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GRANADA GOLD MINE AND VICINITY, ROUYN TOWNSHIP, TEMISCAMINGUE COUNTY

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PROVINCE OF QUEBEC, CANADA

BUREAU OF MINES

Honourable J. E. PERRAULT, Minister of Mines

J. L. BOULANGER, Deputy-Minister A. O. DUFRESNE, Director

ANNUAL REPORT

OF THE

QUEBEC BUREAU OF MINES

FOR THE CALENDAR YEAR

1931

JOHN A. DRESSER, Directing Geologist

PART B

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THE GRANADA GOLD MINE AND VICINITY

ROUYN TOWNSHIP

by J. E. Hawley

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THE GRANADA GOLD MINE AND VICINITY

ROUYN TOWNSHIP

by J. E. Hawley

INTRODUCTION

Since the opening of the Rouyn mining area in the years following 1922, several discoveries of gold-bearing quartz veins have been made in the southern part of Rouyn township. The most important of these deposits, and the only one thus far to come into commercial production, is that of the Granada Gold Mines, Limited, formerly known as the Granada Mining Company, Limited. This deposit lies four miles due south of the town of Rouyn. It is in the form of quartz veins in conglomerate and greywacke, in the vicinity of several intrusive dyke-like bodies of coarse syenite porphyry. These were the subject of investigation by the writer in the latter part of the summer of 1931. An area surrounding this mine and embracing the southwest quarter of Rouyn township and that part of Beauchastel township to the south and east of Pelletier creek, was examined in detail. The results of the work are contained in this report.

Access to the Area

Access to the area is gained by a motor road from Rouyn to the Granada mine. Trails and winter roads extend from the mine south to the Kekeko river, east to the north-south centre line of Rouyn township, and northwest to the old Angliers road which cuts across this part of the area into Beauchastel township. In the early days of development, the district was explored by way of a water route from Rouyn *via* Pelletier lake, Pelletier creek, and Beauchastel (Kekeko) lake, or from the Kinojevis River system into which both Rouyn and Beauchastel lakes drain.

Previous Work

The area under discussion forms a small part of the Rouyn-Harricana region of Quebec which has been examined by officers of the Geological Survey of Canada and which was recently described at length in Memoir 166. To this volume the reader is referred for a complete bibliography and a detailed account of the general geology. It is a summation of previous reports by the authors, H. C. Cooke, W. F. James, and J. B. Mawdsley.

Selected Bibliography

Cooke, H. C., James W. F., and Mawdsley, J. B., *Geology and Ore Deposits of Rouyn-Harricana Region, Quebec*; Geol. Surv. Can., Memoir 166, 1931.

James, W. F., *Rouyn Map Area, Timiskaming County, Quebec;* Geol. Surv. Can., Sum. Rept. 1923, Pt. C, pp. 126-144.

Cooke, H. C., *Opasatika Map-Area, Timiskaming County, Quebec;* Geol. Surv. Can., Sum. Rept. 1922, Pt. D, pp. 19-74.

Gunning, H. C., *Syenite Porphyry of Boischatel Township, Quebec;* Geol. Surv. Can., Bull. 46, 1927, pp. 31-44.

Acknowledgments

During the field work, the writer was ably assisted by Roderick Grimes-Graeme. Grateful acknowledgment is here made to the management of Granada Gold Mines, Limited, for many courtesies and for co-operation in the work.

General Nature of the Area

The area to be described lies within the basin of glacial Lake Ojibway, commonly known as the 'clay-belt' of northern Quebec and Ontario. It is an area of low relief with a general elevation between 900 and 1,000 feet above sea level. Crossing the area in a direction slightly north of east are four distinct bands of rock which vary in composition and in resistance to erosion and make easterly-trending ridges that rise only slightly above the general level. The principal ridges are composed of either lavas or conglomerates. Tuffs are well

A.—View of Beauchastel (Kekeko) lake, looking west to Kekeko hills, which are underlain by Cobalt conglomerate

B.—View looking north from Keewatin ridge to the Noranda smelter. Water for the Granada mining operations is piped to the property from the lake in foreground

displayed on the slightly less elevated ridges south of Gamble lake, but for the greater part they lie beneath a mantle of drift. The southern margin of the conglomerate is marked usually by an abrupt though short drop to the fine-grained greywackes which seldom rise above the clays and sand, and then only a few feet. In the western part of the area are the Kekeko hills, underlain by flat-lying Cobalt conglomerate. These attain a maximum elevation of 1,680 feet (1) and stand up in marked relief.

The area is practically all covered with a green growth of timber, which, on the higher elevations, consists largely of birch and poplar, with relatively sparse spruce and balsam. No important stands of pulpwood were observed anywhere in the area.

While no farming is carried on in this section of the Rouyn district, there are considerable areas which might be adapted for this purpose were roads available. The area is better drained than many of the townships a little farther to the east. Land underlain by clay and sand is accessible from the old Angliers road. Much of the land just to the north of Beauchastel lake and Kekeko river is also of a type suitable for farming.

The Map

Map No. 186 accompanying this report was prepared originally on a scale of 20 chains to one inch, on a base compiled from surveys by the Department of Lands and Forests, Quebec. A photographic enlargement of part of the base-map for the Opasatika Sheet, Map 240A, was supplied by the Topographical Surveys Branch of the federal Department of the Interior. Lines cut and surveyed by various mining companies were rechained and used as base lines and tie points.

GENERAL GEOLOGY

The general geology of the area here dealt with has been well described by Cooke, James, and Mawdsley, to whose report the reader is referred for detailed information (2). Except for a few particulars concerning some of the intrusive rocks and certain structures,

(1) G. S. C., Mem. 166, p. 19.
(2) G. S. C. Memoir 166.

only a brief outline is here necessary. The following classification of the rocks present in the area follows essentially that of the Geological Survey of Canada.

TABLE OF FORMATIONS

RECENT AND PLEISTOCENE		Clays, sands, gravel, boulder clay
KEWEENAWAN (?)	Nipissing (?) diabase	Olivine-gabbro and quartz-gabbro dykes (possibly in part pre-Huronian)
HURONIAN	Cobalt series	Conglomerate, greywacke
	Unconformity	
PRE-HURONIAN	Intrusives	Olivine-gabbro and quartz-gabbro (younger diabase) Granite (felsite) Syenite porphyry, with basic phases (augite syenite) Quartz-diorite (older gabbro)
	Post-Témiscamian folding	
	Témiscamian series	Conglomerate, greywacke, slate, amphibole schists, mica schists
	Unconformity (?)	
	Keewatin series	Tuffs, agglomerate with inter-bedded lava flows Lava flows, basalt, andesite, dacite, rhyolite, and minor tuffs

The Keewatin and Témiscamian rocks are the most prominent and widespread. All of these have been arched into east-west folds, which have been truncated. All dip steeply towards the north. The two series form two uniform belts striking easterly across the area, the Keewatin occupying the northern, and the Témiscamian the southern, portion of the district. Each series consists of two major divisions, which have been mapped according to the dominant rocks present, so that, in crossing the area from north to south, one passes successively over Keewatin lavas, a band of Keewatin tuffs, Témiscamian conglomerate, and finally Témiscamian greywacke.

Intrusive rocks of later age occupy only a small part of the area. Certain of these having the composition of quartz-diorite occur mainly in the northwestern portion of the area, and are entirely within the Keewatin. Acidic intrusions, chiefly syenite porphyry, are confined largely to the area about the Granada mine, and to the east shore of Beauchastel lake. Later dykes of quartz-gabbro cut the syenite at the Granada mine, and are apparently cut by a still younger olivine-gabbro dyke.

Keewatin Series

Lavas:

The Keewatin series is divided into two main groups: an older, consisting dominantly of lava flows, and a younger, of tuffs and other pyroclastics. The lavas are all fine grained and much altered. They vary from dark green to light grey in colour, according to their original composition. The more prominent types are pillow andesites, hard rhyolites, and a peculiar type known as 'variolitic' lava. The darker green, quartz-free lavas range between basalt and andesite in composition.

Andesitic pillow lavas are prevalent on the south and east shores of Pelletier lake. An excellent section through lavas of this type has been exposed in the south cross-cut of the Stadacona mine. There, one flow was observed, with pronounced pillows, which grades northward into a brecciated rock composed of fragments of andesite in a matrix of similar composition. This is succeeded on the north by schistose lavas in which these structures have been obliterated. The top of this flow is therefore considered to be on the north side, and not on the south, as is usual in this area.

The lighter, grey-coloured lavas include both dacites and rhyolites. The former are usually the more altered. A thin section of dacite, taken near the vein deposits on claim T-413, shows a few phenocrysts of quartz and oligoclase in a groundmass characterized by a spherulitic or radial arrangement of plagioclase fibres. Rhyolites with porphyritic texture occur towards the south of the Keewatin lava belt. They are extremely hard, light-weathering rocks, in which rounded eyes of quartz are common, and in places they have been mistaken by prospectors for intrusive porphyries. Phenocrysts of both plagioclase (albite to oligoclase) and quartz lie in an exceedingly fine matrix of quartz, feldspar, biotite, a small amount of hornblende, and dusty magnetite, with secondary chlorite and epidote.

The variolitic ① lavas are light greenish in colour and somewhat amygdaloidal in texture. They are distinguished by the presence of relatively acidic, rounded lumps, an inch or less in size, in a more schistose matrix of similar composition. A prominent belt of these lavas strikes easterly across claims T-412, M. L. 1854, and M. L. 1853, and other examples were noted on small outcrops situated 30 chains south of the east-west centre line of Rouyn township and 30 chains east of the Granada road.

Tuffs:

Lying stratigraphically above the lavas and in part interbedded with them is a parallel belt of thin-bedded tuffs, which in places differ little in appearance from the greywackes of the younger Témiscamian series. Outcrops, hitherto unmapped, of tuff in the western part of the area show that the band continues westward at least as far as Pelletier creek. Beyond this it is concealed, if present, by Cobalt conglomerate. The width of the belt averages about half a mile. The beds are all overturned and dip uniformly to the north at about 70°. Their true thickness is thus approximately 2,500 feet. To the north of the Granada mine and thence eastward along the strike, lava flows are interbedded with the tuffs The southern contact of the tuffs with the Témiscamian conglomerate is probably faulted.

On the weathered surface, the tuffs vary in colour from white to pale, or even dark, olive-green. In thickness, the beds range from a fraction of an inch to ten feet. Passage from one bed to another is usually marked by a change in size of grain.

The volcanic nature of these rocks is well shown by freshly exposed outcrops along the Granada-Rouyn road. In many of these exposures, agglomerate tuffs are interbedded with the fine-grained type. They contain rounded fragments of porphyritic rhyolite up to one inch in diameter. About a mile east of the road, similar beds contain lava fragments five to eight inches in diameter—comparable in size with some boulders in the Témiscamian conglomerate; but they are readily distinguished from the latter in that the fragments are always of acidic lava and never of granite.

① See G. S. C. Memoir 166, p. 57.

In thin section, the fine-grained, green-weathering beds are seen to be composed of angular fragments of quartz and acidic plagioclase. Some contain also lath-like crystals of hornblende, which may be in part secondary. The darker grey beds have a dark, powdery constituent, possibly iron oxide, but too fine for identification.

Both in the field and microscopically, many of these tuff beds show little difference from the greywackes that are interbedded with conglomerates immediately to the south of them, and it seems probable that some of them are actually greywackes derived from the disintegration of already consolidated lavas rather than normal tuffs derived directly from some volcanic source. Also, it may be noted that, interbedded with the conglomerates which outcrop immediately to the south of the tuffs, are greenish even-grained beds which are indistinguishable from beds of similar colour within the tuffs. There is no doubt, however, that the tuffaceous series accumulated while volcanic activity was still proceeding, as is evidenced by the coarser pyroclastics and the lava flows that occur interbedded with them. There is, however, a question as to whether much or little time elapsed between their deposition and that of the overlying Témiscamian sediments.

Structure of Keewatin:

The writer's observations indicate that the structure of the Keewatin lavas and tuffs in the area is essentially as mapped and described by Cooke, James, and Mawdsley ①. The Keewatin rocks, in general, lie on the northern limb of a tightly compressed synclinorium which is overturned to the north, and the central and southern part of which is occupied by the sediments of Témiscamian age. The location of possible minor folds within the larger structure was investigated during the detailed mapping of the area. Data secured suggest the occurrence of only one minor anticline within the lavas, the axis of which probably lies in the vicinity of the Pelletier Lake fault, which strikes easterly from Pelletier lake through a point about 500 feet due south of the Stadacona mine. The evidence for this fold follows.

Between the trace of this fault and a parallel line drawn half a mile to the south, no data as to position of the flow tops are available.

① G. S. C. Memoir 166, pp. 74-90.

Southward, however, to the nearly parallel, southern contact of the lavas with the tuffs, a distance of one mile, the flows face the south

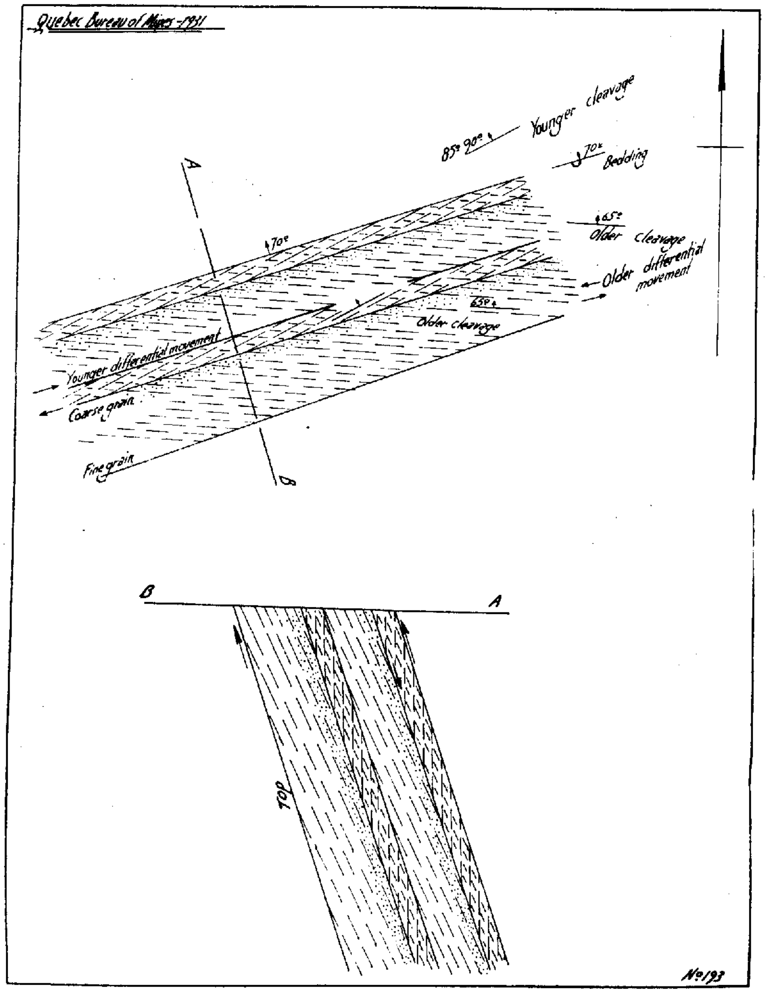


FIGURE 1.—Diagram showing relation of cleavages to bedding in Keewatin tuffs.

and stratigraphically underlie the tuffs. On the other hand, to the north of the Pelletier Lake fault, as noted at the Stadacona mine, the reverse attitude, andesites facing north, was found. The structure thus suggested is that of a faulted anticline.

