CANADA
DEPARTMENT OF MINES
AND
TECHNICAL SURVEYS

GEOLOGICAL SURVEY OF CANADA

PAPER 45-17

GEOLOGY AND MINING PROPERTIES OF PART OF THE WEST HALF OF BEAUCHASTEL TOWNSHIP, TEMISCAMINGUE COUNTY, QUEBEC

(REPORT AND TWO MAPS)

By

J. W. Ambrose & S. A. Ferguson

OTTAWA
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INTRODUCTION

Beauchastel township is crossed from east to west by the southern mining belt of northwestern Quebec. The township is separated from the Ontario boundary to the west by Dasserat township; on the east it adjoins Rouyn township. Horne mine, one of Canada's leading copper-gold producers, as well as several large gold mines, are in the latter township, and at Larder Lake, some 20 miles to the west, are the Kerr-Addison and other gold mines, all in the southern mining belt. One might anticipate, therefore, that mines would be found in Beauchastel township, and it is interesting to note that the earliest discovery of gold in this part of Quebec was made in 1906 in a carbonate zone exposed on the southeast shore of Lake Fortune. Although the discovery did not lead to an orebody at that time, the Lake Fortune carbonate zone is now being prospected actively by Renfort Gold Mines, Limited. As prospecting spread over the township other discoveries were made, some of which developed into mines. Aldermac Copper Corporation, Limited, produced, between 1932 and 1943, 30,845 tons of copper, 10,675 ounces of gold, 389,100 ounces of silver, and 562,400 long tons of pyrite from orebodies just north of MacKay Lake. Arntfield Mining corporation, Limited, produced, between July 1935 and April 1942, $2,011,755 in gold from 529,987 tons of ore. Francoeur Gold Mines, Limited, commenced production in 1938, and to July 1, 1944, milled 387,320 tons of ore to obtain gold worth $2,500,224. The most recent discovery of ore was made in the spring of 1944 by Wasa Lake Gold Mines, Limited. The orebodies outlined by diamond drilling to a depth of 1,240 feet were estimated, in late 1944, to contain some 4,400 tons of ore for each vertical foot, and to be worth $5.50 to $6 a ton in gold. Several companies are now prospecting vigorously in this part of the township, and during most of the summer of 1944 ten diamond drills were employed in surface exploration in various places.

The Nipissing Central Railway and the interprovincial highway cross the township, and colonization roads are opened in some parts. Repeated fires, the most recent in the spring of 1944, have destroyed nearly all forest cover, and have left large islands of bare rock surrounded by drift and clay flats. Geological examination and search for mineral deposits are comparatively easy where rock is exposed. Elsewhere, however, so much of the bedrock is hidden by overburden that the solutions of many structural problems and the locations of other mineral deposits can only be surmised. Much has been learned by diamond drilling and geophysical investigations, but the word "certainty" can yet be applied to only a very small part of the hidden geology.

GEOLOGICAL INVESTIGATIONS

Much geological work has been done in this part of Quebec. The part of Beauchastel township examined in 1944 is included in the map of Opasatika area, first published in 1923[1].

[1] Cooke, H.C.: Opasatika Map-area, Timiskaming County, Quebec; Geol. Surv., Canada, Sum. Rept. 1922, pt. D (1923).

and revised in 1930[1]. Bruce published a detailed study of the

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1 Cooke, H.C., and Gunning, H.C.: Map 240A, Opasatika Sheet; Geol. Surv., Canada (1930)

Arntfield-Aldermac mines area in 1933[2].

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2 Bruce, E.L.: Arntfield-Aldermac Mines Map-area, Beauchastel Township; Que. Bur. of Mines, Ann. Rept. 1932, pt. C, pp. 29-87 (1933).

In 1937 MacKenzie[3] examined two areas; the Wasa Lake

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3 MacKenzie, G.S.: Fortune Lake and Wasa Lake Map-areas, Dasserat and Beauchastel Townships; Que. Bur. of Mines, Geol. Rept. No. 5 (1940).

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area adjoining Bruce's area to the east, and the Lake Fortune area to the west, and in 1938 he examined the Halliwell area[4].

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4 MacKenzie, G.S.: Halliwell Mine Map-area, Beauchastel Township, Témiscamingue County; Que. Bur. of Mines, Geol. Rept. No. 7 (1941).

W. G. Robinson[5] continued detailed work in the north

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5 Robinson, W.G.: Flavrian Lake Area, Beauchastel and Dasserat Townships, Témiscamingue and Abitibi Counties; Que. Dept. of Mines, Geol. Rept. 13 (1943).

A Part of Beauchastel Township, Témiscamingue County; Que. Bur. of Mines, Prelim. Rept. No. 159 (1941).

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half of Beauchastel township.

In 1941 Kindle[6] published a map and report on the

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6 Kindle, E.D.: Geol. Surv., Canada, Paper 41-7 (1941).

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geology of the northeast part of Beauchastel township, and in 1943 Wilson's[7] map of the southeastern part of the township

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7 Wilson, M.E.: Southeastern Beauchastel, Témiscamingue County, Quebec; Geol. Surv., Canada, Paper 43-7 (1943).

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was published.

A great deal of unpublished information has been supplied, on behalf of various mining companies, by other geologists working in the district: as Dr. J.E. Gill, Dr. J.E. Hawley, Dr. A.R. Byres, and Messrs. K.W. Fritzsche, A.C. Lee, A.T. Matheson, and George Salton. Large blocks of claims have been mapped by them on scales as detailed as 1 inch to 200 feet. Such information has been supplemented by that from underground workings, diamond-drill holes, and geophysical examinations. This material was placed at the writers' disposal without reservation, and was used freely throughout their work. Thanks are due to Col. C.D.H. MacAlpine and to Mr. A.A. MacKay for information concerning Wasa Lake Gold Mines, Limited, Aldermac Copper Corporation, Limited, and Francoeur Gold Mines, Limited; to Col. MacAlpine for that concerning Renfort Gold Mines, Limited; to Mr. Redmond Quain, K.C., of Senator Mines, Limited, for information concerning diamond-drill holes in the Archaean window near Olier Lake; to Mr. R.V. Arntfield for information concerning Arntfield Mining Corporation, Limited; and to Mr. J.O. McDonell of Gan Copper Mines, Limited. Mr. J.V. MacKenzie, Mine Manager at Francoeur, offered every assistance. Aldermac Copper Corporation, Limited, very kindly placed the facilities of their camp on MacKay Lake at the parties' disposal. The members of the party, all of whom gave efficient and loyal service, included Messrs. A. Durocher, M. Durocher, S. Roscoe, H. McGrimmin, J.F. MacDougall, Douglas MacNiven, and Miss J. Gelinas. Mr. L.P. Wood assisted with the magnetometer in the first part of the season.

GENERAL GEOLOGY

The geology of part of the west half of Beauchastel township is shown on the two maps accompanying this report. On one (Map 45-17A) as much factual detail is given as is possible on the scale of publication; on the other (Map 45-17B) an interpretation of these facts is offered.

The area is underlain by rocks of Precambrian age. Two principal subdivisions are represented, the Archaean, in the north half, by an assemblage of volcanic rocks cut by several varieties of intrusive rocks, and the Proterozoic, in the south half, by greywackes and conglomerates of Cobalt age. A window through the Cobalt rocks near Olier Lake exposes the only Archaean sedimentary rocks in the area; these are cut by dykes and masses of porphyritic granite.

One dyke of Younger diabase trends northwest across the area. At Wasa Lake a branch dyke extends southwest and presumably joins with a similar dyke that cuts both Cobalt and Archaean rocks farther west.

ARCHAEAN

A complex assemblage of volcanic and intrusive rocks of Archaean age underlies the country north of the Cobalt rocks, or north of about the middle of range IV. Detailed petrographic descriptions of the several varieties present are contained in Bruce's report[1] on the Area Arntfield-Aldermac area.

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1 Op. cit., pp. 40-58.

His report leaves little to be added, and should be consulted if information on these features is desired.

Volcanic Rocks

The volcanic rocks were subdivided in the present work into four main groups, basic flows, associated pyroclastic rocks, acid flows, and associated pyroclastic rocks. Further subdivisions are commonly made by those working in this district: the basic rocks into andesites, dacites, and, rarely, basalts; the associated pyroclastic rocks into corresponding tuffs and breccias; the acid flows into rhyolites and trachytes; and the associated pyroclastic rocks into corresponding tuffs and breccias. All these rocks are now composed of secondary minerals - chlorite, carbonates, sericite, albite, and quartz (in part primary?) - and precise classification is impossible. In an examination of a few claims, recognition of the slight distinctions between, say, "trachyte" and "rhyolite" may prove most useful. However, to attempt to recognize such distinctions consistently over a large area is extremely difficult if not impossible, and benefits to be derived by subdivisions are more than nullified by the danger of confusion. Therefore, the present division was adopted in the interests of consistency.

