitions are presented here. (The definitions are taken from a Glossary of Geology published by the American Geological Institute, Washington, D.C., U.S.A.).

Hypidiomorphic. A textural term applied to granular plutonic rocks in which there are few idiomorphic minerals, most of the constituents being hypidiomorphic (= subhedral). The texture of such rocks is said to be hypidiomorphic-granular (= hypautomorphic-granular).

Lepidoblastic. A term applied to that type of flaky schistosity due to an abundance of minerals, such as mica and chlorites, with a general parallel arrangement.

Nematoblastic. Pertaining to the texture of a recrystallized rock in which the shape of the grains is threadlike.

Poikiloblastic. A metamorphic texture due to the development, during recrystallization, of a few minerals around numerous relics of the original minerals, thus simulating the poikilitic texture of igneous rocks.

Subdoleritic. (= subophitic). Partly ophitic. Applied to a variety of ophitic texture in which the average length of the plagioclase laths exceeds the diameter of the pyroxene grains and in which the pyroxene grains only partly enclose certain of the feldspar laths.

Metavolcanics

The metavolcanics have been divided into two major units: acid and basic rocks. Acid rocks constitute from a quarter to a third of the metavolcanic rocks. Together, the acid and basic metavolcanic rocks underlie about half of the map-area.

The relative ages of the two metavolcanic rock types are not well defined. In part the acid rocks are the older, but in part they are probably contemporaneous with the basic rocks.

ACID METAVOLCANICS

The acid metavolcanics consist of rhyolite, rhyolite breccia and tuff, and their metamorphic equivalents.

The greater part of the acid metavolcanic rocks lies within the prominent band that strikes northeast across the central part of the map-area, from the Wawiag River in the southwest, through Burchell Lake, to the east border of the area. Within the map-area the band has a strike-length of 12 miles and an average width of about 1½ miles. The band attains its greatest widths southwest of Burchell Lake, where widths range between 1¾ and 2¾ miles. It progressively narrows to the east, the width at the east border of the area being ¾ mile. Reconnaissance data suggest that the band rapidly pinches out east of the map-area, but extends at least 13 miles southwest of the map-area.

The second major body of acid metavolcanics is exposed south of Burchell Lake. The body, approximately circular in plan, has a diameter of about one mile, and a lenticular protuberance of it extends southwest for about one mile.

Narrow lenticular masses of acid metavolcanic rocks are present throughout the basic metavolcanic assemblage.

The rhyolites are most commonly light buff, or grey, on both fresh and weathered surfaces, but in a few places they exhibit delicate shades of pink and green.

Most rhyolite is aphanitic, but in places quartz and feldspar phenocrysts are megascopically visible. Examination of thin sections reveals that the aphanitic and porphyritic rhyolites are similar: the megascopic distinction reflects only differences in grain size. These rocks exhibit euhedral to anhedral phenocrysts of quartz and albite set in a very fine-grained schistose matrix that consists largely of quartz, white mica, chlorite, and carbonate. Pyrite, magnetite, leucoxene, and tourmaline constitute minor accessory minerals.

Rhyolite breccia is sporadically distributed throughout the main rhyolite band. Angular fragments constitute very nearly the entire rock, and range in size from those just megascopically visible to those with maximum dimensions of a few inches. Fragments can be distinguished from their matrix only on weathered surfaces. A chemical analysis of a rhyolite breccia is presented below.

CHEMICAL ANALYSIS OF RHYOLITE BRECCIA
(Analysis by Laboratory Branch, Ontario Department of Mines)

	SAMPLE L-3
	percent
SiO_2	69.76
Al_2O_3	15.50
Fe_2O_3	0.69
FeO	1.47
CaO	2.49
MgO	0.15
Na_2O	4.87
K_2O	1.52
H_2O+	1.23
H_2O-	0.02
P_2O_5	trace
TiO_2	0.23
Cr_2O_3	trace
MnO	0.06
V_2O_3	trace
CO_2	1.64
	99.63

Sample L-3 was taken 800 feet west of No. 4 shaft, North Coldstream Mines Ltd.

Acid aphanitic rocks that display excellent uncontorted banding may represent recrystallized rhyolitic tuff. Such rocks exist about 1¼ and 2 miles northwest of Squeers Lake. The bands attain maximum thicknesses of 0.1 inch. A few quartz phenocrysts are visible. In thin sections, these rocks exhibit subhedral to anhedral phenocrysts of quartz, and rarely, altered plagioclase, set in a fine-grained matrix consisting mostly of quartz, with subordinate white mica and carbonate.

Schistosity is commonly well-developed in the rhyolites, and in some places these rocks are extremely fissile. Schistosity surfaces are speckled with white mica, and, occasionally, with patches of chlorite. Although narrow films of sericite schist are common, they are rarely mappable at the scale employed.

Quartz and carbonate veinlets cut the acid metavolcanic rocks. Disseminated pyrite is a ubiquitous and often abundant accessory mineral in the rhyolites, and tiny veinlets of pyrite are present in places. A concentration of such veinlets has given rise to a gossan in the roadcuts of highway No. 11, about 2 miles east of the east boundary of Ames township. Pyrite was the only sulphide noted in these veinlets.

BASIC METAVOLCANICS

The basic metavolcanics consist mainly of amphibolite schist, with minor pillow lava, agglomerate, tuff, chlorite schist, and coarse gabbroic phases that may represent both flows and intrusive masses. Banded iron formation is intercalated with the basic metavolcanic rocks. The basic metavolcanics are believed to be basaltic in composition, no members of an intermediate composition having been recognized.

Rocks of this group exist principally in two major belts that lie on the north and south flanks of the main rhyolite band. The north belt, the thinner of the two, ranges in width between ¼ and 1¼ miles but, for most of its extent, it maintains a width of $\frac{1}{4}$ to $\frac{1}{2}$ mile. The south belt is more variable in width: throughout the east half of the map-area it maintains a fairly uniform width of about 4 miles, but narrows toward the west, exhibiting a width of about $\frac{1}{2}$ mile in the region south and west of Fountain Lake.

Small masses of basic metavolcanic rock are intercalated with the metasedimentary rocks, north of the north belt.

Sparse outcrops of basic metavolcanic rock in the drift-covered area south of Squeers and Watershed lakes suggest the existence of a large inclusion of basic metavolcanic rock in the granite that underlies much of this region.

The basic metavolcanic rocks weather to various shades of green and brown; fresh surfaces are dark green to almost black. Essentially they consist of fine-grained mostly uniform schists in which original textures and primary structures have been either highly distorted or destroyed. Individual flows can seldom be recognized with certainty. Recognizable pillow lavas are rare, and most pillows have been so distorted by shearing that they are not useful for structural determinations.

The amphibolites are fine-grained rocks in which porphyroblasts of blue quartz are common. In thin sections these rocks are seen to consist principally of chlorite, hornblende, tremolite-actinolite, carbonate, albite, epidote, and, in some specimens, quartz. Hornblende is generally pseudomorphically replaced in large part by chlorite. Sphene, magnetite, leucoxene, and pyrite are present in small amounts. For the most part these rocks exhibit lepidoblastic or nematoblastic textures; in some places, diabasic texture is evident.

Narrow bands of chlorite schist are sporadically distributed throughout most of the areas underlain by basic metavolcanic rocks, and have been derived through shearing of the volcanic rocks.

The most extensive part of the report-area underlain by chlorite schist is that about the north and south shores of Upper Shebandowan Lake. In much of the region lying between Upper Shebandowan and Firefly lakes, and upon many islands in Upper Shebandowan Lake, all gradations may be observed between gabbro with thin seams of chlorite schist, and chlorite schist with small lenticular patches of sheared gabbro. The chlorite schist, in this case, clearly has been derived through shearing of gabbro.

Because it is not possible in most cases to determine the origin of a given zone of chlorite schist, and because the mapping was primarily lithological, all chlorite schist was mapped as part of the basic metavolcanic group.

The chlorite schist contains minor amounts of carbonate, white mica, albite quartz, sphene, and leucoxene.

Coarse- to medium-grained gabbroic rocks exist throughout the two major belts of basic metavolcanic rocks, and are particularly common within the west half of the north belt. Such rocks exist also within the basic bands intercalated with the metasedimentary rocks. Some of these gabbroic rocks are almost certainly coarse-grained portions of flows, while others may well be intrusive rocks.

Agglomerate is present near highway No. 11, and on the north shore of Upper Shebandowan Lake. Near highway No. 11, basic and acid fragments appear in a schistose basic matrix. Acid fragments predominate. The fragments are lenticular, in many places exhibit a "pinch-and-swell" structure, and attain maximum lengths of about 20 inches. The agglomerate on Upper Shebandowan Lake consists of subangular basic fragments, up to 2 feet across, set in a schistose basic matrix.

Recognizable pillow lavas appear principally along the northern margin of the north belt of basic metavolcanic rocks, where they have an observed strike-length of about 3 miles. Smaller occurrences of pillow lavas lie east of Firefly Lake; on the north shore of Upper Shebandowan Lake; among the basic rocks a few hundred feet south of the North Coldstream mine; and, upon the northern and eastern shores of the lake 1¾ miles northeast of the southeast corner of Ames township. Individual flows range in thickness from 15 feet to an observed maximum thickness of 45 feet.

For the most part the pillows have been so distorted by regional shearing as to prohibit reliable top determinations. Pillows that are suitable for reliable top determinations exist in the north belt of basic metavolcanic rocks near highway No. 11; near the northeast corner of Moss township; and, in the south belt, on the peninsula at the northeast end of the lake 1¾ miles northeast of the southeast corner of Ames township.

Poorly defined structures, resembling much-distorted pillows, are to be found in several localities throughout areas underlain by basic metavolcanic rocks. Rocks containing such structures have been included in the "amphibolite, amphibolite schist" unit. They generally lie on strike with recognizable pillow lavas, suggesting that a portion, at least, of the "amphibolite, amphibolite schist" unit represents altered pillow lava.

The pillow lavas lying east of Firefly Lake are in many places amygdaloidal and contain thin bands of grey chert. Amygdaloidal lavas that do not exhibit pillow structure are exposed northeast of Grouse Lake, near the trail leading from Grouse Lake to Firefly Lake.

The pillow lavas are petrographically similar to rocks of the "amphibolite, amphibolite schist" unit, described earlier. Presented below is a chemical analysis of relatively undistorted pillow lava. The analysis indicates that the rock is a basalt.

CHEMICAL ANALYSIS OF PILLOW BASALT
(Analysis by Laboratory Branch, Ontario Department of Mines)

	SAMPLE L-1 percent
SiO_2	49.65
Al_2O_3	15.22
Fe_2O_3	nil
FeO	10.00
CaO	9.94
MgO	7.88
Na_2O	2.60
K_2O	0.28
H_2O+	1.38
H_2O-	nil
P_2O_5	trace
TiO_2	0.78
Cr_2O_3	0.06
MnO	0.28
V_2O_3	0.04
CO_2	0.65
	98.76
Specific Gravity	2.97

Sample L-1 taken from rockcut on highway No. 11, ½ mile east of Ames township.

Fine-grained dark-coloured, heavy, schistose rocks, characterized by a banded or streaky appearance, may represent recrystallized basic tuffs and sedimentary rocks. They are most extensively exposed north and west of Grouse and Squeers lakes.

In these rocks, predominant dark green bands alternate with grey-white bands. The bands rarely exceed 0.2 inch in thickness. A specimen collected from the shore of the lake south of highway No. 11, 2¼ miles west of the east boundary of Ames township, consists of angular to subangular grains of quartz and albite set in a fine-grained matrix of hornblende, chlorite, quartz, plagioclase, epidote, and pyrite; the banding is poorly defined in a thin section of this specimen. Other specimens, collected northwest of Grouse Lake, and from a band of basic rocks intercalated with metamorphosed greywackes in eastern Ames township, consist of bands of quartz, with minor plagioclase, alternating with bands that consist principally of hornblende, or biotite, and minor magnetite and pyrite.

About one mile east of Watershed Lake these rocks have been intimately injected by granite and display a marked increase in grain size.

Narrow bands of graphitic schist appear in the basic metavolcanic rocks, but are not mappable at the scale employed.

The basic metavolcanic rocks are cut by numerous small, quartz, carbonate, and epidote veins. Purple fluorite was noted in a carbonate veinlet that cuts pillow lava near highway No. 11.

