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Geology of Fallon and Fasken Townships District of Timiskaming

By
D. R. Pyke

Geological Report 104

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Geological Map

(back pocket)

Map 2253 (coloured) — Fallon and Fasken Townships, Timiskaming District. Scale, 1 inch to ½ mile.
This report describes the Precambrian geology and mineral occurrences in Fallon and Fasken Townships, comprising an area of 72 square miles, located about 25 miles southeast of the town of Timmins.

Steeply dipping metavolcanic flows and pyroclastics of Early Precambrian age are the oldest rocks, and underlie much of the central and western parts of the map-area. Mafic metavolcanic flows comprise most of the lower part of the exposed volcanic sequence; dominantly pyroclastic, felsic metavolcanics form the upper part of the sequence. Intrusive into the metavolcanics are syn- to late-tectonic stocks of monzonite and granodiorite. North-trending diabase dikes of Early Precambrian age intrude the metavolcanics and felsic stocks.

Relatively flat lying sedimentary rocks of the Middle Precambrian Cobalt Group unconformably overlie the Early Precambrian rocks and form a series of high hills in western Fallon Township. A northeast-trending diabase dike postdates the Huronian Supergroup, and is interpreted as being of Middle Precambrian age.

The felsic metavolcanics in central Fallon Township occupy the axial part of a southeast-plunging syncline. The long axis of the monzonitic stock coincides with a synclinal- to basinal-type structure. The Cobalt Group sedimentary rocks form broad, open, north-trending folds. Major faults appear to trend in a north or northwest direction.

Regional metamorphism of the Early Precambrian volcanic and sedimentary rocks occurred under greenschist facies conditions. Pronounced contact metamorphic aureoles having mineralogical compositions indicative of the hornblende-hornfels facies border the monzonite and granodiorite stocks. The Cobalt Group sedimentary rocks are virtually unmetamorphosed.

Only minor sulphide mineralization was observed; this consists mainly of disseminated pyrite within quartz veins or shear zones in the metavolcanics bordering the stock of monzonite in northern Fallon Township. This area, as well as the area of metavolcanics bordering the granodiorite in Fasken Township, is favourably located for hydrothermal mineralization related to the felsic intrusions.
Geology of Fallon and Fasken Townships
District of Timiskaming

By
D. R. Pyke

INTRODUCTION

LOCATION AND ACCESSIBILITY

Fallon and Fasken Townships are 25 miles southeast of the Town of Timmins and are bounded approximately by Longitudes 80°49' to 81°04' west and Latitudes 48°11'30" to 48°16'30" north. Each of the two townships are about 6 miles square.

The eastern side of Fallon Township is accessible via the Night Hawk River; near the southern part of the township the river becomes shallow, and is traversed by a number of beaver dams. The western half of Fasken Township is accessible via the Whitefish River, which is readily navigable from Night Hawk Lake to High Falls, and again south of the falls to the junction of the East Whitefish River. From this junction, the main Whitefish River is the more navigable.

An old wagon and motor road extends from the Forks River in Langmuir Township, southward along the western side of Fallon Township, and into the northern part of Cleaver Township. A branch of this road in the southwestern corner of Langmuir Township leads westward into Eldorado Township, and hence north to South Porcupine. Only the northern half of the road, in Eldorado Township, is suitable for normal motorized vehicles; elsewhere a swamp tractor is required. With the exception of a few swampy patches most of the road is suitable for walking, in particular the part in Fallon Township.

An all-weather road extends from Highway 101 to the southwestern part of Timmins Township; from here a logging road extends to the northeast part of Fasken Township.

PHYSIOGRAPHY

Maximum relief in the area is in the western half of Fallon Township where relatively flat lying Middle Precambrian sedimentary rocks form a series of high hills up to 450 feet above the surrounding terrain. Elsewhere in the area outcrops

---

Fallon and Fasken Townships
generally rise no more than 10 to 70 feet above an otherwise relatively flat swampy terrain.

Pleistocene and Recent alluvium mantle more than 90 percent of the area.

Drainage in the area is afforded by the Forks, Night Hawk, and Whitefish Rivers, which flow northwards into James Bay via Night Hawk Lake and the Abitibi River.

PREVIOUS WORK

Burwash (1896) made the first geological reference to the area while accompanying Niven's Ontario Land Survey party during the cutting of the Nipissing-Algoma boundary line, part of which forms the western boundary of Fallon Township. A geological map by Goodwin (1911) depicts, by means of a few notes, some of the general geology near the western boundary of Fallon Township. A report by Hopkins (1924) includes a sketch map of the geology of a few outcrop areas in Fallon and Fasken Townships.

Although Fallon and Fasken Townships had not been mapped prior to the present survey, many of the surrounding townships had been partly or wholly mapped at scales of 1 inch or ¼ inch to the mile. Cooke (1919) mapped the Matachewan area in 1917-1918; this area included the southern halves of Cleaver and McNeil Townships located south of the Fallon-Fasken Townships area. In 1921, Wright (1922) mapped the Watabeag Lake area, which includes Michie Township to the east of Fasken Township. Bruce (1926) mapped the Redstone River area, which includes Douglas Township to the west of the map-area. In 1939, Berry (1940) mapped a block of townships that adjoins the northern boundary of Fallon and Fasken Townships. In 1967, Pyke (1970) mapped the adjoining townships of Langmuir and Blackstock at a scale of 1 inch to ¼ mile.

FIELD WORK

The field work for the report was done during the summer of 1968. Vertical aerial photographs at a scale of 1 inch to ¼ mile, supplied by the Timber Branch, Ministry of Natural Resources, provided mapping control. The base map was prepared by the Cartography Section, Geological Branch, Ontario Division of Mines, from map sheets of the Forest Resources Inventory of the Ontario Department of Lands and Forests. Traverses by pace-and-compass were not spaced at regular intervals, rather only those outcrops or potential outcrop areas that were identified from the aerial photographs were visited. Because the outcrops are generally readily apparent from the aerial photographs, most of the available exposures were examined. A helicopter was utilized for many of the camp moves, because of the absence of lakes suitable for the landing of float-equipped fixed-wing aircraft. Where possible, a helicopter (Photo 1) was also used to reach isolated outcrops or areas that did not warrant the setting up of a camp. The geology of the map-area is not tied to surveyed lines.
ACKNOWLEDGMENTS

D. R. Sharpe assisted the writer throughout the 1968 field season, and his help was greatly appreciated. In 1967, R. M. Stesky was senior assistant for the writer in Langmuir and Blackstock Townships (Pyke 1970), and at that time did some independent mapping in Fallon and Fasken Townships.