To the southwest of Pelletier lake, on claims T-413 and T-429, lavas, interbedded tuffs, and quartz veins are closely folded. Structures of the veins, particularly, suggest a considerable amount of drag-folding, with the folds pitching rather steeply eastward.

The structural relation of the tuffs to the lavas is one of distinct conformity. Their interbedded character along the northern border of the tuffs is quite apparent, indicating that the tuffs accumulated while some lavas were still being poured out.

Structural determinations across the bedding of the tuffs, along the Granada road and south of Gamble lake, indicate that they constitute a uniform series of strata which lie on the north limb of a syncline and have been overturned so that they now dip north with the lavas.

South of Gamble lake, on a bare ridge of tuff, two distinct ages of fracture cleavage are discernible (See Figure 1). The older strikes almost due east and dips to the north at 65°. This cleavage indicates a differential movement of the north side towards the west and downwards, and, like the change in grain, it denotes overturning of the beds to the north. It is related to the folding.

The younger cleavage, on the other hand, strikes N.60°E. and dips almost vertically. Its attitude shows it is not related to the folding. It has been caused by a differential movement of the strata on the north side towards the east and upwards—just the reverse of the older movement. It is possible that this movement was produced during a period of faulting along the southern border of the tuffs, a structure determined at the tuff-conglomerate contact on the Kinojevis river farther eastward ①. A horizontal displacement of about 500 feet is suggested by the apparent displacement of a quartz-diabase dyke which strikes north from the Granada mine-office, where it cuts Témiscamian conglomerate. North of the fault, in the tuffs, an identical dyke maintains a northerly strike, but is offset 500 feet east.

① G. S. C. Memoir 166, pp. 78-79.

Témiscamian Series

The Témiscamian series in this area occurs as a wide easterly-trending belt and comprises two main groups of water-laid sediments: one, on the north, consisting largely of conglomerate interbedded with greywacke; the other, on the south, of finer clastic sediments, greywacke, arkose, and thin slaty beds. Highly altered phases of the latter group occur also along the shores of the Kekeko river, where they consist of carbonate, serpentinous, and other schists, which are locally graphitic. The Témiscamian sediments all strike about N.80°E. and dip from 50° to 65° north.

The conglomerates usually occur in such massive beds, with a schistose structure, that the bedding itself can be distinguished only where they are interbedded with greywacke. They contain abundant pebbles and boulders, which make up from 40 to 70 per cent of the rock ① and range from a few inches to a foot or more in diameter (see Plate III). Many of these are granite or syenite, others are of Keewatin lavas, and some are of pure quartz. Underground, sections through the conglomerate suggest that greywacke forms a larger part of the series than is apparent on the surface.

The finer sediments which occur both with the conglomerate and to the south of it are in thin beds which seldom exceed a few inches in thickness. They are grey or greenish in colour, and range from quartzite to arkose in composition.

Shearing of the greywackes has caused the development of sericite, chlorite, biotite, and hornblende. On the east shore of Beauchastel (Kekeko) lake, opposite the Kekeko hills, both conglomerate and greywacke are schistose, the pebbles in the former being elongated to cigar-shaped lenses. In the greywackes the bedding has entirely disappeared. On the south shore, at the east end of the lake, some of the beds have been recrystallized with the development of abundant hornblende (Plate IV-A). Where schistose, these rocks contain many bands of a rusty-weathering carbonate. The extreme alteration of these rocks is probably due in part at least to the presence of intrusives and possibly also to faulting along Beauchastel (Kekeko) lake. A dyke of later diabase, which apparently parallels the lake, is exposed

① G. S. C. Memoir 166, p. 55.

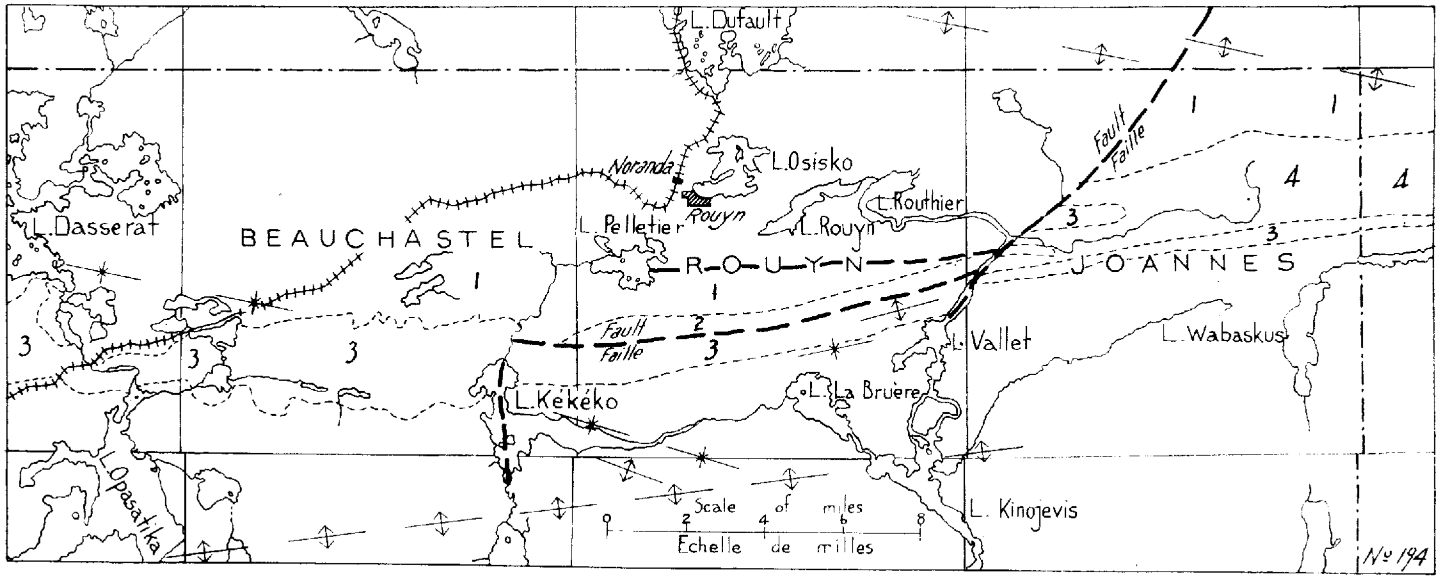


FIGURE 2.—Map showing location of folds in map-area and adjoining townships,—after map No. 271A, Geol. Surv. Can. (1) Lavas; (2) Tuffs; (3) Conglomerate; (4) Greywacke.

on a small island near the south shore. Chemical analyses of greywackes from the Granada mine are given on page 37.

FOLDING OF THE TÉMISCAMIAN SERIES:

From such determinations as were possible, it appears that the conglomerate and the greater part of the greywackes lie on the north limb of a synclinorium, which is overturned to the north. The range in dip is from 50° to 65°N., whereas the tuffs to the north of them have everywhere a steeper dip in the same direction.

Along the southeastern portion of Beauchastel (Kekeko) lake, however, two synclinal axes and one anticline were located, all within a width of about half a mile. The major structure suggested is a synclinorium pitching eastward (see Figure 2).

It is probable that the entire Témiscamian series within this area is closely folded, that is, with axes within one mile of one another, or less. Of particular interest is the structure along the eastern boundary of Rouyn township (see Figure 3), in that here the conglomerate belt of the Témiscamian has been shown to consist, structurally, of an anticline, the axis of which is approximately parallel to the faulted contact with the tuffs. That this structure may continue westward some distance is suggested by the occurrence at and north of the Granada mine of two ridges of conglomerate, while the intervening rocks consist dominantly of greywacke. Still farther west, this central zone of greywacke passes into conglomerate. Should the conglomerate belt at the Granada prove to be an anticline faulted off on the north against the tuffs, the axis lies probably more than 1,000 feet to the north of the mine. How much control such folding has exerted on the intrusions of syenite porphyry is not known. The majority of these conform in strike rather with the schistosity than with the bedding of the conglomerates.

PRE-COBALT INTRUSIVES

Intrusive rocks cutting the Keewatin and Témiscamian fall into three main groups: quartz-diorite or older gabbro, syenite porphyry with associated basic and acidic phases, and dykes of quartz- and olivine-gabbro (younger diabase).

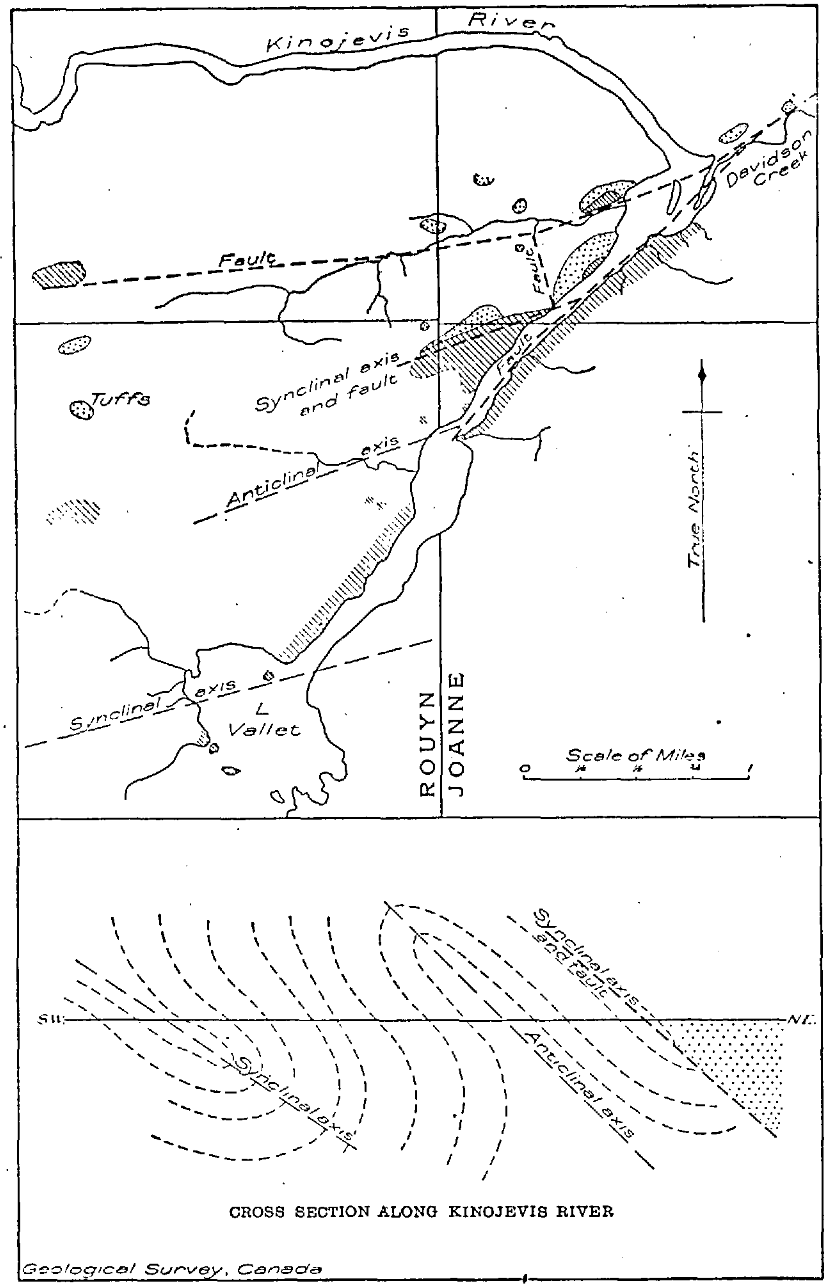


FIGURE 3.—Plan and cross section of Kinojévis River area. Outcrops of Keewatin lavas and tuffs shown by stipple; of Témiscamian sediments by diagonal ruling.

(Reproduced from Memoir 166, Geological Survey of Canada, by kind permission).

QUARTZ-DIORITE (OLDER GABBRO):

Intrusions of a dark green, medium to coarse grained quartz-diorite (older gabbro) are confined to the Keewatin area southwest of Pelletier lake. They form irregular, rounded stocks and dykes and everywhere are considerably altered. Specimens examined microscopically were found to contain andesine ($Ab_{65}\,An_{35}$ to $Ab_{60}\,An_{40}$) which is in most cases partly altered to sericite, chlorite, and epidote or zoisite. Green hornblende, apparently primary, minor amounts of quartz in graphic intergrowth with feldspar, ilmenite, titanite, and leucoxene are other constituents present. In some specimens, 'cube' pyrite replaces the hornblende.

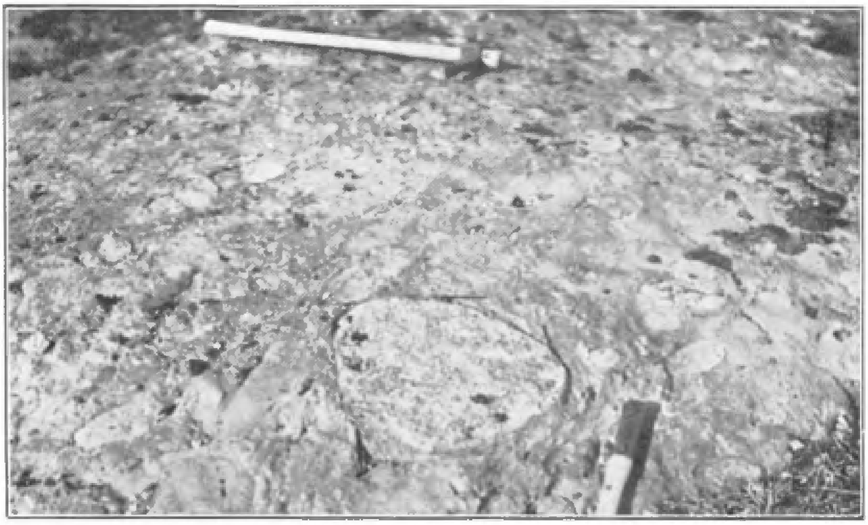
Structural relations indicate that the quartz-diorite intruded the Keewatin subsequently to the folding of the lavas. Elsewhere, these intrusives are cut by syenite porphyries ①, though no example of these relations was noted in the area under discussion.

