ON THE OCCURRENCE OF BERYLLIUM IN THE ZINC DEPOSITS OF FRANKLIN, NEW JERSEY

CHARLES PALACHE, *Harvard University*,
AND
L. H. BAUER, *New Jersey Zinc Company*.

In the spring of 1929, the junior author discovered the presence of beryllium in crystals of a complex silicate of unknown nature newly found at Franklin. Crystallographic and optical tests established the nature of this silicate as vésuvianite, a determination with which the analysis was in agreement. It was further found that cyprine from the same deposit showed the presence of beryllium spectroscopically although not in the same abundance.

In August another unrecognized mineral was found at Franklin which upon analysis proved to be the beryllium-barium silicate barylite, previously known only at Långban, Sweden. These minerals are described in the following pages.

The presence of beryllium in the Franklin ores is of uncommon interest. The present intensive search for adequate supplies of beryllium ores with which to establish the manufacture of this valuable metal makes any new occurrence of the element important. Unfortunately these beryllium minerals occur in veins of moderate extent. But if, as will be shown later to be probable, beryllium is really a normal constituent of vesuvianite then a new source of this element may be available. The probability that beryllium would be found at Franklin in some form was foretold by the observation of the German spectroscopist Eberhard[1] in 1912 of beryllium lines in the arc spectrum of willemite from that place. It appears however from these new discoveries that the beryllium is not typically associated with primary willemite ore but is a post-ore element introduced into the deposit by the contact action of the granite pegmatites as described by Palache.[2]

The vesuvianite occurs in the form of slender brown prisms embedded in a coarsely granular mixture of green willemite, brown garnet, leucophoenicite and barite with subordinate amounts of svabite, native copper and gageite. This is a typical paragenesis for veins of pegmatitic (high temperature) derivation.

The crystals show a simple combination of the common vesuvianite forms, *p*(111), *m*(110) and *a*(100). They are of poor quality

---

[1] Liebisch, *Sitzb. d. preuss. Akad. Wiss.*, **13**, 229, 1912.

[2] Palache. *Am. Mineral.*, **14**, 1, 1929.

for measurement as is so often the case with crystals of this substance. Thirteen values of ρ for (111) on four crystals gave an average angle of 36° 52′ with the range 36° 26′–37° 13′. This corresponds to the element $c=p_0=0.5303$. Dana, *System*, $c=0.5372$. It is optically uniaxial, negative, with absorption in brown, $\omega>\epsilon$ $\omega=1.712$; $\epsilon=1.700$. Specific Gravity 3.385 ± .002.

The chemical analysis of a sample of picked crystals, by L. H. Bauer follows:

ANALYSIS OF BE-VESUVIANITE

	1. Percentages	2. Mol. Ratios	3. Mol. Ratios
SiO_2	34.25	.568	6×.095
CaO	33.15	.591	6×.099
BeO	9.20	.367	4×.092
MgO	3.17	.079	
MnO	4.84	.068	2×.103
ZnO	4.86	.060	
Al_2O_3(FeO*)	9.70	.095	1×.095
H_2O	1.31	.073	
	100.48		

* FeO trace.

This analysis yields very exactly the formula $2RO \cdot 6CaO \cdot 4BeO \cdot Al_2O_3 \cdot 6SiO_2$ where R = Mg, Mn, and Zn in about equal proportions. The small amount of H_2O is ignored as probably unessential. It will be noted in column 3 above that the ratios come out with great exactness. This is noteworthy particularly because in general the molecular ratios derived from vesuvianite analyses yield no such simple formula. It seems highly probable that beryllium is generally present in this mineral but has not been recognized, being determined as alumina. This, because of the very low molecular weight of BeO, would affect the ratios to a large degree. A chemical examination of other occurrences of vesuvianite for a possible beryllium content will therefore be of much interest and will be an early subject of investigation.

The form of vesuvianite known as cyprine is well known at Franklin and has been frequently analyzed. None of the analyses yield a simple ratio. It has now been established by Mr. Nitchie of the New Jersey Zinc Company's chemical staff at Palmerton, Pa., that cyprine shows spectroscopically strong lines of beryllium although relatively less strong than in spectrograms of the brown Be-vesuvianite.

BARYLITE

Barylite was first described fifty years ago as an aluminum barium silicate occurring at Långban in association with hedyphane. It was not until 1923 that a new examination by Aminoff proved that the supposed alumina was really beryllium oxide. Barylite was first found at Franklin last August in specimens of hedyphane and calcite. It was first seen on the picking table but was later found in the mine in 960 pillar, 20 feet below the 400 foot level North about 15 feet from the hanging wall.

Attention was first drawn to the mineral by its vivid blue fluorescence in ultra-violet light, a color not previously yielded by any Franklin mineral. The following analysis by Mr. Bauer was made on selected fragments of the fluorescent substance:

BARYLITE

	1. Percentages	2. Mol. Ratios
SiO_2	36.42	.604
BaO	46.49	.302
BeO	15.77	.628
Al_2O_3	——	
MnO	——	
FeO	.19	
CaO	——	
MgO	.29	
ZnO	present	
PbO	.11	
H_2O 110°C	.40	
	99.67	

Examination of the analysis and derived molecular ratios shows that it is extremely pure material, yielding with great exactness the formula $2BeO \cdot BaO \cdot 2SiO_2$.

It may be observed that the BeO content of barylite, nearly 16 per cent, is higher by 2 per cent than that of beryl, the commonest beryllium compound.

The Franklin barylite is in plates embedded in hedyphane with some willemite. The single specimen seen is clearly part of a well banded vein, the succession of bands from a surface of ore being

(a) brown calcite and native copper; (b) gray calcite; (c) narrow zone of willemite and serpentine; (d) white calcite in curved rhombohedra, strongly fluorescent in ultra-violet light; (e) barylite, hedyphane and willemite. The barylite plates are more or less brecciated and are cemented with thin films of serpentine.

Barylite is white, 7 in hardness, and shows two good cleavages, one basal (001) and the other parallel to the pinacoid (100). Specific Gravity 4.066 ± .002. Optical properties (determined by H. Berman) are:

Biaxial, negative, 2V = 70° ± 2°
(measured on Fedorow stage)

$$\alpha = 1.695 \pm .002$$
$$\beta = 1.702 \pm .002$$
$$\gamma = 1.708 \pm .002$$

Cleavages normal to γ and β.

These data differ somewhat from those given by Aminoff (remeasured by Berman) for the Långban mineral, which has somewhat lower indices of refraction, a slightly lower specific gravity, and the opposite optical sign in most cases. It is also to be noted that two cleavages are here reported whereas but one is given by Aminoff.