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MARGINAL NOTES

Location and Access: The north boundary of Otto Township is at the southern edge of Swastika, a community about four miles southwest of Kirkland Lake. Excellent access is provided in the map-area by Highways 11 and 112; lot, concession, and logging roads; the Blanche River and Round Lake; and the Ontario Northland Railway.

The Trans-Canada natural gas pipeline and its branch to Jones and Laughlin Mining Company's "Adams" Iron mine traverse the map-area, and the branch to Kirkland Lake crosses the northeast corner of the map-area. Power is supplied by electric transmission lines, a main line of which crosses the northwestern part of Otto Township.

Mineral Exploration: Gold was discovered on the northeast shore of Otto Lake in 1905, and the property of Crescent Kirkland Gold Mines Limited (now owned by Gateford Mines Limited) produced during 1911, 1913, 1941, and 1942. The total value of production from this and a nearby property in Teck Township owned by the same company was \$1,001,920. In Otto Township the underground workings consist of a three-compartment vertical shaft 671.5 feet deep, and lateral development on six levels. From 1943 to 1945 the property was diamond drilled extensively from surface, and further development work was done from 1945 to 1949, when the mine was closed down.

In 1935, drilling was done and a 105-foot shaft was sunk on claims of Chelonia-Swastika Mines Ltd. in con. V near the west boundary of Otto Township. The work included 60 feet of latest level, and the work was done by Selected International Mines Ltd. Other shafts and drillholes and numerous pits exist in the interbedded flows and tuffs adjacent to the syenitic stock.

The stock itself has received little attention from prospectors, and the map-area as a whole has undergone very little recent exploration. General Geology: The map-area is in the "Abitibi" belt of Precambrian volcanic, sedimentary, and intrusive rocks that extend from southwest of Timmins, east to Cheltenham, Quebec.

The most prominent geological formation in the map-area, however, is an unusual alkalic igneous stock, a roughly circular complex about five miles in diameter. The stock consists mainly of pink syenite, cut by mafic syenite and lamprophyre, but in places near its contact contains bands of mafic gneiss, with gneissosity roughly parallel to the boundary of the stock. The stock also contains mafic segregations and inclusions of high metamorphic grade. Until recently the youngest felsic intrusive rocks in the Kirkland Lake area were thought to be Algonian in age, such as the Round Lake batholith of granite and granitic xenites (2,390 ± 80 million years, Rb-Sr whole rock; Purdy and York 1968), which extends into the southern part of the map-area. The Otto stock was thought to be an offshoot of the batholith. However, the petrology of the Otto stock is markedly different from that of the Round Lake batholith, and the Otto stock is much younger (1,730 ± 50 million years, Rb-Sr whole rock; Purdy and York 1968). The age of the Otto Township alkalic igneous stock, therefore, is the youngest recorded in the Kirkland Lake area, except for Upper Jurassic kimberlite (151 ± 8 million years, K-Ar; Wanless et al. 1968, p.105) discovered in 1967 nine miles northeast of the Otto stock, in the Upper Canada gold mine. Other rocks of the range of the Otto stock, the Sudbury north-south dyke (1,704 ± 19 million years, Rb-Sr; Fairbairn et al. 1967), and carbonatite intrusions in northeastern Ontario (Gittins et al. 1967), and the kimberlite of the Premier diamond mine in South Africa (1,750 million years, galena method, as mentioned by Dawson 1968).

Surrounding the Otto stock are Keewatin- and Timiskaming-type rocks typical of the Kirkland Lake area, ranging in age upward from 2,343 to 2,368 ± 48 million years (Rb-Sr whole rock; Fairbairn et al., 1966). They consist of flow and fragmental basalt, andesite, dacite, trachyte, and rhyolite, as well as conglomerate, greywacke, and slate. The rhyolitic rocks contain numerous lenses of magnetite and sulphides.

Haleyburian-type mafic and ultramafic sills, stocks, and dikes occur in (and probably are genetically related to) the Keewatin-type rocks.

Most diabase dikes strike generally north, as does the Matachewan swarm, but some might be Nipissing or Keweenaw in age. Examples of possible Nipissing or Keweenaw diabases are those cutting the Otto stock between the road and the north shore of Round Lake.

