

NEW DATA ON LOSSENITE, LOUDERBACKITE, ZEPHAROVICHITE, PEGANITE, AND SPHAERITE

RICHARD M. PEARL,*

Colorado College, Colorado Springs, Colorado.

ABSTRACT

Lossenite of Milch (1894) from Laurium, Greece, is shown to be a mixture of scorodite and beudantite. Louderbackite of Lausen (1928) from the fire zone of the United Verde mine at Jerome, Arizona, is identical with roemerite. Zepharovichite of Bořický (1869) from Třenice, Bohemia, is very probably identical with wavellite. Peganite of Breithaupt (1830) from Langenstriegis, Saxony, is identical with variscite as earlier stated by Larsen and Schaller (1925). Sphaerite of Zepharovich (1867) from Zaječow, Bohemia, is probably identical with variscite.

LOSSENITE

Lossenite was described by Milch (12) in 1894 as a new orthorhombic mineral resembling scorodite in habit. It was found with scorodite and calcite at Laurium, Greece, in druses in a ferruginous quartzose rock. It occurred in acute pyramids, one-half to three millimeters in length, brownish red in color and often altered on the surface. Lacroix (5) in 1915 found beudantite associated with scorodite at this locality and expressed his belief that the original determination of lossenite had been made on a mechanical mixture of beudantite and scorodite. The chemical analysis of the original lossenite and the calculated percentage compositions of beudantite ($\text{PbFe}_3(\text{AsO}_4)(\text{SO}_4)(\text{OH})_{16}$) and of scorodite ($\text{FeAsO}_4 \cdot 2\text{H}_2\text{O}$) are tabulated below for comparison.

	PbO	Fe ₂ O ₃	As ₂ O ₅	SO ₃	H ₂ O	CaCO ₃	SiO ₂	Total
"Lossenite"	10.63	34.53	33.44	3.74	15.55	1.46	1.13	100.48
Beudantite	31.35	33.68	16.14	11.24	7.59			100.00
Scorodite		34.60	49.79		15.61			100.00

A re-examination of type material from Laurium in the Harvard collection (No. 89508) shows the "lossenite" to be partly covered with rhombohedrons of beudantite. This identification of beudantite was suggested by the appearance of the pseudo-cubic crystals and proved by their optical properties and the *x*-ray powder pattern. If the sample upon which the original analysis was made was actually scorodite containing particles of this beudantite, there would be an adequate explanation for the presence of the lead and the sulfate in addition to the constituents due to the scorodite. This is presumed to have been the case,

* Contribution from the Department of Mineralogy and Petrography, Harvard University, No. 323.

especially since Milch described some of the lossenite crystals as being covered with an olive-green alteration layer, whereas the larger crystals had a coating of iron hydroxide. These are obviously two different minerals on the specimen examined here; it is the beudantite crystals that show the alteration layer, which has a greenish yellow color and a bright luster, and is exceedingly thin.

The *x*-ray powder pattern of the lossenite, carefully selected for its freedom from beudantite, is the same as that of scorodite from Utah. The interplanar spacing is somewhat greater in the lossenite than in this particular scorodite, indicating a very slightly larger unit cell, but this increase is within the range of scorodite, in which there may be a substitution of aluminum for iron (toward mansfieldite) and of phosphorus for arsenic (toward strengite).

Lossenite and scorodite are optically similar. The indices of refraction of lossenite ($nX=1.783$, $nY=1.788$, $nZ=1.818$) are within the ordinary range of published values for scorodite and are relatively close to the values $nX=1.771$, $nY=1.805$, $nZ=1.820$ found for the scorodite from the Kiura mine, Bungo, Japan. Both lossenite and scorodite are optically positive, with $X=a$, $Y=c$, $Z=b$, and $r>v$. The other physical properties and the crystallography of lossenite are similar to those of scorodite. For the unit pyramid of lossenite, $\phi=50^{\circ} 12'$, $\rho=55^{\circ} 53'$ (calculated from Milch's original inadequate data); and of scorodite, $\phi=49^{\circ} 02'$, $\rho=55^{\circ} 42'$.

