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GEOLOGICAL REPORT No. 7

HALLIWELL MINE MAP-AREA
BEAUCHASTEL TOWNSHIP, TÉMISCAMINGUE COUNTY
by
G. S. MacKenzie



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BEAUCHASTEL TOWNSHIP, TÉMISCAMINGUE COUNTY

by G. S. MacKenzie

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(At end of volume)

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Beauchastel township.

HALLIWELL MINE MAP-AREA

BEAUCHASTEL TOWNSHIP, TÉMISCAMINGUE COUNTY

by *G. S. MacKenzie*

INTRODUCTION

GENERAL STATEMENT

During the summer of 1938, the writer mapped the geology of an area surrounding the Halliwell mine, in Beauchastel township. The work was a continuation of that of the previous year in the adjoining Wasa Lake map-area to the south (1). The Arntfield-Aldermac area to the southwest was mapped by E. L. Bruce in 1932 (2).

The area is of interest because of the occurrence of gold ore of good grade on the Halliwell property, and in view of its location between the Arntfield-Aldermac area on the west and the Rouyn area not far to the east.

LOCATION, ACCESS, AND CHARACTER OF AREA

The area mapped lies in the north-central part of Beauchastel township, Témiscamingue county. It extends from the middle of range VI, three miles northward to the middle of range IX; and from the west boundary of lot 23, three and a half miles eastward to the east boundary of lot 43.

The Noranda-Swastika branch of the Nipissing Central railway crosses the southern part of the area, and paralleling it is the main highway from Noranda to Kirkland Lake. A motor road branches north from the highway to the Halliwell mine, and continues as a waggon road along the centre-line of the township to Flavrian lake, north of the map-area. A road, usable at times by motor, follows the line between ranges VIII and IX from the east boundary of the area westward to lot 29. This road is reached from the main highway by one branching north at Evain, east of the area. Range lines and trails, in addition to the roads, furnish ready access to all parts of the area.

Most of the area has been swept by forest fires in recent years, with the result that rock outcrops are now well exposed. Low re-growth is an impediment to exploration in range VIII, east of the Halliwell road. Some green spruce of good size is preserved in the eastern part of range IX, and in a few small swampy sections elsewhere. Settlers are located along the main highway and along the road between ranges VIII and IX. They have cleared and commenced to cultivate the land for a few hundred feet back from the roads.

The area has a rugged topography, particularly in the western portion, where outcrops are plentiful. Some rock-ridges in this section rise two to

(1) Que. Bur. Mines, Geol. Rept. No. 5, 1940.

(2) Que. Bur. Mines, Ann. Rept., Pt. C, 1932, pp. 29-87.

three hundred feet and more above the general level of the railway. No large streams cross the area and only two small lakes lie within its boundaries.

PREVIOUS WORK

The results of earlier geological work in Beauchastel township by officers of the Geological Survey of Canada and of the Quebec Bureau of Mines have been summarized in previous reports of the Bureau (1). The reports bearing on the area under discussion are listed below:

- WILSON, M. E., Geol. Surv. Can., Summ. Rept., 1908, 1909, 1910, 1911; Mem. 17, 39, 103.
HARVIE, Robert, *The Opasatica District*; Mines Branch, Dept. Coloniz'n, Mines and Fisheries, Quebec, Ann. Rept., 1910, pp. 78-85.
COOKE, H. C., *Some Gold Deposits of Western Quebec*; Geol. Surv. Can., Summ. Rept., 1923, Pt C1, p. 76.
COOKE, H. C., *Gold and Copper Deposits of Western Quebec*; Geol. Surv. Can., Summ. Rept., 1925, Pt. C.
GUNNING, H. C., *Syenite Porphyry of Boischatel (Beauchastel) Township, Quebec*; Geol. Surv. Can., Museum Bull. 46, 1927, pp. 31-41.
COOKE, H. C., JAMES, W. F., and MAWDSLEY, J. B., *Geology and Ore Deposits of Rouyn-Harricaw Region*; Geol. Surv. Can., Mem. 166, 1932.

The recently published geological map of the Rouyn area (2), prepared by M. E. Wilson, is also pertinent; likewise, a recent study of the granites of northwestern Quebec, by W. C. Gussow (3), and a paper on the geology of the Arntfield mine, by S. E. Malouf (4).

This area is included partly in the Opasatika sheet (Map No. 240A) and partly in the Duprat sheet (Map No. 281A) of the Geological Survey of Canada.

ACKNOWLEDGMENTS

The writer received very helpful co-operation from companies and individuals working in the area, and particularly from Mr. Louis Hurtubise, Secretary, Halliwell Gold Mines, Limited; Mr. J. A. Lindsay and Mr. J. D. Cummings, of Mining Projects of Canada, Limited; Mr. T. Havelock, of the Havelock Development Company, Limited; and Mr. D. Duke, who owns a property in range IX.

Alphonse Morin and Roland Charette, students of l'École Polytechnique, Montreal, rendered capable assistance in the field.

GENERAL GEOLOGY

GENERAL STATEMENT

The consolidated rocks of the area are all Precambrian in age, and the formations represented are, in the main, the same as those met with in the general region surrounding the map-area and which have been described in varying detail in the reports already referred to. Except where they exhibit unusual characteristics, they will be but briefly described in the present report.

Certain features of the geology are in marked contrast to those in the adjoining Wasa Lake and Arntfield-Aldermac areas. Such features are the

- (1) Que. Bur. Mines, Ann. Rept., 1932, Part C; 1940, Geol. Rept. No. 5.
- (2) Geol. Surv. Can., Map No. 453A, 1939.
- (3) Roy. Soc. Can., Trans., Vol. XXXI, Sect. IV, 1937, pp. 129-161.
- (4) Can. Min. Jour., Vol. 59, No. 8, August, 1938, pp. 427-434.

projection into the area of the southern extremity of the Flavrian Lake granite mass; and the absence, at least in the exposed rocks, of persistent shear-zones, such as those in which the Arntfield and Francœur orebodies occur.

Volcanic rocks of Keewatin type are the oldest and most widespread of the formations encountered. The flows of this age now dip steeply as a result of folding, but the details, and even the major features, of the folding are obscure. This obscurity is, in part, a consequence of later disturbances and of a succession of igneous intrusions with related hydrothermal alteration of the volcanics.

Diorite and gabbro, of quite wide occurrence, are the oldest of the invading rocks. Granite is next in age and with it are associated a host of dykes and other intrusive bodies of similar composition. Dykes of gabbro intrude the granite, and others of syenite and lamprophyre cut both the granite and related rocks.

Sediments of Temiscamian type are lacking in the area. The above mentioned intrusives have been assigned a post-Temiscamian and pre-Huronian age by earlier workers from relationships observed elsewhere in the district.