Structural Geology: The most prominent structural feature is the circular Otto stock. Relative to its size, its contact metamorphic aureole is not particularly wide: about one-half mile of garnet-epidote amphibolite between the contact of the stock and volcanic rocks of the chlorite-schist grade of regional metamorphism. Furthermore, microlitic cavities occur in the syenite, and some of the biotite-pyroxene-garnet amphibolite in the stock constitutes roof pendants of highly metamorphosed volcanic country rock. For these reasons the writer considers the stock to be a mesozonal to epizonal intrusion forcefully injected into Keewatin-type volcanic and sedimentary rocks.

A prominent north-striking fault offsets the west half of the Otto stock about 1 1/2 miles south, relative to the east half. The fault is a regional north-south striking fault, and lineaments of the Lake Timiskaming fault system several of which cross the map-area.

Centred on one north-south striking fault, about two miles north of Round Lake, is a circular depression 3,500 feet in diameter. The feature is inside the Otto stock, and outcrops both inside and outside the depression are medium-grained syenite, coarse-grained syenite, and lamprophyre. Possibly the depression marks the location of a younger, related stock, or the junction of several joints and faults.

Economic Geology: Long narrow lenses of banded magnetite-chert iron formation and strata-bound pyrite, pyrrhotite, and graphite are interbedded with tuff and agglomerate of andesitic composition. Most parts of the sulphide zones are barren, but some contain low percentages of copper, zinc, and nickel. Because electromagnetic and magnetic anomalies are widespread, and the total percentages of sulphides in the base metal zones are lower than in the barren zones, drilling based on geophysical work has proved disappointing, however, surface prospecting, soil and bedrock geochemistry, and greater use of geology during interpretation of geophysical work would provide more rewarding drill targets.

Some of the highly metamorphosed biotite-pyroxene amphibolite contact rock of the Otto stock (in concession V, lot 8, south half, northwest quarter) contains small amounts of disseminated bornite. Also, a mineralogically-similar highly metamorphosed roof pendant near Highway 11 is cut by carbonate stringers, a few of which contain chalcocopyrite.

Rocks present at the old mine on the northeast shore of Otto Lake consist of volcanic flows, irregular-shaped bodies of syenite porphyry, and smaller amounts of diorite, granodiorite, and lamprophyre. These formations are intersected by many faults and quartz veins. At least two veins of heavy sulphides have been found. Vein quartz locally contains pyrite and small amounts of galena and molybdenite. Visible gold is present in places along fractures in the quartz. Gold content is high where there are heavy concentrations of fractured pyrite and galena in the veins (Thomson 1948, p.49).

In the northwestern part of lot 12 of concession V, the core from a hole drilled to intersect a zone of shearing, carbonatization, silicification, and pyritization contained small amounts of gold and copper. The band of interbedded flows and tuffs that crosses the map-area contains small lenses of "iron-formation", consisting of black slaty tuffs, whitish chert, and interbedded siltite, red Jasper and magnetite (Hopkins 1923, p.59). According to Cooke (1920, p.19E) the tuff beds, particularly the fine-grained phases, are locally impregnated with pyrite and pyrrhotite.

In at least three places near the contact of the stock the syenite contains nepheline. At one of these locations, about half a mile north of the community of Dane, a northwest-trending band of nepheline-bearing syenite is almost one mile long and about 800 feet wide. The main line of the Ontario Northland Railway enters the southeast end of the band about three-quarters of a mile northwest of Dane station and follows the band for about half a mile.

