CANADA
DEPARTMENT OF MINES
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GEOLOGICAL SURVEY OF CANADA

PAPER 47-12

VAUQUELIN, PERSHING, AND HAIG TOWNSHIPS

ABITIBI COUNTY
QUEBEC

(REPORT AND MAP)

By

G. W. H. Norman

OTTAWA
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(Summary Account)

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Illustration

Vauquelin, Pershing, and Haig Townships,

Abitibi County, Quebec

INTRODUCTION

Vauquelin, Pershing, and Haig townships extend east for 30 miles from the Montreal-Mount Laurier-Senneterre highway, No. 58, 18 miles south of Senneterre and 19 miles east of Val d'Or. Starting from Louvicourt Bridge on highway No. 58 a good water route by way of Sleepy Lake, Bell River, Lac Simon, Lac Gueguen, Marquis River, Lac Blanchin (Garden Island Lake), and Matchi-Manitou Lake gives access to most of Vauquelin and Pershing townships. This route is interrupted by a $\frac{1}{2}$-mile portage between Lac Simon and Lac Gueguen and by a $\frac{1}{4}$-mile portage between Lac Gueguen and Garden Island Lake. Haig township is accessible by Marquis River, which flows west across the centre of the township and then to its southwest corner and on to enter Matchi-Manitou Lake. This stream is small and has numerous rapids. The northeast corner of the township can be reached by way of a chain of lakes with connecting portages from Marquis River, and the northwest corner by way of Assup and Megiscane Rivers from the railway 9 and 22 miles respectively east of Senneterre. A motor road extends 18 miles southward on the east side of Bell River from Senneterre and then southeastward to the Croinor Pershing mine in northeast Pershing township. This road crosses a stream near its mouth at Lac Gueguen and passes close to Garden Island Lake, thus affording another easy road connection with the water routes through three townships.

Early geological work[1] showed that the greater part of the

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1 Bell, L.V., and Bell, A.M.: Bell River Headwaters Area; Dept. of Mines Quebec, Ann. Rept. 1931, pt. B, pp. 59-123.

Bell, A.M.: The Assup River Map-Area: With prospects in Vauguelin and Tiblemont Townships, Abitibi County; Dept. of Mines, Quebec, Ann. Rept. 1932, pt. B, pp. 63-92.

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area was underlain by belts of Keewatin and Timiskaming volcanic and sedimentary rocks similar to those westward toward Rouyn and similarly cut by bodies of diorite, granite, and related rocks, and that these rocks terminated abruptly against an entirely different terrain of gneisses, whose boundary extends diagonally northeast across the centre of Haig township. Later, Tolman[2] mapped the

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2 Tolman, Carl: West Part of Vauquelin township, Abitibi County; Dept. of Mines, Quebec, Geol. Rept. No. 6.

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western half of Vauquelin in more detail, and was able to make further subdivision of the rocks.

From 1939 to 1944 the Geological Survey, Department of Mines and Resources, Ottawa, gradually extended detail mapping in the Malartic-Val d'Or mining camp eastward from Malartic to the Louvicourt-Vauquelin township boundary. The accompanying map embodies the general results of field work in 1946 eastward from

this boundary to Haig township, where the typical Keewatin, Timiskaming, and associated rocks end against gneisses. The mapping was done by three separate parties under the immediate direction of H. C. Norman in Vauquelin, Marcel Tiphane in Pershing, and K. R. Dawson in Haig townships respectively, and to these men much of the credit for the present mapping of the area is due. The writer co-ordinated the work of the three parties with the valuable assistance of A. S. MacLaren, who also mapped a part of northwest Vauquelin. C. K. Bell, D. C. Bulmer, P. R. Eakins, J. F. Macdougall, R. C. Oulton, R. L. Slavin, and R. J. Terroux gave exceptionally good assistance as members of the three mapping parties.

To members of the mining fraternity actively engaged or interested in the area, and to the Quebec Department of Mines, especially W. N. Ingham, resident geologist at Val d'Or, acknowledgments are due for information received, in the form of plans of properties or specific information concerning drilling results and for other courtesies too numerous to mention. Receipt of this information was a large factor in completing the mapping, particularly in the northern half of Pershing township. The detail plans of eight properties that were very kindly furnished by J. H. Norrie and H. Parliment showed the locations of outcrops and picket lines throughout that part of the area, and were invaluable. Mr. Parliment also kindly supplied his notes of a surveyed line across northern Pershing, which materially increased the accuracy of the resulting maps. H. S. Wilson very kindly supplied plans of diamond-drill holes and outcrops of Regcourt and adjoining properties in western Vauquelin, and R. G. Hoiles of the Chimo property in southwestern Vauquelin. Use was also made, in drawing some geological boundaries, of the accurate magnetic maps prepared by Koulomzine and his Company, by J. Randall, and by the Mining Corporation of Canada. These were particularly valuable in tracing iron formation across south Vauquelin. Base maps for the geological work were prepared by the Topographic Division, Bureau of Geology and Topography, Ottawa, from aerial photographs.

Maps of Vauquelin, Pershing, and Haig townships have been issued separately on the 1,000-foot scale to show outcrop relationships and information obtained from diamond-drill holes. The accompanying 1-mile map consolidating this information brings out overall relationships and correlations and may draw attention to some unsolved problems. The summary account has been prepared to supplement the 1-mile map with a brief discussion of the rocks, their structure, and other factors bearing on mineral deposition and discovery.