SYENITE PORPHYRY AND ASSOCIATED INTRUSIVES:

Intrusions of red to grey syenite porphyry are confined almost entirely to the vicinity of the Granada mine and the east shore of Beauchastel (Kekeko) lake. At the lake, the porphyry is in the form of a small stock. At the Granada, the intrusives occur as dykes or lenticular sheet-like masses following the cleavage in the conglomerate rather than the bedding, and fingering off into small dykes to the east and west, but widening somewhat at depth. The porphyries vary somewhat in mineral composition from place to place, and include relatively basic, as well as relatively acidic, phases.

Basic Phases of the Syenite.—What appears to be a relatively basic and early phase of the syenite porphyry occurs 1,050 feet northeast of the Granada shaft, as a small circular outcrop cut by hornblende-syenite dykelets. The rock is dark green and chloritic, resembling altered diabase. Augite, amphibole after augite, and brown biotite together make up 40 to 50 per cent of the rock. The balance is chiefly oligoclase, with minor amounts of microcline and possibly some anorthoclase. Ilmenite and leucoxene, apatite, and secondary quartz, epidote, chlorite, and sericite are minor constituents.

① G. S. C. Memoir 166, p. 110.



A.—Photograph showing undeformed boulders in the Temiscamian conglomerate.

B.—Photograph of schistose Temiscamian conglomerate, showing elongation of boulders.

A.—View of metamorphosed Temiskamian sediments on south shore of Beauchastel (Kekeko) lake. On the left, highly carbonate schists; on the right showing traces of bedding, mainly amphibole and biotite schist.

B.—View of No. 2 vein, Granada mine, showing its lenticular character.

Underground, on the 625-foot level, this mass is intersected by No. 7 north cross-cut, where it is characterized by green hornblende, biotite, apatite, and oligoclase feldspar, with mottled twins of microperthite. This appears to grade into a biotite-rich phase with fine lath-like phenocrysts of feldspar which are similar to those in the main syenite porphyry masses; hence its interpretation as a basic phase of the syenite. On the 125-foot level, north cross-cut, a similar rock occurs which was classed in the field as lamprophyre. It is made up largely of brown biotite, quartz, and feldspar, some of the latter appearing as phenocrysts. Alteration of these to sericite renders their exact determination impossible.

Syenite Porphyry.—The larger masses of syenite porphyry are dark grey to reddish-grey rocks with rectangular phenocrysts of feldspar which range up to one inch by three-quarters of an inch in size. The feldspars are grey to white in colour and usually have a zoned appearance, due to a light brown staining in the centre and grey and white banding in the outer portions. Many of them enclose smaller crystals of plagioclase. They weather to a red colour and, where carbonated, to a rusty-grey shade. Examination of the larger crystals shows that some of them are zoned orthoclase, the outer rims of which contain up to 40 per cent albite in solid solution. Thin sections of many specimens show also the presence of some microcline and probably anorthoclase, the latter with an extremely fine type of pericline and albite twinning. The plagioclase has a composition range from oligoclase to albite.

The groundmass consists of finely crystalline feldspar and quartz, together with the alteration products, chlorite, epidote, sericite, and calcite. Minor amounts of magnetite or pyrite are also present. The ferromagnesian constituent may be biotite (the more common) or hornblende, or these minerals may be almost entirely lacking. The small stock of porphyry on the west shore of Beauchastel lake contains phenocrysts of green hornblende in addition to the usual larger ones of feldspar, and so also do the small dykes that cut the basic phase of the syenite near the Granada shaft. Hornblende, where present, seems to be the ordinary green variety, and not an alkaline type, as it is in the Aldermac and Beauchastel porphyries.

Analyses of the fresh and altered porphyry occurring at the Granada mine, made in the Provincial Laboratory, Ecole Polytechnique, Montreal, are given in Table II (page 37). The analysis of the fresh sample is given also in the accompanying Table I, column I, and, re-calculated, in column II. For comparison with this, analyses are given in columns III, IV, and V of a nordmarkite, an average alkaline syenite, and the syenite porphyry at Kirkland Lake. As will be noted, the similarity of the Granada rock to the nordmarkite is very close, and the presence in it of sodic orthoclase and anorthoclase warrants its being classed with this type of igneous rock, though no aegirine (alkaline pyroxene) was noted in the specimens examined. Compared with the Kirkland Lake porphyry, that at Granada is somewhat more alkaline. The feldspars in nordmarkite are of the same mottled type of those in the Granada porphyries.

The approximate mineral composition of the Granada porphyry, as calculated from the analysis, is as follows:

Quartz	11.37
Orthoclase	26.16
Albite	43.67
Anorthite	4.25
Mg-chlorite	2.74
Fe-chlorite	6.04
Epidote	0.50
Calcite	4.14
FeS_2	0.65
FeAs	0.20
	99.72

There are small dykes of porphyry at the Granada that differ somewhat in appearance from the larger masses just described. On the 125-foot level, some of these dykes have a distinct red tone. Mineralogically, however, they differ little from the grey porphyry, he colour being due, in all probability, to finely divided iron oxide.

TABLE I

ANALYSES OF SYENITE PORPHYRY FROM GRANADA MINE, AND OF RELATED ROCKS

	I Syenite Porphyry, Granada	II Analysis I Re-calculated	III Nordmarkite	IV Average Alkaline Syenite	V Porphyry, Kirkland Lake
SiO_2	62.71	64.83	64.81	62.46	62.19
TiO_2	0.00	0.00	0.45	0.56	0.44
Al_2O_3	16.34	16.89	16.93	18.07	14.85
Fe_2O_3	0.22	0.23	1.09	2.24	1.38
FeO	3.10	3.66	2.73	2.31	2.03
MnO	0.07	0.07	0.15	0.08	0.13
MgO	0.99	1.02	0.73	0.97	2.33
CaO	3.27	3.38	1.56	2.57	3.88
Na_2O	5.16	5.34	5.80	5.58	4.92
K_2O	4.43	4.58	5.66	5.02	3.76
P_2O_5	0.00	....	0.09	0.14	0.37
FeS_2	0.73	....	....	....	....
As	0.09	....	....	....	....
Ignition	3.01	....	....	....	3.84
	100.12	100.00	100.00	100.00	100.12
Sp. Gr.	2.673				2.730

I. Coarse grey porphyry across 25 feet; No. 7 cross-cut, 625-foot level, Granada mine.

II. Re-calculated from No. I, omitting H_2O, CO_2, FeS_2, and As.

III. Nordmarkite; Daly, *Igneous Rocks and their Origin*, New York, 1914. p. 22.

IV. Average alkaline syenite; Daly, *loc. cit.*

V. Kirkland Lake porphyry; Ont. Dept. Mines, Vol. XXXVII, Pt. II, 1928, p. 37.

About half way between the mine and mine offices, there is a composite dyke of the porphyry. The footwall, southern portion, consists of coarse red-weathering porphyry, and the northern part of a finer grained grey, sericitized porphyry, with comparatively few phenocrysts. The contact between the two portions is covered by the road and no evidence was found to determine the relative ages of the two. Somewhat similar fine-grained, sericitized porphyry occurs in the mine as narrow dykes. That paralleling drift No. 2A on the 125-foot level is of this type.

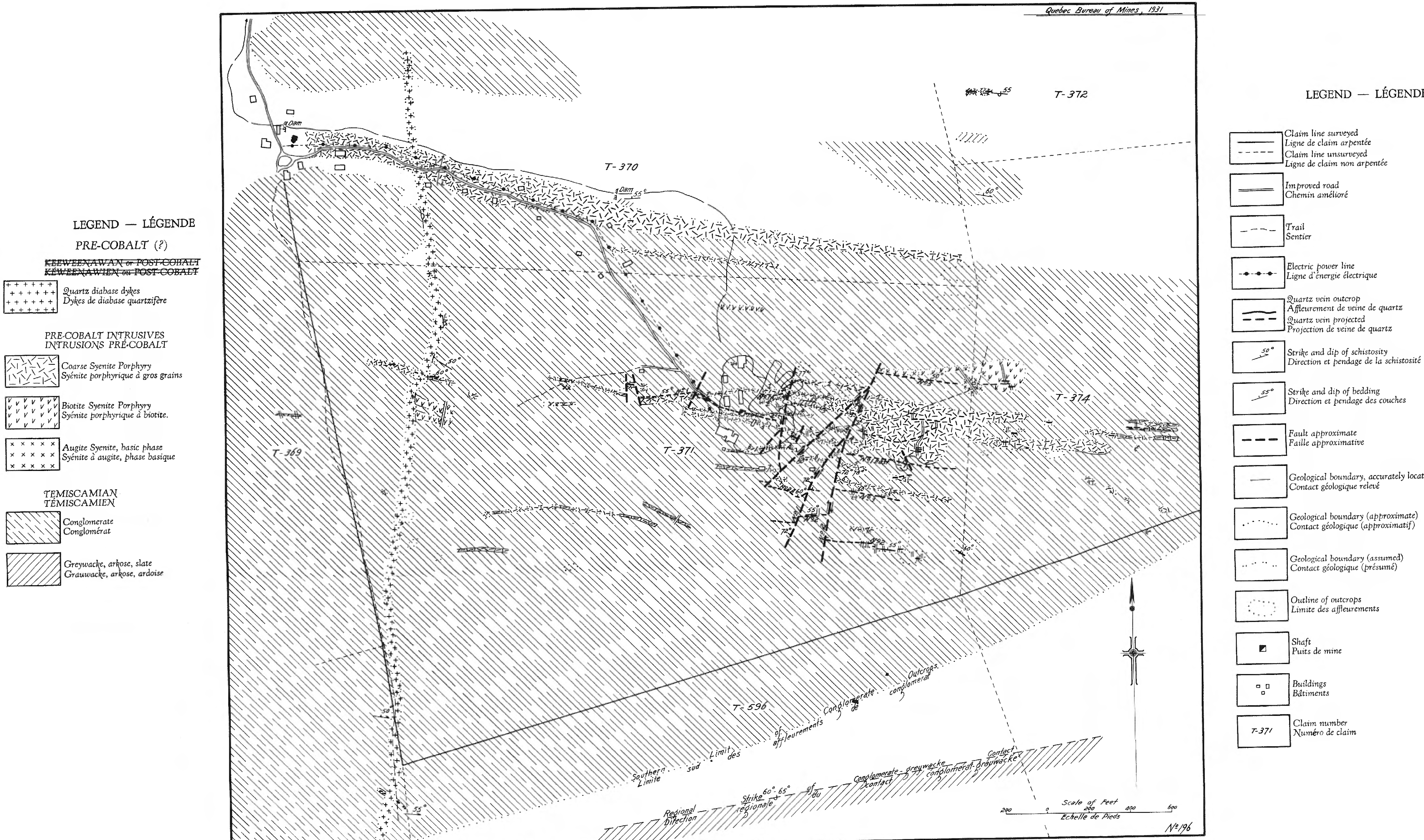
Porphyries approaching albitite and quartz-porphyry in composition were found in recent diamond drilling at the Granada and also on the surface, 1,610 feet S.85°E. from the shaft. Phenocrysts in these are chiefly albite, with some of quartz. A fine-grained, pink porphyry occurring in No. 3 cross-cut, 125-foot level, has a schistose texture but exhibits a few remnants of phenocrysts which were determined as quartz and oligoclase. The fine groundmass contains a fairly high percentage of quartz, with sericite, secondary carbonates, and some magnetite. In composition, this porphyry is distinctly more siliceous than the others.

Alteration of the porphyry is common near the quartz veins or where shearing has occurred. The principal type of alteration is sericitization, the resulting rock being finer grained, in general more siliceous, and mineralized with both pyrite and arsenopyrite. The development of sericite is always accompanied by carbonates, and in the biotite-rich phases of the porphyry, as at No. 5 vein, carbonatization is the dominant change. The chemical nature of the alteration is considered on a later page, in the section dealing with the composition of the wall-rocks of the Granada veins (page 36).

GRANITE (FELSITE):

To the north-northwest of the Granada mine, 3,200 feet distant, a small round stock of a felsitic rock, 280 feet in diameter, intrudes greywackes. It is cut by several irregular quartz veins and locally is impregnated with fine pyrite. The altered portions are somewhat coarse grained and granitic in appearance, with a grey to white colour. The finer grained parts are pale pinkish. Seen under the microscope, this rock is non-porphyritic and composed essentially of quartz, orthoclase, and albite, with minor amounts of biotite and chlorite. Though in texture it is similar to rocks that have been largely recrystallized, its siliceous character suggests it is a late phase of the syenite intrusions.

Pl. V



SURFACE MAP OF GRANADA MINE SHOWING GEOLOGY CARTE DE SURFACE À LA MINE GRANADA MONTRANT LA GÉOLOGIE

OLIVINE-GABBRO AND QUARTZ-GABBRO (YOUNGER DIABASE):

Intruding the Témiscamian sediments and locally cutting the syenite and the quartz veins are dykes of quartz-diabase which in turn appear to be cut by still later olivine-diabase. One of the former, which has a northerly course, but is faulted at the conglomerate-tuff contact, is from 60 to 100 feet wide. It has a medium to fine grain and is comparatively fresh in the thin sections examined. The principal constituents are augite and basic andesine, in distinct ophitic intergrowth. The augite is slightly altered to chlorite, the andesine to sericite. In close association with the augite is a small amount of biotite and magnetite or ilmenite. Filling the interstices between all of these minerals are graphic intergrowths of quartz and feldspar, which are the latest minerals to form.