Basic Lavas

The basic volcanic rocks consist of massive flows, flow breccias, and pillow lavas. The rocks, dark green to brownish green on weathered surfaces and dark green where freshly broken, are composed of a fine-grained aggregate of chlorite, actinolitic amphibole, feldspar near albite, accessory black opaque minerals, and varying amounts of carbonates and leucoxene. Quartz-filled amygdules, with or without crystals of ankeritic carbonate, are common. One of the most useful features of these rocks is the prevalence of pillows. Well-developed and well-exposed pillows provide, in the writers' opinions, one of the most generally useful and surest methods for determination of stratigraphic tops. To work out the structure with any degree of satisfaction without the information that they provide would be virtually impossible.

The only distinctive rock in this group, aside from pillowed flows, is an andesite porphyry, well displayed in a bare rock ridge in lot 31, range VII. In it phenocrysts of white feldspar as much as ¼ inch long are thickly distributed with random orientations in a fine-grained, green groundmass. This porphyritic andesite is extrusive, for much of it consists of a flow breccia with angular fragments of the porphyry in a matrix of the same rock. Again, poorly to well-defined pillows are to be seen in some of the exposures. The flows strike southeast to south, face southwest or west, and dip steeply southwest.

Robinson[1] notes the occurrence of similar porphyritic

[1] Op. cit., pp. 4-5.

andesites in lot 22, range VII, east of the Aldermac syenite stock. West of the stock he traced flows similar in appearance westward to lot 8 in the same range. These flows, ".... strike a little south of east, dip steeply south, and face south....". Although some work remains to be done in this range, these several occurrences may be parts of a single group of flows and form a marker horizon along the north flank and around part of the faulted eastern nose of a large synclinal fold.

Acid Lavas

Acid lavas underlie most of the present map-area. In the west part of ranges V and VI they occupy a large expanse within a syncline. East of the Beauchastel fault they occupy a much narrower width, but a strip does continue east to and beyond the north-south centre line. Some large exposures of acidic rocks occur both southwest and northeast of Wasa Lake. Rocks of this group weather grey, creamy grey, or white. Fresh surfaces are pale green. The grain is very fine to cherty, and quartz grains, prominent in some, are generally inconspicuous or lacking. Some of these rocks contain a fine, unevenly distributed peppering of tiny octahedral crystals of magnetite. Amygdules filled with quartz or carbonate are common.

Lavas of the acidic group lack many of the characteristics of the basic types that are of such aid in geological mapping. It is difficult if not impossible to distinguish individual flows. In those rare instances where diagnostic evidence is obtainable, some of the acidic rocks can be distinguished as intrusions, presumably nearly contemporaneous with adjacent flows. Pillow structures have been reported in acidic rocks, but they are certainly extremely rare.

Pyroclastic Rocks

Beds of pyroclastic rocks form the most generally useful horizon markers in the part of the township examined. Some of the beds can be followed continuously across two or three lots, as in lots 13 to 16, range VI, and lots 14 to 16, range VII. Other beds can be traced through discontinuous outcrops, and with somewhat less assurance, for greater distances. Thus, two beds, one just north of Francoeur mine, and the other 1,500 feet farther north in range V, appear to be continuous at least from lot 6 to lot 10. The large area of pyroclastic rocks shown on Map 44-17B, in range IV, south of the railroad, is a generalization from inadequate data. In contrast with these, beds at Arntfield give the only clue to the very complicated structure thereabouts. East of Aldermac mine still another layer can be traced, in good exposures, around a semicircle that defines the nose of a west-plunging syncline.

Subdivision of the pyroclastic rocks in the area presents some troublesome problems. Although some of the breccias associated with the basic to intermediate group contain basic to intermediate fragments in a chloritic matrix, and, similarly, some of those associated with the acidic group carry acidic fragments in an acidic matrix, a very considerable number do not fit well into either group. These, characteristically, contain light-coloured, acidic fragments in a dark green, chloritic matrix. Are they acid breccias in which the matrix has been chloritized, or are they basic rocks with extraneous fragments or injections of acidic material? Bruce[1] described similar pyroclastic material and

[1] Op. cit., p. 45.

concludes that the chlorite developed in the matrix, as, "......... the result of reactions immediately following the volcanic eruption and of immediate attack of the coarser grained part of the lava which solidified later than the quickly chilled fragments." MacKenzie[2] observed, ".... irregular

[2] MacKenzie, G.S.: Fortune Lake and Wasa Lake Map-areas, Dasserat and Beauchastel Townships; Que. Bur. of Mines, Geol. Rept. No. 5, p. 9 (1940)

areas of rock consisting of rhyolitic inclusions in a highly chloritic groundmass. Some occurrences suggest that the rock is a volcanic fragmental, others that the rhyolitic material is a later injection in a basic flow."

On the Gan property, in lots 13 to 16, range VII, is an excellent exposure of one of these curious pyroclastic rocks. The layer is from 170 to 250 feet thick, and can be followed easily for 3,000 feet along the strike. In it are sharply angular fragments of all sizes to 1 foot across of white to cream weathering, dense, acidic rocks in a medium- to coarse-grained, dark green to almost black matrix. Toward the western end of the layer the matrix is mostly chlorite, but eastwards the layer passes into an area where dalmatianite had developed. Within it the matrix is as strongly dalmatianitized as are the neighbouring rocks. Some of the fragments remain, to the naked eye, unchanged, but most of them are partly chloritized and darkened. More than that, there are sharply angular patches of the size and shape of fragments that are distinguishable from the matrix only because they, probably as a result of small remaining differences in composition, are slightly more resistant to weathering. The presence of dalmatianite demonstrates strong hydrothermal action, and the appearance of the rock in this zone leaves no doubt that some of the fragments succumbed to chloritization. Away from the dalmatianite zone the action has been only sufficiently intense to chloritize the matrix. The implication here at least is that alteration of the matrix of an acid breccia was effected some time after eruption by hydrothermal solutions, a conclusion in substantial agreement with that of Bruce, although his suggestion that the alteration took place immediately after eruption is not supported by this example.

Less information is available on other similar pyroclastic beds in the area. These are mapped as "basic" or "acid" according to the types of flows with which they are associated, although some originally acid breccias have doubtless thus been included in the basic group.

Sedimentary Rocks

Sedimentary rocks of Archaean age are exposed in a window eroded through Cobalt rocks south and east of Renaud Lake. The window is about 9,000 feet long, east to west, and 2,000 feet wide. It lies along the crest of a ridge in the sub-Cobalt surface. Within it only sedimentary rocks cut by pre-Cobalt granite and post-Cobalt dykes of Younger diabase are exposed. Therefore, the relations of these sedimentary rocks to Archaean rocks in the surrounding districts can only be surmised.

Conglomerate is the predominant sedimentary rock exposed. It consists of an exceptional abundance of squeezed and flattened pebbles of greywacke, up to 4 inches long, and a very few of light grey, granitic rocks in a well-sheared matrix of greenish, argillaceous material[1]. The abundance of

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1 Cooke, H.C.: op. cit., pp. 36-37.

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greywacke pebbles suggests that these beds might be correlative with conglomerate beds described by Wilson in Rouyn township and classified by him as Timiskaming[2]. The evidence in Rouyn

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2 Wilson, M.E.: The Early Precambrian Succession in Western Quebec; Trans. Roy. Soc., Canada, 3rd ser., vol. XXXVII, sec. IV, pp. 126-127, (1943).

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township indicates that the Timiskaming beds are uncomformable on an older group of sedimentary rocks to the south. The relations of either of these sedimentary groups to the volcanic rocks that lie to the north are still uncertain.

Intrusive Rocks

The intrusive rocks in this map-area comprise a group of intermediate to basic rocks classed as diorite and gabbro (Older gabbro) with or without some quartz, quartz and quartz-feldspar porphyries, aegerite-augite syenite, porphyritic granite, basic dykes, and diabase dykes (Younger gabbro).

Diorite and Gabbro

Several small plugs and a number of sills and dykes of coarse- to medium-grained, massive diorite or gabbro cut the volcanic rocks in the area. Intrusions of this general type are among the most common in the district. Petrographical descriptions of them are given in numerous reports[3] and need not be repeated here.

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3 Bruce, E.L.: op. cit., pp. 53-55.

The large and many of the smaller bodies of these rocks tend to be elongated parallel to the strike of the flows, but nearly all locally cut across the flows, and are considered to be dykes. A hook-shaped, much faulted body almost encircles Lake Fortune, cutting indifferently across the strike of flows in that vicinity. Part of another larger dyke, with the same general form and trends, is exposed in the extreme northern part of the area. At least two ages of such basic rocks are known, and representatives of several ages may be present, but, so far as known, all are older than the syenitic and granitic rocks of this area. They are cut by dykes of quartz-feldspar and quartz porphyry, by dykes of porphyritic syenite, and by Younger diabase dykes. However, that they are not all of about the same age as the lavas is indicated by the fact that diorite and gabbro dykes near the middle of range VI cut folded lavas, but are themselves unsheared and are, apparently, not folded.