SURFACE FEATURES

The surface features of the area show very little relief, except in southeastern Haig township and directly southwest and southeast of the wide expanse of Matchi-Manitou Lake. There, hills stand 200 to about 400 feet above the general, plain-like surface, and have been indicated on the 1,000-foot maps by form lines. The relief, however, bears very little relationship to amount of rock exposed, because high and prominent ridges and hills may be well mantled by overburden, whereas series of low hummocks in flat areas may consist mainly of rock.

Surface deposits become increasingly more sandy in composition eastward from Vauquelin township, and in Haig township sand, either in low-lying belts or prominent esker ridges, covers large areas. The sand was deposited as outwash along the margin of,

or in channels within, the melting Pleistocene ice-sheet. The smaller eskers wind irregularly south across the area to join a large compound esker-outwash deposit that trends southwest across the centre of Haig township. This arrangement may indicate that the melt water from the wasting ice-sheet was flowing southwest toward Ottawa River basin and thence to the St. Lawrence. This in turn may imply that melting of the ice was more rapid upstream along Ottawa River basin than in adjoining parts. As a consequence, the ice directly south of Ottawa River would be cut off from the main body of ice to the north and become stagnant. The boundary between this stagnant mass and the main ice body would be extended with further melting northeast across Haig township. In this inferred sequence of events the course of the ice-front of the northern ice-mass could change only slightly in the Vauquelin-Haig area, and glacial striae, which are believed by many to be cut at right angles to the ice-front, would remain fairly constant in direction. A more rapid recession of the ice-front northward along the Harricanaw and Bell River basins than elsewhere in areas to the west and northwest would tend to change the course of the ice-front and produce a more irregular pattern of striae. The preserved glacial striae in the Vauquelin-Haig area diverge very slightly east or west from south, unlike areas to the west where intersecting sets are common and support the foregoing analysis. The southerly direction of striae can, therefore, probably be used with some confidence in tracing float back to its source, except perhaps in the southeast part of the area where the ice may have stagnated or even locally moved northwestward.

GEOLOGY

General Statement

The boundary in Haig township between easterly trending Keewatin and Timiskaming rocks, which are a part of the Timiskaming sub-province of the Canadian Shield, and northeast-striking gneisses, which are a part of the Grenville sub-province, is concealed by a belt of sand $\frac{3}{4}$ to 1 mile wide. The boundary is inferred to be a faulted one, because of the great change in lithology and grade of metamorphism and the obvious structural discontinuity that it marks. The rocks on either side of the boundary have, therefore, been classified separately to indicate that their age relations are entirely unknown. However, the coarse-grained, garnetiferous biotite paragneiss southeast of the boundary in Haig, though coarser grained, is very similar in composition to garnetiferous, biotite-rich, recrystallized greywacke that occurs as local phases in the belts of Keewatin-Timiskaming sedimentary rocks on the northwest side of the boundary, and is perhaps a more highly recrystallized phase of these rocks.

Keewatin and Keewatin-Timiskaming Groups

The Keewatin volcanic rocks of the area are an eastward extension of belts of similar rocks present in Dubuisson, Bourlamaque, and Louvicourt townships to the west. A composite section of these rocks, as built up from regional studies, would appear to be, in ascending order, beginning with the oldest, as follows:

(1) A thick group of normal andesite flows, with little if any interbedded tuff.

(2) An interbedded, interfingering group of flows, ranging from andesite or dacite to trachyte, with tuffs and agglomerate of approximately the same compositions. Many of the flows of this group show peculiar features such as variolitic (spherulitic) structures, abnormally large quartz-filled amygdules, coarsely porphyritic phases, abnormally wide or prominently selvaged pillow structures, in places with felsitic cores, and members of these distinct types can be traced for miles.

(3) An interbedded group of normal andesite, tuff, and agglomerate. This group consists almost entirely of andesite in places, and in others of agglomerate or tuff.

No change in grade of metamorphism can be observed in passing eastward along the volcanic belts in northern Vauquelin, Pershing, and Haig townships up to the boundary with the gneisses. The volcanic rocks of the southern belts, however, show a very marked amphibolitization in southeast Vauquelin and the adjoining part of Pershing township. Similar intense amphibolitization of volcanic rocks of the Timiskaming sub-province in Fiedmont township, 20 miles northwest, and elsewhere, suggests that this alteration is due to local factors and cannot be ascribed to the proximity of these rocks to the region of higher grade metamorphism to the southeast.

Determinations of the upper side of beds in the volcanic rocks of northern Vauquelin, Pershing, and Haig townships and in west-central Vauquelin strongly suggest that the volcanic rocks of the northern and central parts of the area underlie the sedimentary rocks classed as Keewatin-Timiskaming. A contact between schistose andesite and greywacke, with interbedded conglomerate, occurs on the Boycon property, northeast Vauquelin, and another between andesite and conglomerate is exposed on the north side of the sedimentary belt across the Raymond-Tiblemont property in the southwest part of the township, but both contacts are too sheared to indicate primary stratigraphic relationships. The distribution of conglomerate is indicated on the accompanying map. Conglomerate occurs in the area in the northern sedimentary belt and in a narrow belt separated from the most southern belt by volcanic rocks, except perhaps in southeast Pershing township. The relationships between the greywacke and volcanic rocks along the south side of Vauquelin is very imperfectly known, and most of the information there regarding their contacts is derived from diamond-drill cores. The observed relationships would seem to be explained equally well by assuming either close infolding, or interbedding, of greywacke with volcanic rocks. In Rouyn township, much farther west along the belt, an unconformity has been observed between a conglomerate-greywacke group similar lithologically to that in Vauquelin township and underlying andesite, and rocks above this unconformity have been classed by Wilson[1] as Timiskaming.

