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MINERALOGICAL NOTES

AN OCCURRENCE OF BARYLITE NEAR SEAL LAKE, LABRADOR[1]

E. WM. HEINRICH AND R. W. DEANE *Department of Geology and Mineralogy, The University of Michigan, Ann Arbor, Michigan, and Lakefield Research of Canada, Ltd., Lakefield, Ontario.*

INTRODUCTION

In 1959 the writers received a number of specimens of vein material and rocks from Seal Lake, Labrador. Assays had indicated unusual concentrations of beryllium, but difficulty had arisen in identifying the beryllium mineral.

This study was undertaken to determine the beryllium mineral and to study its paragenesis. The writers are indebted to Rio Tinto Canadian Exploration Limited for permission to publish results of the study; and to Dr. George Switzer, U. S. National Museum, Dr. Frans E. Wickman, Royal Museum of Sweden, Dr. Heinrich Neumann, University of Oslo, and Dr. Clifford Frondel, Harvard University, for the loan of comparison specimens. Eugene B. Gross assisted in the *x*-ray studies. Professors D. H. Gorman and W. W. Moorhouse of the University of Toronto, who also have studied the mineralogy of the occurrence, kindly discussed their results with Heinrich.

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HISTORY OF BARYLITE

Barylite, first described 80 years ago as a Ba-Al silicate from Langban, was determined by Aminoff (1923) to be a Ba-Be silicate. Palache and Bauer (1930) discovered barylite at Franklin, New Jersey, in a well-banded vein, imbedded with hedyphane and some willemite. Other vein associates were calcite, native copper, and serpentine, the last cementing the brecciated barylite. This information was repeated in the U. S. Geological Survey monograph on the mineralogy of Franklin (Palache, 1935). The structure of barylite has been determined by Ygberg (1941) and by Smith (1956).

The occurrence of barylite in the U.S.S.R. has been reported by Zhabin (1959; Zhabin and Kasakova, 1960).

GEOLOGY

The beryllium mineralization is associated with two lenticular bodies of alkali syenite that intrude rocks of the Precambrian Letitia Lake

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Group (Brummer, 1960; Brummer and Mann, 1961). The Mann No. 1 zone is within the northern syenite lens which occurs " . . . near the gradational contact between the lower porphyritic rocks and the upper banded volcanic and pyroclastic rocks of the Letitia Lake group. The zone of high radioactivity is concentrated along a banded complex of 'gneissic' amphibolite and albite bands. . . . This banded complex represents a shear zone which contains large blocks of syenite in schistose amphibolite." (Brummer and Mann, 1961, p. 1378–1379). The radioactive zone, which strikes N. 80° E. and dips steeply south, parallel with the regional foliation of the Letitia Lake rocks, is at least 1800 feet long and 500 feet wide.

The Mann No. 2 zone, which strikes northeasterly and dips steeply southeast, is three miles southeast of the No. 1. It consists of banded green pyroxene gneiss, sodic amphibolite, albitite, and alkali syenite and can be traced southwestward discontinuously for 20 miles (Brummer and Mann, 1961). The zones were discovered because of their radioactivity.

Rowe (1961, p. 34) states "Two deposits have been located, and, on the basis of surface sampling, it is estimated that one contains more than 9,000 tons per vertical foot averaging 0.44 per cent BeO, and the other contains 890 tons per vertical foot averaging 0.76 per cent BeO."

The specimens available to the writers are believed to represent Zone No. 1. The syenite is a coarse-grained, equigranular, olive-gray to greenish, non-foliated rock that consists chiefly of feldspar and subordinate mafic minerals. Microscopically it is seen to consist of anorthoclase, albite, aegirine, riebeckite, and accessory sphene and apatite. Veinlets of a fine-grained, light-red mineral cut the mafic constituents. Hicks (1958) has identified the red mineral as eudialyte ($\omega = 1.589$, $\epsilon = 1.594$, uniaxial positive). Brummer and Mann (1961) also report eudialyte in both zones. Albite in part replaces anorthoclase; similarly, riebeckite replaces aegirine. The texture is distinctly agpaitic, with most of the mafic minerals in clusters, vein-like aggregates, or disseminated microlites. Most of the sphene occupies the centers of mafic aggregates.

