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Geology of
Lake Township
Hastings County

By
R. K. LAAKSO

Geological Report 54

TORONTO
1968

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2,000—E4—1968

ABSTRACT

This report describes the geology, structure, and mineral deposits of Lake township, Hastings county, an area of 115 square miles situated about 10 miles north of the village of Marmora. The township lies wholly within the Hastings Basin structural subdivision of the Haliburton-Bancroft area of the Grenville province of the Canadian Shield.

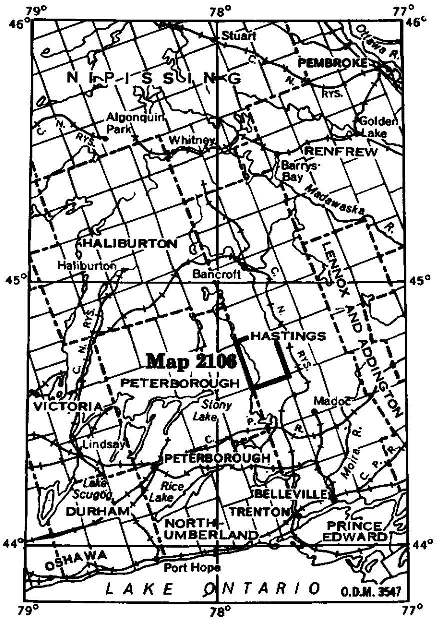

Figure 1 — Key map showing the location of the Lake township map-area. Scale, 1 inch to 50 miles.

The bedrock is of Precambrian and Paleozoic age. The oldest Precambrian rocks are metasediments and metavolcanics of the Mayo Group. They consist of marble, paragneiss, para-amphibolite, schist, and basic and acid metavolcanic rocks. These metasediments and metavolcanics are intruded by gabbro, diorite, syenite, and granite. The largest gabbro bodies are the Lake metagabbro and Tudor gabbro in the southeastern part of the township. The principal granite plutons are the Copeway and Freen granites.

In Paleozoic times, seas covered Lake township, and an outlier of Ordovician (Black River) rock is found at Vansickle.

The area was highly folded during the Grenville orogeny, the main axes of folding being northeast-southwest, parallel to the regional folding. Crossfolding occurs along axes trending northwest-southeast.

Deposits of iron, copper, lead, and talc have been found in the township; small tonnages of lead and iron ore have been mined.

Geology of

Lake Township

Hastings County

By

R. K. Laakso[1]

INTRODUCTION

Lake township comprises an area of approximately 115 square miles in the central part of Hastings county in southeastern Ontario. The area is covered by the Bannockburn and Coe Hill map-sheets of the National Topographic Series.[2]

Prospecting and Mining Activity. Prospecting and mining have been carried out in the area for over 60 years, mainly for iron, lead, copper, and gold.

The Katherine Lead mine was opened in the spring of 1899; sporadic mining and exploration for lead were carried on until the late 1930s. Prospecting and mining for iron have gone on intermittently around Whetstone Lake and along the Crowe River since 1900. There has also been interest in copper and iron prospects near the Crowe River.

Present Geological Survey. The present geological survey of Lake township was carried out in the summers of 1958 and 1959. The field party consisted of a senior geologist who examined the outcrops and a junior assistant who ran pace-and-compass traverses.

Plotting of geological data was done on acetate-foil sheets fitted over vertical air photographs on the scale of 1 inch to 1,320 feet. Pace-and-compass traverses were run between points easily recognizable on the air photographs. Owing to the abundance of topographic control features, such as rivers, lakes and roads, no base lines for traverse control were run. Traverses were usually spaced at ¼-mile intervals. Where bush cover was not too heavy, outcrop areas and the geology between traverse lines were generalized by stereoscopic examination of air photographs. Geological data were transferred from the acetate-foil sheets to a basemap, on the scale of 1 inch to 1,320 feet, by the Cartographic Unit of the Ontario Department of Mines from maps of the National Topographic Series. The original geological outcrop map compiled on the ¼-mile scale was reduced to 1 inch to ½ mile and redrawn with the geology generalized. The final map, No. 2106 (back pocket), is reproduced on the scale of 1 inch to ½ mile.

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[1]Graduate student, Department of Geology, Queen's University, Kingston, Ont., 1959. Manuscript received by Chief Geologist, 26 June 1964.

[2]Published at a scale of 1:50,000 by the Canadian Department of National Defence Survey Establishment; available from the Map Distribution Office, Canada Department of Energy, Mines and Resources, Ottawa.

Lake township

On this geological map, areas of many small outcrops appear as single outcrop areas. In Lake township the rocks commonly show abrupt variations; several rock types may appear in single outcrops. Therefore, on the final map the colours and symbols represent only the most prominent types exposed. Geological generalization is based on ¼-mile-interval traverses. The percentage of outcrop, especially in heavily wooded areas, may be small. In these areas, a string of outcrops indicate the traverse lines followed and show where the rock has been examined.

Acknowledgments. The author was assisted by Jack Bell in 1958 and by Lloyd Koskitalo in 1959. The party also received assistance from many residents and interested nonresidents, particularly from J. Armstrong, J. Bard, I. Sopha, and W. Thompson.

Previous Geological Work. Lake township was first mapped geologically in a reconnaissance fashion, by F. D. Adams and A. E. Barlow in the 1890s; it is included in their geological memoir on the Haliburton and Bancroft areas published in 1910.

The Marmora Sheet (Map 560A, Geological Survey of Canada), shows the extreme southwest corner of Lake township.

Thomson (1943) examined and described the mineral occurrences in the North Hastings area; this includes Lake township.

Abraham (1951) investigated the anomalies shown on the Geological Survey of Canada aeromagnetic maps Bancroft (15G) and Coe Hill (16G). The north part of Lake township is included in the Coe Hill sheet.

Means of Access. Beaver Creek, Crowe River, and Deer River and their tributaries provided early access into Lake township. In the 1850s, the Hastings colonization road from Belleville north to Maynooth provided access, since it forms a part of the east boundary of the township. The road to The Ridge settlement in Wollaston township provides access to the north part of Lake township. Only a part of the centre of the township is accessible by motor road at present. Most of these roads are of poor quality and are used as haulage roads for lumbering or as access roads to private cottages, lodges, and mining prospects.

Highway No. 62 from Madoc to Bancroft runs approximately parallel to the east boundary of Lake township at an average distance of 3 miles east of the township boundary. The Canadian National Railway line runs almost parallel to Highway 62 in Tudor township.

Topography. The maximum relief in Lake township is nearly 500 feet. The highest point (1,200 feet) is a hill to the north of the centre of the township, approximately 1 mile east of the eastern end of Copeway Lake, and the lowest point is in the southwest corner of the township in the valley of the Crowe River (750 feet).

The northwest corner of the township has the least overburden and exposes the most outcrop, up to 80 percent in places, while in the rest of the township the percentage of outcrop is not high.

Lake township contains over 60 lakes, ponds, and flooded areas. The largest of these lakes is Dickey Lake in the northeast corner of the township; it has a length of over 2 miles and is over ½ mile wide at its maximum width. Most of the lakes are in the northern part of the township.

The area is drained by Crowe River, Beaver Creek, and their tributaries: Deer River, Dickey Creek, and Little Jordan Creek. All of these waterways are navigable only with difficulty because of many rapids and waterfalls and the general shallowness of the streams, especially in recent years when there has been little control of water-levels by dams.

The entire drainage of this area is into Lake Ontario via the Trent and Moira river systems; but only the very southeast corner of the township is drained by the Moira system.

Natural Resources. The northwestern and southwestern parts of the township are being farmed. The Ridge settlement in Wollaston township extends a short distance into Lake township. The southwestern part of the township has few farms. The general lack of top soil and the rocky nature of the local terrain make most of the township unsuitable for farming. The farms grow hay and oats as their chief crops; cattle and pigs are also raised.

In the past, lumbering was important in the area. In 1959 only one sawmill operated; but, in the recent past, as many as six have been in operation.

Pickerel, bass, muskelunge, and trout are caught in the lakes and streams of the township. The local game consists of deer, elk, black bear, rabbits, partridge, and duck. Several heronries of the Great Blue Heron are protected by game laws.

GENERAL GEOLOGY

Lake township lies wholly within the Hastings Basin structural subdivision of the Haliburton-Bancroft area of the Grenville province of the Canadian Shield (Hewitt 1956, p. 22–41). The township adjoins Methuen, Wollaston, Tudor, and Marmora townships. The first three of these townships recently have been mapped geologically by the Ontario Department of Mines. The bedrock formations in the area are of Precambrian and Paleozoic age. The oldest Precambrian rocks are metasediments and metavolcanics. The metasediments are largely marble, paraschist, paragneiss, and meta-arkose; whereas the metavolcanics include greenstone schists, amphibolites, and rhyodacite flows and tuffs. The rocks were folded and metamorphosed during the Grenville orogeny and intruded by gabbro, granite, and syenite.

After mountain building, the area was eroded to a peneplane. During Paleozoic times, seas covered Lake township, and consequently an outlier of Black River limestone of Ordovician age occurs at Vansickle in Lake and Methuen townships.

The main axial trends of the folds in Lake township are northeast-southwest, parallel to the regional pattern of folding. Crossfolds have also developed at about right-angles to the main fold axis.

LAKE TOWNSHIP, TABLE OF FORMATIONS

CENOZOIC	Pleistocene	Sand, gravel, clay, silt, till.						
		Unconformity						
PALEOZOIC	Ordovician	Limestone, dolomitic limestone.						
		Unconformity						
				Western part of Lake twp.		Central part of Lake twp.		Southeastern part of Lake twp.
	Plutonic Rocks			Coe Hill Granite		Copeway Granite Freen Granite Whetstone Lake Gabbro		Gawley Creek Syenite Tudor Gabbro Lake Metagabbro
PRECAMBRIAN	Metasediments and Metavolcanics	Lake Subgroup[1]	Big Burnt Lake Formation			Basic Metavolcanics: Rhyodacite, Middle schist, Marble, Lower schist.		Marmora Volcanics(?)
				Southwest[2]	Northwest	Southwest	Northwest	Thompson Lake Beds(?): paraschist, greenstone, amphibolite, marble.
			Vansickle Formation[3]	Upper Marble, Middle Schist, Middle Marble, Lower Schist, Lower Marble.	Tangamong Lake Beds: marble, feather amphibolite, mica schist, garnet paraschist, amphibolite. Troutling Bay Volcanics.	marble, paraschist, amphibolite, scapolite amphibolite and schist.	Murphy Corners Beds(?): marble, amphibolite, paragneiss.	
			Oak Lake Formation[4]	Pink arkose, quartzites, amphibolite schist, feldspathic schist, volcanic amphibolite.	Ridge dome: pink arkose, paragneiss, feldspathic gneiss, volcanic amphibolite.			

[1]Appears to correlate with Mayo Group (Hewitt 1962, p.32).
[2]On Lake twp.—Methuen twp. boundary.
[3]Hewitt (1960, p.118).
[4]Hewitt (1960, p.117).

LEGEND, MAP 2106

CENOZOIC

RECENT AND PLEISTOCENE

Sand, gravel, clay, silt, till.