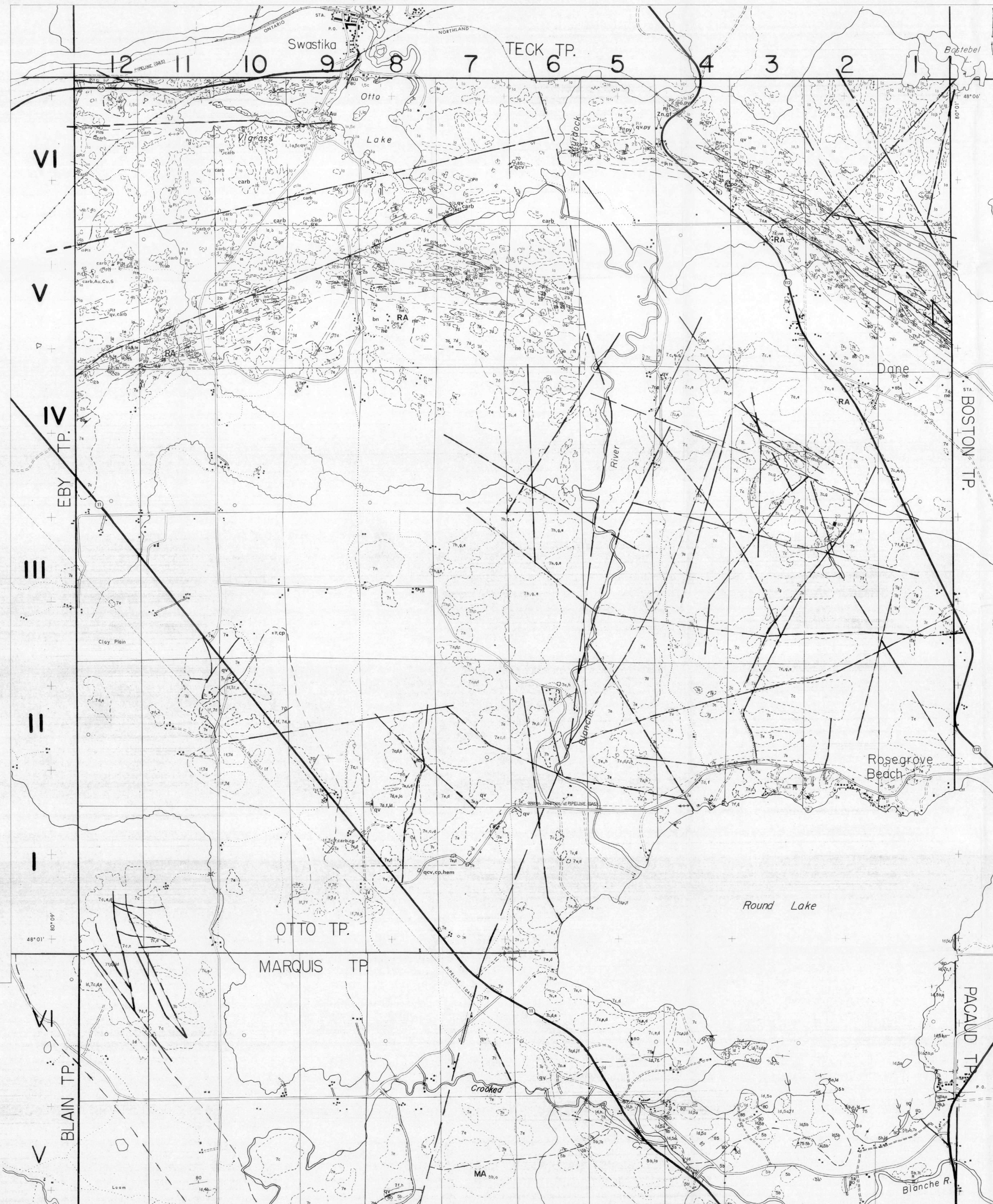
A second area of nepheline-bearing syenite, in Otto Township, concession V, lot 8, south half, was described by Cooke (1922, p.12) as follows:

"South of Otto Lake, the marginal phases of the syenite are much more basic than the main mass of the intrusive. This condition, a very general one on the margins of batholithic masses, is apparently due to the inclusion and digestion of parts of the older rocks, which in this locality appear to have been the basalt tuffs. The basic parts of the syenite, whatever their origin, are strung out into gneissic bands several feet in width, and these bands are highly impregnated with nepheline. The nepheline content varies between 30 and 40 percent, the remainder consisting of albite with about 25 percent of ferromagnesian minerals, which include brown biotite, actinolite, and in some thin sections, aegirine-augite, with accessory magnetite, apatite, and titanite. Amethyst and rutile were also identified in some of the sections".

The third location at which the syenite contains nepheline is in the south halves of lots 10 and 11, concession V.