One small patch of conglomerate caps a hill in the area and rests on eroded Keewatin-type and intrusive rocks. This conglomerate is presumably of Cobalt age. It is intruded by a dyke of lamprophyre.

No dykes of diabase considered to be Keweenawan in age were observed. Such dykes, however, are known to occur just southwest of the map-area.

Unconsolidated, largely glacial, deposits of Pleistocene and Recent age mantle a large proportion of the bedrock.

TABLE OF FORMATIONS

PLEISTOCENE AND RECENT		Boulder clay, sand and gravel, stratified clay
<i>Great unconformity</i>		
PRECAMBRIAN	POST-COBALT	Lamprophyre
	<i>Intrusive contact</i>	
	HURONIAN (Cobalt series)	Conglomerate
	<i>Unconformity</i>	
	ALGOMAN (?)	Gabbro; lamprophyre Granite; aplite and quartz porphyry; syenite and syenite porphyry Diorite, quartz diorite
	<i>Intrusive contact</i>	
	KEEWATIN-TYPE	Volcanic rocks Tuffs, agglomerates Acid to basic flows

KEEWATIN-TYPE SERIES

Rocks of Keewatin age underlie almost all of the southern and western parts of the area, with more patchy occurrences toward the east. The series is made up of a succession of lava flows ranging in composition from rhyolite to andesite, and probably to basalt. Well-preserved pyroclastics were observed only in lot 27 of range VI, where a coarse tuff is exposed. Some of the much altered Keewatin-type rocks, however, may originally have been tuffs. Flow breccias are common in the lavas.

Rhyolites outcrop in the southeastern corner of the area, particularly in range VI, eastward from lot 37. These flows are generally massive, porphyritic in texture, and remarkably fresh in appearance. Fragmental flow tops signify the extrusive origin. Some flows are even-textured and a few exhibit flow-banding. The rhyolites of all textures are grey to buff in colour on the fresh surface, and white on the weathered surface. The phenocrysts are chiefly quartz, in grains up to a quarter of an inch in diameter, but acid plagioclase is prominent. These rocks, in the few places where they are schistose, contain appreciable quantities of chlorite.

Some outcrops along and just north of the railway in the western part of the area have been mapped as acid volcanics. These are much fractured and altered rocks, fine-grained to aphanitic in texture. They exhibit little evidence of volcanic origin, apart from occasional indistinct quartz amygdules. A thin section from a less altered occurrence in lot 35, range VI, just south of the highway, indicated a rock of trachytic composition and texture, with some secondary quartz. Rocks of similar appearance farther west, as in the adjoining Wasa Lake map-area, may be of intrusive origin. Irregular dykes of the same character were observed to cut the basic volcanics in lot 29 of range VI.

Volcanics of andesitic composition underlie the greater part of ranges VII and VIII and much of the western part of range VI. The andesites west of lot 28 in these ranges are fine-grained, with well-developed pillow structure, but in places they carry fragments. In the central lots, much of the rock is markedly porphyritic; bomb-like and irregular fragments are common, though pillow structure is also displayed.

Rocks more acidic than andesite, to judge by appearance, are found over a discontinuous band across the northern part of range VII and southern part of range VIII, from lot 31 eastward to lot 43. The rocks in this band weather a light-green, and are buff, grey, or green in colour on a fresh surface. Many of the flows hold large to small, angular to rounded, fragments of more acid composition than the groundmass. Some of the rounded fragments, two inches or less in diameter, have a somewhat concretionary appearance, with the outer shell up to half an inch thick. The interior of these fragments consists of quartz and material similar to the groundmass of the rock. Thin sections of the rocks show much secondary quartz and carbonate, with little evidence of the original composition or texture. Some may have been tuff breccias, but a highly brecciated and vesicular flow seems indicated. Originally, they may have had the composition of trachyte or dacite; on the other hand, intense alteration due to their brecciated character may account for their relatively acid appearance.

It was not found possible to trace any individual flows for appreciable distances and few good exposures of flow contacts were observed. However, from the information available, and from a consideration of the areal distribution of flows of diverse character, some suggestions may be made as to the trends of the Keewatin-type rocks.

From west to east across the southern part of the area, the strike of the flows changes from north of east to east-west, with a flexure of a few degrees south of east in lots 42 and 43, range VI. From south to north in the western part of the area, the strike changes from northeast to north, and slender evidence suggests a direction some degrees west of north in places in ranges VII and VIII. In the central portion of the area, the strikes seem to be a few degrees south of east in the southern part of range VIII, but north of east farther south, in range VII.

Satisfactory criteria of attitude were not observed. The shape of the pillows in the lavas in the western part of the area generally tends to suggest that the tops of the flows there face west and northwest. This attitude would support the conclusion, reached in an earlier report, concerning the structure of the volcanics in the Wasa Lake and Arntfield-Aldermac map-

areas (1), that the basic volcanics east of the Aldermac mine, which continue into the southwestern corner of the present map-area, mark the emergence of a westward-pitching synclinal structure. Too little information is available to warrant further speculation regarding the folding farther east in the area.

Alteration of the Keewatin-type Volcanics

The volcanics exhibit various types and degrees of alteration. The minor chloritization of the rhyolites has already been mentioned. In places, the basic volcanics are likewise enriched in chlorite. Carbonatization occurs, but only locally is it very marked. More intense and widespread than the above are silicification and albitization.

Silicification of the rock is apparent in range VII, north of the railway, along a general zone traceable from the centre-line of the township eastward to lot 42. Sulphides are widely disseminated along this zone. The rock is grey or buff, with rusty to greyish weathering. Generally, the grain is fine — so much so in places that the rock has a cherty appearance. Some specimens show lighter-coloured nodules, in which there is a concentration of quartz, carbonate, radiating epidote, and sulphides. The original basic character of the rock is indicated by the occurrence within the zone of patches of unaltered andesite, and of large pillows in even the most highly silicified rock. The interior of the pillow is more intensely altered than the margin.

Another type of alteration, somewhat similar to the above in that quartz has been introduced into the rock, is more widespread. In this type, the quartz is more megascopic and, apparently, sulphides are not associated with it. All stages of this type of alteration are to be observed. In many of the pillow lavas, concentric cooling-cracks, spaced a quarter of an inch or more apart, and other systems of minute fractures, are filled with quartz. This results in a lace-like pattern of quartz threads, or veins, which stand in relief on the weathered surface.

Rocks so altered that their original character is entirely masked occur at several places, but particularly in lots 23 to 28 of range VIII. Such rocks appear to represent a further stage in the above described type of alteration, with the addition, or more prominent development, of albite. The typical rocks are buff to green, with a mottled appearance and a rough weathered surface. Some occurrences display phenocrysts of quartz. Chlorite is invariably present, and in some of the thin sections examined it is evenly distributed, in others segregated in patches. Relics of a banded structure are not uncommon. This banding, in a few places, suggests development from a bedded tuff, but elsewhere it clearly represents an inherited foliation. Ghosts of pillows and included fragments are likewise to be seen. Some of these altered rocks superficially resemble granodiorite in composition and grade into rocks indistinguishable from intrusive aplite and quartz porphyry. This feature renders their mapping as units a difficult matter, but an attempt has been made on the map accompanying this report to indicate the more extensive occurrences.