Olivine-diabase occurs as a northeasterly trending dyke which appears intermittently across the area from Beauchastel (Kekeko) lake. Outcrops suggest it consists of several dykes arranged *en échelon*. In width, it varies from 100 to 350 feet. The less altered specimens are composed mainly of labradorite in ophitic relation to both olivine and augite, which constitute about 25 per cent of the rock and are present in nearly equal amounts. The augite exhibits a distinct pleochroism, colourless to pink, and may be titaniferous. The olivine is slightly altered along cleavage cracks to serpentine, and is streaked with finely divided iron oxides. Biotite and magnetite are present in minor amount. Specimens taken from the more southwesterly outcrops of the dyke contain no olivine.

An easterly trending dyke of olivine-free gabbro cuts the small stock of syenite porphyry on the east shore of Beauchastel lake. Fine grained contacts of this diabase with the syenite show its intrusive character. Traced to the southwest, beyond the limit of the present map-sheet, this dyke appears to be overlain by Cobalt conglomerate ① and hence to be pre-Cobalt in age. There is a possibility, however, that some of these gabbro dykes may yet be shown to be post-Cobalt or Keweenawan.

① G. S. C. Memoir 166, pp. 141-145.

Cobalt Series

The Cobalt sedimentary series is of minor interest in this area, since it is represented only by a small outlier, east of Pelletier creek. The main occurrence of rocks of this series lies to the west of Beauchastel lake, where they form the prominent Kekeko hills.

Lithologically, the series consists dominantly of conglomerate with some interbedded greywacke, not very different from the rocks of the Témiscamian series, but readily distinguished from them by their essentially horizontal position. As has been noted by earlier observers, the unconformity between the Cobalt series and the older sediments and igneous rocks is indicative of a prolonged period of erosion, during which time these older rocks were worn down to a peneplain.

Pleistocene and Recent

Pleistocene deposits, both Glacial and post-Glacial, form a mantle over all the older, consolidated rocks. By far the most widespread of these deposits are clays. There are, however, small deposits of gravel in the northern part of the area, and it is possible that more might be found on careful search. Such gravel constitutes valuable material for road building.

DESCRIPTION OF PROPERTIES

The Granada Gold Mines, Limited

History:

The property of Granada Gold Mines, Limited, is situated about four miles due south of the town of Rouyn. The gold-bearing veins are chiefly on claim T-371. This and adjoining claims were first staked in 1922, and were then known as the Bathurst claims. In September, 1923, discovery of vein No. 1, on which the shaft was later sunk, was made by W. A. and Robert C. Gamble. Several other auriferous veins were uncovered later, and in 1924 the property was optioned to the McIntyre-Porcupine Mines, Limited, who surveyed it and explored the veins on the surface by means of trenches and pits. Later, exploratory work was carried on by the Gamble brothers until

1927, when the Granada-Rouyn Mining Company, Limited, was formed and underground exploration was begun. The mine, however, did not come into production until June 28th, 1930.

In 1931, the Company was reorganized as Granada Gold Mines, Limited, and the capitalization was increased to 1,500,000 shares, of which 800,000 were issued. R. C. Gamble is President and Managing Director of the Company, and W. A. Gamble Secretary-Treasurer. Gold produced up to the end of August, 1931, totalled approximately $300,000 in value. The average grade of ore mined is about $11.50 in gold per ton. Mining claims held by the Company cover approximately 6,000 acres, a good proportion of which is drift covered.

Underground Development:

A two-compartment shaft has been sunk to a depth of 625 feet, with extensive lateral workings on the 125-, 375-, 500-, and 625-foot levels. These total about 13,000 feet. At the 250-foot level, only a station has been cut. From the 625-foot level, at a point 550 feet southeast from the shaft, a winze has been sunk on No. 2 vein. It is inclined at 48 degrees to the north and has a length of 155 feet (or reaches to a vertical depth of 740 feet). This is known as the 775 level, and, since the writer's visit, drifts have been opened here on the vein, extending 360 feet to the west and 270 feet to the east. Plans of the workings appear in Plate VI.

Mining operations have been confined largely to the vein known as No. 2, the only present source of ore, though exploratory work on the 125- and 625-foot levels, besides encountering a few minor veins, gave a good idea of the general geological structure. Vein No. 2 has been mined by eight stopes, designated as *A* to *H*, between the 325- and 625-foot levels. Raising in *B* stope from the 775 level is now in progress. Ore has been largely removed from stopes *B*, *C*, *D*, and *E* between the 500- and 625-foot levels. Near and above the 500-foot level, that portion of the vein in stopes *B* and *C* is too narrow for mining, and on the 500-foot level itself the vein is represented only by narrow quartz stringers. Stopes *D* and *E* continue from the 500- to the 375-foot level. In these the ore has been broken and largely removed. Stopes *F* and *G* have been worked from the 625- and 500-foot levels, with ore broken about half way to the levels above. Stope

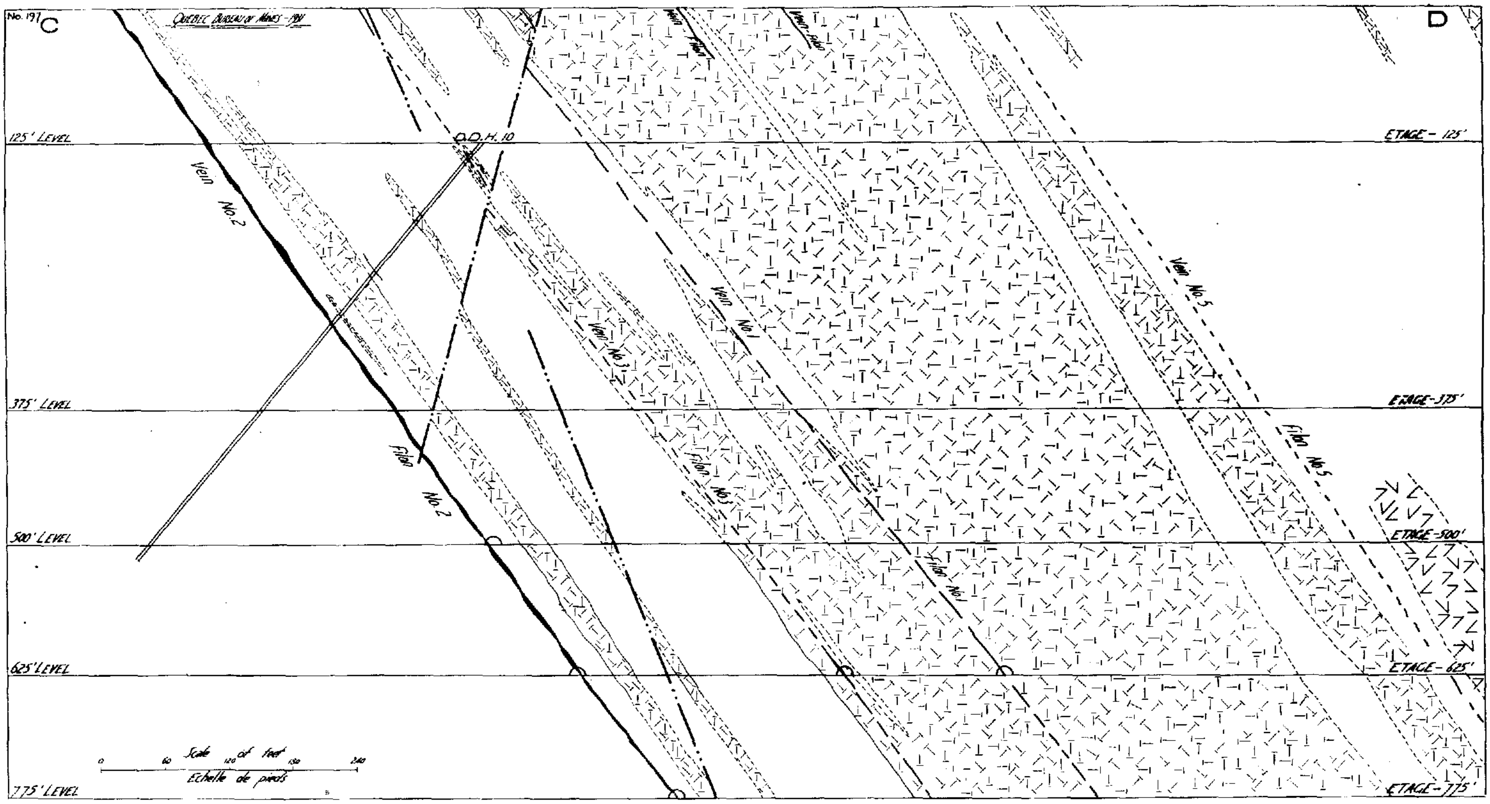
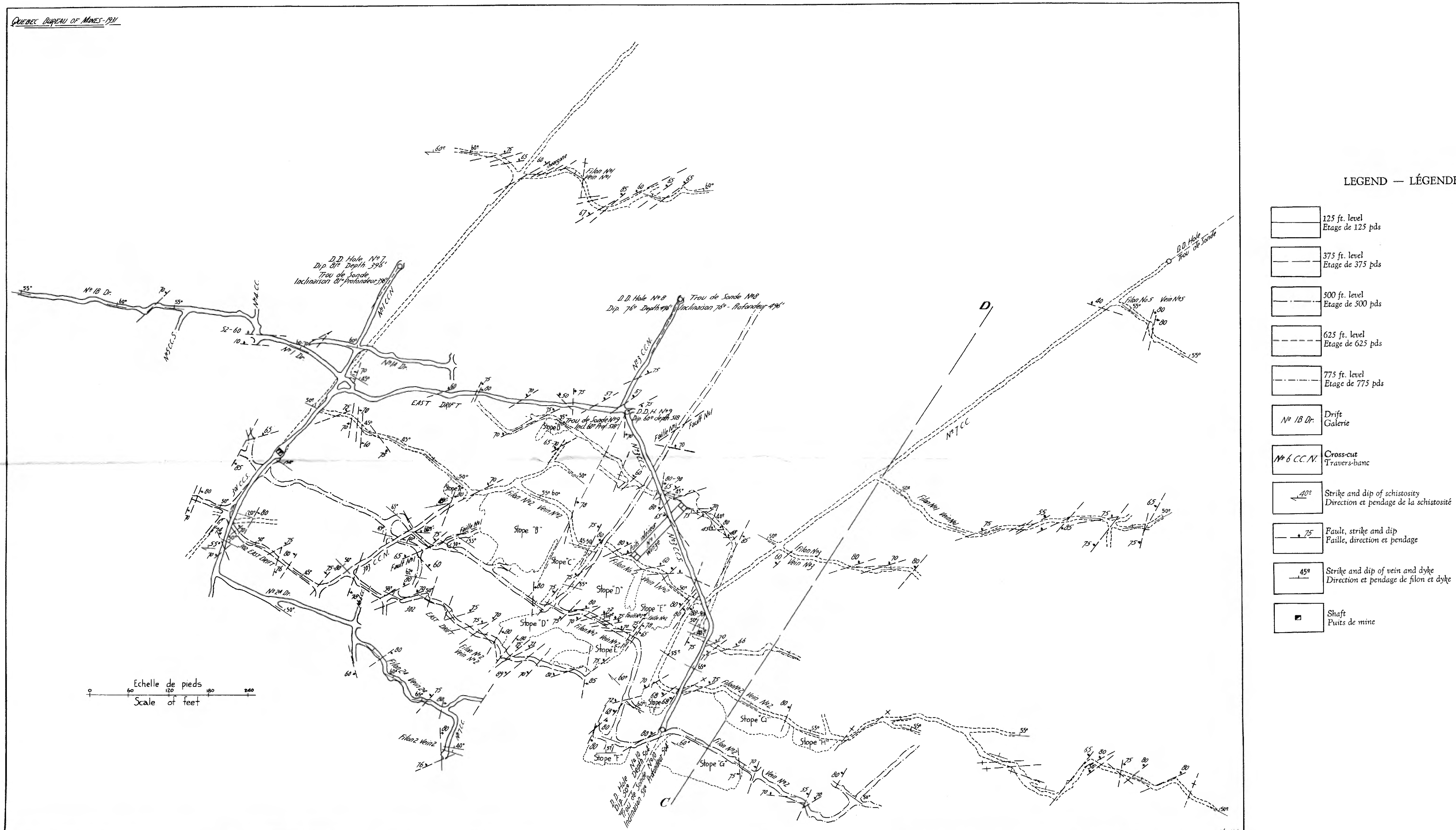


FIGURE 4.—Vertical section showing geology in workings of Granada mine. Granite shown by pattern of angles; Syenite porphyry by pattern of dash and hyphen; Conglomerate and greywacke by blank areas. (See Plate VI).



PLAN OF UNDERGROUND WORKINGS AT GRANADA MINE

PLAN DES TRAVAUX SOUTERRAINS DE LA MINE GRANADA

A was started on the 625-foot level only. Ore reserves are thus confined largely to that section of the vein above the 375-foot level—which (judging by the length on the 500-foot level, 453 feet deep) should be approximately 500 feet long, with an average width of between two and three feet—and to that section now being developed from the 775 level.

Following the recent reorganization of the Company, plans were made for the electrification of the plant, and a power-line is under construction from Rouyn. This will greatly facilitate the deepening of the workings.

Geology of the Deposits:

Details of the geology of the gold-bearing area are shown in Fig. 4 and Pl. V. The vein deposits are of the fracture-filled type and are confined entirely to the belt of interbedded Témiscamian conglomerates and greywackes which are intruded by dykes and lenticular masses of coarse syenite porphyry corresponding chemically to a nordmarkite. This area is about one mile long in an east-west direction and half a mile wide. The conglomerate belt as a whole trends N.80°E., though, locally, the finer grained beds strike slightly more to the east. All the beds dip northward, at from 50° to 65°. Those on the southern margin of the belt, at least, are overturned. It is not certain whether the series is monoclinal or in the form of an anticline, down-faulted on the north. The second possibility has been suggested above. The intrusions of syenite porphyry follow lines, probably faults, conforming more to the schistosity of the sediments than to the bedding, though locally the latter relationship holds.

The general strike of the porphyry is east-west or slightly south of east. The dykes dip to the north at 50° to 60°, approximately parallel to the schistosity and also to the veins. On surface, the main body of syenite lies 600 feet east of the shaft. In outline it is lenticular, fingering out to the east and west into smaller dykes, the delineation of which, under the drift cover, is rendered difficult by oblique faults visible only underground. The greatest width of this syenite body on the surface is 300 feet, and on the 625-foot level this width is maintained. At greater depths the width will probably increase through junction of the main body with a smaller dyke which lies just to the south of it on the 625-foot level. As will be seen later, the distribution of the porphyry at depth has an economic bearing on the deposits. The types of porphyry occurring on the Granada property have been already discussed. The early phases are the most basic and contain either augite or hornblende. Biotite-rich phases occur to the northeast, at No. 5 vein. Fine grained phases, encountered on the 125-foot level, are in part at least more siliceous than the main mass. The coarse, grey to reddish type, with its blocky grey phenocrysts of feldspar, is by far the most abundant. The more siliceous dykes are probably the youngest, presupposing these variations in composition as due to some process of differentiation of the parent magma. In this category, also, may be placed the small felsite stock occurring half a mile to the northwest of the mine. All phases of the porphyry apparently antedate the gold-bearing quartz veins.