Selected References

Aldrich, L.T., and Wetherill, G.W. 1960: Rb-Sr and K-Ar ages of rocks in Ontario and northern Minnesota; J. Geophys. Res., 65, p. 337-340.
Cooke, H.C. 1920: Exploration of the townships west of Kirkland Lake, Ontario; Geol. Surv. Canada, Summary Report, 1919, pt. F, p. 18E-19E.
1922: Kenogami, Round, and Larder Lake areas, Timiskaming District, Ontario; Geol. Surv. Canada, Mem. 131.
Dawson, J.B. 1968: Recent researches on kimberlite and diamond geology; Econ. Geol. Vol. 63, p. 504-511.
Fairbairn, H.W., Faure, G., Pinson, W.H. Jr., Hurley, P.M. 1967: Rb-Sr whole-rock age of the Sudbury lopolith and basin sediments; Can. J. Earth Sci., Vol. 5, p. 707-714.
1966: Age relations of volcanics at Kirkland Lake, Ontario, with the Round Lake pluton; Mass. Int. Tech. 14th Ann. Progress Rept. for 1966.
Gittins, J., McIntyre, R.M., and York, D. 1967: The ages of carbonate complexes in eastern Canada; Can. J. Earth Sci., Vol. 4, p. 651-655.
Hopkins, Percy E. 1923: Label and Gauthier Townships; Ontario Dept. Mines, Vol. XXII, pt.4, p. 52, 55, 59 (published 1925).
Lawton, K.D. 1957: Geology of Boston Township and part of Pacaud Township; Ontario Dept. Mines, Vol. LXVI, pt.5 (published 1959).
Purdy, J.W., and York, D. 1968: Rb-Sr mineral ages of rocks from the Superior Province near Kirkland Lake, northeastern Ontario, Canada; Can. J. Earth Sci., Vol. 5, p. 699-705.
Thomson, Jas. E. 1948: Geology of Teck Township and the Kenogami Lake Area, Kirkland Lake Gold Belt, Ontario Dept. Mines, Vol. LVII, pt.5, p. 1-53 (published 1950).
Wanless, R.K., Stevens, R.D., Lachance, G.R., and Edmonds, C.M. 1968: Age determinations and geological studies, K-Ar isotopic ages, Rept. 8; Geol. Surv. Canada, Paper 67-2, Part A.