Banded iron formation is present in the southern part of the south belt of metavolcanic rocks and is exposed north and west of Grouse and Squeers lakes. The iron formation zones are intercalated with basic tuffs. Exposed individual zones do not appear to exceed 300 feet in length, and do not exceed 60 feet in thickness. The iron formation is fine-grained and consists mainly of magnetite, quartz, and amphibole. Minor amounts of carbonate and epidote are found in some specimens.

Metasedimentary Rocks

Metasedimentary rocks, consisting of greywackes, very subordinate arkoses, and their derived metamorphic schists, lie in a broad arcuate band north of the metavolcanic rocks. The metasedimentary band strikes northeast from northeastern Moss township to the east-central portion of Ames township, and thence east to the east border of the map-area. The outcrop-width of the band is about 4 miles at the west border of the map-area and progressively narrows to the east, thinning to about 1 mile at the east border of the area. The south boundary of the metasedimentary band is well defined. The band is bounded on the north by granite, and the contact between the two rock types is a broad transitional zone in which the metasedimentary rocks have been intimately injected *lit par lit* by granite. The north boundary of the band is considered as the line north of which granitic material first predominates.

The metasedimentary unit consists principally of rather uniform beds of feldspathic greywacke. Graded beds are present along the southern margin of the unit and, although locally predominant, constitute only a minor portion of the unit. Along the southern margin of the unit the greywackes exhibit little effect of recrystallization; however, northward, as the granite is approached, they become recrystallized to schists of the almandine amphibolite facies. Small masses of basic metavolcanic rock are intercalated with the metasedimentary rocks.

The greywackes are very fine-grained rocks, pale buff to almost black on weathered surfaces, and dark grey to black on fresh surfaces. Weathered surfaces commonly have a sandy appearance. On weathered surfaces, graded beds exhibit gradations from pale grey-brown, sandy, basal portions, to dark-coloured, argillaceous tops.

These rocks display remarkably uniform thin bedding. Thicknesses of the beds range from paper-thin (laminae) to an observed maximum of 3 feet; the majority of beds are a fraction of an inch to a few inches thick. In addition to graded bedding, crossbedding and channel scouring appear in the southern part of the metasedimentary unit.

The relatively unmetamorphosed greywackes exhibit their original clastic texture in thin sections. Fragments of quartz and sericitized albite are set in a very fine-grained matrix consisting largely of biotite, white mica, and chlorite, with minor sphene, leucoxene, magnetite, and pyrite. Minute anhedral grains of tourmaline, apatite, and zircon were noted in a few sections. The micaceous groundmass commonly exhibits a well-defined foliation. A chemical analysis of relatively unmetamorphosed greywacke is presented below.

CHEMICAL ANALYSIS OF GREYWACKE
(Analysis by Laboratory Branch, Ontario Department of Mines)

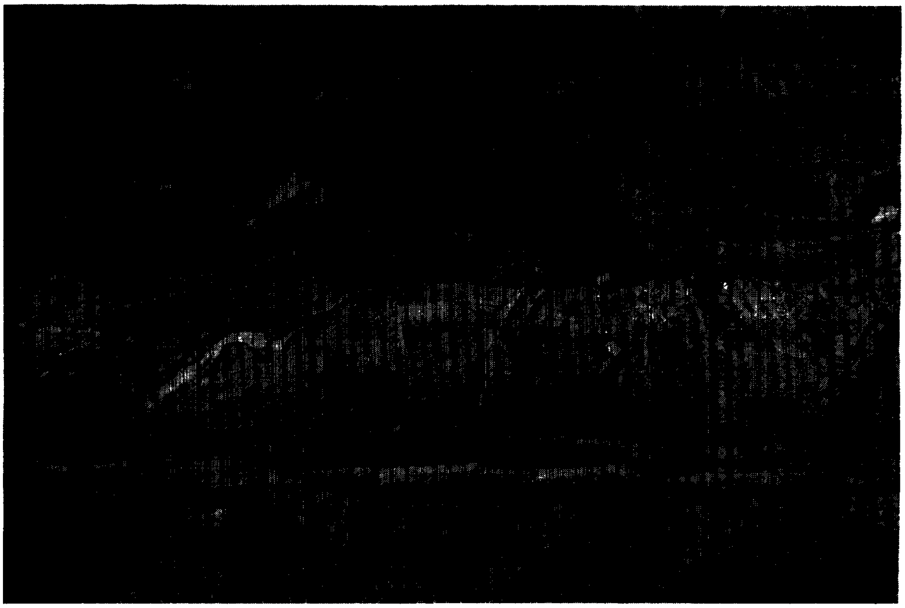
	SAMPLE L-2 percent
SiO_2	59.95
Al_2O_3	18.20
Fe_2O_3	0.80
FeO	5.90
CaO	2.00
MgO	3.51
Na_2O	2.74
K_2O	2.72
H_2O+	2.19
H_2O-	nil
P_2O_5	trace
TiO_2	0.69
Cr_2O_3	0.02
MnO	0.09
V_2O_3	0.02
CO_2	0.19
	99.02
Specific Gravity	2.74

Sample L-2 taken from rockcut on highway No. 11, ¼ mile east of Ames township.

With increasing proximity to the granite on the north, the grain-size of the rocks becomes coarser, and the abundance of large subparallel flakes of biotite in certain beds imparts both a very dark colour and a pronounced schistosity to these beds. The growth of biotite porphyroblasts in the argillaceous upper portions of graded beds leads, in some cases, to apparent reversals of grain gradation. Garnet is developed in certain beds, generally within ½ mile of the granite.

The coarser-grained schists consist largely of quartz, calcic oligoclase, and biotite. Chlorite is commonly intergrown with biotite. When garnet is present, it forms anhedral porphyroblasts, which are commonly elongated parallel to the schistosity, and which poikiloblastically include quartz, plagioclase, and magnetite.

Boudinage structure is present throughout the metasedimentary unit. It becomes better developed, and more common, with increasing proximity to the



Boudinage structure accompanied by step-faulting in metasedimentary rocks; highway No. 11, 1 ½ miles east of the west boundary of Ames township.

granite on the north. Within the garnet zone, boudinage structure was observed in one instance to be accompanied by step-faulting of a nearby bed. This feature is illustrated in the accompanying photograph.

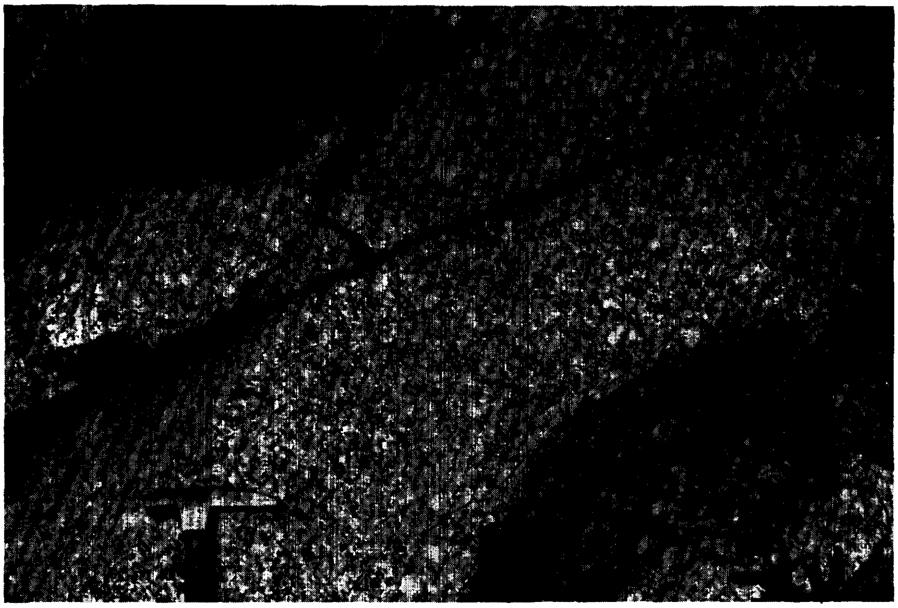
Quartz veins are common throughout the metasedimentary sequence.

Early Basic Intrusive Rocks

Small stocks and sills of gabbro and diorite intrude the metavolcanic and metasedimentary rocks, and are most prevalent within the south belt of basic metavolcanic rocks.

The sills, with the exception of those exposed near Upper Shebandowan Lake, are generally medium-grained massive rocks that exhibit their original igneous textures. Chilled borders are present in most, but occasionally the border zones of the sills consist of narrow zones of schistose amphibolite or chlorite schist. A few angular inclusions of chloritic schist are contained in the gabbro sill that is exposed on the shores of the lake just inside the east boundary of the map-area about 1 mile south of highway No. 11. In thin sections, it is seen that the original ferromagnesian minerals of the sills have been altered to uralite and chlorite, and the original feldspars to saussurite.

The gabbro bodies that are exposed north of the North Coldstream mine, on the peninsula on the southeast shore of Burchell Lake, and on the islands and shores of Upper Shebandowan Lake, are very coarse-grained, and generally light-coloured rocks. Large plagioclase grains, which range in size up to 2 inches across, are set in a streaky chloritic matrix. Porphyroblasts of blue quartz are common. These rocks are traversed by bands of chlorite schist, and there are all gradations from gabbro with small seams of chlorite schist to chlorite schist with small



Gabbro, about 500 feet east of headframe of North Coldstream Mines Limited. Note large grains of feldspar (white in photo).

lenticular patches of sheared gabbro; this is particularly evident in the vicinity of Upper Shebandowan Lake, and along the southern margin of the gabbro body that is exposed north and east of the North Coldstream mine. Epidote and quartz-epidote-carbonate veinlets cut the gabbro bodies.

In thin sections, these gabbros exhibit large, randomly oriented laths of highly saussuritized plagioclase set in a schistose matrix of chlorite, epidote, uralite, carbonate, and minor quartz. Triangular intergrowths of leucoxene and chlorite are disseminated throughout the rocks. Irregularly shaped patches of intergrown epidote, chlorite, and uralite, in which the minerals display no preferred orientation, represent original ferromagnesian minerals. Scapolite has been noted in the gabbro lying east of the North Coldstream mine (Carson 1958).

Thin-section study of a specimen from the gabbro body lying north of Waverly Lake showed this medium-grained rock to consist largely of hornblende and labradorite, with minor magnetite and very minor quartz. The subhedral hornblende poikiloblastically includes plagioclase, quartz, and magnetite. The rock possesses a nematoblastic texture.

The gabbro that lies north of Skimpole Lake is a fine- to medium-grained rock, consisting largely of hornblende and saussuritized plagioclase. Quartz, carbonate, epidote, chlorite, apatite, magnetite, pyrite, and pyrrhotite constitute minor accessory minerals. The rock possesses a subdoleritic texture.

Lamprophyre dikes cut metavolcanic and metasedimentary rocks, and gabbro. Although some small outcrops of lamprophyre are found in areas underlain predominantly by granite and syenite, lamprophyre was not observed to cut the acid plutonic rocks, but is itself intruded by them. Despite the possibility that some lamprophyre may be younger than some of the acid plutonic rocks, all lamprophyre has been assigned tentatively to the early basic intrusive group.

Most lamprophyre dikes are only a few inches thick. The largest known dike is one that cuts the North Coldstream ore zone; this dike attains a maximum thickness of about 8 feet.

With the single exception of the hornblende lamprophyre that is exposed on the shores of the lake 1¼ miles west of the east boundary of Ames township and ¾ mile south of highway No. 11, all lamprophyre dikes observed contain biotite as the predominant ferromagnesian mineral.