UNCONFORMITY

PALEOZOIC

ORDOVICIAN

10 *Limestone, dolomitic limestone.*

UNCONFORMITY

PRECAMBRIAN

PLUTONIC ROCKS

GRANITIC ROCKS

8L *Leucogranite, leucogranite gneiss (includes rocks of granodiorite and quartz monzonite composition).*
8b *Biotite granite.*
8h *Hornblende granite.*
8P *Granite pegmatite.*

INTRUSIVE CONTACT

SYENITIC ROCKS

7L *Leucosyenite, leucosyenite gneiss.*
7b *Biotite syenite, biotite syenite gneiss.*
7P *Syenite pegmatite.*

INTRUSIVE CONTACT

BASIC INTRUSIVE ROCKS

4Am *Orthoamphibolite.*
4Di *Diorite, quartz diorite.*
4Gb *Gabbro*
4Hb *Hornblendite.*
4Mg *Metagabbro, metadiorite.*

INTRUSIVE CONTACT

METASEDIMENTS

CALCAREOUS METASEDIMENTS

3 *Limestone, dolomite, marble; 3sil, silicated marble; 3b, impure marble.*
3A *Interbedded marble and amphibolite, paragneiss or schist.*
3Q *Sandy limestone or marble.*
3Sk *Skarn.*

NON-CALCAREOUS METASEDIMENTS

2A *Para-amphibolite, amphibolite schist, (hornblende-plagioclase gneiss and schist); 2 Ab, biotite amphibolite; 2Ag, garnet amphibolite; 2Ar, rusty amphibolite.*

2F *Arkose, quartzo-feldspathic gneiss, includes some quartzite, feldspathic gneiss or schist; 2Fr, rusty feldspathic gneiss or schist; 2Fa, feather amphibolite; 2Fd, pyroxene feldspathic gneiss or schist.*

2P *Paragneiss, psammo-pelitic gneiss and schist, biotite paragneiss; 2Pg, garnet paragneiss; 2Ph, hornblende paragneiss; 2Pr, rusty paragneiss or schist; 2Pc, calcareous paraschist or paragneiss.*

2agg *Agglomerate.*

2Q *Quartzite.*

2Sch *Schist, mica schist, argillite schist, some greenstone schist.*

METAVOLCANICS

BASIC METAVOLCANICS

1Am *Amphibolite, amphibolite schist, greenstone, greenstone schist.*

1agg *Agglomerate.*

1Fa *Feather amphibolite.*

ACID METAVOLCANICS

1F *Felsite, rhyodacite, acid tuffs, mica schist.*

1agg *Agglomerate.*

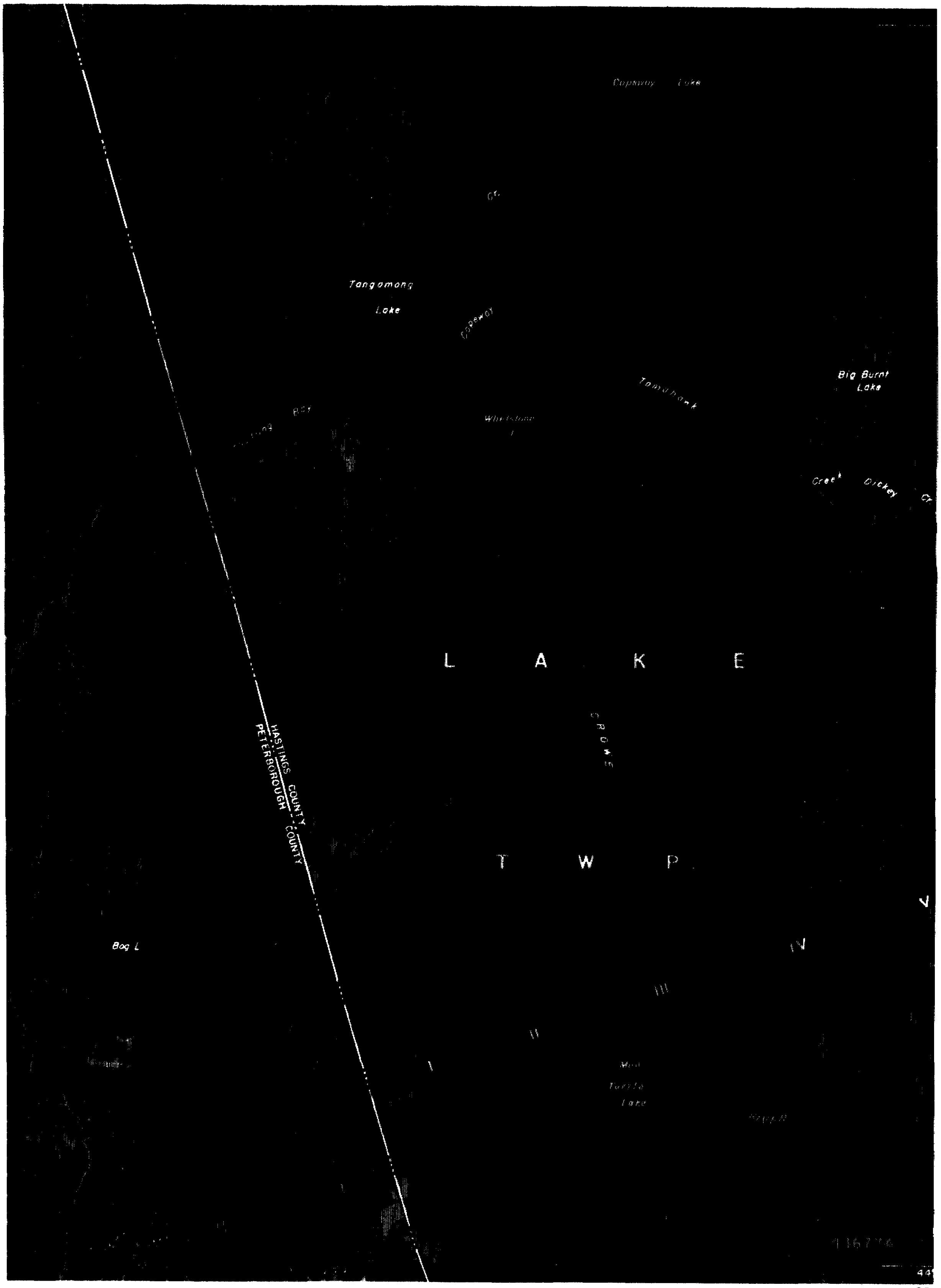

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Photo 1 — Vertical air photograph of the west part of Lake township. (Air photograph courtesy of Ontario Dept. of Lands and Forests.) Scale, 1 inch to 1 mile.

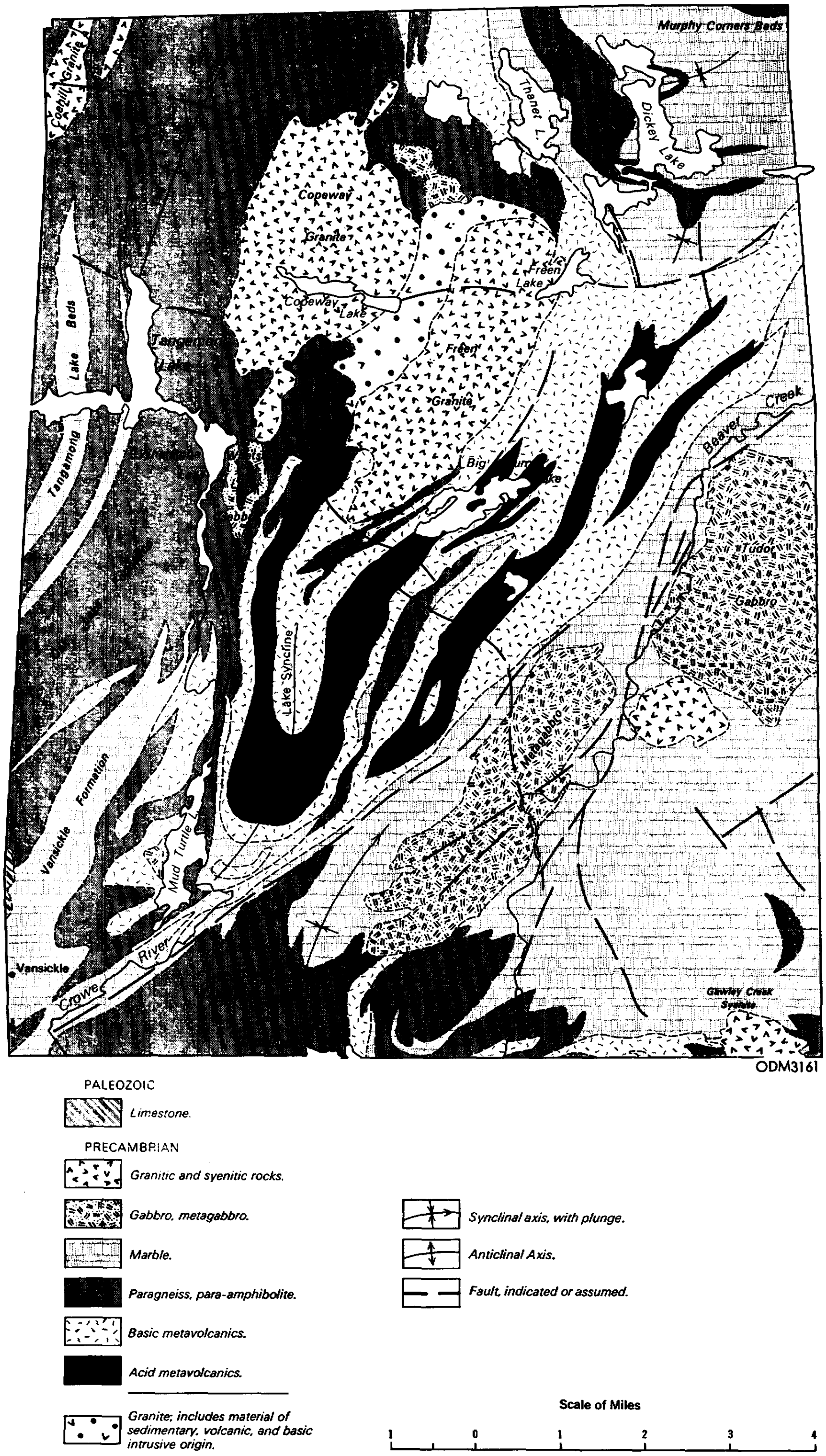

Figure 2 — The formations and major structures in Lake township.

METASEDIMENTS AND METAVOLCANICS

Metasedimentary rocks predominate in the western and southeastern parts of the township; metavolcanic rocks predominate in the Lake syncline trending northeast through the central part of the township. The rocks are described in three areas: western Lake township, the Lake syncline of central Lake township, and southeastern Lake township. Central and southeastern Lake township are separated over part of the area by a strong lineament striking northeast across the township from the southwest township corner.

WESTERN LAKE TOWNSHIP

In order to make the description simpler for the reader, the contact between the Oak Lake Formation and the Vansickle Formation has been taken as the boundary separating western Lake township from central Lake township.

Adams and Barlow (1910, p.177–180) first described the Oak Lake arkoses. Further work and definition have been done by Hewitt (1960, p.177, 118; 1962, p.36, 37) in Methuen and Wollaston townships. Hewitt (1960, p.117) describes the Oak Lake Formation in Methuen township as consisting of "5000 feet of pink arkose, and pink and grey quartzite, with some interbeds of amphibolite schist and greenstone schist."