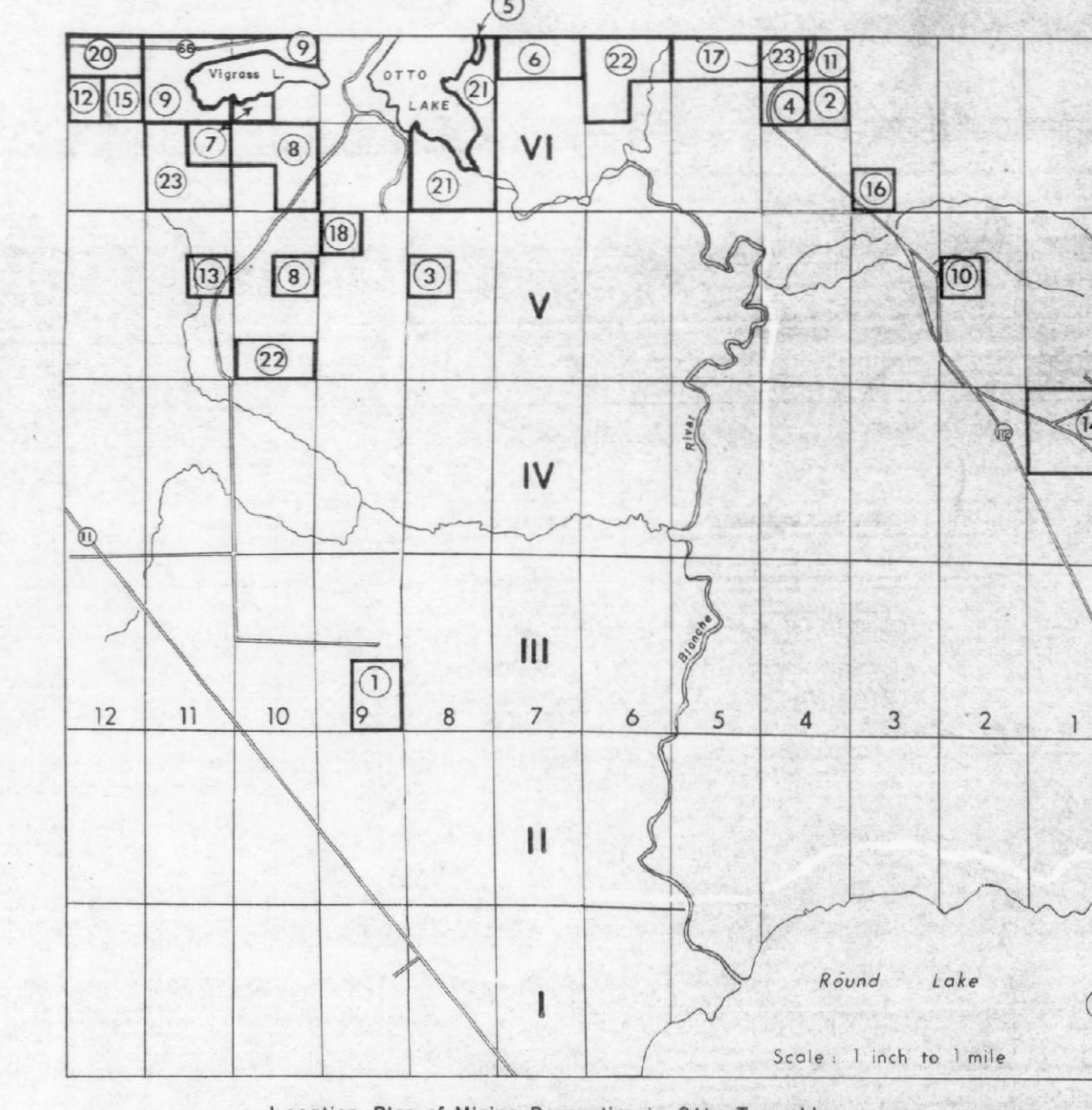


ONTARIO DEPARTMENT OF MINES
PRELIMINARY GEOLOGICAL MAP No. 501
**OTTO TOWNSHIP
AND NORTHERN PART OF
MARQUIS TOWNSHIP**
DISTRICT OF TIMISKAMING
Scale 1 inch to 1/4 mile
N.T.S. Reference 42 A/1 East and 41 P/16 East
C.S.C. Aerometric Maps: 289G and 1506G
LEGEND FOR F. 448 and F. 501

- CEZOIC
PLEISTOCENE AND RECENT
Clay, sand, and gravel
UNCONFORMITY
- PRECAMBRIAN
PROTEROZOIC
9
MAFIC INTRUSIVE ROCKS (NIPISSING OR KEWEENAW)
Biotite
INTRUSIVE CONTACT
- HURONIAN
COBALT GROUP
8
COAGULITE FORMATION
8a Conglomerate
8b Arkose
8c Quartzite and greywacke
8d Argillite and slate
UNCONFORMITY
- 7
ALKALIC INTRUSIVE ROCKS (KILLARNEAN)
7c Coarse-grained syenite; syenite porphyry; pegmatite
7d Mafic syenite; syenite contaminated by country rocks
7e Medium-grained syenite; apatite dikes
7f Tuffite with numerous xenoliths and outcrops
7g Lamprophyre
7h Quartz syenite; granite
7k Biotite
INTRUSIVE CONTACT
- 6
ARCHEAN
6
MAFIC INTRUSIVE ROCKS (OYACHEWAN AND NIPISSING)
Biotite
INTRUSIVE CONTACT
- 5
FELSIC INTRUSIVE ROCKS (ALGONIAN)
5a Granite; porphyritic granite; granodiorite
5b Granodioritic gneiss
INTRUSIVE CONTACT
- 4
MAFIC AND ULTRAMAFIC INTRUSIVE ROCKS (HAILEYBURIAN, EARLY ALGONIAN AND KEEWATIN)
4a Serpentine, peridotite
4b Gabbro, diorite
INTRUSIVE CONTACT
- 3
METASOMIOTIC (TIMISKAMING AND KEEWATIN)
3a Conglomerate
3b Arkose
3c Quartzite, greywacke
3d Slate
3e Tuff; agglomerate; minor amounts of trachyte, trachyte
inclined, and breccia
UNCONFORMITY AND INTERBEDDING
- 2
FELSIC VOLCANIC ROCKS (KEEWATIN)
2a Rhyolite, dacite
2b Iron formation; siliceous tuff, agglomerate
2c Diorite porphyry; amygdaloidal and sparganitic dacite
INTRUSIVE CONTACT
- 1
MAFIC VOLCANIC ROCKS (KEEWATIN)
1a Undifferentiated mafic volcanic rocks
1b Basalt, andesite
1c Chloritic mafic tuff, agglomerate
1d Altered (bleached, carbonized) volcanic and
sedimentary rocks
1e Amphibolite, garnet-epidote amphibolite, amphibolite gneiss
1f Andesite porphyry; amygdaloidal and sparganitic andesite
1g Biotite-garnet-pyroxene amphibolite
INTRUSIVE CONTACT