(1) Que. Bur. Mines, Geol. Rept. No. 5, 1940, p. 14.

ALGOMAN (?)

Diorite and Quartz Diorite

Rocks having the characteristics of the 'older gabbro' of the region outcrop extensively in the western half of the map-area. The main occurrences are irregular in form. The rock is nearly everywhere massive and of medium grain. In composition, it is a quartz diorite, and in some facies the quartz content is rather high, as for example in the mass west and northwest of the Halliwell mine. Limited outcrop suggests that a continuous mass of diorite extends from the western margin of the map-area, in the northern part of range VII, eastward and northeastward across range VIII, to just west of the Halliwell mine.

Well-defined dykes of diabasic diorite, or gabbro, cut the 'older gabbro' and the Keewatin-type volcanics. The description of these dykes is given on page 14.

Granite and Related Intrusives

For purposes of field mapping and description, the Algoman (?) intrusive rocks of acidic composition may be subdivided as follows:

- (a) Granite
- (b) Intrusives associated with the granite
- (c) Syenite

Granite:

The southern extremity of the Flavrian Lake granite mass projects into the map-area. This granite has been described by Cooke, James, and Mawdsley (1) and it has been further studied by Gussow (2).

Outcrops of this granite occur in range IX, from lot 28 eastward to the eastern boundary of the map-area, but nowhere in this stretch does the rock display the coarse texture that characterizes it to the north of the sheet, toward Flavrian lake. West of the centre-line of the township, in range IX, the granite is medium grained with a pink to light-grey colour. It contains acid plagioclase and much quartz. Ferromagnesian minerals are represented by occasional shreds of chlorite. This rock, or at least the coarser grained facies north of the map-area, has been classed with the granodiorites of northwestern Quebec by Cooke, James, and Mawdsley. However, in view of its low potash content, it is, more strictly speaking, a quartz-rich tonalite, as has been pointed out by Gussow.

Some of the 'granite' exposed east of the centre-line in range IX has the same composition as the above, but in many outcrops, especially in lots 35 to 38, the rock is of a hybrid character. Such rock is generally reddish in colour, with abundant needles of hornblende. It has the composition of quartz diorite, but it grades into rock of more granitic character containing much quartz and nodules of epidote. Traversing this rock are a few small dykes of pegmatite, which are lacking elsewhere in the area.

(1) Geol. Surv. Can., Mem. 166, 1932, pp. 127-128.

(2) Roy. Soc. Can., Trans., Vol. XXXI, Sect. IV, 1937, pp. 129-161.

Also found near the borders of the granite is a fine-grained, white-weathering facies almost entirely lacking in ferromagnesian minerals, and resembling the satellitic types described below.

Intrusives Associated with the Granite:

The intrusives that are considered to be associated in origin with the granite include irregular bodies, up to half a mile or more in greatest dimension, which occur between remnants of volcanics in the eastern part of the area, and smaller, irregular bodies and dykes, more common in the western half of the area. These satellites decrease in number southward and southwestward from the granite, presumably because of increasing thickness, in that direction, of the roof-rock over the parent batholith.

The larger of these intrusive bodies occur in ranges VII and VIII, east of the road leading to the Halliwell mine. Typically, the rock is massive, medium to fine in grain, and light-grey in colour, weathering white. In some outcrops, a few phenocrysts of quartz are to be seen. Ferromagnesian minerals appear to be lacking in some specimens, but others are lightly mottled with chlorite. Thin sections show a rock containing up to 70 per cent of quartz and albite in micrographic intergrowth, and, in addition, scattered grains both of quartz and albite, some of the latter being optically continuous with the albite of the intergrowth. Chlorite is segregated in patches up to a quarter of an inch in diameter. A more basic facies of the same rock is exposed just east of the Halliwell road, in the southern part of range VIII and northern part of range VII. This rock is darker grey in colour than that described above. Thin sections show but little granophyric texture. Chlorite is more plentiful and is evenly distributed; it is associated with epidote, apparently secondary after some ferromagnesian mineral.

These satellitic rocks thus range in composition from alaskite to quartz diorite, with the acidic facies more abundant in the easterly outcrops. They appear to be similar in composition, and presumably also in origin, to the Powell granite of the Rouyn area, three miles to the east, to which Wilson has applied the term 'alaskite' (1).

The aplite at the Halliwell mine has certain distinctive features. The form and mode of occurrence of this intrusive body are discussed on a later page, in the description of the Halliwell property. The rock is massive, fine grained, and white to light grey in colour, with greenish or purplish tints in places. In some of the thin sections examined, the rock is composed mainly of quartz grains with less abundant, well-developed crystals of albite (Ab 93); in others, the quartz and albite are in micrographic intergrowth. A fairly large crystal of sphene was observed in one section. Quartz forms over 50 per cent of some sections but is in part a later introduction, appearing rarely, with carbonate, in narrow veinlets traversing the rock. Original ferromagnesian minerals are lacking, but occasional small aggregates of chloritic material are to be seen in some hand specimens. A partial analysis of a typical specimen of the aplite, made in the laboratories of the Quebec Bureau of Mines, gave: Na_2O , 5.00 per cent; K_2O , 0.78 per cent.

(1) Geol. Surv. Can., Map 453A, 1939.

In composition, therefore, the Halliwell aplite is an alaskite and might be termed an alaskite granophyre. The more familiar term 'aplite' is, however, adequate for field purposes. No occurrences of rock quite comparable to this in texture and silica content were observed elsewhere in the area.

The dykes and minor intrusive bodies of granitic character in the western and central parts of the map-area resemble the above described rocks in composition. They range in texture from medium grained to aphanitic. Some are even-grained, but many are porphyritic, with phenocrysts of quartz, and a body of the rock may be even grained in one part and porphyritic in another. Types with quartz phenocrysts are more abundant in the western part of the area than elsewhere. The even-textured rocks are referred to below under the field term 'aplite'.

Some of the dykes of aplite and quartz porphyry display a marked banding parallel to their walls. Several dykes, or parts of one faulted dyke, of aplite in lot 33, just north and south of the line between ranges VII and VIII, show a remarkable breccia-structure. They cross pillowed-andesite in a northwest direction, are up to 30 feet in width, and outcrop over a length of 1,200 feet. The fragments they contain are irregular to angular in form, and only the fact that they are mottled with a little chlorite distinguishes them from the aplite matrix. At two points, this dyke grades imperceptibly into intersecting east-west dykes of aplite that are lacking in fragments but one of which is banded. A possible explanation for the above features is that the main dyke occupies a former fault-zone, and that the fragments it contains represent fault-breccia material originally of andesitic composition and subsequently altered.