Mr. E. J. Leahy, acting Resident Geologist at Timmins in 1968, is gratefully acknowledged for his suggestions during the summer.

Thanks are extended to Mr. J. B. Hill and family of Nighthawk Marina for the many courtesies extended to the writer and Mr. Sharpe during the summer.

GENERAL GEOLOGY

The bedrock in the area is of Precambrian age. Early Precambrian mafic and felsic metavolcanic flows and pyroclastics are the oldest rocks, and underlie about half the area. The metavolcanics are intruded by a small stock of monzonite, in the northern part of Fallon Township, and part of a large stock of granodiorite, in the eastern half of Fasken Township.

Middle Precambrian sedimentary rocks of the Cobalt Group unconformably overlie the metavolcanics, and form a series of high hills in the western half of Fallon Township.
# Fallon and Fasken Townships

## Table 1

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<tr>
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<td><strong>QUATERNARY</strong></td>
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<td><strong>RECENT</strong></td>
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<tr>
<td>Swamp and stream deposits</td>
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<tr>
<td><strong>PLEISTOCENE</strong></td>
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<tr>
<td>Till, clay, sand, gravel</td>
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<tr>
<td><em>Unconformity</em></td>
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**PRECAMBRIAN**

**MIDDLE PRECAMBRIAN**

**MAFIC INTRUSIVE ROCKS**

<table>
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<th>Diabase</th>
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<tbody>
<tr>
<td><em>Intrusive Contact</em></td>
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</table>

**HURONIAN SUPERGROUP**

**COBALT GROUP**

**GOGWANDA FORMATION**

<table>
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<tr>
<th>Arkose, greywacke, argillite, conglomerate</th>
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<td><em>Unconformity</em></td>
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**EARLY PRECAMBRIAN (ARCHEAN)**

**MAFIC INTRUSIVE ROCKS**

<table>
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<th>Porphyritic diabase</th>
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<td><em>Intrusive Contact</em></td>
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**FELSIC INTRUSIVE ROCKS**

Monzonite, porphyritic monzonite, pyroxene amphibolite, porphyritic granodiorite, leucocratic granodiorite

**Intrusive Contact**

**METAVOLCANICS AND METASEDIMENTS**

**FELSIC METAVOLCANICS**

Dacitic and sodic rhyolitic flows and pyroclastics, epidotized dacitic flows and pyroclastics

**METASEDIMENTS**

Hornblende gneiss

**MAFIC METAVOLCANICS**

Massive to foliated lava, porphyritic lava, pillow lava, mafic pyroclastic rocks, epidote-layered mafic volcanic rocks, gneissic mafic volcanic rocks
Northerly trending diabase dikes of Early Precambrian age are common. A northeast-trending diabase dike intrudes the Cobalt Group sedimentary rocks, and is possibly of Middle Precambrian age.

Structurally, the felsic metavolcanics in central Fallon Township are interpreted as occupying the axial portion of a southeast-plunging syncline; most of the western expression of this syncline is unconformably overlain by rocks of the Cobalt Group. The long axis of the monzonitic stock coincides with a synclinal-to basinal-type structure. North-trending open folds characterize the Cobalt Group rocks. Faults, interpreted largely on the basis of topographic lineaments, trend in a north or northwest direction.

Regional metamorphism of the Early Precambrian volcanic and sedimentary rocks occurred under greenschist facies conditions. Pronounced contact metamorphic aureoles border the granitic stocks.

EARLY PRECAMBRIAN (ARCHEAN)

Metavolcanics and Metasediments

The metavolcanics are subdivided into two main units: mafic metavolcanics of a basaltic to andesitic composition; and felsic metavolcanics of a dacitic to sodic rhyolitic composition. This two-fold subdivision was made primarily in the field on the basis of the colour of weathered and fresh surfaces and the siliceous appearance or hardness of the rocks. Selected samples were chosen for microscopic examination in the laboratory to obtain additional information on the mineralogy and texture of the rocks.

Rocks mapped as metasediments are confined to a narrow lens in the north-eastern corner of Fasken Township.

MAFIC METAVOLCANICS

Outcrops of mafic metavolcanics are confined mainly to the northern half of Fallon Township, in particular to that area in close proximity to the outer margins of the monzonitic stock. Because of this spatial relationship to the monzonite, the metavolcanics have, to varying degrees, been subjected to contact metamorphism; the most notable metamorphic feature being the development of irregular epidote-feldspar-quartz layers and patches, both within the pillow lavas and the intercalated tuffaceous layers. The epidote development is most pronounced in outcrops bordering the northern side of the monzonite; as the contact with the monzonite is approached the epidote-rich layers and patches become more prolific, and many are highly contorted. Individual epidote-rich layers have a maximum width of 4 inches, average about 1/4 to 1/2 inch, and are rarely traceable for more than 10 feet along strike. Porphyroblasts of hornblende are also a common feature within the contact aureole.

Where relationships are not obscured by epidote-feldspar layering, the mafic metavolcanics are seen to be fine grained, massive to weakly foliated, medium to
Fallon and Fasken Townships

dark grey weathering, and commonly porphyritic with plagioclase phenocrysts averaging about 0.04 inch in diameter and constituting 10 to 15 percent of the rock. Common primary structures present are pillows and quartz- or calcite-filled vesicles. Spherulites were observed in one outcrop near the south-central boundary of Fallon Township. A few individual flows are recognizable, and range in thickness from 55 to 140 feet. Individual flows are separated by strongly schistose layers 3 to 12 feet thick, which may be tuffaceous units. At one outcrop of mafic metavolcanics, immediately north of the easternmost outcrops of rocks of the Cobalt Group, a pillow breccia was observed in which individual pillows are separated by abundant fragmental material, possibly recrystallized glassy fragments.

Interlaying of felsic and mafic metavolcanics is rare, and confined mainly to those outcrops bordering the large diabase dike in the northeastern part of Fallon Township.