West of the Oak Lake Formation in Lake township are metasedimentary and metavolcanic rocks tentatively called the Tangamong Lake beds; these appear to overlie the Oak Lake Formation and probably correlate with the Vansickle Formation.

Oak Lake Formation

The Oak Lake Formation trends from southeastern Methuen into Lake township; and across Lake township in a northerly direction toward Tangamong Lake and The Ridge dome.

The unconformity apparently separating the Oak Lake Formation from the Vansickle Formation is of particular interest in relation to the rocks in Lake township. The transition is lithological in Methuen, with conglomerates at the base of the Vansickle Formation. The accompanying vertical air photograph, Photo 1, shows the apparent truncation of the Oak Lake beds against the Vansickle Formation.

In northwestern Lake township a pink fine-grained metamorphosed arkosic metasediment occurs interbedded with paragneisses to form The Ridge dome. These rocks represent a continuation of the Oak Lake formation.

Adams and Barlow (1910, p.180) first recognized and described the Oak Lake arkoses of Methuen township; but they considered the rocks of The Ridge dome in Lake and Wollaston townships to be volcanic felsites. Hewitt (1962, p.37) writes: "It appears likely that some of this rock may represent a recrystallized rhyolitic tuff." He also notes (p.37): "This pink 'arkosic' rock is very similar to the arkose of the Hermon Formation in Chandos, Cardiff, and Faraday townships."

Lithologically the meta-arkose of The Ridge dome is a fine-grained, pink to grey, slightly foliated rock composed mainly of quartz, microcline, and plagioclase. Microcline usually exceeds plagioclase in amount, while quartz exceeds the feldspars. Biotite and muscovite are the most common accessory minerals; biotite usually exceeding muscovite in amount. Zircon, apatite, carbonate, sphene, opaques, hornblende, and tourmaline are also found in minor amounts in these meta-arkoses.

Hewitt (1962, p.37), writing about the arkoses of The Ridge dome in Wollaston, notes: "The rocks differ in thin section from the granites in that they are generally much finer in grain, have a great range in grain size, and frequently exhibit banding. They appear to be recrystallized; some secondary microcline appears to be replacing the other minerals and may have been introduced."

Two composite samples of these rocks were analyzed spectrographically by the author and are presented in Table 1

Table 1 | *Ridge dome arkoses. Analyses done at Queen's University, Kingston*

	Ridge No. 1	Ridge No. 2
	percent	percent
SiO_2	71.94	71.04
Al_2O_3	13.50	14.40
Fe_2O_3	2.94	1.74
FeO	1.26	0.65
MgO	0.26	0.45
CaO	0.47	1.00
Na_2O	3.85	4.55
K_2O	4.09	5.69
H_2O-	0.02	0.01
H_2O+	0.46	0.77
CO_2	0.20	....
TiO_2	0.35	0.36
MnO	0.03	0.02
Total	99.37	100.68
	ppm	ppm
Ba	220	170
Cu	6	3
Ni	42	110
V	24	30
Zr	380	420
Rb	100	53

SAMPLES
1. Composite of two specimens from lot 32, con. IV, and lot 31, con. III.
2. Composite of five specimens from lots 29, 30, con. IV; lot 28, cons. II, III; lot 26, con. II.

Interestingly, the barium content (170, 220 ppm) resembles that found in other metasedimentary rocks (45–225 ppm) rather than the amount found in the granites (900, 1100 ppm) or the rhyodacites (780–970 ppm) of the township.

On the east shore of Tangamong Lake, south of The Ridge dome, are a group of paragneisses, paraschists, and amphibolites. In general they are coarser in grain size than the rocks of The Ridge dome. The various types include: medium- to coarse-grained biotite paragneisses; garnet paragneisses, with red garnets up to

½ inch in diameter; pink shiny mica schists, some with ellipsoidal "eyes" of feldspar and quartz surrounded by mica; feldspathic gneisses similar to The Ridge dome rocks; and amphibolite bands, some apparently of volcanic origin.

Tangamong Lake Beds

Occupying the core of a small syncline to the west of The Ridge dome, and north and south of Troutling Bay of Tangamong Lake, are coarse-grained feather amphibolites high in calcite, impure calcareous marbles, calcareous paragneisses, and amphibolites.

CENTRAL LAKE TOWNSHIP

The Lake syncline is the major structural element in central Lake township. Several intrusions, the Copeway granite, Freen granite, Whetstone Lake gabbro, and numerous minor basic intrusions, especially along the west side of the syncline, affect the succession of rocks in central Lake township.

The Big Burnt Lake Formation occupies the Lake syncline, and includes the following members overlying the Vansickle Formation; lower schists, marble, middle schist, rhyodacite member, and a basic metavolcanic member. In the north, the basic metavolcanic rocks and upper schist member swing around the Freen granite and cross the township boundary into Wollaston township. The Big Burnt Lake Formation narrows and several members pinch out (e.g., the rhyodacite) as they trend in a northeast direction across the east boundary of Lake township into Tudor township.

In the northeast corner of the township are the marble, amphibolite, and paragneiss of the Murphy Corners anticline.

To the south of the Big Burnt Lake Formation are marble and calcareous paraschists of the Vansickle Formation.

Vansickle Formation

This formation, first described by Hewitt (1960, p.118) in Methuen township, is also present in Lake township. The typical lithology in Methuen, as well as Lake township, is "schist and limestone or marble, with some conglomerate" (Hewitt 1960, p.118). Hewitt divides the Vansickle Formation in Methuen township into the following members: lower conglomerate, lower marble, lower schist, middle marble, middle conglomerate, middle schist, and upper marble.

In Lake township, because of the lack of outcrop, the members cannot be as definitely defined.

A narrow band of conglomerate, probably correlatable with Hewitt's (1960, p.119) minor conglomerate in the lower schist member in Methuen township, is located on lot 6, concession I. It contains stretched and slightly flattened pebbles of granite, meta-arkose, and quartz in a biotite schist matrix. It is underlain by a much-weathered basic amphibolite.

At the Crowe River, and north along the west bank of the river, the rocks of the formation are transitional into scapolite-bearing amphibolite and scapolite-biotite schist.

On the north shore of the east bay of Tangamong Lake a narrow 5-foot band of conglomerate is exposed. It is similar in character to the above-mentioned conglomerate. The conglomerate is in a sequence of feldspathic gneiss, amphibolite, and paragneiss. East of these rocks there are calcareous amphibolites, calcareous paragneisses, and marbles. These rocks appear to be the continuation of the Vansickle Formation. The northward extension of these rocks is intruded and truncated by the Copeway granite.

In the northeast corner of the township are the marbles, amphibolites and paragneisses of the Murphy Corners anticline; these appear to correlate with the Vansickle Formation and are described by Hewitt (1962, p.38).

Big Burnt Lake Formation

Lower Schist Member

The schists overlying the Vansickle Formation have been taken as the lowest member of the Big Burnt Lake Formation. These lower schists are well represented west of Mud Turtle Lake in Lake township. The greenstones and greenstone schists are composed of quartz and chlorite with minor plagioclase and mica present. Transitional between the greenstone schists and mica schists are rocks containing chlorite and mica in equal amounts. Biotite or ankerite is frequently found in these schists in the form of porphyroblasts. Quartz, plagioclase, apatite, sphene, epidote, and opaques are among the other minerals also present in the schists.

The lower schists can be traced around the east side of the Lake syncline and northward until they pinch out east of Big Burnt Lake.

A similar section of chlorite-mica schists and greenstone schists crosses from Tudor township into Lake township where the Hastings road parallels the boundary. These schists trend southward to the lineament separating central Lake township from southern Lake township. These may be the east limb of a minor anticline, east of the Lake syncline, and therefore equivalent to the lower schists. All the rocks in this section are dark in colour, mostly greys and blue-greys, with some dark-greenish-grey rocks also present. A few amphibolite bands are interbedded with these rocks. Most of the outcrops in this section contain bands of schist with ankerite porphyroblasts. These latter are probably the outcome of the intermingling of carbonate muds with volcanic pyroclastics and greywacke-type materials.

Marble Member

Above the lower schists is a narrow white marble member. Although not continuous in outcrop expression, it can be traced around the Lake syncline. It is both dolomitic and calcareous in character.

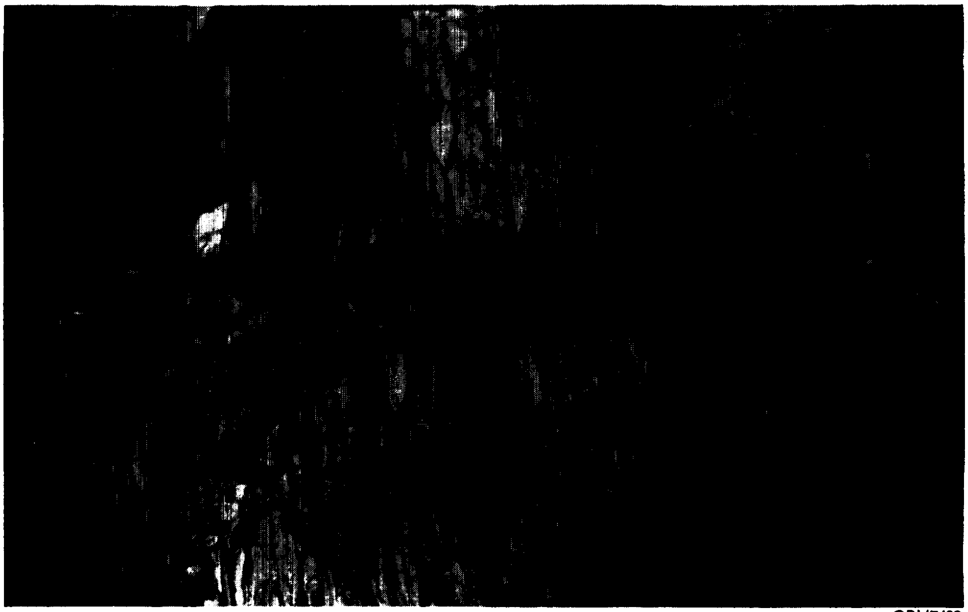

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Photo 2 — Sheared agglomerate, Whetstone Lake access road, lot 19, concession IV.

Middle Schist Member

The middle schists apparently were similar in character to the lower schists as represented by ankerite-bearing schists on the east side of the syncline. Some of the middle schists appear to have been transformed into amphibolites; these schists are scapolite-bearing on the west side of the syncline. A fairly persistent agglomerate bed of varying width is situated near the bottom of the middle schists running north-south parallel to the Crowe River about a half-mile east of it. On the access road to Whetstone Lake (lot 19, con. IV), the agglomerate outcrop width is 4 feet, but in other areas it is wider. The agglomerate is underlain by paragneiss and overlain by volcanic amphibolite, basic amphibolite, and rusty paragneiss. The fragments make up three-quarters of the rock; they are pink and mainly contain plagioclase and quartz. They are rounded, elongate, but not regular in shape. The fragments are sheared and the fractures filled with amphibolite. Some fragments have been epidotized cores. The matrix is amphibole, plagioclase, and quartz. The agglomerate at this location appears to be made up of felsitic fragments cemented by volcanic material similar to the overlying rocks.

Along strike, just north of the road, occurs another exposure of agglomerate. It is made up almost exclusively of fragments; the matrix of biotite and feldspar is a minor constituent of the rock. The fragments here are more ellipsoidal in cross-section than the fragments in the road occurrence. No epidote is present and only a few grains of amphibole were noted in a thin section of the rock.

