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HON. ROBERT LAURIER, *Minister of Mines* H. C. RICKABY, *Deputy Minister*

FIFTIETH ANNUAL REPORT

OF THE

ONTARIO DEPARTMENT OF MINES

BEING

VOL. L, PART VII, 1941

Geology of McGarry and McVittie Townships, Larder Lake Area

By

JAS. E. THOMSON

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COLOURED GEOLOGICAL MAPS, PLANS AND SECTIONS
(In pocket at back of report)

Map No. 50a—Township of McGarry, District of Timiskaming, Ontario. Scale, 1 inch to 1,000 feet.
Map No. 50b—Township of McVittie, District of Timiskaming, Ontario. Scale, 1 inch to 1,000 feet.
Map No. 50d—Kerr-Addison and Chesterville Mines, level plans and sections showing generalized geology and outline of ore bodies; Cross-section through the Ore Zones, Kerr-Addison and Chesterville Mines. Scale, 1 inch to 400 feet.

Photo by Airmaps Limited, Toronto.

AERIAL VIEW OF THE OMEGA MINE, LOOKING NORTH.

Geology of McGarry and McVittie Townships, Larder Lake Area

By Jas E. Thomson

INTRODUCTION

This report covers that part of the Larder Lake gold area that lies within the boundaries of McGarry and McVittie townships. The area comprises a section of the great gold-producing belt that extends for more than 150 miles from Kirkland Lake eastward to and across northwestern Quebec. The village of Larder Lake, which is the largest community in the area, is situated about 15 miles east of Kirkland Lake. Other community centres are Virginiatown and

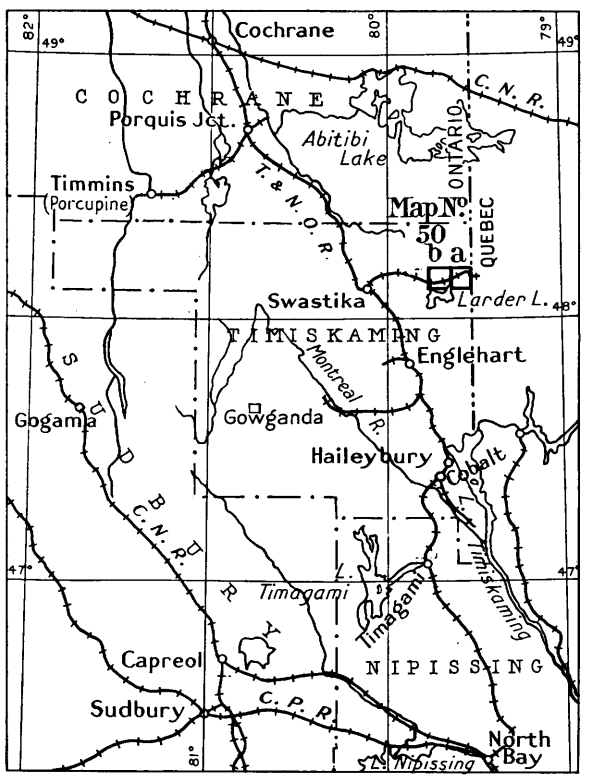

Fig. 1—Key map showing the location of McGarry and McVittie townships. Scale, 1 inch to 50 miles.

Kearns, the townsites of Kerr-Addison and Chesterville Larder Lake mines, respectively. The area is crossed by the Nipissing Central railway and by No. 66 highway, which runs from Kirkland Lake to Noranda.

Although Larder Lake is the oldest gold-mining area in northeastern Ontario, with a record of discoveries dating back to 1906, it failed to become an important camp until 1936. In that year the Omega mine commenced milling operations and a large tonnage of ore was found at the Kerr-Addison mine. A mining boom followed, and during the next three years exploration was carried on at more than twenty-five properties within the two townships. Much new geo-

logical information was made available in the course of this work, and the necessity for up-to-date maps led the Ontario Department of Mines to undertake detailed remapping of the area. This work was carried out during the field seasons of 1938, 1939, and 1940 and incorporated in the accompanying geological maps (Nos. 50a and 50b). In 1941 there were three producing mines within the area with a combined milling capacity of about 3,000 tons daily and a combined annual production of $7,935,417.

Scope of Maps and Report

The object of the investigation was to map the rock formations and structures as accurately as possible in the hope that such work would provide useful information concerning the nature of the known gold occurrences and their relationships to geological features, and thus aid in the search for new deposits. During the past few years a great deal of exploration and development work has been done along the main gold belt by various mining companies. The results of their investigations have been placed at the writer's disposal, and much information from different sources has thus been correlated. This information consists largely of drilling and underground data that could not have been obtained without the co-operation of the companies concerned.

The field mapping of the greater part of the area was done on the scale of 400 feet to the inch. Near some of the mines certain areas were mapped on the scale of 100 feet to the inch. The field sheets were later reduced photographically to 1,000 feet to the inch for publication. This reduction necessitated s slight alteration and exaggeration in dimension of small geological features in order to be able to show them on a map of this scale. Plane-table surveys were carried out at a few points, but most of the geological mapping was done by pace-and-compass traverses spaced at intervals not greater than 400 feet apart. In the southern part of McGarry and McVittie townships these traverses were largely confined to previously surveyed claim and picket lines. On the Kerr-Addison, Chesterville Larder Lake, Sheldon-Larder, Cheminis, and Fernland properties the mapping was done by the use of picket lines spaced at intervals of 150 to 300 feet apart, with stations established about every 200 feet along the lines. On other properties where picket lines were not available compass traverses were made across claims and tied to stations established by chaining along the claim lines. Almost all the traverses were made by a senior and junior geologist working together, the junior man running the line while the senior member examined outcrops on either side of the traverse line.

In the northern part of McGarry township north-south picket lines were cut from the north boundary southward to the railway. These were turned off the boundary line at half-mile intervals and tied in by surveys along the railway. The picket lines were started from mile posts and half way between mile posts along the Ossian-McGarry township boundary. Pace-and-compass traverses were then run in an east-west direction at 400-foot intervals and tied in to stations established by chaining along the picket lines. In the northeastern part of McVittie township picket lines were also cut at half-mile intervals and run from the north boundary southward to surveyed claims. West of Spectacle lake east-west picket lines were cut at about half-mile intervals and tied to surveyed claims. In the northern part of McGarry and McVittie townships, the surveys of township boundaries and mining claims had been made more than thirty years ago and it was necessary to recut the lines before they could be chained and the survey posts located. In certain localities some of the older claim surveys could not be tied in accurately; in these cases the geology was mapped in relation to

later surveys, and the boundaries of the old claims were not searched for and are not located on the geological map.

Difficulties arose in compiling maps for this and adjoining areas owing to the inaccuracy of the original township surveys. As the Ontario Department of Mines had decided to publish separate geological maps of the townships between Swastika and the Quebec boundary, each on the scale of 1,000 feet to the inch, it was eventually decided to draw up a base control for the townships involved. This base control was drawn by the drafting division of the Ontario Department of Mines from the original surveyor's notes. In making this compilation certain minor adjustments of the surveyor's plans had to be made in order that the different townships could be fitted together. For the purpose of this series of maps Newman's base line of 1907, which forms the north boundary of all the townships, was accepted as an east-west line; the survey of the transmission line of the Northern Ontario Light and Power Company was used as the main control in each township. In outlining each township the surveyor's bearings were accepted and adjustments made in the lengths of the lines. In McVittie township the only alteration made was in the first mile along the west boundary. Here the township line was shortened 140 feet to conform with the various claim surveys along and adjoining it.

Using the adjusted township outlines, the base map of each township was drawn on the scale of 400 feet to the inch. The data were taken from the original survey notes of the railway, highways, transmission lines, and mining claims, and supplemented in some cases by surveys made by mining companies and aerial surveys. In some cases slight adjustments in claim outlines and topographical features were necessary to make them fit the control survey plan. The location of practically all diamond-drill holes shown on the maps has been taken from survey plans of the mining companies that did the work. On some properties all the drill-holes are indicated; on others only the holes that provide additional geological information to that of the surface outcrops are shown.

The geological maps show the outline of outcrops or groups of outcrops in as much detail as the scale of publication would permit. Since the whole area is forested and the ridges are moss-covered, delineation of small knolls of rock on a ridge would have been an endless task of doubtful value; accordingly, areas of this sort are shown as large outcrops, even though the drift is sufficient to obscure geological features of interest to the prospector, such as veins, shear zones, gossans, etc. Within the boundaries that have been assigned to rock outcrops, bed rock could be reached by surface trenching over a large percentage of the ground.

Acknowledgments

The writer is greatly indebted to the management, staff, and consultants of the various mining companies in the area for their co-operation during the course of the field work. Every possible assistance was rendered at all the properties visited. Much of the information in this report has been obtained from company maps and records placed at the writer's disposal. A complete list of individuals to whom special acknowledgment is due cannot be given here. The assistance of the following engineers and geologists is recorded in order that the reader may know the exact source of certain information.

The management of Kerr-Addison Gold Mines, Limited, through J. W. Baker, geologist, supplied the mine plans and sections that were used in the preparation of map No. 50d accompanying this report.

W. F. James, B. S. W. Buffam, and associates, provided geological maps,

sections, and drilling plans of the Chesterville Larder Lake, Pelangio-Larder, and Rose Gold properties.

E. K. Fockler, consulting geologist for Arjon Gold Mines, Limited; H. M. Butterfield, manager of Sheldon-Larder Mines, Limited; A. A. Lee, consultant for Wesley Gold Mines, Limited, and Lar Add Gold Mines, Limited; and J. E. Jerome, manager of Raven River Gold Mines, Limited, supplied geological data on their respective properties.

Ventures, Limited, through D. R. Derry, geologist, provided geological maps of the Fernland, Cheminis, and Kohinoor claims. Underground information on the Barber-Larder, Fernland, and Cheminis mines was given by the staff of the Consolidated Mining and Smelting Company of Canada, Limited. A. D. Campbell, manager of Omega Gold Mines, Limited, supplied surface and underground geological maps prepared by C. P. Jenney, geologist.

T. C. Holmes, geologist of Proprietary Mines, Limited, assisted with drilling plans of Sarcee and Legardo ground. W. H. Emens, consultant, supplied drilling information on Laguerre Gold Mines, Limited; H. C. Laird, geologist for Winchester Larder Mines, Limited, provided geological data on that property. Information on the Rose claims was supplied by the Connell Mining and Exploration Company, Limited.

The writer was ably assisted in the field by the following university graduates and undergraduate students: W. A. Norfolk, D. K. Stadelman, D. H. Mode, T. F. Slater, and G. R. Smith, in 1938; D. K. Stadelman, J. C. G. Moore, F. E. Ladner, M. H. Bridgman, G. R. Smith, and Walter Douglas, in 1939; J. W. McBean, F. E. Ladner, F. A. Killer, Murray Frarey, and D. B. Underhill, in 1940. Much of the geological mapping, especially in the northern part of the area, was done by Messrs. Norfolk and Stadelman in 1938, by Messrs. Stadelman and Moore in 1939, and Messrs. McBean and Ladner in 1940. Picket lines were cut by Wm. Gebert and Paul Pelzer in 1938 and 1939 and by A. W. Radkey and David Demers in 1940.

Previous Geological Work

Between 1902 and 1909 the rock formations and gold occurrences of the Larder Lake area were examined and reported on by W. G. Miller,[1] W. A. Parks,[2] R. W. Brock,[3] N. L. Bowen,[4] and M. E. Wilson.[5] In 1918, P. E. Hopkins[6] examined the working properites at Larder Lake. In 1919 and 1920, H. C. Cooke[7] made a geological map of the belt of sedimentary rocks in McGarry and McVittie townships. In 1923 P. E. Hopkins[8] mapped McVittie, McGarry, Hearst, and McFadden townships and described the gold deposits of the area. In 1923 and 1925 H. C. Cooke[9] described the geology of the Crown Reserve and Canadian Associated Goldfields mines. C. P. Jenney[10] has discussed the geology of the Omega mine.

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[1]W. G. Miller, Ont. Bur. Mines, Vol. XI, 1902, pp. 214-230.
[2]W. A. Parks, Geol. Surv. Can., Sum. Rept. 1904, pp. 198-225.
[3]R. W. Brock, Ont. Bur. Mines, Vol. XVI, 1907, pt. 1, pp. 202-218.
[4]N. L. Bowen, Ont. Bur. Mines, Vol. XVII, 1908, pp. 10, 11.
[5]M. E. Wilson, Geol. Surv. Can., Mem. 17, 1912.
[6]P. E. Hopkins, Ont. Bur. Mines, Vol. XXVIII, 1919, pt. 2, pp. 71-77.
[7]H. C. Cooke, Geol. Surv. Can., Mem. 131, 1922, pp. 17-61.
[8]P. E. Hopkins, Ont. Bur. Mines, Vol. XXXIII, 1924, pt. 3, pp. 1-26.
[9]H. C. Cooke, Geol. Surv. Can., Sum. Rept. 1923, pt. CI, pp. 61-73; Sum. Rept. 1925, pt. C, pp. 17-19.
[10]C. P. Jenney, Econ. Geol., Vol. 36, 1941, pp. 424-447.

History and Development

The Larder Lake area was the scene of the first gold rush in the northeastern part of Ontario. The discovery of rich silver ores at Cobalt in 1903 stimulated widespread prospecting, which extended farther and farther afield until in August, 1906, a gold discovery was made by Dr. Reddick on ground now owned by Kerr-Addison Gold Mines near the northeast arm of Larder lake. News of the find caused a stampede of prospectors into the area during the late autumn and winter of that year, and a large part of the country was indiscriminately staked. Development work on this ground during the following summer failed to uncover any important gold showings. The resulting disappointment of prospectors and investors gave the camp a serious set-back for many years.

Much of the early work was done on stockworks of gold-bearing quartz veins and stringers in rusty-weathering carbonate rock, locally called "dolomite." Extensive exposures of these intersecting veins were uncovered, but it was found that values were erratically distributed and confined to areas of visible gold in the quartz. Exploratory operations were carried on sporadically over a period of several years on the Reddick, Kerr-Addison, and Harris-Maxwell properties. At the Reddick property about 100 tons of ore was run through a 20-stamp mill in 1908, and a small production recorded. In 1914 Associated Goldfields, Limited, purchased the Reddick and Kerr-Addison claims and did a considerable amount of underground work and surface drilling. Underground operations were also carried on at the Harris-Maxwell property (now owned by Laguerre Gold Mines, Limited), and a small amount of gold was recovered from a 40-stamp mill in 1912 and 1913. Further work was done by Associated Goldfields, but the mine was closed in 1922.

Meanwhile, in 1914, Jack Costello, a prospector, had discovered a different type of gold deposit, located along a graphite fault near Pancake lake on ground now owned by Omega Gold Mines, Limited. The Costello vein was developed simultaneously by the Associated Goldfields and Crown Reserve mining companies, as it had been traced across both properties. In 1926 Associated Goldfields built a mill; the mine produced $52,295 in gold and silver before closing down in March, 1928. Much underground work was done at the Crown Reserve mine, and a fairly large low-grade ore body was developed before the mine ceased operations in December, 1928.

In 1932 Canadian Reserve Mines, Limited, was formed to develop the Crown Reserve and Associated Goldfields mines, but no work was done. In May, 1935, these mines were taken over by Omega Gold Mines, Limited. Underground work was carried out, and a 300-ton mill was built and began production in February, 1936. The milling rate was gradually increased to about 500 tons daily.

In April, 1936, Kerr-Addison Gold Mines, Limited, acquired from Proprietary Mines, Limited, the old Kerr-Addison and Reddick properties. Exploration in the immediate vicinity of the old workings indicated a large tonnage of ore. The mine began production in May, 1938, at the initial rate of from 500 to 600 tons daily, but this was increased until, in the latter part of 1941, about 2,100 tons were treated daily.

The resumption of mining operations at the Omega mine combined with the important ore discoveries at the Kerr-Addison mine caused a renewal of exploration throughout the Larder Lake area. In 1937 drilling indicated an ore body on the Chesterville claim adjoining the Kerr-Addison mine. After underground development had checked these indications a 500-ton mill was constructed and began production in the summer of 1939. In 1940 the mill capacity was

increased to 700 tons daily. Underground operations have also been carried on at the Barber-Larder, Cheminis, Fernland, Raven River, Laguerre, and Kir-Vit properties. In addition, a large amount of surface work and drilling has been done by several companies, including Sheldon-Larder, Arjon, Proprietary, Pelangio-Larder, Wesley, Armistice, Lar-Add, Sarcee, Thib, McVittie Kirkland, and others.

Topography

The physical features of the area are typically pre-Cambrian and are to a considerable extent dependent upon the nature and structure of the underlying rock formations. As indicated by the geological maps, rock outcrops cover the greater part of the two townships although these exposures are often partly concealed by a mantle of soil, moss, and green forest. In the northern half of the townships high ridges and steep cliffs are found locally within the areas underlain by hard gabbro, diorite, and massive greenstone.

The sedimentary rocks of the Cobalt series provide the most rugged topography of the region. In the southeastern part of McGarry township they extend as a range of hills, which rise as high as 350 feet above the level of Larder lake. Mount Cheminis is the most conspicuous peak in the area, with an elevation of 1,662 feet above sea-level.[1] It is situated near mileage 39 on the Quebec side of the interprovincial boundary and has an outline that resembles a flattened haystack. It rises 785 feet above the level of Larder lake.

From a practical viewpoint, the topographical expression of the carbonate rocks and faulted zones in the area is important because most of the ore bodies occur in this environment. Owing to the quartz content of the carbonate rocks they often stand out as low ridges and are flanked by zones of shearing and faulting represented topographically by valleys.

GENERAL GEOLOGY

The consolidated rocks of the area are pre-Cambrian in age; the formations of economic interest belong to the earlier pre-Cambrian era and consist of volcanics, sediments, and intrusives. Structural studies, discussed later in this report, show that a large belt of volcanic rocks, which occurs in the northern part of the area, underlies a complex of intermingled sedimentary and volcanic strata. The northern volcanics consist almost entirely of acid and basic lava flows and associated pyroclastics; this group is assigned to the Keewatin period. The younger sediments-volcanics complex is classified as part of the Timiskaming series.[2] It occurs as a wide east-west trending belt and extends far beyond the limits of the map area. The Timiskaming series is predominantly sedimentary in character, but a number of volcanic formations are interbanded with the sediments. Certain basic lavas in the Timiskaming series are similar in appearance and composition to those in the Keewatin series and, in some previous geological surveys, were assigned to the Keewatin period because of this lithological similarity. Structural evidence now shows, however, that these volcanics occur at different stratigraphical horizons and are of different ages.

In the northern part of the area there are large bodies of diorite and gabbro, which intrude the Keewatin lavas. Their relationship to the Timiskaming series cannot be established.

[1]Geodetic Survey Publication No. 60, 1936.

[2]The terms "Keewatin" and "Timiskaming" are retained until the sediments-lava complex, which extends as far south as Skead township, has been mapped. When the whole country has been studied a new age classification may be necessary, but it seems inadvisable to introduce a new terminology at this time.

The above-mentioned formations are cut by acid and basic intrusives, which are classified as Algoman in age. A few diabase dikes of possible Keweenawan or Matachewan age are also found. Along certain zones of faulting in the volcanics, and to a lesser extent in the sediments, the original rock has been replaced by carbonate solutions forming a rock locally known as "dolomite." Most of the gold deposits of the area occur within or adjacent to these bands of carbonate rock. In the southeastern part of the area the relatively flat-lying sediments of the Cobalt series cover the older folded formations with great angular unconformity. The mantle of sand, gravel, and clay that covers the bed rock in many places was laid down during the continental glaciation of Pleistocene time.

The various rock formations with their different members may be conveniently classified as follows, the oldest being placed at the bottom of the list:—

QUATERNARY	
PLEISTOCENE:	Clay, sand, gravel.
	Great unconformity
PRE-CAMBRIAN	
KEWEENAWAN or MATACHEWAN:	Diabase.
	Intrusive contact
HURONIAN (Cobalt Series):	Conglomerate, arkose, greywacke, quartzite, and slate.
	Great unconformity
ALGOMAN:	Carbonate rock or "dolomite."[1] Granite, quartz syenite, syenite, syenite porphyry, quartz porphyry, felsite, mica syenite and lamprophyre,[2] quartz diorite, diorite.
	Intrusive contact
TIMISKAMING:	BASIC VOLCANICS: Basic lava, spherulitic lava, fragmental lava; agglomerate and tuff, dacite, talc-chlorite schist. ACID VOLCANICS: Trachyte, porphyritic trachyte, trachytic breccia and agglomerate, tuff. FINE-GRAINED SEDIMENTS: Greywacke, arkose, quartzite, slate, iron formation. Conglomerate with some interbedded greywacke.
	Erosional unconformity
POST-KEEWATIN:[3]	Diorite and gabbro.
	Intrusive contact
KEEWATIN:	Iron formation. BASIC VOLCANICS (greenstone): Andesite, basalt, and pillow lava; dioritic lava; spherulitic and amygdaloidal lava, fragmental lava, agglomerate and tuff, chlorite and talc-chlorite schists. ACID VOLCANICS: Rhyolite and trachyte, acid fragmental lava.

Keewatin Series

The formations and rock types in the Keewatin series that may be recognized in the field are enumerated above and are differentiated on the accompanying geological maps. In a general way, the acid volcanics underlie the basic vol-

[1]In certain areas the pre-existing rock has been almost completely replaced by carbonates of iron, magnesium, and calcium. This carbonate rock is locally known as "dolomite." There are all gradations from "dolomite" to partially carbonatized and unaltered rock.

[2]The mica syenite, lamprophyre, and diorite dikes are often heavily carbonatized and intersected by quartz stringers.

[3]Possibly post-Timiskaming.

canics. In the northwestern part of McVittie township there is a transitional zone between the two groups that contains interbanded acid and basic varieties. Only traces of iron formation occur in the Keewatin series.

Acid Volcanics

Irregular areas of rhyolite and rhyolite breccia occur in the northern part of McGarry township. The rhyolite is a hard, fine-grained, flinty variety, grey in colour, with occasional small phenocrysts of feldspar and quartz. The rock is very massive and, very rarely, shows vesicles, flow structure, and pillows. It grades laterally into more basic types, making the boundaries between the acid and basic groups very difficult to delineate. In places, the dividing line must be arbitrarily drawn.

South of Beaverhouse lake in the western part of McVittie township there is an area of acid lavas and fragmentals. They are light-coloured rocks, which were classified as rhyolite or trachyte in the field. Where the rock is massive it often contains fragments of trachytic material in a slightly more basic groundmass. It is often sheared and carbonatized. Microscopic examination of samples of the freshest-appearing acid volcanics shows that they were originally in the rhyolite-trachyte range, but exact determination is impossible on account of the alteration. In the area west of Spectacle lake the contact between the acid and basic volcanic groups is obscured by carbonatization and interbanding of the different types, but when traced westward into Gauthier township it is well defined southwest of the shaft at the Beaverhouse Lake mine.

Basic Volcanics

The greater part of the Keewatin series is composed of lavas ranging from andesite to basalt in composition and commonly called "greenstone" in the field. These are generally fine- to medium-grained, dark-green rocks, but they show some variation in appearance dependent upon the amount of alteration they have undergone. The texture also varies with the thickness of the flows. Generally the flows are massive and show primary structures such as vesicles, spherules, and pillows. Throughout most of the "greenstone" area in the northern part of McGarry township there is a monotonous continuity of one lava type, and it is generally impossible to recognize individual flows or flow contacts on the outcrops. In the northwestern corner of the township a rather poorly defined zone of amygdaloidal lava occurs. The vesicles are filled with rounded quartz masses as much as 3 inches in diameter. These stand out on the weathered surface and might be mistaken for quartz pebbles in a conglomerate.

In the vicinity of Beaverhouse, Spectacle, and Moosehead lakes in the northwestern part of McVittie township the basic volcanics are very massive and well enough exposed in places to make it possible for individual flows to be distinguished and followed for considerable distances. In cross-section they show fragmental or amygdaloidal tops grading into pillowed and massive horizons. The massive parts of the thicker flows have a medium-grained texture and somewhat resemble the finer-grained phases of the intrusive gabbro and diorite. The dioritic phases represent the central part of the flows, which cooled more slowly than the margins with resultant coarser texture. There is thus a gradation from coarse-grained to fine-grained, pillowed, or fragmental phases of the lava, in contrast to the sharply defined contact of the intrusive diorite and gabbro. The pillows in the larger flows attain a length of several feet and show the later-formed pillows filling the surface irregularities of the earlier ones. The flows range from a few feet to almost 800 feet in thickness.

It is important to note that the basic volcanic group of the Keewatin series is composed almost entirely of lava flows; interbedded iron formation, tuffs, and sediments are scarcely ever observed. In contrast, the basic volcanics in the Timiskaming series contain an abundance of agglomerate, tuff, and sediments interbanded with the lavas.

Iron Formation

Bedded chert and iron formation occur near the west boundary of McGarry township about a quarter of a mile south of the 5-mile post. In one band a width of 50 feet was observed, and 800 feet east of the township line interbanded chert and lava flows occur over an exposed width of 75 feet.

Post-Keewatin Intrusives

In the northern part of the area there are large bodies of altered basic intrusives. These have the composition of gabbro, diorite, and quartz gabbro or quartz diorite, although the quartz-bearing variety is rarely found. The rocks are characteristically massive, dark-green to greenish-black in colour, and of intermediate to coarse texture. Locally they approach the pegmatitic stage with needle-like crystals of hornblende more than an inch in length. As the rock contains magnetite crystals, it disturbs the compass needle to some extent. Microscopic examination of typical samples shows that the constituent minerals are always greatly altered, and the composition of the feldspars cannot be determined. In the field the coarsely crystalline varieties were classified as gabbro and the finer-grained type as diorite. The hard, massive character of these basic intrusives has rendered them more resistant to erosion than the surrounding basic lavas. They thus produce a very rugged terrain and often outcrop as long, high ridges.

Although the gabbro and diorite become fine-grained near contacts, they nevertheless have well-defined intrusive contacts with the basic lavas. Small dikes were observed to intersect pillow structures, and unassimilated blocks of lava were found in the intrusive at several places. Their relationships to the formations of the Timiskaming series, however, could not be ascertained. Offshoots of the diorite and gabbro have never been found to intersect the Timiskaming sediments which adjoin them in the northern part of McGarry and McVittie townships. No pebbles of diorite or gabbro occur in the conglomerate of the Timiskaming series as would be expected if the basal conglomerate lay directly on the intrusives. The lack of a definite relationship is due to the probability that there are faulted contacts between the sediments and intrusives. In Teck and Lebel townships, similar basic intrusives are found along the north side of this same belt of Timiskaming sediments. W. Gerrie and A. MacLean,[1] who have mapped these townships for the Ontario Department of Mines, believe that these intrusives are post-Timiskaming in age.

As the basic intrusives are cut by dikes of syenite and syenite porphyry, they are definitely older than the acid intrusives. The outline of the gabbro and diorite bodies suggests that they may have been intruded as sills parallel to the strike of the lava flows. They are similar in composition and field relationships to the rock classified as quartz diorite or "older gabbro" in the adjacent areas of Quebec.[2]

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[1]Personal communications.

[2]H. C. Cooke, W. F. James, and J. B. Mawdsley, Geol. Surv. Can., Mem. 166, 1931, pp. 108-110.

Timiskaming Series

STRATIGRAPHY

In this report the Timiskaming series is defined as a belt of interbedded sedimentary and volcanic formations lying stratigraphically above the Keewatin series, which is a purely volcanic group. Within the boundaries of the Timiskaming series the sedimentary rocks predominate slightly in amount over the volcanics and associated pyroclastics. The Timiskaming rocks occur in a wide east-west trending belt covering most of the southern part of the map area and extending far beyond its limits.

In field-mapping the Timiskaming series may be conveniently divided into the four main lithological groups indicated on the map legend. As these groups are interlensed and interfingered, there is no uniform stratigraphical sequence for the entire area. An individual group may be repeated at a number of stratigraphical horizons in the complex. All the known data by which the stratigraphical succession may be determined along any particular line of section across the Timiskaming series has been recorded on the geological maps.

In the western part of McVittie township the strata uniformly face in one direction across great widths, and successively younger formations are encountered as the observer goes southward from the Keewatin-Timiskaming boundary. In other localities the rocks are closely folded and the strata are repeated on either side of the fold axes. Where the contacts are not faulted the different groups are conformably interbedded.

The general statigraphical succession of rock groups, not accurate in detail for all parts of the map area, is as follows:—

Group A.—Group A comprises a basal conglomerate with a maximum thickness of 800 feet, grading upwards into fine-grained sediments, mostly greywacke. Local bands of the trachytic volcanics are interbedded with these sediments.

Group B.—Group B is a persistent horizon of trachytic volcanics, attaining a maximum thickness of about 3,600 feet in McVittie township. It is the uppermost group in the subsidiary syncline running east from Beaver lake across the central part of McGarry township.

Group C.—Group C is predominantly fine-grained sediments, chiefly greywacke. It attains a thickness of more than 5,000 feet in the western part of McVittie township.

Group D.—Group D is the gold-bearing horizon of basic volcanics that extends between the Omega and Chesterville Larder Lake mines. The original thickness cannot be estimated on account of the strike-faulting throughout the belt.

Group E.—Group E lies south of group D in McVittie township and the southwestern part of McGarry, and is predominantly fine-grained sediments, chiefly greywacke and slate. There are local areas of conglomerate, especially adjacent to intrusives on the flanks of a cross-fold in the country south of the Omega and Fernland mines. This group is so intricately folded and faulted that no estimate of thickness can be made. It is the uppermost stratigraphical group of the Timiskaming series in the map area.

Thus, in a general way, the Timiskaming series is made up of two main volcanic groups interbanded with three main sedimentary groups. But it would be useless to attempt a rigid adherence to such a stratigraphical classification of groups because in detail some formations of group B occur in group A and vice versa; also lavas of group D are interbedded with sediments of group C. There is also a possibility that group D lenses out entirely to the west, so that groups C and E merge into one. These complications make it impossible to divide the

Timiskaming series into stratigraphical units in geological mapping over wide areas. Instead, a lithological division of the different groups is shown on the accompanying geological maps.

LITHOLOGY

In a field classification the formations that make up the Timiskaming series may be conveniently differentiated into four main groups, most of which contain several members. The four main divisions of the series are indicated by different colours on the accompanying geological maps, and the local rock types are designated by a number and letter. This method was adopted because there are all gradations between certain members of a group both along and across the strike, but the boundaries of the main groups are better defined and so constitute more reliable marker horizons in structural mapping. For example, a lens of greywacke may gradually change to slate, arkose, or quartzite within a short distance, or trachyte may merge into trachytic agglomerate or tuff. On the other hand, the boundary between the volcanic and fine-grained sedimentary group is generally better defined. Conglomerate bands constitute some of the best marker horizons in the sedimentary series.

Conglomerate

This rock may consist of narrow pebbly bands interbedded with arkose and greywacke or it may contain pebbles and boulders over a continuous width of several hundred feet; it also occurs as lenses in the fine-grained sediments. Conglomerate horizons range in size from prominent bands that extend for several miles and attain a maximum width of about 700 feet to tiny bands measurable only in inches. Some of these horizons are composed of many alternating beds and lenses of pebbly conglomerate and arkose. In such bands the sediments are well sorted, the pebbles are fairly well rounded, and the finer-grained sediment is sometimes rudely stratified and cross-bedded. These are intraformational conglomerates, and the pebble size is fairly uniform, averaging from 2 to 4 inches in diameter.

A basal conglomerate generally occurs at the bottom of the Timiskaming series, although at some points it is replaced by greywacke or trachyte. It contains pebbles and boulders with a maximum diameter of 18 inches, but the average would be about 4 inches and large boulders are generally rare. The shapes vary from angular to rounded, with the smaller pebbles showing the effect of greater abrasion and tending to be ovoid or rounded. The basal conglomerate may contain pebbles and boulders of greenstone, rhyolite and felsite, trachyte, granite, syenite, diorite, jasper, chert, iron formation, and vein quartz. Boulders of trachyte are never found in the basal conglomerate but occur in higher horizons. The matrix is generally a massive, sandy greywacke or arkose.

The proportions of the different pebble types vary widely. In the basal conglomerate greenstone pebbles and boulders may constitute 30 to 80 per cent. of the total, followed by rhyolite and felsite, granite and porphyry, chert, jasper, iron formation, and vein quartz in descending order of abundance. In the intraformational conglomerates chert, iron formation, quartz, and felsite pebbles predominate while greenstone and granite pebbles are either scarce or missing. A characteristic feature of all the conglomerates is the widespread occurrence of jasper and iron formation pebbles. They never constitute more than 2 to 5 per cent. of the pebble content but are scarcely ever absent.

Some of the largest masses of conglomerate in the area occur north and northeast of Larder Lake village on the flanks of intrusive bodies. This rock is characterized by the large content of black chert and iron formation pebbles

and the great scarcity of greenstone and granite pebbles. Outcrops east of No. 66 highway immediately north of Larder Lake village show about 65 per cent. of the pebbles to be iron formation. Some of these attain a length of 7 inches and are quite angular in outline; the matrix is green and chloritic. The conglomerate northeast of Larder Lake village is thus lithologically different from the basal conglomerate found at the contacts with the Keewatin rocks and is undoubtedly a different stratigraphical horizon.

Fine-grained Sediments

Greywacke makes up the bulk of the fine-grained clastics in the Timiskaming series. It generally forms beds of regular thickness, which may be distinguished from one another by colour differences, and sometimes show change in grain size from coarser, sandy material at the base to fine-grained slate at the top. The bedding may be accentuated by the development of cleavage in the softer slaty part of the bed, which has yielded to deforming stresses while the hard, sandy portion has remained intact. The beds range in thickness from a fraction of an inch to several feet. With increased thickness of the strata the amount of coarser sandy material increases and the rock becomes an arkose in which bedding is not readily observed. The thinly bedded material is generally slate derived from the alteration of the fine-grained muddy portions of the sediment. In certain areas the sediment is composed largely of metamorphosed quartz grains, and the rock is a quartzite.

The thinly bedded strata of the Timiskaming series are often identical in appearance to so-called "bedded tuffs" found in volcanics and for this reason are sometimes classed as such throughout the area. This interpretation as "tuffs" only implies that the source of the sediment was a volcanic ash rather than a water-borne clay, and there is generally no data to prove or disprove this assumption. For this reason, the term "tuff" is restricted in this report to the thinly bedded strata intimately associated with the lavas, and "slate" is used when the beds are associated with greywacke. In other words the distinction between them is based on field relationships rather than lithology.

The distribution of iron formation in the Timiskaming series is so scanty that it scarcely merits any description. Narrow bands of fine-grained magnetite are interbedded with the greywacke at a few points. The individual beds of iron formation never attain a width greater than two or three feet, and in most cases the widths are measurable in inches, although interbedded iron formation and greywacke may be found across several feet.

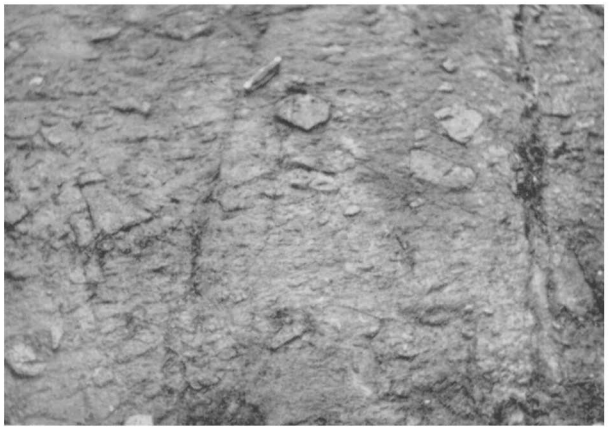
Trachyte and Associated Rocks

The division "trachyte and associated rocks" consists of a heterogeneous assemblage of rocks that have a common volcanic origin and are interbanded with the Timiskaming sediments. Different members of this group vary so greatly in appearance that the investigator may at first doubt that any relationship exists between them. Yet they are repeatedly found to be intimately associated and grade from one type to another. Cooke[1] first pointed out that the principal rock type is trachyte. Detailed mapping, however, has shown that the trachyte flows are quite subordinate in areal extent to the pyroclastic members of the group.

The trachyte has a rather unusual appearance and is characterized by a reddish to pinkish shade of colour. The typical trachyte is a fresh-looking, massive rock of medium- to fine-grained texture, in which crystals of hornblende and feldspar are readily recognized in hand samples. There is generally no

[1]H. C. Cooke, Geol. Surv. Can., Mem. 131, 1922, p. 24.

difficulty in distinguishing it from the lavas of the Keewatin series, although there are certain basic phases of the trachyte that are dark-coloured. Cooke believes that individual flows could be recognized, but the writer was never able to do this satisfactorily. In fact, it is difficult to understand how an extrusive rock could show so little textural change over such large areas. Flow structures



Trachytic agglomerate exposed on claim L. 25,854, west of Cheminis station.

are rarely found in the trachyte, but rudely developed pillows have been recognized and flow breccias are common.

Certain horizons of the trachyte are quite porphyritic and have phenocrysts of feldspar a quarter of an inch in length embedded in a fine-grained groundmass. Hand samples of this rock closely resemble the intrusive syenite porphyry of the area, and field relationships are the only sure criteria for distinguishing between

Thinly bedded tuffs on claim L. 6,624, west of Cheminis station.

intrusive and extrusive. East of Bear lake on claim L. 11,977 in McGarry township, syenite porphyry cuts the trachyte, proving that the latter rock is not a phase of the intrusive, as might easily be imagined from a casual examination.

Trachytic breccia consists of a fine-grained, basic trachytic matrix filled with angular fragments of a coarser, reddish-coloured trachyte. It is interbanded

with massive trachyte and may partly represent fragmental flow tops, although it was never definitely recognized as such. The trachytic agglomerate contains rounded fragments of trachyte and in addition may have a few pieces of foreign rock material. This rock often adjoins the conglomerate, especially in the central part of McGarry township, and could be mistaken for it. The conglomerate, however, may be recognized by the great diversity of pebble types and the arkosic matrix, which contrasts with the igneous nature and predominance of trachytic fragments in the agglomerate. Sometimes trachytic agglomerate occurs with porphyritic trachyte, in which case many of the fragments have a porphyritic texture.