Intrusions distinctly of post-ore age are represented in the western part of claim T-371 by a quartz-diabase dyke which cuts both the porphyry dykes and the veins associated with them.

THE GOLD-BEARING VEINS:

The principal gold-bearing quartz vein at Granada is known as No. 2. This is the only vein that has made any production of ore up to the present. Five smaller veins, Nos. 1, 1 East, 2A, 3, and 5, have been encountered in underground workings, all but No. 5 occurring on claim T-371. No. 5 vein outcrops to the east of the others, on claim T-374. Other veins, on which little recent work has been done, are present to the west of claim T-371, and still another lies 2,000 feet east of the shaft, on claim T-374. The more important veins are 1,100 feet north of the conglomerate-greywacke contact and are found in the conglomerate, in the interbedded greywacke, and in the syenite porphyry itself. They strike in an easterly direction and dip to the north at 50° to 55°.

The veins are composed dominantly of quartz, which varies in colour from a dark grey to white. The white quartz appears to be the later in age. Minor non-metallic minerals include early carbonates, occurring near the walls of the vein; green chlorite, which follows fine fractures as thin seams, either parallel or at right angles to the walls; sericite, along fractures and minor slip-planes in the quartz; and black tourmaline, in occasional small nests of radiating crystals, either with pyrite or close to the edge of the veins.

The metallic minerals are chiefly arsenopyrite and pyrite, with smaller amounts of galena, sphalerite, pyrrhotite, chalcopyrite, molybdenite, and free gold. Pyrite, arsenopyrite, pyrrhotite and molybdenite are confined largely to the sericitized or carbonated wall-rocks, the two last being of very minor importance. Galena and sphalerite, with minor chalcopyrite, occur in the quartz and are more abundant in certain sections of No. 2 vein than in the other veins. The gold, which is rather coarse, is all in the native state and invariably follows the walls of the veins or fills minute fractures in the quartz, which are lined with either chlorite or sericite. Some gold has been found penetrating or lining pyrite cubes and cutting or replacing early carbonates, galena, and sphalerite. Except for such occurrences as these, the sulphides seem entirely free from gold. The sphalerite contains minute blebs of chalcopyrite, but later chalcopyrite and calcite are locally present in irregular veinlets away from the main veins.

Both in vertical and horizontal section, the veins have a characteristic lenticular habit, pinching and swelling from a few inches to a maximum width of 7½ feet. In most of them, the narrower portions seldom have a length of more than a few feet. The foliae of the schistose wall-rocks curve around the ends of the lenses, indicating the effects of pressure on the veins after, and possibly during, their formation. Post-quartz faulting and fracturing is indicated by the numerous chlorite and sericite seams within the veins, and along which the gold was deposited. Post-ore faulting was even more intense, and the veins have been intricately sliced by oblique faults striking to the north, northeast, and northwest and dipping either to the east or west. Many of these faults have caused offsetting of the veins, a few feet back and forth to the north and south, without appreciably changing the general trend. They divide the veins and adjacent rocks into a series of wedge-shaped blocks, and, in mining, often limit the lengths of individual stopes. The more important of these faults have been designated No. 1 and No. 2. No. 1 strikes N.50°E. and dips 68°N.W.; No. 2 strikes N.20°E. and dips 78° E. In

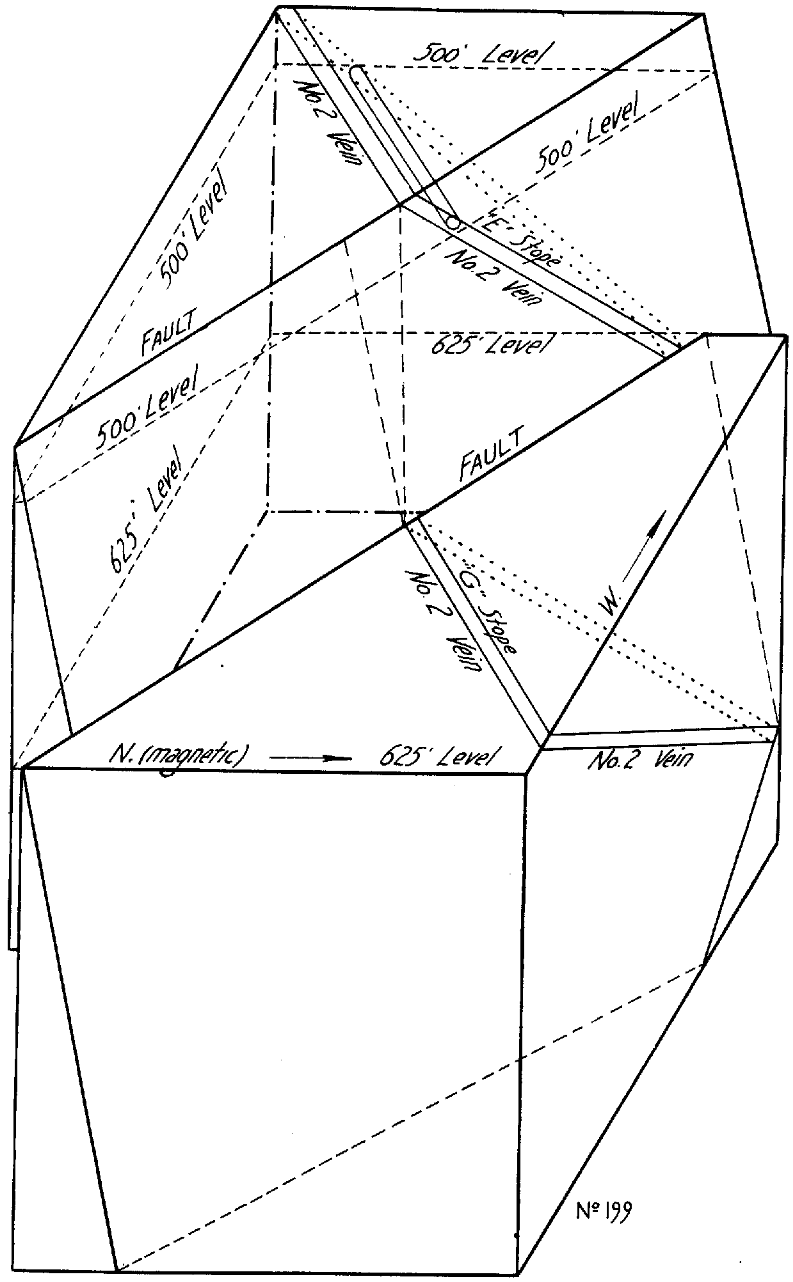


FIGURE 5.—Block diagram showing displacement on No. 2 fault.

fault No. 1 there has been a horizontal displacement of the northwest side southward of 60 feet; in No. 2, of the east side southward, of 150 feet. As shown in Figure 5, this faulting has brought about a nearly vertical displacement of the inclined vein and enclosing strata. Between these two faults lies the richest section of ore in No. 2 vein. The faulting, however, is distinctly later than the gold mineralization.

Description of Veins:

Vein No. 2. This vein outcrops at a point 450 feet south by 400 feet east of the shaft. It strikes in an easterly direction and is displaced by No. 2 fault. On the west side of the fault, only a 15-foot length is exposed. The vein here is 1½ to 2 feet wide, consisting of much-fractured quartz, with sericite developed along the slips. Free gold is present on the footwall. At depth, this is the richest portion of the entire vein. East of the fault, the vein is offset and occurs 120 feet farther south. This portion of the vein may be traced intermittently for 65 feet, with a width varying between ten inches and three feet. Near the fault, it consists of two small veins, six to ten inches wide, separated by 1½ feet of schist. Free gold occurs on both the foot- and hanging-walls, and in one place a half-inch seam of tourmaline and arsenopyrite, with free gold, cuts the quartz.

At the surface, this vein occurs in the sediments. The eastern portion is more than 400 feet south of the main porphyry mass. It dips north at an average of 55°. On the 625-foot level, this (eastern) section of the vein is only 250 feet south of the main intrusive. In the winze below this level, the dip is 48°, and on the 775 level the western portion flattens locally to a dip of about 35°. The inclined distance to which the vein has been explored is 912 feet. The total length so far indicated is 1,600 feet, but of this only 824 feet have been worked. At both eastern and western ends the vein frays out into small stringers. The section between the two main faults has a length, on the 375-foot and 500-foot levels, of about 300 feet, but only 200 feet on the latter level is wide enough for mining. On the 625-foot level, this inter-fault zone widens to 330 feet, and on the 775 level to 345 feet, though at this depth the vein widths are on the whole less than on the level above. In general, this section of the vein is characterized by chlorite seams along fractures spaced at intervals of three to four inches, which run either normal or parallel to the walls. Visible gold is present in many places.

East of fault No. 2, on the 500-foot level, a length of 300 feet, discounting barren zones occasioned by faults, has been mined or is available for mining. On the 625-foot level, the length of this zone is slightly less. In stopes *G* and *H* in this section, the principal sulphides are galena and sphalerite, but they are present in small amount. Assays of individual specimens, however, show the absence of gold in these minerals. Still farther to the east, the vein passes into, and through, a dyke of coarse porphyry. Though maintaining excellent widths for a length of 300 feet, it lacks the chloritic seams and values are low. The eastern extremity is again in sediments, but no sections of good ore appear.

As noted above, the actual displacement of the vein by No. 2 fault has been largely vertical, as indicated by striations, slickensiding, and cleavage, as well as by displacement of nearby porphyry dykes. Figure 5 shows that the portion of the vein east of the fault on the 625-foot level corresponds almost exactly with that on the fault footwall above the 500-foot level. This is corroborated by the general appearance of the vein at these two levels.

Vein No. 1.—This vein is exposed to the west of the shaft, in much altered, rusty greywacke and porphyry. Earlier maps indicate that it had a sinuous strike, winding back and forth across a narrow dyke of porphyry. Its western portion has been projected to the surface at a dip of 60°N. from its position on the 125-foot level, where it consists only of narrow stringers of quartz, two or three inches to a foot in width. Where it passes directly from the hanging-wall to the footwall of a 30-foot dyke of coarse porphyry, it widens to ten feet. The vein there consists of several quartz lenses with irregular inclusions of highly sericitized and schistose porphyry. On the 625-foot level, this vein was intersected in the first cross-cut, 560 feet northeast of the shaft, where it consists only of narrow quartz stringers which are broken by numerous oblique faults. Though locally carrying free gold, its small size renders the vein valueless as a source of ore.

Vein No. 3.—Lying stratigraphically 200 feet above No. 2 vein and dipping north at 55°, vein No. 3 is exposed at the surface at a point 350 feet south by 500 feet east of the shaft, for a length of 40 feet. In the eastern part, a cross-section shows 21 inches of quartz followed on the south by six feet of schistose conglomerate impregnated with quartz stringers. Farther to the west, the quartz is streaked with waxy green sericite inclusions. At depth, the vein passes from the conglomerate into a tongue, or dyke, of porphyry. On the 625-foot level, it has been followed for 150 feet to the east of No. 7 cross-cut. There it is lost by faulting, but it reappears 70 feet farther east. This portion of the vein is of interest because of its relation to the porphyry. As shown in the plan of this level, the porphyry was apparently cut and displaced by a northeasterly trending fault before the fracture occupied by No. 3 vein was formed. Free gold with sericite was observed in the quartz where it passes from porphyry to greywacke on the east. In width, the vein varies between 2 and 2½ feet.

No. 1 East Vein. A vein, known as No. 1 East, was encountered 180 feet to the northeast of No. 3 vein on the 625-foot level. It is apparently not the eastern continuation of No. 1 vein. From No. 7 cross-cut, it has been followed by a drift for a distance of 150 feet, with a width of 1½ to 3 feet. East of this point, it has been intensely faulted and only small lenses of quartz mark its course. It consists of mottled grey and white quartz in parallel seams. Galena, pyrite, and free gold are present. The footwall of porphyry is schistose and shows striations running directly up and down the dip. This vein lies largely within the main porphyry intrusive, but, eastward, it passes into a lens of conglomerate. An assay of the footwall quartz, with its galena and pyrite, gave only a trace of gold.

Vein No. 5.—This vein outcrops on the surface at a point 650 feet east-northeast of the shaft. There it is confined to a much altered, sericitic and carbonated phase of the porphyry, richer than usual in biotite, some of which appears to be secondary after hornblende. The vein consists essentially of a series of quartz lenses. Two trenches have been cut across it. In the trench farthest towards the southeast, a lenticular mass of quartz, 12 by 40 inches, dips to the north at 50°. It contains abundant sericite, is mineralized with arsenopyrite, pyrite, and pyrrhotite, and is reported to carry free gold on the walls. Five feet south of this lens is a second vein, 8 to 12 inches wide. In the trench that is farther northwest, a one-foot quartz vein is followed on the north by altered porphyry and a five-foot zone of schistose porphyry, largely replaced by quartz. The walls carry abundant arsenopyrite. On the 625-foot level, this vein lies in a silicified zone, probably altered porphyry, which is bordered on the north by a biotite-hornblende-rich rock, perhaps a basic phase of the porphyry. The vein has been drifted on to the east for 126 feet. The width of quartz varies from one to two feet.

Other veins exposed on the surface show mineralization similar to that already described, with pyrite and arsenopyrite as the principal metallics. All are too far removed from the present mine to be easily worked, though those to the east and south of No. 5 vein may prove worthy of investigation.

Composition of Wall-Rocks and their Alteration:

A chemical study of the porphyry and greywacke (or greywacke matrix of conglomerate) wall-rocks of the veins was made in order to ascertain if they differ sufficiently in composition to explain the prevalence of gold in veins in the greywacke and conglomerate, compared with its relative scarcity where the veins pass into the porphyry. The accompanying table gives the results of analyses of the porphyry and greywacke, both fresh and altered. Since the sediments are apt to be variable in composition, comparison between the fresh and altered greywacke is not necessarily significant.