Regularly occurring outcrops of the agglomerate bed are found south of the road. Although all fragments were found to be mainly felsitic in composition, Adams and Barlow (1910, p.47) found:

". . . . there are numerous pebbles [fragments] of granular white quartz rock, probably vein quartz, and some magnetite-actinolite rock similar to that found in association with the iron ore about 200 yards farther west, near the shore of Whetstone Lake."

A common variety of agglomerate in this band, found south of the access road (lot 15, con. IV), contains fragments that are elongate and have ellipsoidal cross-sections. These are felsitic and made up of quartz and feldspar with minor muscovite, chlorite, opaque minerals, and epidote. Part of the material, apparently an infilling between fragments, was found to be composed of tiny plagioclase laths surrounded by muscovite, perhaps crystalline tuff material. The minor matrix material present in this exposure of agglomerate is biotite, plagioclase, and quartz in composition.

Rhyodacite Member

The rhyodacite member is composed of flows, tuffs, and schists, with minor agglomerates. This member is exposed completely around the Lake syncline as a narrow horseshoe-shaped outcrop. It varies in thickness from about 1000 feet on the east limb to 2000 feet on the west side. A slight thickening occurs at the nose of the syncline. Three other outcrop areas to the north and east of the syncline appear to be lithologically the same rocks as the rhyodacites encircling the syncline.

The present mapping of Lake township has slightly changed the distribution of the acid metavolcanics as outlined by Adams and Barlow (1910) on GSC Map 708.

The Lake rhyodacite is a fine-grained white-weathering hard massive rock. Adams and Barlow (1910, p.334) first described these rocks.

A porphyritic phase of the rhyodacite is quite common and may have been originally the bulk of the member; but subsequent recrystallization has obliterated its original character in much of the rock, and a white mica schist is now found in outcrops throughout the member, especially on the east limb of the Lake syncline.

Mineralogically these rocks are rhyodacites. The plagioclase content exceeds or equals the potassium feldspar content. It is of interest in this context that potassium feldspar appears to increase towards the top of the member while plagioclase decreases. Quartz and the two feldspars make up more than 90 percent of the less altered variety. Other minerals noted are muscovite, biotite, fluorite, garnet, sphene, apatite, carbonate, and opaque minerals.

In the porphyritic variety, the phenocrysts are all feldspars. Adams and Barlow (1910, p.335) noted that: ". . . . the phenocrysts are exclusively feldspar, some of them orthoclase, but most of them microperthite."

The rhyodacites are all soda-rich compared to potash (see analyses of samples 1, 2, 3, 4 in Table 2). In this respect they compare with the Copeway granite among the Lake township plutonic rocks analyzed. Of interest chemically is the barium content, which is comparable directly with the other plutonic rocks: the Copeway granite, Freen granite, and Gawley Creek syenite; while the metasediments of the southern part of Lake township (analysis of Sample 10 in Table 2) and the two Ridge dome samples (analyses of Samples 8 and 9 in Table 2) are approximately fivefold less in barium content.

Lake township

Another band of rhyodacite similar in character to the band described above runs ½ mile east and parallel to the major rhyodacite unit of the Lake syncline. It also contains a band of agglomerate similar in character to the bands mentioned above. Two smaller bands of rhyodacite similar to those of the preceding paragraph are located just south of Thanet Lake, and ½ mile east of Little Burnt Lake.

At least two separate agglomerate beds occur within the rhyodacite member of the core of the Lake syncline. One of these beds was traced in several outcrops on the west limb of the syncline near the east margin of the rhyodacite member. This agglomerate bed contains a few rounded fragments up to 2 inches in diameter; these are mainly a pink felsite composed almost entirely of quartz and plagioclase with some of the feldspar as tiny phenocrysts. The probable source of these fragments is the slightly porphyritic rhyodacites underlying the agglomerate. A few fragments of schist are also present. Chlorite, muscovite, biotite, quartz, and plagioclase comprise the pale-green schistose matrix of the agglomerate.

Table 2 *Analysis of the rhyodacites, Lake township*

Sample No.	SiO_2	Na_2O	K_2O	Ba
	percent	percent	percent	ppm
1	70.60	5.90	4.85	910
2	71.00	5.85	5.59	970
3	63.94	6.36	5.24	....
4	71.28	5.42	5.32	....
5	78.00	3.29	5.24	780
6	67.31	4.61	3.60	1100
7	70.8	4.40	6.00	900
8	71.94	3.85	4.09	220
9	71.04	4.55	5.69	170
10	77.80	5.10	0.92	45
11	59.14	5.38	6.50	1100

SAMPLES

1. Big Burnt Lake Formation, rhyodacite member, lot 8, con. IV.
2. Big Burnt Lake Formation, rhyodacite member, lot 18, con. V.
3. Adams and Barlow (1910, p.336), Big Burnt Lake Formation, rhyodacite member, lot 19, con. V.
4. Adams and Barlow (1910, p.336), Big Burnt Lake Formation, rhyodacite member, lot 17, con. VI.
5. Small lens of rhyodacite ½ mile east of Little Burnt Lake, lot 21, con. XI.
6. Copeway Granite, lot 23, con. IV.
7. Freen Granite, composite of three samples: lot 27, con. VIII; lot 23, con. VII; lot 20, con. VI.
8. Ridge dome core metasediments No. 1; see Table 1 for complete analyses and location.
9. Ridge dome core metasediments No. 2; see Table 1 for complete analyses and location.
10. Metasediments of south section of township, lot 2, con. V.
11. Gawley Creek syenite, lot 1, con. XI.

The apparent continuation of this agglomerate bed on the east limb of the syncline is similar to the rocks described above. But this agglomerate is more sheared and its fragments are narrowly elongate and ellipsoidal. The matrix is a pale-green mica schist.

Another agglomerate bed, observed in several outcrops, is ¼ mile east of the preceding occurrence; it is on the east limb (lots 15 and 14, cons. VI and V, respectively) of the syncline. It is similar in appearance to the sheared agglomerates. The numerous fragments are pink and greyish pink, ellipsoidal in shape, flattened in the plane of schistosity, and elongate approximately parallel to the dip of the schistosity. The fragments are composed of quartz and plagioclase; whereas the schistose matrix is composed of chlorite, mica, quartz, and plagioclase.

Basic Metavolcanic Member

The basic rocks of the central part of Lake township consist mainly of amphibolites and greenschists intercalated with tuffaceous sedimentary schists and agglomerates.

Flow tops in metabasalts are found in the core of the Lake syncline; a good exposure can be seen on the east-west access road in lot 17 of concession V. These metabasaltic rocks are fine-grained, dark green, and contain phenocrysts of plagioclase; in places they contain blebs of a pink glassy mineral and appear to be amygdules. The plagioclase laths (approximately 20 percent) are surrounded by interstitial fresh green amphibole. The feldspar is present mainly as phenocrysts; it is much altered.

A small amount of pyroxene as partly altered islands, with associated chlorite and opaque minerals, was noted in thin sections of the rock. Quartz is also present in minor amount. Another variety of this rock is found in lot 17 of concession VI. Ovoid-shaped masses scattered throughout the rock are up to 3 inches in diameter, the average diameter being 1.5 inches. Their mineralogy is the same as the flows in which they occur, that is, plagioclase and green amphibole; but quartz, a minor constituent in the surrounding rock, is many times more abundant in these aggregates.

Most of the basic volcanic rocks are more altered and are represented by amphibolites, feather amphibolites, and greenschists. All of these more altered rocks are pale to dark-green in colour.

The amphibolites contain amphibole, chlorite, quartz, plagioclase, carbonate, epidote, apatite, and opaque minerals. In some of these rocks the amphibole needles are aligned subparallel to the dip of the foliation.

Many of the amphibolites have a texture consisting of irregular amphibole crystals lying in criss-crossed aggregates, suggesting feathers, in a lighter-coloured aggregate of the various minerals listed in the preceding paragraph. These "feather" amphibolites are represented by both fine- and coarse-grained varieties. Many of the greenstones of the syncline core contain little or no amphibole. The schists contain chlorite, muscovite, biotite, feldspars, quartz, opaque minerals, sphene, apatite, epidote, and tourmaline; they are probably of tuffaceous and sedimentary origin.

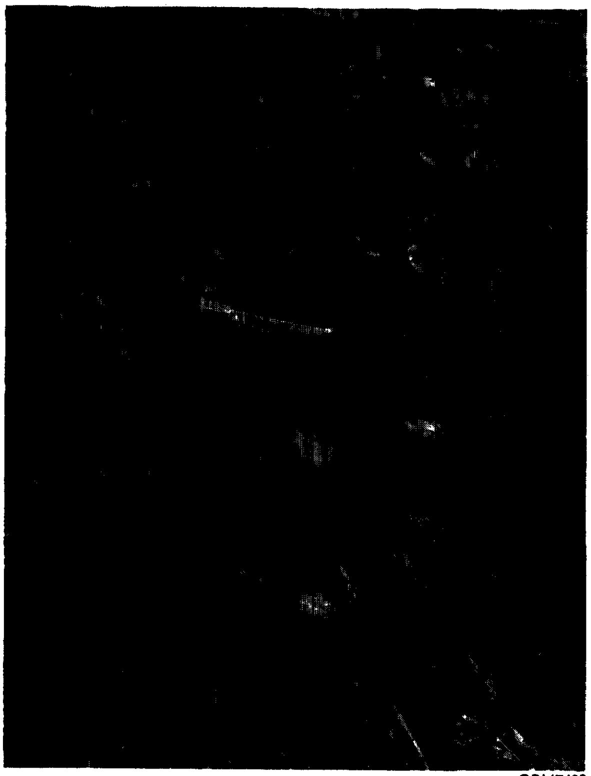

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Photo 3 — Quartz-rich ovoids in basic metavolcanics, lot 17, concession VI.

The basic volcanic rocks described above are found in the core of the Lake syncline and are part of the band of rocks sweeping around the Freen granite and across the township boundary into Wollaston township.

Near the top of the basic metavolcanic member and intercalated with basic flows are tuffaceous metasedimentary schists and agglomerates. Two separate beds of agglomerate interbedded with tuffaceous metasediments are located just north of the Whetstone access road in lot 17, concessions V and VI. Most of the fragments are pink to grey in colour. Some recrystallized fragments of vein quartz are also present. The fragments are flattened and elongate, their cross-sections resembling ellipses. They are up to ¼ inch thick, 3 inches wide, and are many times longer than they are wide.

The fragments represent four varieties: (1) pink fragments whose quartz content equals or exceeds their plagioclase content; (2) grey fragments whose plagioclase content exceeds their quartz content; (3) fragments whose plagioclase content greatly exceeds their quartz content, with the plagioclase in the form of numerous laths, crystal tuff; (4) white fragments completely made up of quartz.

The agglomerate matrix is schistose and composed of chlorite, quartz, and plagioclase. Other minerals noted in minor amounts in thin sections are biotite, garnet, epidote, tourmaline, apatite, and opaque minerals. These minerals are found in the coarse-grained parts of the agglomerate matrix.

The tuffaceous sediments associated with the agglomerates and the basic metavolcanic rocks described above have a salt-and-pepper appearance. Their overall colour is light-grey. Plagioclase, quartz, and chlorite are the essential minerals of these rocks.