The agglomeratic phases often grade laterally into thinly bedded or cross-bedded tuffs. These range from extremely acid, cherty varieties to basic chloritic members and occur in narrow bands, irregularly distributed throughout the trachyte and trachytic agglomerate.

The various members of the trachytic division are too lenticular in outline and variable in character to constitute reliable marker horizons over appreciable areas, but if taken as a unit these volcanics can be used for structural interpretation. Structural evidence shows that this trachytic complex lies below, between, and above sedimentary bands, and so occurs at several different horizons in the Timiskaming series. All these horizons, however, lie within a mile or less of the base of the Timiskaming series and are not present in the southern parts of McVittie or McGarry township.

Microscopic examination shows that the constituent minerals of the trachyte and porphyritic trachyte are generally badly altered, the feldspars being changed to kaolin or sericite and the hornblende to chlorite. In the less altered rock the feldspars are generally albite and orthoclase.

The following analyses of the Larder Lake trachyte show that it is more basic than the average trachytic rock. The higher lime-magnesia content of the Larder Lake trachyte is due to the slight carbonatization of the rock.

ANALYSES OF TRACHYTES

	No. 1	No. 2	No. 3
	per cent.	per cent.	per cent.
SiO_2	52.74	54.90	60.68
TiO_2	.....	.40	.38
Al_2O_3	17.96	18.95	17.74
Fe_2O_3	5.66	.76	2.64
FeO	3.87	2.78	2.62
MnO	.....	.01	.06
MgO	3.76	7.53	1.12
CaO	4.12	6.25	3.09
Na_2O	5.63	4.08	4.43
K_2O	1.93	1.68	5.74
H_2O	2.72	1.73	1.26
P_2O_5	.....	.63	.24
CO_2	1.54	.....	.....
Cr_2O_3	.....	.10	.....
FeS	.....	.26	.....
Total	99.93	100.06	100

Sample No. 1—Trachyte from south of Binney lake. Analysis by W. K. McNeil, Provincial Assay Office.[1]

Sample No. 2—Trachyte from the east shore of Bear lake. Analysis by Provincial Assay Office, 1938.

Sample No. 3—Average composition of 48 trachytes.[2]

[1]P. E. Hopkins, Ont. Dept. Mines, Vol. XXXIII, 1924, pt. 3, p. 6.

[2]R. A. Daly, "Igneous Rocks and the Depths of the Earth," McGraw Hill Book Company, 1933, p. 11.

Altered Sediments, Trachyte, and Pyroclastics

The Timiskaming sediments are considerably altered by the effects of folding, shearing, faulting, and the action of neighbouring intrusives, but the trachyte and associated pyroclastics have generally not been greatly affected. Slight carbonatization of the trachyte is widespread and often quite noticeable near the contact with greywacke, making the distinction between the two rocks rather difficult. The fine-grained sediments have been altered to chlorite-sericite schist along certain zones of intense shearing, but away from these the metamorphism has rarely been so intensive as to entirely obliterate the original bedding although it may be greatly contorted. Carbonatization has been concentrated along pre-existing sheared zones in the sediments, and these are largely localized at or near the contact with volcanics. In such cases the carbonatization of the lavas is more widespread and more intensive than that of the adjoining sediments. This is probably due to the fact that the lavas have a higher original content of lime, magnesia, and iron for utilization in the process of carbonatization. At any rate, the carbonate bodies are largely confined to the basic lavas and certain basic dikes.

Alteration of the sediments in the vicinity of intrusive bodies is due to shearing movements or replacement. Secondary albite crystals are sometimes developed and give the sediment a porphyritic texture. In the vicinity of the diorite and syenite intrusives between the Omega mine and Larder lake the conglomerates are often greatly sheared at the contacts, and the rock is now a chlorite schist with the pebbles almost obliterated. The same conditions occur within the boundaries of Larder Lake village and on claims immediately to the north, where the conglomerate is cut by a network of small dikes and is so greatly altered that only at certain points are pebbles and bedding recognized. The dikes comprise more than half the bulk of many of these outcrops.

Basic Volcanics

Basic volcanics extend across most of the southern part of McGarry and McVittie townships. The belt has been traced across the map area from the Omega property on the west to the Chesterville Larder Lake claims on the east. A further eastward extension is indicated by drilling beneath the Cobalt series on claims of Pelangio-Larder Mines. At the west end of the Omega property the belt pinches out adjacent to intrusives. Another belt has been explored along the strike by diamond-drilling on the Legardo claims, but it may be a different horizon because the Larder Lake sheared zone may angle across between the two bands of volcanics. As the volcanics are very narrow at the west end of the drilled section on Legardo ground, they probably pinch out in this vicinity. Westward along the line of strike to the Gauthier township boundary the country is drift-covered. An outcrop of basic volcanics that could be an extension of this belt occurs at almost the same stratigraphical horizon on the south shore of Fork lake in Gauthier township.

This is the main gold-bearing horizon in the Larder Lake camp and has been extensively investigated by surface-trenching, diamond-drilling, and underground exploration. In McVittie township it ranges from 50 to 1,100 feet in thickness, but in McGarry township it swings southward around the nose of a westward-plunging syncline and widens to at least 2,000 feet on Kerr-Addison ground. There may have been a great deal of difference in the original thickness, as the band has undergone extensive strike-faulting.

Much of the rock within this band of volcanics has undergone intensive alteration owing to the strike faulting and subsequent carbonatization along or

adjacent to the faulted zones. However, lava flows with subordinate amounts of interbedded pyroclastics are readily recognized at many points. The flows generally range from andesite to basalt in composition and in many places are either pillowed or spherulitic. At the Omega mine more acid flows having the composition of dacite occur in the ore zone. At other points west of the mine the lavas are more basic in character but contain small, visible quartz phenocrysts and are about quartz andesite in composition.

Horizons of fragmental rocks occur locally within the volcanics and are of two types, dependent upon their origin. Volcanic breccias consisting of angular to subangular fragments of lava in a fine-grained volcanic groundmass are found in various localities. These often represent flow tops and are repeated across the strike, the number of fragmental horizons probably corresponding with the number of flows. For example, in the underground workings of the Barber-Larder mine various zones of volcanic breccia grade laterally into massive lava. The fragments sometimes contain vesicles, thus proving their volcanic origin. The brecciated zones tend to lens out both vertically and horizontally in conformity with the lenticular character of the flows. Similar fragmental lavas occur in the Cheminis mine workings adjacent to cherty tuff bands.

A second group of fragmental rocks consists of the true agglomerates. These contain bombs and angular fragments of foreign rock material embedded in a fine-grained tuffaceous matrix. The agglomerates are generally interbanded with the basic lava flows, but, rarely, a small band occurs in the sediments. A prominent horizon of agglomerate extends northeastward across claims of Sheldon-Larder Mines in the southern part of McGarry township. It contains angular and rounded fragments of various rock types, which range from minute dimensions to 18 inches in diameter. On claim T. 1,932 of Armistice Gold Mines the agglomerate is interbedded with narrow basic flows. The agglomerate often occurs at or near the upper side of the band of volcanics and adjacent to the overlying greywacke. This relationship may be noticed on the Sarcee, the eastern Cheminis, and the Sheldon-Larder claims. In the southern part of claim L. 2,035 of Sarcee Mines interbanding of agglomerate, greywacke, and pillowed lava may be seen in a trench at the volcanics-sediments contact.

The rock classified as tuff is a thinly bedded, fine-grained sediment and is presumed to represent water-sorted volcanic ash. It occurs as narrow bands intercalated between lava flows and varies considerably in composition and appearance at different points. At the Kerr-Addison mine, bands of hard, cherty tuffs with thin bedding laminae are traced throughout the underground workings and serve as marker horizons. Zones of graphitic schist occur at several points along the band of volcanics and are interpreted as sheared carbonaceous tuffs. The rocks classified as tuffs at the Omega mine are thinly bedded slates and greywackes of grey or black colour. Rarely, thin laminae of magnetite occur, and the rock could be called iron formation. These so-called tuffs are similar in appearance to certain phases of the greywacke that lies north of the volcanic group.

It is purely a matter of individual opinion as to whether the above-mentioned bedded strata intercalated between the flows should be called tuffs or normal sediments. Lithologically, they are sediments similar in composition to some members of the adjacent sedimentary groups. Throughout this report they are classified as tuffs only on account of their intimate association with volcanics. Thus, the distinction between tuffs and normal sediments is based on field relationships rather than lithology.

The stratigraphy of the basic volcanics in the Timiskaming series is notice-

ably different from that of the basic volcanics in the northern part of the area that are assigned to the Keewatin series. Pyroclastics and sediments are interbedded with the Timiskaming basic volcanics but are virtually absent in the Keewatin type. In the Omega mine workings, which traverse the Timiskaming volcanics, a horizon of conglomerate is interbedded with highly altered lavas. If the Omega tuffs are regarded as sediments there would be at least two sedimentary horizons in the Timiskaming volcanics across this section. On claim T. 1,904, in Virginiatown, there is an exposure of bedded tuff and associated agglomerate with rounded fragments. These have been grouped with the pyroclastics but show evidence of considerable water-sorting and abrasion and so are practically true sediments. At some other points on the Kerr-Addison and Chesterville Larder Lake claims the agglomerate shows similar evidence of the action of erosional agencies. Drilling on Legardo claims at the west end of the band of basic volcanics shows interbanding of basic lava with arkose and greywacke. All these facts point to conditions of intermittent vulcanism and sedimentation during the deposition of the Timiskaming basic volcanics. These conditions show a marked contrast to the uninterrupted vulcanism during the formation of the Keewatin basic volcanics.

Altered Basic Volcanics.—The basic volcanics of the Timiskaming series are all somewhat altered, but in certain areas the metamorphism has been intense enough to completely obliterate the original texture and entirely change the original composition of the rock. Intense alteration along the belt has been effected in two different ways: (1) by strong shearing and faulting movements localized along certain zones, and (2) by intense carbonatization from hydrothermal solutions.

Along zones of pronounced regional faulting the lavas have been altered to soft, fissile, talc-chlorite schists. The location of these major sheared zones is indicated on the accompanying geological maps. These sheared zones are sometimes several hundred feet in width. The carbonatized rocks, or "dolomites," are localized along certain of the major faulted zones where lines of weakness had previously been developed and provided access for the carbonate-forming solutions. The carbonate rocks are discussed in detail elsewhere in this report.

Correlation of the Basic Volcanics.—In 1920 Cooke[1] recognized basic volcanics in the Timiskaming series on the north shore of the northeast arm of Larder lake. Later Hopkins[2] traced the continuation of these volcanics across the southern parts of McGarry and McVittie townships but did not have the drilling information north of the Kerr-Addison mine to show that they are separated from the northern volcanics by a narrow band of sediments. Hopkins, therefore, correlated all the basic volcanics with the Keewatin series. The writer has assigned the bands of basic volcanics in the southern parts of McGarry and McVittie townships to the Timiskaming series. The various reasons that led to this decision include both structural and stratigraphical evidence.

From the east boundary of the Omega property to the edge of the Cobalt series in the eastern part of McGarry township the sediments on either side of the band of basic volcanics face south, except where minor drag folds occur. South of the east end of Barber lake the lavas also face south. This would be a simple case of interbanded lavas and sediments if strike-faulting did not complicate the situation. The southern contact of the volcanics and sediments shows

[1]H. C. Cooke, Geol. Surv. Can., Mem. 131, 1922, map No. 1932.
[2]P. E. Hopkins, Ont. Dept. Mines, Vol. XXXIII. 1924, pt. 3, map No. 33b.

evidence of faulting in certain sections, but at other points (e.g. claim L. 2,035, Sarcee Mines) there is interbedding of formations at the contact.The northern contact is along a strong fault (Larder Lake "break"), on which there could be a great amount of displacement, possibly measurable in miles.

There does not seem to be much chance that the volcanics under discussion could be an upthrusted segment of the northern Keewatin volcanics on the south side of the Larder Lake "break." The stratigraphy along a line of section due south from Malone lake in the southeastern part of McVittie township shows an entirely different rock succession south of the Keewatin-Timiskaming boundary from that south of the Larder Lake "break." The very prominent horizon of trachyte and associated pyroclastics that occur north of the Larder Lake fault does not reappear south of it. In order for the volcanics south of the Larder Lake fault to be an upthrust equivalent of the Keewatin volcanics around Malone lake it would be necessary for a greater than 5,000-foot succession of conglomerate, greywacke, and trachytic rocks to lens out in the upthrust and eroded section south of the fault; this is improbable. Then, on the western part of the Omega and Legardo claims in the western part of McVittie township the volcanics occur north of the probable position of the Larder Lake "break." Westward in Gauthier township a similar condition of interbanded basic lavas and sediments occurs.[1] Field work by the writer in Hearst and McElroy townships in 1941 disclosed a great deal of interbanding of sediments and basic volcanics.[2] All this accumulated evidence shows that interbanding of many different horizons of basic lavas and sediments is the normal condition over a large part of the Larder Lake area.

The Keewatin and Timiskaming basic lava flows are generally identical in appearance and composition and the writer knows of no way by which these two groups can be distinguished except through establishment of field relationships. It has already been pointed out in this report that the bands of Timiskaming volcanics contain a large amount of interbedded tuffs, agglomerates, and sediments, in sharp contrast to the almost complete absence of such members in the Keewatin volcanics.

Small patches of basic lavas flank the intrusive stock east of Larder Lake village. These are found at the Raven River mine, on claim L. 19,943 off Enright point, and near the mouth of Pancake creek. These are inferred by the writer to be remnants of different horizons of volcanics interbedded with the Timiskaming sediments. It is known that a north-south cross-fold extends through the intrusive stock from a point near the Omega mine southward down the southwest arm of Larder lake, and it might be argued that the flanking lavas are domed-up remnants of the Keewatin group. If this were the case the stratigraphical succession above the lavas should be somewhat the same as that above the northern Keewatin-Timiskaming boundary. The prominent horizon of trachytic rocks, however, does not occur above the lavas and conglomerate around the periphery of the intrusive dome. The stratigraphy, therefore, suggests that these isolated patches of lavas are not of Keewatin age.

ORIGIN OF THE TIMISKAMING SERIES

Cooke[3] has pointed out that the sediments of the Timiskaming series were probably deposited in a large shallow continental sea, bordered by a mountainous

[1]Jas. E. Thomson and A. T. Griffis, "Geology of Gauthier Township, East Kirkland Lake Area," Ont. Dept. Mines, Vol. L, pt. 8, 1941, in course of preparation.

[2]To be discussed in detail in a subsequent report.

[3]H. C. Cooke, op. cit., pp. 41, 42.

country, from which large amounts of detritus were rapidly accumulated through the action of torrential streams during flood seasons. The climate was probably rigorous and favoured gravel production and incomplete weathering. The river currents would deposit these gravels at the base of the mountain range and on the adjoining piedmont. The deposits of clay, silt, and impure arkosic sand would alternate with great frequency owing to seasonal changes.

This seems to be a logical explanation and would account for the variable thickness and character of the basal conglomerate, the numerous horizons of conglomerate and finer-grained clastics, the lenticular outline and cross-bedding of the arkose and greywacke, and the presence of partly disintegrated feldspars in the arkosic members.

The presence of large amounts of lavas and pyroclastics in the Timiskaming series indicates that sedimentation was accompanied or followed at certain intervals by vulcanism. The lavas and pyroclastics would be accumulated on the flood plains and in the seas along with the sediments where the volcanic ejectamenta could be water-sorted locally. Lenses of greywacke or conglomerate are occasionally interbedded with lavas or pyroclastics and vice versa. The strikes of the beds, also, invariably parallel the contacts between lava and sedimentary formations except where disturbed by later faulting or folding. This indicates the conformable relations of the various lava-sedimentary formations and the absence of a pronounced break in the stratigraphical succession.

KEEWATIN-TIMISKAMING RELATIONSHIPS

For many years the long and comparatively narrow belt of intermingled sedimentary and volcanic formations that extends from Kenogami lake eastward through Teck, Lebel, Gauthier, McVittie, and McGarry townships has been correlated with the Timiskaming series. This correlation implied that the sediments-volcanics complex is folded into a syncline, which lies stratigraphically above the adjacent Keewatin volcanics and is separated from them by an unconformity. The interpretation has been based largely on lithological rather than structural evidence.

In recent years the Geological Branch of the Ontario Department of Mines has carried out a detailed restudy of the entire belt from Swastika to the Quebec boundary, assigning separate field parties to the different townships. This report covers the investigations of the two eastern townships. At the conclusion of the field season of 1940 enough work had been done to show that the belt of sediments and volcanics through Lebel, Gauthier, McVittie, and McGarry townships comprised only the north limb of a major syncline, although subsidiary folds occur throughout it. A few days' study by the writer in Hearst township to the south brought out some evidence to show that the belt of sediments that extends through Hearst, McElroy, and Boston townships might form part of the south limb of this major synclinal structure. With this possibility in mind, the writer began a detailed geological study of Hearst and McElroy townships in 1941. By the end of that season sufficient evidence had been collected to strengthen but not entirely prove the correctness of this idea.[1] The Kirkland Lake–Larder Lake syncline or synclinorium may thus be a much broader structure than previously thought. No complete description of it can be made until the entire southern area of lavas and sediments is mapped.

In McGarry and McVittie townships conglomerate generally occurs at the

[1]A geological report covering Hearst and McElroy townships will be published as soon as the field work is completed.

base of the Timiskaming series, although at a few points greywacke or trachyte replace this rock. The presence of a basal conglomerate that contains pebbles of Keewatin lavas has been accepted as proof of the unconformity between the Keewatin and Timiskaming series, the inference being that the Keewatin rocks were folded and then eroded to provide the material for the sediments. Nevertheless, as stated by Cooke,[1] this proves only that the Keewatin series was undergoing erosion at the point of origin of the pebbles, but perfect conformity might exist at the place of deposition.

This seems to be the proper explanation of conditions in the Larder Lake area. No evidence of a structural unconformity was found at any place along the Keewatin-Timiskaming boundary. At the only point where exact data was secured the Timiskaming basal conglomerate lies with perfect conformity on the Keewatin lava. In the southeast corner of claim L. 9,514, north of Larder Station townsite, a lava flow, 70 feet in width, may be followed for about 600 feet along the lava-conglomerate contact. The contacts are well defined and unsheared. The strike of the flow is parallel to the contact. In the western part of the claim a 6-inch band of rhyolite is interbedded with basic lava at a point 50 feet north of the conglomerate contact. It strikes parallel with the conglomerate-lava contact, which is sharply defined and unsheared.

While the two series are thus structurally conformable there is no doubt about the fact that the Timiskaming series lies stratigraphically above the Keewatin volcanics. The relationship is definitely proved in the western part of McVittie township where top determinations in both Keewatin and Timiskaming series show the relationship clearly. Also at a number of points in McGarry township top determinations check the relative ages of the two series.

Recent detailed mapping of the eastern extension of this sediments-lava complex in the Rouyn-Harricanaw district of Quebec has led the investigators in that region to conclude that there are two ages of both lavas and sediments and that the terms Keewatin and Timiskaming are useless as stratigraphical terms unless redefined.[2] They have, therefore, adopted local names for the different stratigraphical units of lavas and sediments. In the Larder Lake area it is also evident that there are successive stratigraphical horizons of lavas and sediments. But, as previously pointed out under the section on Timiskaming stratigraphy, it would be very confusing to attempt any separation of stratigraphical units with local names within the Timiskaming complex on account of the interlensing and interfingering of formations. No well-defined stratigraphical break in the series has yet been found. Possibly after complete investigation of the south limb of the syncline some definite stratigraphical units could be outlined, but until that work is completed it seems to the writer that the naming of stratigraphical units within the Timiskaming complex would cause considerable confusion and achieve no practical advantage.

Algoman Intrusives

The rocks of the Keewatin and Timiskaming series are invaded by stocks, dikes, and irregularly shaped bodies of intrusives varying in composition from granite to diorite or lamprophyre. The larger exposures, such as the Bear Lake stock or the intrusive body northeast of Larder Lake village, have the general composition of syenite or syenite porphyry, but these may grade into a number

[1]H. C. Cooke, op. cit., p. 36.

[2]H. C. Gunning and J. W. Ambrose, "The Timiskaming-Keewatin Problem in the Rouyn-Harricanaw Region, North-Western Quebec," Trans. Roy. Soc. Can., Vol. 33, 1939, pp. 19-47.

of different phases such as felsite, quartz syenite, diorite, or diorite porphyry. The smaller satellitic masses that adjoin the main stocks may be considerably sheared and carbonatized. This alteration is characteristic of the syenite porphyry on the Armistice and Arjon claims. The roof pendants of sediments and lava in the syenite porphyry mass west of Bear lake indicate that the present erosion surface has only penetrated the periphery of the stock leaving the deeper portions intact.

In the northwestern part of McGarry township the acid intrusives are syenite and syenite porphyry; these are very massive and tightly injected without much evidence of rock disturbance. Across the township boundary in the northeastern part of McVittie township a few outcrops have considerable primary quartz and are granite in composition. The granite has not been found in contact with the surrounding syenite but may be only a local acid phase of the syenite mass and grade into it.

In the vicinity of Beaverhouse lake there are irregularly shaped bodies of massive, pink-weathering syenite porphyry with feldspar crystals ranging from one-eighth to one-third of an inch in length. Basic phases of this intrusive, in which hornblende crystals are predominantly developed, occur on claims of Beaverhouse Lake Gold Mines. Southeast of the lake a reddish syenite porphyry is the common type of intrusive in the small stocks and dikes, and a greyish-coloured phase is found in the central part of the larger intrusive bodies.

On claims of Ross Wall Gold Mines, located north of Larder Station townsite, there is a stock of syenite porphyry of a type different from that usually found in the area. It has well-developed feldspar crystals irregularly distributed in a fine-grained groundmass. The rock occurs in very sharp contact with the surrounding sediments and cuts across the structure. It is quite different lithologically from the nearby extrusive trachyte, with which it has been correlated in some previous surveys.

The intrusives northeast of Larder Lake village are irregularly shaped bodies and are interfingered with older rocks at their margins. The intrusives on L. 11,773, L. 4,438, and adjoining claims have a medium-grained texture and are dark-grey in colour. The predominance of hornblende gives the rock the appearance of diorite or diorite porphyry in the field, but microscopic examination of samples collected from a number of points show that the rock varies in composition from quartz syenite to syenite with certain marginal areas that approach quartz diorite in composition. The feldspars are generally orthoclase and albite; primary quartz ranges in amount from a trace to about 15 per cent. of the mineral constituents. A silica analysis of a composite mixture of four samples from claims L. 4,438, 11,773, and 8,879 showed 57.23 per cent. SiO_2, which is very close to the average silica content of normal syenite.

East of the above-mentioned syenitic body, dikes of diorite, mica syenite, and lamprophyre are found and become quite numerous on claims of Lar-Add Mines. Most of these intrusives are heavily carbonatized and contain a stockwork of quartz stringers. Sometimes a considerable amount of green fuchsite occurs with the carbonate. Most of the less-altered dikes are characterized by the presence of a large amount of mica, which may be either biotite or chlorite. They were classified as mica syenite and lamprophyre in the field, and microscopic study gave no additional information on their composition on account of the intense carbonatization. Basic lamprophyres characterized by a large mica content are sometimes found in the southern part of McVittie township. On Moosewood, Cheminis, and Fernland claims the dikes are fine-grained and the

micas are not abundant. This rock was classified as diorite in the field; it is heavily carbonatized and often contains quartz stringers.

On claims of Laguerre Gold Mines there is an intricate series of dikes and stocks of intrusives, which vary in composition from syenite and syenite porphyry to diorite and lamprophyre. A fine-grained cherty felsitic phase of the syenite occurs in the narrower acid dikes. The lamprophyre is dark-coloured and composed principally of biotite. It cuts the syenite and syenite porphyry. Within the Larder Lake townsite and on claims immediately to the north a swarm of small irregular dikes of acid to basic intrusives cut the conglomerate; in places over half of the outcrop area is made up of these dikes.

A peculiar type of basic dike occurs south of the mill at the Kerr-Addison mine. It ranges from 12 to 20 feet in width and may be traced for about 1,400 feet on the surface. It strikes about parallel to the adjacent flows but is slightly lighter in colour and fine-grained. It contains scattered, rounded boulders and pebbles of granite and porphyry up to 14 inches in diameter. As these boulders are always rounded, the rock resembles a conglomerate in appearance. Along the margins of the dike there are small inclusions of the adjoining flows. Microscopic examination of the rock shows that it is of igneous origin. Near the west end the dike has a slightly porphyritic texture and contains small phenocrysts of quartz and feldspar.

Carbonatized Rocks

The carbonatized rocks of the area have been formed by the alteration of pre-existing rocks through the action of circulating solutions. In some bodies the replacement is sufficiently complete to produce a relatively pure carbonate rock. For many years this has been locally called dolomite, but technically the name is incorrect. The rock is composed largely of carbonate of lime, magnesium, and iron, and so approaches more closely the composition of ankerite. Where this carbonate occurs as the chief constituent the rock is sometimes called grey dolomite. At many places, however, a green mica occurs with the carbonate and gives the rock a green colour. It is then often referred to as green dolomite or green carbonate. The carbonate bodies are often cut by quartz stringers, which form an irregular network throughout the rock, and at the Kerr-Addison and Chesterville Larder Lake mines these quartz stockworks are gold-bearing and produce large ore bodies. Practically all the important gold deposits that have been found to date in the area occur either in or near bands of carbonate rock; their distribution, therefore, is very important from an economic viewpoint.

There are all stages between relatively fresh country rock and complete carbonate replacement. In geological mapping a more or less arbitrary line must be drawn between completely carbonatized, partially carbonatized, and unaltered rock. Observers might easily differ in their classification of some exposures, especially on the weathered surface where the carbonates are altered to a reddish-brown gossan. Any of the pre-Cobalt rocks may be locally carbonatized to some extent. Where the carbonate replacement has been intense, it is very difficult to determine the original composition of the rock, especially in those cases where the carbonate material lies between different rock formations and grades laterally into each, as, for example, at the Kerr-Addison mine. There is evidence, however, that the greater part of the carbonate bands lie within basic lavas and associated agglomerates and tuffs. There are generally certain areas within or along the strike of the carbonate bands where carbonatization is not so intense, and these points provide clues as to the original nature of the rock. The presence of

spherules, vesicles, pillows, agglomeratic fragments, thinly bedded cherty tuffs, and igneous textures are diagnostic criteria that prove that the pre-existing rock was volcanic rather than sedimentary. The fact that the carbonate bands are generally localized within and along the borders of the areas of basic volcanics confirms this point. A few small carbonatized zones lie within conglomerate and greywacke. In the southern part of McVittie and McGarry townships diorite and lamprophyre dikes cutting the sediments may be partly or completely carbonatized while the bordering greywacke shows alteration only a few feet away from the contact.

Generally, carbonatized sediments are found only near contacts where the adjacent basic lavas or dikes have been heavily carbonatized. In these cases the alteration extends laterally a short distance into the sediments but rapidly diminishes in intensity. Fresh samples of partially carbonatized greywacke in drill-cores frequently show a selective carbonate replacement of the basic portions of the beds. In some samples of drill-cores it has been found that only the siliceous layers in the sediments were unreplaced.

From the above facts it would appear that the chemical composition of the original rock has some influence on the carbonatization. Basic lavas and dikes contain a considerably greater content of lime, magnesia, and iron than greywacke. These primary constituents were probably utilized by circulating solutions to produce the secondary mixed carbonates. The igneous rocks would therefore be most easily attacked and show the greatest alteration.

Acid intrusives within the carbonate bodies are altered to some extent but generally not so badly that they cannot be recognized as intrusives. Dikes and irregularly shaped masses of syenite lie within the carbonate bodies in the Kerr-Addison underground workings. These dikes are fractured and contain auriferous quartz veins yet are often only slightly carbonatized compared with the adjoining rocks. Similar conditions occur in the underground workings of the Raven River (Laguerre) mine where the syenite plugs are surrounded by carbonate rock, but the intrusive is not heavily carbonatized although it is greatly altered near the veins. Syenite porphyries on the Armistice and Arjon claims are sheared and carbonatized but not beyond recognition.

Composition of Carbonate Bodies.—Since the carbonate bodies are secondary rocks, they vary in composition according to the amount of replacement that has taken place. The green colour, which is characteristic of a large proportion of the carbonate rock, is due to the presence of a green mineral that has the optical properties of either mariposite or fuchsite, both of which are chrome-bearing micas. The following analyses are of selected samples of the green carbonate from different horizons at the Kerr-Addison mine and other localities. Tiny veinlets of quartz are always associated with the carbonate rock, and these account for part of the silica content of the samples analysed. The remainder of the silica is accounted for by silicification, which seems to have accompanied carbonatization of the rock. A study of the analyses will show that the rock is essentially a carbonate of magnesia, lime, and ferrous iron. The content of chromium oxide is small but, considering the small amount of the green mica in proportion to the carbonates in the samples, is generally in excess of the chromium oxide content (0.18 per cent.) of the only published analysis of green fuchsite known to the writer.[1]

[1]Amer. Jour. Sci., Vol. 49, 1895, p. 377.

ANALYSES OF GREEN CARBONATE ROCKS

	No. 1	No. 2	No. 3	No. 4	No. 5
	per cent.	per cent.	per cent.	per cent.	per cent.
Silica (SiO_2)	29.28	33.86	28.52	18.37	26.20
Alumina (Al_2O_3)	4.46	5.41	9.24	4.19	7.09
Ferric iron (Fe_2O_3)	.36	.33	.44	1.71	.21
Ferrous iron (FeO)	6.15	6.43	7.85	5.59	7.17
Lime (CaO)	8.68	4.17	6.33	19.69	6.15
Magnesia (MgO)	19.08	20.80	17.18	15.54	21.08
Potash (K_2O)	1.56	1.53	2.74	1.01	1.88
Soda (Na_2O)	None	.51	.77	.02	.06
Water (H_2O)	1.18	.72	1.31	.73	1.44
Carbon dioxide (CO_2)	28.26	24.85	24.80	32.66	26.82
Titanium dioxide (TiO_2)	.23	.28	.42	.30	.38
Phosphorus pentoxide (P_2O_5)	.02	.02	None	.01	None
Chromium oxide (Cr_2O_3)	.19	.26	.13	.09	.42
Manganese oxide (MnO)	.05	.06	.04	.01	.43
Pyrite (FeS_2) Fe	.35	.33	.12	.15	.07
Pyrite (FeS_2) S	.40	.38	.14	.17	
Total	100.25	99.94	100.03	100.24	99.40
Specific gravity	2.952	2.921	2.964	2.904	2.959

Sample No. 1—Green carbonate from No. 10 ore body, 300-foot level, Kerr-Addison mine. Analysis by Provincial Assay Office, 1941.

Sample No. 2—Green carbonate from No. 10 ore body, 500-foot level, Kerr-Addison mine. Analysis by Provincial Assay Office, 1941.

Sample No. 3—Green carbonate from No. 14 ore body, 1,000-foot level, Kerr-Addison mine. Analysis by Provincial Assay Office, 1941.

Sample No. 4—Green carbonate from surface pit on claim L. 6,464, Sheldon-Larder Mines. Analysis by Provincial Assay Office, 1941.

Sample No. 5—Green carbonate from underground, Raven River mine. Analysis by Provincial Assay Office, 1941.

Structure of Carbonate Bodies.—On the basis of their structural features the carbonate bodies may be divided into three groups, the first of which is the most widespread and has the greatest economic importance: (1) carbonate replacements along pre-existing faulted zones, (2) carbonate replacements in dikes, and (3) carbonatization adjacent to intrusives.

The larger carbonate bodies generally occur in long narrow bands, which strike about parallel with the contacts of the adjacent rock formations. The carbonate replacement is greatest in the central part of the band and gradually diminishes in intensity both laterally and along the strike. Strong shearing is generally in evidence along the margins of the carbonate zones. Here it may be seen that the carbonates are injected along the shear planes in the soft, fissile schists, but in the central area the intense alteration has completely obliterated any such evidence.

In 1922 Cooke[1] pointed out that the main bands of carbonate rock in the Larder Lake area were localized within strongly sheared and faulted zones. The present detailed study has proved the correctness of Cooke's interpretation. These sheared zones are major faults that strike either parallel or at a low angle to the enclosing formations so that displacement is not readily noticed. Nevertheless, as described in detail in the discussion of the structural geology of the area, the main carbonatized shear zone (Larder Lake "break") has been traced across McGarry and McVittie townships and is localized along a contact of the lavas and sediments; at certain points it truncates minor folds in the sediments. Other carbonatized shear faults lie entirely within lavas, and there is no visible

[1]H. C. Cooke, op. cit., p. 51.

evidence of displacement of marker strata. The intensity of carbonatization varies considerably from place to place along the sheared zones. At certain points, as for example on Pelangio-Larder claims, heavy shearing occurs across a width of about 700 feet and has changed the rock to a soft talc-chlorite schist, but there has been no marked carbonatization. Westward along the strike in the underground workings of the Kerr-Addison and Chesterville Larder Lake mines the carbonate body is quite wide, but it again narrows farther west on the Armistice, Proprietary, and Sheldon-Larder claims. At some places the carbonate replacement has been so intense that the original shearing has been completely masked and is not noticeable in drill-cores or surface outcrops. For example, at the Barber-Larder mine there is little evidence of faulting in the drill cores through the carbonate body.

Carbonate replacement of mica syenite, lamprophyre, and diorite dikes has been discussed above. These carbonatized dikes are numerous in the sediments along the north shore of Larder lake, especially on the Lar-Add claims. The dikes are cut by a network of quartz stringers and may contain disseminated sulphides.

Irregularly shaped bodies of green and grey carbonate adjoin the syenite plugs at Raven River mine. Similar carbonate masses occur along the borders of sheared syenite porphyry on the Arjon claims.

Time of Carbonatization.—All the pre-Cobalt formations in the Larder Lake area have been altered to carbonate rock locally. Boulders of the carbonate are found in the basal conglomerate of the Cobalt series, and erosion remnants of the Cobalt series overlie the carbonate bodies unconformably along the north shore of Larder lake on claim T. 1,840 of Kerr-Addison Gold Mines.

A network of quartz veins cuts the carbonate bodies at most of the mines in the area and are definitely post-carbonate. Syenite dikes within the Kerr-Addison mine workings are carbonatized and cut by gold-bearing veins. This would place the period of carbonatization some time after the injection of the syenites but prior to the formation of the auriferous quartz veins.

In most places throughout the area there is a close association between carbonates and quartz veins. This led Cooke[1] to conclude that the carbonatization was caused by solutions emanating from the quartz veins and certain acid intrusives. More detailed information on these carbonate bands, however, shows that there are areas of intense carbonatization without attendant quartz veins and vice versa. In the ore bodies on the south side of the Kerr-Addison and Chesterville Larder Lake ore zones, and adjacent to the large masses of carbonate rock, there are quartz veins and stringers without any sign of attendant carbonatization. This condition could only occur if the veins were introduced after the carbonatization.

It has generally been assumed that the carbonatization was caused by the reaction of hot solutions from some deep-seated source on the invaded rock. In this case the solutions rose mainly along the faulted zones, which were natural lines of weakness. To a lesser extent they followed fractured zones in dikes and the borders of intrusive bodies. These solutions may have emanated from the same magma reservoir as the Algoman intrusives during the same general period as the quartz veins but slightly in advance of them.

Main Carbonate Band (Larder Lake "Break").—The longest and most important carbonate band in the area is localized along a sheared zone that has been

[1]H. C. Cooke, op. cit., p. 51.

traced from beneath the Cobalt series on Pelangio-Larder ground westward to the Anoki mine in Gauthier township, a distance of over 15 miles. It is possible that this may be the westward continuation of one of the carbonatized sheared zones that lie more or less on strike across the interprovincial boundary in Dasserat, Beauchastel, and Rouyn townships (see Fig. 3 facing page 32). This sheared and carbonatized zone may be regarded as the "main break" through the Larder Lake mining camp, as almost all the ore bodies found in the area to date lie on or near it. A southern branch of the main carbonate band is developed on the Cheminis claims and continues westward through Fernland ground.

Drilling through the Cobalt series on the Pelangio-Larder claims revealed a 700-foot width of talc-chlorite schist, which is probably highly altered lavas. Westward along the strike on claims L. 5,413 and 891 of Chesterville Larder Lake Mines the schist becomes carbonatized. Pillow structures are found at a few points immediately south of the sheared zone, indicating that the schist is an altered lava. On claims T. 1,749 and 1,860 the carbonatized zone widens on the surface owing to a flattening of the dip, but underground at the Chesterville Larder Lake mine it is only 200 to 300 feet in width. Along the north side of the Chesterville and Kerr-Addison ore bodies the sheared zone dips steeply to the north at the contact with the sediments (see map No. 50d). At certain points in the Chesterville main crosscut south of the faulted contact pillows, spherules and igneous textures are preserved. As the area between the Kerr-Addison mine workings and the west boundary of the property is drift-covered, and to date there is no drilling information on the section, it is not known whether the carbonate body continues without a break to the Armistice and Arjon claims. It is narrow in the most westerly underground workings on the 700-foot level at the Kerr-Addison mine (see map No. 50d). It may be cut out in part on the west side of Kerr-Addison ground by a fault that truncates the carbonate body at low angles. The carbonate band may be followed along the south shore of Barber lake and at intervals to Bear lake; there are minor offsets due to faulting. Pillow structures are found in the lavas adjacent to the carbonate zone at several points throughout this area. At the Barber-Larder mine the carbonate band dips about vertically (see Fig. 5 facing page 46). West of Bear lake the carbonate bands dip southward at the Cheminis (see Fig. 6 on page 50), Fernland (see Fig. 9 on page 55), and Omega mines (see Fig. 13 facing page 84). Diamond-drilling on the Legardo claims indicates that the structure dips from about 50° to 65° S. It also dips to the south in Gauthier township.