Many of the dykes, both aplite and quartz porphyry, are regular in form and have sharply marked walls. Other dykes and irregular bodies have gradational contacts with the invaded rocks. Locally, the dykes intersect bodies of the same or but slightly different composition and texture. A few dykes of aplite intrude the granite. No distinction in age could be made between the aplite and quartz porphyry.

A community of origin for the granite and the intrusive rocks discussed in the foregoing paragraphs is suggested by their areal distribution; by their age, all being younger than the older gabbro and older than the syenite described below; by their general high silica, and relatively high soda and low potash, content; and less so by the prevalence of granophyric texture.

The similarity in appearance of some of the highly altered volcanics to the aplites and quartz porphyries has already been noted. The ability of hydrothermal solutions to convert rocks of diverse character into types that have the general features of intrusive rock seems to be clearly demonstrated in the area, and doubtless certain outcrops, or parts of them, that have been mapped as intrusive rock have originated in this manner from the Keewatin-type volcanics.

Syenite:

Dark red, fine-grained and massive, basic syenite outcrops over a small area in the northern part of lot 23, range VI. Traversing this rock are meandering dykes of red trachytoid syenite porphyry, and similar dykes, but with straight-line courses, cut the Keewatin-type and other rocks in the

western part of the area. All these occurrences of syenite belong to the complex north of the Aldermac mine, to the west, which has been described by Gunning (1) and which is referred to in the writer's previous report (2).

One dyke of syenite porphyry in the northern part of lot 23, range VIII, with an average width of less than three feet, is traceable for 1,500 feet or more in a north-northeast direction, roughly paralleling a dyke of altered gabbro (see below). Gussow (3) has described a similar syenite porphyry dyke, with about the same strike (N. 30°E.), cutting the Flavrian granite not far to the north of the present map-area.

Small, irregular masses of medium-grained syenite porphyry occur in lot 26, range VI, and just south of the railway in lot 34 of the same range.

Gabbro and Lamprophyre Dykes

Several narrow, but persistent, dykes of lamprophyre were noted in the area. Some of these appear to be Algoman, others post-Cobalt, in age. One, crossing lots 23 and 24 in range VIII, is a remarkably unaltered rock, even-textured except for occasional prominent flakes of biotite and grains of pyroxene. Usually, however, they are much altered. One such dyke cuts the conglomerate of supposedly Huronian age described below. Similar, but more pyroxenic to gabbroic, dykes elsewhere in the area contain what appear to be rounded pebbles of granite and more basic igneous rocks. A possible origin for such pebbles is indicated below, in the consideration of the conglomerate.

Well-defined dykes of diabasic diorite, or gabbro, cut the 'older diorite' and the Keewatin-type volcanics, as mentioned on page 11 under 'Diorite'. One of these, in the northern part of lot 23, range VIII, is traceable for nearly half a mile in a north-northeast direction. Some remnants of pyroxene were observed in a thin section of a similar rock from another locality. Dykes of the same character, but lacking in pyroxene, cut the granite in lots 29 and 30, range IX. The relationship of these diabase or gabbro dykes to the syenite porphyry was not ascertained. They appear much more altered than similar dykes which, in adjoining areas, have been classed as Keweenawan, and they are here classed, tentatively, as pre-Huronian (Algoman?).

HURONIAN (COBALT SERIES)

Conglomerate

Conglomerate caps the summit of a hill in the southern part of lot 42, range VIII. The outcrop is rudely circular and some 100 feet in diameter. Limited exposures show that the conglomerate rests on the eroded surface of the surrounding Keewatin-type volcanics and intrusive aplite in a bowl or trough-shaped depression. The rock is an arkosic breccia in places, but elsewhere it contains well-rounded and angular fragments of granite, quartz, aplite, and volcanic material, none over two inches in diameter.

(1) Geol. Surv. Can., Museum Bull. No. 46, 1927.

(2) Que. Bur. Mines, Geol. Rept. No. 5, 1940, p. 11.

(3) Roy. Soc. Can., Trans., Vol. XXXI, Sect. IV, 1937, p. 160.

The conglomerate lies in the line of strike of a dyke of lamprophyre exposed to north and south of it, but was not seen to be cut by this dyke. Unfortunately, the relationship between the two is obscured by drift. However, 200 feet to the south of the conglomerate outcrop, a large block of the rock is enclosed in, and veined by, the lamprophyre (Plate I). This suggests that the pebbles occurring in lamprophyre and gabbroic dykes elsewhere in the area may likewise have been derived from overlying, but subsequently eroded, conglomerate.

The conglomerate is presumably an outlier of the Cobalt series exposed on the Kekeko hills, four miles to the south.

PLEISTOCENE AND RECENT

No special study was made of the unconsolidated deposits of the area. Insofar as general observation went, these deposits are largely boulder clay, with, perhaps, bedded clays underlying certain more level sections along and south of the railway, and in the northeastern part of the area. Small deposits of gravel are available, and material from some of these has been used for construction of the main highway and other roads within the area.

STRUCTURAL GEOLOGY

The folding of the Keewatin-type rocks has been discussed on an earlier page. Foliation and shearing are only locally prominent in these and later rocks. In the western part of ranges VII and VIII, the foliation strikes north or northwest and probably in part has been developed marginal to the granite. Across the central and southern parts of the area, there is a tendency for north of east to east-west strikes. Dips in the section along and south of the highway are steep, usually northward but in places southward. North of the railway in range VII and the southern part of range VIII, a number of small east-west shears and parallel schistosity were observed to dip southward, some as flatly as 45 degrees. Some of the above structures may have developed during the primary folding of the volcanics, but most of them appear to be of later origin.

Most of the dykes of aplite and quartz porphyry are irregular and lacking in persistence, but a number of them appear to follow fault or fracture planes. Prominent directions are east-west, northeast, and northwest. There are indications also of northeast fracture systems which are probably younger than those occupied by the dykes. Some quartz and sulphide mineralization occurs along such fractures. Topographic evidence, and information from adjoining areas, suggest that this is an important structural direction.

The absence of direct evidence of long, persistent shear or fault zones in the area has been mentioned. Indirect evidence, however, suggests that such zones may underlie certain drift-covered sections in the southern part of the area.

A drift-filled depression, which lies in the strike of the Horne Creek fault of the Rouyn area to the east, occurs in the southern part of range VII. The depression is occupied by a creek, and is flanked to the south in places by low, but steep-walled, ridges. It is thought that this depression possibly marks the position of a fault. Two fault-zones recognized in the Wasa

Lake and Arntfield-Aldermac map-areas to the south and southwest may mark the westward extension or branches of this presumed fault (1).