The contact metamorphic effects of the monzonite extend for a maximum distance of about 2,500 feet into the adjacent metavolcanics. As mentioned above, contact metamorphosed metavolcanics are characterized by the presence of abundant epidote-rich layers or patches. Microscopically, the distinction is most readily made by the assemblage calcic plagioclase+hornblende in the contact aureole, versus albitic plagioclase+actinolite+chlorite within the regionally metamorphosed volcanic rocks. The approximate contact aureole of the hornblende-hornfels facies, for a part of the area surrounding the monzonite stock, is delineated on the accompanying geological map (Map 2253, back pocket). All the mafic metavolcanics adjacent to the granodiorite stock in Fasken Township were metamorphosed under hornblende-hornfels facies conditions. Locally gneissic mafic metavolcanics, probably formed by metamorphic differentiation, occur near the granodiorite contact.

In thin section many of the regionally metamorphosed mafic metavolcanics have a sub-ophitic texture. Commonly superimposed on this texture are phenocrysts of lath- to rarely equant-shaped plagioclase, averaging about 1.2 mm in length, and constituting about 15 percent of the rock. A fluidal texture (Moores 1959, p.171) is common to some of the thin sections examined. Granoblastic textures generally predominate within a few hundred feet of the contacts with the felsic intrusive stocks.

Plagioclase forms from 40 to 60 volume percent of the mafic metavolcanics; compositions range from albite to sodic andesine, the more calcic compositions being confined to the contact aureoles. Twinning is especially well preserved in the phenocrysts, even when the grains are almost completely altered to secondary minerals that consist mainly of epidote, sericite, and minor chlorite. The degree of alteration and (or) recrystallization of the plagioclase is dependent primarily on coarseness of grain and proximity to the felsic intrusions.

Hornblende, the dominant mafic mineral within the contact aureoles, is pleochroic from medium or dark green to light brown, and averages about 0.1 mm in length. Outside the aureoles shereddy, pale green actinolite, replaced to varying degrees by chlorite, is the dominant mafic constituent.

Other minerals, not mentioned above but which occur in one or more of the thin sections examined, include minor or trace amounts of quartz, calcite, allanite, biotite, sphene, leucoxene, apatite, and opaque minerals.
A finely layered hornblende gneiss outcrops in the northeastern corner of Fasken Township. The gneiss forms the southward extension of the same narrow unit mapped as metasediments\(^1\) by Pyke (1970) in the southeastern corner of Blackstock Township. The rock is well banded, consisting of alternating mafic- and felsic-rich layers up to 1 inch in width. The continuity of individual layers along strike suggests the layering is primary; although metamorphism accompanying the emplacement of the adjacent granodiorites has no doubt enhanced the layering.

This narrow band of metasediments appears to form a screen between two discrete bodies of granodiorite; the granodiorite bodies are to be discussed in the section on 'Felsic Intrusive Rocks'.

Felsic metavolcanics underlie much of the central part of Fallon and Fasken Townships. Many of the exposures are poor due to a persistent lichen cover, but in those outcrops where relationships are not obscured, many of the rocks are seen to have a fragmental texture and consist of tuff or lapilli tuff and more rarely agglomerate. Foliation is generally well developed, and in the fragmental varieties is commonly enhanced due to differential weathering of the various layers. Locally, in east-central Fallon Township, epidote-feldspar-quartz veins and lenses are very abundant (Photo 2), and form prominent protrusions on the outcrop surfaces, which, on lichen covered surfaces, can give the impression of being fragments. Most of the felsic metavolcanics were mapped as dacite, primarily on the basis of the colour of the fresh and weathered surfaces. Weathered surfaces are generally light to medium grey, buff, or locally a pinkish hue. Fresh surfaces are light to medium grey or green, and are distinctly more siliceous appearing than those of the mafic metavolcanics. The texture is commonly inhomogeneous and of a streaky nature; in part perhaps an original flow banding, now modified or enhanced by metamorphism.

A few outcrops of felsic metavolcanics have a distinct light grey-white to pink weathered surface, and were mapped as sodic rhyolite. The term sodic rhyolite is chosen for these rocks on the basis of a high soda to potassic ratio in conjunction with a high silica content (Table 4). A prominent east-west-trending fracture cleavage is characteristic of those outcrops in the south-central part of the area, and numerous small fragments are commonly visible. A few outcrops of massive sodic rhyolite contain numerous phenocrysts of plagioclase up to 0.1 inch in maximum dimension. Some of these porphyritic varieties may be hypabyssal intrusions.

Contact metamorphic effects are prominent in the dacitic volcanic rocks close to the granodiorite in Fasken Township. The outcrops are strongly foliated and contain abundant epidote-feldspar-quartz layers. Although dacitic volcanic rocks persist to the granodiorite contact, they are subordinate to layers of amphibolitized mafic volcanic rocks; the emplacement of the granodiorite having occurred near a mafic metavolcanic-felsic metavolcanic contact.

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\(^1\) As pointed out by Pyke (1970, p. 8) the rocks could also be interpreted as metavolcanics.
In thin section the dacite displays a large variation in texture and composition. Many samples contain fragments consisting of various combinations of plagioclase crystals, chloritized and sericitized rock particles, and recrystallized vitric fragments. Mafic minerals range from about 5 to 25 percent, and consist mainly of hornblende and actinolite. Hornblende is especially abundant in outcrops in close proximity to the granodiorite in Fasken Township, and to a lesser degree in the outcrop area in east-central Fallon Township. The latter outcrop area, as mentioned previously, generally contains numerous epidote veins, and this coupled with the presence of hornblende in excess of chlorite, indicates the close proximity of a felsic intrusion (see the first part of the section on 'Mafic Metavolcanics'). In addition, a thin section of one of the samples from this area contains about 10 percent clinopyroxene; this is indicative of a higher temperature than that generated during regional metamorphism under greenschist facies conditions. The only felsic intrusion noted in this vicinity, other than a few minor dikes, is an exposure of monzonite near the southern part of the outcrop area. It is therefore inferred that perhaps a stock of monzonite intruded this series of dacitic volcanic rocks at a depth sufficiently close to the present surface to place the volcanic rocks within the contact metamorphic aureole.