It may thus be seen that this carbonate band is localized along a strong structure that should persist to great depth. Nevertheless, since the carbonate bodies are of replacement origin, they will undoubtedly be very irregular in outline and may pinch and swell vertically in the same way as they behave longitudinally. The relation of gold deposits to the carbonates and faulting is discussed in a later part of this report.

Cobalt Series

The southeastern part of McGarry township is underlain by relatively flat-lying sediments of the Cobalt series. Erosion remnants of these occur at a few points along the north shore of Larder lake.

During the present study of the area the Cobalt series was not examined in any detail because the mineral deposits of the country are confined to the pre-Cobalt formations. Within the past few years a considerable amount of drilling has been done along the northern border of the Cobalt series on the properties of Pelangio-Larder Mines and Wesley Gold Mines. The object of this work was

to investigate the underlying pre-Cobalt structures. In the course of the work some sections through the Cobalt series were obtained.

The Cobalt series of the Larder Lake and adjacent areas has been studied by Wilson[1] and Cooke.[2] The rocks of the series consist of interbedded conglomerate, greywacke, arkose, and slate. These are massive and so unaltered that original ripple marks and raindrop impressions may sometimes be seen in the slates and greywackes. The beds are devoid of the secondary cleavage generally found in the Timiskaming fine-grained clastics. The conglomerate contains boulders and pebbles of all the rock formations in the Keewatin-Timiskaming-Algoman complex. The dip of the strata is gentle, averaging 10 to 20 degrees

Basal conglomerate of the Cobalt series on claim T. 1,840, Kerr-Addison Gold Mines.

from the horizontal; the general dip near Larder lake is to the south. On claim T. 1,839 of Kerr-Addison Gold Mines erosion remnants of the Cobalt series lie on slates and greywackes of the Timiskaming series. The angular unconformity between the two series is 75 degrees.

At some points within the area it is not easy to determine whether certain isolated outcrops of massive conglomerate belong to the Cobalt or to the Timiskaming series by lithological criteria alone. In case of doubt a search will generally reveal narrow beds of greywacke in the conglomerate, and their dip will indicate the series to which the rock belongs.

Fig. 2 shows a vertical section through the Cobalt series on Pelangio-Larder ground and indicates the marked unconformity between the Timiskaming and Cobalt series. The drilling along this section and elsewhere showed that the pre-Cobalt surface was very irregular and varied as much as 400 feet in elevation. The Cobalt series in this vicinity consists of three distinct stratigraphical units as follows: an upper horizon, about 120 feet thick, consisting of thinly bedded greywacke, slate, and arkose; a middle band of conglomerate, 20 to 70 feet thick; and a lower horizon similar to the upper except that it lacks arkose. The lower horizon varies greatly in thickness, probably owing to its deposition on the uneven surface of the pre-Cobalt terrain. Drilling also indicated post-Cobalt

[1]M. E. Wilson, Geol. Surv. Can., Mem. 17, 1912, pp. 34-46.

[2]H. C. Cooke, W. F. James, and J. B. Mawdsley, Geol. Surv. Can., Mem. 166, 1931, pp. 146-149.

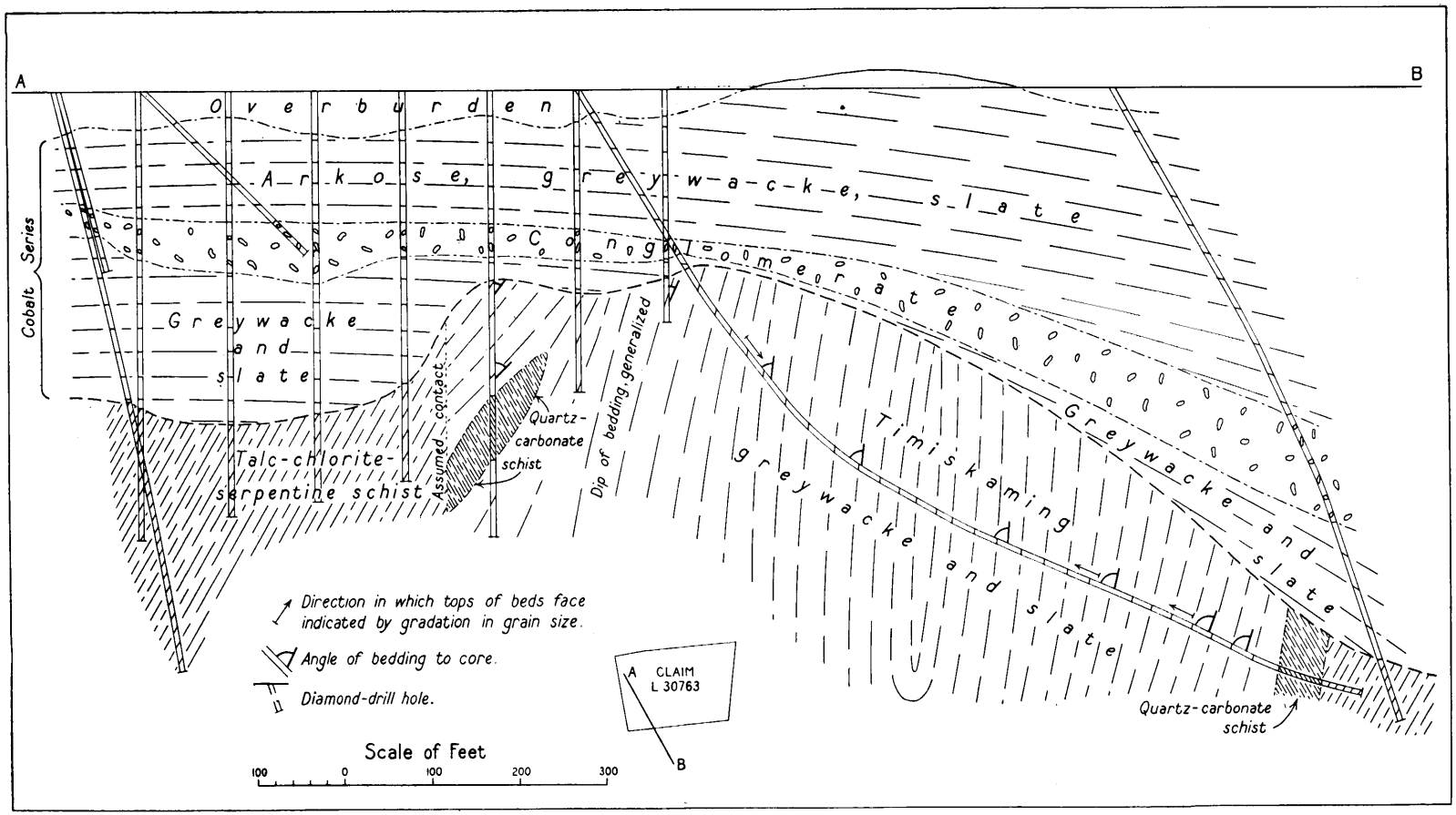


FIG. 2—VERTICAL SECTION ACROSS CLAIM L. 30,763, PELANGIO-LARDER MINES, SHOWING RELATIONSHIP OF COBALT SERIES TO OLDER FORMATIONS.
(Modified after a plan prepared for Pelangio-Larder Mines by B. S. W. Buffam, 1938.)

faulting, with the conglomerate member having about 200 feet of vertical displacement. It is interesting to note 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. The location of certain post-Cobalt faults may thus be of assistance in tracing through the older "breaks" beneath the Cobalt series.

Geologists[1] believe that the Cobalt series was deposited under glacial conditions. Cooke[2] has found glacial striae and gouges on freshly exposed pre-Cobalt rock surfaces. He describes boulders up to 15 feet in diameter in the Cobalt conglomerate and believes these could have been transported only by glacial ice.

Keweenawan or Matachewan

A few diabase dikes are found in the area. They cut all formations of Keewatin, Timiskaming, and Algoman age, but their relationship to the Cobalt series was not established; they may be either Matachewan or Keweenawan in age.

Pleistocene and Recent

Throughout the greater part of the area there is a thin mantle of glacial deposits in the depressions between outcrops. A glance at the accompanying geological maps will show that the country contains a large amount of exposed or partly exposed rock. Varved clays, kame and outwash gravel deposits, sand plains, and large erratics are the products of the Pleistocene continental glaciation. Glacial striae and grooves show that the ice-sheet moved in a southerly direction. A considerable area of sand plain occurs near Cheminis station and in the southwestern part of McVittie township.

Gravel deposits have been opened up at various points along the railway and highway and supply local demands, mainly for highway construction and back-fill at the mines.

STRUCTURAL GEOLOGY

All the field criteria by which structures are determined, such as strikes, dips, tops of beds, faults, and shear zones, are plotted on the accompanying detailed geological sheets (Nos. 50a and 50b). The general interpretation of the regional and local structure is shown on the maps and is based on these data. It is indicated by the lighter tints of colour, which show the assumed extension and boundaries of formations under overburden, and by the location of fold axes, sheared zones, faults, etc. A study of these sheets will show that most of the structural detail was obtained in the sedimentary formations and along the main gold-bearing belt. This was partly due to the fact that a great deal of exploration has been done in recent years in the southern part of the area so that structural details are well exposed by trenches and stripping. Also drilling and underground information supplied by the mining companies filled many gaps in the structural picture. In contrast to these conditions the northern part of the map areas is underlain by large areas of rather poorly exposed, massive lavas and intrusives. These do not yield as much structural information at present on account of the difficulty in tracing marker horizons and accurately observing the attitude of the formations. In the northwestern part of McVittie township the primary structures in the Keewatin volcanics are well-preserved, and it has been possible to outline the general structural picture in that vicinity.

[1]M. E. Wilson, op. cit., pp. 147-149.
H. C. Cooke, Geol. Surv. Can., Mem. 131, pp. 40, 42-46.
[2]H. C. Cooke, W. F. James, and J. B. Mawdsley, op. cit., p. 148.

The detailed structure of the Timiskaming series in the southern half of McGarry and McVittie townships is very intricate. In general, the formations making up the series in the eastern part of the area have been closely folded into pitching anticlines and synclines, the axes of which strike N. 45°–85° E. In the southwestern part of McVittie township the folding becomes simpler, involving only the north limb of a wide syncline. The structure has been further complicated by regional strike-faulting, which has produced wide sheared zones and attendant local drag folds. A later system of north-south trending faults has finally offset the earlier structures at certain points.

In attempting to unravel this complex structural set-up, special attention was paid (1) to the tracing out of reliable marker horizons, (2) to accurate determinations of the tops of lava flows and sedimentary beds, and (3) to locating strong sheared zones. Within the volcanics individual flows could be identified and traced only on rare occasions, but local horizons of sediments, tuffs, and agglomerates interbedded with the lavas were more easily followed. In the Timiskaming series the best marker horizons are (1) narrow bands of conglomerate intercalated between greywacke, and (2) bands of trachyte or trachytic agglomerate interbedded with the sediments. In some parts of the area, fine-grained bedded sediments underlie large areas. Here the structure can only be worked out by determining the strikes, dips, and tops of the strata at close intervals and plotting these features on the map.

The older formations have been so closely folded that flows and beds now have a vertical or near-vertical dip and, in some cases, have been overturned. Direction of dip is thus useless in locating fold axes. The present interpretation of the folding and stratigraphy is based primarily on the determination of the tops of beds and flows. In the finer-grained sediments tops of beds were determined (1) by gradation in grain size across individual beds from coarse-grained material at the bottom to fine-grained at the top, and (2) by cross-bedding. It was found that determinations of tops by the relation of cleavage to bedding was unreliable on account of the steeply pitching drag-folds and cleavage-bedding intersections produced by later lateral movements superimposed on the original folding. In the lavas the tops of the flows were recognized (1) by the shape of the pillow structures, and (2) by fragmental flow tops, especially in those cases where a flow is in contact with some interbanded rock such as bedded tuff. The most satisfactory results were obtained in those areas where the different structural criteria could be compared and checked against one another. For example, in areas of interbanded lavas, tuffs, and sediments, the fragmental tops or pillows in the lavas may be checked against grain gradation in the sediments or cross-bedding in the tuffs.

In the following sections of this report, folding, faulting, shearing, and fracturing are discussed under separate headings for the sake of clarity, but it should be understood that probably some of the folding, faulting, and shearing proceeded simultaneously.

Folding

The folding of the Keewatin and Timiskaming series may be described as a unit because the formations making up the series form a conformable sequence and appear to have been deformed at the same time. In McGarry and McVittie townships determinations of tops show that the Timiskaming series lie stratigraphically above the Keewatin volcanics. Three major folds cross the area in a general east-west direction; the synclinal axes lie within the bands of Timiskaming rocks, and the anticlinal axes in the Keewatin lavas. In some cases, faulting

has either removed, thickened, or displaced a limb of a fold and largely destroyed any original symmetrical arrangement of the formations about the fold axis. In addition, it is believed that the Keewatin and Timiskaming lavas, tuffs, and sediments were originally laid down as a series of rather lenticular strata of limited lateral extent. It could not be expected that the different stratigraphical horizons would always continue around the trough or crest of a fold to the erosion surface, especially where the folds extend to considerable depth.

For purposes of description the three major folds in the country may be referred to as the northern or Beaver Lake syncline, the Spectacle Lake–Kerr-Addison anticline, and the southern or main Larder Lake syncline (see Fig. 3). The last-named syncline extends southward into Hearst and McElroy townships, and in the western part of McVittie township only parts of the northern limb of this fold is represented. The southern part of the main southern syncline is divided into two sections by a north-south anticlinal dome of intrusives, which extends from a point south of the Omega mine down the southwest arm of Larder lake. These parts are an eastern series of subsidiary folds, extending between the Sheldon-Larder and Moosewood properties, and a western unit, largely monoclinal, extending from Fork lake to the Laguerre mine.

BEAVER LAKE SYNCLINE

The northern or Beaver Lake synclinal axis extends across the central part of McGarry township from Monocle lake in McVittie township; it probably continues northwest through the isolated area of conglomerate on the Kir-Vit property, and then disappears into an anticlinal structure near intrusives southeast of Beaverhouse lake. A small infolded remnant of Timiskaming rock lies south of Gem lake on claims Nos. 38,774 and 38,775 and indicates that, before deep erosion, the syncline may have extended to this point. In the vicinity of the Hay-Thompson claims in the central part of McGarry township the synclinal axis appears to be cut off by a wide faulted zone striking N. 55° E. along the contact of the trachytic rocks and the fine-grained sediments.

A section north across the syncline from the west boundary of claim L. 25,195 of Arjon Gold Mines shows north-facing pillowed lavas of the Keewatin series overlain by Timiskaming basal conglomerate, followed by north-facing trachytic agglomerate and tuff. Along the north side of the trachytic rocks the tops are south, and this is also the case wherever top determinations could be made in the various conglomerate, greywacke, and trachyte bands as far north as the Keewatin lava contact. The Keewatin lavas in the northern part of McGarry township revealed a disappointingly small number of good top determinations. Two south-facing tops were found about half a mile south of the north boundary of the township. It will be noted that along this section line the sequence of formations in the Timiskaming series is not the same on both limbs of the fold. The writer is inclined to the opinion that the apparent thickening of the northern limb is due to repeated strike-faulting, which thrust up blocks of sediments, trachyte, and tuffs. There are pronounced long narrow valleys along the railway and 1,100 to 1,800 feet south of it; outcrops adjacent to these depressions are sheared.

In the northeastern part of McGarry township there is no evidence of the Beaver Lake syncline east of the wide faulted zone that angles at N. 55° E. across the Hay-Thompson claims. All the top determinations across the Timiskaming series in this vicinity show that the formations face south. Possibly a steep easterly pitch has carried the fold to great depths and it has ceased to be reflected in the strata now exposed. If the vertical displacement on the fault

happened to be an appreciable amount and the southeast side moved downward, the trough of the syncline would be far below the present erosion surface.

SPECTACLE LAKE–KERR-ADDISON ANTICLINE

The Spectacle Lake–Kerr-Addison anticlinal axis bisects the Keewatin volcanics lying between the north and south synclinal bands of Timiskaming sediments (see Fig. 3). The structure is cut out by intrusives in the general vicinity of Bear lake. This fold pitches steeply to the east, which fact accounts for the increased extent of the Keewatin rocks to the west and their eventual disappearance to the east. The fold axis in the northwestern part of McVittie township

Folded greywacke of the Timiskaming series on claim L. 30,131, Kerr-Addison Gold Mines. The outcrop lies on the crest of a fold, and the schistosity strikes at about right angles to the beds.

lies near the narrows on Spectacle lake, and here the flows dip steeply eastward. One particularly thick, medium-grained, massive flow was traced from the south shore of Beaverhouse lake to the nose of the anticline. The flow lenses out in this vicinity, but another flow of similar character was found near by and traced around the south limb of the fold almost to Moosehead lake. Between Beaverhouse and Gem lakes in the northern part of McVittie township the lava flows strike southeast and face northeast in conformity with the Spectacle Lake anticlinal structure. Near the west boundary of the township on Beaverhouse lake the flows strike north of east. In this vicinity there is a subsidiary south-bending flexure at the Beaverhouse Lake mine in Gauthier township and probably another in the opposite direction about three-quarters of a mile up the lake from the Gauthier boundary.

Between the Kir-Vit property and Bear lake the anticlinal fold is replaced by intrusives, but farther east on the Arjon and Kerr-Addison claims it is found again. The folded lavas pitch beneath Timiskaming sediments north of the Kerr-Addison mine, but the anticlinal structure continues through the sediments for some distance. North of the highway at the Chesterville Larder Lake mine the anticline is flanked by synclines; here all the folds strike north of east and pitch steeply eastward. With increasing distance from the lava contact the anticline would be carried to great depth and eventually would not be reflected at the surface. This probably accounts for its disappearance east of the cross-fault

Insert to face page 82.

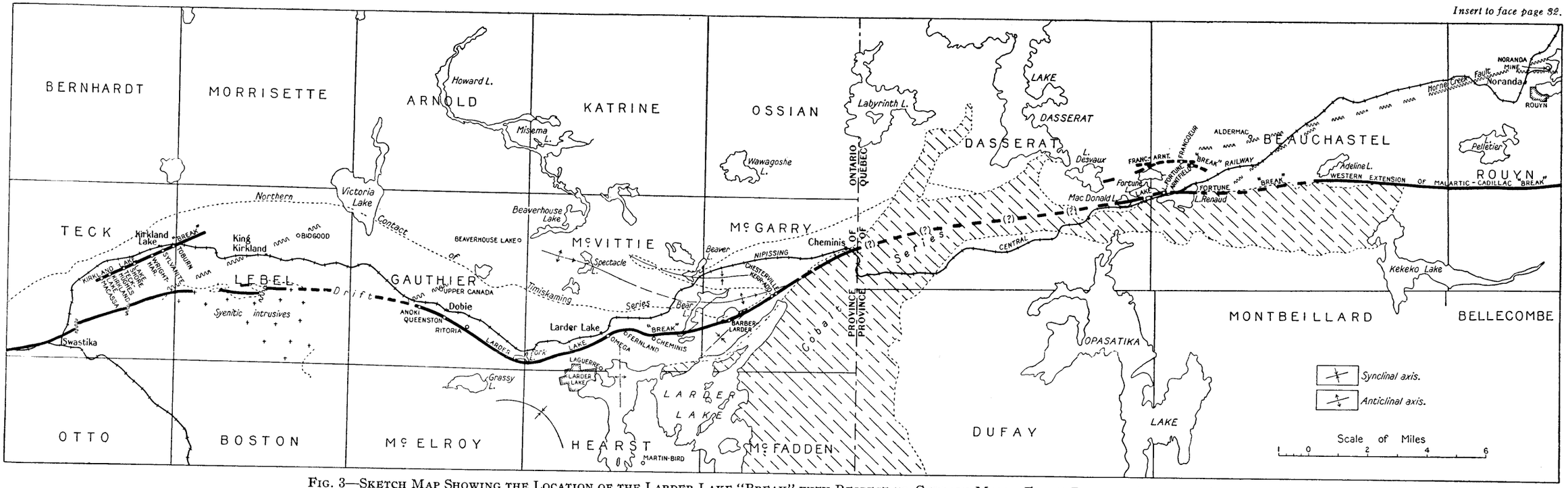


FIG. 3—SKETCH MAP SHOWING THE LOCATION OF THE LARDER LAKE "BREAK" WITH RESPECT TO CERTAIN MAJOR FAULT ZONES IN ADJOINING AREAS.

(Data on the western extension of the Malartic-Cadillac "break" provided by M. E. Wilson, Geological Survey, Department of Mines and Resources, Ottawa. Other Quebec information taken largely from reports of the Quebec Bureau of Mines, especially map No. 462A, by G. S. MacKenzie. Data on faulting near Swastika from geological map of Teck township, by W. Gerrie, in course of preparation by the Ontario Department of Mines.)

located north of Kearns village. Here the strata face south at all points in the greywacke except near the contact of the schisted volcanics on claim L. 5,413, where the beds have been dragged upward and face north.

As discussed later, the carbonate bodies on Kerr-Addison and Chesterville Larder Lake ground lie on or near a wide sheared and faulted zone along the greywacke-lava contact. The synclines in the sediments adjacent to this contact between claims T. 1,860 (Chesterville mine) and L. 5,413 are undoubtedly local folds related to movements along the fault. In the southern part of claim L. 891 the southern syncline has been cut off by faulting and the beds near the fault are truncated almost at right angles to their strike.

LARDER LAKE SYNCLINE

Eastern Section

The eastern section of the southern or main Larder Lake syncline involves the Timiskaming strata in the southeastern part of McVittie township and the southern part of McGarry and probably the large expanse of Larder lake in Hearst and McFadden townships to the south.

On the Sheldon-Larder and Barber-Larder claims in the southern part of McGarry township the greywackes and other sediments are folded into a syncline, which strikes about N. 45° E. and pitches southwest. The north and south limbs of this fold are truncated by faults striking about N. 65° E., which have destroyed the symmetry of the fold. The basic lavas and pyroclastics on the Sheldon-Larder claims and south of the Kerr-Addison ore zone also tend to swing around in conformity with the boundaries of the overlying greywacke. However, a series of strong shears striking northeastward through the carbonate zones has so altered and disturbed the formations south of the Kerr-Addison ore zone that it is impossible to follow a marker horizon for any distance on surface. Then, there is always the possibility that the structure of any particular horizon in the vicinity of this faulted area may be related to local rather than regional folding. On claim T. 8,862, south of No. 66 highway at the west boundary of the Kerr-Addison property, the flows locally swing around to the northwest. On claim T. 1,904, in Virginiatown, bedded tuffs lying between two carbonate bands strike about north-south, while flows lying immediately south of the mine office strike N. 50° E. No accurate determinations of flow tops could be made in the volcanics south of the Kerr-Addison and the Chesterville Larder Lake mine workings. The structure is evidently complex and cannot be stated in detail until further information is available through drilling and underground exploration.

Farther east, drilling through the overlying Cobalt sediments on the Wesley and Pelangio-Larder properties has revealed the presence of steeply dipping greywackes and talc-chlorite schists, presumably altered volcanics. The structure of this area is again complicated by strong sheared zones striking about N. 55° E. One long, relatively flat hole (No. 14) on the Pelangio-Larder claims provided a cross-section of the older strata and revealed a synclinal fold in the greywacke (see Fig. 2 on page 28), but it is a matter of speculation whether this is a local or regional structure. The sediments encountered beneath the Cobalt series on the Wesley claims might be a continuation of the small area on the north shore of Larder lake on the Kerr-Addison claim T. 1,839; the belt of sediments extending eastward to claim L. 31,047 of Sheldon-Larder Mines might also be a part of the same horizon, offset by a fault on claim L. 5,500. These three separate areas of sediments all lie with a faulted contact against lavas to the north.

The band of greywacke lying immediately north of the Kerr-Addison mine workings continues westward through Barber lake and passes into McVittie

township. At Bear lake the belt of Timiskaming rocks widens, and trachyte' trachytic agglomerate, and tuff are interbedded with the sediments. Along this whole unit of Timiskaming strata as far west as the Omega–Rose Gold boundary the various horizons from the basal conglomerate to the upper greywacke formation, which immediately overlies the gold-bearing horizon of basic volcanics, all face south. The effect of regional strike-faulting along the horizon of basic volcanics on the stratigraphy is not known, since the amount of displacement along the sheared zones cannot be estimated.

In the southeastern part of McVittie township the structure of the sediments becomes quite intricate. On the western half of the Lar-Add claims two synclines with an intervening anticline pitch to the west and southwest. At the lake shore on claim No. 27,251 it is possible to walk around the trough of the southern syncline and accurately measure the pitch of the fold. To the west on the Moosewood and Thib claims the number of folds increases. It is probable that minor folds additional to those indicated on map No. 50b could be located by more detailed mapping. All these folds pitch west or south of west at angles of about 30 to 70 degrees, as determined by dip measurements at the crests or troughs of the folds. Along the borders of the syenite and diorite body on Fernland and Moosewood ground, however, the north-south cross-fold through the intrusive mass is reflected, and the strata face northeast or southeast. This abrupt change in structure has undoubtedly been influenced by the doming around the periphery of the instrusive mass. On the west side of the syenite-diorite body on claim L. 4,438 the beds strike north-south and face west. Similar north-south trending structure continues southward through claims of Laguerre Gold Mines.

Western Section

The western section of the southern or main Larder Lake syncline includes the Timiskaming series from the Omega and Laguerre mines to the Gauthier boundary. The major structures involved extend west and south of the map area.

In the vicinity of Pancake lake the sediments have been closely folded into an anticline flanked by synclines. The close folding here in contrast with the simple monoclinal structure along the strike to the west may be due to local crumpling around the arc-shaped bend in the volcanics off the nose of the north-south cross-fold that passes through the intrusives south of the Omega mine. There are two possible explanations for the localization of the folds, each being dependent upon the time relationship between intrusion and shearing movements along the Larder Lake "break." If the intrusives were injected later than the movements along the Larder Lake sheared zone they may have produced these along with other local folds around the margin of the stock. If the intrusion was pre-shearing, it may have provided a buttress, around which the faulting movements had to bend. The local folds could then be produced by dragging movements along the sheared zones in an area where the sediments were caught between the two converging masses of trachytic and basic lavas.

It is known that the Pancake lake synclines are overturned to the south; in all probability the central anticline has a similar dip. In the underground workings of the Omega mine the overturn is as much as 45 degrees. Near the southeast corner of claim T. 219 and also underground the greywacke faces north near the contact with the basic volcanics. The northward-facing sediments are reported in lateral drilling at the west end of the underground workings. Grain gradation in greywacke in the 1,175-foot level north crosscut again suggests that the tops face north, although only fair determinations could be obtained. These

criteria show that the volcanics underlie the sediments at these points, which is directly opposite to the apparent relationships along the same horizon eastward from the Fernland to the Chesterville Larder Lake claims. It is possible that strike-faulting along the Larder Lake "break" may have produced this incongruous structural situation. A glance at the geological maps will show that the Larder Lake "break" follows the contact of the sediments and volcanics east of the Omega boundary for many miles. At the Omega mine, however, it swerves southwest and the volcanics make their only appearance on the north side of the sheared zone. It is also significant that the synclinal axis lying immediately north of the Omega mine appears to be truncated at a low angle near the Omega-Fernland boundary. It is then possible that the volcanics on the north side of the Omega mine workings may belong to an entirely different group from those on the south and may have been accidentally brought together by faulting. In favour of this theory it might be argued that the lavas on the north side of the mine are massive and basic, whereas those on the south are spherulitic and contain interbanded tuffs and sediments, which is a characteristic feature of the Timiskaming basic volcanics to the east.

The structure along the continuation of the belt of Timiskaming basic volcanics west of the Omega mine is rather obscure. The volcanics become interbanded with the sediments, and no top determinations were obtained near the contacts despite much investigation by the writer. It is possible that doming and cross-folding in the area of intrusives on claims L. 7,993 and L. 8,842 has interrupted the band of basic volcanics in this vicinity. Drilling on the Legardo claims shows interbanded sediments and volcanics, the latter being much sheared and carbonatized at certain points. The structure dips from 50° to 65° S. on claim L. 26,270. North of the volcanics the tops of the strata face south, with one exception, across the full width of the Timiskaming and Keewatin series as far as Spectacle lake.

In the vicinity of Larder Lake village and Gold King peninsula the structure in the sediments swings about considerably from southeast to south to east in conformity with the outline of intrusive bodies. So far as is known, all the strata face south or west, except on claim L. 1,053, where north-facing beds are found. At the Raven River mine the north-south cross-folding has uncovered small areas of basic volcanics. These lie along the flank of intrusives and are bordered by conglomerate. The reason for including these lavas in the Timiskaming rather than the Keewatin volcanics are given elsewhere in this report in the general discussion of the Timiskaming basic volcanics.

Faulting

The rock formations of the Larder Lake area have been greatly disturbed by faulting. The locations of all known and many assumed faults are indicated on the accompanying geological maps, and an attempt has been made to differentiate between the shear zone type and those faults that are a well-defined, clear-cut fracture.

The faults in the area may be divided into two distinct sets. The set that is most important economically consists of strike faults, which are sometimes represented by wide sheared zones. These have often been the locus of heavy carbonate alteration, which has masked the original evidence of movement within the shear zone. In a general way the strike faults represent an older system of faulting, probably contemporaneous with regional folding, although later movements may also have taken place along the original shear zone. Most of them strike in a general east-west direction. The second set consists of trans-

verse or cross-faults; these sometimes offset the earlier shear zones. The position of the transverse faults with respect to the strike faults suggests that both sets may have resulted from the same deforming forces, the strike faults being developed under compression and the transverse type by the complementary tensional adjustments which relieved the strains set up during folding.

For purposes of description in the following paragraphs the faults will be named as far as possible according to the properties on which they terminate or beyond which their extension has not been so definitely proved.

STRIKE FAULTS

Larder Lake "Break"

The Larder Lake "break" is the most important faulted zone in the area and might be regarded as the "main break" through the Larder Lake camp, for it and its branches appear to have had some structural influence on the localization of most of the ore bodies. It has been traced at intervals on surface from a point north of Kearns townsite on Chesterville Larder Lake ground eastward across McGarry, McVittie, and part of Gauthier township. East of Kearns its probable extension beneath the Cobalt series has been sectioned by diamond-drilling on Pelangio-Larder claims. Data on a section west of the Omega mine is not very complete, although the sheared zone encountered by drilling on the Legardo claims probably represents it. From here to the Gauthier boundary the country is drift-covered, but the faulting adjacent to No. 66 highway near the east side of that township is probably on the same structure. In Gauthier township faulting with attendant carbonatization extends northwestward from the McVittie boundary through the Ritoria, Queenston, and Anoki mine workings.[1]

Nothing definite is known about the possible extension of the Larder Lake "break" west of the Anoki mine. The country between the Anoki mine and the Lebel township boundary is heavily drift covered and in the south-central part of Lebel township syenitic intrusives may have cut out most of the structure (see Fig. 3 facing page 32). It is interesting to note, however, that MacLean[2] has found green carbonates in Lebel township that could possibly represent a portion of the fault zone. In addition, Gerrie[3] has traced a strongly faulted zone across the southern part of Teck township; this passes near the village of Swastika. There is a possibility that this could be the western continuation of the Larder Lake "break."

The Larder Lake "break" may be the westerly extension of one of the strong faulted zones that have been found across the interprovincial boundary in Quebec (see Fig. 3 facing page 32). Wilson[4] has traced the Malartic-Cadillac–Lake Bouzan fault westward as far as a point south of Adeline lake near the centre of Beauchastel township. Directly on line west of this is the Lake Fortune sheared zone, which has been traced as far west as MacDonald lake.[5] There is only a 10-mile gap, which is covered by Cobalt sediments, between MacDonald lake and the most easterly drilling intersection on the Larder Lake "break" on the Pelangio-Larder claims. A slight swing in the strike would bring these

[1]Jas. E. Thomson and A. T. Griffis, Ont. Dept. Mines, Vol. L, 1941, pt. 8, in course of preparation.

[2]A. MacLean, "Lebel Township," Ont. Dept. Mines, map in course of preparation.

[3]Wm. Gerrie, "Teck and Otto Townships," Ont. Dept. Mines, map in course of preparation.

[4]M. E. Wilson, Can. Dept. Mines and Resources, Mines and Geology Branch, Ottawa, personal communication.

[5]E. L. Bruce, Que. Bur. Mines, 1932, pt. C, p. 59.
S. E. Maloof, Can. Min. Jour., Aug., 1938, pp. 427-434.
G. S. MacKenzie, Que. Bur. Mines, Geol. Rept. No. 5, 1940.

faults into alignment. Both are strong, wide, carbonatized sheared zones, characterized by the presence of green mica and quartz stockworks. In Gauthier, McVittie, McGarry, Rouyn, and Beauchastel townships the sheared zones are pretty well localized along the contact between lavas and sediments, although the relative positions of these formations are reversed on either side of the overlying Cobalt series. There are, however, a number of more or less parallel sheared zones in both the Quebec townships and in McGarry township. This condition makes it difficult to determine definitely just how the various sheared zones might join up beneath the Cobalt series. It is, nevertheless, an interesting speculation that one strong fault may extend for a hundred miles or more across northwestern Quebec and the Larder Lake and Kirkland Lake areas.

In McGarry township the Larder Lake sheared zone strikes N. 60°–70° E., but in McVittie township the strike varies considerably, owing to gentle bends and folds. Throughout its entire length this fault zone is characterized by strong shearing accompanied by carbonate replacement of varying intensity. Where there is little replacement along the shear zone, the rock is a soft talc-chlorite schist, which feels "soapy" when rubbed. On Pelangio-Larder claims a maximum width of 700 feet of talc-chlorite schist was cut in drilling across the sheared zone. At the Chesterville Larder Lake and Kerr-Addison mines the zone of intense shearing ranges from 100 to 500 feet in width and dips steeply north (see map No. 50d). In the western part of the Kerr-Addison mine the sheared zone swings southward. Up to the end of 1941 no information on the structure of the area between the west end of the mine workings and the Armistice boundary had been obtained. On claim T. 1,932 of Armistice Gold Mines a strong transverse sheared zone strikes parallel to the highway. This may have offset the northwest side of the main sheared zone to the southwest near the west boundary of the Kerr-Addison property.

Shearing and carbonatization may be traced along the greywacke-volcanic contact at intervals from the Armistice boundary along the south shore of Barber lake and west to the south end of Bear lake. At the Barber-Larder mine the carbonate band through which the shearing originally passed dips about vertically (see Fig. 5 facing page 46). On the Cheminis claims the carbonate band divides into a northern and southern branch. The north carbonate band follows the greywacke and trachyte contacts across Fernland ground to the Omega boundary and then swings southwest through the Omega mine workings. At the Cheminis (see Fig. 6 on page 50), Fernland (see Fig. 9 on page 55), and Omega mines (see Fig. 13 facing page 84) and westward on to the Lardego claims, the sheared and carbonatized zones dip to the south.

This faulting along the Larder Lake "break" has drag-folded and truncated the adjoining formations. The volcanics to the south of it are also affected by other parallel faults, with the result that their local structure is sometimes very complex. The greywacke on the north side of the Larder Lake "break" shows evidence of local deformation. On claim L. 5,413, north of Kearns townsite, a local syncline has been developed about 100 feet from the fault zone and is probably the result of upward dragging movement by the south side of the fault. Southwest of the Chesterville Larder Lake mill and near the northwest corner of Kearns townsite local northeastward-pitching synclines occur adjacent to the fault and were probably formed by drag-folding movements. East of the Chesterville Larder Lake mill, at the fault contact, the south limb of an anticline is truncated almost at right angles to the strike of the beds. Near the east boundary of the Omega property a synclinal fold in the greywacke may be cut off at a low angle by the fault.

The amount and direction of displacement along the Larder Lake "break" is not known. It cannot even be definitely stated whether the displacement is measurable in hundreds of feet or in miles. Nevertheless, the length of the fault zone, combined with the alteration along it and the deformation of adjoining formations, strongly suggests that the total displacement has been very great. If the local drag folds in the greywacke near the Chesterville Larder Lake mill were produced by the faulting movements, they show that the south side moved eastward and upward with respect to the north side in that vicinity.

Chesterville–Kerr-Addison Footwall Fault

A strong graphite fault occurs immediately north of the shaft at the Chesterville Larder Lake mine. It dips vertically in the upper part of the mine. This fault has been traced westward through the Kerr-Addison workings, where it lies near the south side of the ore zone. Here it dips about 77° N. At the west end of the mine it swings around to the west and probably joins the north fault. Branch faults angle northeastward off the footwall fault.

Southern Pelangio–Wesley Fault

A zone of intensely sheared rocks was cut in drilling beneath the Cobalt sediments in the southern part of the Pelangio-Larder and in the northern part of the Wesley claims. If these intersections are on the same fault, its projection to the southwest would coincide fairly well with the sheared and carbonatized zone along the north shore of Larder lake at Virginiatown. This zone of shearing lies parallel to and about 2,000 feet south of the Larder Lake "break." Other more or less parallel sheared and carbonatized zones lie between these two faults on Kerr-Addison ground and are indicated on the geological map.

Barber-Larder–Armistice Fault

A well-defined graphite fault lies along the contact between the volcanics and the sediments on the south side of the Barber-Larder ore zone. To the east the fault closely follows the Proprietary Mines power line. It has been traced through the underground workings at the Barber-Larder mine (see Fig. 4 on page 46 and Fig. 5 facing page 46), was found by surface exploration on the Proprietary claims, and was intersected by diamond-drilling on claim L. 11,135 of Sheldon-Larder Mines. On claim T. 1,932 of Armistice Gold Mines, this fault cuts off a horizon of agglomerate that strikes northeast across the Sheldon-Larder claims. On claim L. 11,135 the fault also truncates the axis of a synclinal fold in the sediments to the south.