Structurally the bodies of diorite and gabbro seem to have acted as buttresses. Here and there they are sheared, but the shear zones are well defined, and the rock a short distance away from them is massive. Along their margins both they and the adjacent country rocks are commonly more or less schistose, as though shearing movements had been localized along the contacts.

Quartz-feldspar and Feldspar Porphyry Dykes

Dykes of these rocks occur in all parts of the area. They weather pink to grey, and contain phenocrysts of feldspar up to $\frac{1}{4}$ inch long, in a fine-grained groundmass of quartz, feldspar, and sericite. Quartz rarely forms phenocrysts in small dykes, but is abundant in round grains in two larger bodies of this rock, one forming a prominent ridge north of the highway west of Aldermac station, and the other an irregular-shaped mass east of Aldermac mine. The body near Aldermac mine is almost certainly intrusive. Evidence as to the relations of the one near the station is unsatisfactory, but it is probably intrusive as well. A smaller body of similar rock was intersected in a diamond-drill hole near the middle of lot 16, range V. The outline of this body shown on Map 45-17B is inferred from magnetometric data. Two or three smaller bodies of similar rock occur near Arntfield mine, and one near the east-west centre line in lot 13, range V.

Aegirite-augite Syenite and Related Dykes

North of Aldermac mine there is a complex of dykes that together form an intrusive body some 3 miles long and a mile or so in maximum width. The complex has been described in detail by Gunning[1]. The rocks are characterized by the

[1] Gunning, H.C.: Syenite Porphyry of Boischatel Township, Quebec; Geol. Surv., Canada, Bull. 46, pp. 31-41 (1927).

presence of tabular, flesh-coloured crystals of feldspar and an aegirite-bearing pyroxene. Most of the feldspar tablets are 1 to 2 inches long by $\frac{1}{4}$ inch thick, though here and there they are as much as 6 inches long. They tend to sub-parallel arrangement, commonly alined in dykes with the dyke walls. The amount of dark minerals present ranges in the several varieties from well over 50 per cent to almost negligible. Small dykes of these rocks are common south and southeast of the main body of the complex; one was found about 1,000 feet west of Aldermac station. In contrast with this, none was found west of a north-northeast striking fault that marks the west margin of the intrusive complex in this area.

Porphyritic Granite

Porphyritic granite is exposed only in the Renaud Lake, Archaean window. The western quarter of the window is occupied by a body of this rock, with numerous inclusions of the sedimentary rocks into which it is intrusive. The number and size of the inclusions increase as the eastern margin of the intrusion is approached, to a point where the granite body breaks up into a series of dykes. These dykes, in their turn, decrease in size and number eastwards, but some, fairly large, persist to the eastern edge of the window.

The rock is massive, grey to pink weathering, with stumpy prisms of potash feldspar up to $1\frac{1}{2}$ inches long in a medium- to coarse-grained matrix of quartz, feldspar, chloritized biotite, and some white mica. The phenocrysts are well formed, and twins are quite common. They vary somewhat in distribution: over considerable sections of some dykes they are inconspicuous or lacking, whereas in other places a dozen or so can be found in a square foot of the rock's surface. The rock is not weathered deeply, but a thin rubble of loose crystals has accumulated in some places.

Basic Dykes

These dykes are comparatively few and of small areal extent. Most of them are less than 10 feet in width, and few have been followed along their strike for more than a few hundred feet. One variety is the usual lamprophyre, with phenocrysts of hornblende and biotite; another variety has small, blocky, phenocrysts of augite surrounded by lath-like feldspars. This last type of dyke was observed cutting a feldspar porphyry dyke.

COBALT

Rocks of Cobalt age form the Kekeko Hills, an east-trending range of some 500 feet relief that occupies the south half of the area. The range is here 2 to 3 miles wide. The hills fall off abruptly along both north and south flanks to the lower and less rugged country underlain by Archaean rocks. The range, and the Cobalt rocks, end some 3 miles east of the map-area, along Pelletier Creek and Kekeko Lake, but westward they continue to, beyond, and southward along, the interprovincial boundary. The rocks consist mainly of argillaceous to arenaceous greywackes, with interbedded lenses of conglomerate. Bedding in the greywackes is in many places obscure. A bed of varved argillites is well displayed along the south flank of the range, from lots 20 to 31, range III, and again near range line III-IV, in lots 25 to 31. The varves consist of alternating layers, $\frac{1}{4}$ to $\frac{1}{2}$ inch thick, of fine-grained, reddish to purplish quartzite and dark green argillite.

Conglomerate beds are most common along and near the north flank of Kekeko Hills. Measurements of thickness of individual beds are difficult because of incomplete exposures and the discontinuous nature of the lenses, but some of them are over 100 feet thick. The pebbles and boulders are characteristically sub-rounded to sharply angular, and include rocks of every type known in the district. Sorting is conspicuously lacking - the pebbles, boulders, and sand grains forming a heterogeneous jumble in which blocks up to 5 feet long may be alongside pebbles as small as peas, all cemented in a matrix of rock fragments and sand grains. The assemblage is so strongly cemented that the boulders break with the matrix, and, as a consequence, it is virtually impossible to loosen any so they may be examined for soled or striated surfaces. No areas of recently exposed sub-Cobalt surface were seen.

Approximately 400 feet southwest of the Wasamac shaft the unconformable contact of Cobalt rocks lying upon the Older gabbro is exposed. A vertical section 7 feet high shows a gently curved contact dipping steeply southward at not less than 55 degrees. Along the northern face of the hillside the contact is well exposed for about 20 feet. The contact is sharp, with smoothly undulating curves. There is no evidence of weathering along the old land surface. The overlying Cobalt is a conglomerate without the slightest suggestion of bedding.

Structure

The Cobalt rocks are separated from the underlying Archaean assemblage by a great unconformity. The structures in the two thus have little or no direct relationship, aside from some post-Cobalt faulting noted below.

The Cobalt strata are, in general, nearly flat lying. Dips from 10 to 25 degrees are most common, although here and there dips as high as 70 degrees may be found. Such steep dips are, however, only local, and, most probably, as Gill[1] has

[1] Gill, J.E.: unpublished manuscript.

suggested, the result of pre-consolidation slumping.

The attitudes obtained show that the Cobalt strata form shallow folds, although delineation of the folds is made difficult by the absence of marker horizons. In general, dips along the north flank of the ridge are gently south; those along the south flank gently north. The ridge thus appears to be the topographic expression of a broad syncline. The window of older rocks near Olier Lake adds variety to this simple structure. Dips along its north and south margins are, in general, away from the axis of the window. Along and near the eastern projection of the axis across the Cobalt, the dips are horizontal, and fall off gently both north and south. That is to say, the window is along the crest of a low anticline of Cobalt strata within the broader synclinal structure.

The gentle dips of Cobalt strata appear to afford a faint reflection of the underlying topography. The beds may have been folded into their present attitudes, but, as has been noted by others[2], little or no secondary cleavage has

[2] Thomson, J.E.: Geology of McGarry and McVittie Townships, Larder Lake Area; Ont. Dept. of Mines, Ann. Rept. 1941, vol. L, pt. VII, p. 27 (1943).

been developed. An exception to this generalization is seen along the walls of a slot-like, south-trending valley that cuts through Kekeko Hills south of Wasa Lake. This cleavage or schistosity appears to be related to post-Cobalt faulting rather than to folding. Elsewhere, even where the strata dip as much as 70 degrees, or where they are contorted, as in exposures in Dasserat township south of Lake Fortune, no cleavage has been developed. Such steep dips and local contortions have already been ascribed to pre-consolidation slumping. It seems at least possible, if not indeed probable, that dips in Cobalt strata in general have tended to accommodate themselves to original land forms. Should this be so, it implies that this region has been unaffected by folding movements since deposition of the Cobalt began.

Although the Cobalt strata may not have been folded since deposition, it does not follow that they have remained unfaulted as well. Thomson[1] records a post-Cobalt fault,

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1 Op. cit., p. 29.

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discovered in diamond drilling, with a vertical displacement of about 200 feet. He makes the interesting observation that, "... this faulting lines up with an underlying schist belt, indicating that some post-Cobalt movement has probably taken place along the older sheared zone." Cooke had, much earlier, described a post-Cobalt fault on which he found Cobalt conglomerate transformed to a finely laminated schist in a zone 75 feet or more wide. The fault line, he noted, follows the linear valley of Milky Creek. A similarity in form and strike between Milky Creek Valley and that occupied by the northeast arm of Larder Lake led him to suggest the latter might also mark the course of another post-Cobalt fault[2].