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[1] Wilson, M.E.: The Early Precambrian Succession on Western Quebec; Roy. Soc., Canada, Trans. Third Series, Sec. IV, vol. 37, p. 124 (1943).

A greywacke group in southern Rouyn township is classed by Wilson as pre-Timiskaming, and this group has been traced continuously

east from Rouyn to Vauquelin township. The probability, therefore, that the Archaean sedimentary rocks of the area may belong to two distinct age groups, although these cannot be readily separated, is indicated by classing these rocks as Keewatin-Timiskaming.

Data on the distribution of iron formation, shown on the map, were derived largely from magnetic surveys, by which such rocks are easily detected due to their high magnetite content. These bands undoubtedly help to reveal the structure as local horizon markers. Between Cadillac and Pershing townships, however, they occur at apparently quite different horizons, as follows: in Cadillac township, in the Cadillac group of greywacke and conglomerate; in Malartic township, in the basal part of the northern belt of the Kewagama greywacke; in northern and southeastern Pershing township, with greywacke having interbedded conglomerate; and in south Vauquelin township, within a band consisting perhaps of alternating highly altered greywacke and volcanic rocks.

Archaean Intrusions

Diorite, and periodotite, which is altered to amphibole, talc, serpentine, and magnetite aggregates and to talcose schist, are probably the oldest Archaean intrusive rocks, and form sill-like masses for the most part parallel with the enclosing volcanic flows and tuffs. Though not fully exposed in the area they seem to occur as smaller bodies and to be much less common than in Louvicourt township and in townships to the west.

The diorite porphyry masses along the south side of Lac Gueguen are comparable with the diorite porphyry bodies that occur in a zone of volcanic rocks about 1½ miles wide in Bourlamaque township east from Lamaque and Sigma mines, and directly south of the Bourlamaque batholith. The volcanic rocks of this zone include coarsely porphyritic andesite to andesite-trachyte flows, and agglomerates with porphyritic andesite to trachyte fragments that are very similar to the volcanic rocks associated with the porphyritic diorite at Lac Gueguen. Indeed the similarity is so great that the porphyritic volcanic group at Lac Gueguen may be inferred to be a direct continuation eastward of this Bourlamaque zone. On earlier maps a large area along the south side of Lac Gueguen was shown as undifferentiated diorite or quartz diorite porphyry, with some quartz monzonite porphyry. The rocks of this area, on the 1,000-foot map of Vauquelin township, have been much subdivided, and include, besides fine-grained granodiorite, feldspar and quartz-feldspar porphyries, and diorite porphyry, a large proportion of unusual volcanic rocks. The two main types of volcanic rocks are very coarsely porphyrytic andesite flows, with large pillows having felsitic selvages, associated flow breccias, and unbedded breccias containing small to large unsorted fragments of felsite, and andesite porphyry contrasting very obviously one with another in the amount and size of feldspar phenocrysts. The porphyritic volcanic rocks are followed to the south by well-bedded tuffs and breccias with feldspar phenoclasts prominently developed, and the diorite porphyry forms intrusive bodies of various size, mainly in these pyroclastic rocks.

Fine-grained, dark, basic dykes, 1 foot to 10 feet wide, are very common in the volcanic rocks south of the greywacke in northwest Vauquelin township. Similar dykes are common in the Bourlamaque batholith and in the volcanic rocks east from the batholith to Vauquelin township.

The more siliceous intrusive rocks comprise a wide range of quartz-feldspar and feldspar porphyries, hornblende granite, hornblende syenite, and biotite granite. Biotite granite occurs only along the north border of Vauquelin township and in northeastern Haig township. The Vauquelin mass is the most southern fringe of the Tiblemont-Pascalis batholith, which extends northwest for about 20 miles to Fiedmont township. It is a quartz-rich type, probably with albite as the principal feldspar constituent, and has a faintly cataclastic texture due to deformation. Strongly sheared, coarse, quartz-feldspar porphyry dykes and irregular bodies occur principally in northern Pershing and Vauquelin townships and to a less extent in west-central Vauquelin, and are seemingly related to the biotite granite. They do not occur or are very rare in the townships west of Vauquelin, but are to be found westward from the Tiblemont-Pascalis batholith in Barraute and Landrienne townships. These porphyries weather pale grey to white, have numerous glassy quartz phenocrysts 1/8 to 1/2 inch in diameter, and resemble quartz porphyry of the Porcupine camp in Ontario. Feldspar phenocrysts are common in these rocks, and may appear more prominently than the quartz. The biotite granite in northeastern Haig township is the southwestern part of a large mass. The boundaries of this mass are concealed by sand in Haig township and can only be defined with a wide margin of error. In the few outcrops where this granite is exposed it shows a well foliated structure.

A suite of light-coloured intrusive rocks forming dykes of fine feldspar porphyry, coarse feldspar porphyry with sparse quartz phenocrysts, and small, irregular bodies of fine, even-grained granodiorite, with in places angular greenstone inclusions, is very common on the Russian Kid property at the south end of the west arm of Lac Gueguen. Similar dykes trending for the most part southeast occur in nearly all outcrops east from this property and between Baie Vauquelin and the greywacke belt 1½ miles south. The Regcourt mass, which is a light-coloured, fine-to medium-grained, feldspar-rich rock, probably belongs to this group. On the Russian Kid property the light-coloured suite of intrusions is cut by a series of extremely coarse, quartz-bearing, feldspar porphyries that contain numerous small hornblende phenocrysts and resemble the coarse feldspar porphyries associated with the syenite mass in the centre of Bourlamaque township.