Seven thin sections of sodic rhyolite were examined, and the majority of these consist predominantly (70-80 percent) of a very fine-grained mosaic (0.015-0.10 mm) of feldspar and presumably some quartz, although much of the quartz appears to have crystallized as somewhat larger grains (0.05 mm). In a few thin sections, skeletal grains of plagioclase were observed, indicative of rapid cooling. These grains consist of an optically continuous, incomplete framework of plagioclase,
embedded in a very fine mosaic of what appears to be recrystallized glass. A few varieties of sodic rhyolite have numerous and well developed phenocrysts of plagioclase in an otherwise non-descript fine-grained mosaic of feldspar and quartz (Photo 3); the texture indicates these may be hypabyssal rather than extrusive rocks. Minor chlorite, sericite, opaque minerals, and epidote are invariably present. Near the contact with the granodiorite in Fasken Township epidote forms up to 15 percent by volume of the sodic rhyolite, hornblende is generally the dominant mafic mineral, and minor biotite is locally present. Minor or trace amounts of one or more of the following minerals are also present in a few of the thin sections: calcite, leucoxene, potassic feldspar, apatite, allanite, and sphene.

**Felsic Intrusive Rocks**

Felsic intrusive rocks are confined mainly to two bodies: one consisting of a small stock of monzonite in the north-central part of Fallon Township; the other of a large stock of granodiorite\(^1\) underlying the eastern half of Fasken Township and a large part of some of the surrounding townships. Part of each of these stocks has recently been described by Pyke (1970, p. 21 and 23). The age relationships

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\(^1\) Henceforth referred to as the Blackstock Granodiorite.
Figure 2—Ternary plot showing volume percent of quartz, potassic feldspar, and plagioclase in felsic intrusive rocks of Fallon and Fasken Townships. Percentages were determined by modal analyses and recalculated to 100 per cent.
between these felsic intrusions are not definitely known. However, it is suggested that the monzonite postdates the granodiorite in that syenitic dikes, which intrude both the monzonite and granodiorite, are interpreted as being genetically related to the monzonite. This is indicated both by the undersaturated affinity between the dikes and monzonite, and by the fact that the dikes are most prolific within and in close proximity to the monzonite. Nevertheless, both the monzonite and granodiorite appear to have been emplaced after the culmination of regional metamorphism, as both intrusions are enveloped by a contact aureole, and no evidence was seen in the aureole rocks of any overprinting by a later regional metamorphism. The conformability with the regional structure, together with the massive nature of the plutons, indicates that they are probably late tectonic intrusions. Modal analyses of the granodiorite and monzonite are given in Tables 2 and 8 respectively. The volume percent of quartz, plagioclase, and potassic feldspar recalculated to 100 percent is shown in Figure 3 for the two plutons. Chemical analyses of a sample of granodiorite and monzonite are given in Table 4.

BLACKSTOCK GRANODIORITE

The Blackstock Granodiorite is a medium- to coarse-grained porphyritic rock that typically forms low-lying hummocky outcrops. Fresh and weathered surfaces are light shades of pink and grey. Phenocrysts of potassic feldspar are uniformly distributed throughout the stock, constitute about 12 percent by volume, range from 0.2 to 1.0 inch in length, and rarely display a weak preferred orientation. In addition to the obvious diabase dikes that intrude the granodiorite, narrow veins and dikes of quartz, pegmatite, and felsite postdate the consolidation of the stock. Most of these felsic phases can be attributed to late stage differentiation of the granodiorite magma.

Thirteen thin sections of the granodiorite were examined, and gave an average composition of: 54.2 percent plagioclase; 18.2 percent potassic feldspar; 17.9 percent quartz; and 8.7 percent mafic minerals, of which approximately 7 percent is hornblende, the remainder being biotite.

Most of the potassic feldspar occurs as large subhedral, semi-equant perthitic phenocrysts commonly about 6 to 7 mm in maximum dimension. The exsolved sodic plagioclase occurs as fine stringers, or coarser, somewhat irregular veins, both of which are generally parallel to the (100) plane. Inclusions of all other major rock forming constituents of the granodiorite are common in the feldspar, signifying that the phenocrysts were one of the last minerals to form. Many of the inclusions are aligned parallel to crystallographic directions within the potassic feldspar. Most of the phenocrystals display a very patchy, irregular type of grid twinning, indicative of an inferior triclinicity (Marmo et al. 1964), which as shown by Nelssen and Smithson (1965) is the result of variations in the triclinicity for various domains throughout the individual crystal. The grid twinning in the phenocrysts is generally best developed towards the margins of the grains. Potassic feldspar also occurs as finer interstitial grains, which are generally non- or weakly-perthitic, and display a much more uniform type of grid twinning in contrast to the phenocrysts.

Plagioclase ranges in composition from sodic to intermediate oligoclase, is almost invariably twinned according to the albite law, and forms subhedral grains
## Table 2

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*x denotes generally less than one percent of the mineral present.*
up to 6.0 mm in length, averaging approximately 2.0 to 2.5 mm. All the grains are weakly saussuritized, especially towards the central, generally more calcic parts. Many of the grains are zoned; the zoning varies from an ill-defined normal type to a distinct oscillatory type. Minor myrmekite has developed at some interfaces of plagioclase with potassic feldspar or quartz.

Hornblende is pleochroic from medium green to light brown, and forms subhedral to anhedral grains averaging about 1.0 mm in length. A few grains show minor alteration to biotite, which in turn is commonly partly altered to chlorite. Most biotite however forms separate discrete grains and does not appear to be an alteration product.

Sphene, apatite, and opaque minerals are ubiquitous accessory minerals. Traces of allanite and zircon are present in a few of the thin sections examined, as well as minor secondary epidote and calcite.

Minor crushing and recrystallization is a common feature at the margins of some of the grains, and imparts a weak protoclastic texture to the rock.

LEUCOCRATIC GRANODIORITE

Fine- to medium-grained, equigranular, leucocratic, biotite granodiorite is exposed in the northeastern corner of Fasken Township. This granodiorite differs from the Blackstock Granodiorite, from which it appears to be separated by a thin screen of metasediments or metavolcanics. The extent of the leucocratic granodiorite into adjoining Michie and Timmins Townships is not known. Whether or not this is a differentiated phase of the Blackstock Granodiorite, or is a separate unrelated intrusion is not known, however the spatial association of the two would suggest a genetic relationship.

Two thin sections of the leucocratic granodiorite were examined and contain an average of 58.4 percent albitic plagioclase; 17.4 percent potassic feldspar; 21.2 percent quartz; and 2 percent biotite, most of which is altered to chlorite. Magnetite, sphene, muscovite, and leucoxene are present in minor to trace amounts.