SOUTHEASTERN LAKE TOWNSHIP

The metasediments and metavolcanics of southeastern Lake township are complexly folded. There are three main rock units: a marble underlying the rest of the rocks; low-grade paraschists, grading into the marbles and overlying them; and volcanic greenstone schists interbedded in the metasediments. Strong lineaments, the Tudor gabbro intrusion and the Lake metagabbro intrusion, complicate the structure and relations of the rock units. These rocks have not been directly correlated with others in the township; they are tentatively called the Thompson Lake beds.

To the south, in Marmora township, a belt of basic volcanic rocks appears to overlie the southeastern Lake metasedimentary units.

Marble

The southeastern Lake marbles are generally grey or blue-grey, well-bedded, and fine- to medium-grained. They are of the "Hastings type" described by Adams and Barlow (1910, p.221–226). The marble is calcareous; coarse silicate impurities are rare. Fine-grained argillaceous material is found commonly segregated into impure layers; these layers weather less than the purer marble.

Near lineaments, which are common in this part of the township, white coarse calcareous marble is found.

Metasediments

The metasediments of southern and southwestern Lake township are folded into a series of anticlines and synclines whose axes trend approximately northeast-southwest and appear to plunge steeply under, and therefore to underlie, the basic volcanic rocks of Marmora township to the south. The main rock type is a fine-grained paraschist interbedded with a few narrow bands of fine-grained amphibolite, feather amphibolite, and marble. In the south-central part of the township, just north of Thompson Lake, occurs a band of greenstone schist and amphibolite. North and northeast of this, the paraschists intertongue with marble and disappear by facies change into impure marble bands.

The paraschists are fine-grained, grey, and thin-bedded. Although phases of the rock contain up to 40 percent micaceous minerals, megascopic foliation is not obvious because of the fineness of grain size. Quartz and plagioclase are approximately equal in amount in the paraschists. Biotite is the major micaceous mineral although muscovite and chlorite are locally abundant. Chlorite is the major micaceous mineral in the paraschists just south of the Crowe River near the Marmora township—Lake township boundary.

The thin bedding is strikingly marked by colour. Biotite-rich beds are dark-grey, and those beds poorer in biotite are a lighter grey.

Tiny garnet porphyroblasts were noted in thin sections of some of the biotite-rich paraschists. Other minerals, noted in addition to the quartz, plagioclase, biotite, chlorite, muscovite, and garnet already mentioned, are apatite, carbonate, and opaque minerals.

The fine-grained marbles in the extreme southeastern part of the township contain interbeds of fine-grained quartz-rich paraschists, which approach micaceous quartzites in composition.

Greenschists and Amphibolites

Throughout the southern and southeastern parts of the area, fine-grained "feather" amphibolites with tiny "feathers" of amphibole are interbedded with paraschists in minor amounts.

The lithology is characterized by a plagioclase-biotite-amphibole-quartz mineral assemblage; this may have been the more limy beds of the impure sediments that produced the paraschists. Adams and Barlow (1910, p.169) noted similar "feather" amphibolite development in the impure marbles of lot 1, concession I, Lake township. North of this area, where the amount of marble increases and where interfingering and facies change from paraschists (impure shales) to impure marbles (impure limestones) takes place, similar fine-grained feather amphibolites are found. Accessory minerals in these amphibolites are sphene, apatite, garnet, and opaque minerals.

A single band, up to ¼ mile wide, of chlorite schist and basic amphibolites is interbedded with the paraschists and marbles just north of Thompson Lake. A larger greenstone volcanic area in northern Marmora township is represented in Lake township by two small outcrop areas just inside the south township boundary. The rocks are volcanic amphibolites and greenschists.

PLUTONIC ROCKS

Basic Intrusive Rocks

Three major basic intrusive bodies occur in Lake township; the Tudor gabbro, Lake metagabbro, and Whetstone Lake gabbro and metagabbro.

The Whetstone Lake gabbro, and the north-to-south series of basic intrusions of which it is the largest, appear to be the oldest intrusive rocks in the township, since they are intruded by granite and granite pegmatite.

The age of the Tudor and Lake bodies compared to other intrusions cannot be ascertained because no cutting relations with other intrusions were observed.

All the basic intrusions are altered in varying degrees.

The mapping indicates that what was thought by Adams and Barlow (1910, map) to be one single intrusion, the Tudor gabbro, is actually three separate bodies. These are: the Lake township portion of the Tudor gabbro; the Lake metagabbro; and a small satellitic granodiorite body at the south end of the Tudor gabbro.

Tudor Gabbro

The Tudor gabbro is exposed in both Lake and Tudor townships. It was first described by Adams and Barlow (1910, p.151, 152). In Lake township, it has an outcrop area 3 miles long and 2 miles wide. Like the Lake metagabbro, it rises into high rugged hills above the marble and completely surrounds the part of the marble in Lake township. A narrow alteration rim of coarse-grained marble with lime silicate minerals rims the gabbro. A zone of much greater alteration occurs in the country rock on the northwest side of the gabbro body along Beaver Creek. This appears to be partly due to faulting as well as intrusive alteration by the gabbro. Much tremolite, actinolite, and impure talc in coarse marble are present in this zone. The gabbro is much less altered in general than the Lake metagabbro. The grain size ranges from medium- to coarse-grained. The pyroxene (15 to 35 percent) has been almost completely uralitized although vestiges of the original pyroxene were seen in most of the samples examined by the author. The plagioclase present was found to be labradorite (An_{52-60}) in the one specimen studied. Minerals present in minor quantity are scapolite, zoisite, carbonate, sericite, apatite, iron oxides, biotite, chlorite, and epidote.

The feldspar in much of the gabbro is dark in colour. Exposures showing white- and pink-coloured feldspar are also common. For example, along Beaver Creek on the west outcrop boundary and along the southwest edge of the gabbro, a more-altered pink foliated variety is present.

The Ricketts iron prospect (lots 16 and 17, con. XI, see page 26) is, so far, the only mineral prospect found in the Lake portion of the Tudor gabbro.

Lake Metagabbro

The Lake metagabbro in south-central Lake township is an elongate intrusion about 1 mile wide and 4½ miles long. It trends northeast. The metagabbro rises well above the more readily weathered limestone surrounding it. A narrow alteration rim, consisting of coarse-grained marble with lime silicate minerals, surrounds the metagabbro.

The mineral composition varies in the quantity of the different minerals present; but, in general, white to pale-pink granular plagioclase (much altered), pale to dark-green amphibolite, chlorite, and epidote make up the bulk of these rocks. Remnant zoning in the amphibole suggests that it was pyroxene before alteration. Minor quartz, mica, carbonate, leucoxene, and sphene are also present in the various varieties studied. The grain size ranges from fine to pegmatitic.

Foliation, brought out by amphibole and chlorite alignment, is present near lineaments in the intrusion.

The body is not outlined by an aeromagnetic anomaly as is the Tudor gabbro. No mineral occurrences have been found in the Lake metagabbro.

Whetstone Lake Gabbro and Related Basic Intrusions

The Whetstone Lake gabbro is a small basic intrusion near the east shore of Whetstone Lake. It is the largest of a group of small basic intrusions that occur from the southwest corner of Lake township north to Steen Lake. Included in this north-trending belt of basic intrusions are: a small centre of altered basic rocks on the west shore of Mud Turtle Lake; the Whetstone Lake gabbro; a small gabbro body just northeast of the Copeway granite; and small exposures of basic amphibolite all along the belt. The Copeway granite and the screen between the Copeway and Freen granites contain some amphibolite inclusions of material that appears to be of basic origin.

The Whetstone Lake gabbro is much altered and according to Adams and Barlow (1910, p.355): " . . . . the original pyroxene is now completely altered to a green hornblende . . . . [and] . . . . from the shape of the plagioclase which it contains, it seems to have originally possessed a diabasic structure."

The feldspar has retained its dark colour, as in most of the Tudor gabbro, and thus, along with the dark hornblende, gives the medium- to coarse-grained rock an extremely dark colour in outcrop.

Many pits and showings, including the Mag-Iron mine and some of the iron and copper prospects of the township, are situated along this belt of altered basic rocks. These are discussed in more detail under Economic Geology, pages 23 to 29.

Granitic and Syenitic Rocks

Five acid intrusions occur in Lake township; the Copeway, Freen, and Coe Hill granites; the Gawley Creek syenite; and a small circular granodiorite body spatially related to the Tudor gabbro.

Small bodies of pegmatite and aplite are abundant throughout the township.

Copeway Granite

The Copeway granite body is situated in the north-central part of Lake township. It is oval in shape, being about 3 miles long and 2 miles wide. Lithologically the rock is a pink, massive, fine- to medium-grained, leucocratic granite. The major minerals present are oligoclase (An_{20}), microcline, and quartz. Biotite, muscovite, sphene, zircon, fluorite, tourmaline and myrmekite are minor in quantity, making up less than 5 percent of the rock. The ratio of potash feldspar to plagioclase in the Copeway granite indicates that it is compositionally a quartz monzonite. There are numerous fairly large, disoriented inclusions of metasediments and metavolcanics in the northern part of the body; but, in the south, few inclusions are observable. There is little contamination; the inclusions are undigested by the invading granite. The contacts of the granite are sharp with the surrounding rocks, with little apparent contact effects. Many granitic offshoots occur in the metamorphic rocks north of the body. Between the Copeway and Freen granite bodies, and to some extent north of the Copeway granite mass, occurs a screen composed of blocks and some assimilation products of basic amphibolite, volcanic, and metasedimentary rocks in the granite. The Copeway granite body was apparently forcefully intruded into the surrounding rocks as evidenced by their curvature around it.

Freen Granite

The Freen leucogranite in north-central Lake township is elongate, trends north, and is about 4 miles long and 1 mile wide. A prominent jointing pattern results in a rough terrain. In elevation, the granite stands well above the surrounding rocks. The essential minerals are microcline, microperthite, plagioclase, and quartz; minor amounts of muscovite, biotite, sphene, zircon, opaque minerals, tourmaline, carbonate, and apatite are also present. In the north, east, and south, the Freen granite body cuts across the foliation of the surrounding metamorphic, volcanic, and sedimentary rocks. In the west a screen of basic amphibolite, metavolcanics, and metasediments is situated between the Copeway and Freen granite bodies; it has been discussed under Copeway granite. On the east side of the granite, a fine-grained facies may indicate that this side was the near-surface side during intrusion, and that the granite mass as a whole is a near-surface intrusion.

Coe Hill Granite

In the northwest corner of Lake township occurs a narrow band of leucogranitic rock joining the Methuen granite in Methuen township to the Coe Hill granite in Wollaston township. Its relations to the surrounding metasediments are intrusive in character. Sharp cross-cutting relations, large undigested blocks of sedimentary rock in the granitic rocks, and also granitic and pegmatitic offshoots from the main granitic rocks are present in Lake township. Oligoclase (An_{27}), microcline, quartz, biotite, muscovite, perthite, apatite, zircon, sphene, and opaque minerals make up the mineralogy of the Coe Hill granite in Lake township.

Hewitt (1960, p.152) gives a Rosiwal modal analysis of a sample of this granite (576) obtained from near the boundary of Lake and Methuen townships (lot 30, con. I, Methuen twp.). The sample showed: 30.1 percent oligoclase (An_{20-28}); quartz 26.3; microcline 38.2; biotite 4.4; muscovite 0.5; opaques 0.3; and apatite 0.2 percent. Compositionally, therefore, the rock is a quartz monzonite.