The hornblende granite and syenite of the area belong to the microcline-bearing suite of intrusions that are well developed to the northwest in Lacorne, La Motte, and Preissac townships. In the latter townships the microcline-bearing suite includes large masses of pegmatitic and muscovite granite, which are present as dykes in southeast Pershing township. Spodumene and fern-like aggregates of scaly muscovite, secondary after spodumene, occur in some of the Pershing pegmatites and resemble occurrences of these minerals in La Motte and Lacorne townships. Hornblendite, in places with pyroxene and/or biotite, is developed along the northern and western margins of the hornblende granite at Baie Vauquelin and Lac Gueguen. This rock occurs also as dykes and small bodies within the band of greywacke that crosses northern Vauquelin and northeast Louvicourt townships, and in places passes gradually into a diorite with increasing feldspar content in which the only dark-coloured mineral is biotite.

Proterozoic Diabase

The Proterozoic diabase dykes of the area belong apparently to two main sets. One set, which is poorly exposed in southeast Vauquelin township, trends slightly north of northeast, perhaps parallel with a large diabase dyke across the centre of Louvicourt township. The other set trends very slightly north of east and appears to step north en échelon eastward. This set is exposed in northeast Pershing and southwest Vauquelin townships. The latter occurrence lines up well with a series of diabase dykes that have been traced across southern Bourlamaque and Louvicourt townships. These dykes produce fairly strong negative magnetic anomalies in the latter township, and a similar negative anomaly has been found in the southern part of the southwest arm of Lac Gueguen. It seems most probable that this system of diabase dykes extends continuously from Lac Gueguen to northeast Pershing, although not exposed in eastern Vauquelin and western Pershing townships.

STRUCTURE

Folds

The Keewatin volcanic rocks of the area alternate with the Keewatin-Timiskaming greywacke and interbedded conglomerate as belts that extend east to end abruptly against gneisses with a general northeast trend. In Haig township and northeast Pershing these belts swing southeast with marked angular discordance to the northeast trend. Determinations of the upper sides of beds in widely scattered outcrops from Louvicourt township east indicate that the greywacke belts of the area, except the most southern one in Vauquelin, are essentially synclinal although perhaps in part with faulted boundaries. In passing eastward the various greywacke belts merge into one mass probably complex in structure in southeast Pershing township, around the southeast end of the hornblende granite of Lac Gueguen, Baie Vauquelin, and Matchi-Manitou Lake. The mergence of synclinal greywacke belts may indicate an easterly plunge, and similarly the volcanic rocks in anticlines between these belts may plunge eastward to disappear.

The structure of the belts of volcanic rocks across the northern part of Vauquelin, Pershing, and Haig townships is imperfectly known. The upper sides of flows in most places in these belts face southward where determined, except for a series of reversals, possibly indicating local folds, determined by K. R. Dawson in the south part of northwest Haig township. The structure of these belts, however, is probably more complicated than the top determinations suggest, and may include more than one important fold and fault.

The structure of the volcanic rocks across the centre of Vauquelin township probably includes several folds. The occurrence of sill-like peridotite bodies in the lowermost andesite group in Vassan, Dubuisson, and Bourlamaque townships, suggests that peridotite and associated andesite in Vauquelin also are part of the lowermost rocks brought up by folding along a narrow anticlinal structure, which is indicated also by top determinations. The eastward extension of the anticlinal structure would pass between greywacke outcrops that occur between Sleepy Lake and Lac Gueguen. The northern greywacke outcrops are part of a synclinal belt that extends continuously west from Haig township to the north boundary

of Louvicourt. Determination of tops in the few greywacke outcrops directly south of the anticlinal extension suggests a synclinal structure, whose extent in concealed by overburden.

The southern-most of a series of drill holes that were drilled to give a cross-section on the east side of Sleepy Lake lies directly west of the inferred axis of the syncline. It passed through first a series of trachytic flows and fragmental rocks, and, south of these, through 170 feet of south-facing tuff or possibly greywacke to the end of the hole at 710 feet. The latter strata are interlayered with black, graphitic, fine-grained ash(?) beds 1 to 6 feet thick, and closely resemble strata cut by diamond drilling on the Rainville copper property $\frac{1}{2}$ mile south of the main road at the Pascalis turnoff 10 miles west in Louvicourt township. The location and attitude of the graphitic beds in Vauquelin township may indicate that they are the lowest member of the greywacke group and on the north limb of the synclinal structure. This structure probably plunges eastward or is faulted, because neither graphitic beds nor greywacke were encountered in the section drilled farther west, west of Sleepy Lake. However, it may continue westward north of the Regcourt granodiorite plug and across Louvicourt township, because the graphitic strata in Vauquelin and Louvicourt townships are along the same general strike, as if they were parts of the same structure.

A belt of south-facing volcanic rocks extends northwest across the south end of Lac Gueguen to pass about 2 miles south of the Regcourt plug and perhaps form the south limb of a major anticline. These rocks compare in composition with those exposed in western Louvicourt and eastern Bourlamaque townships between the east-west centre line and the main road. The southern part of this belt is marked by a series of strong shear zones. These zones may be important faults, which are perhaps also indicated by the marked divergence of strike between these rocks and those exposed farther south.