PORPHYRITIC MONZONITE, PYROXENE AMPHIBOLITE

Medium-grained, pink, porphyritic monzonite forms a small northeast-trending elliptical-shaped stock near the northern boundary of Fallon Township. Rocks from many of the exposures vary greatly in texture and composition, probably because they are near the margins of the intrusion. This is particularly noticeable along the southern margin of the stock where, over short distances, the mafic content ranges from 5 to 60 percent, and the structure changes from massive to strongly foliated with or without augen of feldspar. Although outcrops are limited, it appears that the monzonite becomes less contaminated towards the central and southwest part of the intrusion, where it is generally massive to weakly foliated and contains 10 to 15 percent mafic minerals. Phenocrysts of light pink to greenish white coloured plagioclase constitute about 10 to 20 percent of the monzonite, range in maximum dimension from 0.1 to 0.8 inch and average about 0.25 inch. Pegmatitic phases are not common and were observed in only one outcrop.
A zone composed dominantly of medium- to coarse-grained, massive pyroxene amphibolite borders the northern periphery of the monzonite, and is locally gradational into mafic-rich monzonite. Apophyses of the pyroxene amphibolite are present in the adjacent metavolcanics. No truly comparable zone borders the remainder of the monzonite, although similar phases occur locally within the contaminated monzonite along the southern margin of the intrusion. The pyroxene amphibolite probably represents a highly contaminated part of the monzonite due to the partial assimilation of the adjacent mafic metavolcanics (Pyke 1970, p. 23). A few exposures of fine-grained, well-foliated amphibolite within this border zone represent parts of the metavolcanics that were not assimilated.

Five thin sections of what appeared to be homogeneous monzonite in the field were examined and were found to have an average composition of 46 percent plagioclase, 31 percent potassic feldspar, 15 percent hornblende, and minor amounts of epidote, chlorite, sphene, magnetite and apatite. Traces of one or more of zircon, clinopyroxene, myrmekite, quartz, or leucoxene are present. The texture varies from hypidiomorphic granular to porphyritic.

The plagioclase has a composition of calcic oligoclase to sodic andesine, displays albite and rarely albite pericline twinning, and is commonly in part, and rarely completely, altered to epidote and sericite. Narrow albite rims occur at a few of the plagioclase-potassic feldspar interfaces. Grain size averages about 1.5 mm; phenocrysts 3 to 5 mm in length are common. Minor myrmekite has formed at the margins of a few of the grains.

The hornblende is pleochroic from medium green to light brown, averages about 0.7 mm in length, shows minor alteration to chlorite, and characteristically contains numerous inclusions of magnetite and lesser epidote (both the magnetite and epidote probably formed during the conversion of primary pyroxene to hornblende). In one thin section vestiges of pyroxene remain towards the centres of some of the hornblende grains.

The potassic feldspar is microcline that is interstitial to the plagioclase and hornblende, but in one thin section forms phenocrysts up to 7.0 mm in length.
Three thin sections of the pyroxene amphibolite, which forms the northern boundary of the monzonite stock, were examined (Pyke 1970, p.23) and they have an average composition of 43 percent hornblende, 33 percent clinopyroxene, 11 percent oligoclase, 5 percent apatite, and minor sphene, epidote, calcite, and quartz.

Table 4

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Sample Number  Description
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P-239-67  Granodiorite, Fallon Township
P-337-68  Monzonite, Fasken Township
P-325-68  Diabase, Fasken Township

Mafic Intrusive Rocks

PORPHYRITIC DIABASE

Most of the north- and northwest-trending diabase dikes in Fallon and Fasken Townships probably form part of the Matachewan dike swarm that is prominent throughout northeastern Ontario, and considered to be of Early Precambrian age (Fahrig and Wanless 1963). However, one north-trending diabase dike outcrops in an area otherwise wholly underlain by rocks of the Cobalt Group in the northwestern part of Fallon Township. This dike is shown on the accompanying map as being post-Huronian Supergroup in age. Nevertheless, the dike could conceivably be an inlier, as contacts with the surrounding sedimentary rocks are not exposed.

The diabase is massive, dark grey, fine to medium grained, and weathers dark grey to orange-brown. The dikes are invariably porphyritic or glomeroporphyritic, containing 5 to 10 percent green saussuritized plagioclase phenocrysts, averaging about 0.1 inch in length. Exceptionally large blocky phenocrysts (Photo 4) up to 2.5 inches in length and forming up to 40 percent by volume of the diabase occur
Fallon and Fasken Townships

Photo 4—Porphyritic diabase dike with exceptionally large and abundant plagioclase phenocrysts; 1 mile northeast of High Falls, Fasken Township.

locally along the dike that passes through High Falls on the Whitefish River.

One thin section of diabase was examined and found to contain: 51.7 percent plagioclase (calcic andesine); 37.6 percent augite; 5.9 percent quartz; 3.3 percent opaque minerals; and minor biotite, apatite, and calcite.

MIDDLE PRECAMBRIAN

Huronian Supergroup

COBALT GROUP

Gowganda Formation

Relatively flat-lying sedimentary rocks of the Gowganda Formation form a series of high hills in the western half of Fallon Township. These sedimentary rocks can be readily subdivided in the field into sandstones (arkose and greywacke), argillite, and conglomerate.

The sandstones consist predominantly of massive, fine- to medium-grained, blocky weathering arkose. Weathered and fresh surfaces are generally various shades of red to greyish red. Primary structures are relatively uncommon, and where observed consist of: (1) bedding, marked by a variation in grain size, colour, or very thin argillaceous layers; (2) graded bedding; (3) ripple mark casts, observed at only one locality, 1 mile northwest of Rat Mountain; and (4) intraformational conglomerate.
Greywacke, unlike the arkose, is dark grey in colour, and poorly sorted, consisting of small angular quartz-feldspar grains and lesser lithic fragments in a fine-grained matrix. Gradational varieties between arkose and greywacke exist, but generally, on the basis of colour and texture, the sandstone can readily be assigned to either type.

The argillite is buff weathering, aphanitic, fissile, dark grey-green to reddish grey, and typically contains numerous, generally closely spaced, northeast- and southeast-striking joints. Outcrops characteristically have a flaggy-type weathering (Photo 5). The strong fissility of the argillite usually obscures any layering, but where the two were seen in conjunction they are parallel. Intraformational conglomerates are common and a few scattered granitic pebbles can be found in many of the outcrops. Ripple marks were observed at one locality about 1 mile north-west of Rat Mountain.