Southern Barber-Larder–Sheldon Fault

A strong sheared zone strikes N. 65° E. across the Sheldon-Larder claims near the north shore of the northeast arm of Larder lake. This truncates a horizon of agglomerate at a sharp angle in the northern part of claim L. 30,691. The zone of shearing and rock disturbance was traced through the sediments to the west of this claim for over half a mile. The probable continuation of this fault to the east along the strike has been encountered in a drill-hole under the lake at a point where a carbonate zone was cut just before the hole entered the Cobalt series. There is a possibility that this fault may be a continuation of the faulted zone found along the lake shore south of Virginiatown and offset from it by a cross-fault on claim L. 5,500. In both places the fault is bounded by sediments on the south and volcanics on the north.

Arjon–Hay-Thompson Fault

Drilling on Arjon ground along the Keewatin-Timiskaming contact in the northern part of claim L. 25,195 revealed faulted conditions and carbonatization. Another faulted zone runs southwest across the southeast corner of the same claim, and shearing is seen along the strike for an additional 2,000 feet. Northeast along the strike from the Arjon boundary the ground is largely drift-covered, but intense shearing on the southeast side of a ridge that crosses claims L. 30,768, 30,773, and 30,772 may represent the edge of the faulted zone. This fault cuts off the synclinal fold that strikes eastward across the central part of McGarry township from Beaver lake and also the syncline in the greywacke near the north boundary of the Kerr-Addison claims.

There is also a topographical suggestion that the greywacke-trachyte contact south of the Nipissing Central railway on the Hay-Thompson and Chesterville Larder Lake claims may be faulted. The strike of the bedding in the greywacke is truncated at a low angle at some points near the contact.

Ivan Larder Faults

The topographical depression along the Nipissing Central railway in the western part of McGarry township may be due to strike-faulting. A strip of low ground runs about parallel to this from 1,100 to 1,800 feet south and is probably the locus of parallel faulting. Both of these assumed faults cross claims of Ivan Larder Mines and adjoining groups. In this vicinity it is noticeable that the north limb of the syncline of Timiskaming sediments has a greater apparent thickness than the south limb. The northern horizon of trachytic volcanics and the bands of conglomerate that lie immediately south of the railway are missing on the south side of the fold. It is probable that strike-faulting has produced the repetition of volcanic and sedimentary horizons on the north limb of the fold. There is also evidence that marker horizons are truncated at certain points along the assumed faults.

Beaver Lake–Kir-Vit Fault

A well-marked topographical depression extends northwest from Beaver lake to claim L. 25,637 of Kir-Vit Mines. The valley lies between gabbro to the northeast and Keewatin lavas and Timiskaming sediments to the southwest. On claims L. 25,231, 25,230, and 25,234, the Timiskaming sediments are cut off along this depression, which thus appears to mark the position of a fault.

Laguerre Fault

A zone of intensely sheared rock was traced out by diamond-drilling on the west side of claim L. 1,053. This lies near the shaft of Laguerre Gold Mines and strikes in a north-south direction. It follows along a well-marked topographical depression between conglomerate on the west and a complex of intrusives and schists on the east.

TRANSVERSE FAULTS

The interpretation of the position of transverse faults is almost entirely based on the offset of marker horizons, contacts, or fold axes. The location of some of these faults is expressed topographically by narrow valleys. In certain instances the fact that different marker horizons are offset unequal distances suggests that the movement on the fault plane has been rotational.

Shearing and Fracturing

The rocks in the southern part of the map area have failed by shearing to a much greater extent than those in the northern part. The shearing in the southern part of McGarry and McVittie townships strikes parallel to the fold axes, to the boundaries of intrusive bodies, and to strong strike faults. It is not uniformly distributed but rather concentrated in the vicinity of the strong sheared zones that have been previously described. Along these zones, lavas, pyroclastics, sediments, and intrusives are changed to chlorite, talc-chlorite, or sericite schists. The shearing, however, is more pronounced in the softer, less competent strata, such as Timiskaming greywacke and slate, whereas the larger masses of Timiskaming trachyte, Keewatin volcanics, and Algoman intrusives are noticeably massive.

Vein fracturing has been confined to the more competent rocks that lie adjacent to strong sheared zones. These harder rocks have failed under tension, and an irregular pattern of intersecting quartz-filled fractures has been formed. These make up the stockwork type of vein deposit. The fracturing is discussed in greater detail under the description of ore deposits and mining properties.

ECONOMIC GEOLOGY

Gold is the only metal of economic importance that is known to occur in the area mapped. Although spasmodic attempts at gold-mining have been made in the Larder Lake area since 1906, the ventures proved unprofitable until recent years. Between 1936 and 1939 the southern part of the area went through a period of great prospecting, developing, and mining activity. During this interval most of the known occurrences were re-explored and promising ground in their vicinity was prospected on surface and by drilling. In the area under discussion, a considerable amount of underground development has been done on eight properties, three of which are at present in production. All this work has yielded a considerable amount of new information as to the general character of the gold deposits and their geological relationships.

The northern part of the area contains extensive areas of very massive rock formations and has not received a great deal of attention, although gold has been found at a few scattered points. The most important deposit yet developed in this part of the country is the Beaverhouse Lake (old Argonaut) mine, located in Gauthier township near the McVittie township boundary.[1] The occurrence of copper at this mine, and of a small copper-zinc showing in the northwestern part of McGarry township, would suggest that the possibility of finding base-metal deposits in this part of the country should not be overlooked.

General Character of the Gold Deposits

To date, an occurrence of gold of sufficient size and grade to be classed as "ore" has been found at seven different properties in McGarry and McVittie townships. The list includes the Chesterville Larder Lake, Kerr-Addison, Barber-Larder, Cheminis, Fernland, Omega, and Laguerre mines.[2] The Kerr-Addison and Chesterville Larder Lake ore zone is a single geological unit that is being developed by separate companies. Laguerre Gold Mines controls two separate occurrences, one at the Raven River workings and the other at the Laguerre shaft.

[1]Jas. E. Thomson and A. T. Griffis, Ont. Dept. Mines, Vol. L, pt. 8, 1941, in course of preparation.

[2]The Cheminis and Fernland mines were taken over by Amalgamated Larder Mines, Limited, in 1941.

In detail these gold deposits occur under a variety of geological conditions, but, in a general way, they have a few common characteristics. The features common to all deposits are as follows: (1) They are all relatively low-grade, large tonnage operations ($5.00 to $8.00 grade); (2) they all occur within or adjacent to strong sheared zones or "breaks"; and (3) the ore bodies occur within or adjacent to zones of carbonate alteration. At some mines, e.g. Kerr-Addison, the ore shoots or portions of ore shoots range from very high to medium and low grade, and the overall grade-tonnage ratio is a matter of company policy. All the ore bodies in the country are irregular in outline; their boundaries are defined by assays rather than by sharply defined geological contacts.

Gold occurs in a variety of rock types at different properties, and even within the limits of one mine's workings. Ore bodies are found in (1) carbonate rock (dolomite), (2) basaltic lava, (3) dacitic lava, (4) syenite dikes and stocks, (5) tuffs, and (6) talc-chlorite schist with interfingered dikes. It will thus be apparent that structural deformation with accompanying rock alteration is of prime importance in the search for new ore bodies and that the rock types present are of secondary importance.

The larger and better-grade ore deposits occur in those areas along the main "breaks" where fracturing under tension has predominated over shearing and sulphide replacement. At the east end of the "camp" fracturing is pronounced and appears to be controlled to some extent by local folds and faults, whereas at the west end the ores are of the sulphide-replacement type with correspondingly fewer quartz-filled fractures. Native gold occurs in the quartz-filled fractures in the Kerr-Addison and Chesterville Larder Lake mines but is scarcely ever found in the sulphide ores to the west.

No genetic relationship has been established between the gold deposits and any particular type of intrusive. Evidence of structural control over localization of the ore shoots is more apparent and is discussed in a later section of this report.

Types of Gold Deposits

For purposes of discussion the gold deposits may be classified under the six general types defined below, but more than one type may occur at a mine. The cassification is based primarily on the ratio of quartz to sulphide material in the ore, i.e. the amount of fracturing versus the amount of replacement in the ore zone.

1. Fissure or Composite Quartz Veins

The fissure or composite quartz vein type consists of quartz veins that occupy a single fissure with well-defined walls or consist of irregularly connected parallel veins. Such veins occur at a number of places in the area, but to date few have been of economic importance. Quartz veins were stoped at the Raven River mine during its period of operation. Similar veins within the graphite fault at the Omega mine are productive but comprise only a small percentage of the mine's ore; these veins contain patches of native gold.

2. Quartz Stockwork Deposits in "Dolomite"

Quartz stockworks in "dolomite" provide a large tonnage of ore at the Kerr-Addison and Chesterville Larder Lake mines. Although such stockworks are commonly found along the Larder Lake "break" to the west, they have been largely unproductive to date. These stockworks are large irregular bodies of branching, interlocking, and intersecting veins and veinlets. In mining these bodies, certain fairly strong veins are sometimes encountered; but at most places

the rock is a vein breccia containing blocks of host rock in a network of quartz stringers. The host rock is barren carbonate material and often contains sufficient green mica to give the whole mass an apple-green colour. The quartz is white. Traces of sulphides, usually pyrite, occur in this carbonate ore. The gold occurs in the native state and concentrations of coarse-grained "high-grade" are distributed spottily. The ore bodies on the north side of the Kerr-Addison (Nos. 9, 10, 14, etc.) and Chesterville Larder Lake (Nos. D, E, F) mines belong to this type.

3. Quartz-Sulphide Deposits in Lavas and Tuffs

Quartz-sulphide deposits in lavas and tuffs are really a phase of the stockwork type, in which there is more sulphide material and fewer quartz veins. The appearance of the ore is quite different from the previously described group, owing to the absence of green carbonate alteration. The quartz is usually smoky in colour and occurs in veins and veinlets that cut the sulphide material. Visible gold occurs in the dark-coloured quartz, occasionally in spectacular amounts, but the sulphides also carry appreciable values. The host rock is either lava in which pillows, amygdules, or spherules may be seen, or tuffs in which bedding is sometimes preserved. The ore bodies on the south side of the Kerr-Addison (Nos. 16, 21, etc.) and Chesterville Larder Lake (Nos. A, B, C) ore zones belong to this group.

4. Sulphide Bodies without Much Quartz

The type "sulphide bodies without much quartz" consists of sulphide replacement bodies of irregular outline. The predominant sulphide is pyrite, and lesser amounts of pyrrhotite, chalcopyrite, and arsenopyrite occur locally. The sulphides replace lavas and, to a much lesser extent, tuffs. Gold values are confined to the sulphides, and sometimes to certain zones within the sulphide bodies. Visible gold is practically absent. The grade is generally medium to low. The Barber-Larder, Fernland, Cheminis, and Omega mines have ore of this type.

5. Gold-bearing Talc-Chlorite Schist

No. 19 ore body on the upper levels at Kerr-Addison mine lies along a zone of intensely sheared talc-chlorite schist. The schist contains small irregular blocks and fingers of intrusives. In the deeper levels this changes to the "green carbonate" type of ore.

6. Mineralized Dikes

Many dikes throughout the country are carbonatized, mineralized, and cut by a stockwork of quartz stringers, but few are known to be gold-bearing. The Laguerre gold-bearing dike and parts of the No. 14 ore body at the Kerr-Addison mine are examples of this type of deposit. A dioritic dike on the Sheldon-Larder claims also carries gold values.

Structural Control of the Gold Deposits

It has already been pointed out that the most important gold deposits yet discovered in the area lie along a belt of Timiskaming basic volcanics in the vicinity of a strongly sheared and carbonatized zone, the Larder Lake "break." Ore bodies have been found along the "break" on the following properties in McGarry and McVittie townships: Chesterville Larder Lake, Kerr-Addison, Barber-Larder, Cheminis, Fernland, and Omega. Small amounts of gold are known to occur on other properties. The Queenston and Anoki ore bodies in

Gauthier township are located on its probable westward extension (see Fig. 3 facing page 32). If, by chance, the Larder Lake "break" should be the westerly continuation of the Malartic-Cadillac "break," then many important gold mines in northwestern Quebec are located in the vicinity of the same structure.

The rocks along the Larder Lake "break" are highly sheared, contorted, and impregnated with carbonate material that often contains green mica. Throughout a considerable part of its length the sheared zone marks the faulted contact between volcanics and sediments, although the carbonate alteration is largely confined to the volcanics. At some points the faulted zone branches and produces transverse or parallel shear zones in the volcanics; these might be considered as subsidiary "breaks." Only a fraction of the ore bodies lies within the original zone of intense shearing. The remainder lies in adjacent hard, competent rocks, which failed under tension during different periods of movement along or near this line of weakness. In the Kerr-Addison mine there are different generations of veins, which are undoubtedly related to different periods of movement along the shear zones.

The main ore bodies appear to be associated structurally with periods of deformation that followed the carbonatization of the Larder Lake "break." These later movements include folding and faulting, although, in some cases, post-ore movement seems to have taken place along pre-ore faults. It is thus important to note that unless there is some evidence of post-carbonate deformation the fracturing tends to be weak and the gold content is low. Much of the drilling along the Larder Lake "break" has revealed low gold values in areas devoid of these favourable conditions.

Thus, while most of the important gold deposits lie in the vicinity of the main "break" in the country, sufficient development work has been done to show that certain sections along it are more favourable for the occurrence of ore bodies than others. An important structural control over the localization of ore bodies is the presence of folds or gentle bends in the adjacent strata. At the Chesterville Larder Lake and Kerr-Addison mines the ore bodies on the south side of the ore zone appear to be localized in part within a pitching anticlinal fold (see map No. 50d), although the structure is badly broken up by faults. The No. 10 ore body at the Kerr-Addison mine lies within a gentle fold in the marker horizon of footwall tuffs. At the Cheminis mine there is evidence of gentle warping of the strata in the ore zone. In places the ore zone at the Omega mine shows a gentle swing in strike, and the ore bodies lie near the apex of the arching. Another important physical condition necessary for the formation of ore shoots is the presence of relatively brittle and competent rocks in the disturbed zone. These may be "dolomite," lava flows, syenite dikes, cherty tuffs, or in fact any hard rock that has a tendency to fail by fracturing rather than by shearing. The "dolomite" has apparently been rendered competent by virtue of the silicification that accompanied the carbonatization. Silicification of the lavas in the ore zones has also increased their competency and made them more amenable to fracturing.

There can be little doubt that the Larder Lake "break," which is so persistent on surface, will also continue to great depth. Some idea of its strength and persistence is conveyed by the fact that it has been traced on the surface for about 15 miles across McGarry, McVittie, and Gauthier townships and probably continues westward to and beyond Swastika (see Fig. 3). If it should prove to be the westerly continuation of the Malartic-Cadillac "break," it would be over 100 miles in length with no evidence of termination at either end. There is, then, every reason to believe that the favourable structural, physical, and mineralogical conditions associated with the Larder Lake "break" should have a

vertical range somewhat comparable with the horizontal extent. In other words, the major structural control of the gold-bearing deposits should continue to great depth. Of course, it cannot be assumed that an individual ore shoot adjacent to the "break" will be equally persistent. If the localization of ore shoots is influenced mainly by local conditions, such as later faults, subsidiary minor folds, and the presence of masses of competent rock, the mineable areas will always vary in size, shape and continuity. The disappearance or weakness of a local condition and associated ore shoot at a certain horizon may be compensated for by the appearance of a new ore-making condition at another point. Another encouraging feature is that the "breaks" and ore zones strike and dip about parallel with the enclosing formations; consequently, there is less likelihood of any sudden change of host rocks at depth.

Future Possibilities

Within the last few years most of the favourable ground within the zone of influence of the Larder Lake "break" in McGarry and McVittie townships has been explored, but limited areas of almost virgin ground await further examination. Exploration along the possible extension of the Larder Lake "break" outside of the area under discussion, especially to the west, also merits attention. In addition, there are still possibilities of finding ore bodies within or adjacent to areas that have been investigated. When the history of the Larder Lake camp is considered it will be seen that the early development of so successful a mine as the Kerr-Addison was disappointing, but subsequent exploration revealed important ore bodies in the vicinity of earlier workings. As previously stated, the magnitude of the major structural control would strongly suggest that it should persist to considerable depth. Consequently, at those properties along it where near-surface investigations were unsuccessful or only moderately encouraging, there is always the possibility that ore-making conditions may be encountered below the horizons already investigated. It is important to note, however, that the large-scale fracturing which is so important at the Kerr-Addison and Chesterville Larder Lake mines has not been encountered to date along the westerly extension of the "break," although there is no particular reason why it could not be found.

Zones of shearing and strike faulting, apparently unrelated to the Larder Lake "break," also occur in the area and merit investigation. Gold occurs in the vicinity of these structures at the Laguerre and Thib properties. At the Laguerre mine, gold is found in a syenite dike that is fractured, altered, mineralized, and cut by quartz stringers. The dike is adjacent to a strongly sheared zone and, being a competent rock, it would fracture as the result of adjacent shearing movements.

As stated elsewhere in this report, the possibility of finding deposits of base metals in the northern part of the area should not be overlooked.

DESCRIPTION OF PROPERTIES[1]

Arjon Gold Mines, Limited

Arjon Gold Mines, Limited, was organized in 1937 to develop a group of 5 claims in the west central part of McGarry township adjoining those of Kerr-Addison Gold Mines on the west. The property was explored by surface-trenching and diamond-drilling in 1937; additional drilling was done in 1938. A total

[1]In the following descriptions values are based on gold at $35.00 per ounce, except where otherwise stated.

of 18 holes, comprising 8,880 feet, was put down to investigate veins, sheared zones, and carbonate bodies on different parts of the property.

The rocks on the four southern claims consist of basic lavas, greywacke, syenite porphyry, and carbonate bodies. The carbonates are localized along pre-existing sheared zones. The syenite porphyry forms irregularly shaped masses, which intrude the lavas. Many of the porphyry outcrops show strong shearing as the result of faulting movements in their vicinity.

A sheared and faulted zone, which contains carbonate bodies, was traced out by drilling under a swamp along the contact between the lavas and sediments near the north boundary of claim L. 25,195. A similar zone strikes southwestward across the southeast corner of this claim. Some quartz veins and sulphide mineralization occur along the carbonate band and in the adjoining lava but, on investigation, were found to contain only traces of gold.

Carbonate bodies occur along the north and south side of the band of greywacke on claim L. 935. The southern carbonate band is localized along the Larder Lake "break."

No ore was found on the property, and work was discontinued in the autumn of 1938.

Amalgamated Larder Mines, Limited

Amalgamated Larder Mines, Limited, was organized in November, 1941, and amalgamated a number of mining properties located along the Larder Lake "break" in the southeastern part of McVittie township and the southwestern part of McGarry. The properties taken over included those of Fernland Gold Mines, Limited, Cheminis Gold Mines, Limited, and Sarcee Mines, Limited: claim L. 7,987, belonging to Omega Gold Mines, Limited; 2 Harris claims (L. 8,512 and T. 2,137); and 4 Proprietary claims (T. 2,218, 2,217, 1,884, and 1,888). In 1942 the property of Barber-Larder Gold Mines, Limited, was also purchased. Amalgamated Larder Mines was financed by four mining companies, each participating equally in the venture: Anglo-Huronian, Limited; Noranda Mines, Limited; Ventures, Limited; and the Consolidated Mining and Smelting Company of Canada, Limited.

In the early months of 1942 Amalgamated Larder Mines drilled 19 holes, totalling 9,722 feet, to prospect certain sections of virgin ground along the gold-bearing horizon. Some mineralization and low gold values were obtained, but no ore was reported from these operations.

Developments on the various groups of Amalgamated Larder Mines are discussed below under the original property names.

BARBER-LARDER GOLD MINES, LIMITED

Barber-Larder Gold Mines, Limited, was organized in 1937 to develop a group of 11 claims located between Barber lake and the northeast arm of Larder lake in McGarry township. Practically all the work was confined to a band of volcanics along the south shore of Barber lake. Following a drilling campaign in which an ore body was indicated, a shaft was sunk 410 feet and levels opened at 125, 250, and 400 feet. The company's operations were financed by the Consolidated Mining and Smelting Company of Canada, Limited, from August, 1938, until the mine closed down in June, 1939. An ore body was outlined on the first level, but only scattered values were found in the deeper development.

Early in 1942, the property was acquired by Amalgamated Larder Mines, Limited.

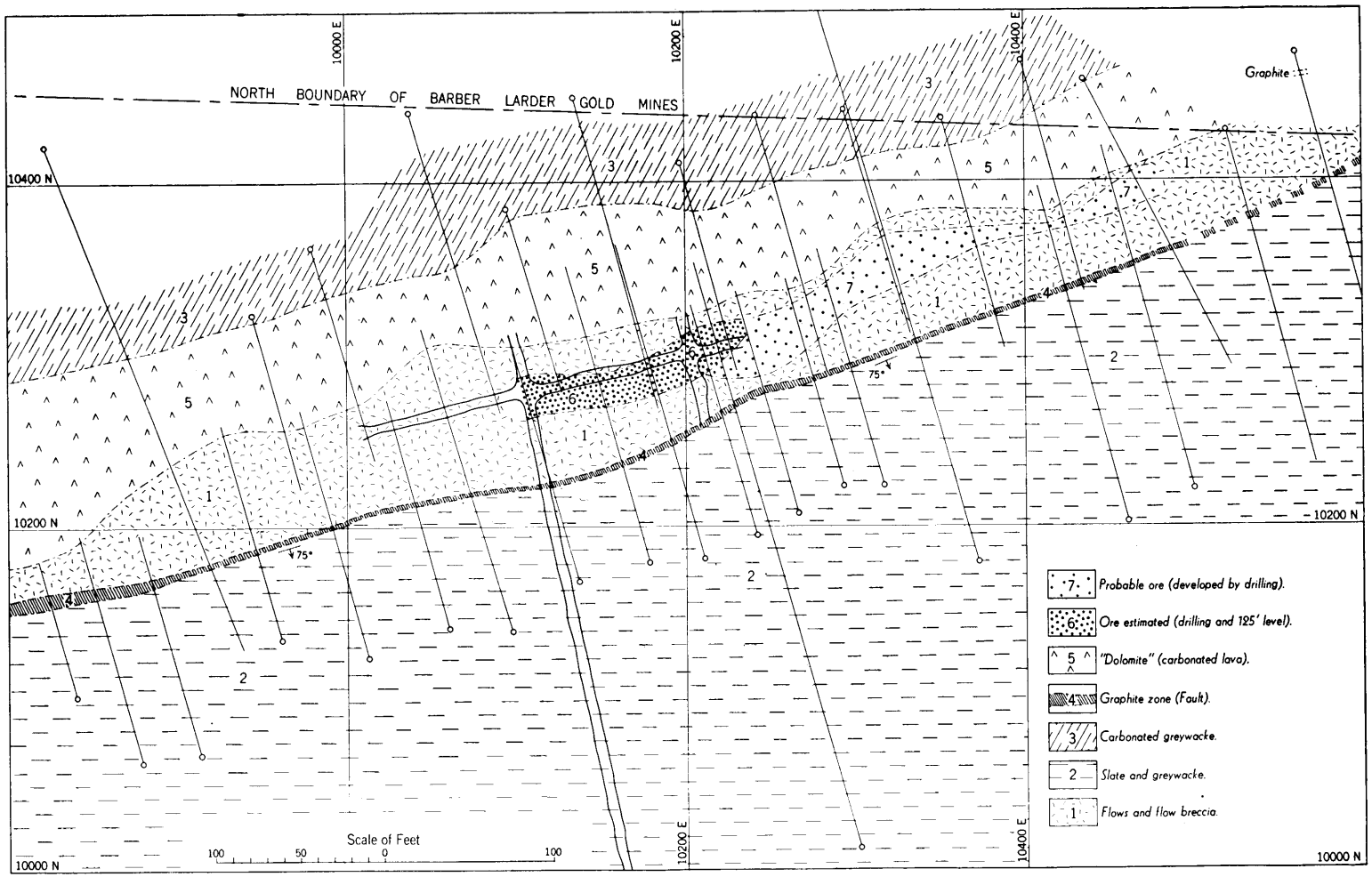


FIG. 4—GEOLOGICAL PLAN OF THE 125-FOOT LEVEL, BARBER-LARDER MINE; COMPOSED FROM DIAMOND-DRILLING.
(Revised to June 21, 1939).

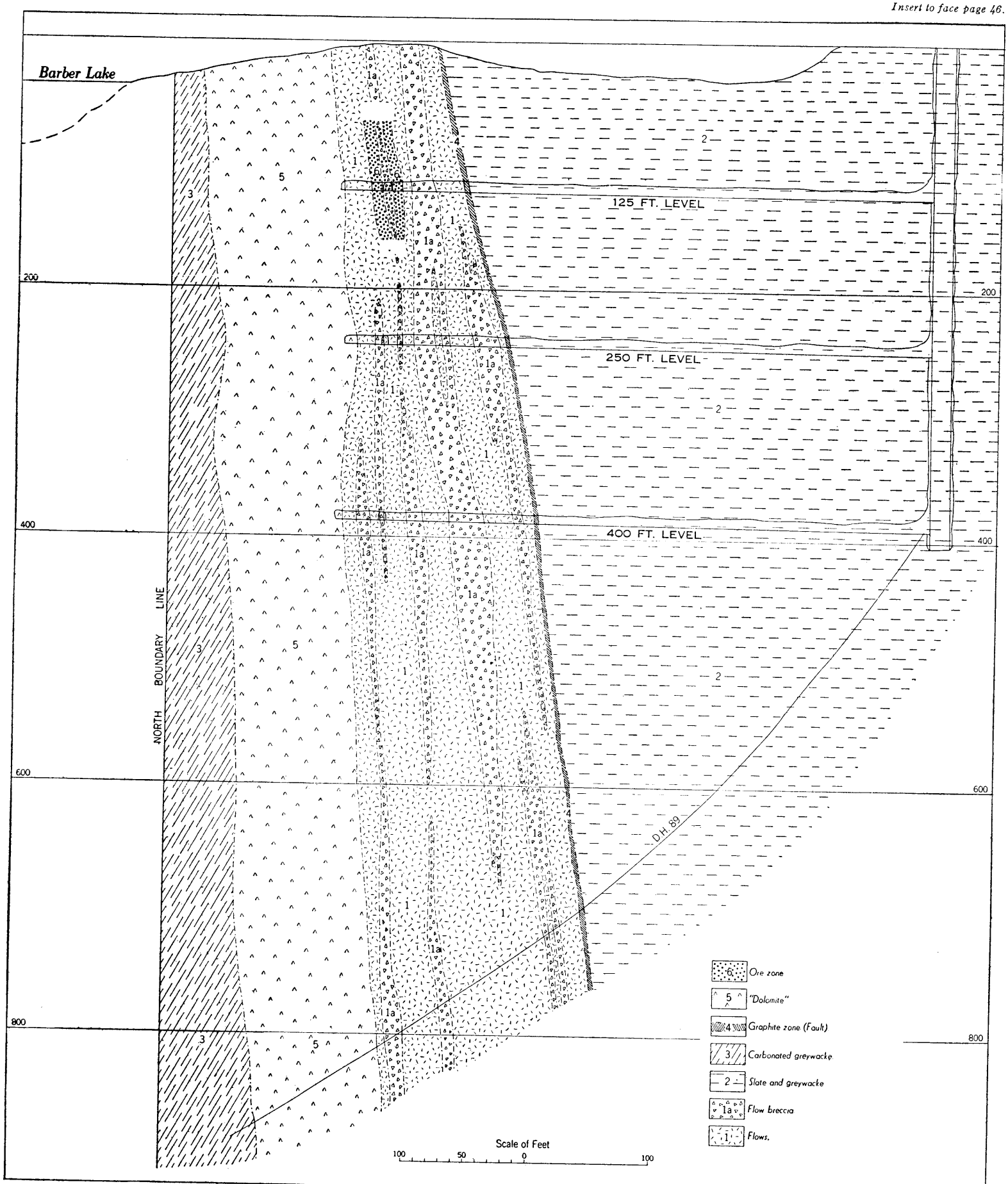
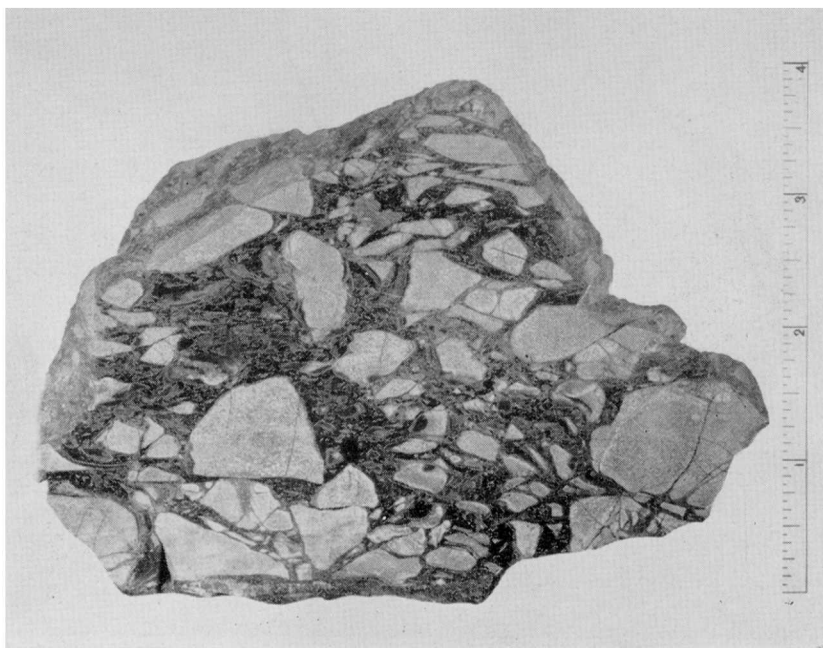


FIG. 5—VERTICAL SECTION ALONG MAIN CROSSCUT, BARBER-LARDER MINE, SHOWING GENERALIZED GEOLOGY.
(Modified after mine plans, April, 1939.)

General Geology

Most of the property is underlain by sediments of the Timiskaming series A band of volcanics and carbonate rock, 200 to 400 feet in width, lies along the south shore of Barber lake on claims L. 318 and 25,536. The south side of the band consists of basic lava flows and breccia. Pillow structures occur in an outcrop of the lava near the west boundary of claim L. 318. Along the northern border of the band secondary carbonate material lies between the volcanics and sediments across an average width of 100 feet. The carbonates are localized within the Larder Lake "break." A graphite fault separates the lavas and



Polished specimen of volcanic breccia, Barber-Larder mine.

breccias from the sediments to the south. This fault truncates the strike of a prominent marker horizon of conglomerate at an angle of 25 to 30 degrees. The dip of the faults and the enclosed lava band is almost vertical.

Ore Zone

The favourable gold-bearing horizon lies within the band of lava flows and breccias (see Figs. 4 and 5). The lava is a fine-grained, dark-coloured basalt. The brecciated zones occur at certain horizons in the flows and are probably fragmental flow tops. The fragments are often angular and more acid than the matrix. They occasionally contain small rounded or elongated vesicles or amygdules. Surface-drilling and underground development established the continuity of the favourable horizons of flows and breccias for a distance of over 3,000 feet across the property. Their average width is about 220 feet.

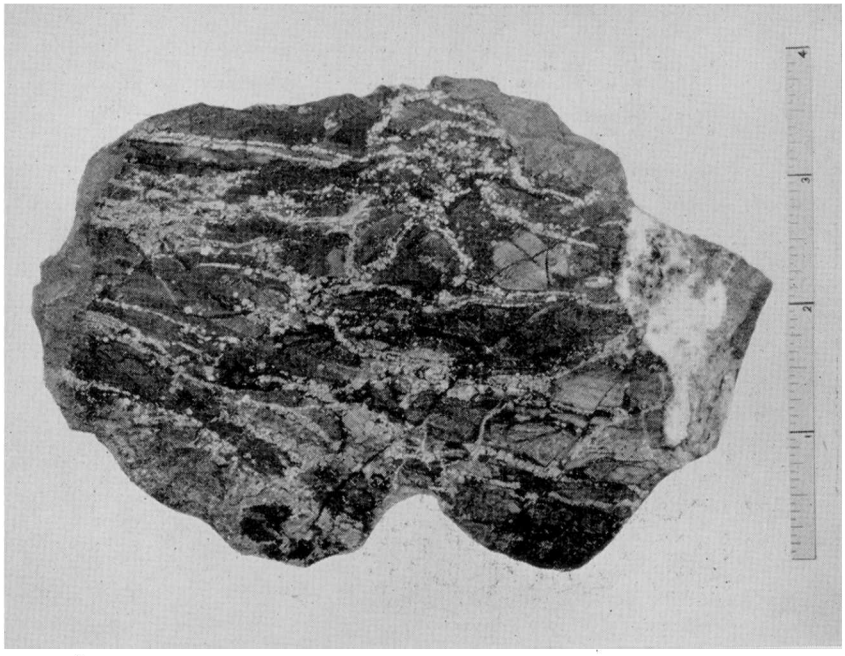
Gold occurs in scattered sulphide bodies, which replace either flows or flow breccias. The sulphides consist of finely crystalline pyrite, pyrrhotite, and traces of chalcopyrite. They occur in disseminated masses throughout the host rock and in a series of interlocking veinlets. These veinlets sometimes surround frag-

ments of the breccia type of ore. Quartz is scarce and confined to a few post-sulphide stringers.

The massive green carbonate (dolomite) body that adjoins the ore-bearing horizon on the north is largely devoid of quartz veinlets. It is reported to contain disseminated mineralization but no ore.

Ore Developments

In the annual report of the company, dated March 10, 1939, the following summary of ore developments was reported by J. G. Tatham, mine manager:—



Polished sample of gold ore, Barber-Larder mine, showing sulphide veinlets in volcanic breccia.

125-foot Level.—Development was carried 101 feet west and 223 feet east of the main crosscut. The west end of the ore body was intersected by the main crosscut. Here channel samples indicate a width of 27.3 feet, with an average grade of $7.40. The No. 1 crosscut east, situated 100 feet east of the main crosscut, indicates a width of 25.5 feet, with an average grade of $6.34. Due to the high degree of accuracy with which the underground development agreed with the surface diamond-drilling, and the fact that the ore body over its total length was drilled from surface at approximately 25-foot intervals, the No. 1 drift east was discontinued at 223 feet from the main crosscut. The ensuing development was concentrated on the lower levels.

Underground development and surface diamond-drilling indicates an ore body 400 to 450 feet long, approximately 25 feet wide, having an average grade of $6.50 to $7.00 per ton. Longitudinal diamond-drill sections indicate ore at least 50 feet above and below the level. This would give approximately 84,000 tons with a potential value in place of $567,000.

250-foot Level.—Development was carried 246 feet west and 458 feet east of the main crosscut. The geology was found to be identical to that of the 125-foot horizon. Scattered assays gave encouragement, but due to the lack of replacement sulphides no commercial ore has been blocked out.

400-foot Level.—Development was carried 380 feet west and 395 feet east of the main crosscut. The geology is identical to the 125- and 250-foot levels. Bands of sulphide mineralization were encountered giving scattered assays, but to date no commercial ore has been blocked out.

After the above report was written the 400-foot level drift was continued to a point 1,305 feet west of the main crosscut and east from it to the property

boundary. In addition, three deep drill-holes were put down from the 400-foot level to intersect the ore-bearing formation at a vertical depth of about 800 feet. This work failed to indicate additional ore.

CHEMINIS GOLD MINES, LIMITED

In 1940 Cheminis Gold Mines, Limited, owned a group of 12 mining claims located in the southeastern part of McVittie township. The favourable lava-tuff-carbonate horizon that extends across the country from the Kerr-Addison to the Omega mine crosses the property in an east-west direction. In 1937 and 1938 a large amount of diamond-drilling was done along this zone on the Cheminis claims. This work revealed gold values interesting enough for the Consolidated Mining and Smelting Company of Canada, Limited, to finance a programme of underground development, which was started late in 1938. A shaft was sunk to a depth of 300 feet, and the ore zone was explored on the 275-foot level. The shaft was then deepened to 553 feet, and lateral work was done on the 400- and 525-foot levels; some drilling was done below the 525-foot level. Total drifting and crosscutting on all levels amounted to 4,902 feet. Company engineers estimated that these underground operations indicated about 321,000 tons of ore, grading about 0.16 ounces per ton in gold. The Consolidated Mining and Smelting Company suspended operations at the property in the summer of 1940. Cheminis Gold Mines was acquired by Amalgamated Larder Mines in November, 1941.

General Geology

The rock formations strike in a general east-west direction across the Cheminis claims. These are indicated on the accompanying geological map of McVittie township (No. 50b) and consist of interbanded sediments and volcanics of the Timiskaming series cut by an occasional narrow dike of diorite or lamprophyre. The gold-bearing horizon lies within a band of highly sheared and carbonated basic lavas and tuffs. Surface outcrops of spherulitic basic lava occur west of the shaft; in the underground workings fragmental basic lavas are interbedded with narrow bands of dark cherty tuff. At the east end of the property a horizon of agglomerate occurs on the south side of the volcanic band and serves as a marker formation.

The greater part of the volcanic belt, however, has been the locus of heavy east-west shearing followed by intense carbonatization along certain zones; consequently, most of the rocks within the band are of secondary origin. Much of the low ground within the volcanic belt is underlain by an intensely sheared talc-chlorite schist produced by strike-faulting movements, probably of considerable magnitude. Along the north and south margins of the volcanic band these faulted zones have been the locus of heavy carbonatization. The carbonate is commonly accompanied by green fuchsite and cut by a stockwork of quartz veins; this material is locally called "dolomite."