A belt of greywacke and conglomerate is shown on the accompanying map crossing the north end of Lac Villebon to join a similar belt very poorly exposed 5 miles west in Louvicourt township. This belt is inferred to continue eastward to link up with a narrow belt in which greywacke is poorly exposed across southeast Vauquelin and in which conglomerate occurs near mile post 2 at the Vauquelin-Pershing boundary. If the continuity of this narrow greywacke-conglomerate belt is correctly inferred, it seems probable that the succeeding belt to the south, consisting of andesite, is also a continuous one across southern Vauquelin. The westernmost exposures of andesite in this belt are at the south end of Lac Trivio in the centre of southwest Louvicourt township.

Andesite is well exposed directly south of greywacke and conglomerate in southwest Vauquelin near the western end of the iron formation, and also in numerous outcrops north of this iron formation group in southeast Vauquelin. In southeast Vauquelin, however, the rocks of this inferred andesite belt become increasingly more highly amphibolitized eastward to the Vauquelin-Pershing boundary, and may include, there, irregular bodies of intrusive amphibolite.

The structure of the alternate belts and masses of greywacke and altered andesite along the south border of Vauquelin is imperfectly known. The occurrence of two iron formations in southeast Vauquelin joining westward to form one band has the appearance

of a synclinal structure. The iron formation, however, is here apparently interbedded with volcanic and sedimentary rocks, unlike the iron formation interbedded with greywacke in Pershing township.

Faults and Shear Zones

Two main types of faults are inferred to occur in the area. One type, indicated by strongly sheared zones, is developed parallel with the strike of the Archaean formations; the other separates these formations from the gneisses to the southeast. Undoubtedly smaller faults occur at various angles to the strikes and dip of the formations, but examples of such faults were not observed.

The most northerly of the shear-zone types occurs along the north contact of the northern greywacke belt. This contact has been drilled at several places between Lac Gueguen and the Vauquelin-Pershing township boundary. Two or three hundred feet of pale grey, sericite schist occur there, in drill holes along the north side of rocks that can be certainly identified as greywacke, and zones of lightly to strongly talcose schist occur within the greywacke near its north boundary. Similar zones of talc schist have been encountered in drilling the contact along the north side of Garden Island Lake, and suggest that talc schist zones are characteristically developed close to this contact throughout the area. Strong shearing of the volcanic rocks along the north side, and in places for some distance north of the contact, is also a persistent feature across the area, and is accompanied in places by zones of strong carbonatization that are not continuous with one other.

The south contact of the northern greywacke belt is concealed. The volcanic rocks exposed directly south of the greywacke, about half a mile east of the Louvicourt-Vauquelin township boundary, are heavily carbonatized. They are interpreted to be part of an eastern extension of a wide belt of poorly exposed, intermediate tuffs and breccias exposed in Louvicourt township directly south of the greywacke belt. Strongly carbonatized zones occur in these tuffs and breccias in Louvicourt south of Pascalis railway station, and suggest that persistent zones of carbonatized rock might be expected, either along the south contact of the northern greywacke belt or within the tuffs and breccias on its south side.

Strongly sheared zones of schist with fine quartz-carbonate laminae occur in the volcanic rocks between the Regcourt intrusion and the peridotite 1 mile north of the intrusion. Zones of strong shearing strike east-southeast at the eastern outlet of Lac Gueguen, and are in alinement with similar zones about a mile farther east, on the Russian Kid property. The position of these zones in the regional structure is similar to that of zones of sericite schist in the volcanic rocks extending east across central Bourlamaque township.

The Cadillac fault zone in Cadillac, Malartic, and part of Fourniere townships, consists of zones of strong shearing along which a narrow belt of andesite is sandwiched between greywacke to the south and greywacke and conglomerate on the north. The extension of this zone eastward to central Bourlamaque has been defined by drilling, and consists of a narrow belt, mainly of altered peridotite and talcose schists, with greywacke on either side. East from central

Bourlamaque the zone is concealed by overburden, and has not been drilled; its possible extension can only be inferred from the strike of greywacke exposed at widely separated intervals. In general the greywacke south of this zone is coarser grained and more biotitic than that to the north and this difference in the character of the greywacke may help to define its eastern extension. The inferred extension across Louvicourt township passes the south end of Lac Trivio, where a belt of andesite 1,000 feet wide, followed south by 1,300 feet of talcose rocks derived probably from peridotite, is exposed with greywacke on either side. The air-borne magnetometer survey detected an anomaly over the talcose rocks, and indicated that these rocks form a comparatively short lens. The volcanic rocks at Lac Trivio may form, as mentioned in a previous section, the western part of a narrow belt that extends across southern Vauquelin township directly south of a belt of greywacke and conglomerate; and if the volcanic and talcose rocks at Lac Trivio lie in the Cadillac fault zone, it follows that the extension of this belt across Vauquelin may be a further eastward extension of the Cadillac fault zone structure. The possibility of such an extension is somewhat confirmed by the occurrence of arsenopyrite at the Chimo and Raymond-Tiblemont properties in southwest Vauquelin, close to the inferred extension of the zone,[1]

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[1] See Map No. 47-6C: Southwest Vauquelin; Bureau of Geology and Topography, Department of Mines and Resources.

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as this mineral has been found to occur very persistently along this zone from Bourlamaque to Cadillac township and is rare elsewhere.

A major fault zone is inferred to separate the Archaean rocks, which comprise a group characteristic of the Val d'Or and other mining camps to the west, from the gneisses in the southeast part of the area. The inference is based on the very obvious and marked change in trend of structure that occurs along the northwest side of the gneisses, and on the great difference in lithology of the two rock groups. The fault zone is not exposed, and is surmised to lie beneath a belt of sand and drift ½ to 1 mile wide that separates outcrops of the two distinct rock groups.