Gawley Creek Syenite

The Gawley Creek syenite lies mainly in Madoc and Marmora townships; it is also exposed in the extreme southeast corner of Lake township. The area in Lake township respresents only a small part of the Gawley Creek syenite shown on Ontario Dept. Mines Map 1957b.

In Lake township the body is mainly a porphyritic microcline-microperthite leucosyenite. The northern contact area of the pluton increases in quartz, and mineralogically, it is a granite.

The pink leucosyenite making up the bulk of the pluton in Lake township contains large phenocrysts of pink feldspar (microcline-microperthite) in a medium-grained groundmass of plagioclase, quartz, sphene, biotite, muscovite, amphibole, apatite, and opaque minerals.

Granodiorite

A small circular granodiorite intrusion, about 1 mile in outcrop diameter and apparently satellitic to the Tudor gabbro, occurs directly south of this gabbro. The two are separated by a narrow band of marble. A point count of a section of the rock by S. B. Lumbers (personal communication) indicated the following mineralogy: plagioclase (oligoclase?) 54.8 percent; potassium feldspar (microline, minor perthite) 18.5; quartz 18.1; amphibole 6.4; biotite 2.2; and as accessory minerals, zircon, apatite, and epidote.

STRUCTURE AND STRATIGRAPHY

Structurally the township is within the Hastings Basin subdivision of the Grenville province of eastern Ontario (Hewitt 1956, p.30).

The rocks of the area are generally folded and their metamorphic grade is low to high. Hewitt (1962, p.46) points out: ". . . . the tectonic style and metamorphic grade are distinctly different from that in the Haliburton-Hastings Highland gneiss complex to the north."

Folding

The main folding is north-northeast in direction, conforming to the Hastings Basin regional folding. A secondary, less distinctive, northwest-southeast regional set of crossfolds is also present and accounts for domes and basins found in the area.

Five major fold structures were recognized in Lake township. The Ridge dome occupying northwestern Lake and southwestern Wollaston townships is the main structure in northwestern Lake township. Central Lake township is dominated by the Lake syncline. The Freen and Copeway granite intrusions obliterate the north end of this structure. In the southeastern part of the township a series of steeply dipping anticlines and synclines underly the Marmora township basic volcanic rocks. The large limestone area in the southeast appears to be part of a basin structure that extends into Tudor township; but strong lineaments, and also the Lake metagabbro intrusion, confuse the structural pattern in this area. In the northeast corner of the township, the axis of the Murphy Corners anticline (Hewitt 1962, p.47) trends and pitches southwest-by-west, and is mainly in Wollaston township. In Lake township the south limb includes several lesser synclines and anticlines. Along the west boundary of Lake township is the long Tangamong Lake syncline of calcareous, metasedimentary, and metavolcanic rocks.

Faulting

Air photographs, valleys, and scarps provide evidence of several prominent lineaments perhaps representing normal faults. A large north-south lineament follows Beaver Creek and fans into many separate lineaments in the marbles and Lake metagabbro of the southeastern part of the township. A branch of the main lineament takes a southwest-northeast trend and is expressed in the southern part of the township as the Crowe River valley; it crosses the extreme southwest corner of Lake township and passes into Belmont township.

Another strong lineament with weaker parallel lineaments to the north apparently begins near Whetstone Lake; it crosses the township in a slightly curved line toward the southeast-by-east.

These two main lineaments have complimentary semiparallel lineaments striking about northeast-southwest and northwest-southeast in the southeast basin area. These lineaments are lead-bearing in places. (See references to these in Economic Geology, under the heading "Lead").

The Freen granite body contains four sets of joints (two strike N30°E and dip 50°SE and 50°NW; the other two strike N45°W and dip 50°NE and 65°SW).

Stratigraphy and Correlation

Many factors make it difficult to determine the stratigraphic section in Lake township and to correlate it with adjoining areas. Folding and faulting complicate the structure; lithological units thicken and thin rapidly, often disappearing along strike; intrusions complicate the picture; and top determination data, when present, are difficult to interpret satisfactorily.

The Oak Lake, Vansickle, and Big Burnt Lake formations have been tentatively classified together as the Lake Subgroup, which appears to correlate with the Mayo Group (Hewitt 1962, p.32).

The Ridge dome arkoses correlate with the Oak Lake Formation of Methuen township.

The Vansickle Formation in the southwest corner of the township appears to correlate with the Tangamong Lake beds to the northwest, with the Murphy Corners beds in the northeast corner of the township, and perhaps with the Thompson Lake beds of southeast Lake township.

In places the contact between the Oak Lake Formation and the Vansickle Formation appears to be simply a lithological change with several conglomerate horizons; but southwestern Lake township appears to contain a disconformity between these two formations (see Figure 2, p.7).

Overlying the Vansickle Formation are the rocks of the Big Burnt Lake Formation, occupying the Lake syncline. These may be correlatable with the Marmora township basic volcanic rocks, the Tudor volcanics, the south Wollaston township volcanics, and the Belmont township volcanics.

ECONOMIC GEOLOGY

Deposits of iron, copper, lead, talc, and gold have been opened up in Lake township. Commercial production of iron took place in the past; no properties have been in production recently. Prospecting activity for copper and iron occurred in the township in 1958 and 1959.

COPPER

CONCESSION VII, LOT 30

According to Thomson (1943, p.17): "In 1915 the south half of the east half of lot 30, concession VII, Lake township, was staked for copper although there is no record of what was uncovered."

In 1957, V. A. McMurray of Gilmour had a grab sample assayed from a pit on the east shore of Steen Lake, in lot 30, concession VII. The sample contained 3.0 percent copper, 0.03 percent nickel, and a faint trace of silver, according to the assay report.

GOLD

SOPHA MILLER GOLD MINES LTD., CONCESSION I, LOTS 6-8

In 1950 preparations were made to sink a shaft in lot 6, concession I, to investigate a gold occurrence previously indicated by diamond-drilling. A timber headframe hoist, and compressor equipment were set up. The prospect has been dormant since 1951.

The description of Sopha Miller Gold Mines Limited given in the Sixtieth Annual Report of the Ontario Department of Mines, pt. 2 (1951), is as follows:

> Sopha Miller Gold Mines, Limited, was incorporated in January, 1950, with an authorized capitalization of 3,000,000 shares of $1 par value, of which 150,000 have been issued. The officers and directors are: A. B. Miller, president; A. D. Miller, vice-president; Helen Swingle, secretary; W. Jema, treasurer; P. Lesnoka, A. De Cente, B. Cannon, and B. Sopha, directors. The head office and mine address are 412-414 Bay Street, Toronto.
>
> The property consists of lots 6, 7, and 8, concession I, Lake township, Hastings county.
>
> About June 1, preparations were started to sink a shaft on lot 6, to investigate a gold occurrence previously indicated in a diamond-drill hole.
>
> A hoist-room, change-house, and a building to house a diesel-driven compressor were erected. A hoist and compressor were installed.
>
> An excavation was made for the shaft collar through eight feet of overburden and a timber headframe prepared.
>
> B. Sopha is in charge and four men were employed.

IRON

Since 1900, exploration for iron prospects and their subsequent development have gone on intermittently around Whetstone Lake and along the Crowe River as far south as Mud Turtle Lake in Lake township.

A correlation evidently exists between magnetite-(copper) mineralization and the Whetstone Lake gabbro. All prospects are found in the aureole zone of the basic intrusion and related bodies. This zone is mainly a scapolite amphibolite skarn. The pre-pneumatolytic rocks appear to have been in part the basic intrusion itself and in part volcanic-sedimentary rocks. Numerous small actinolite-magnetite lenses have been found in the aureole; as, for example, the prospects in lot 18 of concession III and also on the Alsof property.

The magnetite in lot 20, concession IV, is localized in a shear zone near a granite contact; but it appears to be an extension of the aureole spoken of above. The minerals in the mineralized shear zone at Mag-Iron Mining and Milling Limited include talc, actinolite, calcite, black mica, and magnetite.

Although exploration has been active along this apparently favourable zone from the Mag-Iron prospect in the north on Whetstone Lake down to Mud Turtle Lake in the south, where Selco Exploration Co. Ltd. has been reported to have done exploration work in 1959, nothing of major interest has as yet been uncovered.

MAG-IRON MINING AND MILLING LTD., CONCESSIONS III-IV, LOTS 18-20

The presence of magnetite on the east shore of Whetstone Lake has been known for many years. As early as 1910, Adams and Barlow (p.355) wrote:

> A considerable body of iron ore crosses near the line between concessions III and IV of the township of Lake, on lot 18, about a couple of hundred yards east of the Deer River (Crowe River). This is a black magnetic ore holding only a very little iron pyrite, and was traced along the river bank parallel to the strike of the enclosing rock for a distance of over 200 yards. In this band a width of six feet of nearly pure ore is exposed in one place, and a width of three and a half feet in another. A specimen of this ore, collected on lot 18, of concession III, was found to contain 60.09 percent of metallic iron, and to be free from titanic acid.

E. Lindeman and L. Bolton (1917, p.119) wrote about the prospects in lots 19 and 20, concession IV, as follows: "Small patches of magnetite are associated with amphibolite. Several openings have been made along a ridge running north and south without revealing any ore-body of economic importance."

Interest in the area did not diminish. In 1943, Thomson (p.39, 40) wrote:

> Tomahawk Iron Mines, Limited, holds a group of claims on the east side of Whetstone Lake, in lot 20, concession IV, Lake township. The occurrence of magnetite at this location has been known for many years, but the early work failed to reveal anything of commercial interest. Development work was carried on by Tomahawk Iron Mines Limited during 1941 and 1942 on various magnetite deposits on the property. The work consisted of stripping, test-pitting, and diamond-drilling.
>
> On the principal showing, small patches of magnetite are exposed in amphibolite and a talc-actinolite rock in the general vicinity of a granite contact. Seven trenches located at intervals over a length of about 1,000 feet indicate scattered and irregularly located lenses and patches of rich magnetite. Up to August, 1924, a series of 20 holes had been drilled along this zone and its extension, revealing sections of magnetite, but no analyses were available.
>
> Some work was also done on magnetite showings located on lot 18, concessions III and IV, near the east shore of Whetstone Lake and south of the camp. Scattered nodules and small lenses of magnetite are exposed at intervals over a length of 1,300 feet along a ridge of amphibolite schist. Some diamond-drilling has been done along this zone. Immediately north of the camp, small, irregular patches of pure magnetite 4–8 feet in width have been uncovered.

In 1946 a 20-ton mill was constructed in lot 20, concession IV, by Tomahawk Iron Mines Limited. In 1947 the mill was tested with magnetite-bearing rock in the stockpile; 150 tons had been treated by the end of the year.

Early in 1950, Mag-Iron Mining and Milling Company Limited began operations, and using magnetite-rich rock from a previous stockpile, they produced about 50 tons of concentrate. Of this amount, 22 tons were sold, mostly to England. Later that year, mining was resumed in the open cut in lot 20 concession IV. Mag-Iron continued mining and milling on a small scale, using an average of 6 to 10 men, until 1955 when Clarkden Development Company began to operate the pit and mill on a royalty basis. The mill has not operated since 1958.