- GLIOLOGICAL AND MINING SYMBOLS
Glacial striae.
Area of bedrock outcrop.
Bedding, top unknown; (inclined, vertical).
Lave flow; top (arrow) from pillow shape and pecking.
Schistosity; (horizontal, inclined, vertical).
Gneissosity; (horizontal, inclined, vertical).
Foliation; (horizontal, inclined, vertical).
Geological boundary, observed.
Geological boundary, position interpreted.
- Fault; (observed, assumed).
Lineament.
Jointing; (horizontal, inclined, vertical).
Drag folds with plunge.
Drill hole; (vertical, inclined).
Vein, vein network. Width in inches.
Shaft; depth in feet.
Gravel pit.
Magnetic attraction.
Radioactivity.

- LIST OF PROPERTIES
1. Holden, Trygve
2. Bostwell, Mrs. Helen
3. Duchene, Joseph
4. Frazer, Henry Estare
5. Gateford Mines Ltd.
6. Gordon Label Mines Ltd.
7. Hailybury Lumber Company
8. Hill, C.R.
9. Iroquo Consolidated Mines Ltd.
10. Kirkland Lake Golf Club Ltd.
11. Lake Shore Mines Ltd.
12. Michel, Mrs. Lucy
13. Michener, Miss Margaret
14. Ontario Northland Transportation Commission
15. Pain, S.E.
16. Poirier, Mr. and Mrs. Leo
17. Porter, Mrs. A.A.
18. Robinson, Lady Head
19. Sherborne Mining Corporation Ltd.
20. Strom, Diane C. (formerly Kirkland Mines Ltd.)
21. Teck, Corporation of Township of
22. Upper Kirkland Mines Ltd.
23. Walhanna Enterprises



- METAL AND MINERAL REFERENCE
Au Gold
bn Bornite
carb Carbonate
cp Chalcocopyrite
Cu Copper
gr Graphite
hem Hematite
ne Nepheline
py Pyrrhotite
pr Pyrite
vc Quartz-carbonate vein
qv Quartz veins
s Sulphide minerals
Zn Zinc
- NOTES
Geological mapping was tied to lakes, roads, and other landmarks recognizable on air photographs.
Claim maps may be obtained from the Mining Recorder, Kirkland Lake, Ontario.
- SOURCES OF INFORMATION
Geology of the three southern concessions of Otto township and the northern part of Marquis township by Howard Lovell and assistants, 1968. Geology of northern halves of lots 8, 9, 10, 11, and 12, concession V, from O.D.M. Map No. 1943-1, Township of Teck.
Geology of remainder of concessions V and VI by K.D. Lawton and assistants, 1959; field notes and reports compiled by John Sandson and Howard Lovell, 1965.
Geology of concession IV by John Sandson, 1965.
Geological and geophysical maps and reports of mining companies.
Base map derived from maps of the Forest Resources Inventory, Ontario Department of Lands and Forests, with revisions by Howard Lovell.
Magnetic declination is approximately 9° 27' W.
Issued 1969.