The more northerly of these two fault-zones, if it continues so far eastward, would cross the northern part of range VI, north of the railway. The southerly zone would approximately follow the power line and railway. The topography along the two directions is not inconsistent with the assumption that they mark fault-zones. Further evidence for the existence of the fault-zones, particularly the southerly one, is the presence of schisted and fractured rocks along the indicated directions. Such disturbed rocks are exposed along the creek crossing lots 31 to 42 of range VII; just south of the main highway in lots 24 and 35, range VI; and alongside the highway in lot 31, range VI. Marked, east-west and northeast valleys north of the railway in range VII may indicate underlying zones of weakness. It is to be noted, also, that a zone of sulphide impregnation occurs across this section, and is a further implication of disturbance.

ECONOMIC GEOLOGY

GENERAL STATEMENT

Gold ore of good grade, but unfortunately limited in quantity, has been produced from the Halliwell mine within the map-area. The ore contains copper values also. Mineralization carrying one or both of these metals has been discovered elsewhere in the area. The copper sulphide deposits of the Aldermac mine lie just beyond its southwest boundary.

To judge by the occurrences of mineralization so far observed in the area, the Keewatin-type volcanics of basic composition are the most favourable host-rocks. The rhyolites in range VI, in the southeastern section, are generally massive, but farther north and west some shearing, fracturing, and mineralization is present in rocks of this composition. Irregular quartz veins carrying at least some values in gold occur in the granite and associated intrusives. Dykes of aplite and quartz porphyry are, in several places, fractured and mineralized, and carry values in gold and copper.

The most widespread mineralization in the area occurs along a general, but irregular and interrupted, zone crossing range VII from the southern part of lot 34, eastward and northeastward to lot 44. Reference has already been made to the intense silicification of the rocks along this zone (page 10), which is marked by rusty outcrops due to oxidation of disseminated pyrite, pyrrhotite, and occasionally chalcopyrite. Pyrite and pyrrhotite occur together in some places, separately in others, pyrite alone being the most common. No very marked shears occur within the zone, but a few minor ones trending east and northeast have been observed. Assays of material from various points along the zone have shown appreciable, though not very high, gold and copper values. Results of some of these assays are given at the end of this report. More scattered sulphide mineralization occurs west of the centre-line of the township, in range VII, and to the southwest, in range VI, and perhaps marks the westward extension of the zone discussed above.

(1) Que. Bur. Mines, Geol. Rept. No. 5, 1940, pp. 16-17. Also J. E. Gill, personal communication.

The structural relationships of both the main and south showings on the Halliwell property are obscure, but at certain other points within the area, the mineralization, though not yet proved of major importance, follows definite structures. Some veins in the western part of the area occupy north and northwest trending fractures. Others, especially in the central section, strike northeast and, as mentioned earlier (page 15), this is believed to be an important structural direction. It is to be further noted in this connection that the veins at the property of La Mine d'Or Champlain, Limitée, in the Wasa Lake map-area to the south, and those at Flavrian lake to the north, occur in northeast trending fractures. A northeast to north trending mineralized zone seems indicated across the northern part of lots 27 and 28, range VI, and southern part of lots 29, 30 and 31, range VII. Quartz and gold-bearing mineralization occurring along this stretch is described below and includes the south showing of the Halliwell mine and showings on the Centre Boischatel property.

Almost the whole of the area merits, and has already received, intensive prospecting. Most of the outcrops have been carefully examined and future attention will mainly be given to drift-covered sections. The southern and western parts deserve first consideration. They are underlain by favourable host-rocks, and structural conditions also appear favourable.

DESCRIPTION OF PROPERTIES

Halliwell Gold Mines, Limited

Halliwell Gold Mines, Limited, holds a group of claims, totalling 2,548 acres, lying east and west of the centre-line of the township, in ranges VII and VIII.

The property has been explored at intervals since 1926 (1). This work, which has included surface trenching, geophysical surveys, and some 40,000 feet of diamond drilling, has been centred mainly in claims T. 3804 and 3805, in the northern part of lot 34, range VIII, where the early trenching and drilling had indicated the presence of an orebody. In the spring of 1937, a shaft was sunk on the showing, and mining equipment, using electrical power, was installed. The shaft has a depth of 496 feet, with stations at the 150-, 300-, and 450-foot levels. Nearly 2,000 feet of lateral work has been done, mostly on the 450-foot level. Raises were driven from this level to explore, and later were used to mine, the orebody.

At the time the writer visited the property, in the middle of June, 1938, many of the surface exposures were concealed beneath buildings or waste, and débris filled many of the trenches. Also, the orebody had been largely removed by mining and the raises were no longer accessible. However, excellent maps and models of the deposit were available, from which the writer derived much of the information given below. Geological work on the property has been done by J. C. Rogers, E. K. Fockler, J. Collins, and H. Hopkins. The models were constructed by J. D. Cummings, mine manager.

(1) Que. Bur. Mines, Ann. Rept., 1928, p. 71; 1933, Pt. A, p. 93; 1934, Pt. A, p. 72; 1936, Pt. A, p. 51; 1937, *Mining Industry and Statistics*, p. 52.