Structure

Top determinations (shown on map No. 50b) indicate that the volcanic and sedimentary strata are interbedded and form a stratigraphical succession from older formations on the north side to later ones on the south side. The strata generally dip steeply to the south. The northwestern part of the property lies on the north limb of a syncline; close folding and cross-faulting are indicated on the southeastern claims. A gentle bend on the south side of the lava-tuff-carbonate horizon results in a slightly arched structure. The intense strike-

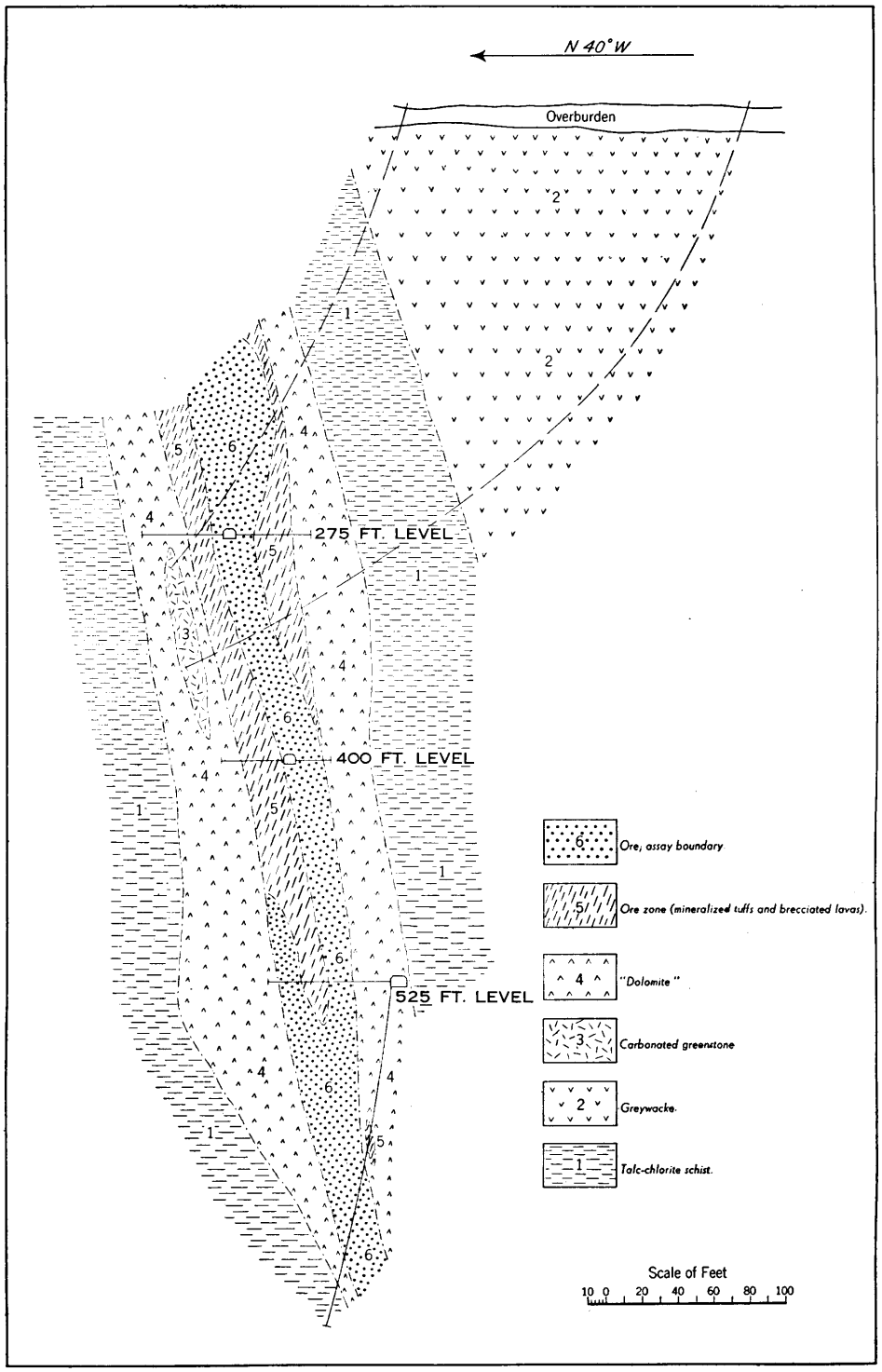


Fig. 6—Generalized vertical section through the Cheminis mine along the line A–B in Fig. 7. (Modified after mine plans, April, 1940.)

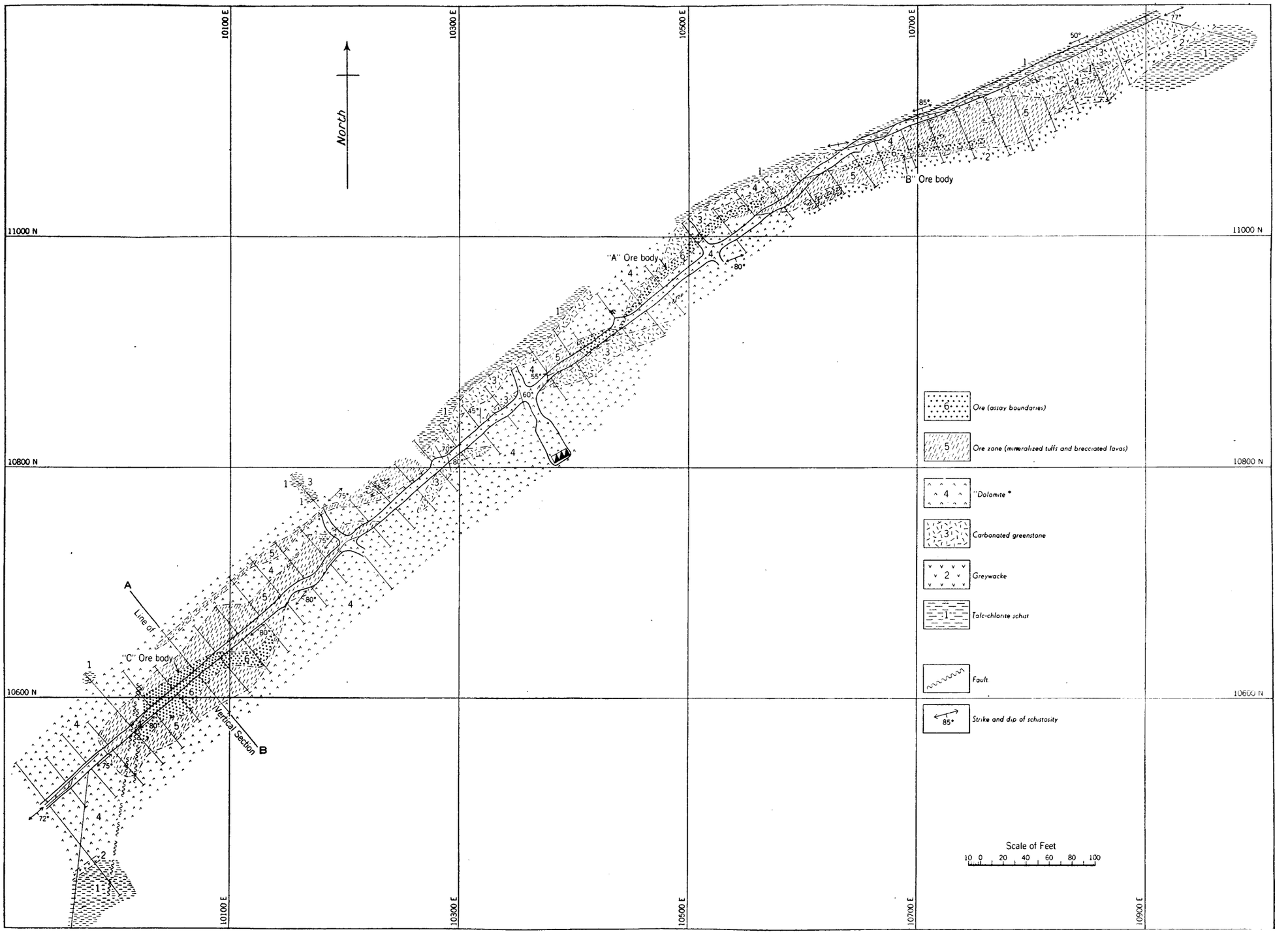
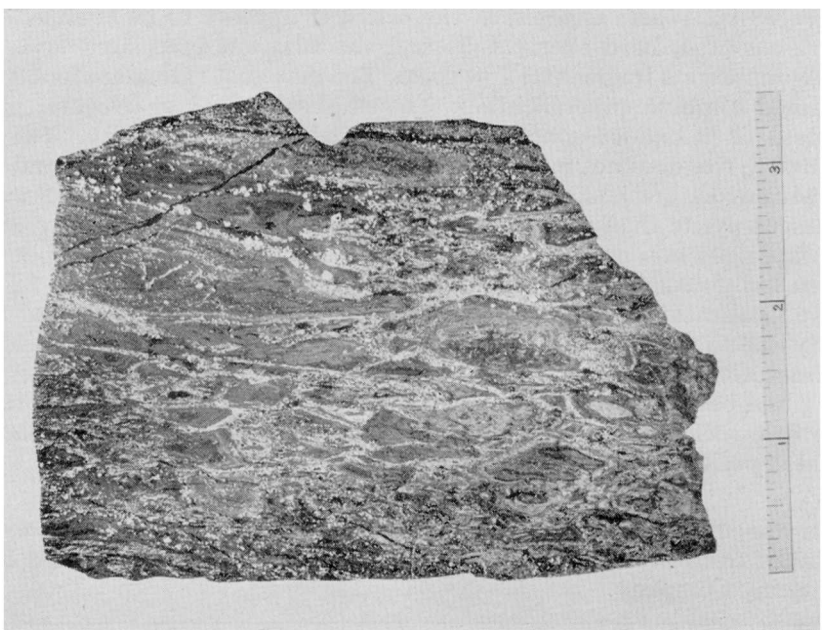


FIG. 7—GEOLOGICAL PLAN OF THE MAIN SECTION OF THE 275-FOOT LEVEL, CHEMINIS MINE.
(Modified after mine plans, July, 1940.)

faulting within the volcanics makes it difficult to determine accurately whether this is due to variation in thickness of the band or to later structural deformation. The attitude of the sediments immediately to the south, however, suggests that this arching is a structural feature. There are points along the south contact where pillowed lava and chloritic tuffaceous beds are interbanded with the greywacke, showing that the change from vulcanism to sedimentation was gradual. In this area the greywacke beds swing around in conformity with the south margin of the volcanics, which they would not necessarily do if the arching were due to the



Polished sample of gold ore from "C" ore body, 275-foot level, Cheminis mine, showing sulphide veinlets in brecciated lava. Tiny quartz-filled fractures cut the sulphides.

original narrowing of an underlying lens of volcanics. The absence of this gentle fold on the north side of the volcanics may be due to faulting along the contact. It is shown elsewhere in this report that most of the ore bodies in the Larder Lake area are found in the vicinity of folds, although small local rolls or drag folds within the area of the Cheminis mine workings are known to have no influence on the position or grade of ore shoots.

The carbonate bodies on Cheminis ground are confined to two bands, which probably merge near the east end of the property. The north band follows the greywacke contact and is localized along the Larder Lake "break." The south band contains the Cheminis and Fernland ore-bearing horizons and also follows a zone of intense shearing and alteration.

Cross-faults offset marker horizons on the claims west of Tournene lake. The folded horizon of conglomerate on claims L. 23,882 and 23,884 may have been thrust into this position through block-faulting. A cross-fault with small displacement cuts across the west end of the "C" ore body at the mine.

Ore Bodies

The gold-bearing horizon is confined to a zone of mineralized basic lavas and cherty tuffs, which have been traced about 2,500 feet across the property.

It is generally bounded by "dolomite," which in turn is flanked by a zone of talc-chlorite schist, especially on the north side (see Figs. 6 and 7). The "dolomite" contains a network of barren white quartz veins. There are all gradations between "dolomite," carbonatized lava, and talc-chlorite schist; boundaries between these rocks must be arbitrarily drawn. The general dip of the ore zone is about 80 degrees to the south or southeast, but this attitude is not uniform owing to rolls in the structure, which flatten the dip locally. These local folds do not seem to have any influence on the position or grade of the ore shoots.

The ore occurs in irregular bodies along the mineralized zone and is bounded by assay walls. Where exposed in the drifts, it appears to be confined within the dark-coloured, hard cherty tuffs and the adjacent brecciated lava, which probably represents fragmental flow tops. The best gold values are found within fine-grained sulphide mineralization. The sulphides occur as irregular patches, in veinlets, or in banded zones running parallel to the schistosity. The coarse crystalline pyrite does not make ore. There is some weak fracturing and quartz filling within the ore bodies, but the gold is more closely associated with the replacement pyrite than with any quartz. Arsenopyrite occurs locally with the pyrite, especially in some of the holes drilled below the 525-foot level, but it does not seem to influence the ore grade.

The localization of the ore bodies within the fragmental lavas and tuffs is probably due to the fact that they are hard, competent rocks, which yielded by slight fracturing under tension at the time when the adjacent rocks yielded by shearing and became talc-chlorite schists. Openings would then be produced in these brittle rocks, and they would become the locus of sulphide replacement and gold deposition.

Ore Developments

The dimensions and grade of the ore bodies are listed below, the information being taken from the original reports of engineers of the Consolidated Mining and Smelting Company.

Level	Ore body	Length	Width	Uncut grade	Tons per vertical foot
		feet	feet	oz. per ton	
275-foot	A	205	6.3	0.185	.....
	B	125	4.4	.273	.....
	C	150	20.7	.169	291
400-foot	A	35	5	.124	.....
	B	133	7.26	.147	.....
	C	180	20.6	.148	348
	[1]C_1	208	10.4	.106	203
525-foot	A	142	4.9	.145	.....
	B	100	3.8	.119	.....
	[2]C	232	11.2	.145	244
	C_2	78	10	.130	73

[1]Or alternately, a 76-foot length with an average width of 6 feet would grade 0.2 ounces per ton and contain 43 tons per vertical foot.

[2]Or by mining a width of 12.9 feet, the grade would be cut to 0.134 ounces per ton, with 281 tons per vertical foot.

There is estimated to be 321,607 tons of ore indicated in the workings to a depth of 700 feet, having an uncut average grade of 0.158 ounces or $5.35 per ton. "A" zone is credited with 62,639 tons, grading 0.153 ounces (uncut) per ton, after allowing for 10 per cent. dilution. "B" zone is estimated to contain 29,898 tons, grading 0.155 ounces (uncut) per ton, after allowing a dilution

factor of 20 per cent. "C" zone is the important of the three and is estimated to contain 229,070 tons, grading 0.160 ounces (uncut) per ton, after allowing for a dilution of 10 per cent.

FERNLAND GOLD MINES, LIMITED

The property of Ferland Gold Mines, Limited, consisted of 12 mining claims located in the southern part of McVittie township between the Cheminis and Omega mines. In 1937 a campaign of surface-trenching and diamond-drilling along the favourable gold-bearing zone of carbonates and volcanics that crosses the area indicated two low-grade ore shoots. In February, 1938, underground work was commenced on the main ore zone. From October, 1938, until the mine closed in March, 1939, the company's operations were financed by the Consolidated Mining and Smelting Company of Canada, Limited. Three levels were opened at depths of 275, 400, and 525 feet. Crosscutting through the ore zone and drifting along the margin of the ore body was supplemented by lateral drilling at closely spaced intervals. Six hundred and three feet of drifting and crosscutting was done on the 275-foot level, 872 feet on the 40-foot level, and 1,332 feet on the 525-foot level. Some 4,321 feet of diamond-drilling was carried out from the three levels.

The property was acquired by Amalgamated Larder Mines in November, 1941.

General Geology

On Fernland ground the formations strike in a general east-west direction and consist of three main belts. The north belt is largely made up of massive trachyte and trachytic agglomerate with lesser amounts of interbedded arkose, greywacke, quartzite, and tuff. These are all part of the Timiskaming series. The south belt contains conglomerate, arkose, greywacke, and slate of the Timiskaming series.

The middle belt is made up of Timiskaming lavas with interbedded tuffs. It has a width of 500 to 800 feet and contains the favourable gold-bearing horizon of the area. It extends for about 4,300 feet across the Fernland claims and continues through the mine workings of the Omega mine to the west and those of the Cheminis mine to the east. Although the lavas are greatly altered by shearing or carbonatization, there are outcrops where pillow structures and spherules may be observed. The tuffs occur in narrow bands between the flows and are thinly bedded sediments. Where the lavas are highly sheared it is sometimes difficult to distinguish tuffs from schists. Much of the low ground within the belt of volcanics is underlain by a soft talc-chlorite schist, which feels soapy when rubbed by the fingers.

The belt of volcanics has been the locus of intense strike-faulting movements, which produced wide sheared zones. The carbonate rock or "dolomite" has replaced the original rocks along these lines of weakness. The maximum carbonatization is generally found along contacts.

Southwest of the shaft intrusive masses and dikes of micaceous lamprophyre and fine-grained syenite and diorite cut the sediments.

Structure

All the rock formations have been steeply folded. The strata face south across the full width of the property except south of the shaft where there is a synclinal fold. The belt of lavas, tuffs, and carbonates dips to the south at an angle of about 65 to 70 degrees and, in plan, are slightly bent along the strike to form an arch that is gently concave to the south. The strike and dip of the schistosity conforms to the arching and dip of the volcanics and carbonate bodies.

There are two fault systems on the property. The older faults have formed wide sheared zones along the strike of the formations and have been the locus of carbonate replacement. They are localized within the belt of volcanics. The north sheared zone follows the greywacke contact and is part of the Larder Lake "break." The south carbonate band contains the gold-bearing horizon of the Fernland and Cheminis mines. A later set of cross-faults may be divided into two groups according to the strike. One group strikes west of north and dips about 70° W.; these offset the west side north. Another set strikes east of north and dips at 70° to 85° E.; the east side has moved north. The combination of the two sets has produced a block-faulted pattern. The horizontal displacement along the faults may be due mainly to the vertical movement of the blocks with the dip being the cause of the shift to the north or south.

Ore Bodies

Surface-drilling along the mineralized gold-bearing belt indicated two possible low-grade ore shoots. The main ore zone follows a band of tuffs and highly altered lavas. The tuffs are thinly bedded and contain an occasional cherty member. In places they are brownish in colour, owing to carbonatization. The ore zone is bounded by carbonate rock and talc-chlorite schists derived from basic lava flows. A band of green carbonate rock (dolomite), up to 40 feet in thickness, has replaced the schist along the hanging-wall side of the gold-bearing zone on the upper levels. It often contains a network of barren quartz veins. The formations dip 65° S. and strike about east-west. The hanging wall of the tuff band is well defined. The footwall is not so cleancut but may be followed in drifting. The tuffs are generally carbonated and silicified, especially on the upper levels.

The values are found in the mineralized sections of the ore zone with the best grade developed in the coarse-grained pyrite. Other sulphides present are chalcopyrite, arsenopyrite, and sphalerite. There is no particular structural control of the ore shoots, and the boundaries are defined by assays. Some irregular quartz and carbonate stringers cut through the mineralized and silicified zone, but fracturing is relatively weak.

The main ore shoot strikes about parallel to the tuffs, and the dip is slightly flatter; consequently, the shoot tends to extend from the footwall to the hanging wall at depth (see Fig. 9). The grade of this shoot diminished with depth. If the values on the 400-foot level are considered as an extension of the main ore on the 275-foot level, there is no particular rake to this ore shoot. Other small shoots were indicated by scattered values in the drilling.

Ore Reserves

Main or West Shoots.—The following table summarizes the ore developed on two levels, as calculated by the mine staff. No ore was found on the 525-foot level. As no raises were put up, the vertical continuity of the ore was not established.

Level	Shoot No.	Length	Width	Uncut grade	Grade ($35 gold)	Tons per vertical foot
		feet	feet	oz. per ton		
275-foot	A	215	12.25	0.181	$6.34	215
	B	27	4.94	.172	6.02	11
	C	64	3.42	.185	6.47	17.5
	D	19	5.44	.330	11.55	9
400-foot	A	115	6.65	0.150	5.25	60
	B	150	11.10	.093	3.25	150

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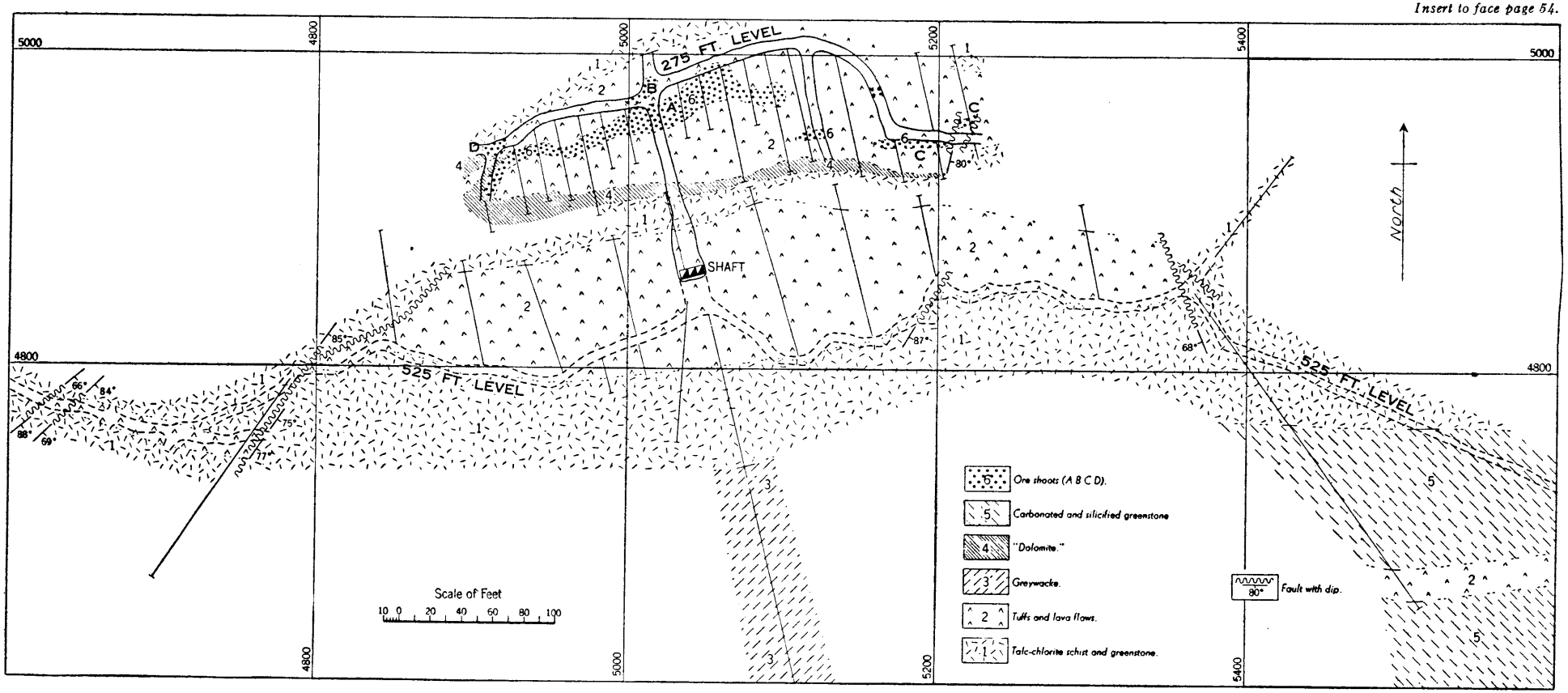


FIG. 8—GEOLOGICAL PLAN OF THE 275-FOOT AND THE MAIN SECTION OF THE 525-FOOT LEVEL, FERNLAND MINE.
(Modified after mine plans, March 15, 1939.)

East Shoot.—The East shoot lies about 1,200 feet east and 300 feet south of the main shoot. A long drive from the 525-foot level towards this body had about 700 feet to go when operations were suspended. In 1938, D. R. Derry, of

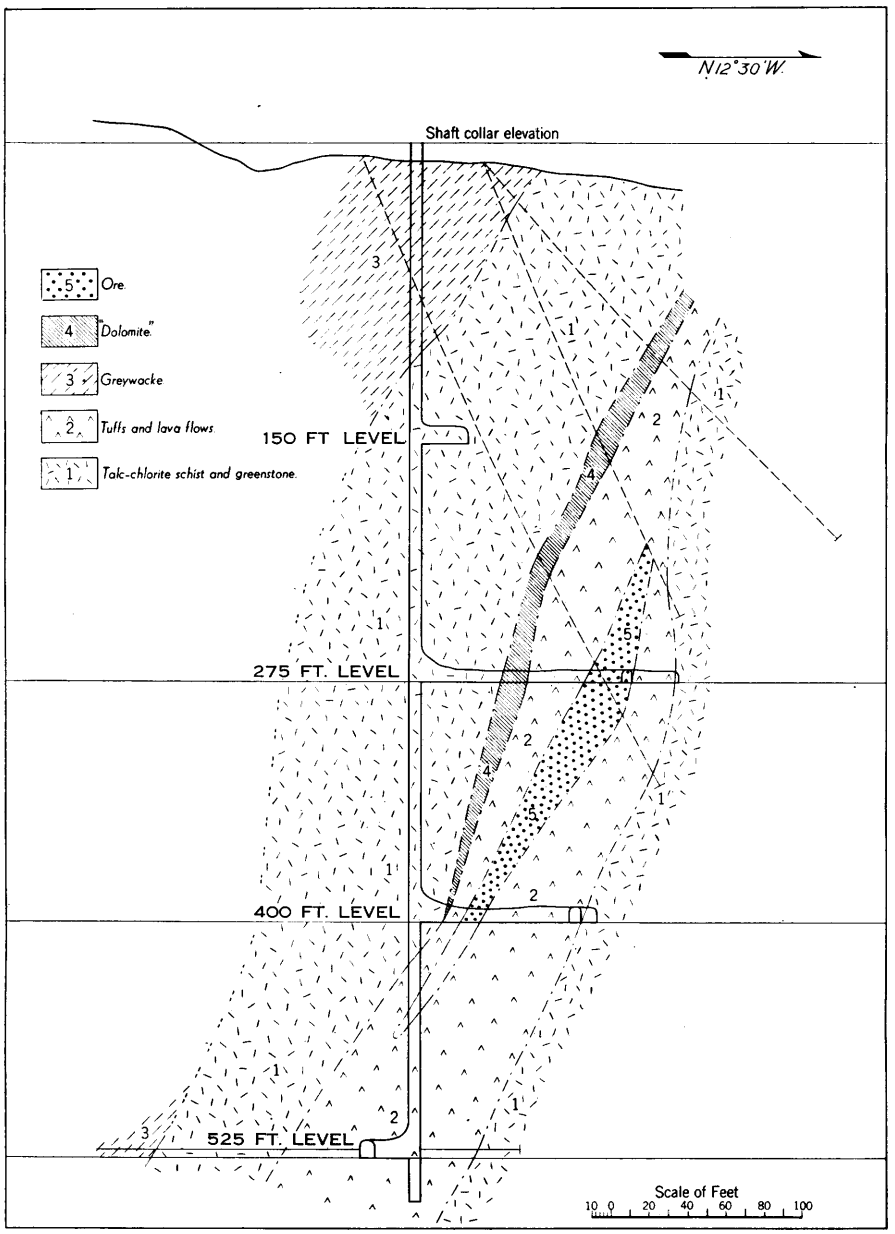


Fig. 9—Vertical section through the shaft, Fernland mine. (Modified after mine plans.)

Ventures, Limited, estimated that this shoot had a probable length of 100 feet and averaged $5.22 over a width of 10 feet. This was based on a westerly rake of the shoot and included the five surface drill-holes that gave the best values. In 1939, in a report to Fernland Gold Mines, B. S. W. Buffam estimated that

if the shoot had no rake and was cut by 9 surface drill-holes, it would be 350 feet long and average $3.78 over an average width of 12.5 feet.

SARCEE MINES, LIMITED

Sarcee Mines, Limited, was organized in December, 1938, and acquired a group of 8 claims in the vicinity of Bear lake in the southeastern part of McVittie township. Seven of these were obtained from Proprietary Mines, Limited, for a share interest in the new company. The remaining claim was acquired from Cheminis Gold Mines, Limited. In 1937 Proprietary Mines did some surface exploration on the ground, and early in 1939 Sarcee Mines, Limited, drilled 4 holes through the ice on Bear lake on claim L. 8,111. Nothing of importance was found.

A narrow band of volcanics flanked by carbonate rock crosses claims L. 2,035, 2,044, 8,111, and 2,034. This is the same band of volcanics that occurs at the Barber-Larder mine to the east and at the Cheminis and Fernland mines to the west. Outcrops of spherulitic and fragmental lavas occur on claims L. 2,035 and 2,044. A horizon of agglomerate lies along the south margin of the volcanics and is in contact with the south belt of sediments, which tend to be tuffaceous near the agglomerate. The northern part of the property is underlain by the trachyte and sediments of the Timiskaming series.

The carbonate rock or "dolomite" has replaced the schists within the Larder Lake "break." A considerable amount of vein quartz occurs in the "dolomite" on claim L. 2,034. The volcanic and carbonate horizons have been offset a short distance at certain points by north-south trending faults.

In 1937 trenching and stripping across the lavas and carbonates on claim L. 2,034 indicated a few points where traces of gold occurred.

HARRIS CLAIMS

In 1941 Sam Harris, of Toronto, owned two claims, L. 8,512 and T. 2,137, which adjoin highway No. 66, west of Barber lake in McGarry and McVittie townships. The favourable gold-bearing horizon that extends between the Kerr-Addison and Omega mines crosses both these claims and consists of outcrops of "dolomite" and basic lava. The band is flanked by greywacke and conglomerate.

Old test-pits along the "dolomite" bands indicate that these two claims were explored in the early days of the camp. In 1937, Proprietary Mines owned claim T. 2,137 and investigated the carbonate bodies by surface-trenching. Out of 54 samples taken only 8 were reported to have assayed over a trace of gold and none assayed over 0.01 ounces per ton. In November, 1941, these two claims were taken over by Amalgamated Larder Mines, Limited.

PROPRIETARY CLAIMS

In 1941, Amalgamated Larder Mines, Limited, took over claims T. 1,884, 1,888, 2,218, and 2,217 from Proprietary Mines, Limited. These are located south and southwest of Barber lake in McGarry township.

Claims T. 1,884 and 1,888 immediately adjoin the underground workings of the Barber-Larder mine on the east and have the continuation of the formations in which the Barber-Larder ore is found. These rocks consist of a band of lavas, with a maximum width of 250 feet, flanked by "dolomite," which is localized along the faulted contacts between the volcanics and adjoining sediments. The "dolomite" zones in places contain a stockwork of quartz stringers and show disseminated sulphides. In 1937 Proprietary Mines examined these two claims on surface, but nothing of commercial interest was found.

Armistice Gold Mines, Limited

Armistice Gold Mines, Limited, was organized in 1937 and acquired a group of 15 claims, which surround the north, east, and west sides of Barber lake in McGarry township. Claim T. 1,932 of the group adjoins the property of Kerr-Addison Gold Mines on the west, and the greater part of the company's development work and drilling has been concentrated here. In 1937 surface-stripping and drilling was done, and 16 holes, aggregating 6,415 feet, were drilled. Additional diamond-drilling, totalling 8,105 feet, was done in 1941 on claim T. 1,932.

On the claims in the vicinity of Barber lake Keewatin lavas and Timiskaming sediments are intruded locally by irregular masses of syenite porphyry. In the northwestern part of claim T. 1,932 a carbonatized fault zone along the contact between sediments and lavas strikes N. 65° E.; this is the Larder Lake "break." A parallel sheared and faulted zone lies about 400 feet south and runs near the power line. Both of these faults may be traced westward for a considerable distance. South of the power line interbanded lava flows and agglomerate strike about N. 25° E. but are cut off on the north side by the south fault.

A third zone of strong faulting and shearing strikes N. 30° E. and runs about parallel with highway No. 66 across the eastern part of the claim. Evidence of intense shearing is found in the drill-holes in this area and in the outcrops of carbonatized agglomerate on the south side of the highway. The faulting along the highway strikes across the two faults trending N. 65° E. and may have offset them to the northeast. The band of sediments lying north of the Larder Lake "break" has either been offset or bent between the east boundary of the Armistice claims and the Kerr-Addison mine workings. To date, however, there is no definite structural information in this area, as no drilling has been done on the drift-covered Kerr-Addison ground adjacent to the Armistice boundary.

Some small veins and lenses of quartz occur in the sheared zones on claim T. 1,932. Low, scattered gold values are reported on surface and from drilling, but no ore has been found to date.

Beaverhouse Lake Gold Mines, Limited

Beaverhouse Lake Gold Mines, Limited, owns a group of mining claims located in the northeastern part of Gauthier township and the northwestern part of McVittie. Underground developments on the property have been confined to claims in Gauthier township and are discussed in detail in a report covering that township.[1]

Burbank Ramore Syndicate

The Burbank Ramore syndicate owns a group of 11 claims located between Monocle and Beaver lakes in the east central part of McVittie township. Surface prospecting and trenching has been done on the property, but the writer has no information about the result of this work.

The southern claims of the group are underlain by Keewatin greenstone, which is intruded by irregularly shaped bodies of syenite and syenite porphyry. Sheared zones occur locally in the greenstone. A narrow belt of Timiskaming greywacke and conglomerate crosses claims L. 25,230, 25,231, 25,233, and 25,234. This belt may be cut off by shearing and faulting along a well-defined valley running northwest from Beaver lake. North of this valley there are massive lavas cut by sill-like masses of gabbro.

[1]Jas. E. Thomson and A. T. Griffis, Ont. Dept. Mines, Vol. L, pt. 8, 1941, in course of preparation.

Photo by Airmaps Limited, Toronto.

AERIAL VIEW OF THE CHESTERVILLE LARDER LAKE MINE, LOOKING SOUTHEAST.

Chesterville Larder Lake Gold Mining Company, Limited

The Chesterville Larder Lake Gold Mining Company, Limited, owns 17 claims in the east central part of McGarry township. The company was organized in 1907 during the first gold rush into the Larder Lake area. At that time the company developed a gold discovery on claim T. 1,860 made by J. T. Kearns, the original staker. Some rich specimens of gold were found on the surface and two 30-foot shafts were sunk on the deposit. But it was not until thirty years later, in 1937, that a diamond-drilling campaign, again inaugurated by the Kearns interests, indicated over a million tons of ore on the southern part of the claim. In 1938, a shaft was sunk to a depth of 328 feet, and drifting and cross-cutting were done on the 150- and 300-foot levels. This work indicated five ore shoots in a zone about 650 feet from south to north. The ore occurs under the same geological conditions as at the neighbouring Kerr-Addison mine, and some ore bodies extend from one property to the other.

In 1939 the shaft was deepened to 600 feet, and the 425- and 550-foot levels were opened up. The shaft was further deepened in 1941 to 1,245 feet, and 5 new levels were established to the 1,175-foot horizon. By the end of 1942, the shaft had been deepened to 1,703 feet and three new levels had been established, the lowest being at a depth of 1,625 feet.

In 1939 the company commenced gold production by installing a 500-ton mill. The mill capacity was gradually stepped up to 700 tons daily in the summer of 1940.

In 1938 the company purchased the adjoining claims of the Rose Gold Mining Company and Shaver McGarry Gold Mines.

The company townsite is called Kearns and is located on the property.

General Geology

The rock formations on the property have a regional strike of N. 60°-70° E. but are locally contorted by close folds. The succession from north to south consists of three principal rock groups. These are: (1) trachyte, trachytic agglomerate, and tuff; (2) bedded greywacke and slate with some arkose; and (3) basic lavas with minor amounts of interbedded agglomerate, tuff, and carbonaceous sediments. These are all classified as members of the Timiskaming series.

To date everything of economic importance has been found along the band of carbonates and altered lavas on claim T. 1,860. These have been explored in the mine workings (see map No. 50d). Over a distance of 200 to 400 feet from the sedimentary contact there is a complex of highly sheared talc-chlorite schist and irregularly shaped areas of "dolomite" containing emerald-green fuchsite and quartz stockworks. Within this zone there are occasional small patches of less-altered rock, which resembles the basic volcanics. To the south the alteration becomes less intense, and the rock may be recognized as dark-grey basaltic lava, which is locally pillowed and spherulitic. Within these volcanics there are bands of agglomerate, and black carbonaceous and cherty sediments, which are probably of tuffaceous origin.

A few small, irregular areas of intrusives occur in the mine workings. Occasional small masses of fine-grained altered syenite are found and are similar to the dike rocks across the boundary on Kerr-Addison ground, where they are often important host rocks for ore. A more massive, light-coloured, acid intrusive occurs on the 125-foot level. On microscopic examination, it proved to be a syenite porphyry and corresponds to similar porphyry found near by in the Kerr-Addison workings.

Structure

Folding.—On the northeastern claims of the Chesterville Larder Lake the formations strike north of east and dip almost vertically. Cross-bedding in the tuffaceous horizons of the trachyte-agglomerate-tuff series and grain gradation in the bedded greywackes indicate that the tops of the strata face south. The structure follows this regular pattern southwestward until it is interrupted by abrupt cross-folds in the sediments on claims L. 891 and 30,131 and the northern part of T. 1,860. In the vicinity of the mill (see map No. 50a) there is a central anticline bounded on either side by a syncline, all three of which are closely folded and pitch steeply to the east or northeast. The central anticline extends off the nose of the underlying Keewatin lavas and is believed to be a regional structure. The closely folded syncline near the northern boundary of claim T. 1,860, however, has probably been produced by dragging movements along the sheared and faulted contact with the lavas to the south. East of the mill this syncline is cut off, and the south limb of the anticline is truncated almost at right angles by the fault contact. Near the northwest corner of claim T. 1,861 another eastward-pitching syncline occurs adjacent to the contact and has also probably been produced by dragging movements along the fault zone. East of the cross-fault on claim L. 5,413 the sediments immediately adjacent to the fault face north, again probably owing to vertical dragging movements along the main sheared zone. The disappearance of the cross-folds in this vicinity may be due to the fact that they have been carried to great depth and have ceased to be reflected in the upper horizons of sediments now exposed.

The sediments at the contact with the carbonatized lavas immediately south of the highway on claim T. 1,860 face south. Within the intensely sheared and carbonatized zone south of the contact it is difficult to recognize definite folds, but towards the south side of the mine workings the A ore body lies within and along an anticlinal fold that pitches west into Kerr-Addison ground (see map No. 50d). This anticline is wedged between two strong faults and is undoubtedly due to local deformation.