In 1959 trenches and pits were worked in lot 18 of concession III. Minor chalcopyrite and malachite mineralization was noted, along with chalcopyrite and magnetite, in these trenches and pits. A grab sample high in magnetite with minor pyrite, taken by the author from one of the pits and analyzed by the Laboratory Branch of the Ontario Department of Mines, contained 50.9 percent iron and 0.11 percent copper.

ALSOF MINES LTD., CONCESSION III, LOTS 14, 15, AND E½ 16 AND 17

To the south of the Mag-Iron workings along the general trend of the magnetite-bearing zone, Alsof Mines Limited has staked 12 claims in lots 14 and 15, and the east half of lots 16 and 17, in concession III. The area was prospected by Ivan Sopha in 1955 and 1956; in 1957, Alsof Mines Limited was incorporated. In 1958 some trenching was done and about 20 diamond-drillholes totalling around 2200 feet were drilled. One small showing in lot 14, concession III, was drilled by four holes and was said by the company to average 2.3 percent copper over a width of 7 feet for a distance of 175 feet.

A ground magnetometer survey in the east section of lot 17, concession III, was run in 1948 by T. S. Gaffney to check an anomaly shown on the Aeromagnetic Map 14G published by the Geological Survey of Canada. Several small intense anomalies were noted.

In 1959 the claims were optioned to Merlin Mines Limited who mapped the area geologically and drilled nine holes for a total of 1032 feet. In trying to extend the zone in lot 14, concession III, mentioned above, Merlin Mines Limited found that this particular showing was small and not of economic interest. A magnetometer and electromagnetic survey was undertaken by R. A. Geisler in January and February 1960, on the Alsof claims, for Merlin Mines Limited. Several anomalies were delineated. In the south, presumably on lot 14, concession III, he found no strong electrical anomalies.

In lot 17, concession III, the author found seven showings that had been stripped of overburden and several pits and trenches. Magnetite and chalcopyrite mineralization was noted in these.

CONCESSION XI, LOTS 16 AND 17 (RICKETTS)

Lindeman and Bolton (1917, p.119) describe this iron prospect as follows:

"On lot 17, concession XI, some prospecting has been done on several small patches of titaniferous magnetite associated with gabbro-diorite."

The ore, according to Robinson (1922, p.77) consists of

. . . . pockety segregations of titaniferous magnetite, similar in every respect to those on the Orton mine (Tudor Twp.). Though a magnetic survey (Lindeman and Bolton 1917, Map 405) indicates that the area over which these occur is somewhat more extensive than that on the Orton mine, some half-dozen or more exposures on lot 17, the Ricketts property, shows the ore to be somewhat leaner and the deposits more irregular.

Table 3	*Two analyses from the workings, lot 17 (Ricketts)*	
	No. 1	No. 2
	percent	percent
Iron	52.40	46.52
Insoluble	25.25	.....
Silica	.....	2.10
Sulphur	0.034	0.038
Phosphorus	0.012	0.016
Titanium	15.31	17.53

No. 1. Analysis in Lindeman and Bolton (1917, p. 119) of a sample from one of the workings in lot 17, con. XI.

No. 2. Analysis in Robinson (1922, p. 78) of a sample from one of the pits, lot 17.

LEAD

KATHERINE LEAD MINE, CONCESSION XI, LOT 8

According to Adams and Barlow (1910, p.349):

Katherine Mine . . . . was first opened up in the spring of 1899 . . . . a considerable proportion of zinc blende accompanies the galena.

A shaft was sunk 125 feet deep and at a depth of 100 feet a level was driven north 100 feet, and some stoping done. Half a mile south of this shaft another was sunk to a depth of 18 feet. Some prospecting was done by means of a drill, and a hole 292 feet deep was made.

Describing this occurrence, De Kalb (1901, p.130) writes:

The vein carries argentiferous galena and zincblende in calcite, the average of the ore showing 10 ounces of silver. It lies wholly between walls of diorite, with a width varying from 1–4 feet, and a known longitudinal extension of half a mile . . . . half a mile south of the main shaft is the south shaft . . . . The vein here is less highly mineralized, having however a width of 9 feet, with six ore-bearing streaks, containing galena, but no zinc.

A later examination of the property by Alcock (1930, p.158) resulted in the following report:

In the winter of 1925 some new work was done about 500 feet southeast of the main shaft. The vein at this place was opened for a length of 70 feet. It has here a strike of south 55 degrees east magnetic and a dip of 70 degrees northeast. The country rock is a hard, bluish quartzite. The vein has an average width in the trench of about 4 inches, increasing in places to 7 inches. The gangue is calcite and barite, showing good crustification. Galena occurs in bunches and seams in the vein.

Thomson (1943, p.54) gives a resume of the Katherine Lead Mines Limited:

In 1937 the property was taken over by Katherine Lead Mines Limited. Some camps were built and the underground workings were examined, but little underground development was done. The shaft headframe, mine buildings, and equipment have since been removed from the property.

Very little can now be seen at the main shaft. A report by the consulting engineer of Katherine Lead Mines in 1936 states that some galena is to be seen in the underground workings, but sphalerite is very scarce; only a trace of silver was indicated. He reports that at the northern face of the drift, the calcite vein is 12 inches wide; at the southern drift face it is 28 inches wide and contains 28 percent galena. Concentrations of galena were in evidence on the hanging wall of the vein. The drift on the 100-ft. level was reported to be about 250 feet in length.

In 1959, when the area of the property was mapped, only the relics of the mine foundations, the old overgrown trenches, and the water-filled shaft were noted. Galena, sphalerite, barite, and coarse-grained calcite specimens were found loose around the shaft opening. The charter of Katherine Lead Mines Limited was cancelled in 1954.

CONCESSION XI, LOT 10

Vennor (1869, p.163) writes:

> On this lot... occurs the Donahue vein, striking N50°W, and standing in a vertical attitude. Little, however, has here been done, and although the lode has a width in some parts of from twenty to twenty-four inches, bounded by regular walls of grey calc-schist, the galena occurs only in scattered and irregular patches, and in considerable quantity.

CONCESSION XI, LOT 8

Vennor (1869, p.163) writes:

> In lot 8, concession XI of Lake (or possibly in concession X) a vertical vein, holding galena in a gangue of heavy-spar, runs through the calc-schist in the direction N45–50°W. The lode varies in thickness from ten to eighteen inches, and is bounded by well-defined walls.

CONCESSION XI, LOT 11

According to Adams and Barlow (1910, p.350), galena has also been found on lot 11, concession XI, Lake township.

None of these old prospects were found during the present survey, mainly because the area has become overgrown in the many years since it was last prospected. Another hindrance to location is the fact that the old lot and concession data are probably inaccurate.

Two distinct systems of lineaments are of interest to prospectors in southeastern Lake township. These may readily be seen on the air photographs as striking generally N45°E and N55°W. The northwest-trending faults have been mineralized as is evidenced by the above lead prospects. Uglow (1916) and Alcock (1930) drew attention to these mineralized lineaments. Vennor (1869, p.163) wrote:

> In these townships (Lake and Tudor) there appear to be two distinct sets of these veins; one of them running northwest, and the other northeast by north, those in the former direction being the more numerous.

TALC

CONCESSION X, LOTS 15, 16, 17, 18

A low-grade talc-bearing band, in lots 15, 16, 17, 18, concession X, parallels the west bank of Beaver Creek.

The talc occurs in a talc-tremolite-carbonate band enclosed in dolomite and along what appears to be a fault zone. The strike of the narrow talc-bearing band is N10°E and its dip is vertical. Lenses of bluish quartzite are also found in the dolomite. The Tudor gabbro is about 300 yards east of the talc band; a fine-grained bluish calcareous marble is present toward the west.

CONCESSION XI OF LAKE TOWNSHIP

F. F. Osborne (1930, p. 57 mentions an: ". . . . occurrence [of talc] in concession XI of Lake township [that] is back of B. G. Airhardt's mill. The talc is of very low grade."

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Lake township

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MAPS

Geol. Surv. Canada

Map 560A. Marmora; Hastings, Peterborough and Northumberland counties, Ontario, Scale, 1 inch to 1 mile. (Published 1940).

Map 14G. (Aeromagnetic map). Bannockburn, Ontario. Scale, 1 inch to 1 mile. (Published 1950, Revised 1957).

Map 15G. (Aeromagnetic map). Bancroft, Ontario. Scale, 1 inch to 1 mile. (Published 1950, Revised 1957).

Map 16G. (Aeromagnetic map). Coe Hill, Ontario. Scale, 1 inch to 1 mile. (Published 1950, Revised 1957).

Ontario Dept. Mines

Map 25b. Part of Ontario showing the location of lead and zinc deposits. Accompanies O.D.M. Vol. 25, pt. 2. Scale, 1 inch to 35 miles. (Published 1916).

Map 25c. Part of southeastern Ontario showing relations of galena-calcite-barite veins to major elements of geologic structure. Accompanies O.D.M. Vol. 25, pt. 2. Scale, 1 inch to 7.89 miles (=1:500,000). (Published 1916).

Map 39h. Hastings county, showing location of nonmetallic mineral occurrences. Accompanies O.D.M. Vol. 39, pt. 6. Scale, 1 inch to 3.95 miles (=1:250,000).

Map 52b. North Hastings area. Accompanies O.D.M. Vol. 52, pt. 3. Scale, 1 inch to 2 miles. (Published 1943).

Map 1957b. Haliburton-Bancroft area, Province of Ontario. Scale, 1 inch to 2 miles. (Published 1957).

Map 1960e. Methuen township, County of Peterborough. Accompanies O.D.M. Vol. 69, pt. 8. Scale, 1 inch to ½ mile. (Published 1961).

Map 2020. Township of Wollaston, County of Hastings. Accompanies Geol. Rept. 11. Scale, 1 inch to ½ mile. (Published 1962).