LOUDERBACKITE

Louderbackite was described by Lausen (11) in 1928 as a new mineral formed under fumarolic conditions, together with eight other hydrous sulfates (four of which were also regarded as new species), as a result of a fire in the United Verde copper mine at Jerome, Arizona. It occurs as a translucent to transparent thin crystalline crust of pale chestnut-brown color.

The absence of certain critical data in the original description of louderbackite, together with apparent similarities between louderbackite and roemerite, suggested the advisability of re-examining this mineral. The study was made on a type specimen of louderbackite from Jerome (H. 90534). The reported chemical analysis of louderbackite is given below in comparison with the calculated percentage composition of roemerite.

	Na ₂ O	FeO	Fe ₂ O ₃	Al ₂ O ₃	SO ₃	H ₂ O	Total
Louderbackite	0.88	7.01	20.84	2.55	39.34	31.33	101.95
Roemerite		8.94	19.86		39.83	31.37	100.00

The *x*-ray powder pattern of louderbackite is identical with that of

roemerite. Any changes in structural dimensions due to difference in chemical composition between the two specimens is imperceptible. The indices of refraction of louderbackite as newly determined diverge somewhat from those of roemerite as shown in the following tabulation:

	Louderbackite Lausen (11)	Louderbackite (New data)	Roemerite Rammelsberg (New data)	Roemerite California (10)
<i>n</i> X	1.544	1.543	1.525	1.526
<i>n</i> Y	1.558	1.560	1.571	1.571
<i>n</i> Z	1.581	1.582	1.582	1.583

A difference in composition must be responsible for this divergence. The different indices also account for the fact that louderbackite is optically positive, whereas roemerite is negative. $2V$ is about 40° or 45° for both minerals. Louderbackite is non-pleochroic, whereas roemerite is pleochroic in colorless and lemon yellow. The very strong disperison ($r > v$), not previously recorded for louderbackite, is characteristic of both minerals, as may be expected from the chemical composition. The other physical properties of both minerals are closely alike. It is improbable that louderbackite is orthorhombic as stated; in sodium light, used to eliminate the anomalous interference colors, the extinction is found to be inclined rather than parallel. The triclinic crystallization of roemerite is well known. Attention should be called to the chemical analysis of louderbackite. Depending upon the selection of material and the adequacy of the analysis, louderbackite may be regarded as an aluminian variety of roemerite, explaining thereby the optical differences between them.

ZEPHAROVICHITE

Zepharovichite was described as a new mineral from Třenice near Cerhovic, Bohemia, in 1869 by Bořický (1). The chemical analyses were based upon admittedly impure material, and Dana (3) long ago expressed doubt that the species was valid because of its resemblance in composition to callainite, which he regarded as a distinct mineral. Callainite has since been shown by Lacroix (4) to be in all probability identical with variscite. Two of the original analyses of zepharovichite are given below in comparison with the calculated composition of wavellite.

	CaO	Fe ₂ O ₃	Al ₂ O ₃	P ₂ O ₅	H ₂ O	SiO ₂	Total
Zepharovichite	0.54		28.44	37.46	26.57	6.05	99.06
Zepharovichite	1.38	0.86	29.60	37.80	28.98	0.46	99.08
Wavellite			37.11	34.47	28.42		100.00

No optical data were given in the original description. A later observation by Slavik (14) put the mean index of refraction at 1.55, the fibers

having positive elongation. Larsen (6) recorded a similar index, with a birefringence about 0.01 to 0.02, on material from the original locality, and stated that the mineral may be impure wavellite. A specimen labelled zepharovichite (H. 101399) from Cerhovic, Bohemia, occurring as a white fibrous crust with the same optical properties, gave an *x*-ray powder pattern like that of authentic wavellite from Montgomery County, Arkansas. In view of these facts, zepharovichite appears to be identical with wavellite. Some uncertainty still remains, however, since the specimen examined is not of the type material.

PEGANITE

Peganite was described in 1830 by Breithaupt (2) as a new mineral, occurring in a thin crystalline crust on a siliceous rock at Langenstregis, east of Frankenberg, Saxony. The general appearance of the material, its chemical composition, and its association with wavellite have since suggested a possible identify with variscite. Moschetti (13) in 1918 re-analyzed a specimen from the original locality and found the formula to be the same as that of variscite. Larsen and Schaller (7) further suggested the identity of peganite and variscite from optical data—the indices of refraction, sign, $2V$, elongation, and extinction being similar. They recommended that the name peganite, which, though older, had been proposed for a mineral that was improperly analyzed, be discarded.