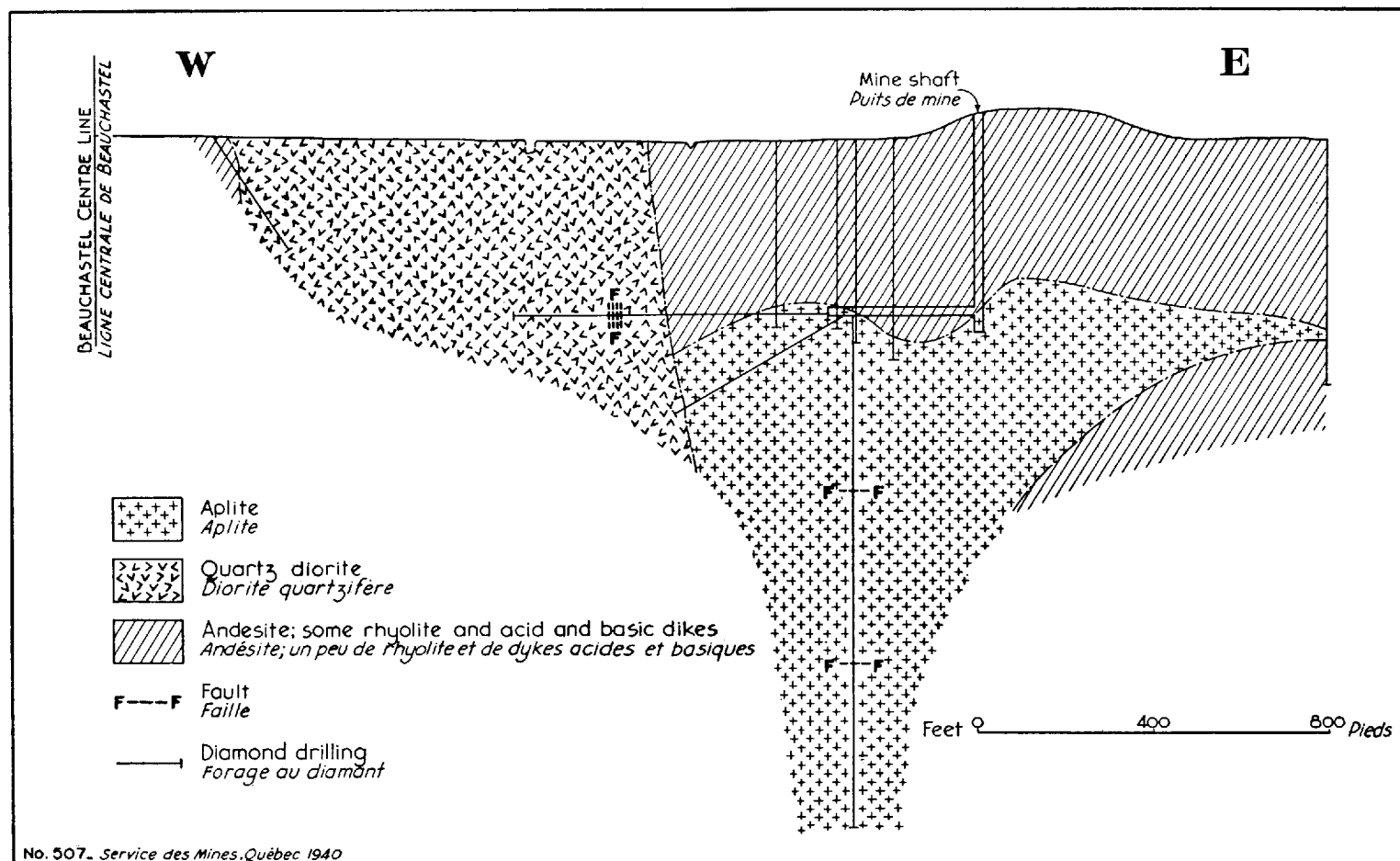


Figure 1. — East-west vertical section, Halliwell mine.

The outstanding feature of the geology of the main showing is the occurrence underground of a body of aplite which does not extend to the surface, except as a small outcrop some distance from the shaft. A petrographic description of this aplite (alaskite granophyre) has been given on page 12. The aplite is encountered at an average depth of 450 feet in the mine workings and at greater and lesser depths in drill holes beyond the workings. Keewatin-type volcanics lie above and to the east of the aplite, and a quartz-rich facies of the older diorite to the west. The contact of the aplite with the latter rock lies some 600 feet west of the shaft. The aplite has been intruded along the contact of the quartz diorite and volcanics to within 450 feet or so of the present surface, with a wedge projecting some 1,500 feet eastward into the volcanics (Fig. 1). A drill hole put down 1,200 feet below the 450-foot level of the mine encountered only aplite. The intrusive approaches the surface to the north of the mine workings, and it appears at the surface as a small outcrop on the range road, 1,800 feet northeast of the shaft. The reverse condition is found to the south, aplite being encountered only at a depth of 1,200 feet, in a drill hole put down 1,000 feet south of the shaft (Fig. 2).

The Keewatin-type volcanics lying above the aplite, and exposed at the surface, are mainly andesite flows showing pillow structure and containing occasional bomb-like fragments. A porphyritic texture is common. Where exposed northeast of the shaft, the rock is remarkably fresh, but west and southwest of the shaft it is irregularly fractured and mineralized with sulphides. Dyke-like and irregular masses of fine grained to aphanitic siliceous material occur in this fractured andesite. Some of these may represent intrusive rhyolite, or included fragments of this rock; others may be highly altered facies of the andesite itself. There are also some irregular dykes of altered basic rock cutting the andesite. Other more definite dykes of aplite and albitite are probably related in origin to the main, underlying aplite intrusive, though their relationship to this rock has not been established, as far as the writer is aware. The andesite and other rocks above the aplite are in places silicified, carbonatized, or chloritized, the last named being the most common type of alteration in the mineralized sections.

The orebody, now mined out, occurred in the andesite and associated rocks, some 250 feet west of the shaft, on and above the 450-foot level, at which horizon it bottomed at the roof of the aplite body. It had a roughly conical shape (Figure 3), with a diameter at the base of some 60 feet and a vertical extent also about 60 feet. The ore consists in general of chloritized andesite speckled with fine chalcopyrite and pyrite. More massive chalcopyrite occurs occasionally in veinlets and in lenses up to several feet in length. Pyrrhotite, sphalerite, and molybdenite have also been reported. Mill tests have indicated that the ore contains bismuth, but no bismuth-bearing mineral has been positively identified. Quartz is not prominent in the ore, though some lenses occur, and some fractures are filled with quartz and calcite, mineralized with chalcopyrite. The only mineralization observed in the aplite is an occasional small cube of pyrite and microscopic veinlets of quartz and carbonate.

Gold values varied from place to place within the orebody and locally amounted to several ounces per ton. The calculated average for the body