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2 Cooke, H.C.: Larder Lake Area, Timiskaming District, Ontario; Geol. Surv., Canada, Mem. 131, p. 58. (1922).

In this map-area indirect evidence indicates that Cobalt strata have been faulted. South of Wasa Lake Kekeko Hills are crossed by a straight slot half a mile long and, in many places, less than 200 feet wide, with steep to vertical walls 100 feet or so high. Rocks along the base of the cliffs have a well-developed cleavage that strikes parallel to the valley's length, and dips vertically. The Archaean rocks directly north of the valley are so distributed that a south-striking fault seems to be a structural necessity. These several facts are taken to indicate that the valley across the Cobalt is the topographic expression of a post-Cobalt fault.

Another quite different line of reasoning leads again to the conclusion that there has been some post-Cobalt faulting in this district. A dyke of Younger diabase cutting Cobalt rocks is well exposed south of Wasa Lake, and again near Olier Lake. This dyke is a southwest-trending branch of a northwest-trending dyke, which, in turn, is offset horizontally some 400 feet along a fault near Aldermac siding. Obviously the post-dyke fault movement must also be post-Cobalt. If it intersected Cobalt rocks some effect of it should be seen. Actually, near Arntfield, the fault appears to enter Renaud Lake near the south shore of its northeast bay. Curiously enough, directly across the lake on the strike of the fault, there is a sharp linear valley in the Cobalt rocks with the same trend, as though it were the topographic expression of this fault. In a similar way, the continuations of the two other faults defined in the Archaean rocks may be indicated by steep-walled valleys along the prolongation of their strike across Cobalt strata.

Thickness, and Sub-Cobalt Topography

That the sub-Cobalt surface is one of some relief was suggested over 20 years ago by Cooke[1]. From surface

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1
Cooke, H.C.: Opasatika Map-Area, Timiskaming County, Quebec; Geol. Surv., Canada, Sum. Rept. 1922, pt. D, p. 61.
Cooke, H.C.: James, W.F., and Mawdsley, J.B.: Geology and Ore Deposits of Rouyn-Harricanaw Region, Quebec; Geol. Surv., Canada, Mem. 166, pp. 146-7 (1931).

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exposures he discovered that the old surface had a relief of at least 200 feet. Thomson was able to show from diamond-drill results on a property in the Larder Lake area that the sub-Cobalt surface was very irregular, and varied as much as 400 feet in elevation[2]. Apparently this condition is widespread,

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2
Thomson, J.E.: Geology of McGarry and MacVittie Townships, Larder Lake Area; Ont. Dept. Mines, Ann. Rept. 1941, vol. L, pt. VII, pp. 27, 28 (1943).

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for Hopper[3] notes that a vertical drill hole 1,000 feet from the

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Hopper, C.H.: Geology of Matachewan Consolidated Mine; Trans. Can. Inst. Min. Met., vol. 45, p. 389 (1942).

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contact between Cobalt and older rocks in the Matachewan district passed through 1,100 feet of the younger sediments before reaching the contact.

The northern boundary of the Cobalt in this area is about 5,000 feet north of the Archaean window. The intervening strata dip about 10 degrees north. Not enough attitudes were obtained here to determine whether, as supposed, they lie in a shallow syncline, but in any case the maximum thickness below lake-level, computed from the dips, should not be over 450 feet 2,500 feet north of the window. However, the actual thickness there must be much more, for a vertical diamond-drill hole on the east shore of Renaud Lake, about 2,000 feet north of the window, was stopped at a depth of more than 600 feet without having left Cobalt rocks. Another vertical diamond-drill hole on the south shore of Renaud Lake, in lot 6, range III, gave even more surprising results. This hole was drilled at a point about 800 feet northwest of the window. If the dip of the Cobalt strata were any indication of the thickness of the series the drill should have passed into Archaean rocks at a depth of about 150 feet. Instead, it remained in Cobalt rocks to a depth of 650 feet, where the hole was stopped. In other words the northwest contact of the window falls more than 650 feet vertically in a distance of only 800 feet; it must dip more than 38 degrees north, although the surface dips, as noted, here average about 10 degrees north. These results confirm those reported from an earlier hole drilled southward from the south shore of Renaud Lake at 45 degrees, in lot 2, on range line III-IV. This hole, said to be over 1,000 feet deep, encountered only Cobalt rocks. The vertical depth would be about 700 feet.

Interesting information concerning the dip of the north contact comes from drill holes just south of Arntfield. These holes were drilled south from points near two small exposures of Cobalt conglomerate. One of them started at an angle of 62 degrees, entered Cobalt rocks at the collar, left the Cobalt at 66 feet, and continued to 1,277 feet in the older rocks. The average dip of the hole was 45 degrees. Another hole, located 115 feet to the east, was started in andesite, passed into Cobalt rocks at 533 feet, and remained in these rocks to the bottom of the hole at 940 feet. The dip of this hole was 45 degrees at the collar, but flattened to an average dip of 34 degrees. These results show that the north contact here slopes southward at more than 34 degrees and less than about 45 degrees, at least to a vertical depth of between 535 and 907 feet. There is thus quite a remarkable correspondence in slope of the northwest contact of the window and that of the north contact, the slopes, of course, being in opposite directions. The sub-Cobalt surface, therefore, has slopes of not less than 40 degrees. The thickness of Cobalt below lake-level may be about 1,000 to 1,500 feet, and the total thickness, including that exposed above lake-level in Kekeko Hills, some 2,000 feet or even more. In other words, it is necessary to visualize a sub-Cobalt valley 1,000 to 1,500 feet deep between the Olier Lake window and the north contact. Furthermore, diamond drilling in Cobalt rocks just west of the interprovincial boundary is reported to have remained in these rocks to depths of more than 1,000 feet, with the contact not reached. Eastward, on the other hand, the Cobalt rocks terminate near Pelletier Creek. The sub-Cobalt valley may be supposed, therefore, to trend west and to deepen westward from nothing to 1,000 feet or more in 7½ miles, an average gradient of 133 feet in a mile. Such a gradient is characteristic of mountainous countries, and is nowhere approached even remotely in this part of the Shield today.

To carry the speculation one step farther, one may suppose that if the Cobalt rocks were removed they would reveal a sub-mountainous topography with a relief of 1,000 to 1,500 feet. The contrast with present adjoining areas, where the relief nowhere exceeds 100 feet, would be striking, to say the least.

One other possibility remains to be noted. A regional shear zone, the Cadillac-Bouzan Lake fault zone, is exposed east of the east end of Kekeko Hills. The fault zone strikes west, and recent diamond drilling has revealed that about a mile west of Pelletier Creek it lies just under the northern edge of the Cobalt series[1]. This zone is believed to extend west below the

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1 Wilson, M.E.: Geol. Surv., Canada; personal communication.

Cobalt series towards, and probably continuous with, the Larder Lake fault zone[2] in Ontario. The Archaean rocks below the

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2 Thomson, J.E.: op. cit., Fig. 3.

Cobalt, near Arntfield, cut by the diamond-drill holes mentioned earlier, become progressively more schistose toward the bottoms of the holes, that is, towards the south. Their appearance suggests that a major shear zone is being approached, a shear zone that would thus lie below the deeper parts of the sub-Cobalt valley. In other words, this sub-Cobalt valley may be an old topographic expression of a major shear zone.

Origin

The rocks of the lower Cobalt series are generally conceded a glacial origin. No evidence was found during the present study that conflicted with this conception. Indeed, the possibility that a sub-mountainous topography was completely buried by Cobalt sediments is quite compatible with the glacial hypothesis, for the valleys have simply been filled with, and the intervening ridges buried by, several hundreds or even thousands of feet of detritus, poorly rounded and poorly sorted. Deposition of most of it by heavily overloaded streams is indicated. The material must have come from some source that stood appreciably higher than the crests of sub-Cobalt ridges. The suggestion may, therefore, be ventured that the Cobalt sediments formed as a great outwash apron along a glacial front, that is to say, as glaciofluvial deposits. The presence of some varved beds indicates that the outwash plain was covered at intervals by lake waters.

STRUCTURE

An interpretation of the structure of the Archaean volcanic rocks is given on Map 45-17B. The rocks, except in the northwest part of the area, are broken into a series of fault blocks. Satisfactory correlations from one block to another are possible in only a few places. One major fold axis was delineated across range VI, but the remainder of the area is so broken by faulting that the forms of folds that may have existed could not be deciphered.