Peganite from the type locality (H. 101400) has been re-examined by both optical and *x*-ray methods. The material answers to the original description, consisting of dark- and bright-green radiating fibers in botryoidal crusts and has indices of refraction ($nX=1.562$, $nY=1.582$, $nZ=1.588$) that check with those obtained by Larsen and Schaller. This authenticated peganite gave an *x*-ray powder pattern exactly like that of authentic specimens of the green variscite from Fairfield, Utah, described by Larsen and Shannon (8) and by Larsen (9). The name peganite should by now be fully discredited.

SPHAERITE

Sphaerite was described in 1867 by Zepharovich (15) as a new mineral occurring in small globules at Zaječow, north of St. Benigna, Bohemia. Larsen (6) published some optical data on a specimen from Cerhovic, Bohemia. The optical properties of a specimen of sphaerite labelled as from Cerhovic, Bohemia, in the Harvard collection (H. 98201) are within the range of microcrystalline variscite. The mineral occurs as greasy, bluish gray spherulitic shells and appears coarsely fibrous to platy under the microscope. It is associated with wavellite, which is in characteristic radiating globules. The indices of refraction are $nX=1.564$, $nY=1.577$,

$n_Z = 1.590$. The optic sign is negative, but the elongation is positive. $2V$ is large, about 70° .

Another specimen of sphaerite labelled as from Třenice, Bohemia, (H. 98149) gives closely similar indices of refraction and other optical properties, and both specimens check with the data given by Larsen for so-called sphaerite from these localities. The x -ray powder patterns of the sphaerite from Cerhovic and Třenice are identical with that of variscite from Fairfield, Utah.

The original analysis of sphaerite from Zaječow is given below in comparison with the calculated percentage composition of variscite.

	CaO	MgO	Al ₂ O ₃	P ₂ O ₅	H ₂ O	Total
Sphaerite	1.55	3.04	42.56	27.90	24.06	99.11
Variscite			32.26	44.94	22.80	100.00

It is impossible to reconcile the analyses of the two minerals. Significant amounts of CaO and MgO have been reported in analyses of variscite, but the greater amount of aluminum and the lesser amount of phosphorus in sphaerite as compared to variscite is not easily explained as due other than to gross admixture. No evidence of such admixture was found in the present optical and x -ray study, and it appears that sphaerite is wholly identical with variscite. A re-examination of type material would be desirable.

ACKNOWLEDGMENT

Grateful acknowledgment is made to Dr. Clifford Frondel for his supervision and generous help throughout.

REFERENCES

1. BOŘICKÝ, E.: *Sitzber. Ak. Wien*, **59**, 593 (1869).
2. BREITHAUP, A.: *J. Chemie u. Phys.*, **60**, 308 (1830).
3. DANA, E. S.: *System of Mineralogy*, 6th ed., 825 (1892).
4. LACROIX, A.: *Min. de la France*, **4**, 480 (1910).
5. ——— *Bull. soc. min.*, **38**, 35 (1915).
6. LARSEN, E. S., JR.: *U. S. Geol. Surv., Bull.* **679**, 135, 158 (1921).
7. ——— AND SCHALLER, W. T.: *Am. Mineral.*, **10**, 23 (1925).
8. ——— AND SHANNON, E. V.: *Am. Mineral.*, **15**, 307 (1930).
9. LARSEN, E. S., III: *Am. Mineral.*, **27**, 281 (1942).
10. LANDON, R. E.: *Am. Mineral.*, **12**, 279 (1927).
11. LAUSEN, C.: *Am. Mineral.*, **13**, 220 (1928).
12. MILCH, L.: *Zeit. Krist.*, **24**, 100 (1894).
13. MOSCHETTI, L.: *Atti Accad. Sci. Torino*, **53**, 1062 (1918).
14. SLAVIK, F.: *Rozpravy České Ak.*, **26**, Cl. 2, no. 60 (1917).
15. ZEPHAROVICH, V. R.: *Sitzber. Ak. Wien*, **56**, 24 (1867).