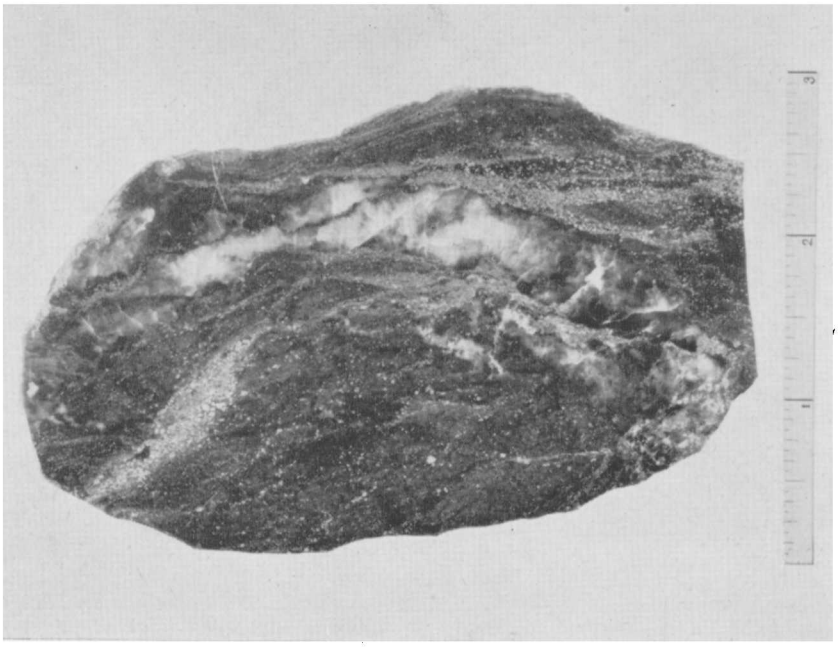
Faulting.—Evidence of faulting is found in wide sheared zones, which strike north of east about parallel with the formations, in narrow well-defined graphitic zones and in cross-slips with no appreciable gouge. Faulting has evidently taken place at different periods and in some cases been recurrent along previous faulted zones. As stated elsewhere in this report the main carbonate band extending across the country from this property to and beyond the Omega mine occupies a wide sheared zone along the contact of the lavas and sediments (Larder Lake "break") and is believed to be the locus of extensive faulting movements. In the main crosscuts at the Chesterville Larder Lake mine the sheared zone has a maximum width of 400 feet. At the contact with the sediments the dip generally ranges from 70° to 75° N. (see map No. 50d).

Immediately north of the shaft there is a strong, vertically dipping graphite fault, which has been traced westward through the Kerr-Addison mine and forms the footwall fault on the south side of the ore bodies. This fault appears to split on Kerr-Addison ground, and a strong north branch crosses through the Chesterville mine in the vicinity of the C and D ore bodies. The lavas between these two faults are folded into an anticline, which pitches west into the Kerr-Addison workings.

Several other faults are found in the underground workings and are indicated on map No. 50d.

Ore Bodies

All the ore bodies that have been found to date are on claim T. 1,860. They occupy a part of the gold-bearing horizon of "dolomite" and altered lavas that strike into the property from the Kerr-Addison mine on the west. East of claim T. 1,860 the surface exposures of the carbonate horizon re-enter the east claim of Kerr-Addison and then extend north of east across the claims of Chesterville Larder Lake. Certain ore bodies extend across the boundary between the Kerr-Addison and the Chesterville Larder Lake and are mined by both companies. The position of the different ore bodies on the 300-foot level at both mines is shown on the accompanying geological map of McGarry township (No. 50a).



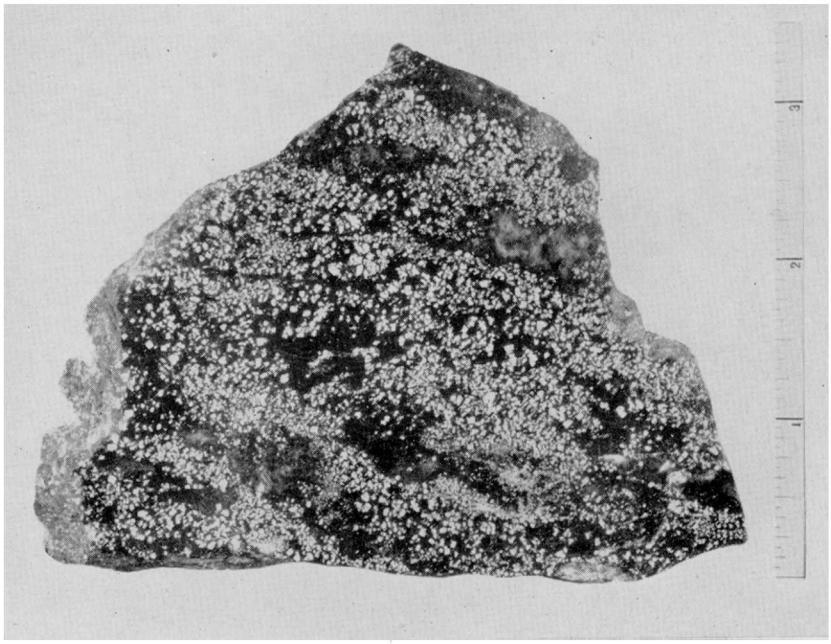
Polished sample of gold ore from the A ore body, Chesterville Larder Lake mine, showing pyrite mineralization and grey quartz stringers.

As these are vertical projections and the ore bodies dip north, certain of the north ore bodies might appear from the map to lie in the sediments, but actually they occur in the "dolomite."

The various ore bodies within the mine workings are irregular in outline. They have no definite geological or mineralogical boundaries, and their extent is arbitrarily defined by assay figures. The ore shoots from south to north are designated as A, B, C, D, E, etc. Their relative positions are indicated on map No. 50d.

The A ore shoot occurs in a fine-grained, dark-grey basaltic lava, which is locally pillowed and spherulitic. The ore consists of portions of the lava that contain finely disseminated sulphides and smoky-grey quartz stringers. A later generation of white quartz cuts the smoky quartz and mineralized rock. Pyrite is the only abundant sulphide, but negligible traces of chalcopyrite, pyrrhotite, and magnetite have been recognized. Native gold occurs in places in or adjacent to the smoky quartz stringers, but most of the values are confined to the sulphides.

The A ore body occurs on an anticlinal fold, which pitches westward and carries the ore body into Kerr-Addison ground at depth. Map No. 50 shows how this ore body is folded. In the vicinity of the main crosscut, it ends abruptly against a fault near the surface, dips flatly to the second level, and then steepens until it is almost vertical. The A ore zone varies in true width from 10 to 70 feet and has an average horizontal width of 70 feet. It contains a number of ore shoots, which dip steeply even in the flatter upper part of the fold. This ore zone has provided the bulk of the mill feed from the mine to date. The ore is removed by a sublevel stoping method.



Polished sample of gold ore from the A ore body, Chesterville Larder Lake mine, showing heavy pyrite mineralization.

The B and C ore bodies are similar mineralogically to the A body. The D, E, and F ore bodies are quite different in character. They are "green carbonate" ore, similar to much of the ore material on the north side of the Kerr-Addison ore zone and are composed of a stockwork of quartz veins, which make up 40 to 75 per cent. of the rock. The remainder is siliceous carbonate material containing bright-green fuchsite. The bulk, if not all, of the gold occurs in the native state distributed erratically throughout the quartz.

The E ore body was developed only on the second level. Mining of this body proved disappointing as the grade decreased below commercial limits as the stope worked up from the level.

Ore Relationships

Microscopic study of polished sections of the A zone type of ore show that the gold occurs as minute grains around the edge of pyrite crystals and in cracks and fractures within the sulphide. It also occurs as small blebs in the quartz-carbonate stringers. Small irregular grains of chalcopyrite and pyrrhotite are found in the pyrite.

Microscopic examination of the ore from the B body by the Mines Branch, Ottawa,[1] revealed pyrite with traces of chalcopyrite, gersdorffite (NiAsS), sphalerite, and magnetite. Their analysis of the A type ore revealed 0.03 per cent. Cr_2O_3 and 0.03 per cent nickel. The "green carbonate" ore contained 0.17 per cent Cr_2O_3 and 0.07 per cent nickel.

Production, Ore Reserves, Profits, Etc.

The information in the following table has been taken from the annual reports of the company for the years shown:—

	Dec. 15, 1939[1]	Dec. 19, 1940	Dec. 15, 1941	Dec. 15, 1942
Tons milled	89,174	219,109	250,793	243,294
Average recovery per ton	$5.03	$5.74	$5.67	[2]0.137
Value of bullion recovered	$448,461	$1,258,946	$1,422,290	1,156,229
Operating costs per ton milled	$3.29	$3.19	$3.01	3.13
Estimated ore reserves...tons	871,707	851,198	757,000	583,400
Estimated average grade of ore reserves...ounces per ton	0.166	0.154	0.140	0.140
Yearly operating profit	$155,392	$559,671	$650,615	379,127
Net yearly profit (after write-offs)	$76,926	$381,601	$449,468	[3]$234,986
Dividends paid		$86,778	$260,334	$43,389

[1]Six months operation.
[2]Ounces per ton.
[3]Before provision for taxes.

Dalby-Larder Gold Mines, Limited

In 1938 Dalby-Larder Gold Mines, Limited, did assessment work on a group of 6 claims, L. 25,387 to 25,389 and 29,858 to 29,860, adjoining the Nipissing Central railway in the eastern part of McVittie township. These claims are underlain by syenite porphyry and some irregularly shaped masses of greenstone. Development work was concentrated on a sheared zone about 40 feet in width near the north shore of Blackwell lake. Low gold values were reported from test pits along this sheared zone.

Hay-Thompson Claims

In 1938 the Hay-Thompson group consisted of 18 claims located in the central part of McGarry township adjoining the Kerr-Addison and Chesterville Larder Lake claims on the north. Development of these claims to date has been limited to assessment work.

The rocks on the northern claims of the group are trachyte, trachytic agglomerate, tuff, and conglomerate, all belonging to the Timiskaming series. Bedded greywacke occurs on the southeastern claims. This formation is probably separated from the trachytic rocks by a sheared and faulted zone, which strikes about N. 50° E. across claims L. 30,772 and 30,768, and may continue through L. 30,770 and southwest across the Kerr-Addison and Arjon claims.

A few small quartz veins and stringers have been uncovered on the claims, but no gold discovery of economic importance has been reported to date.

Hay Syndicate

In 1938 the Hay Syndicate controlled two groups of claims in the southern part of McGarry township. One group of 13 claims adjoined those of Wesley

[1]Investigation No. 766, Bureau of Mines Report No. 805, Department of Mines and Resources, Ottawa, 1939.

Gold Mines on the east; the second tied on to Kerr-Addison ground on the south. Both these groups are underlain by the sediments of the Cobalt series.

Ivan Larder Mines, Limited

Ivan Larder Mines, Limited, was organized in 1937 to develop a group of 12 claims in the west central part of McGarry township. Surface work and diamond-drilling were done in 1937 and 1938.

The rocks on the claims consist largely of conglomerate, greywacke, trachyte, trachytic agglomerate, and tuff, all part of the Timiskaming series. A few outcrops of Keewatin lava and intrusive porphyry occur on claim L. 31,093 north of Bear lake.

The formations of the Timiskaming series are quite massive. They are closely folded into a syncline, the axis of which strikes in an east-west direction and pitches to the east. There are probably strike faults along the pronounced east-west valleys on the north limb of the fold.

Small quartz veins have been uncovered at a few points. They occur largely in the trachyte and trachytic agglomerate. In the northeast corner of claim L. 31,094 a 15-foot test pit reveals a small showing of quartz with pyrite and chalcopyrite. Another pit on the east boundary of claim L. 35,961 contains quartz stringers with magnetite crystals. A grab sample of this material taken by the writer contained no gold when assayed.

Kerr-Addison Gold Mines, Limited

Kerr-Addison Gold Mines, Limited, was incorporated in April, 1936, and acquired 10 patented claims, known as the Kerr-Addison and Reddick groups, from Proprietary Mines, Limited. Proprietary Mines, Limited, had previously secured these claims from the bankrupt Canadian Associated Goldfields. An additional 16 claims were acquired at that time and others were purchased later. In 1941 the company owned 34 claims in McGarry township.

The Reddick and Kerr-Addison claims had been worked as early as 1907. A 20-stamp mill was erected on the Reddick property in 1908, and a small amount of gold was recovered. In 1914 Associated Goldfields purchased the Reddick and Kerr-Addison claims. A shaft was sunk 86 feet on the Reddick claims, and about 2,200 feet of drifting and crosscutting was carried out on the 83-foot level. At the same time a shaft was sunk to a depth of 325 feet on the Kerr-Addison claims and considerable drifting and crosscutting were done on the 175- and 300-foot levels. In addition, more than 16,000 feet of diamond-drilling was done on both properties.[1]

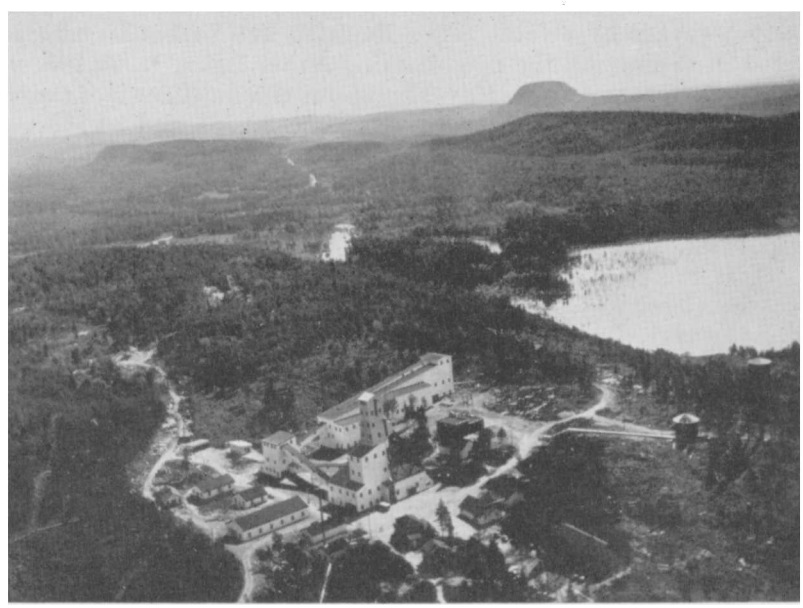
In 1936 Kerr-Addison Gold Mines carried out a large-scale sampling project throughout a wide ridge of "dolomite" that contained a network of gold-bearing veins. This was done by driving four adits, 400 feet apart, into the hillside. The rock from these adits was crushed and sampled in a special plant. Gold-bearing sections were indicated in two adits, and on these some drifting was done and closely spaced holes were drilled, but the results were not very satisfactory. Before abandoning the project it was decided to drill one deep hole from the surface. This hole cut what eventually proved to be the No. 10 ore body and returned a core length of 150 feet of ore. With this encouragement the old Kerr-Addison shaft was dewatered, and the old workings were resampled. Oddly enough, there was no ore in evidence on either level, although some visible gold could be seen in the old crosscut on the 300-foot level and the ore bodies that

[1]H. C. Cooke, Geol. Surv. Can., Mem. 131, 1922, p. 59.

were removed later lay in the immediate vicinity. New development drifts were driven from both levels along the footwall of the main ore zone, and diamond-drilling was used to outline the ore bodies.

A large tonnage of ore was thus indicated, and preparations were made for production. A 500-ton mill was ordered in 1937 and commenced production in May, 1938. In 1939 the mill was expanded to treat 1,200 tons and in 1940–41 was further enlarged to 1,800 tons' capacity. By the end of 1941 the mill was treating an average of about 2,100 tons daily.

In 1937 a new 5-compartment shaft (No. 3) was sunk on the south side of the ore bodies. By 1942 levels had been opened at 175, 300, 500, and 700 feet and at additional 150-foot intervals to a depth of 1,450 feet. At the end of 1942,



Aerial view of the Kerr-Addison mine looking east toward Mount Cheminis. The Chesterville shaft appears at the left of the central point of the photograph.

the shaft had been deepened for the opening of an additional 8 levels, the deepest being at 2,650 feet. In 1941 a long crosscut was started to the southeast from the 1,000-foot level for the purpose of exploring carbonate bodies exposed at the surface near the lake shore.

Virginiatown, the townsite of the mine, is operated by the company's wholly owned subsidiary organization called Kerr-Addison Properties, Limited.

General Geology

The rocks on the Kerr-Addison claims that are situated north of the mine workings consist of andesitic Keewatin lava in the western claims overlain by Timiskaming greywacke in the eastern claims. Outcrops of Timiskaming conglomerate, trachyte, and tuff, occur on claims T. 2,018 and 2,178. The ground between the mine workings and the shore of Larder lake shows outcrops of Timiskaming volcanics. The rocks in the volcanics include basic lavas, sometimes pillowed, agglomerate, and bedded greywacke and tuff; zones of intensely sheared and heavily carbonatized rocks strike in a northeasterly direction

through this area. A small area of Timiskaming greywacke and slate is exposed on claim T. 1,839. A small outcrop of quartz-feldspar porphyry occurs on the main "dolomite" ridge. Immediately southeast of the mill and No. 3 shaft there is a narrow band of basic rock containing rounded boulders of granite. It has been described in a previous part of this report and is believed by the writer to be a basic dike that has picked up granitic boulders. Small erosion remnants of the greywacke and conglomerate of the Cobalt series occur in Virginiatown and along the lake shore.

Structure

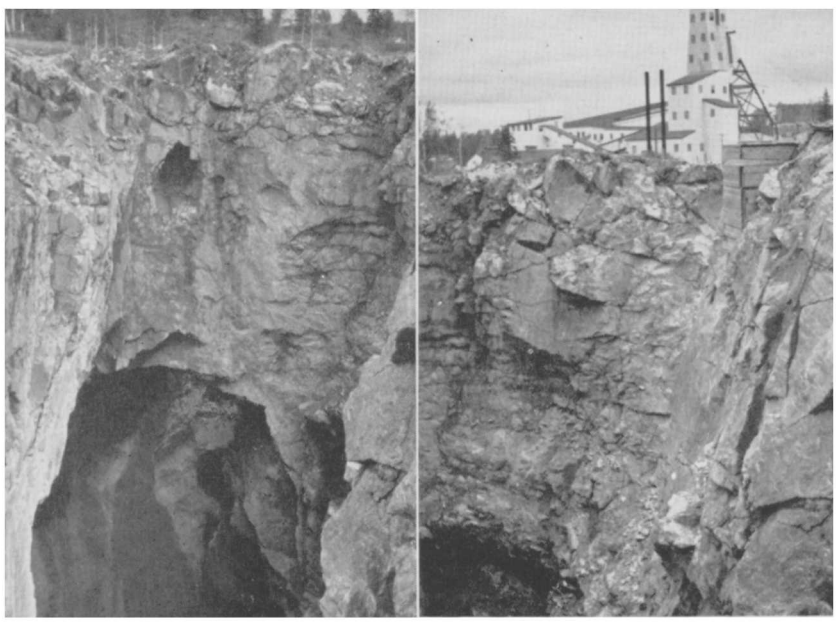
The Keewatin lavas and Timiskaming sediments that lie north of the mine workings have been folded into a central anticline flanked by synclines. These folds pitch very steeply to the east. The trachyte and associate agglomerate and tuff in the northwest corner of the property are believed to be separated from the greywackes by a fault zone. Faulting and carbonate alteration were encountered in drilling on the neighbouring Arjon claim, L. 25,195. Along the strike to the northeast on the Hay-Thompson claims there is intense shearing along the southeast side of a ridge on claims L. 30,768 and 30,773, and this is thought to be the continuation of the shear zone found on the Arjon claims. Further evidence of faulting along this zone lies in the fact that the north synclinal fold on the Kerr-Addison claims is cut off at a considerable angle along the assumed position of the fault. A synclinal fold in the Timiskaming series that extends across the central part of McGarry township from Beaver lake is also cut out in the vicinity.

The greywacke along the north side of the main carbonate body at the Kerr-Addison and Chesterville Larder Lake mines faces south. As pointed out in a previous section of this report, the greywacke-volcanic contact is the locus of heavy strike-faulting, although the bulk of the movement appears to have taken place in the volcanics and at some points the contact of the volcanics and sediments is sharply defined. This fault (Larder Lake "break") has been traced for several miles across McGarry and McVittie townships; its total displacement is not known but may be very great, even measureable in miles. Other faulted zones lying approximately parallel to the Larder Lake "break" occur southeast of the mine workings. These main sheared zones have acted as lines of weakness along which circulating hot solutions have altered large areas of the original rock to a mixed carbonate, which has the approximate composition of ankerite but is often referred to locally as "dolomite." The "dolomite" contains a stockwork of quartz veins. In some portions of the central part of the carbonate bands all vestiges of movement have been obliterated, but along the edge of the bands the intense shearing is quite noticeable. Some of these southern carbonate bands contain stockworks of quartz similar in appearance to the main quartz ore bodies in the mine.

The regional structure in the basic volcanics, agglomerates, and tuffs south of the mine workings cannot be definitely stated at present owing to lack of detailed information. It is known, however, that the structure is complex. On the adjoining Sheldon-Larder property the volcanics lie on the south limb of a synclinal fold, which pitches southwest, and a well-defined marker horizon of agglomerate at the sedimentary contact strikes northeast. South and west of the Kerr-Addison mine workings there are scattered clues that suggest that the volcanics swing around to the north towards the synclinal axis in conformity with the overlying agglomerate and sediments found on the Sheldon-Larder claims. On claim T. 8,862 the flows locally strike north and then swing around to the northwest. On the west boundary of claim T. 1,848 the flows strike west

of north and the schistosity about north-south. At both localities there is some suggestion of westward-facing tops of the flows. Immediately south of the mine office the flows strike about N. 50° E., but the top direction could not be determined. On claim T. 1,904 in Virginiatown, bedded sediments strike about north-south. As discussed in detail later, some of the southern ore bodies at the Kerr-Addison and Chesterville Larder Lake mines appear to fold about a westward-plunging anticline. At any one or all of these points, however, it is possible that the attitude of the strata may be due to local drag folds produced by faulting rather than to regional folding.

If the above-described attitudes of the strata should be related to regional folding, a northwest-southeast trending anticlinal cross-fold might be suspected



Views of the open stope where the Kerr-Addison No. 10 ore body has been mined to the surface.

to lie somewhere in the Timiskaming volcanics, probably in the vicinity of the eastern Kerr-Addison claims. In support of such a theory it might be argued that the synclinal fold of Timiskaming greywacke found by drilling on the Pelangio-Larder claims could represent the continuation of the Sheldon-Larder sediments on the east limb of the cross-anticline. The fact that these two bodies of sediments do not lie on strike means little in an area of such intense strike-faulting. But, as stated above, the available data are too meagre to warrant any conclusions on this important point of structure.

Mine Geology

The following description of the mine geology and ore bodies is based on underground developments to September, 1941, and covers geological features found to a depth of 1,300 feet.

Within the upper levels the ore zone lies in a block of ground over 2,500 feet in length and ranging in width from 200 to 600 feet (see map No. 50d). Geologically the zone is bounded by the greywacke contact on the north; there is no

definite geological boundary to the south, but most of the ore bodies lie north of the footwall graphite fault. At the east end the ore zone continues into Chesterville Larder Lake ground; at the west end of the underground workings on the 700-foot level it narrows considerably but has not been investigated between the west limits of the mine workings and the Armistice boundary.

On the north side of the ore zone the rock is very largely secondary, whereas on the south side lavas and tuffs are recognized, although in places they are considerably altered. A generalized section across the ore zone from north to south would start with greywacke, which becomes increasingly sheared and carbonatized. Despite the intense alteration the contact between the sediments and the talc-chlorite schists is sharply defined at many points. Carbonate replacement of varying intensity has taken place within the schist band; quartz stockworks cut through the carbonate material. Thus, within the area of secondary rocks there is a complex of quartz-carbonate-schist bodies varying

Surface exposure of the Kerr-Addison ore body near No. 1 shaft, showing a stockwork of gold-bearing quartz stringers in "dolomite."

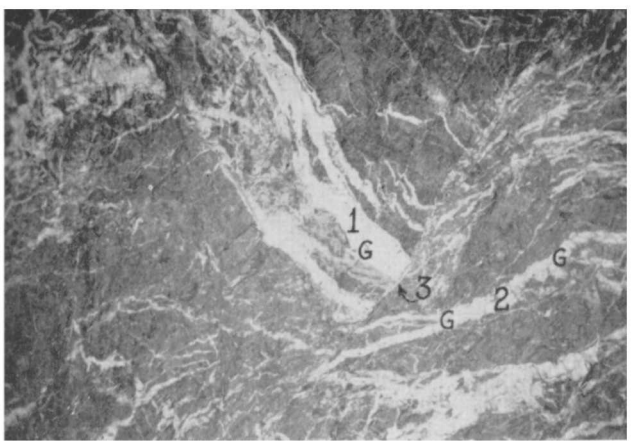
greatly in shape, appearance, and composition from point to point throughout the mine. Within this complex there are irregularly shaped bodies of altered syenitic intrusives. Both the carbonate rock and the intrusives are the hosts of large stockworks of gold-bearing quartz veins and veinlets. Along the south side of the schist-carbonate-quartz complex a horizon of tuffs is recognized. These show delicate bedding *laminae* in places. Interbanded with the tuffs and lying to the south of them are basic lava flows in which spherules and amygdules may be seen. These also contain ore bodies.

The rocks from which the schist-carbonate complex on the north side of the ore zone were derived are thought to have been predominantly volcanic, although at most points it is impossible to be certain, as every vestige of original rock composition and texture has generally disappeared. At certain less altered places, however, the rock is quite chloritic and looks like an altered lava with some vestiges of flow structure. Eastward along the strike on the Chesterville Larder Lake claims and the eastern Kerr-Addison claim the alteration becomes less intense, and igneous textures and pillow structures are occasionally found in the carbonate band. A fragmental rock which is found occasionally throughout the mine may represent remnants of agglomerate.

The carbonate rock or "dolomite" is often greenish in colour owing to the presence of emerald-green chrome mica and chlorite. This is sometimes referred to as "green carbonate" or "green dolomite." At other points the carbonate rock is brownish in colour. Often patches of brown carbonate occur in the greenish type and vice versa. At many places the carbonate rock is either slightly sheared or else shattered to form a breccia. Much of the carbonate rock is cut by such a network of quartz veins and stringers as to form a vein breccia of carbonate fragments surrounded by quartz.

Structure of the Ore Zone

The wide zone of shearing along the north side of the ore zone is part of the Larder Lake "break." As shown on Map No. 50d (in pocket) this sheared zone dips very steeply to the north and in some places is vertical. On the



Exposure of ore on the breast of No. 321 stope, Kerr-Addison mine, showing three generations of quartz veins. No. 1 vein lying in green "dolomite" (upper left) is cut off by a syenite dike (lower right), which in turn is intersected by quartz veins (No. 2). The latest quartz (No. 3) occurs along the dike-dolomite contact. Visible gold occurs at points marked "G." (Photo by J. W. Baker.)

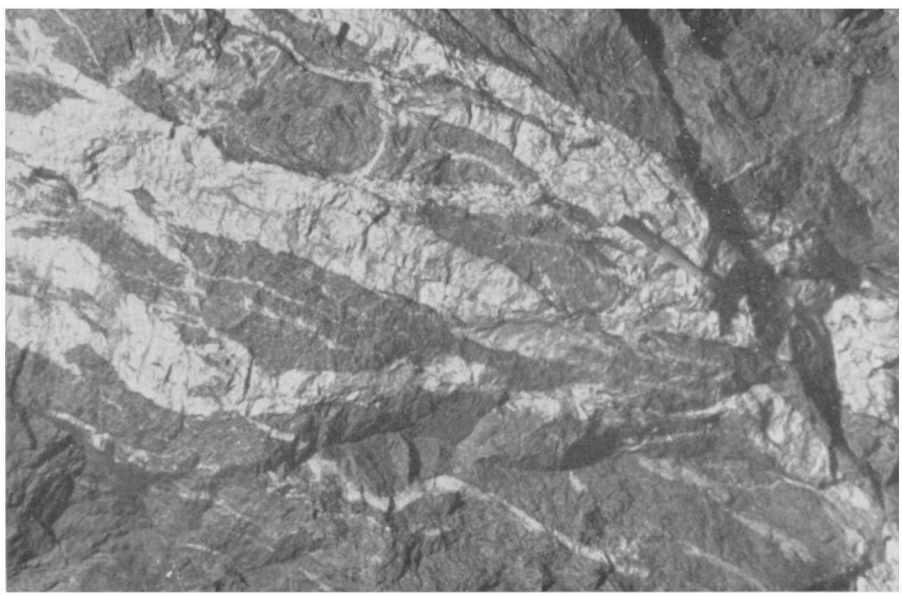
south side of the ore zone lies a graphite footwall fault, which dips about 77° N. on the upper levels. Other faults angle off the footwall fault as shown on map No. 50d. In the west end of the Kerr-Addison mine the footwall fault swings around to the west and may merge with the hanging-wall shear zone.

The recognizable horizons of tuffs and lavas that are situated on the south side of the ore zone have undergone varying degrees of folding. At the west end of the mine the tuffs show gentle arching, and in the southeastern section the interbedded lavas and tuffs are more closely folded into a westward-pitching anticline, although, in part, this anticlinal structure is broken up by strike-faulting.

The movements along the various faults undoubtedly produced a system of tension fractures, which would relieve the compressional stresses set up by shearing. This fracturing apparently took place during the general period of vein formation, and these openings became filled with quartz. Repeated shearing movements and vein fracturing would produce different generations of intersecting veins. These are the actual conditions found in the quartz stockworks. At some

points in the mine two or more generations of quartz occur, and gold is found in all of them.

There is no definite pattern of quartz veins for the whole mine, although locally in a stope or ore body the more prominent veins may have definite orientations. In a very general way, one prominent set of vein fractures strikes north-south throughout the mine and has a steep dip; these lie about normal to the long axis of the ore bodies. Another prominent set dips flatly. Areas of flat veins have yielded surprisingly large bodies of ore in certain parts of the mine where systematic lateral drilling had failed to indicate any ore. For example, the original drilling of the No. 9 ore body showed only low values because the holes



Stockwork of relatively flat-lying quartz veins in "green carbonate" exposed on the wall of No. 714 east drift, Kerr-Addison mine.

ran parallel to the flat quartz veins. When stoping operations were commenced these flat veins were sufficiently rich to make it profitable to remove very large tonnages of ore. At one point in this ore body over 3,000 tons per vertical foot were mined. At some points where an ore body occurs in the trough of a gentle bend in the footwall tuffs, the fractures tend to radiate normal to the bend. Occasionally prominent veins can be followed for a considerable distance, but most of the ore bodies contain only a swarm of interlocking veins and stringers.

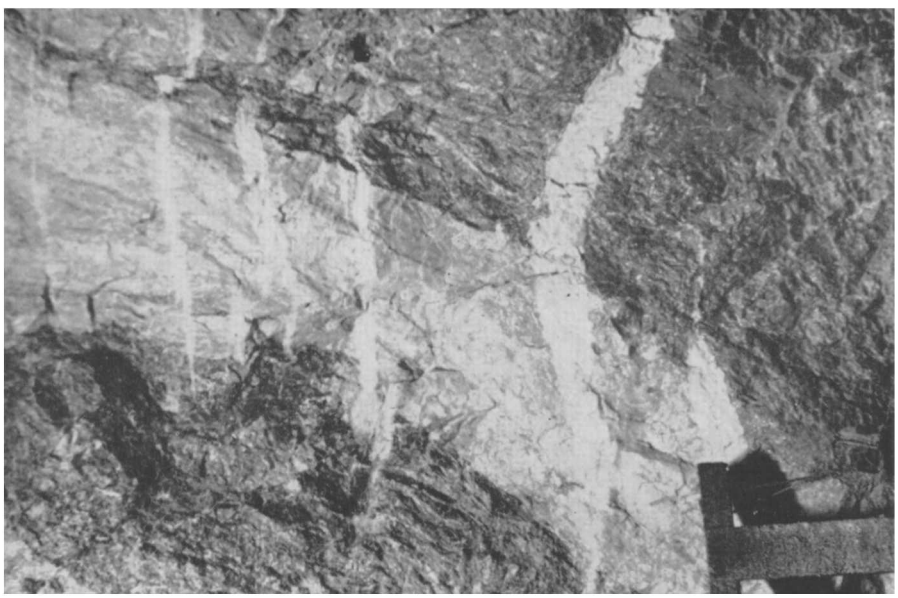
According to mine officials, recent development work (1942) has shown that there has been considerable post-ore movement on the footwall and subsidiary faults. No. 17 ore body appears to be a part of the No. 21 ore body displaced downward by the footwall fault. In turn, a subsidiary fault displaces part of No. 17 ore body.

Ore Bodies

The known ore bodies are disconnected, irregular shoots scattered throughout an overall length of about 2,500 feet along the ore zone (see map No. 50d) from the Chesterville Larder Lake boundary. The long axis of an ore body is approximately parallel to the strike of the enclosing formations. The host rocks

for the ore bodies are (1) carbonate rock, (2) basic lavas, (3) syenite dikes, (4) tuffs, and (5) talc-chlorite schists. The bulk of the ore occurs in the first three classes of rock mentioned. With increasing depth a much greater proportion of the ore is found in the footwall lavas. The syenite, lava, and tuffs are sheared and slightly carbonatized, but the original rock type may be recognized, whereas in the case of the carbonate ore the host rock is altered beyond recognition. The larger syenite bodies are generally well-defined dikes, but the smaller masses are irregular patches, blocks, and fingers, which are extremely variable in outline.

Certain ore bodies show a considerable change in physical character at different levels in the mine. For example, No. 19 ore body on the 300-foot level



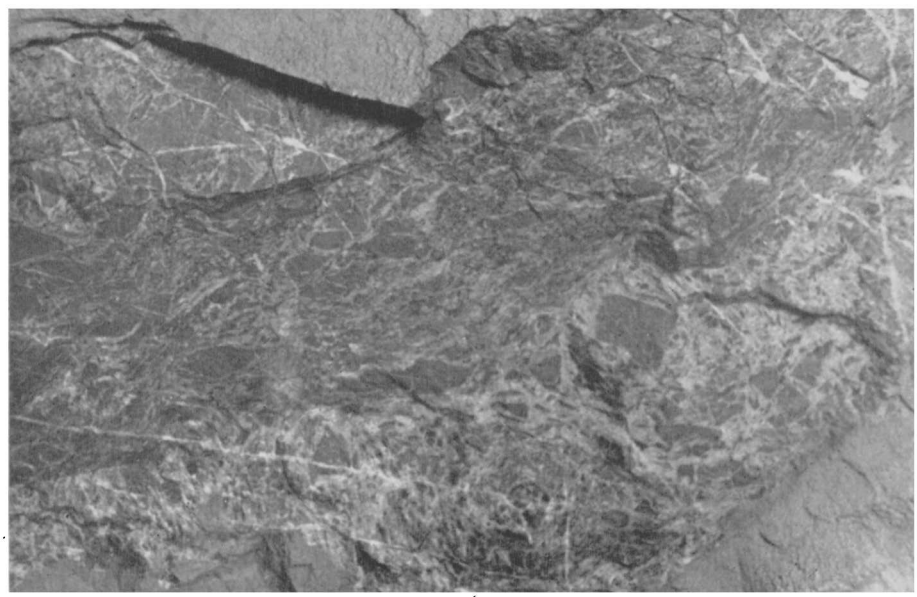
Later generation of quartz veinlets cutting a flat-lying quartz vein, No. 524 north stope, Kerr-Addison mine.

lies in talc-chlorite schist with small irregular patches of intrusive. At the 1,000-foot level this ore body has changed to the normal green carbonate type of ore. The bulk of No. 14 ore body on the 300-foot level lies within an altered syenite dike, but on lower levels it changes to green carbonate ore with only scattered patches of dike material.

The ore bodies occur in those parts of the favourable zone where there has been large-scale fracturing and auriferous quartz-filling. All of the quartz veins and stockworks are not of ore grade. The limits of the ore bodies are thus not geological boundaries but are arbitrarily defined by assay values. The boundaries of the ore bodies are quite irregular in outline. On the south side of the east end of the mine the ore bodies have a definite westerly rake, in places as much as 45 degrees. The ore bodies at the west end dip steeply. Their irregular outline makes any calculation of rake impossible until stoping is completed, because it is sometimes found that the different ore bodies will merge or individual ore bodies break up into different shoots between levels. The quartz stockwork type of deposit produces wide ore bodies in certain areas. Individual ore shoots, such as No. 10, attain stoping widths up to 170 feet at certain points. Owing to the irregularity of values in the gold-bearing stockworks, stoping sometimes reveals

a larger block of mineable grade than was indicated by lateral exploratory drilling, and sometimes the situation is reversed.

Two different types of ore occur in the mine. The difference is primarily due to the nature of the host rocks. When the ore lies in "dolomite" or syenite intrusives, e.g. ore bodies Nos. 9, 10, and 14, the quartz veins are white and contain wisps of chlorite and green mica along fracture planes. The gold occurs in the native state, often in coarse grains and patches. It is irregularly distributed throughout the quartz and is often concentrated along the vein margins and in fractures containing wisps of green mica. Sulphide mineralization is very scanty in these ore bodies and consists mostly of much disseminated pyrite; traces of arsenopyrite, chalcopyrite, and sphalerite have been found. The pure carbonate material lodged between the quartz stringers is devoid of gold but



Breccia type of "green carbonate" ore, No. 714 east drift, Kerr-Addison mine.