The analyses show that the greywacke, even in its altered phases, is considerably more basic than the porphyry, with a lower silica and alkali content, and higher ferrous iron, magnesia, and lime. Mineralogically, this difference is due largely to the greater abundance of chlorite and the smaller amount of the alkali feldspars in the greywacke. Insofar as the ferromagnesian minerals are rather effective precipitants of gold from solution, the greywacke and conglomerate would naturally be the more favourable wall rocks. This, however, is not the only factor determining the distribution of values, as is indicated below.

TABLE II

ANALYSES OF FRESH AND ALTERED SAMPLES OF SYENITE PORPHYRY AND GREYWACKE

(Provincial Laboratory, Ecole Polytechnique, Montreal)

	I Fresh Porphyry	II Altered Porphyry	III Fresh Greywacke	IV Altered Greywacke
SiO_2	62.71	67.59	56.95	49.99
Al_2O_3	16.34	11.30	16.67	17.64
Fe_2O_3	0.22	0.94	0.86	0.45
FeO	3.10	1.62	6.72	4.47
Fe (total)	2.905	2.958	6.70	5.79
MnO	0.07	0.16	0.40	0.20
MgO	0.99	0.65	3.22	3.74
CaO	3.27	2.81	4.15	6.87
Na_2O	5.16	3.62	2.94	1.86
K_2O	4.43	4.05	2.43	3.77
H_2O+CO_2	3.01	3.86	4.01	6.46
FeS_2	0.73	2.23	1.86	4.28
As	0.09	0.98	0.06	0.12
TiO_2	None	None	None	None
P_2O_5	"	"	"	"
Au	"	"	"	"
Ag	"	"	"	0.06 oz. per ton
Sp. Gravity	2.673	2.675	2.754	2.913

I. From largest mass in No. 7 cross-cut, 625-foot level.
II. From footwall of No. 1 East vein.
III. From a point 60 feet south of No. 1 East vein in same workings as II.
IV. Composite sample of sericitized greywacke from footwall of No. 2 vein. *G* stope and *B* stope.

Comparison of the altered wall-rocks with their fresh phases has been made in graphical form in Figure 6, a straight-line diagram. Curve *A* shows the relative gains and losses of constituents for the porphyry; curve *B* gives similar data for the greywacke. Figures for each constituent represent the number of grams of altered rock required to furnish the amount of that constituent in the fresh rock.

Assuming any constituent in either set of analyses as constant, points to the right indicate a relative loss, those to the left a relative gain. Thus, for the porphyry, if, as is customary, alumina is assumed to have remained constant, soda too has remained constant; there are minor gains in potash, lime, silica, and total iron; and more marked gains in ferric iron, manganese, pyrite, arsenic, water, and carbon dioxide. Mineralogically, the changes consist chiefly in the sericitization of the feldspars, with destruction of the phenocrysts; the in-

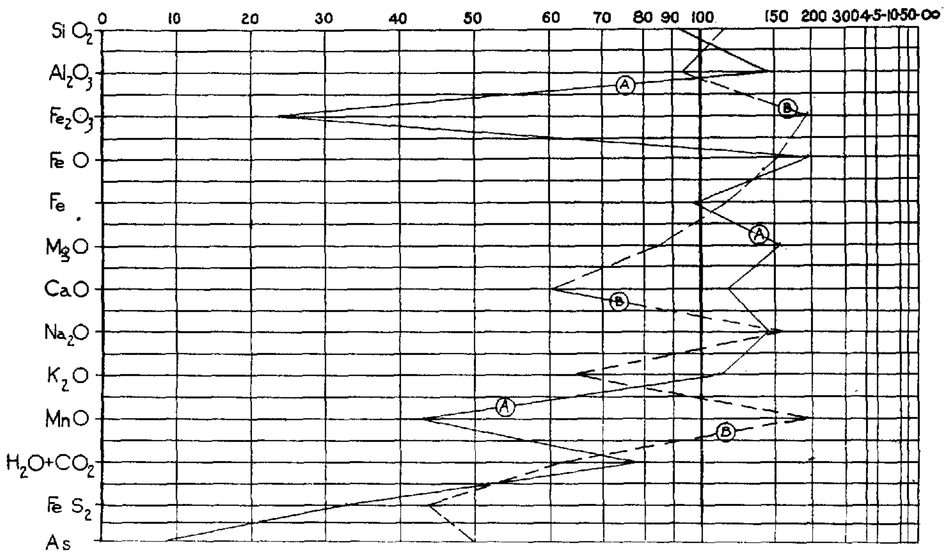


FIGURE 6.—Straight-line diagram showing alteration of syenite porphyry (A) and greywacke (B) near veins at Granada gold mine. Points to the right indicate relative losses, to the left relative gains, of constituents.

troduction of some quartz and calcite; and the development of pyrite and arsenopyrite. The formation of the two last named minerals obviously has been brought about chiefly by the addition of sulphur and arsenic and by the utilization of the iron present in the wall-rock.

Analyzing the alteration of the greywacke in like manner, and assuming, as before, no change in the alumina content, there has been a marked gain of potash, lime, water, and carbon dioxide; important gains in sulphur and arsenic; but losses of silica, total iron, ferrous and ferric iron, and soda. The development of sericite and sulphides is the typical change.

From the foregoing, it would appear that the solutions causing the alterations, and related at least to the earlier constituents of the veins, were neither highly alkaline nor exceptionally rich in magnesia, as they were in the case of some other ore deposits. Sulphur, arsenic, calcium carbonate, silica, minor boron, potash, and the metallics iron, lead, zinc, and gold, were the principal constituents they carried. As has been noted, chlorite and sericite are relatively abundant in some sections of the Granada veins. Both occur along fractures in the quartz and are of late development. The sericite seems particularly related to the shearing of the quartz. The chlorite was apparently deposited from solution; it may, in part, have been derived from the wall-rocks, though such a relation is not easily demonstrated.

Paragenesis:

The succession of events in the formation of the Granada gold-bearing veins, as indicated by the general geology of the deposits and a study of polished sections of the ore ①, is as follows.

At some time after the intense folding of the Témiscamian sediments, intrusions of syenite—first a basic, later a more alkaline, phase—and finally of felsite, occurred, following essentially the planes of schistosity of the sediments, and replacing them in part. Minor faulting offset a few of the dykes, and then the fractures in which the veins occur were opened, some of them passing from conglomerate into and through the porphyry. Into these fractures, arsenopyrite, pyrite, and quartz were introduced as the earlier minerals, with minor tourmaline, molybdenite, and carbonates, while the temperature was fairly high, though not extreme, and while the area was under considerable stress. Galena and sphalerite, with minute amounts of intergrown chalcopyrite, followed. Re-fracturing of the veins allowed the introduction of chlorite, the development of some sericite, and the deposition of gold, chiefly along the vein walls and in fine chlorite seams. Polished sections (Figure 7) show clearly that the gold

① The writer is indebted to N. D. Runnalls for the preparation of the polished sections of ore and for the drawings, which were made at Queen's University.

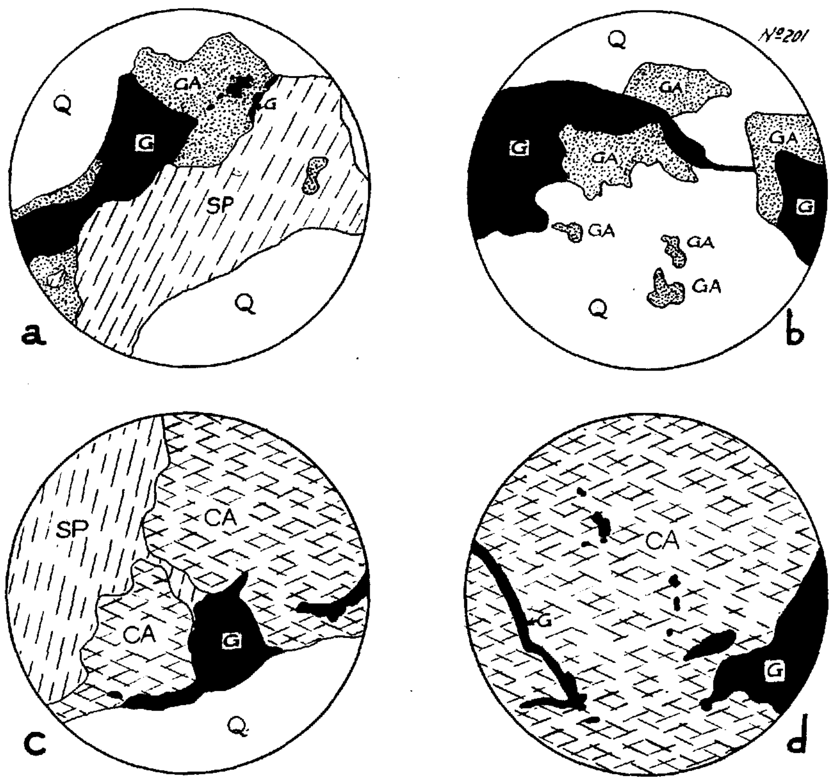


FIGURE 7.—Drawings of polished sections (× 60) of Granada ore, No. 2 vein, showing gold as later than sphalerite, galena, carbonates and quartz.

SP—sphalerite; CA—carbonate; G—native gold; GA—galena; Q—quartz.

a and **b**.—From raise at 375-ft. level, showing gold cutting and replacing galena, sphalerite and quartz.

c and **d**.—From wall of No. 2 vein, showing gold as later than sphalerite and carbonates.

is later than all the sulphides ①, a fact corroborated by the milling practice in use. Minor carbonates and non-auriferous chalcopyrite,

① Recent reports by mine officials state that, on the 775 level, No. 2 vein carries massive auriferous pyrite. A specimen received by the writer has coarse crystals of pyrite, one to two inches in diameter, in a matrix of quartz. The pyrite has been fractured and the fine openings have been filled with later quartz. Some of the gold in the pyrite may thus have been introduced with the second-age quartz.

which occur in only a few places, were probably later in age. Intensive post-vein and post-gold faulting followed and accounts for the present segmented nature of the veins.

From the above, it is apparent that the presence of the sulphides, galena and sphalerite, is not necessarily indicative of pay-ore. The narrower portions of the lenticular veins appear no richer than the wider parts. Deposition of the gold is related to two factors: one, and probably the more important, the amount of fracturing and chlorite-seaming in the quartz immediately preceding the period of gold mineralization; the other, the chemical composition of the wall-rocks. Both conditions are more favourable in the greywacke and conglomerate than in the porphyry—a feature which probably will be found quite general. The general lack of seaming in the veins enclosed by porphyry is probably to be explained by the greater competency of these rocks and by their resistance to later fracturing. Where, however, they are found to have this favourable structure, gold values may be expected.

The source of the gold and associated minerals is unquestionably related to the intrusions of syenite porphyry and associated rocks. The mineralization may be regarded as an end phase of this period of activity, since quartz veins with traces of gold are present even in the felsites, regarded as the latest phase of the syenite porphyry intrusions. Molybdenite, pyrrhotite, arsenopyrite, and tourmaline indicate an igneous origin, and that the early temperatures were fairly high. The deposit may be classed as one of intermediate depth. The vein-forming solutions obviously followed the same pathway as the intrusions from a deeper-seated magma, and hence the most favourable ground for exploration is in the vicinity of the intrusives.

Problems and Possibilities:

Since the known ore supply is as yet limited to No. 2 vein, an important question is the depth to which this vein may continue and the effect to be expected if it passes into the larger porphyry mass on the north. As noted above, the vein and porphyry approach one another by at least 100 feet in a depth of 625 feet. The flattening of the vein below this level, and the possible widening of the intrusive in depth, indicate that the two will finally meet. The depth at which this junction may be expected is uncertain. Should the dip of the vein, 52°N., as is shown in Figure 4, page 28, (vertical section), be maintained, and should the porphyry remain constant in width, the two will intersect at a vertical depth of between 4,000 and 5,000 feet. If the porphyry widens at depth, as seems probable, the junction will occur at a lesser depth. These estimates are based on the structure of that portion of the mine lying east of No. 2 fault. West of this fault, no information is available as to the exact size or position of the porphyry, except that the intrusive fans out into several small dykes in a westerly direction.

Whether values may be expected to continue in the vein where it meets the porphyry is doubtful. It is possible the vein may continue down the footwall of the intrusive instead of entering it, in which case gold should continue to be present. If it cuts into the porphyry, however, judging by other such veins, values may be expected to decline. But the total area available for exploration for new sources of ore is extensive, and, being largely drift covered, its possibilities are still little known. The presence of one ore-bearing vein warrants search for others. Little is known of the ground to the south of No. 2 vein, or, for that matter, to the north and northeast. The rather prominent depression on the north of the long porphyry dyke, between 800 and 1,000 feet north of the shaft, is worthy of investigation. Also, the experience in certain other gold camps of finding the grade of ore improve with depth should not be overlooked.

GOLD PRODUCTION AND MILLING PRACTICE:

Production of gold and silver to date from the Granada mine has been as follows:

	Gold		Silver	
	Ounces	Value	Ounces	Value
1930 (5 months).....	6,317.509	$ 130,594.50	871.62	$ 332.56
1931...............	12,065.905	249,424.38	1,951.01	582.76
Total.........	18,383.414	$ 380,018.88	2,822.63	$ 915.32

The mine is equipped with a mill of 70 tons daily capacity. Until recently, power was supplied by Diesel engines, but electrification of the mine and mill has been in progress during the winter of 1931-32, a power-line having been erected from Rouyn to the property.

A complete account of the milling practice followed at the Granada mine has been given recently by Bertrand Robinson ①. Because of the uncombined nature of the gold, concentration is effected by what are essentially placer methods, and recovery of gold from the concentrate is made in part by amalgamation at the Granada mill, and in part at the Noranda smelter.

North Granada Showing

(Rouyn township)

A mineralized zone of geological, rather than economic, interest, known as the *North Granada Showing*, occurs immediately east of the Granada-Rouyn road, at the bend three-quarters of a mile north of the Granada mine offices. Here a very fresh olivine-gabbro (younger diabase) dyke strikes N.80°E. through the Keewatin tuffs. In small fractures in the latter, on the north side of the dyke, are irregular stringers or dykelets of a light-weathering rock, probably a phase of the diabase, with segregations of chlorite along their borders. The diabase contains a few inclusions of tuff and sugary quartz. Here, over a zone five feet wide, is a sparse mineralization of pyrrhotite with a little chalcopyrite, which follow distinct fractures striking N.75°W. in both light and dark varieties of the diabase. Some sulphides were also noted replacing the diabase away from the fractures.