Syenitic and Granitic Rocks

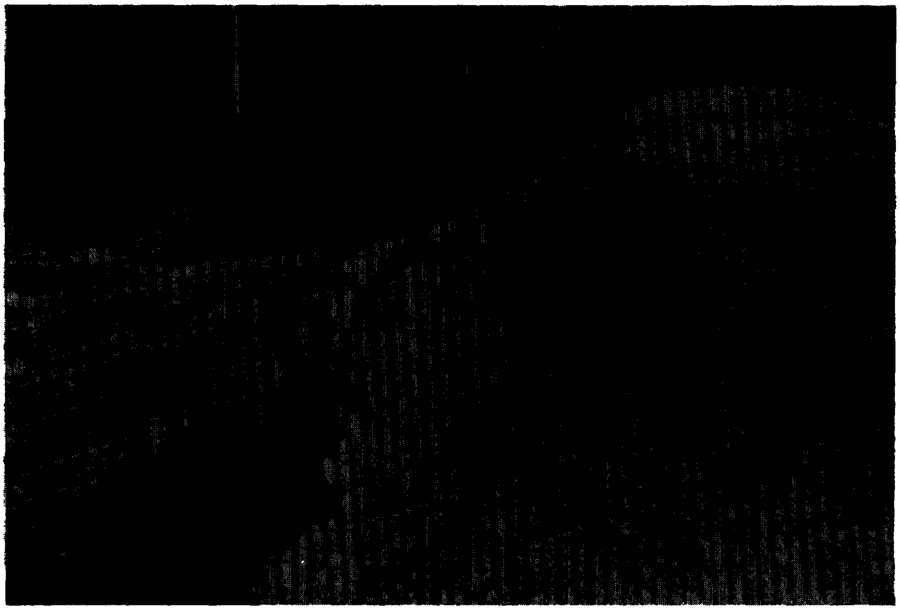
Two major groups of acid plutonic rocks are found within the map-area: (1) grey, in places gneissic, biotite and muscovite granites; and (2) pink, in places composite, bodies of biotite and hornblende granite and syenite, which are usually massive but which may exhibit primary foliation. Lack of field evidence prohibits an age distinction, and the two groups are considered to be contemporaneous.

Grey gneissic granite underlies the northern part and the southeast corner of the map-area.

With the exception of the pink syenite mass underlying the southwest corner of the map-area, the principal bodies of pink syenite and granite lie along the flanks of the main rhyolite band. Small dikes and sills of pink syenite and granite, and of grey granite, intrude metavolcanic, metasedimentary, and early basic intrusive rocks.

The contact of the grey granite, which underlies the northern part of the map-area, with the metasedimentary rocks is a broad zone of *lit par lit* injection, in which cross-cutting relationships are common, and in which replacement of the metasedimentary rocks is evident in many places. Near its southern margin, the granite is commonly medium- to coarse-grained, with numerous, small, pegmatitic patches. A few granite pegmatite dikes cut the metasedimentary rocks. Though the granite is most commonly massive, in many places it exhibits a foliation caused by subparallel alignment of scattered mica flakes; by lenticular, subparallel, pegmatitic patches; and by prominent biotite bands (*see* photos opposite). Such bands probably represent almost completely replaced metasedimentary rocks. In one place, perthite porphyroblasts, ranging up to 12 inches in length, were observed to cut this banding without distorting the banding.

Muscovite is generally the predominant accessory mineral of the granite near its southern margin. Northward, with increasing distance from the metasedimentary unit, biotite supersedes muscovite as the predominant accessory mineral; concomitantly, pegmatitic patches and metasedimentary inclusions become smaller and fewer. Within about ½ mile of the north border of the map-area, the granite is pink, rather than grey. Garnet is distributed sporadically throughout the granite, tending to be more prevalent near metasedimentary inclusions.



Granite cutting metasedimentary rocks; highway No. 11, about 1 mile west of the map-area.

Banding in granite (dark spots are lichen); about 50 feet north of viewpoint of photo above.

The granite consists largely of albite, microcline, microcline perthite, and quartz. The plagioclase is commonly much altered to very fine-grained white mica. Myrmekite was noted in one specimen. Muscovite, biotite, chlorite, apatite, zircon, magnetite, and pyrite constitute the common accessory minerals. Garnet is present as discrete euhedral grains that are free of inclusions; this mode of occurrence is in noteworthy contrast with that of garnet in the nearby metasedimentary rocks.

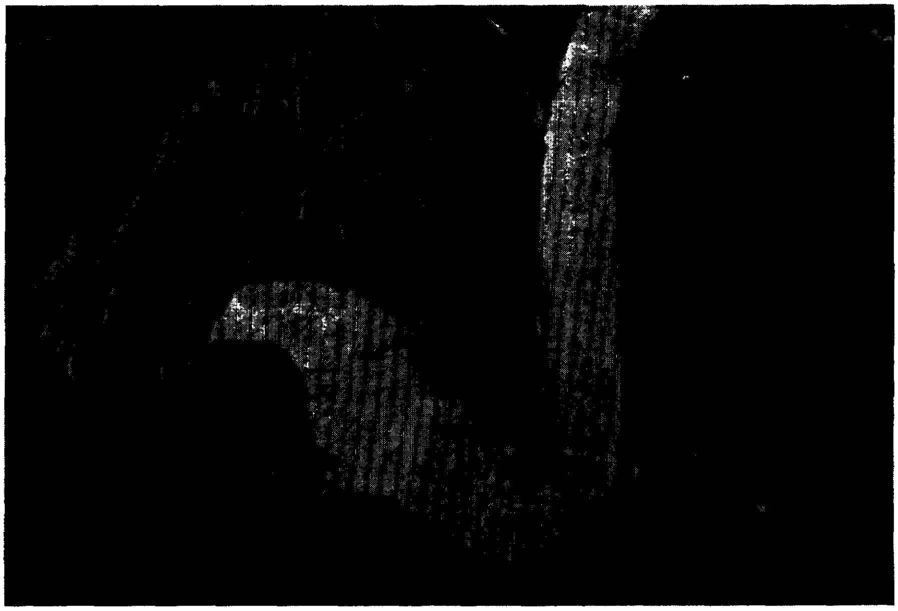
Granite pegmatite dike cutting metasedimentary rocks; highway No. 11, about 1¼ mile west of the map-area. (For close-up, see photo on facing page.)

Grey, medium-grained, gneissic granite underlies the southeast corner of the map-area. The grey granite is separated from the basic metavolcanic rocks on the north by a border phase of pink hornblende granite and syenite. The bordering metavolcanic rocks locally exhibit coarsening of grain size where they have been intimately injected by granite and syenite. The grey, gneissic granite consists largely of microcline, albite, quartz, and myrmekite. Biotite is the predominant accessory mineral. Other minerals present are hornblende, chlorite, white mica, epidote, sphene, apatite, and magnetite.

The acid plutons that lie along the flanks of the main rhyolite band consist of medium- to coarse-grained, pink, generally massive, granite and syenite. Inclusions of metavolcanic rocks and gabbro are present, but are not common. The plutons have caused no apparent recrystallization of their wallrocks. The syenitic border phases of the larger plutons are probably a result of assimilation of wallrock material.

The largest of these plutons is that exposed north of Burchell Lake. This body is roughly circular in plan, and has a diameter of about 2½ miles. The greater part of the pluton consists of biotite granite, which is in many places porphyritic, with feldspar phenocrysts attaining maximum lengths of about 1 inch. The rock consists largely of albite, microcline microperthite, quartz, and intergrown biotite and chlorite. White mica, occurring mostly as an alteration product of plagioclase, epidote, apatite, sphene, zircon, leucoxene, magnetite, and pyrite, are present in minor amount. The rock displays an hypidiomorphic-granular texture.

The pluton has a narrow, discontinuous border zone of hornblende granite, hornblende syenite, and biotite syenite. Clinopyroxene was noted in one specimen of hornblende syenite. Purple fluorite was also noted in one specimen.



Granite pegmatite dike cutting metasedimentary rocks; this is a close-up of feature in photo on facing page.

The pluton is cut by small quartz veins and, near Burchell Lake, by granite pegmatite dikes that attain maximum observed thicknesses of one foot.

Smaller, composite bodies of granite and syenite exist southeast of Burchell Lake, and in Moss township on the north flank of the main rhyolite band. A small granite pluton is exposed on the western shore of Burchell Lake, and a poorly-exposed syenite mass lies between Fountain and Hermia lakes. Biotite and hornblende, the characteristic accessory minerals of these granites and syenites, are seen in thin sections to have been mostly pseudomorphically replaced by chlorite. Aplite dikelets and quartz veinlets cut these rocks.

Grey granite, characterized by the presence of blue quartz eyes, constitutes a minor phase of the small granite body exposed on the west shore of Burchell Lake. Outcrops of similar material are scattered sporadically in the areas underlain by metavolcanic and metasedimentary rocks. In thin sections, granite that is characterized by blue quartz eyes exhibits pronounced cataclastic texture.

Coarse-grained pink hornblende syenite underlies the southwest corner of the map-area. Subparallel perthite laths, which range in length up to 1½ inches, impart a marked foliation to the rock. The foliation trends suggest that the foliation is primary. Near the north border of the pluton, biotite is in a few places the predominant accessory mineral. Both hornblende and biotite are in relatively small grains, which generally lie parallel to the large feldspars. In thin sections, small grains of microcline, albite, and rarely, quartz, are seen between the large perthite laths. Hornblende is intergrown with clinopyroxene in many places. Epidote, apatite, sphene, and magnetite are minor accessory minerals.

Late Basic Intrusive Rocks

Rocks of this group are represented by a very few diabase dikes. The dikes were observed to intrude metavolcanic and metasedimentary rocks and granite; they cut cleanly across the intruded rocks and display chilled contacts. The dikes strike northwest and, in general, dip vertically or nearly so. Widths of the dikes range between 1 and 100 feet.

The diabase is dark reddish-brown on weathered surfaces, and dark grey to black on fresh surfaces. The rock consists principally of labradorite and clinopyroxene, with minor interstitial quartz and micropegmatite. Apatite, magnetite, and pyrite are present in small amounts. In contrast with the early basic intrusive rocks, the diabase is little altered. The clinopyroxene is commonly unaltered, while the plagioclase exhibits little to moderate saussuritization.

Pleistocene

Pleistocene deposits of sand and gravel are widespread throughout the map-area. There is a poorly defined facies-change, from predominantly gravel in the northern three-quarters of the area, to predominantly sand in the southern quarter.

Glacial striae indicate that the direction of movement of the last continental glacier was between S.5°E. and S.25°W. Striae are not common. The indicated directions of movement are tabulated below.

Number of Striae Occurrences	Indicated Direction of Movement
4	S.25°W.
1	S.10°W.
1	S.5°E.

The Pleistocene mantle is generally thin and, therefore, bedrock is well exposed throughout the area, with the following exceptions: (1) in the region southeast of an imaginary line joining Squeers, Watershed, and Firefly lakes; (2) in the area lying between Burchell Lake, Fountain Lake, and the Wawiag River; and (3) southwest of Fountain Lake.

Diamond-drilling has provided considerable information on the depth of overburden in the map-area. On Map No. 2036 overburden depths have been shown beside all drillholes that penetrated more than 20 feet of overburden. Depths less than 20 feet have been indicated in those cases where nearby holes penetrated substantially greater depths, or in areas where outcrop is scarce.

The existence of a deep pre-Pleistocene valley, now buried by glacial debris, is indicated south of Burchell Lake, in the vicinity of Squeers Creek, Hermia Lake, and Fountain Lake. The valley is of particular importance because of the chalcopyrite occurrence lying beneath it east of Hermia Lake. Depths of overburden up to 200 feet were encountered in drilling near Squeers Creek, east of Hermia Lake.

A hole under Hermia Lake ended in overburden at a depth of 235 feet. Drilling from the ice of Fountain Lake generally failed to reach bedrock after having penetrated overburden to depths as great as 300 feet. An interesting hole is that collared approximately on the east border of Moss township, west of Hermia Lake. This hole, drilled northwest with a dip of 45°, penetrated, successively, overburden to a vertical depth of 60 feet, syenite (presumably bedrock) to a depth of 95 feet, then encountered sand and ended therein at a total vertical depth of 110 feet. The syenite encountered may mark the edge of a portion of the preglacial valley.

Recent

Recent deposits consist principally of organic material collecting in swamps. Streams, and wave action along lake shorelines, are reworking glacial deposits.

STRUCTURAL GEOLOGY

Folding

The main direction of folding is northeast, but owing to the general obliteration of primary structures in the metavolcanic and metasedimentary rocks by regional metamorphism, details of the fold pattern are, in general, obscure.

Meagre evidence suggests that, within the metavolcanic assemblage, the main rhyolite band forms the core of an anticline. The fold is indicated by the north-facing pillow lavas of the north basic metavolcanic belt, and by one south-facing pillow lava exposure within the south belt, observed at the east end of the lake that lies 3 miles northeast of the North Coldstream mine. Elsewhere within the metavolcanic terrane, top determinations are lacking, and the fold pattern is unknown.