Layers of boulder and pebble conglomerate ranging in thickness from a few feet up to a maximum of 40 feet occur throughout the stratigraphic section, but appear to be most prolific towards the upper part. Pebble and boulder density ranges from about 10 to 70 percent; the largest boulder observed was 3 feet in maximum dimension. By far the majority of the boulders are of a granitic composition; one of the most common is a quartz-rich muscovite granite, of which no comparable outcrops were seen in the area. Monzonite pebbles and boulders, presumably derived from the adjacent stock, are also common. Other fragments include mafic and felsic metavolcanics, vein quartz, and other sedimentary rocks of the Gowganda Formation. The matrix varies from that of a greywacke to a fine pebble conglomerate.
No areas are well enough exposed to give a general section of the Gowganda Formation. However, care was taken at two localities along the western side of the high ridge in the northwestern part of the area to obtain a reasonable estimate of the abundance of the various rock types. For an approximate 250-foot stratigraphic section these are: arkose 45 percent; argillite 35 percent; greywacke 10 percent; and conglomerate 8 percent. Most of the conglomerate occurs preferentially towards the upper part of the exposed section; the arkose, argillite, and greywacke are intimately interlayered.

In thin section the argillite and much of the fine-grained groundmass in the greywacke is seen to be composed mainly of clay minerals or fine rock detritus. Minor chlorite, sericite, and biotite are present as detrital grains, and are commonly bent or broken. Where these platy minerals are exceptionally fine-grained, the detrital nature is not so evident, and some may have formed by recrystallization of the matrix. The quartz and feldspar grains in all the sedimentary rocks are angular to subrounded (Photo 6), and incipient recrystallization is a common feature at most of the grain boundaries. Much of the matrix is a dull, light brownish red, extremely fine, scaly appearing matte, which under crossed nicols is seen to contain disseminated flecks of birefringent material in an essentially dark grey to non-birefringent groundmass. Bedding, graded bedding, breccias, faults, clastic dikes (Photo 7) and soft-sediment folds are commonly recognized microstructures.

Four thin sections of arkose were examined; all the arkose is very feldspathic, averaging about 62 percent plagioclase, 15 percent potassic feldspar, and 20 percent quartz.
There is no evidence to indicate that the rocks of the Cobalt Group have undergone regional metamorphism. The minor recrystallization observed in the thin sections is probably best explained as caused by diagenetic processes.

**Mafic Intrusive Rocks**

**Diabase**

A large northeast-trending diabase dike extends from the northwestern part of Fasken Township to the south-central part of Fallon Township. Because of the limited exposure in the southern half of Fallon Township, Aeromagnetic Maps (ODM-GSC 1970a,b) were especially useful in delineating the diabase dike in this area.
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In this part of the Superior Province, northeast-trending diabase dikes are generally considered to be part of the Late Precambrian Abitibi dike swarm (Fahrig et al. 1965). However, the recent geological map of Ontario, east-central sheet (Ayres et al. 1971), shows there are two distinct directions of northeast-trending diabase dikes in the general area between Sault Ste. Marie and Timmins: one a more northerly trending set, the other a more easterly trending set. The more northerly trending set (one of which forms the northeast-striking diabase dike in Fallon Township) appears to be the older of the two sets. This is indicated by displacements of the two sets of dikes along northerly trending faults; the older, more northerly trending diabase dikes display greater offsets than the more easterly striking, presumably younger, set of diabase dikes.

As mentioned above, the northeast-striking diabase dike in Fallon Township forms part of the presumed older set of dikes. The dike, however, is post-Huronian Supergroup in age, as it intrudes rocks of the Gowganda Formation in the south-western part of Fallon Township. From this evidence, the dike could range in age from early Middle Precambrian to Late Precambrian. The dike is tentatively shown as being of Middle Precambrian age on the accompanying map (Map 2253, back pocket).

The diabase is massive, forms craggy to hummocky outcrops, and weathers dark grey to dark orange-brown. Fresh surfaces are dark grey near the fine-grained margins and light grey to pinkish grey within the coarse-grained central part of the dike. The dike attains a maximum thickness of 600 feet near the northern boundary of the area.

Five thin sections were examined from a series of samples taken across a well exposed section of the dike in the northeastern part of Fallon Township. One sample is from the chilled margin; the remainder are at distances of 12, 75, 120, and 200 feet from the margin respectively. In thin section the chilled margin is seen to consist of an equal volume (4 percent) of plagioclase and clinopyroxene phenocrysts in a very fine-grained ophitic groundmass (Photo 8). Some of the plagioclase phenocrysts are extremely elongated, having length to width ratios up to 20:1. Conversely, pyroxene is more equant in shape. Twelve feet from the contact the diabase is non-porphyritic, and has an average grain size of about 0.8 mm. The ophitic texture is still pronounced, a feature common throughout the entire dike. The most notable changes on progressing from the marginal (0-12 feet) area of the dike to the central part are: (1) increase in uralitization and chloritization to the extent that there is only a trace of primary pyroxene remaining in the central part of the dike; (2) increased saussuritization of the plagioclase; (3) increase in the quartz content, both as discrete, interstitial grains, and as minor graphic-like intergrowths with plagioclase; (4) marked increase in the alteration of ilmenite to leucoxene (Photo 9); and (5) increase in grain size to an average of about 1.8 mm. Most, if not all, of the observed alteration effects, on progressing from the margins to the central part of the dike, seem best attributed to autometamorphism.

Plagioclase averages about 57 percent by volume, and is intermediate labradorite (An55-60) in composition. The pyroxene is predominantly a light greyish brown, non-pleochroic diopside or augite, that forms, on the average, about 25 percent by volume of the rock. Minor (2.5 percent) hypersthene occurs throughout the dike. Apatite and magnetite-ilmenite intergrowths are ubiquitous accessory minerals.
Photo 8—Photomicrograph of chilled margin of northeast-striking diabase dike (X18), west of Night Hawk River, northeastern Fallon Township.

Photo 9—Photomicrograph of magnetite-ilmenite intergrowth, ilmenite altered to leucoxene (X51), west of the Night Hawk River, northeastern Fallon Township.
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A chemical analysis of a sample from the chilled margin of the dike is given in Table 4. The composition is very similar to the average of 10 analyses of Abitibi dikes reported by Fahrig et al. (1965, p. 285).