The most abrupt change in lithology, in crossing the inferred fault zone, occurs in southwest Haig township. The Keewatin lavas there are chloritic, and have undeformed pillow structures that indicate the upper sides of the flows, and, similarly, the Keewatin-Timiskaming greywacke and conglomerate are comparable in degree of metamorphism with the least altered examples of these rocks in the Abitibi region. Outcrops of these rocks lie about 1 mile northwest of outcrops of garnetiferous biotite and hornblende gneiss.

The volcanic rocks in northeast Haig are poorly exposed, and those nearest the fault zone consist mainly of hornblende schist. They are interlayered with some highly sheared diorite sills, and with light grey, fine-grained, cherty rocks that show good bedding in places and are possibly tuffs. The cherty rocks are rusty weathering in part, as if partly carbonatized or very finely mineralized with sulphides, and are much fractured. These rocks strike in general north of east nearly parallel with the gneisses from which they are separated superficially by the 1-mile wide belt of sand and drift.

The rocks in southeast Pershing are blanketed by an extensive sand plain that conceals the gneisses except for a few small outcrops. The inferred fault zone is assumed to split into two branches beneath this sand plain. Medium-grained, massive, unfoliated hornblende syenite and greywacke outcrop north of the northern branch. The greywacke is cut by dykes and small bodies of unsheared pegmatite, associated in places with biotite-muscovite granite, and is recrystallized to a biotite phase containing garnet and/or staurolite. The trend of the schistosity of greywacke is parallel with that of the inferred faults. Rocks between the assumed faults are exposed on either side of the mouth of Marquis River at Matchi-Manitou Lake. They are similar to those just described, but in general are more sheared, do not include hornblende syenite, and contain a greater proportion of the biotite-muscovite granite, converted partly to gneiss. The pegmatite in these rocks is much fractured and deformed, and the biotite-muscovite granite in outcrops north of Marquis River grades northward into a sericitic schist derived by mylonitization of the granite, suggesting that an important fault separates these outcrops from the massive unfoliated hornblende syenite exposed farther north. Only one outcrop was found in the sand area directly south of the two assumed faults. This lies a few hundred feet south of the point where the main fault is assumed to split, and exposes pegmatite, light-coloured granite-gneiss, and a little garnetiferous biotite gneiss with cyanite that resembles phases of the coarse garnetiferous biotite gneiss to the southeast more closely than garnetiferous phases of the recrystallized greywacke. Sheared pegmatite occurs on the northwest flank of this outcrop, and at the north end of the outcrop is converted by intense shearing into a closely cleaved sericitic schist.

The age of the faulting along the northwest border of the gneisses is inferred to be Late or post-Late Precambrian by comparison with the structure at Mistassini Lake, where Late Precambrian dolomitic limestone and iron formation are faulted against a gneiss group similar to that in Haig township. The gneisses, however, may have developed in part at least during Archaean time. Prior to the period of faulting, therefore, it is possible that there was a gradual transition from normal greywacke southeastward into garnetiferous biotite gneiss. Fine-grained, banded, garnetiferous, biotite gneiss, undoubtedly derived from greywacke that occurs along the northwest margin of the gneisses in Pershing and Haig townships, would seem to confirm such a gradual transition.

MINERAL DEPOSITS AND DEVELOPMENT

General Statement

The rocks and structures in Vauquelin, Pershing, and in part of Haig townships are similar to those of townships to the west, and, as would be expected, contain similar types of mineral deposits. Widely scattered throughout the area are gold-bearing shear zones, replacement deposits, and veins, and in the southern part of the area are massive pyritic sulphide replacement deposits. These replacement bodies contain very small amounts of sphalerite, galena, and chalcopyrite in places, and sphalerite and some silver

is reported to occur in shears $\frac{3}{4}$ mile south of the west arm of Lac Gueguen. Interest in the area centres chiefly on the underground development of gold deposits from shafts at Croinor and Regcourt, and results of drilling on the Chimo and adjacent properties.

Detailed accounts of many of the occurrences are contained in Quebec Department of Mines report, P.R. 190, M.1136, and in others listed on page 2. Due to extensive overburden the area has been difficult to prospect. Prior to 1930 several gold-bearing quartz and pyritic showings were discovered and explored by trenching. By the beginning of the last war a considerable amount of drilling had been done also, chiefly to explore showings in the northern volcanic belt between Sleepy Lake and Lac Gueguen, on the Bruell and Aurora properties, and north of Garden Island Lake, and also in the volcanic and sedimentary rocks south of the west arm of Lac Gueguen. At the latter locality a spectacular gold discovery in agglomerate on the Maniwaki property, 1 mile south of the portage island at the outlet of Lac Gueguen, was thoroughly stripped and tested by pitting, but proved to be of small extent. In 1935 a small shaft was sunk on the Aurora property, and 1,000 feet of lateral development was done on the 100-foot level to explore a quartz-veined, carbonate zone. Shafts were sunk to depths of 45 and 85 feet on a quartz vein and on a carbonate zone on the Bruell property in 1937, and in 1939 Consolidated Mining and Smelting Company of Canada sank a 136-foot inclined shaft to explore a gold-bearing quartz vein in northwest Pershing near Garden Island Lake, and completed 585 feet of drifting and 133 feet of crosscutting on the 120-foot level.