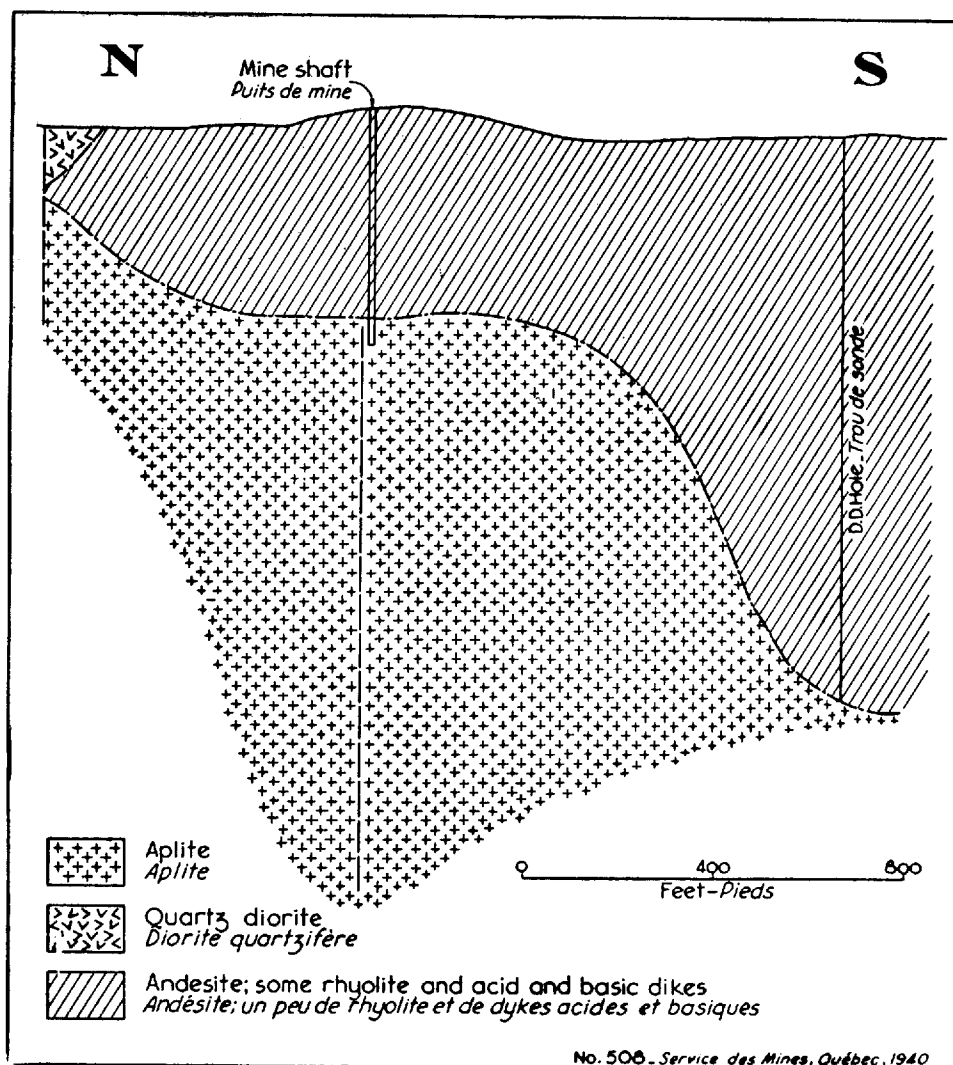


Figure 2. — North-south vertical section, Halliwell mine.

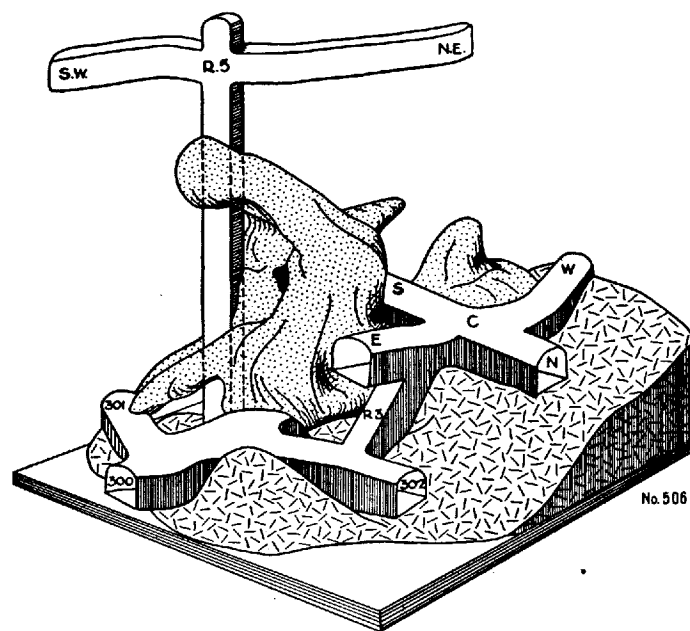
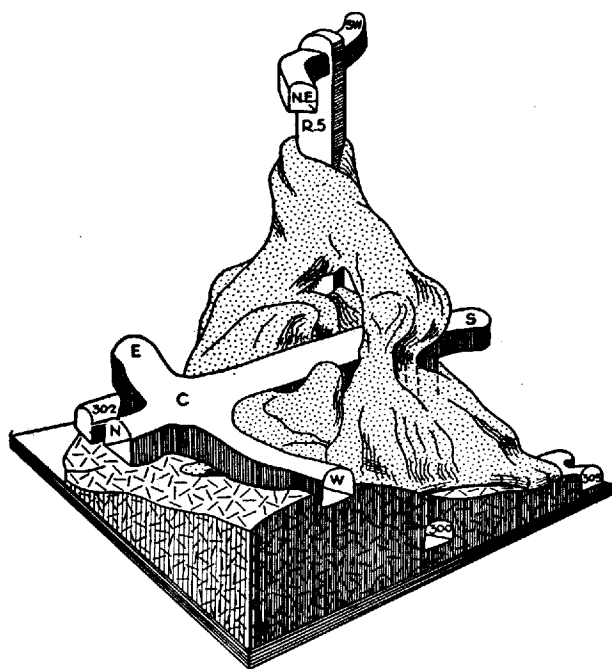


Figure 3. — Drawing from model of orebody, Halliwell mine.

as a whole was somewhat over half an ounce per ton, but the recovery from the ore mined was a little below this figure, due to some dilution. Copper values ranged from less than one per cent to several per cent. Gold and copper values also occurred irregularly beyond the mineable limits of the ore. The ore mined amounted to 2,719 tons and was shipped by truck to the Arntfield mill for extraction of the gold. The copper was not recovered. Total gold recovery had a value at the Mint of \$41,115.

No marked shear-zones or fractures are apparent which might have controlled the ore deposition, though minor slip-planes are present. There is a suggestion in certain lenses and veinlets of parallelism to the surface of the underlying aplite body. The andesite was evidently minutely fractured prior to the mineralization. Doubtless the massive quartz diorite to the west, and massive aplite below, were factors in localizing the stress effects in the less homogeneous rocks in which the orebody occurs.

Diamond drilling in the vicinity of the mine has failed to locate other orebodies. The volcanics near the buried aplite-granodiorite contact would appear to be the most favourable section for further exploration, particularly to the southwest of the mine, where the covering of volcanics deepens.

Other discoveries of gold-bearing mineralization have been made on the property. The most important of these is at the south boundary, in lot 30, range VII. This, like the main showing, is irregular in form, but differs in the greater abundance of quartz and the absence of chalcopyrite. The country rock is massive, porphyritic to even-textured, andesite, carrying some large, rounded fragments, and cut by a dyke of syenite porphyry. The 'showing' consists of white quartz cementing and veining brecciated, chloritized fragments of andesite, though the surrounding volcanics are not noticeably fractured or sheared. Diamond drilling in ten holes has indicated a body of irregular, pipe-like form, roughly 100 feet in diameter. The pipe pitches about 80 degrees to the southwest to a depth of 400 feet; below this, the pitch flattens to 57 degrees for the next 70 feet in depth, which was the limit of the drilling. The axis of the pipe strikes approximately S. 66°W. Quite coarse, free gold has been observed in the quartz, but results of assays indicate very erratic distribution and range of values. Pyrite occurs sparingly in the quartz and more abundantly in the fragments included in the andesite. From the results of the drilling, the Company concluded that the deposit was not of commercial grade.