The faults are of two distinct types: first, and most numerous, a series of northeast- to north-striking vertical or steeply dipping faults; and second, east-striking faults that dip 45 to 55 degrees north. The best known example of the first type is the Horne Creek fault. The rock along it is severely shattered and cut by mud seams, but is not notably schistose. The rock along the second type, of which the Lake Fortune shear zone may be taken as an example, is highly schistose, strongly carbonatized or silicified, as in the instance of the Wasa shear zone, and commonly carries some disseminated pyrite and, in places, gold. Whether or not these two types of faults differ appreciably in age is uncertain. At Arntfield mine an east-west, gold-bearing shear zone, the Francoeur-Arntfield shear zone, appears to be offset along a northeast-trending fault, the MacKay Lake fault. Near Aldermac station a diabase dyke is offset along a northeast-trending fault, the Horne Creek fault, but crosses an east-west shear zone, the Wasa shear zone, with no offset. These items show that in these places the latest faulting movements occurred along the northeast set of faults. However, on the Horne Creek fault, at least, this latest movement accounted for only a small part of the total displacement that has taken place along it and the fault has undoubtedly had a very long history.

Furthermore, a northeast-striking fault that crosses Lake Fortune, and two others that cross Wasa Lake, apparently do not offset east-west shear zones, but, rather, seem to turn into, and be subsidiary to, them. This conflict in data suggests that distinction between the two fault types should be based not so much on attitude as on the character of the faulted rock, that is, as to whether it is a fracture zone with mud seams or is schistose, carbonatized, etc. Unfortunately, few of the faults or shear zones form outcrops, and data for such a classification are available, in general, only where the faults have been drilled. For the present, therefore, the simpler though more superficial method of classification is used.

FOLDS

A synclinal axis is defined near the middle of range VI on the basis of opposing stratigraphic tops indicated by pillowed flows. These flows apparently occupy a narrow strip along the trough of the fold. East of Aldermac mine, approximately along the strike of the synclinal axis, a bed of acid pyroclastic rocks outcrops in the form of a horseshoe open to the west, as though it outlined a west-plunging syncline. Near the north-south centre line, in range VII, there outcrops a series of flows of distinctive andesite porphyry, previously described. As already noted, these may be correlative with similar rocks near the south side of range VIII. Those in range VII face southwest, as determined from pillows, and those in range VIII face south. If they are parts of one succession of flows, they also outline the west-plunging syncline.

FAULTS

Faults Striking North and Northeast

The synclinal axis referred to above is crossed, in lot 15, range VI, by a fault that trends a few degrees east of north. Horizontal displacement on the fault is between 100 and 200 feet. The course of the fault northwards is marked by a narrow swampy valley that follows, to the north edge of the area mapped, the west margin of the Aldermac aegirite-augite syenite mass. Neither the dip of the fault nor the net displacement is known. It should be noted that, in addition to the main body of aegirite-augite syenite, dykes of this rock are common east of this fault; west of it no alkalic syenite was found.

The syncline is truncated along the southeast side by the MacKay Lake fault. A short section of this fault has long been known to exist along or near the north shore of MacKay Lake, in lot 21, range VI. Its course there is marked by an east-west linear valley, and the rocks along the north side of the valley are heavily stained with rust formed by weathering of sulphides. East of the lake the same features continue across lot 23. The fault may continue across lot 24 along either the north or south margin of a narrow body of diorite, but farther east it is lost in a wide, drift-covered area. It may be part of the Horne Creek fault, traced southwestwards by Wilson[1] to

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[1] Wilson, M.E.: Southeastern Beauchastel, Témiscamingue County, Quebec; Geol. Surv., Canada, Map 43-7A (1943).

lot 41, range VII, and it may also be joined by a fault, in range VII, east of the north-south centre line indicated by Kindle[1].

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[1] Kindle, E.D., Northeastern Part of Beauchastel Township, Témiscamingue County, Quebec; Geol. Surv., Canada, Paper 41-7 (1941).

West of MacKay Lake the fault can be traced without difficulty to the west side of lot 19, range VI. There it enters an area of scattered outcrops of acid volcanic rocks, and, although small sheared zones about on strike are known, the exact course of the fault is doubtful.

The probable western continuation of this fault was discovered during last field season just north of Renaud Lake and is believed to extend across Mud Lake, where it was discovered that a feldspar porphyry dyke 30 feet wide is cut by a northeast-trending fault. The horizontal displacement is 1,700 feet, left hand. A large diorite dyke is similarly displaced.

A most interesting possibility is that the Lake Fortune shear zone, well exposed along the main highway west of the fault, may also be displaced, and that its eastern continuation may be represented by a zone of sheared, carbonatized rocks, 100 feet wide, that was intersected in a diamond-drill hole just south of Mud Lake. This zone may be continuous, in its turn, with sheared carbonatized rocks cut by quartz veins exposed along the highway and railroad north of the east end of Renaud Lake. It is probable that the zone extends to, and is cut off by, the Horne Creek fault.

Diamond drilling at Arntfield mine has revealed a fault striking northeast just west of the No. 3 shaft. This fault is probably continuous to the southwest with the one traced above to Mud Lake. To the east no more information is available, but it may join the MacKay Lake fault, as indicated on Map 45-17B. The north-northeast fault that displaces the synclinal axis may be a branch of this fault.

The isthmus between Lake Fortune and Samia Lake is crossed by two well-exposed, northeast-trending, carbonatized, sheared zones, and magnetometer data indicates that some 1,000 feet east of these a third nearly parallel fault is hidden below drift. These three faults may be branches of a fault that, it is supposed, offsets the large diorite dyke between Lake Fortune and King of the North Lake. The principal offset indicated is left hand, and amounts to about 1,000 feet.

The Lake Fortune shear zone may be displaced along this fault in the same manner as is supposed along the MacKay Lake fault to the east. The horizontal displacement would carry the shear known west of the fault on Macfort ground northward east of the fault to a position in Lake Fortune near the south shore.

The structure within the strip of country between the MacKay Lake and Horne Creek faults needs no detailed description. All the flows therein strike nearly east, dip 45 to 60 degrees north, and face north, except in a small area of complicated folds and faults between Arntfield mine and Arntfield village. In this small area well-bedded tuffs strike south or southwest, dip from 55 degrees west or northwest to 65 degrees east. The interpretation offered on the accompanying map (45-17A) is that the beds form a drag-fold cut off on the north end by the Arntfield shear zone and on the south end by the Horne Creek fault.

The Horne Creek fault, as noted above, was traced westward by Wilson from Noranda to lot 41, range VII, Beauchastel tp. No information as to its course farther southwest was available, but a fault disclosed in 1937 by diamond drilling near Aldermac station was generally supposed to be its southwestward continuation. Diamond drilling in this vicinity in 1944 confirmed the position of the fault, and a magnetometer survey showed that a dyke of Younger diabase was offset horizontally some 400 feet by it. The importance of this discovery lies in the fact that the Horne Creek fault is the only one known to the writers in this district that offsets Younger diabase dykes. The fact that the fault at Aldermac station offsets a diabase dyke there is regarded as good grounds for its correlation with the Horne Creek fault.

Southwest of Aldermac station the course of the fault is marked by a swampy, linear valley that is followed by the railroad and highway to Arntfield. A series of springs of excellent water occur along this part of the fault's course.

West of Arntfield the valley falls off into the northeast bay of Renaud Lake. The fault may be supposed to extend across the lake and may, as has been noted in discussing the faulting of the Cobalt series, underlie a linear valley in those younger rocks southwest of the lake.

Only a few items are known concerning the structure of the lavas in the triangular fault block southeast of the Horne Creek fault. Several top determinations were made on pillowed lavas, but most of these are poor and none is completely reliable. All indicated that the flows face south or southwest. They strike somewhat south of east, and dip 45 to 80 degrees north. Schistosity is rather well developed, and so far as determined is, in general, parallel to the bedding.

Along the southeast corner of this triangular block, east-striking, pillowed, basic lavas occur northwest of a linear ravine. Across the ravine, directly on strike, are large outcrops of acid lavas. The ravine apparently marks the course of another northeast-trending fault. Northeast of Wasa Lake its course is not known, but it may swing into a more easterly direction to join the Wasa Lake shear in the east half of the township.

The rock distribution in the vicinity of the east end of Wasa Lake seems to require the existence of a north-striking fault. As has been explained in connection with the Cobalt series, this possible fault strikes southward into a narrow slot through Kekeko Hills, and the rocks along the slot walls, though of Cobalt age, have well-developed north-striking schistosity, as though the Cobalt itself had been faulted.

East-west Shear Zones

The principal east-west shear zones in this area are the Francoeur-Arntfield shear zone, the Wasa Lake shear zone, and the Lake Fortune shear zone. The Cadillac-Bouzan Lake shear zone, well known in and east of eastern Beauchastel township, probably is hidden below Cobalt rocks in western Beauchastel. The Wasamac shear, an east-west shear zone of moderate size, is exposed south of Wasa Lake.

Francoeur-Arntfield Shear Zone

This shear zone can be traced westward, by mine workings and diamond-drill data, from Arntfield No. 3 shaft through Francoeur property to the west boundary of Beauchastel township. Farther west it curves to strike southwest. It has been followed, by diamond drilling, through Arncoeur ground nearly to Desvaux Lake, in Dasserat township, or a total distance west of Arntfield mine of about $3\frac{1}{2}$ miles. East of the mine it has been followed by mine workings for about 1,200 feet. From there it is projected east, on the basis of magnetometric data, to meet the Horne Creek fault, as shown on Map 45-17B.