More recently, extensive drilling has been done along the northern volcanic belt, mainly from the Croinor Pershing mine westward to Lac Gueguen. The incentive for this drilling was provided by the extensive occurrence of gold-bearing quartz-tourmaline-pyrite veins, proved first by trenching, later by drilling, and presently by mining, that occur in diorite on the Croinor Pershing property in northeast Pershing. In northwest Vauquelin the volcanic rocks around the Regcourt intrusion, which contains important gold-bearing quartz-tourmaline veins, have been well tested by drilling. In southwest Vauquelin some shear zones, and some partial cross-sections, have been drilled in, and across, the volcanic belt $2\frac{1}{2}$ miles wide directly south of the west arm of Lac Gueguen, and in the greywacke-conglomerate belt directly south of this volcanic belt. At present, drilling mainly in southwest Vauquelin, and also in part in southeast Vauquelin, is concentrated in exploring the extension and occurrence of gold-bearing zones with quartz stringers and arsenopyrite in schists near the iron formation. An occurrence of this type 350 feet south of the west end of the iron formation was found by drilling on the Chimo property 3 miles south of the west arm of Lac Gueguen.

Two shafts, one on the Croinor Pershing property in northeast Pershing, the other in the Regcourt property in northwest Vauquelin, have been sunk in the area since 1945, and underground work at these shafts is continuing.

Croinor Pershing Property

The Croinor Pershing shaft is about a mile east of the township centre line in northeast Pershing township, and can be reached by motor road from Senneterre. The deposit consists of quartz veins and some zones heavily mineralized with coarse pyrite in a diorite sill striking south 62 degrees east parallel with the strike of the agglomerate and tuff within which it lies. At the shaft the diorite ranges from 380 to 450 feet in width, but widens eastward and thins west and has been traced for about 3 miles. The agglomerate-tuff member, which encloses the diorite, is about 2,000 feet wide near the shaft. It apparently wedges out westward near the centre line into the andesite, which forms the prevailing rock on either side of the agglomerate members, and eastward is mostly concealed by overburden.

A feldspar porphyry dyke, with sparse quartz phenocrysts, 100 to 200 feet or more wide and striking south 23 degrees east, cuts across the diorite and agglomerate $\frac{1}{4}$ mile west of the shaft. This dyke has been traced only by drill holes, and its extent is unknown.

The veins on the property exposed in trenches consist of quartz with tourmaline, fairly coarse pyrite, sparse chalcopyrite and pyrrhotite, and some carbonate. On the second level south of the shaft the ore intersection consisted mainly of partly silicified diorite, studded with fractured pyrite cubes $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter forming 10 per cent or more of the rock, and to a very minor extent of vein quartz. The average dip of the veins and of the diorite, indicated by drilling, was between 50 and 60 degrees north. However, in the underground workings the dip of both the diorite and of the veins varies, being as low as 45 degrees in places, and much development work will be required to establish the true dips of the vein systems and of the diorite.

Drilling on the property has intersected gold-bearing veins in the diorite for a total length of about 3,400 feet. These veins are probably a series of veins, both along the strike and down the dip of the diorite, rather than one continuous vein. Information regarding the underground operations up to March 1947 has been kindly supplied by H. Parliment, geologist at the Croinor Pershing mine. At that date the underground work consisted of a shaft 275 feet deep; 257.4 feet of crosscutting and 966 feet of drifting on the 125-foot level; and 98 feet of crosscutting and 1,107.4 feet of drifting on the 250-foot level. On the 125-foot level 490 feet of drifting was in ore averaging 0.17 ounce gold a ton across a drift width of 5.8 feet, and on the 250-foot level 640 feet was in ore averaging 0.24 ounce gold a ton across a drift width of 7.1 feet. The drifts have not yet been slashed out, however, to the full width of the ore on either level.

Other Occurrences in the Northern Volcanic Belt

Numerous other occurrences of gold have been found in the northern belt of volcanic rocks of the area. These consist of various types: quartz stringers with tourmaline and pyrite in chlorite schist; quartz veins with carbonate and a little pyrite;

zones mineralized with coarse pyrite; feldspar-quartz porphyry dykes cut by stockworks of quartz stringers and enclosed in schistose andesite with disseminated pyrite; and heavily carbonatized zones, cut by small quartz and quartz-carbonate stringers, some with sparse tourmaline, and containing about 5 per cent disseminated cube pyrite. The distribution of these occurrences indicates the rather widespread occurrence of gold in the northern andesite belt. This belt is largely concealed by overburden; and on the 1,000-foot maps, issued separately, it was found impossible to map tuff and agglomerate members interbedded with the andesite except in northeast Pershing township. The association of agglomerate, diorite, and feldspar porphyry at Croinor Pershing suggests that similar associations should be sought for elsewhere along this belt and thoroughly explored.

Regcourt Property

The gold veins at the Regcourt property in northwest Vauquelin are quartz-tourmaline types with coarse pyrite, a little chalcopyrite, and visible gold. The veins occur in an irregular-shaped, light-coloured, fine-grained granodiorite mass about 750 feet wide, whose longer axis, determined by drilling, extends about 2,000 feet northeast. The intrusion cuts intermediate volcanic rocks consisting largely of agglomerates with some interbedded lavas, whose dip is probably steeply northward. The volcanic rocks a few hundred feet north of the intrusion, where intersected by drilling, contain strongly sheared zones. These zones may, perhaps, be correlated and continuous with the zone of strong shearing that extends east from the Golden Manitou property in Bourlamaque township. The Regcourt shaft is planned to continue to 500 feet, and has now reached 430 feet. According to information kindly furnished by S. P. Jowsey, the shaft intersected: 2 feet of quartz dipping 45 degrees south at 150 feet, which assayed 3.3 ounces gold a ton; 3 feet of quartz at 250 feet, which dipped out of the shaft 1 foot wide at 70 degrees 58 feet lower down, and assayed 1.14 ounces gold a ton; a series of flat quartz stringers and veins up to 1 foot wide, containing visible gold, between depths of 342 and 370 feet; 6 inches of massive tourmaline with visible gold at 398 feet; 1 foot of quartz with visible gold at 402 feet; and several similar stringers between 402 and 416 feet. Systematic development work will be required underground to ascertain the structural pattern that these numerous veins and stringers form within the intrusive mass.