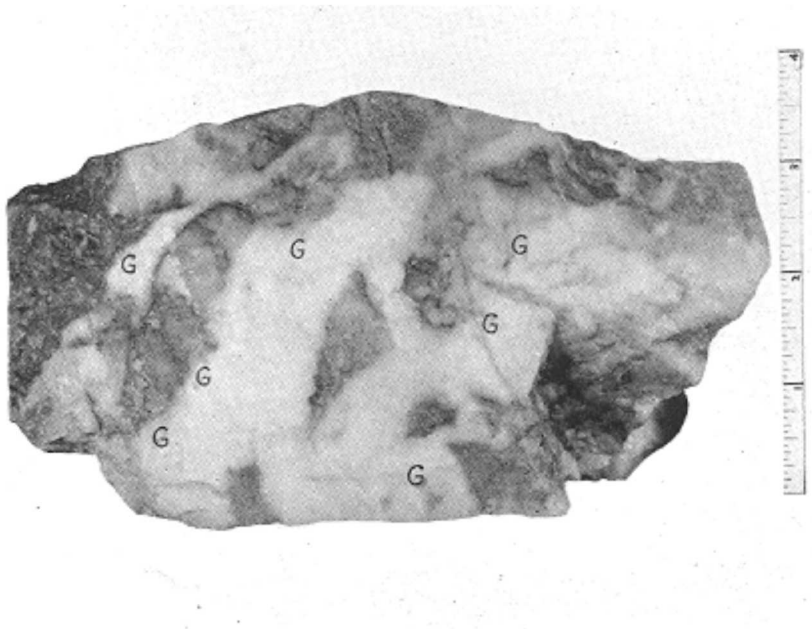
must be mined in order to secure the gold-bearing quartz. The spotty distribution of the gold makes it necessary to use special precautions in estimating grade and makes it difficult to outline ore bodies by lateral drilling. Experience has shown mine officials that the percentage of certain types of vein quartz in the drill core is sometimes a better criterion for evaluating the ore possibilities of certain areas than the grade indicated by the core assays. Originally, the company policy was to evaluate both cut and uncut grade, but after a few years of operating experience this practice was discontinued as it was found that, by observing certain precautions, the average mill grade could be pretty accurately estimated.

When the ore bodies occur in lavas and tuffs (e.g. ore bodies Nos. 8, 16, 17, and 21), there is considerable pyrite mineralization; traces of arsenopyrite, chalcopyrite, galena, and spalerite are also found. Scheelite is disseminated throughout certain areas in the tuffs. The sulphides are cut by dark-coloured smoky quartz veins and veinlets. In this type of ore mine officials state that a considerable part of the gold content is bound up with the sulphides. Coarse

patches and grains of native gold occur in the quartz veins and stringers, but their occurrence is spotty. These ore bodies are located in the southern part of the ore zone.

Structural Control of Ore Bodies

The localization of the ore bodies appears to have been controlled to a considerable extent by two geological features, one of which is structural, the other dependent upon the physical nature of the rock within the ore zone. Certain ore bodies lie within or adjacent to gentle folds in the lavas or tuffs located on the footwall side of the ore zone. The mine plans show how the Nos. 8, 9, 10, and adjoining ore bodies lie largely within the trough of a gentle fold in the footwall tuffs. The flat-lying vein fractures in the No. 9 ore body lie roughly



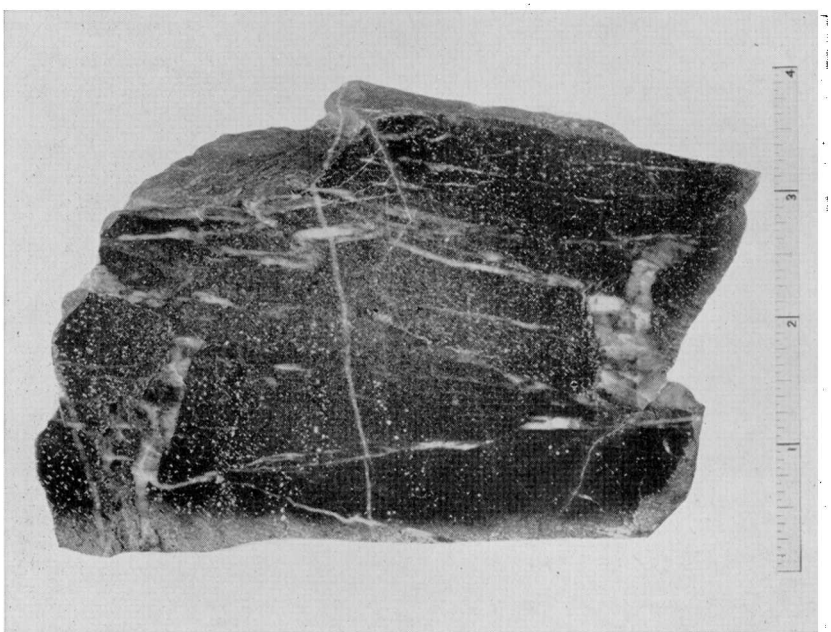
Polished sample of the "green carbonate" type of ore from No. 10 ore body, Kerr-Addison mine. Gold (G) occurs in white quartz; the dark-coloured material is green mica and carbonate.

normal to this fold and appear to radiate from it. The Nos. 16 and 17 ore bodies are localized within an anticlinal fold, which pitches to the west. In section, the Nos. 14 and 15 ore bodies show a gentle fold.

Ore developments to date also suggest that faulting may have some influence on the localization of certain ore shoots, and in some cases a combination of both folding and faulting may have been effective. No. 19 ore body lies in a part of the main fault zone near the greywacke contact and is the only ore shoot that conforms with a fault plane. Nos. 8 and 21 ore bodies are adjacent to faults in most places, but the influence of the faulting is not definitely known, and in the case of No. 21 ore body it is thought that at least some of the movement is post-ore. According to mine officials, the pitch of Nos. 16, 17, and 21 ore bodies appears to be related, in part, to the hinging movement of subsidiary faults on the main footwall fault. In this part of the mine the faulting appears to be closely related to the folding with a concentration of movement near the crests and axes of folds.

The localization of ore within the more brittle, competent rocks is shown in a number of ore bodies. The harder rocks yielded to deformation by fracturing, while the softer adjacent rocks failed by shearing. The more competent rocks were the basic lavas, syenite, and carbonate bodies, while the shearing movements were concentrated in the talc-chlorite schists and tuffs. Ore bodies in the carbonate rock show evidence of much brecciation of the host rock. It is probable that the competency of both the "dolomite" and the basic lavas was greatly augmented by the silicification which appears to have been so closely related to the period of carbonatization.

The complex system of folding and fracturing within the ore zone seems to be logically related to the strong faulted zones that occur within and adjacent



Polished sample of gold ore in tuffs, No. 11 ore body, 300-foot level, Kerr-Addison mine, showing fine-grained sulphides and quartz stringers.

to it. The wide sheared zone along the greywacke contact and the graphitic footwall fault converge and unite towards the west end of the mine; between these shear zones there are other transverse faults. The ore bodies thus lie within an area pretty well bounded and traversed by strong sheared zones. Movements along these lines of weakness would produce folds and associated tension fractures favourable for the deposition of quartz and sulphides. Repeated movements on the faults during the general period of ore formation would produce a series of intersecting vein fractures such as occur at the mine. It is in these areas where openings were formed under tension by the adjacent shearing and warping of the strata that the bulk of the ore occurs. Recent development work has revealed that at least part of the movement on the footwall and subsidiary faults is post-ore, although it is quite evident that the main sheared zone is pre-ore, even pre-carbonate. Faulting and folding thus appear to have recurred at intervals in the ore zone over a considerable period of time.

The strength and persistence of the sheared zone along the greywacke contact (Larder Lake "break") has been discussed elsewhere in this report. If the

above assumption that the ore-making fractures are related to this regional structure is correct, there is every reason to expect that the favourable structural conditions will continue to great depth. But, if the localization of individual ore shoots in the vicinity of the sheared zone is controlled by later faults, subsidiary minor folds, and the presence of masses of competent rock, these separate mineable areas will always vary considerably in size, shape, and continuity. The disappearance of a structure and associated ore shoots at a certain horizon in the mine may be compensated for by the appearance of new ore shoots at another point. To date, however, the main ore bodies show every evidence of vertical continuity to the deepest horizon yet explored.

Production, Ore Reserves, Costs, Profits, Etc.

The data in the following summary is taken from the annual reports of the company for the years indicated.

	Dec. 31, 1938	Dec. 31, 1939	Dec. 31, 1940	Dec. 31, 1941	Dec. 31, 1942
Tons milled	148,642	268,409	445,864	694,894	756,453
Tons milled daily	609	735	1,218	1,904	.....
Recovery per ton	$6.63	$7.39	$7.95	$8.10	$8.24
Value of bullion recovered	$985,641	$1,984,858	$3,544,433	$5,626,389	$6,232,794
Operating costs per ton milled	$3.85	$4.00	$3.09	$2.96	$2.93
Net operating profit at the mine per ton milled	1.51	2.34	3.97	5.14	5.31
Estimated ore reserves .....tons	1,727,637	[1]2,636,469	5,140,491	8,151,844	8,212,292
Grade of ore reserves:					
Uncut..ounces per ton	0.264	0.263	0.199	0.185	0.1927
Cut[2]....ounces per ton	0.180	0.170			
Net operating profit	[3]$412,938	[3]$627,110	[3]$1,768,084	[4]$2,454,039	[4]$2,395,064
Dividends paid	.....	.....	$709,545	$1,655,605	$1,655,605

[1]In addition, drilling had indicated 1,054,663 tons grading 0.235 ounces per ton uncut, or 0.176 ounces per ton cut.

[2]Cut grade is calculated by reducing all high assays to $25.00 per ton. In 1940 the company abandoned the policy of estimating cut and uncut grade.

[3]Provision for depreciation and deferred development, but not for taxes.

[4]After provision for depreciation, deferred development, and taxes.

Kir-Vit Mines, Limited

Kir-Vit Mines, Limited, was organized in 1937 and succeeded a private organization known as Kir-Vit Gold Mines, Limited. In 1938 the property consisted of 17 claims, including the Grainger-Yuill group of 13 claims, in the central part of McVittie township. The camp is reached from Larder Lake station by a wagon road about 3.7 miles in length.

The gold occurrences on the Grainger-Yuill claims were examined by Erie Canadian Mines, Limited, in 1935, but the option was later dropped. In 1937 the present company did about 7,000 feet of diamond-drilling and then installed a mining plant, sank a shaft 275 feet, and opened levels at depths of 125 and 250 feet. Most of the drifting was done on the 125-foot level. Underground developments were disappointing, and the mine closed down in the spring of 1938.

On the northern part of the property Keewatin lavas and Timiskaming sediments, chiefly conglomerate, are intruded by irregularly shaped masses of syenite porphyry and gabbro. Diabase dikes cut all other formations. The sediments are interfingered with the lavas and appear to be a rather shallow erosion remnant

lying on the volcanics. The southern claims contain massive lava, pillowed in places, which is intruded by irregular bodies of syenite porphyry.

Northwest of the shaft the gold-bearing areas in the surface workings are pyritized sheared zones in lavas and syenite porphyry. In places the intrusive is fine-grained and felsitic in texture. The underground workings are in basaltic lava cut by syenite porphyry dikes. They do not show any well-defined vein, but some narrow, irregular, silicified areas occur on the 125-foot level and are reported to contain low values in gold.

It was reported that surface sampling northwest of the shaft indicated four separate gold-bearing areas spread over a length of about 600 feet. The individual shoots were 40 to 60 feet in length and 3.6 to 7.3 feet in width, and were said to average $3.73 to $7.80 per ton in gold. Diamond-drilling throughout these gave low values. Low values were also reported from drilling at scattered points throughout a distance of 1,300 feet southeast from the shaft.

Kohinoor Gold Mines, Limited

Kohinoor Gold Mines, Limited, was organized in 1938 and took over a group of 7 claims located in the vicinity of Binney lake, southwestern part of McVittie township. These include claims L. 9,084 and 10,900, on which a quartz vein was exposed by surface work several years ago. In 1939 Ventures, Limited, optioned this property and a few adjoining claims to the west and northeast. The earlier workings were re-examined, and a 360-foot drill-hole was put down on claim L. 4,533. On the adjoining Caplan claim, L. 30,090, a 985-foot hole was also drilled for exploratory purposes.

The claims are underlain by sediments and volcanics of the Timiskaming series; these formations strike in an east-west direction. The southern claims show outcrops of arkose and greywacke with local zones of shearing, which strike north of east. These sediments are succeeded to the north by a band of intermingled trachyte, porphyritic trachyte, and trachytic agglomerate, about 2,000 feet in width. North of this lies another band of sediments. These different bands form a continuous stratigraphical sequence with the oldest formation to the north followed by successively later formations to the south.

The main vein on the property lies near the south shore of Binney lake on claims L. 9,084 and 10,900. It strikes about N. 50° E. and dips north. The quartz has been uncovered at intervals over a length of 1,400 feet, and a possible extension outcrops 1,800 feet to the southwest near the south boundary of claim L. 4,533. The quartz lenses occupy a sheared zone and average about 1.5 feet in width with local bulges up to 4 feet. The quartz is white in appearance and contains only traces of pyrite and carbonate. The wall rock is schisted and carbonatized trachyte and trachytic agglomerate.

Ventures, Limited, cleaned out and sampled all the old trenches and pits on this vein, but no assays of commercial interest were obtained. A quartz vein containing chalcopyrite was discovered near the southwest corner of claim L. 9,084 but yielded no commercial gold values. The remainder of the property was prospected, but as nothing of interest was found the option was dropped.

Laguerre Gold Mines, Limited

Laguerre Gold Mines, Limited, was organized in October, 1939, and took over 14 claims and a fraction near the village of Larder Lake in the southern part of McVittie township. These comprised the entire property and plant of Raven River Gold Mines, Limited, two adjoining claims, which were purchased

from Proprietary Mines, Limited, and claim L. 1,053, which was secured from the Knutson Mining Corporation, Limited. In 1939–40 development work by Laguerre Gold Mines was confined to surface-trenching and 9,452 feet of drilling in the vicinity of a gold discovery made on the Knutson claim during the summer of 1939. Underground operations had ceased at the Raven River mine in June, 1939, and no additional exploration was carried out by the new owners. Negative results were obtained from the drilling campaign on the Knutson claim, and development work was suspended in March, 1940. Between September, 1940, and January, 1941, an additional 15 holes, totalling 6,396 feet, were drilled in the swamp area along the northern continuation of the intrusives in which the Knutson discovery had been made. This work indicated a possible ore shoot on the south side of claim L. 879. Recommendations were made for underground exploration and in May, 1941, shaft-sinking was commenced. The shaft was sunk 280 feet, and 282 feet of crosscutting and 419 feet of drifting were done on the 250-foot level. No ore was found on this level, but three drill-holes cut ore below the level near the 500-foot horizon. Mine operations ceased in January, 1942.

KNUTSON DISCOVERY (CLAIM L. 1,053)

The Knutson Mining Corporation found two gold-bearing zones by surface-trenching along a drift-covered ridge on claim L. 1,053. The rocks in this vicinity are a very complex assemblage of different types. Timiskaming sediments, chiefly conglomerate with iron formation, tuffs, and highly schistose rocks are intersected by a great number of dikes and irregularly shaped intrusive bodies. The main intrusives are syenite, felsite, diorite, and lamprophyre. The syenite is pink in colour and quite massive, but local phases are porphyritic. Near the edge of the dikes a hybrid type of biotite syenite is sometimes developed. The felsite is a fine-grained, cherty variety of the syenite and is confined to narrow dikes. The lamprophyre is highly micaceous.

The general dip of the formations in the vicinity of the showings is about 70° W. This is indicated by marker bands of tuffs, which were cut at various horizons in drill-holes. West of the gold-bearing zones a band of talcose chlorite schist, carbonatized in places, was revealed by drilling across a valley. This is the locus of faulting movements along and near the contact with the conglomerate.

Veins

On the surface, No. 1 vein zone strikes north-south and dips west. Within it there are highly sheared sediments and narrow bands of bedded tuff and iron formation, the latter containing thin beds of magnetite. These are cut by swarms of irregular felsite, syenite, and diorite dikes. The gold values occur in an area of silicified and mineralized tuff, iron formation, and felsite. There are spotty areas of sulphide mineralization. Gold values are erratic in this vein on the surface.

No. 2 vein zone lies within the boundaries of a pink syenite dike, which is mineralized with pyrite, chalcopyrite, and magnetite and cut by small quartz stringers. It strikes east of north and dips to the west. Sampling of this vein by W. H. Emens, engineer for Anglo-Huronian, Limited, showed a length of 191 feet, averaging 0.24 ounces in gold over an average width of 54.9 inches.

In a summary report on drilling operations, dated March 12, 1940, C. H. E. Stewart, engineer-in-charge, stated that the Nos. 1 and 2 vein zones had been explored to a vertical depth of 500 feet with negative results. The sheared zone immediately to the west was drilled over a length of 1,100 feet with no encourag-

ing results. Drilling of a section between Nos. 1 and 2 veins and the Raven River mine workings yielded nothing of importance.

The later drilling programme, which extended from September, 1940, to January, 1941, traced the probable extension of the mineralized syenite dike (No. 2 vein above) for a distance of 1,370 feet. Throughout this length the dike was found to range in width from 3 to 75 feet; in some holes it split into two or more sections. Gold values were obtained from those parts of the syenite dike that have been fractured, pyritized, and cut by quartz stringers.

According to W. H. Emens, holes Nos. 23, 24, 25, 29, and 36 indicated a possible ore body 250 feet long; in hole No. 29 it was cut at a vertical depth of 480 feet. These 5 holes indicated an average grade of $7.24 over a horizontal width of 23.2 feet.

Mr. Emens reports that underground work on the 250-foot level showed that the dike was separated by faulting into two sections about 150 feet apart. The shaft crosscut passed through a strongly sheared zone containing chlorite schist, in which there are many prominent mud seams. The dike has apparently acted as a competent rock that failed by fracturing in the vicinity of the zone of strong shearing movements. Values in gold occur throughout the dike on the 250-foot level but no ore shoot could be outlined.

As mentioned above, ore was intersected in three drill-holes near the 500-foot horizon; these cover a length of about 80 feet. The company decided that any development of this horizon should be deferred to the post-war period.

RAVEN RIVER MINE

Raven River Gold Mines, Limited, operated its mine from the time of organization in 1934 until work was suspended in 1939. The company took over 11 claims including the old Harris-Maxwell property. Part of this ground was acquired from Proprietary Mines, Limited, which controlled the new company. In November, 1939, the assets of Raven River Gold Mines were sold to the newly organized Laguerre Gold Mines, Limited.

The Harris-Maxwell was one of the earliest mining operations in the Larder Lake area. Several years ago the Associated Goldfields Mining Company, Limited, sank a shaft to a depth of 420 feet and did about 3,000 feet of drifting and crosscutting on five levels at depths of 53, 100, 249, 325, and 420 feet. Raven River Gold Mines sank a winze from the 420-foot level for a distance of 296 feet, and two new levels were established at 125-foot intervals. About 8,000 feet of lateral work has been done from all levels within an area 700 feet from north to south by 600 feet from east to west. In addition, a considerable amount of underground diamond-drilling has been done.

Production and Ore Possibilities

A 50- to 70-ton cyanidation mill was operated from November, 1937, to June, 1939. During this period 40,401 tons were milled and yielded $264,127.40 in gold. This is an average grade of $6.54 per ton. For a period before operations were suspended the ore had dropped below a profitable grade. Most of the ore was obtained by mining the main quartz veins within the intrusive bodies. Considerable attention was also given to the possibility that the entire intrusive might be of sufficient grade to permit profitable treatment on a large scale. In a joint report, J. E. Jerome, manager, and T. C. Holmes, geologist, in May, 1939, estimated that the deposit might contain 11,000,000 tons of material grading in the neighbourhood of $1.80 per ton to a depth of 2,000 feet. A later estimate by C. H. E. Stewart, engineer for Laguerre Gold Mines, in March, 1940, stated

that the two main intrusive bodies might contain a gold content of approximately 0.04 ounces or $1.40 per ton and have a potential tonnage factor of 5,600 tons per vertical foot.

Mine Geology

Within the mine workings there are two pipe-like bodies or "plugs" of an altered acid intrusive (see Fig. 10). This rock was classified as diorite prophyry by Cooke[1] and Hopkins,[2] and as alaskite by the mine officials. The writer examined a number of thin sections of it from different parts of the mine. It

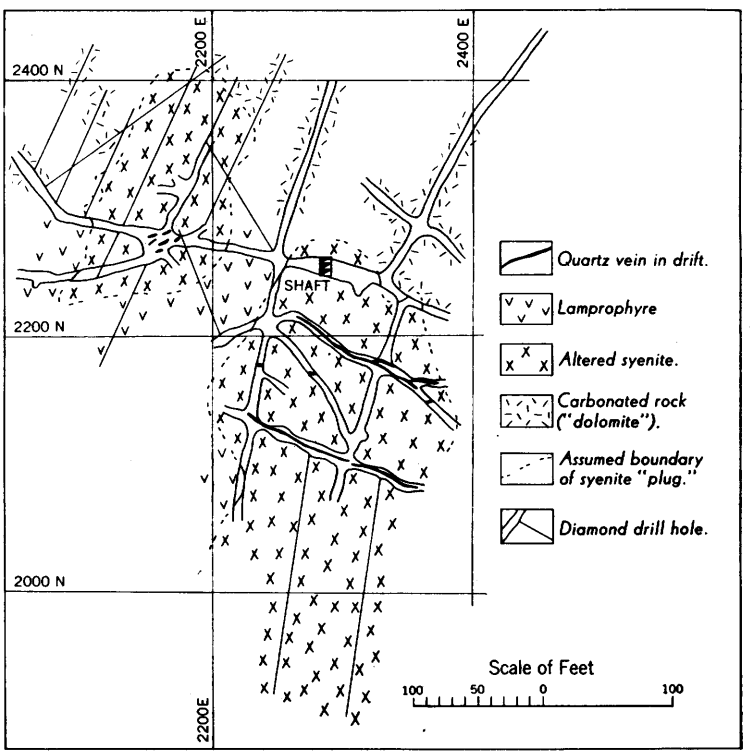


Fig. 10—Generalized geological plan of the 325-foot level, Raven River mine. (Modified after company plans, June, 1939.)

contains orthoclase and albite or oligoclase but only traces of primary quartz. There is much secondary sericite, quartz, carbonate, and sulphides. The rock thus appears to be a greatly altered syenite.

The rocks bordering the syenite bodies are green carbonate, talc-chlorite schist, greenstone, and lamprophyre. The largest intrusive "plug" is roughly elliptical in outline and about 350 feet by 180 feet in dimension. It plunges at about 65 degrees in a direction S. 25° W. and has been cut in drilling at a depth of 1,800 feet. Within this "plug" there are seven known veins above the seventh level, all of which strike north of west and dip south. The main veins dip at flatter angles than the intrusive body and so tend to cross it. The northwest "plug" is roughly circular and about 120 feet in diameter. It dips about vertically.

[1]H. C. Cooke, Geol. Surv. Can., Mem. 131, 1922, map No. 1932.
[2]P. E. Hopkins, Ont. Dept. Mines, Vol. XXXIII, 1924, pt. 3. map No. 33b.

The ore is confined to the syenite bodies, although values have been found near the contact in the talc schist and carbonate. There is a great deal of barren quartz in the green carbonate bodies adjacent to the intrusives. The bulk of the gold occurs in veins and lenses in the syenite. It is spotty in distribution and is often found in the native state along fractures in the quartz. Owing to the erratic occurrence of the gold, the grade was determined chiefly by milling the vein material. Some pyrite, chalcopyrite, and galena occur in the veins. The veins tend to be discontinuous and were sometimes difficult to trace from level to level.

Lar-Add Mines, Limited

The property of Lar-Add Mines, Limited, consists of a group of 13 claims lying north of Larder Lake in the townships of McGarry and McVittie. In 1937 the property was optioned by the Nipissing Mining Company, Limited. After a programme of surface exploration the option was allowed to expire. No work of any consequence has been done since that time.

The rocks on the claims consist largely of sediments of the Timiskaming series. In McVittie township these are closely folded into two synclines with an intervening anticline, all of which pitch to the southwest. Locally the beds are very much contorted and drag-folded.

The sediments are intruded by a considerable number of dikes varying in composition from lamprophyre to mica syenite. The intrusives are generally carbonatized and cut by a network of quartz veins. Sometimes dlsseminated sulphides occur in the carbonatized zones. The sediments are generally carbonatized for a short distance on either side of the dikes.

Most of the quartz-carbonate stockworks were sampled in 1937, but they failed to show any appreciable amount of gold. Some small quartz veins were also investigated.

Lardego Gold Mines, Limited

Lardego Gold Mines, Limited, was organized in February, 1937, and acquired a group of 15 claims adjoining the property of Omega Gold Mines on the west in the southwestern part of McVittie township and a second group of 3 claims near Pearl Beach townsite in the southeastern part of the same township. Development work consisted of surface prospecting and a small amount of drilling on the larger group. In 1939 the 15-claim group was sold to Legardo Gold Mines, but the parent company still retained controlling interest in the new organization.

The Pearl Beach group consists of three unsurveyed claims, L. 29,982, 29,983, and 29,984, adjoining Pearl Beach townsite on the north. The outcrops on these claims are largely greywacke, slate, and quartzite of the Timiskaming series. Carbonatized lamprophyre and diorite dikes cut the sediments.

Carbonatized dikes containing quartz stringers and pyrite mineralization occur on claim L. 29,984 and have been developed by trenches and test-pits. Sampling of these carbonatized zones is reported to have indicated only traces of gold.

Legardo Gold Mines, Limited

Legardo Gold Mines, Limited, acquired a group of 15 claims from Lardego Gold Mines, Limited, in January, 1939. The property is located immediately west of that of Omega Gold Mines in the southwestern part of McVittie township. Owing to the large amount of overburdern on the claims most of the development work to date has been done by drilling. Six holes were put down

in 1937 and 1938 by Lardego Gold Mines on the claims south of the railway. In the winter of 1938–39 the property was under option to E. M. Thomson and associates, of Toronto, and 12 additional holes, totalling 5,882 feet, were drilled under the supervision of T. C. Holmes.

The rocks in the drill-cores and on surface outcrops are largely arkoses and greywackes of the Timiskaming series. Along the south side of claims L. 26,270, 22,980, and 25,554 the drilling revealed a band of sheared and carbonatized rocks. These are largely talc-chlorite schists, locally carbonatized. At a few points within the band the rocks are fragmental and contain structures that resemble altered spherules or amygdules, so it is probable that the intense shearing may be localized within a narrow band of basic lavas. A few acid dikes of syenite and felsite and numerous small lamprophyre dikes were cut in the drill-holes.

The drilling traced a strongly sheared zone at intervals of 300 to 600 feet over a total length of nearly 3,000 feet. The shearing is about 250 feet wide in the middle section but narrows to around 100 feet near the ends; it dips 50° to 65° S. on claim L. 26,270. This sheared zone is probably a westerly continuation of the Larder Lake "break" from the Omega mine. It lines up with the Omega sheared zone and dips in the same direction.

Green carbonate with associated quartz stringers was found in four holes (Nos. 9 to 12) over a length of 850 feet. One assay of $2.45 in gold over a width of 5.5 feet was obtained from the quartz carbonate material. Irregular patches and veinlets of grey and white carbonate are abundant in all parts of the main shear zone.

Two other sheared zones lie to the north and were cut by drilling. They were relatively unimportant and not extensively explored.

McVittie Kirkland Mines, Limited

In 1937 the property of McVittie Kirkland Mines, Limited, consisted of 5 claims (L. 19,094 to 19,097 and 19,099) adjoining the Nipissing Central railway in McVittie and McGarry townships. The claims were developed by surface prospecting and a small amount of diamond-drilling in 1937.

North of the railway the claims are underlain largely by massive gabbro, greywacke, and conglomerate. In the southern parts of claims L. 19,096 and 19,095 there are outcrops of greenstone and intrusive syenite porphyry, both of which are sheared.

Near the south boundary of claim L. 19,096 a narrow sheared zone was opened up by test pits and an open cut. Vein material in the shear zone consists of quartz stringers in the slightly mineralized carbonatized schist. Nine holes were drilled in this vicinity, and six of them intersected vein material at a depth of about 150 feet. Low values in gold over narrow widths were reported from surface sampling and drill intersections. The best vein intersection assayed $7.70 per ton in gold over a core width of 3 feet, but holes within 50 feet on either side gave low values.

A quartz vein occurs near the east shore of Beaver lake on claim L. 19,097. Sampling of the vein in a test pit and one drill intersection showed negligible gold values.

Moosewood Gold Mines, Limited

When Moosewood Gold Mines, Limited, was organized in 1938, it acquired a group of 14 claims in the southeastern part of McVittie township. The property

adjoins Cheminis, Fernland, Thib, and Omega claims. No work of any consequence has been done on this property to date, although some old test pits may be seen.

Most of the claims are underlain by conglomerate, greywacke, and slate of the Timiskaming series. These sediments are closely folded into a series of pitching anticlines and synclines and cut by oblique faults. Near the mouth of Pancake creek there is an exposure of pillow lava and carbonate rock. In the western part of the property numerous dikes and irregularly shaped bodies of diorite intrude the older rocks. The diorite bodies are often carbonatized and cut by a network of quartz stringers.

Omega Gold Mines, Limited

Omega Gold Mines, Limited, was organized in May, 1935, by Castle-Trethewey Mines, Limited, and took over the properties owned by Canadian Reserve Mines, Limited, and Proprietary Mines, Limited. In 1930 Proprietary Mines, Limited, had acquired the assets of the bankrupt Canadian Associated Goldfields, Limited. Canadian Reserve Mines had been formed in 1932 to develop the Crown Reserve and Associated Goldfields mines, but no work was done. The Crown Reserve and Associated Goldfields mining companies had developed simultaneously different parts of the Costello vein. This had been discovered in 1914 by Jack Costello and was eventually traced out on both properties. In 1926 Associated Goldfields built a mill and are reported to have produced $52,295 in gold and silver from the treatment of 22,585 tons before closing down in March, 1928. Underground work was suspended at the Crown Reserve mine in December, 1928.

Omega Gold Mines commenced milling operations in February, 1936, at the rate of 300 tons per day. The mill capacity was gradually raised until, in 1939, an average of 486 tons per day was treated, a figure which has been fairly constant to date.

Previous owners had developed the Omega mine by separate workings. On the Crown Reserve property a shaft (Omega No. 1 shaft) had been sunk to a depth of 1,200 feet and levels opened, mostly at 125-foot intervals, to a depth of 1,175 feet. The Associated Goldfields shaft (Omega No. 2) had been sunk to a depth of 1,050 feet, and seven levels were opened, the lowest at a depth of 1,000 feet. In all, previous operations had completed 27,500 feet of lateral work and 700 feet of winzes and raises. The present company has done further lateral work on all levels from No. 1 shaft and have developed and stoped a number of different ore bodies. In 1939–40 the No. 1 shaft was deepened 393 feet and new levels opened at 1,300, 1,425, and 1,550 feet.

In 1940, Omega Gold Mines owned 26 mining claims in the township of McVittie.

The geology and underground developments on the Crown Reserve and Associated Goldfields properties have been discussed by Cooke[1] and Hopkins.[2] The geology of the Omega mine has been described by C. P. Jenney,[3] geologist for the company.

General Geology

The rock formations on the Omega claims have a general east-west trend and include four distinct stratigraphical horizons, some of which have a number of

[1]H. C. Cooke, Geol. Surv. Can., Sum. Rept. 1923, pt. CI, pp. 61-73; Sum. Rept. 1925, pt. C, pp. 17-19.
[2]P. E. Hopkins, Ont. Dept. Mines, Vol. XXXIII, pt. 3, 1924, pp. 11-20.
[3]C. P. Jenney, Econ. Geol., Vol. 36, 1941, pp. 424-447.

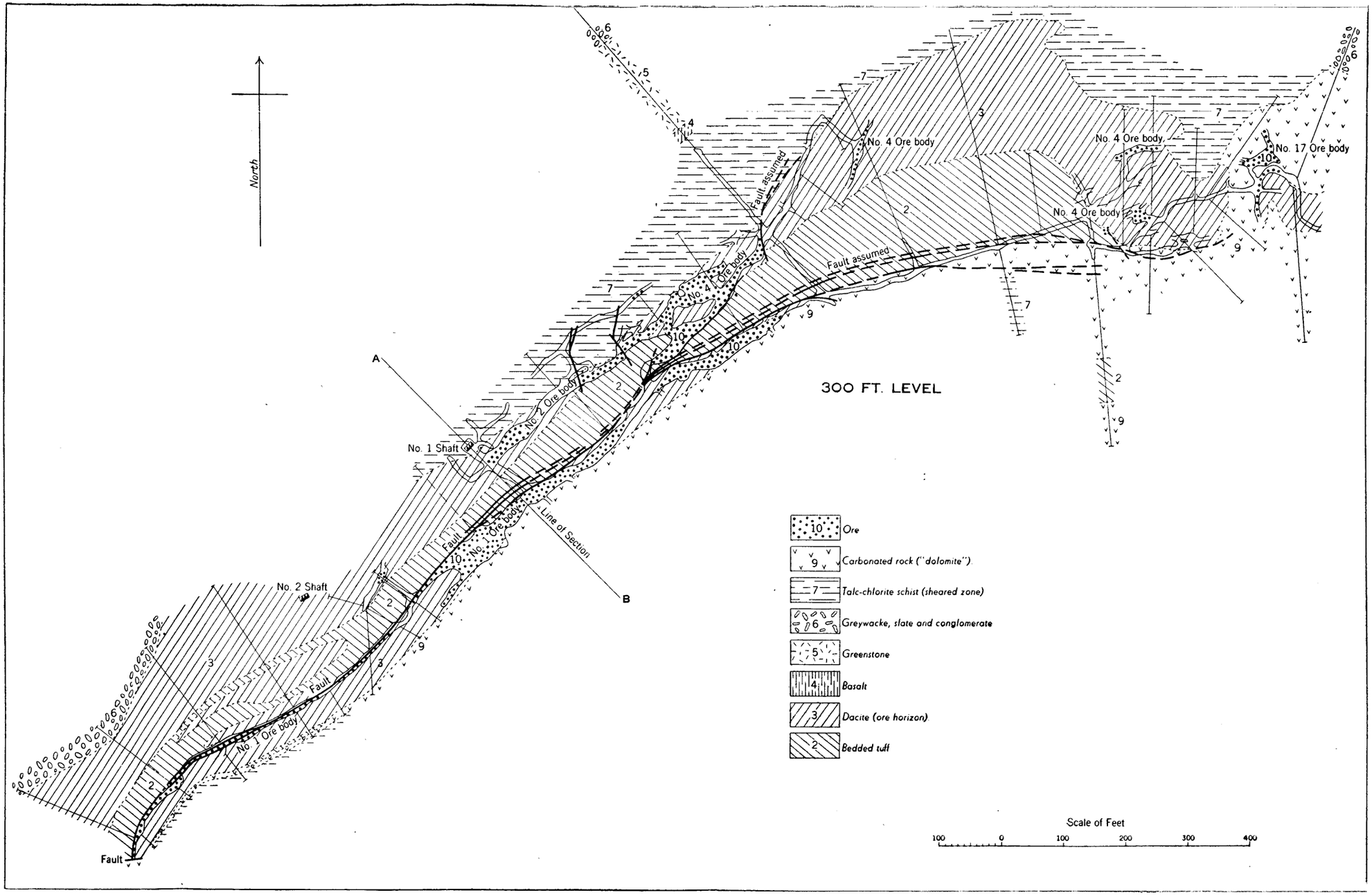


FIG. 11—GEOLOGICAL PLAN OF THE 300-FOOT LEVEL, OMEGA MINE.
(Modified after mine plans, September, 1941.)

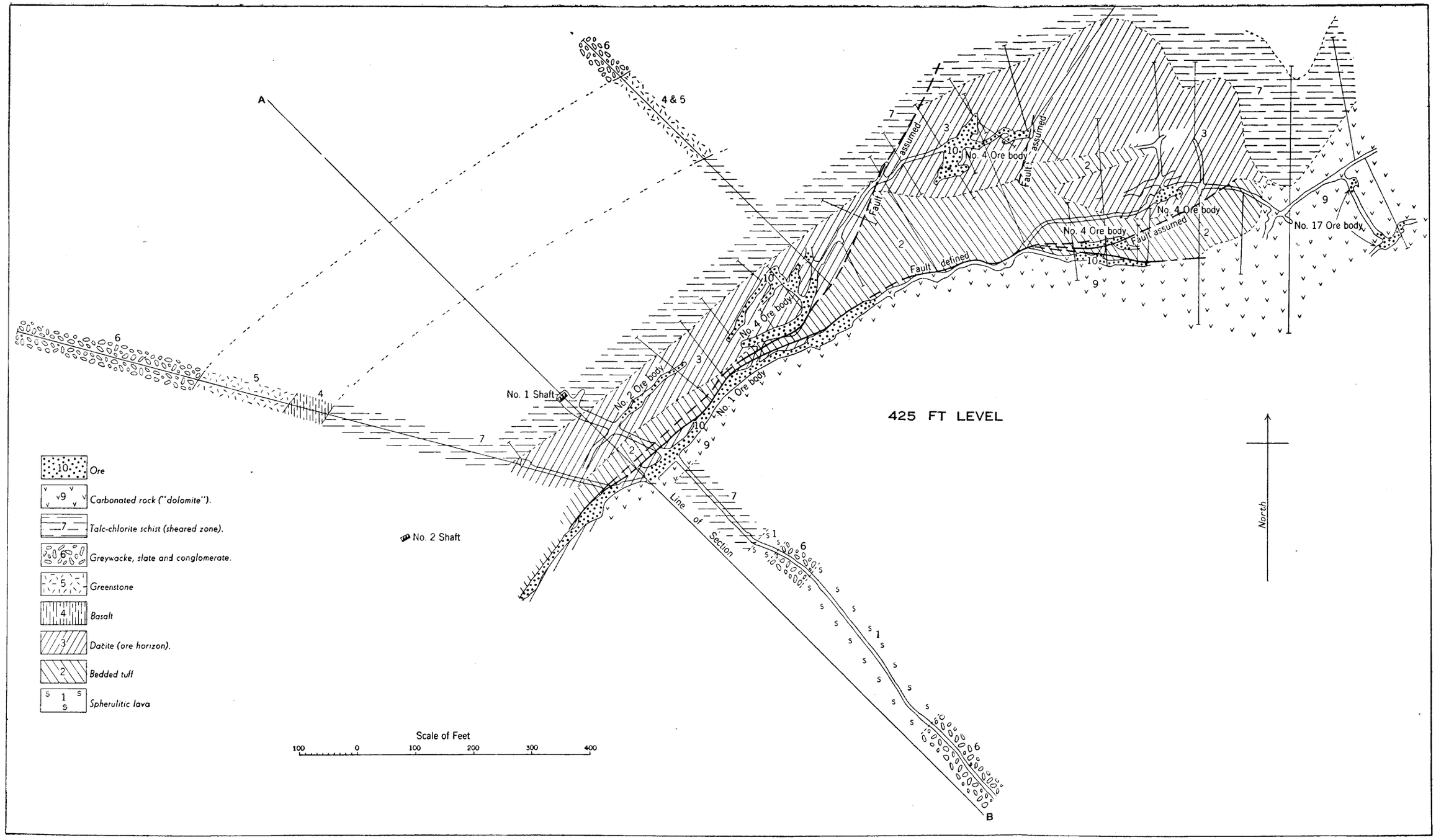


FIG. 12—GEOLOGICAL PLAN OF THE 425-FOOT LEVEL, OMEGA MINE.
(Modified after mine plans, September, 1941.)

members. From north to south these main rock groups consist of (1) trachyte and trachytic agglomerate and breccia; (2) bedded greywacke with local horizons of arkose, pebble conglomerate, and iron formation; (3) a series of lava flows, ranging from basalt to dacite in composition, with interbedded tuffs and a little conglomerate; and (4) patches of conglomerate. The south side of the lava-tuff band and the southern exposures of conglomerate are intruded by bodies of syenite and related rocks.