Owing to the recrystallization that the metasedimentary rocks exhibit with increasing proximity to the granite on the north, reliable top determinations are lacking in all but the southern part of the metasedimentary unit. In the southern part, top determinations made from graded bedding, crossbedding, and channel scouring, indicate that the rocks face north. The internal structure of the metasedimentary unit is unknown within the map-area, but there is evidence from the Kashabowie area, a few miles east, that the unit is isoclinally folded (Perdue 1938).

As discussed later in this report, evidence suggests that the metasedimentary unit is separated from the principal metavolcanic assemblage by a fault; thus the fold patterns in the two assemblages may be dissimilar.

Lineation

A poorly-developed lineation, produced by intersecting shear planes, is present in certain metavolcanic and early basic intrusive rocks. It is subparallel to the northeast-trending fold axes, and plunges northeast at 15°–30°.

Stratigraphic Relationship of the Metavolcanic and Metasedimentary Rocks

The following discussion is concerned with the stratigraphic relationship of the metasedimentary rocks and the principal mass of metavolcanic rocks. The small masses of basic metavolcanic rocks intercalated with the metasedimentary rocks are regarded as an integral part of the metasedimentary unit. They are not referred to hereinafter; in the following discussion, all references to metavolcanic rocks are to those that constitute the large mass lying south of the metasedimentary unit.

The contact of the metavolcanics with the metasediments is not exposed and is marked by valleys, swamps, streams, and lakes. Some information concerning the contact is provided by diamond-drilling results. In 1957, Arcadia Nickel Corporation Limited drilled three holes, with a total length of 1,030 feet, through the contact near the west border of the map-area. The holes were drilled to investigate an anomaly revealed by an electromagnetic survey.

All holes encountered narrow graphitic zones in the metavolcanic rocks. In the easternmost hole a 4-foot-thick acid dike separated the metavolcanic rocks from the metasedimentary rocks. A 4-foot-long intersection of material logged as "graphitic fault zone, 2 inches of gouge" (logs submitted as assessment work, Arcadia Nickel Corporation Ltd.) was encountered within the metasedimentary rocks, 10 feet from the acid dike.

A narrow acid dike also separated the two major rock types in the central hole.

In the westernmost hole, greywacke was encountered in contact with basic metavolcanic rock. The greywacke was logged as "sericitic, sheared" for a distance of 11 feet from the contact (logs submitted as assessment work, Arcadia Nickel Corporation Ltd.).

The stratigraphic relationship of the metavolcanic rocks and metasedimentary rocks is not made clear by present information, and has been the subject of some controversy.

In the Burchell Lake area, near highway No. 11 about ½ mile east of the east boundary of Ames township, pillow lavas face north, toward the metasedimentary rocks. The metasedimentary rocks here also face north. This relationship, together with the essentially conformable nature of the contact, suggests that the metasedimentary rocks stratigraphically overlie the metavolcanic rocks.

That the relationship is more complex than that suggested above is indicated by evidence from the Kashabowie area, a few miles east of the Burchell Lake area, where the metavolcanics-metasediments relationship has been studied by several workers.

On the basis of graded bedding, observed in the metasedimentary rocks near a metasediments-metavolcanics contact which he believed to be unfaulted, Tanton (1938b) concluded that the metavolcanic rocks stratigraphically overlie the metasedimentary rocks. He correlated the metasedimentary rocks with the Couchiching, the metavolcanic rocks with the Keewatin.

Perdue (1938) made a detailed study of this relationship in the Kashabowie area. He noted the presence of isoclinal folding in the metasedimentary sequence, and a slight discordance in strike of bedding in the metasedimentary rocks and schistosity in the metavolcanic rocks. Pillow lavas were found to face north toward the metasedimentary rocks. In most cases, the metasedimentary rocks near the contact were found to face south, but at one locality they were found to face north. It was concluded that the metavolcanic rocks and metasedimentary rocks were separated by a major thrust fault of unknown displacement, and that the relative age of the two groups is uncertain.

If the fault postulated by Perdue does, in fact, exist, it most probably also forms the boundary between the metavolcanic rocks and metasedimentary rocks within the Burchell Lake area.

The fault zone, if present in the Burchell Lake area, must be very narrow. Outcrops of metasedimentary rocks and metavolcanic rocks were in many places observed within 100 feet of one another. In all cases, the rocks near the contact exhibit little evidence of deformation. The pillow lavas at the contact are among the least deformed of the area; these pillows show no apparent distortion and are among the few within the area that provide reliable top determinations. Pillow lavas a few hundred feet stratigraphically below those at the contact are much distorted; many of the pillows are extremely elongated, and are totally unsuitable for top determinations. Yardley (1947) noted a lack of increased deformation near the contact within the Kashabowie area.

Faulting

As noted in the preceding paragraphs, a fault may separate the metavolcanic rocks from the metasedimentary rocks.

A northwest-striking fault lies along Crayfish Creek, near the east boundary of the map-area. Perdue (1938) shows this fault as extending about 1 mile southeast of the map-area, and offsetting the postulated boundary fault between the metavolcanic and metasedimentary rocks.

Tiny faults, with offsets of inches or fractions of inches, are common in the metasedimentary rocks.

Several conspicuous lineaments, which are evident on air photographs, are topographically expressed as valleys, and may represent faults. The most prominent is that which extends northeast through the western arm of the larger unnamed lake lying north-northwest of Span Lake. Cataclastic textures are prevalent in the granite and syenite near the lineament. Other prominent lineaments exist south of highway No. 11 about 1½ miles east of the east boundary of Ames township and south of Crayfish Lake near the east boundary of Ames township.

The extensive zone of chlorite schist about the shores of Upper Shebandowan Lake suggests the existence of a major shear zone lying near the axis of the lake.

Age of Metamorphism and Granitic Intrusion

Potassium-argon age determinations indicate that regional metamorphism and intrusion of some, at least, of the granite occurred about 2,500 million years ago. Age determinations were made on biotite, taken from one sample of lamprophyre from within the map-area, and from one sample each of granite and metasedimentary rock from nearby localities. The ages are tabulated below.

Rock Type	K-A Age	Location of Sample	Reference
	million years		
Granite(1)	2,550	Kashabowie Lake, 4 miles east of map-area.	Goldich *et al.* 1961, p. 70.
Biotite paraschist(2)	2,500	Highway No. 11, ½ mile west of map-area.	Lowdon *et al.* 1961, p. 58.
Lamprophyre(3)	2,610	North Coldstream mine.	Taylor 1957, p. 37.

(1)Sample No. KA-258; determination by University of Minnesota.
(2)Sample No. GSC 60-98; determination by Geological Survey of Canada.
(3)Sample No. not listed; determination by University of Minnesota.

The granite dated is from the granite body that lies north of the metasedimentary rocks. The metasedimentary rock dated is from the northern border zone of the metasedimentary unit; the age of this rock is the age of metamorphic recrystallization, and is a minimum for the age of deposition of the sediments.

ECONOMIC GEOLOGY

Copper, iron, and gravel deposits exist within the area.

Copper is currently produced by North Coldstream Mines Limited. To the end of 1961, the total value of copper, together with that of minor byproduct gold and silver, produced from this property was $9,337,132.

Some exploration work has been carried out in the vicinity of the iron deposits. Gravel has been used for road construction in the area.

Copper

The sulphide minerals of the copper deposits consist of chalcopyrite and pyrite, sometimes accompanied by very subordinate pyrrhotite, which have replaced and filled fractures in the host rocks.

The orebodies of the North Coldstream mine are massive sulphide bodies, disseminated sulphide bodies, and concentrations of narrow sulphide stringers. The principal host rock is a very siliceous, aphanitic, brittle, brecciated rock, known locally as chert. A small amount of ore is derived from mineralized schists that flank, or are included within, the main chert zone. In these rocks, the sulphides form narrow stringers along schistosity surfaces.

Sulphide bodies on the adjoining property of The Shield Development Company Limited are also in chert. The indicated Shield ore zone is an extension of the North Coldstream ore zone.

Elsewhere in the area, disseminations and narrow stringers of sulphides are found most commonly in acid metavolcanic rocks, less commonly in basic metavolcanic rocks, and only seldom in basic and acid intrusive rocks.

In general, the known copper deposits are to be found principally in the relatively hard and brittle rocks of the area. Emplacement of the sulphide bodies appears to have been controlled, in part at least, by the availability of openings in the country rocks. The chert and acid metavolcanic rocks appear to have fractured more readily than other rocks of the area and, thus, have afforded more numerous openings for sulphide deposition.

On a broad regional scale, the known copper deposits are found close to the margins of the main band of acid metavolcanic rocks. Most of the deposits, including the North Coldstream and Shield deposits, lie near the southern margin of the band. In this regard it is noteworthy that, about 5 miles southwest of the map-area, two small chalcopyrite showings lie along the south margin of the band (Moretti 1957); this is mentioned also in assessment work reports submitted by MacLeod-Cockshutt Gold Mines Limited.

In further prospecting for copper deposits, attention should be concentrated upon the relatively hard and brittle rocks of the area, which are the chert and the acid metavolcanic rocks. The zone about the southern boundary of the main acid metavolcanic band would appear to be a favourable zone for copper deposition.

Aeromagnetic maps are useful in tracing the main band of acid metavolcanic rocks southwesterly, beyond the area of detailed mapping (O.D.M. *and* G.S.C. 1961). The band and certain of its satellitic acid plutons appear as a magnetic low that can be traced for about 33 miles southwest of the map-area. Reconnaissance work (Tanton: 1938b; 1940) indicates that the westernmost 20 miles of this magnetic low is probably underlain by granite; from present information the acid metavolcanic band appears to extend about 13 miles southwest of the map-area, to the vicinity of the east boundary of Quetico Provincial Park.

Iron

Magnetite is found in iron-formation zones, which are intercalated with basic tuffs. Known iron-formation zones are restricted to the southern part of the south belt of basic metavolcanic rocks, and are exposed north and west of Grouse Lake and the larger of the two unnamed lakes immediately southwest of Grouse Lake. Exposed individual iron-formation zones are small; they do not appear to exceed 300 feet in length, and do not exceed 60 feet in thickness. The iron-formation zones constitute a minor part of the tuff–iron-formation assemblage.

A small zone of strong magnetic attraction exists near the south shore of Firefly Lake. A magnetometer survey conducted on lines spaced at 400-foot intervals obtained off-scale readings on two adjacent lines (Walter 1957). The interpreted area of off-scale readings strikes northeast, is 700 feet long, and ranges in width from 50 to 250 feet. Outcrop is lacking, and trenching to a depth of 12 feet failed to reach bedrock. The anomalous zone lies in that portion of the south basic metavolcanic belt in which iron-formation zones are known to occur and, therefore, it is probably caused by a small iron-formation zone.

Gravel

Gravel from local deposits has been used in road construction in the area.

Description of Properties

All properties patented as of the end of 1961 are described in this section.

During the 1950s, many companies carried on exploration activities in the area, but only a few of the companies patented any claims. In those cases where the work on unpatented properties produced significant results, or involved diamond-drilling, the work is described under the appropriate company name. Work done by companies, and not described herein, is described in the assessment work reports listed on page 3.

ANDOVER MINING AND EXPLORATION LIMITED (3)

Location and History

At the end of 1961, Andover Mining and Exploration Limited held forty-three patented claims in the vicinity of Fountain Lake.

The property was previously owned by Greatlakes Copper Mines Limited, which prior to 1953, carried out prospecting and geological mapping, and drilled ten short holes.[1] Newkirk Mining Corporation Limited optioned the property, and carried out a resistivity survey in 1954. The property subsequently reverted to Greatlakes Copper Mines Limited; in 1956-57, this company carried out an

[1]The logs of the holes were not available to the author.

electromagnetic survey and drilled 15 holes, with a total length of 5,477 feet. The present owners acquired the property in 1958.

General Geology

The property is underlain by basic and acid metavolcanic rocks that have been intruded by diorite, syenite, and granite. Twelve chalcopyrite occurrences are known; private reports to the owners indicate that only three consist of more than traces of chalcopyrite. These three occurrences are indicated on the accompanying map and are described below.

Description of Occurrences

No. 3 Occurrence

This showing lies in the northwest quadrant of claim T.B.32138, about 200 feet east of the east border of Moss township, and about 1,800 feet south of the point at which the township border meets the southeast shore of Fountain Lake.