To the northeast, 150 feet distant, folded and contorted green tuffs, interbanded with a hard, black rock, possibly rhyolite, contain minor amounts of pyrrhotite and chalcopyrite, with a few quartz stringers following the strike of the beds, over a width of about ten feet. The axial planes of the drag-folds strike N.60°E. and they pitch northeast at 50°. Between this zone and the diabase are finely bedded tuffs with small lenses of quartz and altered chlorite layers. A similar type of mineralization occurs in the tuffs, eastward 40 chains along the strike, on claims held by the Astoria Mines, Ltd.

① Can. Min. Jour., Vol. 53, No. 2, 1932, pp. 53-57.

Claim R-6579

(Rouyn township)

On this claim, $1\frac{5}{8}$ miles to the east of the Granada shaft, a 16-foot dyke of coarse syenite porphyry strikes across the conglomerate at N.78°E. and dips 65°N. The north edge of the dyke and the adjoining conglomerate are highly schistose and carbonated and are penetrated by narrow quartz stringers. Three trenches were dug across the outcrop, but did not encounter any well defined veins. The conglomerate-greywacke contact lies 130 feet to the south.

Claims R-6891 and 6892

(Rouyn township)

On the north shore of the eastern extremity of Beauchastel lake, just west of the first constriction, and $1\frac{3}{4}$ miles east of the west township-line, is a zone of highly altered Témiscamian greywackes which consist of biotite-hornblende schists, carbonate and serpentine or talcose schists, and dark to black graphitic schists. The strike of these is irregular and locally drag-folds are present. At the small peninsula on the north shore, $1\frac{3}{4}$ miles east of the west line of Rouyn township, the rock is dark green and has almost an igneous aspect. Microscopically, it is found to contain about 40 per cent brown biotite and green hornblende, which penetrate albite and quartz, the other principal constituents. Titanite and carbonates are present in minor amount. The texture is clearly that of a recrystallized rock. Farther to the west, on the south shore of the lake, similar rocks occur as bands, six feet wide, interbedded with the sediments and probably derived from them. At the peninsula mentioned, and to the north of the cabin situated just two claims to the west of it (see map), the altered sediments are traversed by separate dykes of porphyry which have a width of one foot. That at the lake is a hornblende-syenite porphyry. The other is highly altered and possibly more acidic, and within it is a flat lens of quartz, $1\frac{1}{2}$ feet wide, but playing out in the schists adjoining the dyke. In a trench, 15 feet to the east of the quartz lens, is a five-foot band of black, graphitic schist, mineralized with 'cube' pyrite which follows the schistosity. Other trenches still farther to the east show highly altered carbonate-chlorite schists, but immediately to the north is a ridge of unaltered greywacke. No discoveries of importance seem to have been made here.

Astoria Rouyn Mines, Limited

(Rouyn township)

This company holds claims T-313, 329, and 330, situated about one mile north of the Granada shaft, in the southwest quarter of Rouyn township. Camps are situated on the Granada-Rouyn road, just south of the small lake used by the Granada Company as a water supply. The claims cover a portion of the contact between the Keewatin lavas and tuffs. Interbanded with the latter are minor lava flows and some rusty-weathering carbonate-schist zones. A northerly trending quartz-gabbro (diabase) dyke cuts across the Keewatin from north to south. It is bent both to the east and to the west, where intersected by an easterly-trending dyke of olivine-gabbro (younger diabase).

Two areas of mineralization have received some attention. The earlier work was done on a ridge just to the south of the camps, where the quartz-diabase dyke cuts the lavas and interbedded tuffs. One pit was sunk at the margin of the dyke on a narrow zone containing sparse mineralization of pyrrhotite and chalcopyrite. Several other small pits are situated farther to the east on short zones in tuffaceous beds carrying similar sulphides, epidote, and calcite. In width, these zones vary from two to three feet, but they have no continuity along the strike. At the base of the ridge, and a short distance east of the camps, a tunnel was driven for a distance of 175 feet at N.15°E. and a small amount of drifting was done from the end, without, however, encountering any mineralized zone of importance. In these occurrences, the mineralization is possibly related to the olivine-diabase dyke.

More recent work was carried on in an area to the south of the above, on claim T-330, about 2,000 feet southeast of the Granada-Rouyn road. On the north is a zone of rusty-weathering carbonated schists, 300 feet long and 75 feet wide, but extending on to the east for at least 10 chains beneath a heavy mantle of drift. Rocks identical with these occur in Keewatin areas in many localities in Ontario and Quebec. They are here penetrated by an irregular stock-work of quartz stringers, some of which attain a width of 1½ feet. Tourmaline is present with the quartz in a few places. The schist itself contains abundant grey carbonate (ankerite), green chromiferous mica, and 'cube' pyrite. Numerous trenches and pits have been dug across the outcrop, but no important values in gold have been reported. A sample of quartz containing tourmaline gave, on assay, 20 cents in gold per ton.

To the immediate south is a narrow stretch of low ground, occupied by similar schists, but in which a more continuous quartz vein (No. 4), six to twelve inches wide, has been traced, striking N.83°E. The schist here, however, carries abundant arsenopyrite near the quartz. Vein No. 3 is ten feet to the south of No. 4 and consists of similar quartz lenses in a five-foot zone impregnating schists, also mineralized with arsenopyrite. Assays of this material, however, show only low values or mere traces of gold. No. 2 vein lies 80 feet south of No. 4 vein, in less altered tuffs, some of which closely resemble fine greywacke. In a pit a short distance to the east of this vein are two quartz lenses, two feet and six inches wide, respectively, separated by 1½ feet of schist. Both quartz and schist carry arsenopyrite. An assay across the quartz gave only a trace of gold. Vein No. 1 occurs in well-bedded tuffs at a point 110 feet south of No. 2 vein, and consists of minor stringers of barren quartz.

In age and origin, these veins antedate the intrusions of quartz-diabase, since, near the western border of the outcrop on which they occur, both quartz veinlets and the carbonate zone are truncated by a northerly trending dyke of this rock. They are probably related to the still earlier period of syenitic intrusions, as suggested by the presence of arsenopyrite, which is relatively abundant near such rocks at the Granada mine. No intrusives of this type were observed on the property, however, and this fact coupled with the carbonate type of alteration, suggests that the veins are rather distant from the intrusives, and hence are less apt to be highly auriferous. Since syenite and related intrusives are present on the Granada claims immediately to the south of this property, prospecting in that direction may reveal other veins carrying higher values than those so far uncovered, none of which show much promise.

Stadacona Rouyn Mines, Limited

(Rouyn township)

Near the shore of Pelletier lake, on the bay that extends into the northwest corner of their claim, M. L. 1818, the Stadacona Rouyn Mines, Limited, sank a shaft 300 feet deep to explore a vein in which free gold had been found. A plan of the 300-foot level appears in Figure 8.

The claim is heavily drift-covered, the principal rock outcrops being confined to the shores of Pelletier lake. These are all of Keewatin lavas, chiefly andesite with a pillow structure, porphyritic andesite, or chloritic schists derived from them. The general geology appears on the map accompanying this report.

The lavas strike N.65°E. and dip steeply to the north, in which direction, also, their brecciated tops face, as is shown in the south cross-cut at the 300-foot level. The limited workings show the presence of several shear-zones in the lavas, which have been rendered highly schistose. To the southwest of the mine, 35 chains, a more marked shear-zone, named the Pelletier Lake fault by Cooke ①, strikes N.80°E. from the shore of the lake. Underground, this should be encountered within a distance of 500 feet south of the shaft.

Just to the west of the shaft, two pits in much fractured andesite show narrow, sugary quartz lenses with some calcite, pyrite, and a little chalcopyrite. They strike N.68°E. and dip to the north at 75°. The greatest width of quartz is two feet. Free gold is reported in the quartz.

Exploration work on the property during 1928 included 7,409 feet of diamond drilling ②. One hole, No. 27, drilled at 45° to a depth of 700 feet, is reported to have encountered seven mineralized zones which carried values in gold over sections varying in length from 2 to 15½ feet. Most of these averaged less than $5.00 in gold per ton. During 1928-29, a vertical, two-compartment shaft was sunk to a depth of 300 feet, with lateral workings on this and the 150-foot levels.

① G. S. C. Memoir 166, pp. 98-99.
② Que. Bur. Mines, Ann. Rept., 1928, p. 80; 1929, Pt. A, p. 112.

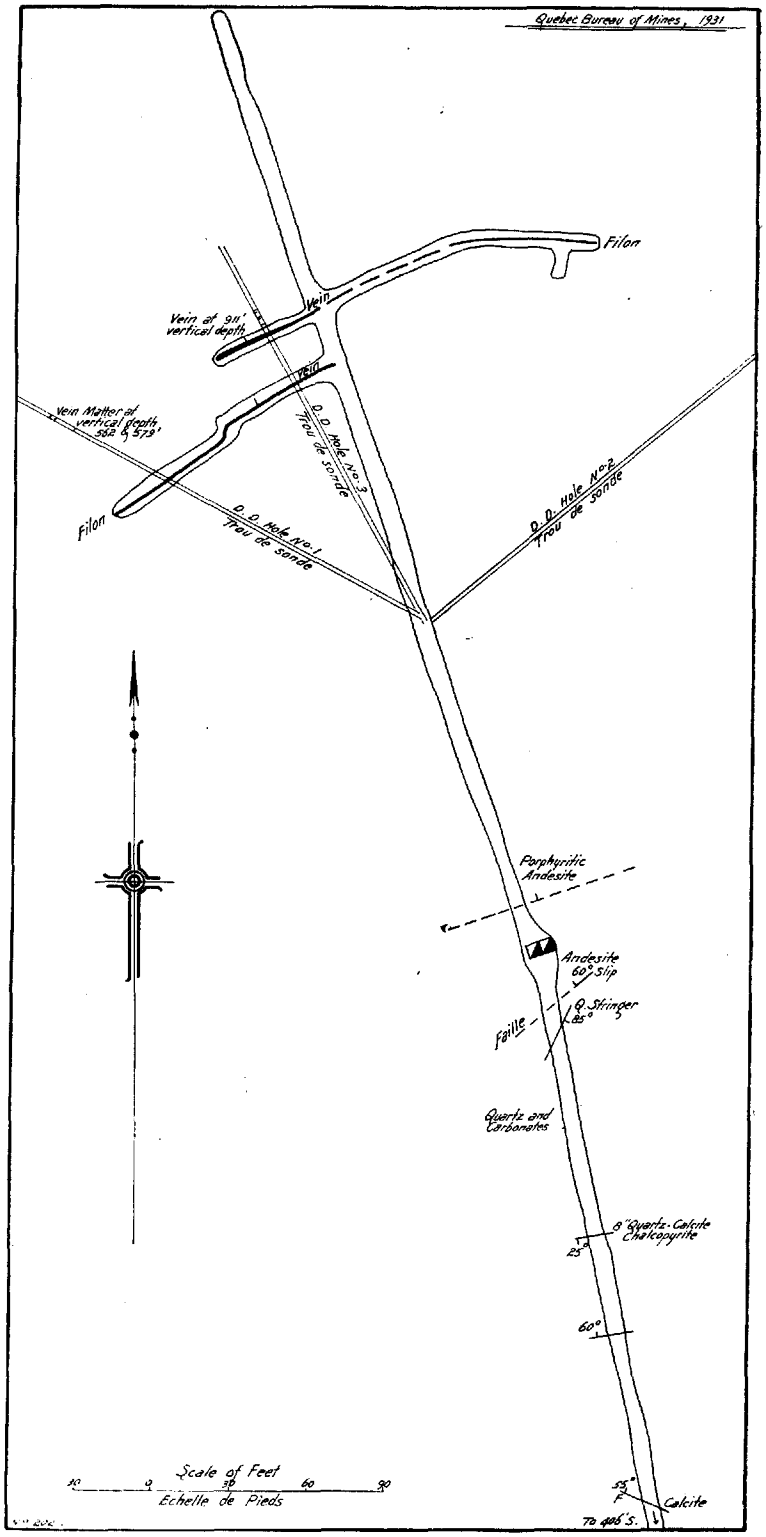


FIGURE 8.—Plan of 300-ft. level, at Stadacona-Rouyn Mines, Limited, property.

On each level, a cross-cut was driven to the south, for 35 feet on the 150-foot, and for 406 feet on the 300-foot. On the latter level, a cross-cut was driven to the north also.

At 325 feet in the south cross-cut on the 300-foot level, a one-foot quartz vein is followed on the north by a 25-foot band of chlorite schist cut by innumerable fine carbonate veinlets which dip north at 30° to 60°. The dip of the flows is about 85°N. The schist, and also numerous small slip-planes, dip steeply to the north and strike anywhere from N.50°E. to N.25°W., while minor breaks dip 65° to 75° south. In the north cross-cut on this level, a bulkhead has been erected, and the water and timbering prevented any examination of this part of the work by the writer. R. H. Taschereau ① reports on these workings as follows:

> "Two quartz veins were intersected... at distances of 237 and 257 feet from the shaft. Beyond the north vein the ground is badly fractured, and a considerable amount of water was encountered, so a concrete bulkhead was erected 25 feet from the face of the cross-cut.
>
> "The north vein was followed to the west for a distance of 43 feet. A drift to the east, on the vein, encountered a fault at a distance of 115 feet from the cross-cut. The vein averages about 2.5 feet in width, and lies in an intensely fractured and sheared zone. The drift has been completely timbered....
>
> "The south vein is very narrow in the cross-cut, but drifting to the west showed an increased width. Both the north and south veins carry gold values.
>
> "Later in the year, a diamond drill was brought in, and three holes were put down to a total length of 2,000 feet from a station in the north cross-cut on the 300-foot level."

No. 1 hole was drilled to the northwest at 60° and encountered the two mineralized zones at a vertical depth of 562 and 579 feet, respectively; No. 3 hole, drilled at 79° to the northwest, intersected a single mineralized zone at a vertical depth of 911 feet; and No. 2

① Que. Bur. Mines, Ann. Rept., 1929, Pt. A, p. 112.

hole, drilled on the horizontal to the northeast, is reported not to have cut the veins. As no core was available for examination, it is not possible here to make any statement regarding the character of the veins. Hole No. 3 indicates that, at 911 feet, the two veins have merged.