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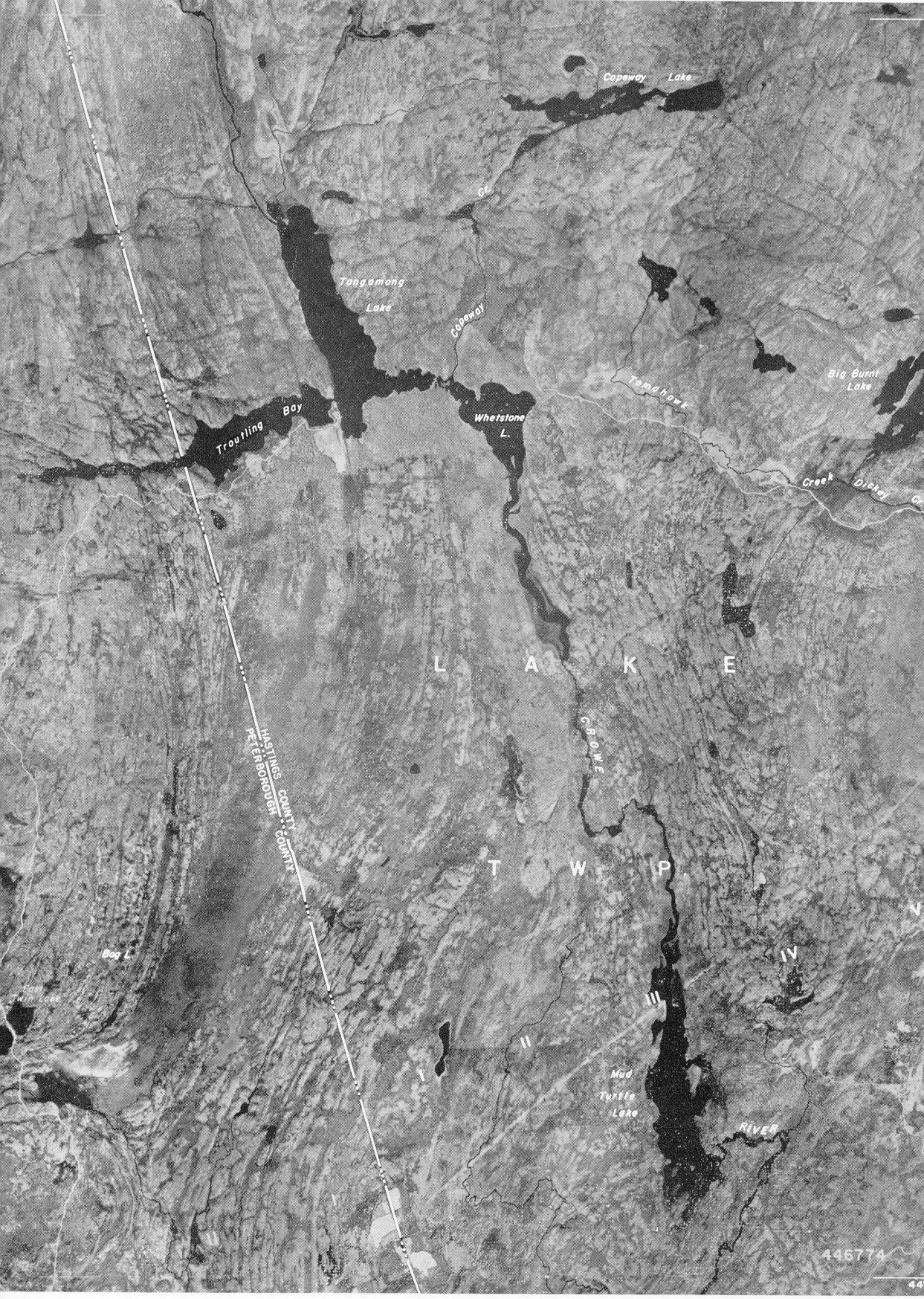
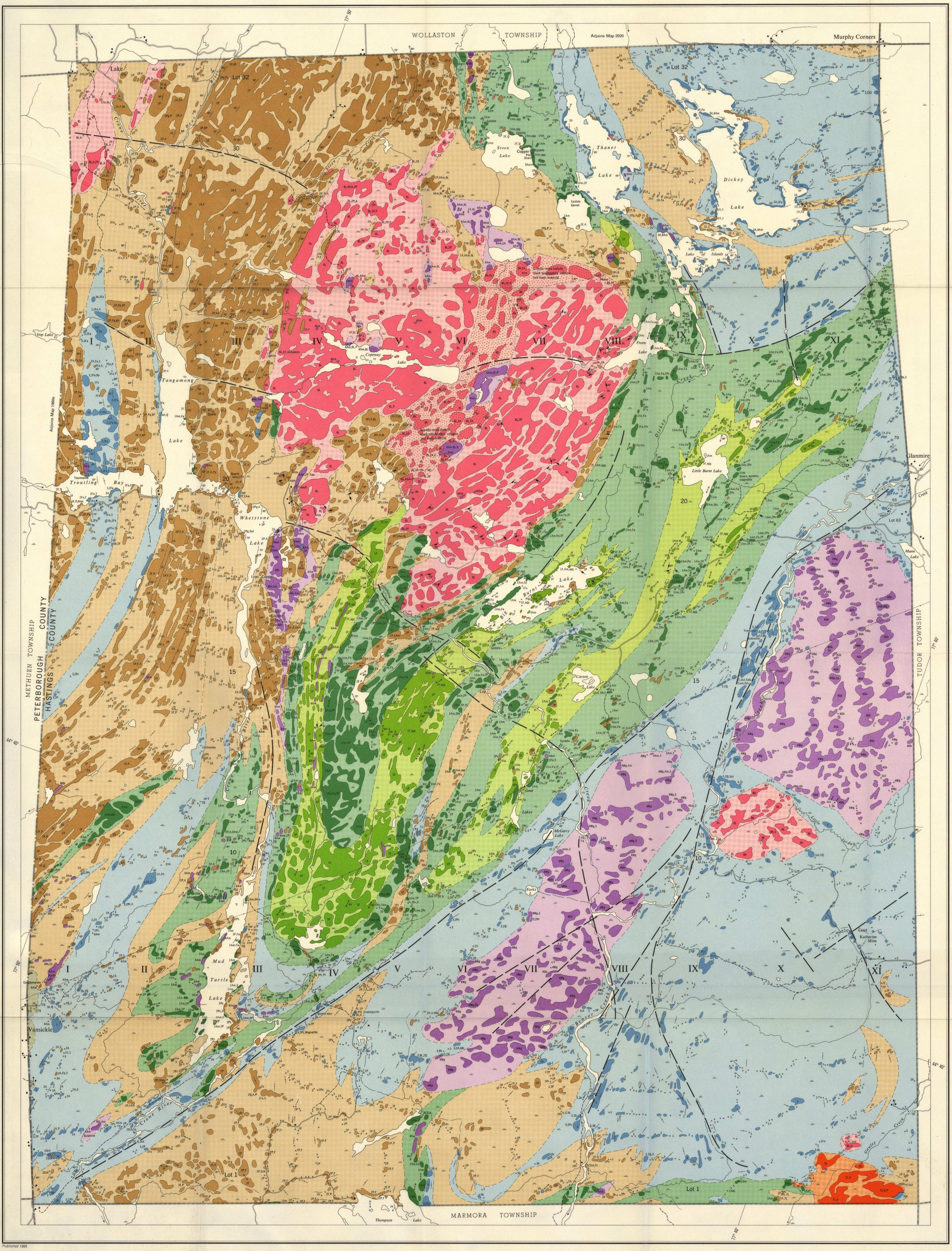
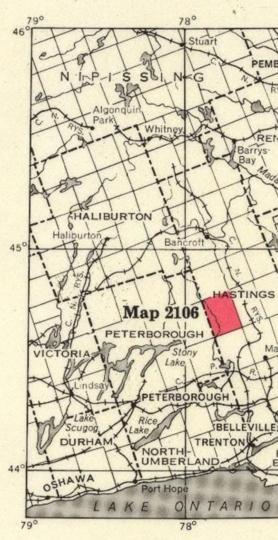

Copeway Lake
Cr.
Tangamong Lake
Copeway
Troutling Bay
Whetstone L.
Tomahawk
Big Burnt Lake
Creek
Dickey
L A K E
CROWE
HASTINGS COUNTY
PETERBOROUGH COUNTY
T W P.
Bog L.
East Twin Lake
IV
III
II
I
Mud Turtle Lake
RIVER
446774

Map 2106
Lake Township

ONTARIO
DEPARTMENT OF MINES

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





Scale 1 inch to 50 miles

N.T.S. reference 31 C/12, 31 C/13

LEGEND

CENOZOIC*

RECENT AND PLEISTOCENE
Sand, gravel, clay, silt, till.

UNCONFORMITY

PALEOZOIC**

ORDOVICIAN

10 *Limestone, dolomitic limestone.*

UNCONFORMITY

PRECAMBRIAN**

PLUTONIC ROCKS

GRANITIC ROCKS

8L *Leucogranite, leucogranite gneiss (includes rocks of granodiorite and quartz monzonite composition).*
8b *Biotite granite.*
8h *Hornblende granite.*
8P *Granite pegmatite.*

INTRUSIVE CONTACT

SYENITIC ROCKS

7L *Leucosyenite, leucosyenite gneiss.*
7b *Biotite syenite, biotite syenite gneiss.*
7P *Syenite pegmatite.*

INTRUSIVE CONTACT

BASIC INTRUSIVE ROCKS***

4Am *Orthoamphibolite.*
4Di *Diorite, quartz diorite.*
4Gb *Gabbro.*
4Hb *Hornblendite.*
4Mg *Metagabbro, metadiorite.*

INTRUSIVE CONTACT

METASEDIMENTS

CALCAREOUS METASEDIMENTS

3 *Limestone, dolomite, marble; 3sil, silicated marble; 3b, impure marble.*
3A *Interbedded marble and amphibolite, paragneiss or schist.*
3Q *Sandy limestone or marble.*
3Sk *Skarn.*

NON-CALCAREOUS METASEDIMENTS****

2A *Para-amphibolite, amphibolite schist, (hornblende-plagioclase gneiss and schist); 2 Ab, biotite amphibolite; 2Ag, garnet amphibolite; 2Ar, rusty amphibolite.*
2F *Arkose, quartzo-feldspathic gneiss, includes some quartzite, feldspathic gneiss or schist; 2Fr, rusty feldspathic gneiss or schist; 2Fa, feather amphibolite; 2Fd, pyroxene feldspathic gneiss or schist.*
2P *Paragneiss, psammo-pelitic gneiss and schist, biotite paragneiss; 2Pg, garnet paragneiss; 2Ph, hornblende paragneiss; 2Pr, rusty paragneiss or schist; 2Pc, calcareous paraschist or paragneiss.*
2agg *Agglomerate.*
2Q *Quartzite.*
2Sch *Schist, mica schist, argillite schist, some greenstone schist.*

METAVOLCANICS

BASIC METAVOLCANICS

1Am *Amphibolite, amphibolite schist, greenstone, greenstone schist.*
1agg *Agglomerate.*
1Fa *Feather amphibolite.*

ACID METAVOLCANICS

1F *Felsite, rhyodacite, acid tuffs, mica schist.*
1agg *Agglomerate.*

Stippled areas of granitic rocks include much material of sedimentary, volcanic and basic intrusive origin.

**Unconsolidated deposits. Cenozoic deposits are represented by the lighter coloured parts on the map.*

***Bedrock geology. Outcrops and inferred extensions of each rock unit are shown, respectively, in deep and light tones of the same colour.*

****May be of more than one age, possibly including some sedimentary or volcanic rocks.*

*****Possibly including some volcanic metasediments and volcanic amphibolites.*

SYMBOLS

Small rock outcrop.
Boundary of rock outcrop.
Geological boundary, defined.
Geological boundary, approximate.
Geological boundary, assumed.
Strike and dip; direction of top unknown.
Strike and vertical dip; direction of top unknown.
Strike and dip; top in direction of arrow.
Strike and dip of schistosity; trend and plunge of lineation.
Strike and dip of schistosity.
Strike of vertical schistosity.
Strike of schistosity, dip unknown.
Strike and dip of bedding; trend and plunge of lineation.
Strike of vertical gneissosity.
Lineation (plunge known, plunge unknown).
Jointing, inclined.
Jointing, vertical.
Drag-folds. (Arrow indicates direction of plunge).
Fault, indicated or assumed.
Muskeg or swamp.
Motor road.
Other road.
Trail, portage, winter road.
Building.
Test pit.
Trench.
County boundary, approximate location only and not to be relied on.
Township boundary, approximate location only and not to be relied on.

Published 1968

Map 2106
LAKE TOWNSHIP
HASTINGS COUNTY

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 R. K. Laakso, 1958, 1959.

Cartography by F. W. Dawson, Ontario Department of Mines.

Base map derived from maps of the Forest Resources Inventory, Ontario Department of Lands and Forests, with additional information by R. K. Laakso.

Magnetic declination in the area was approximately 10°W., 1959.