The host rock is described in company reports as chert, which locally grades to cherty rhyolite. The chert band strikes easterly, and dips to the south at 80°–85°. Fractures in the chert contain pyrite, chalcopyrite, and quartz, over an area 27 feet long by 12 feet wide (Sheppard 1954, p. 12).

Sheppard (1954, p. 13) states:

Diamond drill holes Nos. 5 to 9 were drilled in November 1952 from the same setup on top of the main trenched zone no. 3. The following samples were taken from these holes:

Sample No.	Drillhole No.	Depth of Sample	Copper	Zinc	Nickel
		feet	percent	percent	
1	6	68	1.98	0.05	trace
3	5	19	0.46	——	——
4	5	90	5.08	——	——

These samples were grab samples selected from what appeared to be the best mineralized lengths found in the core.

. . . .

The drilling from this location showed that an irregular wedge-shaped plug of chert touches the surface at this point. It strikes west and plunges west, widening out in depth. The chalcopyrite mineralization appears to decrease rapidly with depth.

Hole M-4, collared 130 feet west of holes 5 to 9, was designed to explore the occurrence at depth. Basic metavolcanic rocks and numerous small chert bands were intersected. Chalcopyrite and pyrite formed small stringers in, and were disseminated in, chert, basic metavolcanic rock, and cherty, brecciated, basic metavolcanic rock. No assays were reported (Broadhurst and Morrison 1956).

No. 6 Occurrence

The occurrence lies in the southwest quadrant of claim T.B.32271, about 500 feet east of the point at which the east border of Moss township meets the southeast shore of Fountain Lake. Bridger (1954, p. 9) has described the occurrence as follows:

The no. 6 showing . . . consists of a weak shear zone, located close to a contact between rhyolite and andesite. This shear zone strikes N.80°E., dips about vertically, and contains fairly heavy pyrite mineralization, over 6 to 12 inches. A little chalcopyrite and sphalerite was noted . . .

No. 12 Occurrence

This mineralized zone is in claims T.B.43383 and 43384, east of Hermia Lake in the northeast corner of the company's property. The attitude and extent of the zone are not well defined. Present data suggest an east strike and, in this direction, the zone has been traced for a length of about 1,300 feet.

Chalcopyrite and pyrite are found as stringers and disseminations in acid and basic metavolcanic rocks, chert, diorite and syenite. Brecciated acid metavolcanic rocks appear to be the most favourable host rock.

The mineralized zone lies, in part at least, beneath the buried pre-glacial valley that is described earlier, in the section devoted to Pleistocene geology. Overburden depths as great as 150 feet were encountered in drilling the deposit.

Outcrops are exceedingly scarce in this region. Attention was attracted to the area by a small surface showing of chalcopyrite, described by Bridger (1954, p. 10) as follows:

It consists of a very strong shear zone in basic lavas. This strikes about N.80°W. and dips vertically. It is up to 8 feet wide. It contains fair pyrite mineralization throughout, and in places, concentrations of chalcopyrite across a width of 3 to 5 feet.

This occurrence has been traced, in several trenches, for a length of 100 feet, passing into overburden at both ends.

Five holes, with a total length of 2,117 feet, were drilled in the vicinity of the showing. They are shown on map No. 2036. From west to east, the drillhole numbers are M-6, M-5, M-7, M-8, and M-9. The surface showing lies between holes M-6 and M-5.

The following compilation of drilling data is summarized from reports of Broadhurst and Morrison (1956; 1957).

Holes M-5 and M-6 encountered minor pyrite and chalcopyrite in chlorite schist, diorite, and chert. No assays were reported.

Hole M-7 cut chlorite schist, andesite, rhyolite, chert, and diorite. Assay results, taken from Broadhurst and Morrison (1957, p. 7) are summarized below.

Summary of Assay Data

Footage	Core Length	Copper	Host Rock
	feet	percent	
230–244......	14	0.80	Breccia; chert and rhyolite fragments in silicified chloritic matrix.
277–285.5.....	8.5	1.00	
327–335......	5	0.60	Diorite, sheared.

Hole M-8 did not reach bedrock.

Hole M-9 cut acid and basic metavolcanics, diorite, and syenite. Assay results presented below are summarized from Broadhurst and Morrison (1957, pp. 7, 8).

Summary of Assay Data

Footage	Core Length	Copper	Gold	Host Rock
	feet	percent	ounces	
504 –506.5..........	2.5	0.32	0.02	Syenite.
506.5–511.5..........	5.0	0.37	0.02	Syenite.
593 –598............	5.0	0.28	0.01	Acid metavolcanic.
598 –601............	3.0	0.36	0.03	Acid metavolcanic.
655 –659............	4.0	1.10	0.03	Acid metavolcanic, brecciated.
667 –673............	6.0	0.49	0.02	Acid metavolcanic, brecciated.
673 –679............	6.0	0.73	0.02	Acid metavolcanic, brecciated.
681 –683.5..........	2.5	0.34	0.03	Acid metavolcanic, brecciated.
688 –691............	3.0	0.59	0.02	Acid metavolcanic, brecciated.
691 –694............	3.0	0.28	0.02	Acid metavolcanic, brecciated.
694 –699............	5.0	0.37	0.02	Acid metavolcanic, brecciated.
699 –703............	4.0	0.48	0.01	Acid metavolcanic, brecciated.
762.5–764.5..........	2.0	1.09	0.03	Diorite, silicified, brecciated.
769 –771............	2.0	0.77	0.02	Acid metavolcanic, brecciated.
786.5–791............	4.5	0.47	0.03	Acid metavolcanic, brecciated.

ARCADIA NICKEL CORPORATION LIMITED (7)

The company carried out electromagnetic and magnetometer surveys in northeastern Moss township. In 1957, four holes having a total length of 1,329 feet were drilled. Three of the holes were drilled to investigate an electromagnetic anomaly lying along the contact between the metavolcanic and metasedimentary rocks. The anomaly apparently indicated the presence of graphitic zones in both rock types near the contact.

A chalcopyrite occurrence is reported near the east border of Moss township, about ¼ mile north of Burchell Lake, by Zurowski (1957, p. 2), as follows:

> In the southeast corner of claim T.B.83367, disseminated pyrite and meagre chalcopyrite mineralization was noted in a sheared silicified rhyolite. The mineralization occurs on the south side of a bluff, and could not be traced for any distance because of the heavy mantle of snow.

Hole No. 4, with a depth of 299 feet, was drilled beneath this occurrence. It encountered rhyolite with meagre pyrite. No chalcopyrite was found.

BURCHELL LAKE MINES LIMITED (8)

In 1956, Burchell Lake Mines Limited drilled six holes, having a total length of 5,272 feet, near the southeast shore of Burchell Lake. Rhyolite and minor amounts of syenite were intersected. Pyrite and traces of chalcopyrite were reported, the latter being found predominantly in rhyolite. No assays were reported.

GAY INCORPORATED (4)

This company holds six patented claims in Moss township, most of which lie within the Burchell Lake map-area. The property is underlain by metasedimentary and basic metavolcanic rocks, which have been intruded by narrow sills of diorite and syenite.

HERMES MINES LIMITED

Hermes Mines Limited carried out prospecting about 1952 on a property on the west shore of Burchell Lake. This property is not shown on Map No. 2036. Page (1952) reported the presence of pyrite and minor chalcopyrite in chert and sericite schist north of Burchell Lake, and on the shore of the lake about ¾ mile east of the east boundary of Moss township. No dimensions nor assay values were reported.

JACK LAKE MINES LIMITED (9)

In 1956, Jack Lake Mines Limited drilled five holes, with a total length of 2,435 feet, about 1½ miles west of the east boundary of the map-area, ¼ mile south of highway No. 11. Rhyolite was intersected.

KINASCO EXPLORATION AND MINING LIMITED (10)

In 1956–57, this company drilled ten holes in the region that lies about 1 mile northwest of Squeers Lake. The holes had a total length of 2,658 feet. Only five of the holes are shown on Map No. 2036; the remainder could not be plotted at this scale. The holes encountered basic metavolcanic rocks, biotite schist, gabbro, and syenite.

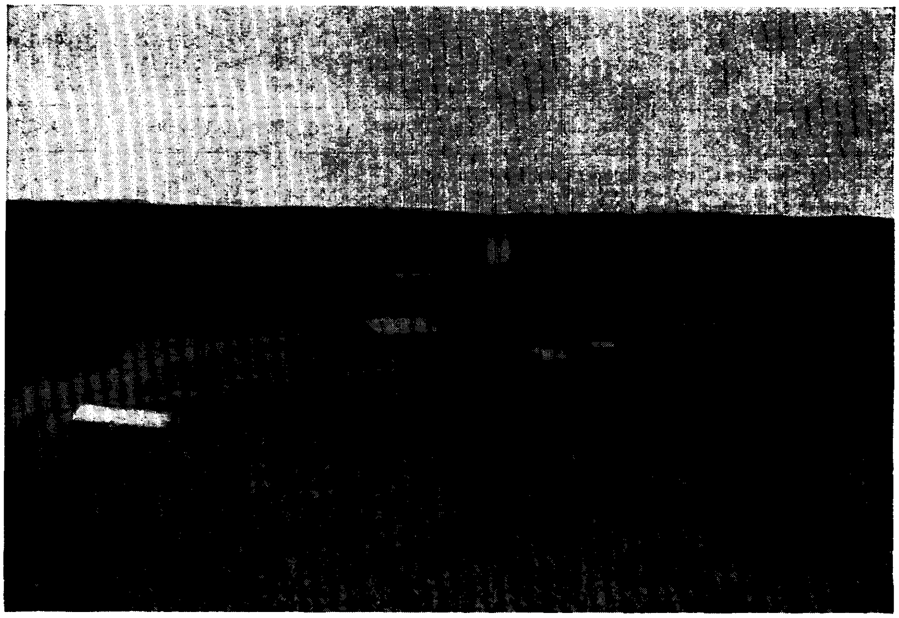
NEW JACK LAKE URANIUM MINES LIMITED (12)

In 1956 and 1957, the company drilled 13 holes, with a total length of 9,215.5 feet, in the vicinity of the lake 3 miles northeast of the North Coldstream mine, and near the road extending from highway No. 11 to the village of Burchell Lake. Basic and acid metavolcanic rocks, and gabbro, were intersected. A few traces of chalcopyrite were found in acid and basic metavolcanic rocks. No assays for copper were reported.

NORTH COLDSTREAM MINES LIMITED (1)

Property and History

The company held forty-six claims under patent and licence of occupation in 1961, as well as several unpatented claims. All production to the end of 1961 has been derived from claim K.65, ¼ mile east of the village of Burchell Lake.



Plant, North Coldstream Mines Limited.

Copper was discovered at the present mine site in the 1870s, and several claims, including K.65, were patented during that decade. In 1902, The New York and Canadian Copper Company Limited was incorporated, and acquired the discovery, then known as the Tip Top mine. Copper was produced in 1903, 1906, and 1916-17; data are given in the table under Production and Ore Reserves.

Diamond-drilling was carried out in 1942 by Frobisher Exploration Company Limited. Greatlakes Copper Mines Limited subsequently carried out further exploration work.

In 1951, Coldstream Copper Mines Limited was incorporated, and acquired the property. A new vertical three-compartment shaft was sunk, the mine was prepared for production, and a mill and service facilities were constructed. Production commenced in June 1957 and continued until February 1958.

The company was reorganized in 1959, and the name was changed to North Coldstream Mines Limited. Production was resumed in February 1960. The main production shaft has a depth of 1,596 feet. Levels have been established at depths of 200; 350; 500; 650; 800; 950; 1,100; 1,250; and 1,400 feet.

From 1942 until 30 June 1962, a total of about 189,600 feet of diamond-drilling was carried out on the property.

Production and Ore Reserves

PRODUCTION, NORTH COLDSTREAM (TIP TOP) MINE
(Data from Statistician of the Ontario Department of Mines, and from company annual reports. For blank spaces, figures are not available).