For most of this distance the shear zone dips 45 to 60 degrees north. It lies along or near a contact between acid lavas and pyroclastic rocks on the north and basic lavas on the south. East of Arntfield mine, the rocks that form the hanging- and foot-walls are not exposed near the shear zone, but areal distribution suggests that the situation may be the reverse, with acid lavas in the foot-wall and basic in the hanging-wall, as indicated on Map 45-17B. This is admittedly only a guess.

The shear zone ranges in width, according to MacKenzie,[1]

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1 MacKenzie, G.S.: Fortune Lake and Wasa Lake Map-areas, Dasserat and Beauchastel Townships; Que. Bur. of Mines, Geol. Rept. No. 5, p. 23 (1940).

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up to 150 feet. It consists of highly schistose, carbonatized material that grades into dull reddish or pink, massive, siliceous rock mineralized with small, scattered cubes of pyrite and some gold.

On Francoeur ground, the shear zone, which there dips 60 degrees north, is reported to be cut by a persistent fault that dips 45 degrees north.

Wasa Lake Shear Zone

A shear zone, now known as the Wasa Lake shear zone, was discovered by diamond drilling, under the direction of Dr. J. E. Gill, in the spring of 1944. The shear was first intersected in lot 30, range V, at a point about 600 feet south of lot post 29-30. It is covered by some 60 feet of overburden. To the east, the zone is now known to extend at least to lot 42. Westward, it has been followed by drilling for 1,400 feet, that is, to the middle of lot 28.

Magnetometer data indicate that it probably continues farther, and may have been intersected by a hole drilled southward from a point about 500 feet south of the main highway near Aldermac station. West of that point its course is not yet known. The eastern extension of the shear zone strikes 8 to 10 degrees south of east; the western extension strikes about 35 degrees south of west, and the ore-bearing section is found in the part of greatest flexure. The zone dips about 49 degrees north, and ranges in width from about 20 to 150 feet, the widest parts so far known being found in the curved section. The zone follows along or near a contact between acid lavas on the north and basic lavas on the south, precisely as does the Francoeur-Arntfield shear. The sheared material in the Wasa Lake zone is likewise quite similar in appearance, character of alteration, mineralization, and gold content to that at Arntfield and Francoeur. It seems reasonable on these grounds to suppose that they were once parts of a continuous shear zone. However, the course of such a continuous shear, if it existed, is not known, as yet, across the intervening 2 miles. Nor is it known whether or not these east-west shear zones are offset along the northeast-striking faults, which, if they are continuous, must be encountered.

Lake Fortune Shear Zone

This shear zone was well described and figured by Bruce,[1] and those interested in the character of alteration and

1 Op. cit., pp. 62-64.

mineralization should refer to his report. The principal features to be reported here concern the possible extensions of this shear zone both east and west.

The shear zone dips 50 to 60 degrees north, and, according to Bruce, ranges from 30 to 300 feet wide. East of the east end of Lake Fortune it is well exposed along the main highway, and can be followed for some 1,200 feet east of the lake. There it reaches low ground, but, as described in connection with the MacKay Lake fault, it may be offset 1,500 feet north to extend east to the Horne Creek fault as indicated. East of the Horne Creek fault its course is not known.

Westward the shear zone can be traced for 1,500 feet along the south shore of the lake. The zone strikes nearly due west, and as the shore curves gently southward the shear gradually disappears below the water. Farther west its course was not known, although MacKenzie[2] suggested that a shear zone

2 Op. cit., p. 16.

exposed just east of Samia (McDonald) Lake lay along its course. With this suggestion the writers agree, but are inclined to doubt whether the shear exposed east of Samia Lake extends directly east across the isthmus to Lake Fortune, as supposed. It is true that sheared rocks are exposed in a trench on strike about 600 feet west of Lake Fortune, but the intensity of the shearing, the amount of carbonatization, and the width of the shear zone are all substantially less than in the zone near Samia Lake. Furthermore, the eastern shear zone virtually disappears 50 feet west of the old trench, and trenching last summer along the shore of Lake Fortune on strike revealed only moderately sheared rocks that bear no resemblance to the Lake Fortune shear zone exposed at the east end of the lake. Nor does the strike of the schistosity in the westernmost exposures of the main shear zone, near the Dasserat-Beauchastel boundary, show any tendency to deviate from its east-west course, as it should if it were to join with the supposed shear zone. With the discovery, last season, of a probable northeast fault that should cut off the shear about halfway between Samia and Fortune Lakes, there is a reasonable chance that it offsets the shear, left hand, about 1,000 feet, and that its continuation east of the Lake Fortune shear should occur under the lake near the south shore.

Cadillac-Bouzan Lake-Larder Lake Shear Zone

This regionally important shear zone or zones is now known in Quebec to extend eastward from Beauchastel township to and probably beyond Louvicourt township[1], or over 80 miles.

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[1] Norman, G.W.H.: Geol. Surv., Canada, personal communication.

Recent drilling in lot 45, range IV, has shown that this shear zone does not follow the north flank of Kekeko Hills as previously supposed, but instead lies a few hundred feet south of the north flank, thus being hidden by rocks of Cobalt age. There is, however, a good possibility that it crosses this part of the township beneath a cover of Cobalt rocks. As previously described, there is a valley in the sub-Cobalt surface, between the Olier Lake Archaean window and the north edge of the Cobalt rocks, that is 1,000 feet or so deep. It is reasonable to suppose that this valley was eroded, in pre-Cobalt time, along a shear zone of some size. The fact that deep drilling below Cobalt rocks south of Arntfield cut moderately schistose, mildly carbonatized rocks similar to rocks known elsewhere alongside major shear zones, lends some colour to this supposition.

It should be noted, in passing, that other east-west shear zones probably occur beneath Cobalt rocks. For example, one such may lie along the south flank of the Olier Lake sub-Cobalt ridge. In fact, along the east-west valley, in range II, that contains Donez and Nissaki Lakes, the Cobalt rocks themselves are said to be strongly sheared. The Cadillac-Bouzan Lake-Larder Lake break in this vicinity may actually include several sub-parallel shear zones distributed across a considerable width.

Wasamac Shear Zone

This shear zone is exposed south of Wasa Lake, in range IV, and must not be confused with Wasa Lake shear zone north of the lake, in range V. South of the lake, coarse, massive diorite is sheared and carbonatized in at least three parallel zones that range from 12 to 20 feet wide. Such zones occur in outcrops over a length of 1,300 feet, but their extensions either east or west below drift-covered ground are not known.

MINING PROPERTIES

In the summer of 1944 no ground in the area covered by the present map was open for staking.

Three mines in the west half of Beauchastel township, the Aldermac, the Arntfield, and the Francoeur, have produced ore; the first copper, gold, and pyrite, and the other two gold. On another property, owned by Wasa Lake Gold Mines, Limited, a large tonnage of low- to medium-grade gold ore has been discovered by diamond drilling. In 1944 prospecting by diamond drilling was done on properties held by Renfort Gold Mines, Limited, by Macfort Gold Mines, Limited, by Arntfield Mining Corporation, Limited, by the Horne Fault Prospecting Syndicate, and by Gan Copper Mines, Limited. Prospecting and development work has also been done from time to time on properties in this part of the township by Renown Mining Company, Limited, by Algray Mines (Quebec), Limited, by Wasamac Mines, Limited, and by Senator Mines, Limited, but these companies were inactive in 1944. Other blocks of ground are held by Mr. Redmond Quain, by Nipissing Mines Company, Limited, and by Messrs. Winru and Manolavici.

ALDERMAC COPPER CORPORATION, LIMITED

<u>Reference</u>: Bruce, E.L.: Arntfield-Aldermac Mines Map-area, Beauchastel Township; Que. Bur. Mines, Ann. Rept. 1932, pt. C, pp. 74-86 (1933).

The Beauchastel property of Aldermac Copper Corporation, Limited, consists of 712 acres in ranges V, VI, and VII. The orebodies, now mined out, were found in lot 20, range VI. They consisted of massive pyrite with copper, gold, and silver. A three-compartment shaft was sunk to 1,250 feet, with levels at intervals of 125 feet to 750 feet, and further levels at 925, 1,135, and 1,250 feet. Total production from six orebodies discovered during the life of the mine was 30,845 tons of copper, 10,675 ounces of gold, 389,100 ounces of silver, and 557,400 long tons of dry pyrite. Production commenced in 1929 and ceased in October 1943. The mining plant and 1,000-ton mill have been dismantled. A few hundred tons of pyrite remained to be shipped in 1944.

Examination of the underground workings was impossible. For a detailed description of the geology and orebodies, as known up to 1932, reference should be made to Bruce's report cited above. No later published information is available.