Some trenching was done, and three diamond-drill holes were put down, at the boundary of lots 37 and 38, range VIII, east of the main showing. Silicified and locally carbonatized andesite, cut by a few quartz stringers along an indistinct north-south fractured zone, is mineralized with scant pyrite and pyrrhotite. No encouraging gold values were obtained.

Another showing, in lot 25, range VIII, has been explored by two diamond-drill holes. A dyke of quartz porphyry, striking north-northeast, occurs here along the contact of diorite to the west and altered volcanics to the east. The dyke is fractured and silicified, and contains lenses and veinlets of yellowish carbonate; it is mineralized with coarse pyrite. Some gold values were obtained here but no extensive or persistent ore-zones are

indicated. Similar mineralization of quartz porphyry dykes, trending in the same direction, occurs in nearby sections of the property.

The outcrops generally over the property have been thoroughly examined by the Company, and any occurrences of mineralization have been sampled.

Duke Property

D. Duke holds claims R.28234 to 28236 and 30443 to 30445 in the southern part of range IX, east and west of the centre-line of the township. Trenches in lot 32, over a north-south distance of 200 feet, show, to the south, an aplitic border facies of the granite veined by over 50 per cent white quartz. Farther north in the trenches, large, irregular lenses of massive quartz are exposed over widths up to 50 feet. Coarse cubes of pyrite occur in clusters in the massive quartz, with erratic distribution. An assay of a single sample of the mineralized quartz, taken by the writer, showed a gold content of 0.005 ounces per ton. Mr. Duke reports higher values from other samples, but no average sampling results are available; indeed, reliable sampling of the showing is scarcely possible without first doing further work on the property. Smaller quartz veins, with pyrite mineralization in the enclosing granite as well, occur in lot 31.

Havelock Development Company, Limited

This Company holds a group of claims in the southern part of range VII, extending from lot 31 eastward to lot 41.

Stripping of an outcrop just north of the creek in the southern part of lot 41 has disclosed a slight shear and disturbed zone, striking a few degrees south of east, in rhyolite and intrusive rhyolite porphyry. Altered diorite is exposed on the south bank of the creek. A few quartz stringers, containing carbonate, pyrite, and a little galena, occur along the zone. Assay of a sample taken by the writer yielded 0.010 ounces gold per ton, and Mr. Havelock reports similar low assays. The occurrence is of interest, however, in showing the presence of stress effects and mineralization in this generally drift-covered section of the map-area.

A number of old trenches, and some more recently made, were observed in the claims north of the highway, acquired by the present Company from Norfield Mines, Limited. These are mainly in lots 34 and 35, 1,000 to 2,000 feet north of the southern boundary, range VII. This section of the property is within the general zone of sulphide mineralization that crosses the area. The volcanics here are intensely silicified over certain ill-defined zones on which the trenches are located and are mineralized with pyrite, pyrrhotite, and lesser chalcopyrite. Two drill-holes, whose locations are indicated on the map accompanying this report, were put down in earlier years to explore two such zones. An assay of a sample from a roughly east-west zone, 60 feet south of the more northerly drill-hole, yielded a gold value of 0.055 ounces per ton. Another sample, taken from the less highly silicified country rock, 500 feet to the south, showed a gold content of 0.010 ounces per ton.

Other old trenches in lot 31, some 200 feet west of the centre-line of the township, and 1,000 feet north of the southern boundary of range VII,

reveal irregularly shattered volcanics veined by quartz which includes large grains of carbonate and is mineralized with coarse pyrite. The zone appears to strike northwest and is exposed over widths up to 30 feet in two trenches 50 feet apart. An assay of a single representative sample of this material, taken by the writer, yielded 0.020 ounces per ton in gold.

The assays quoted above were made in the laboratories of the Quebec Bureau of Mines. They are not intended to represent the value of the showings concerned, but merely to indicate the occurrence of gold values in such mineralization.

Centre Boischatel Copper Company, Limited

Some work was done in 1929 on the ground held by this Company (1). The property includes blocks 48 to 52, and block 116, in ranges VI and VII, just west of the centre-line of the township. No additional work appears to have been done since 1929, but mineralization uncovered at that time is of interest in view of the subsequent discovery of the south showing on the Halliwell property, which lies just to the north.

In block 49 (lot 30), some chalcopyrite-pyrite-quartz mineralization occurs along a small north-south sheared zone in basic volcanics. A shallow shaft was put down here in 1929, but the zone is now but little exposed.

A trench in block 48 (lot 29) shows quartz stringers quite heavily mineralized with chalcopyrite and pyrite over a width of two feet, with less prominently mineralized stringers extending for several feet to each side. The stringers are in a dyke of chloritized aplite, striking N.20°E. Similar stringers occur at intervals for 200 feet or more to the northeast. An assay of the most heavily mineralized material in the trench showed a copper content of 11.27 per cent, but only 0.008 ounces of gold per ton. The assay was made in the laboratories of the Quebec Bureau of Mines.

Lot 27, Range VI

Some narrow quartz veins were observed by the writer in two aligned exposures, 150 feet apart, in the northern part of lot 27, range VI. The veins strike northeast. The quartz, as well as the wall-rock of andesite, is very sparingly mineralized with pyrite. A sample from one outcrop assayed 0.020 ounces gold per ton. No work has been done at this point and the veins are but little exposed. The occurrence is of interest, despite the low gold value, because of the location and direction of the veins.

Sulphide Zone in Range VII

A number of trenches made in earlier years were observed along the general zone of sulphide mineralization in range VII, in addition to those mentioned in describing the Havelock property. Samples for assay were taken by the writer at intervals along this zone, some from trenches and some from outcrops on which no work had been done. The locations of the samples, character of the rock and mineralization, and results of the assays, are summarized below.

(1) Que. Bur. Mines, Ann. Rept., 1929, Pt. A, p. 100.

LOCATION	COUNTRY ROCK	MINERALIZATION	GOLD (oz./ton)	COPPER (Per cent)
Lot-line 35-36, 1,400 feet north of railway; trench...	Silicified andesite	Pyrite, pyrrhotite, chalcopyrite	0.032	0.14
Lot 37, 2,000 feet north of railway; trench.....	Andesite	Quartz, with pyrite	0.021	Not det'd
Lot 40, 800 feet north of railway; outcrop.....	Silicified andesite	Pyrite	0.008	"
Lot 40, south of highway; outcrop.....	Silicified andesite	Pyrite	0.015	"
Lot 42, 400 feet south of north boundary of range; outcrop.....	Silicified andesite	Pyrite	0.043	"



Conglomerate embedded in lamprophyre, lot 42, range VIII,
Beauchastel township.

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