OCCURRENCE OF RIEBECKITE IN THE MICHIPICOTEN DISTRICT, ONTARIO

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Abstract

In reply to a recent paper by J. E. Hawley, evidence is presented according to which riebeckite occurs in the Michipicoten district as a hydrothermal alteration product, accompanying lamprophyre dikes. From these dikes the mineral was locally introduced into the gold-bearing and barren quartz veins, as well as other rocks cut by the lamprophyre intrusions. It is evident from these relations that the riebeckite was not associated with the gold-bearing solutions, since the period of gold deposition was separated from the formation of riebeckite by the intrusion of later dikes.

In a recent issue of this Journal, Professor J. E. Hawley[1] published a description of riebeckite from the Michipicoten district. As stated in the introduction to his paper, Hawley based his investigation on a number of specimens collected by Mr. O. A. Evans. It appears unfortunate, indeed, that Hawley had not had the opportunity of studying the occurrence of the mineral in the field, as his article contains erroneous inferences as regards the association and the origin of the Michipicoten riebeckite.

The present writer had observed the mineral during his activity in the Michipicoten district as mining engineer and geologist as early as 1928. In connection with his work for his doctor's thesis he determined the mineral as riebeckite on the basis of its optical characteristics and a qualitative analysis, and referred to it in two publications on the gold deposits of the same area.[2]

According to Hawley, riebeckite would appear to be an original though rare constituent of some quartz veins in the Michipicoten area. He states that "in the Michipicoten area, deep blue riebeckite is found in a few quartz veins and in both granitic intrusives and basic volcanics near the veins." Referring to the replacement of other constituents of the wall rocks of the quartz veins by riebeckite, he concludes as follows: "It would appear, therefore, that the riebeckite is one of the latest minerals to develop in both the veins and wall rocks."

Although riebeckite is quite frequently observed in the gold-bearing, as well as barren quartz veins, in the Michipicoten area, there is con-

[1] Hawley, J. E., Riebeckite in quartz veins from the Michipicoten district, Ontario: *Am. Mineral.*, **22**, 1099–1103 (1937).

[2] Frohberg, M. H., Beiträge zur Kenntnis der turmalinführenden Goldquarzgänge des Michipicoten Distriktes, Ontario: *Min. Petr. Mitt.*, **44** (5), 363 (1933).

Frohberg, M. H., The ore deposits of the Michipicoten area: *Ont. Dept. Min., 44th Ann. Rept.*, pt. **8**, 47 (1937).

clusive evidence that this mineral is not an original constituent of the quartz veins but is a hydrothermal alteration product accompanying lamprophyre dikes from which it was locally introduced into the quartz veins and their country rocks. This genetic relation is borne out by the fact that the mineral is rather common along the hydrothermally altered margins of the lamprophyre dikes which are considerably younger than the quartz veins. Gold mining operations in the district have yielded proof that riebeckite occurs in the lamprophyres, at considerable distances from the quartz veins, whereas its occurrence in the latter is invariably confined to places where such dikes intersect them. As the lamprophyre intrusions are the youngest rocks known in the area, riebeckite has been found in practically all rocks traversed by them.

The relative age of the quartz veins and lamprophyre intrusions is illustrated in the following table:

TABLE OF FORMATIONS IN THE MICHIPICOTEN DISTRICT

QUARTERNARY	
Recent:	Alluvial deposits
Pleistocene:	Glacial drift and lake deposits
PRE-CAMBRIAN	
Keweenawan:	Lamprophyre dikes Red feldspar-carbonate veins Younger diabase dikes
Algoman:	Pegmatitic (barren) quartz veins Gold-bearing quartz veins Granite, granodiorite, diorite and related porphyries
Haileyburian:	Older diabase dikes
Timiskaming:	Dore series: conglomerates, greywacke, tuffs, arkose
Laurentian:	Granite, diorite, various porphyries
Keewatin:	Basic and acid volcanics (flows, tuffs, breccias, agglomerates) with local sedimentary material and iron formation

The Michipicoten lamprophyres are rather fine-grained rocks occurring in the form of dikes which vary from a few inches to over five feet in width. Gledhill[3] distinguished two types, a biotite-rich and an olivine-bearing variety which he classed with the picrite family. The primary mineral components listed by Gledhill include olivine, biotite, and magnetite. Other dikes studied by the writer under the microscope are made up essentially of biotite with some magnetite and apatite, and one dike encountered underground at the Parkhill mine, contains as much as 50% magnetite in coarse aggregates, with biotite, augite and rutile as additional constituents.

[3] Gledhill, T. L., Michipicoten gold area: *Ont. Dept. Min., 36th Ann. Rept.*, pt. **2, 14** (1927).

Characteristic of most lamprophyre dikes is a marked decomposition of the original constituents. This alteration is not due to weathering but is the result of hydrothermal infiltrations which in many cases proceeded along the dike walls. This fact is readily borne out by the bleached appearance of the marginal portions of many dikes. The alteration products include fibrous hornblende, serpentine, chlorite, epidote, riebeckite and carbonate. The last named is the final and most important of the secondary minerals and in some dikes has almost completely replaced the earlier alteration products. Locally, some pyrite or chalcopyrite has been deposited along the dike walls during the late hydrothermal stage of the lamprophyre intrusions.

These processes were not confined to the lamprophyres but to a lesser degree affected also the wall rocks of the dikes. As a result, the country rock generally shows an increased amount of carbonate and a development of silicates similar to those observable in the lamprophyres, although there are considerable variations in different rocks. The lateral extent of the alteration rarely exceeds one foot, but exceptions were noted where cracks in the wall rock of the dikes had provided an easy access for the rising solutions. In several instances, riebeckite accompanied by carbonate was found in veinlets reaching as far as ten feet from a dike.