FRANCOEUR GOLD MINES, LIMITED

<u>Reference</u>: MacKenzie, G.S.: Fortune Lake and Wasa Lake Map-areas, Dasserat and Beauchastel Townships; Que. Bur. of Mines, Geol. Rept. No. 5, pp. 24-26 (1940).

This company owns a gold-producing property of 1,250 acres in western Beauchastel township. The mill has a daily capacity of 200-225 tons, but in September 1944 the mill was closed and the ore is now shipped by truck to Noranda for treatment. The deposit has been opened by two inclined shafts: No. 1 to a depth of 615 feet, with levels at 100, 200, 300, and 500 feet; and No. 2, west of No. 1, to a depth of 565 feet, with levels at 190, 315, 440, and 565 feet. Most of the production to date has come from the No. 2 shaft, but in 1944 the No. 1 shaft was re-opened. The mill began operations in August 1938 and total production to July 1944 amounted to $2,500,224 in gold from 387,320 tons of ore, or an average recovery of $6.45 a ton. Ore reserves were estimated on December 31, 1943, at 213,185 tons of ore, carrying 0.222 ounce of gold a ton.

The geological setting and development until 1940 have been described in detail by MacKenzie. The present writers made no examination of the mine workings in 1944. A magnetometric survey was made of part of the property in an effort to delineate a body of diorite, and to trace the course of one of the ore-bearing shear zones, called the No. 8 shear zone. The results of this survey are described in detail elsewhere[1].

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[1] Ambrose, J.W.: Geol. Surv.,, Canada, Geol. Surv. Bull. No. 2 (in press).

In summary, it may be noted that the orebodies at the Francoeur mine occur in shear zones along contacts between acid and basic flows that strike westerly and dip about 60 degrees north. The shear zones are displaced along a fault that strikes parallel to them, but dips 45 degrees north. Gold occurs in reddish to cream, silicified, pyritized sections of the shear zones. Veinlets of quartz and yellowish carbonate cut the silicified material.

ARNTFIELD MINING CORPORATION, LIMITED

References: Malouf, S.E.: Geology of Arntfield Gold Mines, Ltd.; Can. Min. Jour., vol. 59, pp. 427-434 (1938).

Bruce, E.L.: Arntfield-Aldermac Mines Map-area, Beauchastel Township; Que. Bur. of Mines, Ann. Rept. 1932, pp. 64-72 (1933).

MacKenzie, G.S.: Fortune Lake and Wasa Lake Map-areas, Dasserat and Beauchastel Townships; Que. Bur. of Mines, Geol. Rept. No. 5, pp. 22-24 (1940).

This company, which took over the assets of Arntfield Gold Mines, Limited, in 1942, owns 2,110 acres in west-central Beauchastel township. Its predecessor produced gold ore, from July 1935 to April 1942, to a total value of $2,011,755, from 529,987 tons of ore, an average grade of $3.80 a ton. The mill, of 350 tons daily capacity, was dismantled and sold after production stopped.

The orebodies were found along a north-dipping, east-west shear zone, and were opened by three shafts. No. 1, near the west boundary of the property, was sunk vertically to 100 feet, and then at 45 degrees north to 250 feet; the No. 2 shaft, 700 feet east, went to a depth of 1,075 feet on an inclination of 45 degrees to the north; and the No. 3 shaft, 2,000 feet east of No. 2, was sunk to a depth of 1,000 feet, also on an inclination of 45 degrees to the north. The shafts are connected by lateral workings underground, and drifts have been carried eastward along the shear zone from the No. 3 shaft on the 525-, 825-, and 975-foot levels for more than 1,200 feet. The shear zone has thus been opened for more than 4,000 feet of its length and for more than 1,000 feet down the dip. Below the lower levels the shear has been explored by diamond drilling.

The geology of the Arntfield mine is fully described and figured by Malouf. Reference should be made to his report for detailed information.

The new company carried out a vigorous diamond drilling campaign in 1944. Two drills were in operation until late in the season, and one at least continued during most of the winter of 1944-45. The drilling was aimed, first, to find and explore the possible sub-Cobalt extension of the Bouzan Lake-Larder Lake fault zone, and, second, to find and explore the eastward extension of the Arntfield shear zone or the westward extension of the Wasa Lake shear zone.

In the first undertaking, five deep holes were drilled southwards below Cobalt rocks just south of Arntfield. Inclinations of the holes ranged from 34 to 62 degrees, and inclined depths from 1,125 to 1,400 feet. Moderately sheared, carbonatized volcanic material was encountered near the bottoms of these holes. Quartz veins with some pyrite were cut, and some encouraging returns in gold were obtained. However, the difficulty and expense of such deep drilling resulted in the work being abandoned.

In the second undertaking, exploration was directed to a drift-covered area east and northeast of Arntfield. Unfortunately, heavy, boulder-filled overburden was encountered and progress was slow. In late September the drill was moved eastward beyong the main drift area and a hole was drilled southward. At the time of writing the results from this or later holes had not been learned by the writers.

In an effort to aid in outlining the geology of the claims a magnetometric survey was undertaken[1]. Some intrusive

[1] Ambrose, J.W.: op. cit. (in press)

bodies were delineated, and suggestions were obtained as to the courses of the major faults.

WASA LAKE GOLD MINES, LIMITED

<u>Reference</u>: MacKenzie, G.S.: Fortune Lake and Wasa Lake Map-areas, Dasserat and Beauchastel Townships; Que. Bur. of Mines, Geol. Rept. No. 5, p. 18 (1940).

This company, originally incorporated as La Mine d'Or Champlain, Ltee, changed its name to its present form in March 1944. The company now holds a group of twenty-eight claims that straddle the north-south centre line of the township, in ranges IV, V, and VI.

In the early work on the property, a two-compartment shaft was sunk to 220 feet in lot 30, range V, 1,700 feet south of the east-west centre line, to investigate a gold-bearing zone outlined by diamond drilling. The zone is reported to contain in the neighbourhood of 30,000 tons of ore, which contains an average of 0.20 ounce of gold a ton.

In April 1944 an extensive diamond drilling campaign was started under the direction of Dr. J.E. Gill. This was aimed to explore a drift-covered area between the original showing and the east-west centre line. A wide shear zone that contains gold-bearing ore was intersected in the first drill hole.

By December 1944 seventeen holes had been drilled. The ore-bearing zone, up to 120 feet wide, had been traced 2,400 feet along the strike. Deep drilling intersected the ore zone 1,275 feet down the dip. The company reports that two orebodies have been outlined within the shear zone, one about 1,400 feet long, containing approximately 4,000 tons a vertical foot, and another about 500 feet long, containing about 500 tons a vertical foot. It is expected that the average grade will be between $5.50 and $6. a ton.

Recent diamond drilling in the eastern part of the property, beyond the limits of the present map-area, is reported to have intersected gold-bearing shear zones. Drilling is being continued.

RENFORT GOLD MINES, LIMITED

Reference: Bruce, E.L.: Arntfield-Aldermac Mines Map-area, Beauchastel Township; Que. Bur. of Mines, Ann. Rept. 1932, pt. C, pp. 59-64 (1933).

This company holds twenty-four claims and, under concession, three blocks around Lake Fortune.

The principal showing on this ground consists of the well-known Lake Fortune shear zone, described above. This shear zone, as noted, carries some gold, and, since 1907, several companies have attempted to outline commercial orebodies in it. One shaft was sunk at a point about 800 feet east of Lake Fortune, and another on the shore of the east end of the lake. The second shaft was sunk to 150 feet, and at that level some 550 feet of lateral work was done. Operations ceased in 1933 and were not resumed until 1944. That year, following organization of the new company, an extensive program of geological mapping and diamond drilling was carried out. Two diamond drills were in operation until late in the autumn, one engaged in drilling a series of short, closely spaced holes in the shear zone near the old workings, and the other in cross-sectioning the property and obtaining other geological information. Drilling in the shear zone obtained some gold, but its distribution appears to be spotty, and no orebody was outlined. At last report, drilling on this zone was continuing, the drill having been moved westward during the winter to operate from the ice.

In the latter part of the summer the shaft at the lake shore was being dewatered in order that the old workings might be re-examined.

The second drill obtained much information that was of great assistance in solving some of the geological problems. A cross-section from north to south was started with a hole drilled southwards from a point near the south shore of Mud Lake. A wide zone of moderately sheared, carbonatized rocks was encountered, and is believed to be on the extension of the Lake Fortune shear zone east of the Beauchastel fault. The cross-section was continued to extend well below Renaud Lake, but no other shear zones of interest were intersected. Two vertical holes were drilled in Cobalt rocks, one on the south shore of Renaud Lake, in lot 6, and the other on the east shore, in lot 9. Both of these were drilled to depths of more than 650 feet, and both remained in rocks of Cobalt age throughout. As noted in the section on the Cobalt series, it is not unlikely that the sub-Cobalt surface at its deepest point may be 1,000 feet or so below the level of Renaud Lake.