CENOZOIC

Quaternary

PLEISTOCENE AND RECENT

Thick deposits of glacial lacustrine sand, silt, and clay mantle a large part of the map-area. Most of these sediments were deposited in glacial Lake Barlow-Ojibway (Stockwell 1957, p. 480), which covered a large part of northeastern Ontario during the Pleistocene Epoch.

Minor diamond drilling carried out in the northern part of the area encountered drift ranging in thickness from 15 feet to 170 feet.

A few kettle lakes and kame-like deposits of poorly stratified sand and gravel occur in the north-central part of the area.

Gently sloping deposits of till are common on the 'leeward' side of some prominent rock protuberances (crag-and-tail); Rat Mountain in Fallon Township is a notable example.

Recent deposits consist mainly of organic material accumulating in the swamps and muskegs, and some detrital material being deposited in stream beds.

STRUCTURAL GEOLOGY

Scarcity of outcrops and the lack of identification of any marker horizons precludes all but a general structural interpretation of the area. Figure 3 is a sketch map of the general geology showing the distribution of the various rock types, fold axes, and faults (observed and assumed).

Folds

Although the few pillow-top determinations obtained suggest the presence of an anticline across the central part of Fallon Township, other evidence, particularly that obtained during mapping in Douglas Township (Pyke 1971a), indicates the main structure may be synclinal. In the northeastern part of Douglas Township the axial portion of a syncline is delineated by a unit of felsic metavolcanics, which when projected eastwards apparently correlates with the felsic metavolcanics in Fallon Township. On this basis, the main structure in Fallon Township is interpreted as an eastward-plunging syncline, the axial trace of which trends southeast within the felsic metavolcanics. The two pillow-top determinations in the mafic
Figure 3—Sketch map illustrating the general geology of Fallon and Fasken Townships.
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metavolcanics south of the monzonite stock appear reliable, and indicate tops to the northeast. However, this is difficult to explain on the basis of a synclinal axis in the felsic metavolcanics immediately to the south, as this would require very tight folding of the mafic metavolcanics in the area south of the northeast-trending diabase dike and north of the felsic metavolcanic unit. It could perhaps be explained by small-scale folding, although from the exposures observed there is little or no evidence to support this.

Any eastward projection of the axial trace of the syncline in the felsic metavolcanics from Fallon Township to Fasken Township would be highly skeptical in lieu of the lack of outcrop between the Night Hawk and Whitefish Rivers and the abrupt change in the foliation from an easterly direction in Fallon Township to a northerly direction in Fasken Township. The north-trending foliations in Fasken Township parallel the western margin of the Blackstock Granodiorite. Dynamic and contact metamorphism have profoundly affected the rocks between the Whitefish River and the western margin of the granodiorite stock. Strong foliation, cataclastic textures, and irregular layers and bands of epidote, feldspar, and quartz are common; in addition metamorphic differentiation into narrow mafic-rich and felsic-rich layers occurs locally. Nevertheless, the main structural trend appears to parallel the stratigraphy (e.g. the sodic rhyolite-dacite contact near the south-western corner of Fasken Township).

Pillow-top determinations indicate that the stock of monzonite may lie along a northeast-trending synclinal- or basinal-type structure.

The Cobalt Group sedimentary rocks form a series of very broad, open, shallow southward-plunging, north-trending folds.

**Faults**

Criteria used for the interpretation of faults consists of: observed shearing in outcrops; offsets of geological as well as topographical features; topographic lineaments such as continuously straight parts of streams, rivers, or valleys; and the projection of known or interpolated faults from surrounding areas into the map-area.

An early north-trending, and a later northwest-trending set of faults are interpreted to be the main directions of faulting. Ill-defined topographic lineaments indicate the possible presence of a few northeast-trending faults, intermediate in age between the north and northwest sets; none are outlined on the accompanying map (Map 2253, back pocket).

The Montreal River Fault (Ginn *et al.* 1964) trends northwest across the central part of the area, coinciding in part with the Night Hawk and Whitefish Rivers. This fault is one of a number of northwest-trending faults that extend across east-central Ontario (Wilson 1949; Lovell and Caine 1970). The displacement is left-lateral in Fallon and Langmuir Townships (Pyke 1970), whereas displacement is right-lateral in Fasken Township. This difference may be a reflection of a dominant dip-slip movement along the fault. Strike separations along the fault are on the order of 1/4 to 1/2 mile.

A second northwest-trending fault is assumed to occur subparallel to and about 1.5 miles southwest of the Montreal River Fault. This fault is interpreted on the basis of topographic lineaments, and the projected southward continuity of a fault in Langmuir Township (Pyke 1970).
North-trending faults are assumed to be coincident with the Whitefish and Night Hawk Rivers respectively; primarily on the basis of the north-trending lineaments occupied by these rivers. Offsets of the lineaments by the northwest-striking faults are of the same sense and degree as that shown by the diabase dikes. Similarly a north-trending fault may be coincident with the West Night Hawk River, the southward projection of which coincides in part with a prominent valley in the southeastern part of Fallon Township.

A north-trending fault may underlie the Cobalt Group sedimentary rocks in the western half of Fallon Township. It has been suggested by S. B. Lumbers (Geologist, ODM, personal communication, October 1969) that the narrow, finger-like northward extensions of the Gowganda Formation in the Timmins-Kirkland Lake area, may be the reflection of pre-Cobalt Group north-striking fault valleys. Indirect evidence in Fallon Township supports this, in that the proposed projection of the synclinal fold axis from Douglas Township to Fallon Township seems to be displaced underneath the cover of Cobalt Group sedimentary rocks.

**ECONOMIC GEOLOGY**

Very little exploration work has been done in the area, and no significant appearing prospects have been discovered. Although the area is relatively close to Timmins, it does not appear to have received the thorough examination for gold mineralization so evident in many of the nearby townships; perhaps, in a large part, due to the inaccessibility of much of the area. During the present survey, pyrite was the only sulphide observed in all but one of the mineralized showings examined. The pyrite is associated with quartz veins, quartz-carbonate veins and (or) shear zones within the metavolcanics. Most of the known pyrite occurrences are either within or near the contact metamorphic aureole bordering the monzonite. This area as well as that underlain by the metavolcanics in close proximity to the Blackstock Granodiorite in Fasken Township is favourably located for hydrothermal mineralization related to the felsic intrusions.