Beryllium Mineralization

Beryllium mineralization occurs in two ways: 1) as high-grade barylite-bearing veinlets cutting fenitic gneisses; and 2) as disseminated grains of barylite in fenitic gneisses.

Veinlets. The veinlets apparently are narrow; specimens received by the writers are about an inch thick. Megascopically the pieces resemble a faintly-banded brownish chert; no grains are distinguishable. The material is slightly radioactive (as much as 0.04% *e* U_3O_8), and very thin seams fluoresce a deep red. Microscopically, the very fine-grained aggregate can be seen to consist of about 40–50% quartz, 1–10% albite and a

TABLE 1. *X*-RAY POWDER DIFFRACTION DATA FOR BARYLITE. CU RADIATION, NI FILTER

Barylite, DH-3-A		Barylite, Langban, Sweden	
d(Å)	I	d(Å)	I
5.84	mw	5.82	m
4.56	mw	4.5	m
4.35	w	4.33	mw
4.26	w		
3.35	vs	3.38	vs
3.25	w	3.23	w
3.04	m	3.02	s
2.99	m	2.98	m
2.93	ms	2.92	vs
2.50	w	2.50	w
2.45	ms	2.448	m
2.40	w	2.39	w
2.37	vw	2.33	m
2.25	vw	2.25	w
2.22	w	2.21	w
2.17	vw	2.16	w
2.13	vw	2.14	vw
2.07	vw	2.08	w
		2.07	w
2.04	vw	2.03	vw
		1.94	vvw
1.90	vw	1.89	w
1.85	vw	1.85	mw
1.817	vw		
		1.74	w
		1.71	vvw
		1.686	mw
		1.622	w
		1.59	vvw
		1.57	vvw
		1.527	m
		(and others)	

colorless mineral with the properties:

Biaxial (+), 2V = 60°, r > v moderate

$$\alpha = 1.680$$
$$\gamma = 1.706$$

B on cleavage pieces is low; 2 cleavages, 1 perfect, another good at right angles to the first; colorless; does not fluoresce.

These properties compare favorably with those listed for barylite by Larsen and Berman (1934).

Positive identification of the mineral as barylite proved difficult. A specimen from the U. S. National Museum was labelled barylite with hedyphane and native copper from Franklin, New Jersey. According to Palache (1935), Franklin barylite is strongly fluorescent in vivid blue. One corner of the U. S. National Museum specimen showed such a fluorescent color, and this material was *x*-rayed. The powder pattern did not correspond to that of barylite isolated from the Seal Lake vein material, nor did these two patterns agree with those of other beryllium minerals; namely: beryl, chrysoberyl, harstigite, trimerite, melinophane, and leucophane. Finally, a specimen of barylite from Langban was received from Dr. Frans Wickman. Its *x*-ray powder pattern corresponded to that of the Seal Lake mineral (Table 1). Subsequently, some barylite was also detected in the U. S. National Museum specimen, but it is impure, largely admixed with hedyphane. The *x*-ray powder data of Smith (1956) obtained on Franklin barylite are very similar to those from both the Seal Lake and Langban material.

Analysis of the vein material had indicated several % Be, Si$>$25%, Al$\leqq$1%, Ba 1–10%, Ca, K, Na trace, Fe, P nil. Analyses made on samples of vein material by various individuals and methods showed: Be $=2.5, 3.0, 3.2, 4.0\%$.

A more complete analysis on a partly purified sample of vein barylite yielded:

BeO	7.0
BaO	24.6
MnO	0.05
CaO	0.01
Na_2O	0.78

The sample was estimated to consist of nearly 50% barylite, the remainder being mainly quartz and a trace of albite. The BeO/BaO ratio in pure barylite approaches 1:3.

Fenitic gneisses. The fenitized gneisses are amphibole gneisses that have been metasomatized by alkali solutions presumably derived from the alkali syenite. They are conspicuously banded in dark-light, the dark layers consisting chiefly of aegirine or sodic amphibole or both, and the light layers made up of orthoclase and albite. The sodic amphibole is probably arfvedsonite. The light feldspathic layers fluoresce in brilliant white, light greenish-white, bright creamy-orange, and pale red, probably owing to the presence of rare earth elements in the alkali feldspars. Analyses of the gneisses show: La$=$200–4000 ppm; Y$=$200 ppm; Yb$=$tr; other RE not sought.