Year	Milled	Concentrate	Copper	Gold	Silver	Value
	tons	tons	pounds	ounces	ounces	
1903(1).......	——	——	768,000	——	——	$ 30,720
1906(1)(4).....	——	——	72,000	——	——	7,200
1916(1).......	——	——	52,467	——	——	9,831
1917(1).......	——	——	420,512	——	——	84,677
1957(2).......	89,493	7,585	3,593,911	656	15,699	1,076,161
1958(2).......	33,094	3,457	1,728,089	313	7,657	456,563
1960(3).......	266,154	24,521	11,462,930	2,208	53,354	3,594,510
1961(3).......	232,783	24,471	13,395,790	3,047	62,795	4,077,470
Total.....	——	——	31,493,699	6,224	139,505	$9,337,132

(1)New York and Canadian Copper Company Limited.
(2)Coldstream Copper Mines Limited.
(3)North Coldstream Mines Limited.
(4)Production for 1907 is believed to be included in this figure. Production figures for 1907 are not mentioned in Departmental publications: Metal Resources Circular No. 2, p. 48; Ont. Bur. Mines, Vol. XVII, 1908, p. 21.

Ore reserves at the end of 1961, after allowing for dilution, were estimated to be 1,558,000 tons, having an average grade of 2.08 percent copper (North Coldstream Mines Limited, Annual Report for the year ended 31 December 1961).

General Geology

The property is underlain by acid and basic metavolcanic rocks, gabbro, diorite, syenite, granite, basic and acid dikes and chert. The mine is on the south side of a gabbro mass that has intruded the contact separating the main rhyolite band from the south belt of basic metavolcanic rocks.

The gabbro, like the metavolcanics, has been highly sheared. The shearing is especially noticeable along its southern margin, where much of the gabbro has been converted to chlorite schist.

Contacts and schistosity, in the immediate vicinity of the mine, strike east and dip steeply north or vertically.

Economic Geology

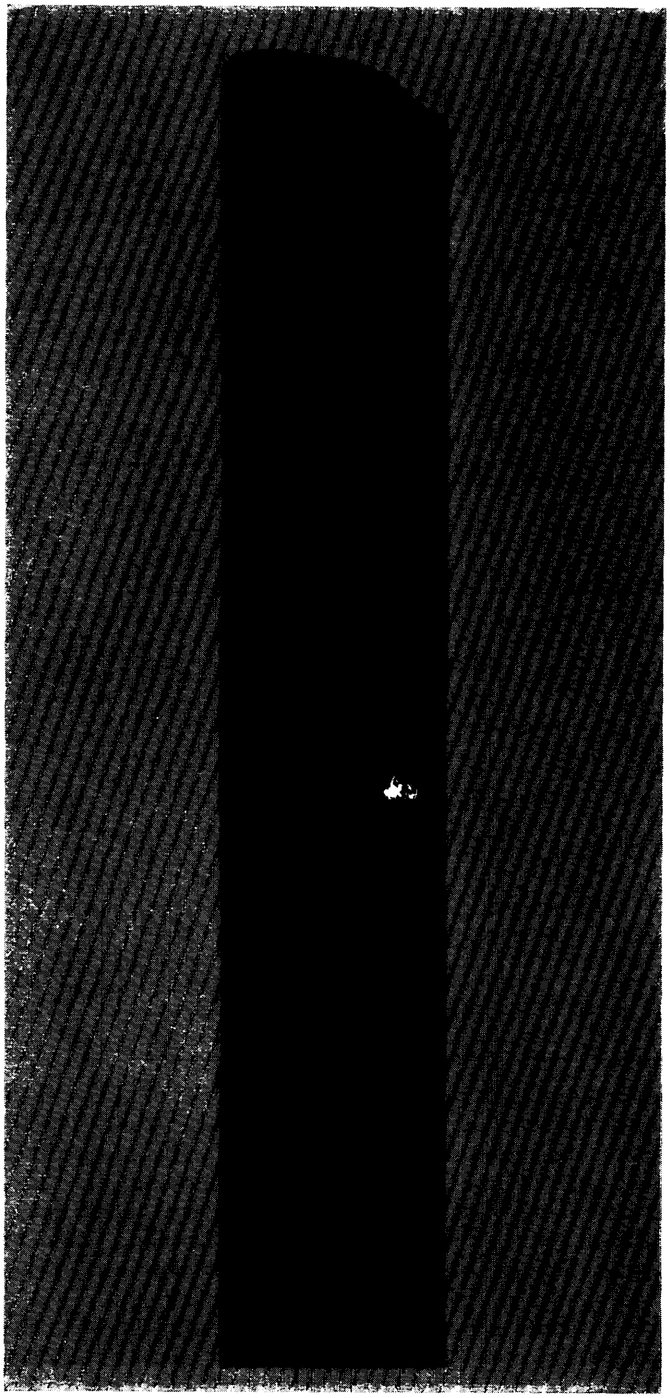
Introduction

Most of the sulphide orebodies are restricted to a lenticular body of highly siliceous rock, locally termed chert; a very minor quantity of ore is derived from mineralized schists that flank, or are included within, the main chert body.

The principal body of chert strikes east, dips to the north at 80°–90°, and plunges east at about 50°. In plan, it attains maximum dimensions of about 1,000 feet in length, and 400 feet in width. It lies between a hanging wall of sheared gabbro and chlorite schist on the north, and a footwall of chlorite schist, sericite-quartz-carbonate schist, and basic metavolcanic rocks on the south. Smaller chert lenses lie in the footwall schists. Several lenses of chlorite schist, and of sericite-quartz-carbonate schist, lie within the main chert body. The chert, and orebodies, are cut by east-striking, successively younger dikes of diorite, lamprophyre, and feldspar porphyry.

Chert

The chert is blue-grey, grey, and various shades of brown, and is aphanitic. Although it is a massive rock for the most part, in some parts it exhibits banding.



Banded and brecciated chert; North Coldstream Mines Limited. Photo is not to scale. Core sample is actually 5½ inches long.

The lenticular bands are thin, ranging in thickness from a fraction of an inch to about 1 foot, and they extend over observed strike-lengths of a few feet. The banded chert grades, almost imperceptibly, into massive chert. The attitude of the banding is irregular in detail, but in general is conformable with the regional attitude. The banding is, in many places, offset a fraction of an inch along extremely thin quartz-filled fractures.

Very small angular fragments of chert enclosed in a chert matrix of slightly differing colour are common. There is a marked tendency for such fragments to be concentrated within certain bands. The maximum observed thickness of such a breccia band was 10 inches.

The chert consists almost entirely of quartz; with minor amounts of carbonate, albite, white mica, chlorite, leucoxene, and magnetite. Minute discrete grains of pyrite and chalcopyrite are disseminated throughout the greater part of the chert zone. Chemical analyses of two samples of chert are presented in the accompanying table.

CHEMICAL ANALYSES OF TWO SAMPLES OF CHERT, NORTH COLDSTREAM MINE
(Analyses by Laboratory Branch, Ontario Department of Mines)

	Sample S-2 Taken from No. 3-3-53 Crosscut	Sample S-5 Taken from No. 6-4E-58 Subdrift
	percent	percent
SiO_2	92.84	92.22
Al_2O_3	2.44	2.81
Fe_2O_3	0.16	1.21
FeO	0.32	0.37
CaO	0.21	0.24
MgO	trace	trace
Na_2O	0.04	0.04
K_2O	0.12	0.04
H_2O+	nil	0.11
H_2O-	nil	nil
P_2O_5	nil	nil
TiO_2	3.72	2.93
Cr_2O_3	trace	trace
MnO	trace	trace
V_2O_3	trace	0.02
CO_2	nil	0.12
	99.85	100.11
Specific Gravity	2.65	2.60

In thin sections, the massive chert is seen to consist of anhedral quartz grains, throughout which the accessory minerals are disseminated. The quartz grains range in size from those just resolvable to those with an observed maximum dimension of about 0.1 millimetre. Many quartz grains exhibit a parallel elongation. In some specimens that appear massive to the naked eye, thin-section study reveals a faint banding that is caused by alternating bands of coarse and fine-grained quartz. Elongation of the quartz grains, if present, is parallel to the banding.

The plagioclase exhibits varying degrees of alteration to white mica. Magnetite, pyrite, and chalcopyrite most commonly exist as tiny discrete grains that appear to occur within quartz grains as well as along grain boundaries. The sulphides also exist as tiny veinlets. While leucoxene frequently surrounds magnetite, most leucoxene is not associated with magnetite, and appears as small irregular-shaped patches disseminated throughout the rock. Relict triangular intergrowths of magnetite and titanium minerals were noted by Carson (1958) in the chert from the adjoining property of The Shield Development Company Limited.

Megascopically visible banding appears to be the result of two features: (1) alternation of coarse- and fine-grained quartz bands; and, more commonly, (2) pronounced enrichment of leucoxene in certain bands.

The angular fragments of chert, which lie in a chert matrix, exhibit a complete gradation in size from those just discernibly larger than the groundmass, to those that attain maximum observed dimensions of about 7 millimetres. Nearby fragments often display matching borders. Under crossed nicols each fragment is seen to consist of a mosaic of fine-grained equigranular quartz grains, whose maximum dimension is about 0.1 millimetre. The fragments are set in a groundmass of quartz, leucoxene, and pyrite. The groundmass quartz grains are generally less than 0.1 millimetre in maximum dimension. Leucoxene is finely disseminated throughout the groundmass in such quantity that, in reflected light, it imparts a uniformly white appearance to the groundmass in most specimens. Pyrite is disseminated throughout both groundmass and fragments.

Contact relationships of the chert and the wallrock schists are variable. Sharp contacts exist between chert and the sericite-quartz-carbonate schists. Contacts of the chert with gabbro, chlorite schist, and basic metavolcanic rocks, are sharp in some cases, gradational in others. The transition from basic wallrock to chert is marked by an increasing content of disseminated blue quartz in the basic rock, accompanied by considerable disseminated magnetite. The zone of transition is, in these places, generally several feet wide.

Chert near such a gradational contact is generally bluish in colour, contains abundant fine-grained disseminated magnetite, and contains a few inclusions of the wallrocks.

The origin of the chert has been a subject of controversy in the past. The rock has been variously described, in published and private reports, as a fahlband, as quartzite, as quartz porphyry, and as the product of silicification of one or more of gabbro, basic volcanic rocks, and acid volcanic rocks.

Present evidence suggests that the chert has formed through silicification of its wallrocks, principally the basic wallrocks. In support of this hypothesis the following evidence is cited: (1) there is a transition, through gradual increase in quartz content, from basic wallrock to chert; (2) relict triangular intergrowths of titanium and iron minerals in the chert suggest derivation of the chert through replacement of a basic rock; (3) the uncommonly high, and apparently quite consistent, titanium content of the chert further suggests its derivation through silicification of a basic rock.

After its formation, the chert underwent severe brecciation.

Mineralization and orebodies

Chalcopyrite and pyrite, sometimes accompanied by very subordinate pyrrhotite, constitute the sulphide minerals of the ore zone. The fine-grained sulphides replace and fill fractures in the host rocks.

Chert is by far the most important host rock. A little ore is derived from the zone of transition from wallrock schist to chert, and from the schists that surround, or are included in, the main chert zone.