MACFORT GOLD MINES, LIMITED

Reference: MacKenzie, G.S.: Que. Dept. Mines, Geol. Rept. No. 5, p. 21 (1940).

This company, formed in 1944, acquired the McLaren claims situated about Samia (McDonald) Lake. The claims, all in Dasserat township, lie west of those held by Renfort and south of Arncoeur ground. Much of the claim area is covered by Samia and Fortune Lakes, but exposures in the remaining land areas are fairly abundant. Enough has been learned from these, from diamond drilling, and from a magnetometer survey, to reveal several interesting structural possibilities.

Two main showings have been found on the claims, one west of Samia Lake and the other between Samia and Fortune Lakes. Only the latter was examined during the course of the present work.

The showing between Samia and Fortune Lakes is exposed in trenches just east of Samia Lake, and consists of two parallel shear zones about 30 feet apart. The shear zones strike east and dip 50 to 60 degrees north. The southernmost of the two occupies a sharp valley; it consists of a 20- to 30-foot belt of well-sheared and carbonatized, rusty weathering volcanic rocks with some coarse pyrite. Volcanic breccias and pillowed andesites form a ridge along the foot-wall of the zone. The hanging-wall that separates this zone from the parallel shear to the north consists of volcanic breccia. Although no gold has been reported from this shear, it is important because of its structural significance. In appearance and character it strongly resembled the Lake Fortune shear zone as exposed at the east end of Lake Fortune. Eleven hundred feet east, directly on strike, sheared rocks are exposed in a trench, and the natural inclination has been to correlate these with the shears farther west. However, the eastern material is very different in intensity of shearing and carbonate content. Furthermore, it virtually disappears within 100 feet to the west of the trench, and exploration eastward on the shores of Lake Fortune failed to reveal a comparable zone. The main shear, consequently, does not appear to continue eastward as previously supposed; instead its continuation must be looked for elsewhere.

Evidence is accumulating to show that the main shear encounters a northeasterly striking cross fault about 800 feet east of the trenched area, and that it is offset, left hand, along it for about 900 feet. The evidence is, first, that a cross fault in this vicinity with left-hand offset of about 1,200 feet is indicated from distribution of a diorite body north of Lake Fortune. The course of this fault south of the lake is indicated by the distribution of a body of diorite partly exposed and partly outlined by a magnetometric survey. Second, two small northeasterly striking faults are known to cross the narrow isthmus between the two lakes. These are probably branches of the larger cross fault. Third, a strong northeasterly striking cross fault offsets the Lake Fortune shear in the same sense about 1,300 feet east of Lake Fortune. The eastward continuation of the main shear east of the cross fault is, therefore, most probably to be found under Lake Fortune near its south shore. As gold can be panned from carbonatized rock along the most southeasterly branch of the cross fault at a point halfway between the two lakes, gold mineralization is later than the cross faulting. Therefore, the section of the main shear, where it encounters the main cross fault either on the mainland or below the lake, should be favourable prospecting ground.

Attention has been directed to the trenched section just east of Samia Lake, mainly by reason of the northern shear zone. This zone lies along the contact between massive diorite on the north, or hanging-wall, side and volcanic breccia on the south. The zone is crossed by five trenches and is stripped lengthwise in one place for 40 feet. It consists of carbonatized, sericite-chlorite schists cut by irregular quartz veins and mineralized with disseminated pyrite. Sections of intensely sheared rocks alternate with others moderately sheared over a width of 20 feet or so. The most interesting part of the zone so far exposed is to be seen in the second trench east of the lake. There the rock has been blasted to open a section about 50 inches wide, composed, from north to south, of 10 inches of white quartz, 20 inches of sericitic carbonatized schist, and 20 inches of dark streaky grey, well-fractured quartz.

Finely divided pyrite is moderately abundant, and some specks of chalcopyrite are to be found. Molybdenite is conspicuous, especially near and in the grey quartz. Grab samples from this zone are reported to assay up to 1 ounce in gold a ton. The best samples apparently come from the grey quartz, and the foot-wall part of the vein. Eastwards the grey quartz vein pinches out within 10 feet; westwards it is drift covered, but does not appear in a trench 100 feet west on strike.

Much diamond drilling has been done on this property on both sides and north of Samia Lake. An old drill hole, of which no records are available, was collared 100 feet north of the richest trench and was drilled southerly at 47½ degrees. About 1937, five holes were drilled, one under the main showing, two others along its supposed western extension, one east of the main showing, and a fifth below the trench 1,100 feet east of the main showings. In the autumn and winter of 1943 further diamond drilling was done on this property. One hole drilled through the ice of Samia Lake just west of the east shore showed that the carbonatized shear zone extended in that direction, probably being offset near shore a few feet on one of the northeast faults. The remainder of the drilling was done to explore other zones, mostly west and north of the lake.

In the summer of 1944, the present company drilled five closely spaced short holes below the main showing. An assay of more than 1 ounce in gold a ton across 18 inches was obtained in one hole, but other returns were low. A fifth hole was drilled through the gold-bearing northeasterly fault near the main showing. This drilling has so far failed to reveal any commercial orebodies, although good assays may be obtained in places. Some possibilities, as noted above, remain to be investigated east of Samia Lake.

HORNE FAULT PROSPECTING SYNDICATE

This syndicate, under direction of Mr. Cyril T. Young obtained control of a group of seven claims west of those held by Wasa Lake Gold Mines, Limited. Adjacent ground west and south of these claims is held by Aldermac Copper Corporation, Limited, and by Arntfield Mining Corporation, Limited. The Horne fault claims lie astride the Nipissing Central Railway and include Aldermac siding.

During 1944 five "E" core diamond-drill holes, to a total of approximately 3,000 feet, and a number of X-Ray drill holes were put down to explore this ground. Three of the larger holes were drilled southwards across the low ground followed by the railroad. Each of these cut the Horne Creek fault, and some wide sections of pyritized, varicoloured, silicified rhyolite were cut, but returns in gold were disappointing. Another was drilled northwestwards below a drift-filled valley between two areas of outcrops. The fifth hole was drilled southwards at an angle of 50 degrees from a small hill in lot 26, range V, 625 feet south of Aldermac loading platform. This hole intersected from 380 to 401 feet of sheared, bleached andesite with a moderate amount of fine, disseminated pyrite. Small quartz and carbonate stringers cut the sheared material, and some acicular tourmaline is present. Although the sheared material is less silicified than that of the Wasa shear zone, the two are not unlike and may be correlative. This correlation is suggested on the accompanying interpretative map (Map 45-17B).

GAN COPPER MINES, LIMITED

This company holds a group of fourteen claims in lots 10 to 20, rge. VII, Beauchastel tp. The claims adjoin the north side of a group held by Algray Mines (Quebec), Limited. The geology of the Gan group was examined by W.S. Robinson in 1939 and by G.F. Flaherty in 1943. The writers had access to reports by both of these men. In 1944 a diamond-drilling program was carried out. Some twelve holes were drilled to a total footage of about 10,000 feet.

The present examination covered an area that extends 3,400 feet north of the southern boundary of range VII in lots 10 to 17. This area includes only the southern part of the Gan group of claims.

The geology within these claims, and those of the Algray property to the south, is complex. The principal feature of interest is a triangular area of dalmatianite in lots 14, 15 and 16. The base of the triangle of dalmatianite is about 1,000 feet long, north to south, and rests with probably faulted contact against porphyritic syenite on the east. The apex of the triangle is some 1,200 feet west of the base.

The rocks in which dalmatianite has formed, traced beyond the limits of dalmatianitization, prove to be rhyolite flows and pyroclastic rocks, strongly chloritized for several hundred feet on all sides of the dalmatianite area. The strike of the lavas, well delineated by an horizon marker of chloritized and dalmatianitized rhyolite breccia near the north boundary of the Algray claims, is nearly east. The breccia bed does not dip north, as is demonstrated by its failure to appear in a diamond-drill hole driven southward in lot 15. It probably dips 70 to 80 degrees southwards. The attitude of some highly altered pillow lavas, exposed on or near the south contact of a large diorite sill across the north part of the claims, is similar to that of the breccia. The flows face south.

The breccia bed is underlain on the north by a sill (or flow) of massive rhyolite, 450 feet thick. This rock, although dalmatianitized in part, was much more resistant to alteration than were the adjacent flows.

The altered rhyolites are crossed from southeast to northwest by a dyke of younger diabase up to 100 feet wide. The dip of the dyke is unknown.

A thin seam of chalcopyrite was discovered in lot 15, about 2,100 feet north of the range VI-VII line. Extensive trenching and diamond drilling in that vicinity failed to reveal any commercial deposits. The present investigation indicates that, aside from the northern part of the claims, some structural possibilities remain to be investigated.