Thompson-Hoffman Claim

(Rouyn township)

The Thompson-Hoffman claim, M. L. 1744C, is situated on the east shore of Pelletier lake, half a mile to the southwest on the Stadacona mine. It is underlain entirely by Keewatin lavas, partly andesites, which have been sheared and carbonated and, in places, cut by small quartz veins. The sheared lavas strike N.60°-70°E. They weather to a rusty schist, typical of such carbonated zones, and where mineralized they contain a bright green chromiferous mica, with fine 'cube' pyrite. Across two such carbonate bands, several trenches have been dug, showing quartz veins, six to eight inches wide, with black tourmaline, carbonates, and pyrite. A few narrow veins of short length are also present in less altered andesite.

During the summer of 1931, the Cléricy Consolidated, Ltd., did 1,000 feet of diamond drilling on the property, distributed over 5 holes, each about 200 feet deep. Some values in gold are reported, but, judging from experience elsewhere, this type of deposit is not favourable as a source of gold ore in commercial quantities.

Rubec Mines, Limited

(Rouyn township)

The property held by this Company comprises M. L. 1819, 1820, 1850-4, and R-9422-3. It borders the southwestern shore of Pelletier lake, and is reached either from the lake or by way of the Angliers road. Old camp buildings are situated on M. L. 1851. No work appears to have been done here since 1928. For the most part, the claims are covered by drift, with outcrops most numerous in the southwest section, where the elevation is relatively high.

All of the rocks exposed consist either of Keewatin lavas or quartz-diorite (older gabbro). In the southeast section of the property, on claim M. L. 1853, the lavas are porphyritic rhyolites, and appear to have been mapped by Company officials as porphyry intrusions. These are followed on the north by more basic lavas, including a peculiar 'variolitic' type which forms distinct easterly-trending bands, up to 150 feet wide. These 'variolites' are somewhat amygdaloidal, have a very rough weathered surface, and contain rounded lumps of acidic lava, somewhat resembling coarse spherules. Still farther to the north are several irregular intrusions of much altered quartz-diorite (older gabbro), in the form either of dykes, up to 300 feet wide, or small stocks.

The earlier work on this property, carried on in 1928, was largely confined to claim M. L. 1850, just south of the outlet of Pelletier lake. According to R. H. Taschereau ①, "Test pits were sunk on a mineralized zone in which stringers, consisting mainly of pyrrhotite with some chalcopyrite, occur. This zone is near the contact of a gabbro and basic Keewatin flow rocks. Two thousand feet of diamond drilling was completed in six holes on this zone."

On the line dividing claims 1853 and 1854, some 1,300 feet north from the Angliers road, a quartz vein was discovered and explored by a series of trenches and pits. The vein lies in a much sheared and fractured zone in basic Keewatin lavas, which have a general strike of N.60°E. and dip steeply to the north. It has been traced for a distance of 260 feet. At the west end, the wall-rock on the north resembles the older gabbro. A thin section shows it to be a granophyre, with abundant graphic intergrowths of quartz and feldspar and a minor amount of chlorite. The plagioclase present is albite. Here the fracture zone has a width of 25 feet: the rocks are carbonated and in places mineralized with 'cube' pyrite and a little chalcopyrite. Narrow quartz stringers and lenses are present in tight fractures on the north side of the shear zone. The strike of the entire fracture- or shear-zone is about N.80°W., and the schist in this zone dips at 70° to the north. Farther eastward, a lenticular vein of quartz cuts the shear-zone. Its width is for the most part small, six inches to one foot, but at the east end it is two feet wide. The dip is to the south at from 15° to 35°, so that it cuts across the main fractures in the lava, which dip north at 70°. Pyrite and carbonates accompany the quartz or impregnate the walls. No information is available as

① Que. Bur. Mines, Ann. Rept., 1928, p. 80.

to values obtained. They apparently did not warrant exploration at depth. Trenches across the outcrops to the east of this vein showed small shear-zones in the basic lavas, but no quartz nor sulphides were present. Near the western boundary of the property, on M. L. 1854, a one-foot quartz vein was found in basic carbonated lavas. The vein strikes N.40°E. and dips 60° S.E. It is exposed for a length of only 25 feet, and carries tourmaline and carbonates, in which respect it resembles the veins on the Huronian Belt property to the west.

HURONIAN BELT COMPANY, LIMITED

(Beauchastel township)

This block of claims (T-412, 413, 414, 415, and 411*a* and T-2098 to 2102 inclusive), extends across the easterly-trending bands of Témiscamian conglomerate, Keewatin tuffs, and Keewatin lavas, from south to north. Practically all the work on the property has been confined to the northernmost claim, T-412, which is underlain by Keewatin volcanics, consisting largely of the more basic lavas, basalt and andesite, with minor bands of lighter grey dacite or rhyolite, foliated tuffs, and sericite, carbonate, and chlorite schists. The few outcrops on claims 2098 and 2099, to the south of T-412, consist entirely of rusty-weathering carbonate schist. Along the north line of claim T-412 (and also on the adjoining claim, T-688*a*) are small intrusions of quartz-diorite (older gabbro). Figure 9 shows the geology and workings on T-412, 2098, and 2099. The property may be reached by trail from the Angliers road, or by boat from Pelletier creek.

A surprisingly large number of veins or mineralized zones have been found on claim T-412, though none have yet been proved of sufficient size or grade to warrant intensive exploration. Free gold is reported from some of them, though none was seen by the writer, and assays made on samples from several veins showed only a trace of gold. Most of the veins have been explored on the surface by trenches. The most important, No. 12, was also explored by a shaft to a depth of about 44 feet.

The lavas, tuffs, and schists strike in an easterly direction, but locally this varies to southeast, suggesting drag-folding. The veins occupy shear-zones parallelling the general schistosity, or curve from a northwesterly strike on the south to a N.15°E. strike on the north. The dip is to the north or east, at about 70 degrees. In general, the veins are lenticular, attaining widths up to six feet, but pinching out

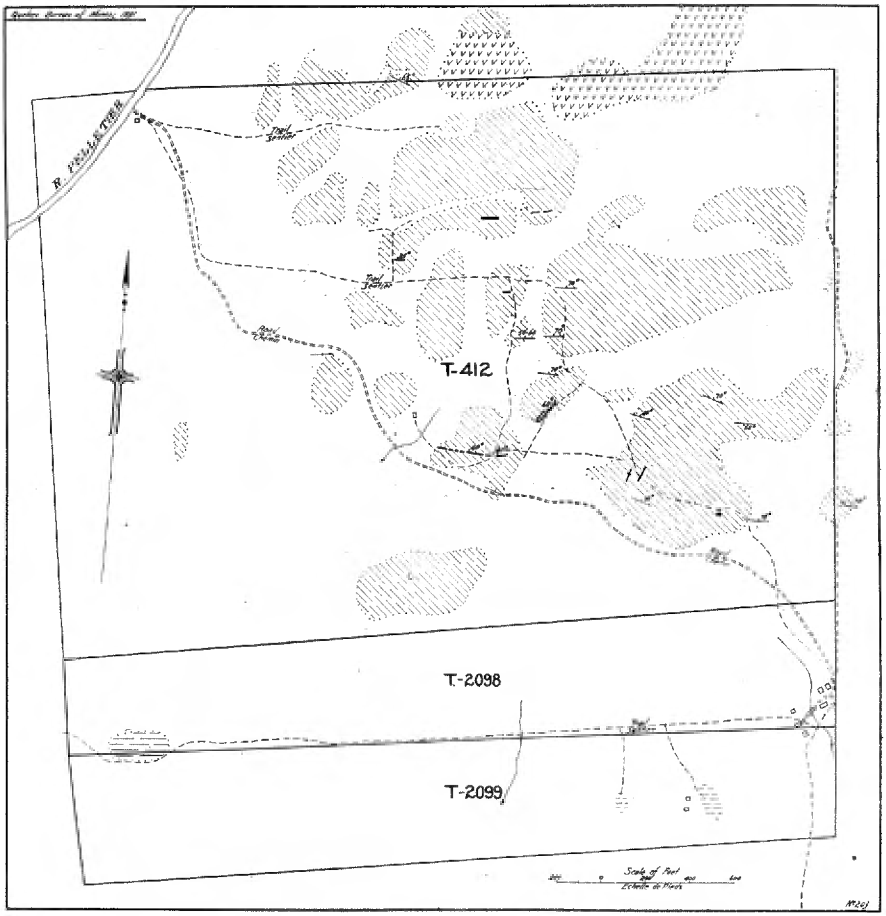


FIGURE 9.—Plan of claims of Huronian Belt Co., Ltd., showing geology. Quartz diorite shown by pattern of angles; Keewatin, basic lavas (chiefly) by diagonal broken ruling; Keewatin carbonate schists by horizontal broken ruling.

along the strike. They are usually accompanied by rusty-weathering carbonate, cube pyrite in irregular nests, and some tourmaline and chlorite.

Very little of No. 12 vein could be seen on the surface. Pits to the east and west of the shaft show small quartz stringers in carbonated lavas. The shaft was apparently put down on the widest portion of the vein as exposed at the surface. At depth, the vein is reported to have first widened, spreading out into the volcanics, and then pinched down again at the bottom of the shaft. Some good values in gold were reported from the wider section, but they did not continue downwards. Associated with the quartz stringers is a band, one foot or less wide, of a light grey rock resembling a porphyry. Thin sections of this show it to be composed of rounded phenocrysts of quartz in a matrix of acidic feldspars, largely albite, which have a distinct radial arrangement, suggestive of spherulitic texture. It is probably a narrow rhyolite flow rather than an intrusive.

Vein No. 11 lies immediately to the west of No. 12 but apparently is not connected directly with it. It consists of two lenticular masses of quartz, arranged *en échelon*, with a general northwesterly strike and a fairly steep dip to the northeast. The more northwesterly of the two lenses is offset about 15 feet to the southwest of the other. It curves in strike from N.W. to N.15°E., and dips steeply east. The lenses each attain a maximum width of six feet but narrow rapidly along their strike. They contain some tourmaline, and pyrite, and are enclosed by carbonated and schistose flows. A sample across five feet of quartz gave only a trace of gold.

Another vein, known as No. 9, lies about 1,000 feet west of the shaft. It follows a curved course, with a strike of N.85°E. at the eastern end and of N.80°W. at the west. At pit No. 9 it consists of a stock-work of quartz, three feet wide, which plays-out upwards into a 15-inch vein. The quartz has been much fractured and carries abundant sericite, chlorite, and carbonate, being lined with the last named. To the west, 110 feet from the pit, the quartz vein is only one foot wide and here it dips north at 30° to 40°. As in No. 11, pyrite and tourmaline are minor constituents.

No. 1 pit, 200 feet south of the north claim-line, exposes a sericite-carbonate schist zone striking N.65°E. and dipping north at 70°. It contains only a few small lenses of quartz, assays of which show a trace of gold. A narrow trap dyke cuts across both quartz and schist.

To the south and southeast of this pit, in massive basic flows, some quartz-tourmaline veins were observed, but with widths of only one foot. One of these dips north at 25°. Another is drag-folded and cut by an oblique fault striking N.40°W. Pit No. 3 is 1,375 feet northwest of the shaft on vein No. 12 and shows an easterly-striking lens of quartz, one to two feet wide, carrying abundant tourmaline, which is cut in turn by quartz. No. 4 showing is 200 feet south of No. 3 and crosses highly fissile, carbonated, chlorite schist, but it exposes no quartz veins. Other workings on this claim are on minor shear zones or small quartz stringers of the type already described.

To the south, on claim T-414, which is underlain by Témiscamian conglomerate, a shallow pit was dug on a fault zone striking N.13°E. and dipping 80° east. The zone has a width of about three feet, carries irregular stringers of quartz up to one foot in width, and is mineralized with chalcopyrite in irregular bunches. The length of the fault zone is 300 feet, but only over short distances is there an appreciable amount of chalcopyrite. This is the only type of mineralization found on this claim. Drift covers the fault zone on the north and south.

McDonough Claim

(Beauchastel township)

The property known as the McDonough claim, or claim T-429, is situated just west of the Huronian Belt claim T-412. To the northwest of Pelletier creek, on an outcrop of Keewatin lavas, a considerable amount of trenching has been done on quartz veins and shear zones. A mineralized zone with chalcopyrite is reported, but was not seen by the writer. The only vein of importance lies to the southwest of the outcrop referred to above and has a curved outline, as if folded, similar to No. 11 vein on the Huronian Belt property. It dips steeply to the east. The vein has been traced for 150 feet, over which it varies in width from eight inches to four feet, and it carries pyrite, a little tourmaline, and chlorite. The wall-rocks are carbonated. An assay of the quartz with tourmaline and sulphides failed to show even a trace of gold.

Claim M. L. 1861B (M. L. 2911A)

(Beauchastel township)

A small amount of trenching has been done on this claim across a 100-foot schistose zone in Keewatin lavas. Only a few quartz stringers are present in the schist, which is not mineralized.

Claims R-7469, 7470 and 8670

(Beauchastel township)

Prospecting on these claims around the small stock of hornblende-syenite porphyry which lies on the east shore of Beauchastel lake, Beauchastel township, has revealed the presence of a few short lenses of quartz, striking N.75°W. and dipping south at 60°. These occur a few feet south of a diabase dyke which cuts the porphyry. The main lens is less than 50 feet long and attains a maximum width of four feet. In consists of coarsely crystalline white quartz, but carries no sulphides. The diabase is apparently free from olivine.

RÉSUMÉ

Three rather distinct types of mineralization have been noted within this area: (1) quartz-arsenopyrite-gold; (2) quartz with carbonate, minor tourmaline, with or without arsenopyrite, and only traces of gold; and (3) pyrrhotite-chalcopyrite, with or without quartz. Only the first type is economically important. Mineralization of this type in this area has, so far, been observed only on the Granada property, where it occurs in the Témiscamian conglomerates and greywacke, which are cut by syenite porphyry. Though later than the porphyry which they cut, the quartz, arsenopyrite, and gold were probably derived from the same source at depth, and they seem to owe their distribution to the same structural features that controlled or allowed the intrusion of the porphyry. While the veins within the porphyry dykes are of lower grade than those in the sediments, the more favourable areas for future prospecting are in the vicinity of these intrusives.

The second type of mineralization, occurring within the Keewatin tuffs and lavas, is probably related to the first, but these deposits are farther removed from the intrusives and in all likelihood are of lower-temperature formation. They are pre-olivine-diabase (younger diabase) in age. The rusty-weathering carbonate-schist zones are not to be recommended for exploration.

The third type of mineralization, characterized by pyrrhotite and chalcopyrite, appears to be post-olivine-diabase (younger diabase) in age. The known deposits of this type are all too small in extent to be of any economic importance.