The specimens range in radioactivity from .04–.09% *e* U_3O_8; Brummer and Mann (1961, p. 1379) state that " . . . a zone of highly radioactive amphibolite showed a value of 2.30% ThO_2." Thorium values on the hand specimens range from 0.08–0.4%. The radioactivity is concentrated in the mafic bands, in which pyrochlore appears in euhedral to anhedral golden isotropic grains. Brummer and Mann report as much as 1% Nb_2O_5; the specimens studied contain 0.01–0.3% Nb. Other minerals in the mafic bands are abundant apatite in clusters of slender needles, triplite, epidote, sphene, hematite, an opaque black metallic species, locally abundant biotite, and several unidentified species. In addition to the feldspars the felsic layers contain barylite, quartz, traces of rhombohedral carbonate, and, locally, flakes of muscovite. In some bands the albite appears as semi-radial groups of thin plates (cleavelandite), more or less normal to the layering. Some specimens are cut by thin seams of deep red sphalerite.

The disseminated barylite has optical properties similar to that occurring in the veinlets, except that it occurs in relatively large grains (as much as 5 mm across). Some grains are partly replaced by an exceedingly fine-grained mineral of very low birefringence.

The Be content of the gneisses ranges from .003–.025% (seven specimens). In addition to the barylite, a little Be also occurs in the pyrochlore, and some may be in the aegirine. Rowe (1961, p. 33–34) states, "Although barylite is the only beryllium mineral that has been identified, its presence does not account for by (*sic*) all of the beryllium consequently there must be other beryllium or beryllium-bearing minerals in the rock." That another Be mineral in addition to the barylite probably was present was suspected by one of us (R.W.D.) about $1\frac{1}{2}$ years ago. The other Be mineral appears in the light specific gravity fraction (<3.0) and has optical properties that suggested it might be epididymite (Michel-Levy, 1961). We were, however, unable to isolate a sufficient number of grains for a positive identification by *x*-ray means.

The unknown minerals, on which work is continuing, include:

Unknown No. 2. Deep brownish red; pleochroic from deep red to golden brown; anhedral to skeletal; Biaxial (+) $2V=60°$; $v>r$, extreme; two cleavages at 80°. B 0.022. High relief (1.72–1.75). May be intergrown with pyrochlore. Strongest lines in *x*-ray powder pattern: $d=3.43$, 3.17, 2.90, 2.45. A silicate of Ti and Fe.[1]

Unknown No. 5. Moderate relief (1.60), moderate birefringence; biaxial (+), $2V=65°$; two good cleavages.

Origin. The barylite occurrence near Seal Lake is similar to that at Vishnevye Gory, U.S.S.R., (Zhabin and Kasakova, 1960), where the

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[1] Since this was written, this mineral has been identified as neptunite (Heinrich and Quon, manuscript in preparation).

mineral occurs in calcite veins that cut fenites. The veins also contain aegirine-augite, microcline and albite and accessory bastnäsite, eschynite, barite, strontianite, thorogummite, harmotome, fluorite, quartz, several sulfides, and TiO_2 minerals. The geology of the Seal Lake deposits is completely different from the other two known occurrences; namely, Langban, Sweden, and Franklin, New Jersey.

The Seal Lake barylite has been formed as a product of alkali metasomatism in fenitized amphibole gneisses which have received Na, Nb, Th, RE, Zr, Ba, Be, P, Zn, Ga, and doubtless other elements from solutions related genetically to crystallization of the alkali syenite. An analysis of one specimen of the syenite showed but 0.0002% Be. Alkalic rocks may contain noteworthy Be concentrations (e.g., nepheline syenites average about 0.001% Be), probably chiefly in aegirine (Warner *et al.*, 1959), yet are not noted for associated accumulations of Be minerals. In the Seal Lake deposit, the accumulation of Be in barylite, marginal to the intrusive, accompanies a paucity of Be in the intrusive itself. This suggests the operation of an unusually efficient process of Be fractionation and concentration.

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