As brought out in the section on structural geology, the felsic to intermediate metavolcanics in the central part of the area are interpreted as lying along the axial portion of a syncline that extends westwards, beneath the unconformably overlying Cobalt Group, and correlates with the felsic metavolcanics in northern Douglas Township. With the exception of one outcrop containing minor sulphide-bearing iron formation in Douglas Township (Pyke 1971a) the observed sulphide mineralization within this belt of felsic metavolcanics is restricted to sparsely disseminated pyrite. It might be noted that the felsic metavolcanics through the Douglas-Fallon-Fasken area are stratigraphically above the felsic metavolcanics and associated iron formation units in the McArthur-Bartlett area (Bruce 1926; Pyke 1971a,b) to the southwest, and the Langmuir-Eldorado area (Pyke 1969; 1970) to the northwest. Although the felsic metavolcanics in Fallon and Fasken Townships cannot be ruled out as possible host rocks for base metal volcanogenic deposits, both the Eldorado-Langmuir and McArthur-Bartlett and associated areas would, in the writer's opinion, appear to be more favourable prospecting areas for this type of deposit. This is suggested on the strength of the presence of two features in the McArthur-Bartlett and Eldorado-Langmuir areas as opposed to the Fallon-Fasken area. These are: (1) the general abundance of sulphide-bearing
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iron formation units, many of which contain minor or trace amounts of base metal mineralization, and hence are indicative of the availability of these metals at a particular time in the volcanic evolution of the region; and (2) the presence of felsic, epizonal (possibly subvolcanic) intrusions that could provide a source for ore-bearing solutions, as suggested for the Temagami area by Lumbers (1970) and the Kamiskotia area by Pyke and Middleton (1970).

International Kenville Gold Mines Limited (property 1), Magoma Mines Limited (property 2), and United Buffadison Mines Limited (property 5) are the only three companies which have filed assessment work with the Ontario Department of Mines and Northern Affairs for Fallon and Fasken Townships to the end of 1968.* At the end of 1968, only United Buffadison Mines Limited had claims in good standing. A summary of the exploration work conducted by the above three companies is given below, in addition to a brief description of a galena showing.

GALENA OCCURRENCE

Near the north boundary of Fallon Township, about 2.4 miles east of the northwest corner, two trenches have been blasted in a quartz-carbonate vein, and associated monzonitic dike, within sheared and chloritized mafic metavolcanics. Sulphide mineralization consists of about 2 percent disseminated pyrite and less than 0.5 percent galena, generally concentrated along narrow seams within the quartz-carbonate vein. One specimen, collected by the writer and assayed by the Laboratory and Research Branch of the Ontario Department of Mines and Northern Affairs, was found to contain 0.11 ounce gold per ton and 3.21 ounces silver per ton. This showing is very close to the Fallon-Langmuir township boundary and may in fact occur just within Langmuir Township. The township line was not located at the time of mapping, but has subsequently been recut.

DESCRIPTION OF PROPERTIES

International Kenville Gold Mines Limited (1)**

In 1965, International Kenville Gold Mines Limited carried out magnetic and electromagnetic surveys on a group of 32 claims in the northeastern corner of Fallon Township. The northwestern part of the claim group straddled the monzonite-metavolcanic contact and the southeastern part of the claims extended just south of the large diabase dike east of the Night Hawk River. On the basis of the geophysical surveys, 5 diamond drill holes were bored to test one magnetic and one electromagnetic anomaly. Very minor pyrite and a few traces of possible chalcopyrite were the only sulphides encountered.

* November 1970, Noranda Exploration Company, on property in both Fallon and Fasken Townships, filed the results of assessment work done in 1969 and 1970, on property in both Fallon and Fasken Townships.

** Number in brackets refers to property number shown on Map 2253, back pocket.
Magoma Mines Limited (2)

In 1965, Magoma Mines Limited did a magnetic and electromagnetic survey on a group of 12 claims, 11 of which were located in the southwestern corner of Langmuir Township, and one in the northwestern corner of Fallon Township. The area seems to be underlain mainly by mafic metavolcanics, although there is no outcrop on the claims. On the basis of the geophysical surveys further work did not seem warranted and the claims were allowed to lapse.

United Buffadison Mines Limited (3)

In 1968, United Buffadison Mines Limited held a group of 18 unpatented claims, P86189, P86190, and P86214 to P86219 inclusive in the northwestern corner of Fasken Township. This was formerly part of a larger claim block consisting of an additional 15 contiguous claims: 12 in Fasken Township and 3 in Langmuir Township respectively. In 1966, United Buffadison Mines did magnetic, electromagnetic, and geochemical soil sampling surveys on the claim group in Fasken Township. The soil samples, analyzed for copper, lead, and zinc were taken in areas designated as having anomalous geophysical conditions. On the basis of the geochemical results, a total of five holes were drilled totalling 1,305 feet. Two were abandoned due to thick drift. Spectrographic analysis of nine samples of core revealed no anomalously high concentrations of sulphide minerals. No further work has been done on the property.
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SYMBOLS

Small bedrock outcrop.
Area of bedrock outcrop.
Bedding, top unknown; (inclined, vertical).
Bedding, top indicated by arrow; (inclined, vertical, overturned).
Lava flow; top (arrow) from pillows shape and packing.
Foliation; (inclined, vertical, unknown).
Lineation with plunge.
Geological boundary, observed.
Geological boundary, interpreted.
Geological boundary, deduced from geophysics.
Outer margin of contact metamorphic aureole.
Fault; (observed, assumed). Spot indicates down throw side, arrows indicate horizontal movement.
Drag folds with plunge.
Trace of axial plane; anticline, syncline.
Drill hole; (vertical, inclined).
Vein.
Swamp.
Trail, portage, winter road.
Township boundary with milepost, approximate position only.
Surveyed line, approximate position only.
Location of mining property, unsurveyed.

LIST OF PROPERTIES

FALLON TOWNSHIP
1. International Kenville Gold Mines Ltd.

FASKEN TOWNSHIP
3. United Buffadison Mines Ltd.

SOURCES OF INFORMATION

Geology by D. R. Pyke and assistant, 1968.
Geology is not tied to surveyed lines.
Preliminary maps, P. 496 Fallon Township and P. 497 Fasken Township, scale 1 inch to 1 mile, issued 1968.
Cartography by M. J. Colman and assistants, Ministry of Natural Resources, 1972.
Basemap derived from maps of the Forest Resources Inventory, Ministry of Natural Resources.
Magnetic declination in the area was approximately 9 a West, 1970.