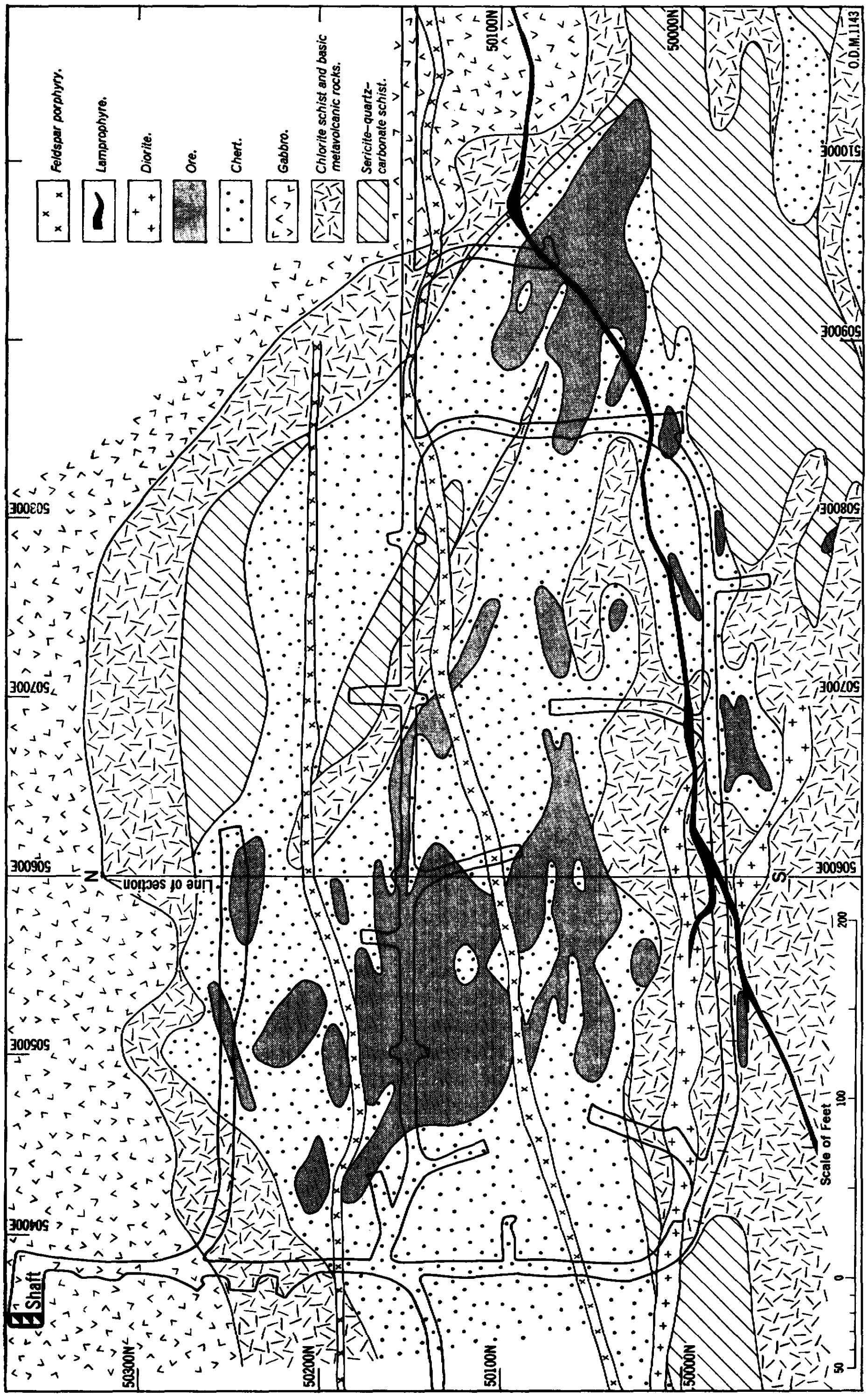


Figure 2 — Geological plan of the 500-foot level of the North Coldstream mine. (After mine plans, 1961.)

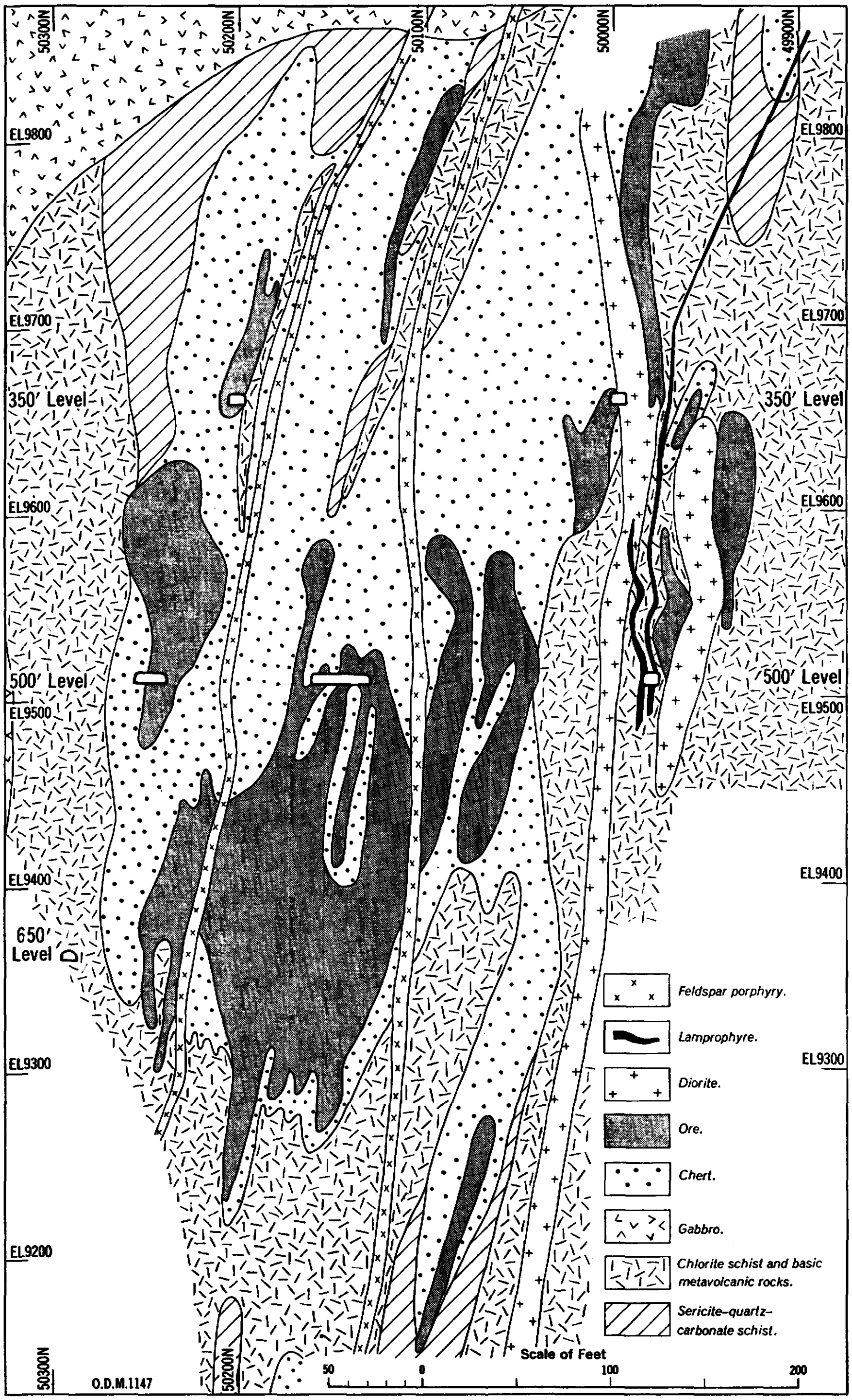


Figure 3 — Vertical geological section, looking east, showing the workings of the North Coldstream mine. The section is taken along the 50600E grid line as shown on Figure 2. Elevations shown are not related to sea-level, but are taken only from a local nominal datum. (After mine plans, 1961.)

Orebodies in the chert consist of massive sulphide bodies, disseminated sulphide bodies, and concentrations of narrow sulphide stringers. Most of the chert contains some disseminated mineralization and, therefore, orebody boundaries within the chert are determined by assay.

The orebodies, in common with their host rock, strike east, dip north at 80°–90°, and plunge east at about 50°. They are lenticular in shape, and are distributed, apparently at random, throughout the main chert zone. As may be noted from inspection of the accompanying typical plan and section the orebodies vary greatly in size.

Within orebodies, the ratio of chalcopyrite to pyrite varies widely and erratically over distances of a few feet. Parts of some orebodies exhibit pronounced enrichment in chalcopyrite near, and at, contacts between chert and chlorite or sericite-quartz-carbonate schist.

Sulphides in the schists included in, or surrounding, the main chert zone are found principally as narrow stringers along schistosity surfaces.

The orebodies are cut by three types of coarse-grained veins, all of which attain maximum observed thicknesses of a few inches and lengths of a few feet. The most common type of vein consists of quartz, carbonate, pyrite, and chalcopyrite. Carbonate veinlets constitute the second commonest type. Relatively rare are veins consisting of quartz, carbonate, barite, purple fluorite, dark brown sphalerite, and chalcopyrite.

Age of the Ore

As noted earlier, biotite from a lamprophyre dike that cuts the ore has been dated, by the potassium-argon method, at 2,610 million years. Its date of crystallization, or recrystallization, corresponds approximately with the age of metamorphism and granitic intrusion, suggesting that the ore was emplaced before or during the period of metamorphism and granitic intrusion.

Other Copper Occurrences

Several holes, drilled near the north and west shores of Burchell Lake by Coldstream Copper Mines Limited and North Coldstream Mines Limited, have encountered low-grade chalcopyrite mineralization. Logs submitted by the two companies as assessment work, show that the host rocks are acid metavolcanic rocks, chert, and syenite.

PARRY PROPERTY (13)
(Rio Tinto Canadian Exploration Limited, Option)

In 1956, the company held under option a group of claims in the vicinity of the lake 3 miles northeast of the North Coldstream mine. Electromagnetic, self-potential, magnetic, and geological surveys were carried out. Four holes, with a total length of 1,343.4 feet, were drilled. Chalcopyrite in acid metavolcanic rocks was encountered in the hole north of the lake. Assay data tabulated below were submitted as a personal communication to the author by the company.

SUMMARY OF ASSAY DATA

Footage	Core Length	Copper	Gold	Silver	Zinc
	feet	percent	ounces	ounces	percent
266.6–267.8..........	1.2	0.05	trace	trace	trace
271.6–272.4..........	0.8	0.12	trace	trace	nil
311.3–312.1..........	0.8	0.02	trace	trace	nil

RITCHIE ESTATE (5)

Four patented claims were held, as of 1961, by the C. H. Ritchie estate. The claims are underlain by gabbro and basic metavolcanic rocks.

ROSS ESTATE (6)

As of 1961, the C. F. Ross estate owned one full patented claim and portions of two patented claims within the map-area. These claims, lying south of Upper Shebandowan Lake, are part of a group that extends east of the map-area. Claims within the map-area are underlain by gabbro and basic metavolcanic rocks, which have been intruded by narrow sills of granite.

SHIELD DEVELOPMENT COMPANY LIMITED (2)

Shield Development Company Limited holds four patented claims lying east of Burchell Lake. Three claims are contiguous and lie east of the North Coldstream mine, the fourth lies west of the mine near the shore of Burchell Lake.

No outcrop exists on the single claim near the lake. The claim is probably underlain by acid metavolcanic rocks.

The property lying east of the North Coldstream mine is underlain by gabbro, basic metavolcanic rocks, and chert. The main chert zone of the North Coldstream mine extends easterly into the western portion of this claim group.

Drifts have been extended east from North Coldstream workings into Shield property on the 800-foot, 1,100-foot, and 1,400-foot levels. From 1956 until 30 June 1962, a total of 56,900 feet of diamond-drilling has been carried out on the property.

By the end of 1961, this work had indicated about 160,000 tons of ore, having an estimated grade of 2.63 percent copper after allowance for dilution, according to the annual report of The Shield Development Company Limited for the year ended 31 December 1961. The indicated ore is in three separate bodies, two of which adjoin the common boundary with North Coldstream Mines Limited.

TRUDEV PROPERTY (11)
(Mining Corporation of Canada Limited, Option)

The company formerly held three groups of claims in the vicinity of Fountain Lake: one group was south and southwest of the lake, one was east of the lake, the other was in the vicinity of Hermia Lake, Squeers Creek, and the north end of Fountain Lake. Electromagnetic and geological surveys were carried out. In 1957, 13 holes with a total length of 4,753 feet were drilled.

Chalcopyrite, accompanied by pyrite and pyrrhotite, was intersected in hole T2-8. This hole was collared about 150 feet north of Squeers Creek, and about ½ mile east of the point at which the creek enters Hermia Lake. The hole penetrated 200 feet of overburden before reaching bedrock. Assay data are summarized in the accompanying table.

Summary of Assay Data
(from log submitted as assessment work)

Footage	Core Length	Copper	Gold	Host Rock
	feet	percent	ounces per ton	
513.4–514.7	1.3	1.50	0.02	Granodiorite.
575.7–580.1	4.4	0.10	nil	Acid agglomerate.
580.1–582.0	1.9	0.58	0.005	Acid agglomerate.
582.0–584.2	2.2	1.14	0.02	Acid agglomerate.
639.0–640.0	1.0	1.22	0.03	Rhyolite tuff.