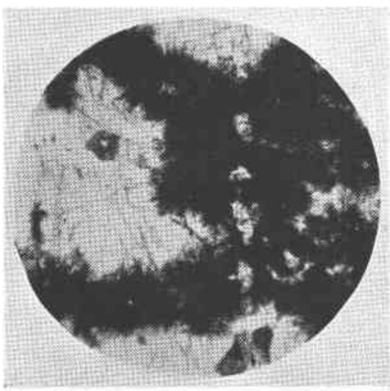

FIG. 1. Photomicrograph of a thin section showing riebeckite veinlets in gold-bearing quartz of the Parkhill Mine; riebeckite (black), carbonate (white, high relief), quartz (white, low relief). One nicol, ×60.

Owing to its blue color, the riebeckite is the most conspicuous of the various alteration products although it is, quantitatively speaking, of minor importance. Macroscopic aggregates generally occur in veinlets and cracks varying from a fraction of a millimeter to one centimeter in width (Fig. 1). The presence of microscopic needles of riebeckite can easily be detected by the bluish tinge of the altered rocks.

The Michipicoten riebeckite forms globular, botryoidal, and quite commonly almost earthy aggregates which consist of radiating or felt-like masses of minute fibers. As a rule, the individual fibers or needles

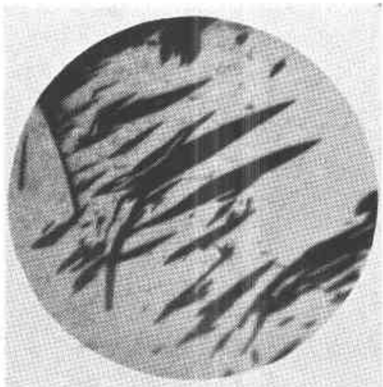

Fig. 2. Photomicrograph of a polished section of the Grace Vein, Darwin Mine, showing idioblastic crystals of riebeckite (black) in native gold (light-grey). One nicol, ×410.

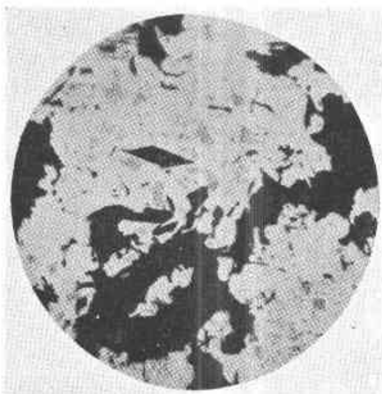

Fig. 3. Photomicrograph of a polished section of the Grace Vein, Darwin Mine, showing idioblastic crystals and veinlets of riebeckite (black) in native gold (light-grey) with inclusions of chalcopyrite (grey). One nicol, ×560.

are of microscopic size, although lengths up to three millimeters have been observed. The crystallographic habit of idioblastic needles is illustrated by Figs. 2 and 3. The color of the mineral ranges from deep blue to lavender and greyish-blue shades.

In some thin sections of gold-bearing quartz traversed by veinlets carrying riebeckite, the latter appears to line the walls of the fracture, with idioblastic needles protruding outward into the quartz whereas carbonate makes up the center of the veinlet. Occasionally such veinlets carry also some epidote and pyrite. The epidote in nearly all cases shows signs of replacement by the riebeckite thus indicating its earlier age. Riebeckite and the carbonate appear to be essentially contemporaneous although a later carbonate generation distinctly replaces the riebeckite.

The age relations of the components of the veinlets are in accord with the observed sequence of the alteration products in the lamprophyres. Riebeckite appears to be invariably the latest of the newly formed silicates, as is evidenced by numerous examples of progressive replacement. As for the relations of the riebeckite to the sulphides deposited during the same hydrothermal stage, no conclusive evidence of a difference in age was ascertained, although in one case the writer observed what appeared to be a narrow veinlet of riebeckite extending a short distance into a pyrite aggregate. In places where the carbonatization of the lamprophyres has reached an advanced stage, remnants of riebeckite and of other silicates are found in the carbonate. The latter obviously corresponds to the second generation of carbonate observed occasionally in the riebeckite-bearing veinlets.

Wherever riebeckite is found in the wall rocks of the lamprophyre dikes its late age is borne out by a partial or complete replacement of the components of those rocks. As a rule, members of the ferro-magnesian group such as biotite, hornblende, chlorite and epidote appear to have been more readily replaced than other silicates. This seems to suggest that the iron contained in these minerals was used in the formation of the riebeckite molecule.

The age relations of the riebeckite to the late generation of native gold in the gold-bearing quartz veins is well illustrated in Figs. 2 and 3. These photomicrographs show idioblastic needles and veinlets of riebeckite in an aggregate of native gold which occurred in vein fragments within a wide lamprophyre dike cutting the Grace Vein at the Darwin Mine. In this case, the later age of the riebeckite was further proven by the fact that the riebeckite veinlets also cut red feldspar-carbonate veins[4] which traverse the gold-bearing quartz.

It is of interest to note that the association of the riebeckite with lamprophyre dikes is not confined to the Michipicoten district. In the Goudreau-Lochalsh gold area which is about 30 miles northeast of Michipicoten, the writer observed riebeckite in and near a lamprophyre

[4] See table of formations.

dike which cuts the gold veins of the Edwards Mine. Also in this case, some riebeckite had been introduced into the gold-bearing quartz in the vicinity of the dike.

Acknowledgments

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