East and Southeast of the Regcourt Property

East from the Regcourt intrusion to Lac Gueguen, along the direction of shearing and schistosity, rocks are concealed by overburden except for a few outcrops of greywacke and quartz porphyry on the Capri property on the west side of the lake. The size and shape of the quartz porphyry on the Capri property is not known, but is inferred on the accompanying map to be a body of moderate size. In the outcrop of porphyry nearest the lake, trenching and stripping have uncovered a few veins of quartz with pyrite that are reported to assay low in gold. One and a half miles south of the Capri outcrop are a few exposures of porphyritic andesite breccia cut by a feldspar porphyry dyke 8 feet wide on the shore of

Lac Gueguen. The dyke is much fractured, and is veined by irregular sets of quartz stringers 2 to 6 inches wide. The quartz stringers contain a little carbonate and very minor tourmaline, and a little pyrite occurs along their walls. A few holes have been drilled to explore the ground near these outcrops, and one assay of $3.50 in gold a ton has been reported from 3.5 feet of core. These occurrences and that of quartz-vein float along the shore in the vicinity of the outcrops, carrying, by report, as much as $25 a ton, indicate that further exploration of the structure east from the Regcourt intrusion to Lac Gueguen is warranted.

Lac Gueguen and Baie Vauquelin

Numerous dykes of quartz-feldspar porphyry and a few irregular bodies of fine-grained granodiorite similar to the Regcourt intrusion occur in the volcanic rocks south of the west arm of Lac Gueguen, and quartz-feldspar porphyry dykes are very common in the volcanic rocks directly south of Baie Vauquelin. Except where strong shear zones occur, quartz veins are mainly concentrated in fractures in these intrusive rocks and stop at their margins. The veins are in general narrow, dip gently, and may form stockworks. Those observed contained very sparse or no sulphides, and do not appear promising. One occurrence of this type, from which gold can be readily panned according to report, lies about 5,000 feet south-southeast of the southeast corner of Baie Vauquelin. A feldspar porphyry dyke 80 feet wide at this locality strikes southeast across coarse agglomerate, and is partly exposed in outcrops and trenches for 60 feet along strike. A quartz vein, nearly 2 feet wide, with a small amount of pyrite along its walls, dips gently south in the porphyry. The vein is exposed for nearly 40 feet in a large pit, and six shallow holes have been drilled to explore the occurrence.

Chimo Property and Vicinity

A series of parallel, gold-bearing zones was discovered by drilling on the Chimo property in southwest Vauquelin in 1946. The largest of these lies about 350 feet south of the iron formation directly west of a wide sand belt that extends southward across the township. The main zone had been traced (October 1946) for 650 feet parallel with the iron formation, and consists of varying amounts of quartz stringers, disseminated arsenopyrite, and a little chalcopyrite in schist. The zone varies from 20 to 30 feet or more in width (core length). The best values apparently occur in those sections with numerous quartz stringers and abundant coarse arsenopyrite, and a few specks of free gold are reported to occur in the quartz in places. The average grade for ore sections within this zone has been estimated as $7 a ton, but much sampling will probably be required to establish a reliable figure.

The main zone, as determined by drilling, has a Z-shaped surface trace. The trace suggests that a drag-fold controls the structure of the deposit, and tends to confirm the interpretation of magnetic anomalies a few hundred feet northeast, by R. G. Hoiles in charge of exploration on the property, that led to the discovery of the zone.

The schists enclosing the ore zone can be observed only in drill core and range from grey to green, with faint banding showing in places. Part of the rock is amphibolitized and contains garnet. The schists are interpreted to be in part derived from lava, but some seem to be definitely bedded and derived from greywacke. Along the strike of these rocks, in outcrops in southeast Vauquelin, well-bedded, dense, siliceous types occur that are interpreted to be rhyolitic tuff. One and a half miles to the west of the Chimo deposits the rock section exposed in outcrops consists of 1,300 feet of altered andesite followed northward by greywacke and conglomerate that is well sheared and contains, in its southern part, zones with quartz stringers and coarse arsenopyrite and some gold similar to those on the Chimo property. The continuation of this rock section eastward is concealed by overburden, but on the accompanying map it is inferred from the direction of bedding and shearing to pass north of the iron formation. The occurrence of carbonatized greywacke in trenches about half a mile northwest of the Chimo deposit tends to confirm this interpretation, and small quartz veins with free gold occur in carbonatized greywacke in the southern part of the trenched area.

In a previous section the possible eastward extension of the Cadillac fault zone across Vauquelin township is discussed. The writer favours the idea that this zone may continue eastward along the south side of the andesite exposed 1½ miles west of the Chimo deposit to pass north of the iron formation and associated bedded rocks. It is, however, probable that the period of extensive amphibolitization that has altered the rocks in southern Vauquelin is later than the Cadillac fault zone, and that amphibolitization may obscure much of the evidence for tracing the zone.