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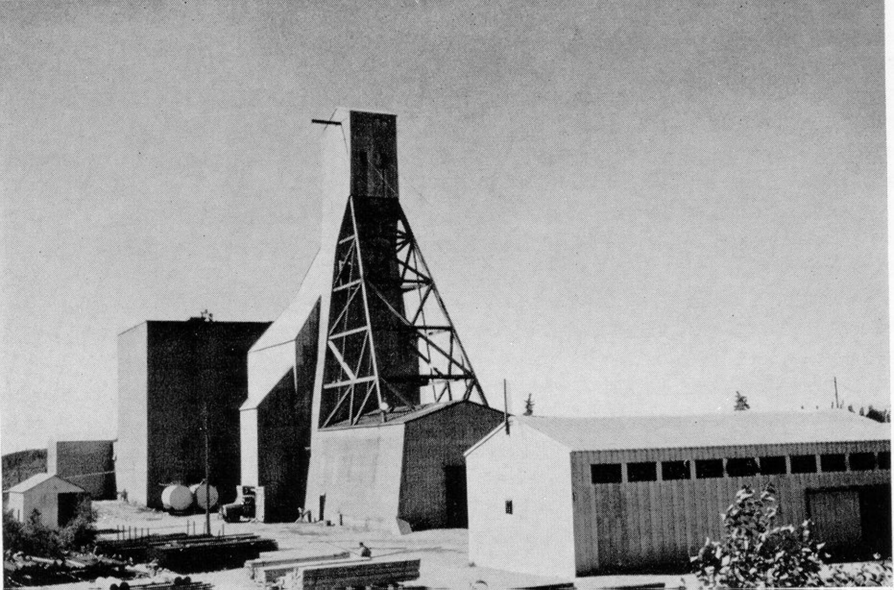
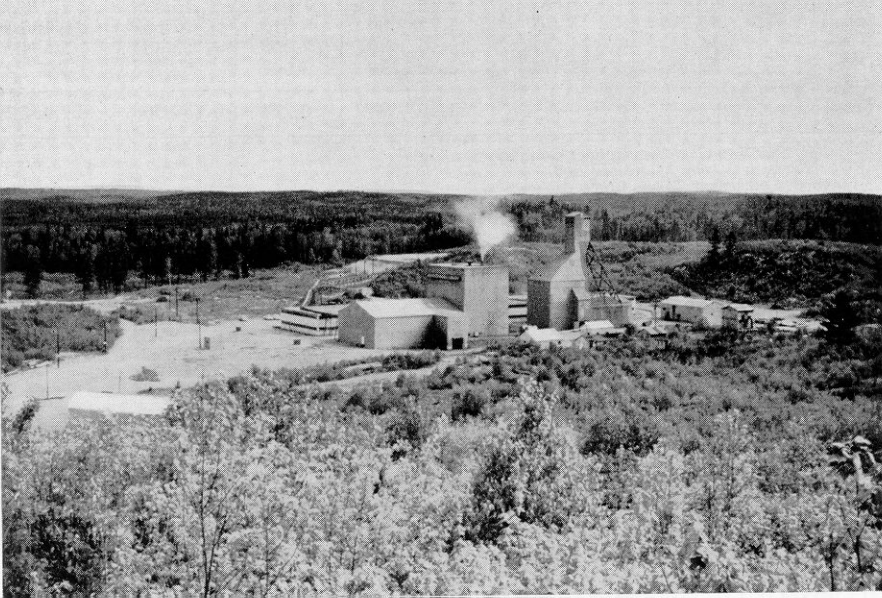
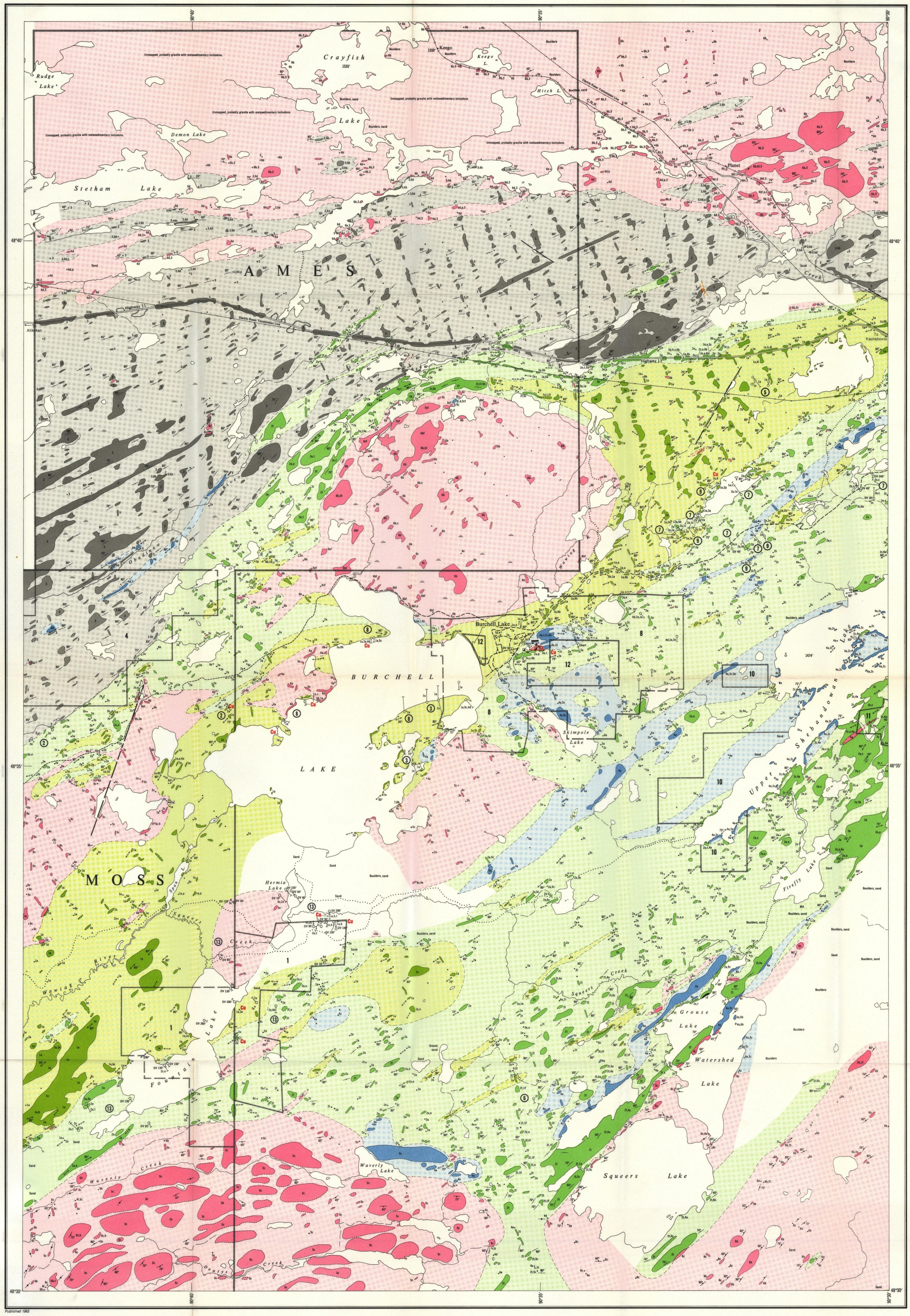




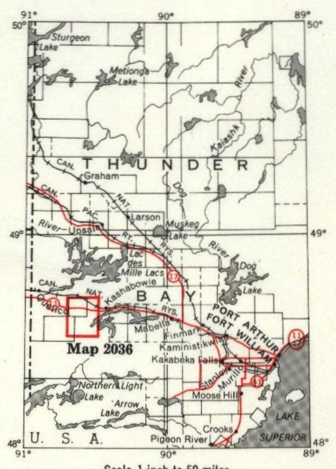
ONTARIO
DEPARTMENT OF MINES

HON. G. C. WARDROPE, *Minister of Mines*
D. P. Douglass, *Deputy Minister* M. E. Hurst, *Director, Geological Branch*



Published 1963

Map 2036
Burchell Lake Area



Scale, 1 inch to 50 miles

N.T.S. reference 52 B/7, 52 B/10

LEGEND

CENOZOIC*

RECENT

Swamp and stream deposits.

PLEISTOCENE

Sand and gravel.

GREAT UNCONFORMITY

PRECAMBRIAN**

PLUTONIC ROCKS

LATE BASIC INTRUSIVE ROCKS

7 — *7 Diabase dikes.*

INTRUSIVE CONTACT

GRANITIC ROCKS

6 — *6a Leucogranite.*
6b Biotite granite.
6bf Porphyritic biotite granite.
6c Hornblende granite.
6cf Porphyritic hornblende granite.
6d Muscovite granite.
6p Granite pegmatite.

SYENITIC ROCKS

5 — *5a Leucosyenite.*
5b Biotite syenite.
5bf Porphyritic biotite syenite.
5c Hornblende syenite.
5cf Porphyritic hornblende syenite.

INTRUSIVE CONTACT

EARLY BASIC INTRUSIVE ROCKS

4 — *4a Gabbro.*
4d Diorite.
4l Lamprophyre.

INTRUSIVE CONTACT

METASEDIMENTS AND METAVOLCANICS

METASEDIMENTS

3 — *3 Greywacke, biotite-feldspar-quartz schist.*

POSSIBLE FAULT CONTACT

BASIC METAVOLCANICS

2 — *2a Amphibolite, amphibolite schist.*
2c Chlorite schist.
2e Coarse gabbroic flows and intrusions.
2h Agglomerate.
2p Pillow lava.
2t Tuff, basic sedimentary rocks; iron formation (I.F.).

ACID METAVOLCANICS

1 — *1a Rhyolite.*
1b Rhyolite breccia.
1c Sericite schist.
1p Porphyritic rhyolite.
1t Rhyolite tuff.

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

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

SYMBOLS

Glacial striae.

Small rock outcrop.

Boundary of rock outcrop.

Geological boundary, defined.

Geological boundary, approximate.

Geological boundary, assumed.

70° — *Strike and dip; direction of top unknown.*

Strike and vertical dip; direction of top unknown.

70° — *Direction (arrow) in which inclined beds face as indicated by gradation in grain size.*

Direction (arrow) in which vertical beds face as indicated by gradation in grain size.

70° — *Direction (arrow) in which overturned beds face as indicated by gradation in grain size; dip in direction of loop.*

Direction (arrow) in which inclined beds face as indicated by cross-bedding.

Direction in which lava flows face as indicated by shape of pillows.

70° — *Strike and dip of schistosity.*

Strike of vertical schistosity.

Strike of schistosity, dip unknown.

70° — *Strike and dip of gneissosity.*

Strike of vertical gneissosity.

Lineation (plunge known).

Drag-folds. (Arrow indicates direction of plunge).

Lineament or fault.

Muskeg or swamp.

Railway.

Electric power transmission line.

Highway.

Motor road.

Wagon road.

Trail, portage, winter road.

Building.

70° — *Shaft, vertical or inclined.*

Gravel pit.

Drillhole, geology projected vertically to horizontal plane.

OV 200′ — *Depth of overburden in feet.*

Ore zone, 350-ft. level, projected to surface.

MA — *Magnetic attraction.*

Cu — *Copper occurrence.*

Township boundary, approximate position only.

8 — *Location of mining property, surveyed. See list of properties.*

(3) — *Location of mining property, unsurveyed. See list of properties.*

LIST OF PROPERTIES

1. *Andover Mining and Exploration Ltd.*
2. *Arcadia Nickel Corporation Ltd.*
3. *Burchell Lake Mines Ltd.*
4. *Gay Incorporated.*
5. *Jack Lake Mines Ltd.*
6. *Kinasco Exploration and Mining Ltd.*
7. *New Jack Lake Uranium Mines Ltd.*
8. *North Coldstream Mines Ltd.*
9. *Parry property, Rio Tinto Canadian Exploration Ltd. option.*
10. *Ritchie Estate.*
11. *Ross Estate.*
12. *Shield Development Co. Ltd.*
13. *Trudev property, Mining Corporation of Canada Ltd. option.*

Map 2036

BURCHELL LAKE AREA

THUNDER BAY DISTRICT

Scale 1:31,680 or 1 Inch to ½ Mile

Chains 80 60 40 20 0 1 2 Miles
Metres 1000 0 1 2 3 Kilometres
Feet 1000 0 5,000 10,000 Feet

SOURCES OF INFORMATION

Geology by P. E. Giblin and assistants, 1961.

Geological maps and plans of North Coldstream Mines Ltd.

Cartography by R. B. Robinson and P. A. Ralph, Ontario Department of Mines, 1962, 1963.

Base map compiled from Ontario Forest Resources Inventory maps, and air photographs.

The geology is not tied to surveyed lines.

Magnetic declination was approximately 3° E., 1961.