The band of volcanics is the gold-bearing horizon and consequently has been well explored in the mine workings (see Figs. 11, 12, and 13). A section across it from north to south shows the following rock types:—

1. A dark-green lava with small quartz phenocrysts, locally called "greenstone," but petrographically about quartz andesite in composition.
2. Fine-grained basalt.
3. Talc-chlorite schist, which has been the locus of strong shearing movements.
4. A band of dacitic lava, lighter in colour than the "greenstone" and characterized by quartz phenocrysts. This band contains a number of ore shoots.
5. Thinly bedded sediments, locally called tuffs, which lie south of the ore bodies. These are similar in appearance to certain phases of the greywackes and slates that occur in large areas throughout the country and can only be distinguished from them by their stratigraphical position between lava flows. Locally in the mine workings they are sometimes altered to green, brown, or black slates. Occasionally thin dacite flows are interbedded with the "tuffs."
6. A wedge-shaped mass of altered dacite, which borders the "tuffs" on the south and in which is contained the No. 1 ore body.
7. A band of dolomite, which forms the hanging wall of No. 1 ore body.
8. Another talc-schist sheared zone.
9. Spherulitic lava, which borders the talc-schist sheared zone and contains at least one lens of conglomerate.

The "dolomite" generally occupies zones where the talcose schists have been heavily impregnated with siliceous-carbonate material and cut by a stockwork of quartz veins. In places it is only a carbonatized schist. In some parts of the mine the so-called "dolomite" contains a great deal of green mica, probably fuchsite, but scarcely any carbonate; but in underground mapping all this green mica-carbonate rock must be arbitrarily grouped together. Both dolomite and talcose-schist zones have been the locus of heavy shearing movements.

A stock of intrusives underlies the southeastern claims. Many dikes and irregularly shaped offshoots from this body cut the conglomerate and lavas adjacent to highway No. 66. On claims L. 8,879 and 11,773 and nearby claims the intrusive is massive and medium-grained and contains a considerable amount of dark-coloured minerals. It looks like a syenite or diorite in the field. Microscopic examination shows that the rock varies between normal syenite and quartz syenite. At some points the primary quartz content is about sufficient for the rock to be classified as granite. On claims L. 8,842 and 9,616 in addition to the syenitic intrusives the conglomerates are cut by many lamprophyre and other fine-grained basic dikes.

Structure

Folding.—The talc-chlorite schist and "dolomite" zones that extend through the north side of the Omega mine workings form part of the main Larder Lake sheared zone or "break," on which there may be considerable displacement. It is thus preferable to consider the folding of the formations on either side of the sheared zone as separate units.

In the vicinity of Pancake lake, top determinations show that the sediments have been closely folded into a central anticline flanked by synclines. These are overturned to the south. The northern syncline either pinches out or is cut off by the sheared zone near the east end of the Omega property on claim L. 8,713. West of No. 1 shaft there is not enough information available to reveal accurately the structural relationships of the lavas and sediments, and any interpretation is hypothetical. Jenney[1] interprets the lava-sediments contact as bending sharply to the south with the sediments lying unconformably on the lavas. Since the writer has found no evidence of angular unconformity between the volcanics and sediments anywhere throughout the area he has interpreted the relationship as shown on the accompanying geological map (No. 50b), making a conformable, folded structure.

South of the strong sheared zones that run through the mine workings there is no definite information concerning the folding and the relationships of the lavas and sediments on the Omega claims, owing to the absence of outcrops and the intrusion of a large body of syenitic rock. The horizon of volcanics, however, extends eastward across the country, and there is evidence at a number of points that the sediments on the south side of it face south at the contact and thus overlie the lavas.

It has previously been considered that the Omega ore bodies lay within a narrow band of Keewatin lavas in a tightly folded anticline overturned to the south, although trouble has been experienced in correlating the formations on either limb of the fold. At the north contact of the lavas and sediments in the mine grain gradation in greywacke shows that the tops face north, indicating an overturned anticlinal structure at that point. But, as pointed out elsewhere in this report, the part of the band of volcanics lying south of the main Larder Lake sheared zone when traced beyond the Omega property appears to be interbanded with the main belts of sediments lying to the north and south, the whole sequence being monoclinal and facing south. It would thus appear that the lavas on the north side of the main sheared zone might be quite a different stratigraphical horizon from those on the south side and that both horizons might have been accidentally brought together by strike-faulting. All this deformation has produced an anticlinal structure across the band of volcanics, but as the north and south members are in faulted contact, the structure is unsymmetrical.

Minor Folds.—Developments in the eastern section of the mine have revealed an intensely folded condition (see Figs. 11 and 12) compared with the rather uniform strike and dip of the formations in other parts of the mine. Developments on the 300- and 425-foot levels indicate that some of these folds pitch very flatly to the south.

Faulting.—Evidence of faulting movements is to be observed in two different structures. The first includes the wide talc-chlorite schist bodies, sometimes carbonatized, which represent sheared zones on which a displacement of great magnitude is a strong possibility. These lie on the hanging wall and footwall of the main ore-bearing horizon. They range in width from 150 to 350 feet, the contacts being gradational.

The second type of movement is seen in the well-defined graphite fault with its characteristic graphitic gouge. The main graphite fault strikes and dips about parallel to the sheared zones, but branches offset the schisted rocks, showing that it belongs to a later period of faulting. The graphite fault ranges in width from a few inches to several feet, and in places it branches into a number

[1]C. P. Jenney, Econ. Geol., Vol. 36, 1941, map on p. 427.

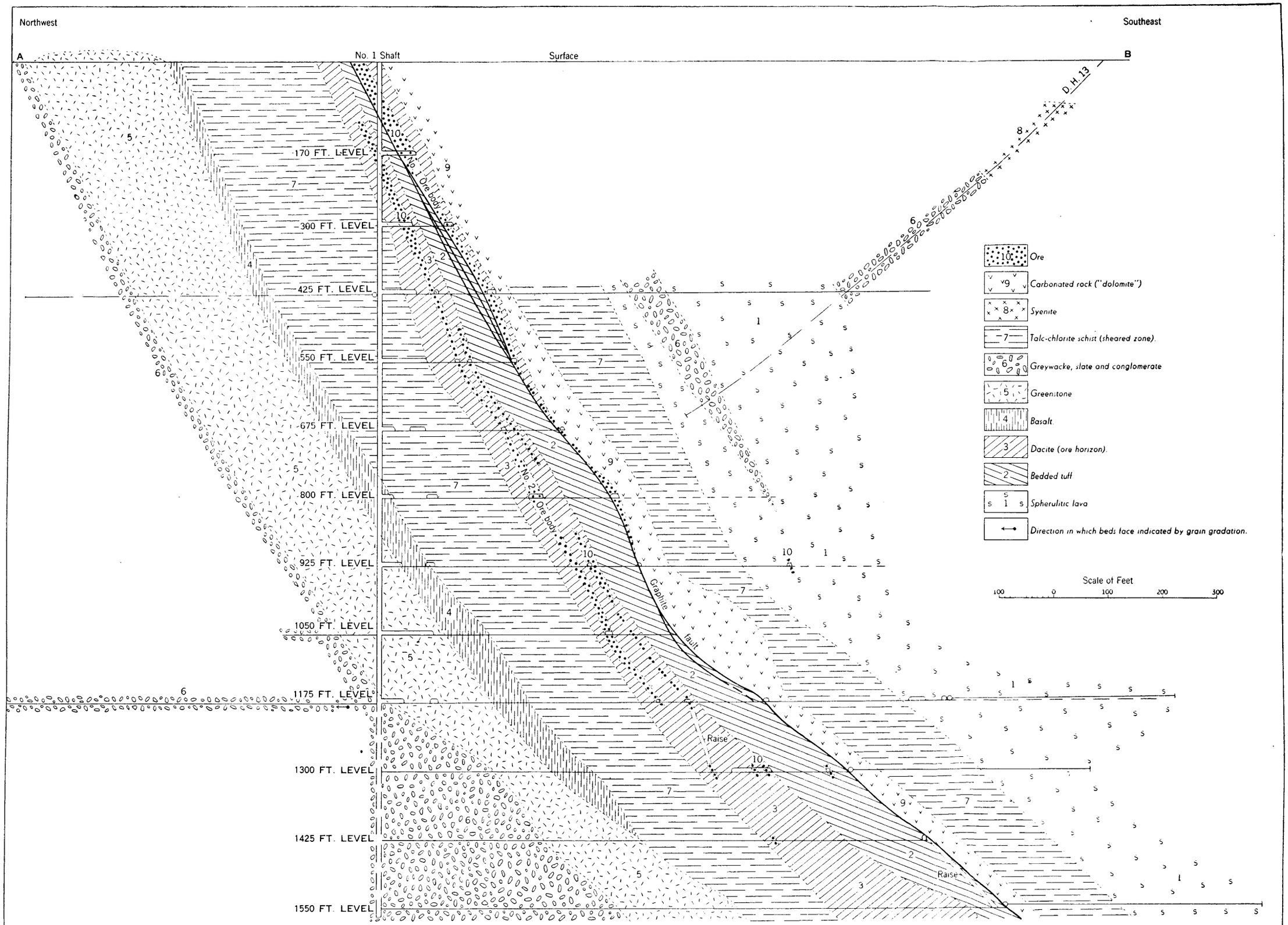


FIG. 13—GEOLOGICAL CROSS-SECTION THROUGH NO. 1 SHAFT, OMEGA MINE.
(Modified after mine plans, September, 1941.)

of different slips. To a depth of 550 feet it has an average dip of about 60° S.E., but below the 1,050-foot level the dip flattens to about 40 degrees. It has been traced for over 2,000 feet to the southwest of No. 1 shaft, but to the east it divides into a number of weaker branches. In detail the fault plane is irregular and sinuous in certain parts of the mine. Cooke[1] and Jenney[2] state that it is a thrust fault with the south side displaced upwards, but the amount of movement is not known. That at least part of the movement is post-ore is indicated by vein fragments in the fault gouge and by the drag of the ore along the fault plane. Certain well-defined gold-bearing quartz veins lie within or between closely spaced graphitic faults in the No. 1 ore body and appear to have been introduced after the faulting. Nevertheless, since these veins are distinctly different mineralogically from the main ore bodies and probably belong to a later period of gold mineralization, the graphite fault could post-date the bulk of the ore.

Cross-faults with a few feet of displacement occur locally throughout the mine. A north-south cross-fault may have offset a well-defined band of tuffs on the west side of claim L. 8,046.

View of "carbonate" type of ore in No. 317 stope, Omega mine.

Ore Bodies

Practically all of the Omega ore developed to date lies between the north and south sheared zones in two dacitic lava flows. The ore horizon has been explored in places throughout an overall length of about 2,500 feet. The bulk of the ore is confined to the Nos. 1, 2, and 4 ore bodies (see Figs. 11, 12, and 13). No. 1 ore body occurs within the southern dacite flow, while Nos. 2, 4, 6, and 7 ore bodies lie in the northern dacitic band. In addition, a small tonnage of ore has been found in "dolomite" (No. 17 ore body) at the east end of the mine. A number of non-commercial gold-bearing zones have also been explored.

The No. 1 ore body extends from surface to below the 800-foot level (see Fig. 13). In certain stopes it is bounded on the footwall by the graphite fault, while at other places it lies a short distance from the fault. At many points "dolomite" forms the hanging wall of the ore, and the ore boundary is sharply delimited at the contact. The ore lies in a highly silicified and mineralized dacite. The typical ore material is reddish and greyish rock containing a considerable amount of fine-grained sulphides and cut by a few narrow fractures filled with quartz and calcite. The No. 1 ore body could be an upthrust wedge on the south

[1]H. C. Cooke, Geol. Surv. Can., Sum. Rept. 1925, pt. C, p. 18.
[2]C. P. Jenney, op. cit., p. 441.

side of the graphite fault, and there is always the possibility that its continuation might be found beneath the fault at some lower horizon.

The bulk of the ore along No. 1 ore body is the sulphide replacement type with weak fracturing. The gold content is associated with the sulphides, and visible gold is scarcely ever found. The ore boundaries are limited by assay walls, except in places where mining is carried to the graphite fault or the "dolomite" contact. The ore bodies are quite irregular in outline.

In addition to the sulphide ore, distinct quartz veins occur at a few points along the No. 1 ore body. These veins contain white or bluish quartz with black chloritic seams. Certain sections contain patches of visible gold and make high-grade ore. Cooke[1] states that these veins are later than the main sulphide ore bodies. This is probably a correct interpretation, because at a few points throughout the mine small gold-bearing quartz veins and stringers cut the sulphide ore bodies and the adjacent "dolomite."

Nos. 2, 4, 6, and 7 ore bodies are irregular, disconnected replacement masses of silicified and mineralized material within the horizon of dacite north of No. 1 vein. The ore scarcely ever penetrates into the hanging-wall tuffs but is frequently found adjacent to them. The boundaries of the ore shoots are arbitrarily defined by the grade of the gold-bearing rock, and the stopes are thus irregular in outline. In places a north branch of the graphite fault passes through or adjacent to an ore body. Jenney[2] points out that at some places in these ore bodies the relation between faults and ore shoots suggests some influence of the faults on the localization of the ore shoots.

No. 17 ore body is located at the east end of the mine on the 300- and 425-foot levels. The host rock contains a large amount of green mica and is classified as "dolomite." Values are found in parallel and interlocking quartz stringers containing some sulphides. Visible gold occurs in the quartz and along the quartz-schist contacts. The grade of the ore shoot is good, but the tonnage is small. The ore shoot is localized in the vicinity of folds in the enclosing formations and adjacent to a fracture or fault that contains very little gouge.

No. 14 zone is in a band of spherulitic lava lying south of the southern talc-schist zone. It has been explored on the 800-, 925-, 1,050-, and 1,550-foot levels. The vein structure is definite, but the gold-bearing sulphides in the area are erratically distributed. Rich sections have been encountered, but average values have so far been below mine grade. Values occur in heavy sulphides and, to a lesser degree, in dark cherty quartz veins and stringers.

Mineralogy of the Ore Bodies

The typical ore of Nos. 1, 2, and 4 ore bodies consists of greyish to reddish rock containing fine-grained sulphides. The chief sulphide is pyrite, and lesser amounts of arsenopyrite and chalcopyrite occur. The ore bodies are largely of the replacement type and show only weak fracturing and quartz-filling. Some parts of No. 1 vein appear to be made up of an introduced syenite or syenitized aggregate of quartz and feldspar. This material has undergone considerable alteration and is replaced by sulphides and cut by quartz-calcite veinlets. A feature of this ore is the reddish alteration adjacent to small fractures, which is due to the formation of iron oxide. Visible gold is very rare in the sulphide ore, but occurs spottily in the quartz veins.

The ore is difficult to mill owing to the association of the gold with fine-grained sulphides and the presence of graphite. After flotation the sulphides are reground to pass 325 mesh before cyanidation.

[1]H. C. Cooke, Geol. Surv. Can., Sum. Rept. 1923, pt. CI, p. 70.
[2]C. P. Jenney, op. cit., pp. 440-443.

Localization of the Ore

In certain parts of the mine the ore is adjacent to graphitic faults, and these may have some bearing on its localization. This relationship is especially noticeable in the case of the quartz veins that lie within graphitic gouge. The bulk of the ore, however, occurs in large, irregular replacement bodies, which bear no noticeable relationship to the graphite faults, even in the No. 1 ore zone. It is known that at least part of the movement on the graphite fault and its branches is later than the sulphide ore, and it is difficult to prove that any pre-ore movement took place. In the case of No. 1 ore body it might be argued that the tuff-ore and tuff-dolomite contact was a line of weakness along which post-ore adjustments took place. As stated above, there is some evidence that the quartz veins within the graphitic fault belong to a later period of gold deposition than the main ore bodies.

If, therefore, any influence of the graphite fault is disregarded, it will be seen that the main ore shoots lie in dacitic lava between two heavy sheared zones represented by the talc schist and "dolomite." Movements along these shear zones would tend to shatter the harder, more competent lavas and cause rock flowage or shearing along the bedding planes of the softer tuffs, especially the slaty varieties. Under such circumstances the lavas would contain fractures and openings which would allow the circulation of the ore-bearing solutions and would become the locus of sulphide replacement with attendant gold deposition. The tuffs, on the other hand, would be unfavourable, for they could not maintain the fractures. Under such a conception of structural control any portion of the harder lavas or similar competent rocks adjacent to the sheared zones would be favourable prospecting ground.

It has been pointed out elsewhere in this report that most of the ore-bearing ground that has been found to date along this belt of volcanics between the Omega and Chesterville Larder Lake mines is bounded by strong sheared zones. The most noticeable difference between the ores in the western part of the "break" from those at the east end is the absence in the former of strong high-grade quartz-filled fractures in the replacement sulphides, and consequently the average grade is lower. Small patches of higher-grade quartz ore have been found at the Omega mine, and there is no reason why other and larger bodies may not be found by systematic exploration along and across the band of volcanics.

Production, Ore Reserves, Costs, Profits, Etc.

The information in the following table has been compiled from the annual reports of the company for the years indicated.

	Mar. 31, 1936[1]	Mar. 31, 1937	Mar. 31, 1938	Mar. 31, 1939	Mar. 31, 1940	Mar. 31, 1941	Mar. 31, 1942
Tons milled	17,352	132,642	167,051	177,388	174,449	176,300	171,916
Tons milled daily	.....	.....	458	486	478	483	471
Value per ton	$4.28	$5.00	$5.36	$5.57	$5.81	$5.75	$5.82
Recovery per ton	$3.52	$4.32	$4.66	$4.88	$5.10	$5.03	$5.16
Value of bullion recovered	$60,992	$573,504	$779,766	$866,503	$890,341	$887,354	$886,738
Operating costs per ton milled (exclusive of depreciation and taxes)	$3.70	$3.46	$3.88	$4.02	$4.23	$4.21	$4.25
Estimated ore reserves..tons	440,000	514,600	515,000	520,000	490,000	485,000	425,000
Estimated grade of ore reserves.....ounces per ton	0.197	0.164	0.164	0.160	0.158	0.157	0.160
Yearly operating profit (before depreciation, etc.)	.....	$107,734	$121,858	$142,070	$135,376	$131,301	$139,830
Net yearly profit	.....	.....	$28,809	$63,022	$54,142	$9,093	$15,310

[1]Two months' mill operation.

Pelangio-Larder Mines, Limited

Pelangio-Larder Mines, Limited, was organized in 1937 to develop a group of 19 claims in the east central part of McGarry township. The property adjoins the Chesterville, Hay-Thompson, and Wesley claims on the east. In 1937 and the early months of 1938, 25 holes, aggregating 15,338 feet of drilling, were put down on different parts of the property. The claims are almost entirely underlain by the flat-lying sediments of the Cobalt series, which are not gold-bearing. Consequently, more than half the footage was used up in traversing the Cobalt series before penetrating the underlying Timiskaming formations. The drilling indicated that the contact of the Cobalt sediments with the older formations ranges from 200 to 700 feet below the present surface. The preliminary drilling explored the property along two cross-sections located 4,200 feet apart They lay across the projection of the strike of the Kerr-Addison and Chesterville Larder Lake ore zone.

General Geology

The drilling showed that the pre-Cobalt surface had local variations in elevation amounting to as much as 400 feet. The valleys on this old surface lie along bands of soft talc-chlorite schists. The writer believes that these rocks are highly altered volcanics, because westward along the strike on Chesterville Larder Lake ground outcrops of the same schists grade laterally into less altered lavas, which show pillow structures. The ridges between the valleys are composed of relatively unaltered, steeply folded sediments. These consist of rather thinly bedded greywackes and black carbonaceous slates.

A section through the Cobalt series shows three distinct members, as follows: an upper member of thinly bedded greywacke, shale, and arkose, which has an average thickness of about 120 feet in the area drilled; a middle member of conglomerate, which is 20 to 70 feet in thickness; a lower member, which is similar to the upper except that it is devoid of arkose and which varies greatly in thickness as a result of being deposited on the irregular pre-Cobalt surface.

Structural Geology

A long, flat drill-hole (No. 14) sectioned the steeply dipping greywacke and slate of the older series. These sediments showed grain gradation at three different points, which indicated that a synclinal axis is located somewhere near the middle of the band (see Fig. 2 page 28).

The two main talc-chlorite schist zones in the pre-Cobalt formations have been produced by shearing and are the locus of strong faulting movements. The northern schist belt has a maximum width of 700 feet and lies along the northeasterly extension of the faulted zone on the north side of the carbonate body at the Kerr-Addison and Chesterville Larder Lake mines (Larder Lake "break"). The south belt was not completely traversed by the drilling, but it has a width in excess of 350 feet. It lies along the strike of an assumed fault, which extends along the north side of the northeast arm of Larder lake.

Post-Cobalt faulting movements have probably occurred along the southern schist belt. This is indicated by an offset of the conglomerate member of the Cobalt series. The south side of the fault has dropped about 200 feet.

Gold Occurrences

Scattered low gold values were found in the altered phases of the older sedimentary series near the schisted zones. Two narrow gold-bearing quartz stringers were cut in the unaltered sediments. Five intersections returned assay

values of more than $1.00 per ton in gold across narrow widths. The best intersection assayed $15.40 over 1.25 feet. No ore was indicated.

Proprietary Mines, Limited

Proprietary Mines, Limited, was organized in 1930 and took over the assets of the bankrupt Canadian Associated Goldfields, Limited. In 1941 the company owned a share interest in several mining companies in the Larder Lake area. These included the Kerr-Addison, Omega, Laguerre, Amalgamated Larder, and Moosewood properties. The company also owns the electric power plants located at Raven River and Corset Falls in the southern part of McFadden township. The Larder Lake Land Company is a wholly owned subsidiary of Proprietary Mines, Limited. Early in 1942 the company also held claim T. 1,886 in McGarry township and three groups of claims in McVittie township.

BEAR LAKE GROUP

In 1941 the Bear Lake group consisted of 11 claims located west of Bear lake and adjoining the Cheminis and Fernland properties on the north. The southern claims of the group are underlain by volcanics and sediments of the Timiskaming series; on the northern claims the sediments are intruded by bodies of syenite porphyry. The rocks are quite massive.

These claims were prospected in 1937, but nothing of interest was found.

LARDER TOWNSITE GROUP

The Larder Townsite group is located within the townsite of Larder Lake. Most of the ground is covered by overburden. The outcrops consist of highly altered sediments of the Timiskaming series cut by innumerable dikes and irregularly shaped bodies of syenite, lamprophyre, and related intrusives. These claims were prospected in 1937, but nothing of importance was uncovered.

LEMIEUX LAKE GROUP

The Lemieux Lake group consists of 5 claims near Lemieux lake in the northeastern part of McVittie township. The rocks on the claims are mostly massive greenstone, sometimes fragmental, cut by many small syenite dikes. Near the north boundary there is a band of gabbro and diorite.

Rose Claims

In 1942, H. S. Rose held a group of 27 claims, most of which are located in the northwest corner of McGarry township; the remainder are in McVittie and Ossian townships. These include the old Rochon claims, which are mentioned in a report by Gledhill[1] in 1928.

A large part of the property is underlain by Keewatin volcanics, which sometimes show pillowed structures. Near the mineral showing the lavas are amygdaloidal and somewhat resemble the dalmatianite associated with the base metals at the Waite Amulet mine in the Noranda area of Quebec. The lavas are cut by small bodies of diorite and syenite porphyry.

The principal mineral showing occurs in the vicinity of trenches and test-pits on claim L. 30,473. This lies about 1,700 feet south and 1,400 feet east of the northwest corner of McGarry township. Amygdaloidal rock somewhat resembling dalmatianite and containing patches of sparse mineralization is found over

[1]T. L. Gledhill, Ont. Dept. Mines, Vol. XXXVII, 1928, pt. 3, pp. 27, 52.

an area about 250 feet by 200 feet in surface dimensions. The mineralization consists principally of pyrite and negligible amounts of pyrrhotite, sphalerite, and chalcopyrite.

In the summer of 1942, Connell Mining and Exploration Company, Limited, International Mining Corporation, and G. B. Webster did some exploration on the property, the work being under the direction of Jas. G. MacGregor, consulting geologist. Five short drill-holes were put down to explore the amygdaloidal rock, but no important sulphide concentrations were intersected. According to MacGregor, the drilling proved that the "dalmatianite-like" rock occurred as a flat-lying sheet about 60 feet in thickness and dipped to the south at an angle of from 25 to 35 degrees. Two vertical holes were drilled to the southwest of the main workings, but nothing of interest was found and the work was discontinued.

Rose Gold Mining Company, Limited

In 1940 the Rose Gold Mining Company, Limited, owned a group of 8 claims, which adjoin the property of Omega Gold Mines on the north in the central part of McVittie township. No recent development work on these claims has been reported.

The northern half of the property is underlain by Keewatin lavas, the southern half by conglomerate, greywacke, and trachyte of the Timiskaming series. There is some carbonatization along the conglomerate-lava contact. This contact has been offset by cross-faults at a few points.

Some small veins are found in old test-pits and trenches. In 1924 Hopkins[1] reported:—

> Some gold was obtained by assay from surface veins on R.S.C. 298 [T. 2,857]; much diamond-drilling was done during 1922.

Sheldon-Larder Mines, Limited

Sheldon-Larder Mines, Limited, was organized in March, 1937, and acquired a group of 11 claims, which adjoin the property of Kerr-Addison Gold Mines on the southwest in McGarry township. A programme of surface development and diamond-drilling was carried on during 1937 and 1938. Sixty holes, aggregating 22,143 feet, were put down on different parts of the property. All work was suspended in November, 1938.

General Geology

The eastern part of the property is underlain by interbanded lavas, agglomerates, and tuffs of the Timiskaming series. Another band of Timiskaming lavas runs along the south side of Barber lake and cuts across the corner of claim L. 11,135. Massive pillowed and spherulitic lavas predominate in these areas, but they are traversed by zones of talc-chlorite schist, which are the locus of intense shearing movements. A prominent horizon of agglomerate and tuff lies stratigraphically above the lavas and strikes N. 30° E. between claims T. 1,955 and L. 4,898; it is cut off at either end by faulting.

Timiskaming sediments underlie most of the northwestern claims on the property. These sediments are also found along the lake shore on claims L. 30,691 and 5,792. Drilling in this locality has indicated that narrow horizons of agglomerate and tuff are interbanded with the greywacke and slate. A lamprophyre dike intrudes the lavas on claims L. 5,792 and 4,898; a narrow dike of altered diorite or gabbro occurs on claims L. 5,499 and 5,500. The northern

[1]P. E. Hopkins, Ont. Dept. Mines, Vol. XXXIII, 1924, pt. 3, p. 21.

extremity of the Cobalt series lies from 400 to 800 feet southeast of the lake shore, and isolated remnants occur on claim L. 5,499.

There are different areas of green and grey carbonate rock or "dolomite" on the property. The most prominent band extends from claim T. 1,955 to L. 4,898 and lies between the lavas and agglomerate. Certain unaltered areas within it show that the original rock was largely lava. West and north of the main carbonate body there are areas of partially carbonatized agglomerate and tuff. A small portion of the carbonate band that probably extends from the Barber-Larder to the Kerr-Addison mine lies in the northwest corner of claim L. 11,135. Green carbonate is developed within and adjacent to the lamprophyre dike on claims L. 5,792 and 4,898.

Structure

The Timiskaming rocks on the Sheldon-Larder claims have been folded into a syncline, the axis of which strikes about S. 45° W. across claim L. 11,135. This syncline pitches to the southwest. Both limbs of the fold have been truncated by faults striking N. 60°–65° E.

A number of these strike faults traverse the property and are indicated by wide zones of shearing. In some instances later carbonate replacement has masked the original shearing. The Larder Lake "break" cuts across the northwestern extremity of claim L. 11,135. About 400 feet to the south a parallel graphite fault occurs along the contact of lavas and sediments. This has been traced westward to the underground workings of the Barber-Larder mine. Another wide sheared and faulted zone strikes N. 30° E., parallel to highway No. 66, on claim T. 1,932 of Armistice Gold Mines and extends into claim L. 4,898 on Sheldon-Larder ground. A fault striking N. 65° E. near the north shore of Larder lake truncates the agglomerate and carbonate bands on claim L. 30,691. To the east it follows the contact of the lavas and sediments. The wide carbonate band extending from claim T. 1,955 to L. 4,898 replaces an earlier sheared zone in the characteristic manner of all carbonate bodies in the area. Drill-holes across it show sections of talc-chlorite schist where carbonate replacement has not been sufficiently complete to mask the original shearing.

Gold Occurrences

To date gold has been found at a number of places on the property but nowhere in sufficient quantity to make an ore body. Mineralized areas and veins or stockworks of quartz occur in the carbonate bodies, basic dikes, and sheared zones.

A carbonatized and mineralized area occurs along a sheared zone at the contact of sediments and lavas on claims L. 30,691, T. 1,955, and L. 5,792. This contains three separate gold-bearing zones from 100 to 200 feet in length and from 2 to 10 feet in width. H. M. Butterfield, manager of the property, estimated that these would average less than $3.00 per ton in gold and contain 225 to 250 tons per vertical foot.

Gold occurs in a dike of altered diorite or gabbro, 3 to 3.5 feet in width, on claims L. 5,499 and 5,500. In places the dike is fractured and contains quartz and calcite stringers with associated pyrite. According to Mr. Butterfield, thorough bulk-sampling of the dike indicated a shoot 121 feet long and 3.25 feet wide, which averages $7.40 per ton in gold. An additional 300 feet carries lower values, averaging less than $3.00 per ton. Native gold was found in a quartz stringer in one trench. Drilling indicated low gold values in the dike.

A surface discovery in mineralized carbonate material near the middle of

the east line of claim L. 6,464 was trenched over a length of 240 feet and indicated a shoot up to 5.5 feet in width and possibly 40 to 50 feet in length, grading about $4.00 per ton in gold.

Gold was found along the contact of the lamprophyre dike on claim L. 5,792. This area was thoroughly trenched and sampled. All but one sample assayed less than $4.00 per ton over widths of 1.5 to 3 feet.

Spectacle Larder Lake Mines, Limited

Spectacle Larder Lakes Mines, Limited, was organized in 1938 and acquired a group of 21 claims from the Yield Gold Mining Syndicate. In 1941 the company held the following claims: L. 32,991–96, 35,584–88, 35,510–12, 33,062–65, 33,076, 33,077, and 35,903. The property is situated in the vicinity of Spectacle lake in the west central part of McVittie township. A small amount of surface-trenching and diamond-drilling was done in 1939.

The rock exposures on the property consist largely of massive basic lava flows of the Keewatin series. Interbanded with these are small amounts of acid lavas and fragmentals. A few dikes of syenite and quartz porphyry cut the lavas.

The lava flows on the property have been folded into an anticline, the axis of which strikes southeastward across the central part of Spectacle lake. Near the narrows that join the two parts of the lake there are some small quartz veins and stringer zones, which have been investigated.

Thib Gold Mines, Limited

In 1938 Thib Gold Mines, Limited, held a group of 11 claims in McVittie and Hearst townships in the vicinity of Enright point on the north shore of Larder lake. Most of the property underlies the waters of Larder lake. The original staking was done by Eli Thib during the earliest gold rush into the area. Showings were developed by test pits and open cuts. Most of the recent development work has been done by diamond-drilling under the lake near Enright point. Ten drill-holes, totalling 3,829 feet, were put down on the property in 1938.

On claims T. 1,997 and L. 25,410 the rocks are largely greywackes and slates of the Timiskaming series. A small amount of conglomerate occurs on the west side of claim T. 1,997 near the lake shore. The sediments are intruded by dikes of diorite, syenite porphyry, and lamprophyre. The diorite is sometimes carbonatized and cut by a network of quartz stringers.

The rock on Enright point is a highly altered diorite. It has been carbonatized and silicified and occasionally contains a little pyrite, chalcopyrite, and quartz stringers. Drilling indicated that a band of sediments 140 to 260 feet in width lies immediately southwest of the point. A zone of highly sheared talc-chlorite schist adjoins the sediments. One hole (No. 2) cut through the sheared zone and passed into a rock classified as basaltic lava. The true width of the sheared zone would be 175 to 200 feet. This is the locus of strong faulting movements along the lava-sediments contact. The sheared zone strikes northwest.

A stockwork of quartz veins occupies a fractured zone in highly carbonatized rocks on the lake shore northwest of Enright point. Some green fuchsite occurs with the carbonate. Part of the exposed area of the quartz-carbonate stockwork lies on Thib ground and the remainder on claim L. 1,947. It is very difficult to determine the nature of the original rock within the altered zone, but along the strike there are some exposures of conglomerate and it is probable that the

quartz stockwork is located in a section of this conglomerate band. Within the quartz-bearing zone there is at least one dike of syenite porphyry. The boundaries of the network of quartz veins are poorly defined, but the body is approximately 100 to 150 feet in width and about 500 feet in exposed length. No development work has been reported on this stockwork in recent years.

Most of the drilling in 1938 explored the extension of a gold showing in an old test pit on the southeast shore of Enright point. While gold values are reported from some of the cores over considerable widths at a number of different points, the drilling did not outline a body that could be considered of ore grade. All the values in the drill-holes were found in the greywacke or in diorite near the greywacke contact. They were localized on the south side of the main diorite mass and within a short distance of the faulted contact of the sediments and lavas.

Wesley Gold Mines, Limited

The property of Wesley Gold Mines, Limited, consists of 31 claims in the eastern part of McGarry township. These adjoin the Chesterville Larder Lake and Pelangio-Larder claims on the south. The property is covered by the relatively flat-lying sediments of the Cobalt series. Development work has consisted of drilling to investigate the older favourable formations, which lie beneath the Cobalt series. In 1937 and 1938 a total of 14 holes, aggregating 11,792 feet, was drilled along the north boundary of the property on claims L. 32,732 and 33,281. A little additional drilling was done in the autumn of 1941. The thickness of the Cobalt series in this vicinity ranges from 210 to 670 feet.

The pre-Cobalt rocks cut in the drilling consist of steeply dipping sediments, basic lavas, and their altered equivalents. A wide band of talc-chlorite schist, carbonatized in places, strikes south of west across the north corner of claim L. 32,732. From the field relationships it would appear that most of this schist is altered lava, although in hole No. 8, which sectioned the entire band, the schist adjacent to the recognized sediments might possibly be an altered conglomerate. The sediments are bedded greywacke and slate, presumably part of the Timiskaming series. Some tuff beds occur in the volcanics.

The talc-chlorite schists have been produced by strong shearing. They are very probably localized within the fault zone that was found by drilling on claims L. 26,339 and 26,340 of Pelangio-Larder Mines. If these intersections are on the same shear zone, its projection to the southwest would coincide fairly well with the highly sheared and carbonatized zone along the north shore of the northeast arm of Larder lake on the Kerr-Addison claims. This southern faulted zone strikes about parallel to the strong northern shear zone that extends along the north side of the Kerr-Addison and Chesterville Larder Lake ore bodies (Larder Lake "break"). The two shear zones or "breaks" are approximately 2,000 feet apart at the east end of the mining camp.

The drilling revealed some low gold values in mineralized zones. A. A. Lee, consultant for the company, reported that in hole No. 6 a core length of 24.3 feet averaged $2.43 per ton. This was obtained in carbonatized chloritic rock mineralized with pyrite and cut by quartz stringers. It adjoined the intensely sheared talc-chlorite schists of the faulted zone. The same mineralized zone was cut at greater depth in hole No. 12, but carried no values. In hole No. 14 a 60-foot intersection was reported to average $2.80 per ton in gold.

Winchester Larder Lake Mines, Limited

Winchester Larder Lake Mines, Limited, was organized in March, 1941, and took over a group of 12 claims formerly held by Hayes Cadillac Gold Mines,

Limited, and 2 adjoining claims to make a block of 14 claims in all. These claims lie on either side of the McGarry-McVittie township line in the vicinity of the northern part of Bear lake.

In the summer of 1941 the claims were developed by preliminary surface prospecting, and a geological survey of the property was completed. The claims are underlain by Keewatin lavas and Timiskaming sediments and volcanics, all of which are intruded by large irregular masses of syenite porphyry.

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