

NEW DATA ON AGRICOLITE, BISMOCLITE, KOECHLINITE, AND THE BISMUTH ARSENATES

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ABSTRACT

Agricolite is identical with eulytite. Rhagite is identical with atelestite. Arsenobismite from Tintic, Utah, is a valid species and a new locality at Tazna, Bolivia, is noted. A new but un-named bismuth arsenate is briefly described and three localities are cited. Two new localities are cited for both koechlinite and bismoclite. X-ray powder spacing data are tabulated for atelestite, arsenobismite, koechlinite, and for a new un-named bismuth arsenate.

IDENTITY OF AGRICOLITE WITH EULYTITE

Eulytite, $\text{Bi}_4\text{Si}_3\text{O}_{12}$, occurs as well-developed isometric hextetrahedral crystals. The material usually is weakly birefringent, and has been thought to be only pseudo-isometric at ordinary conditions. Some crystals are internally divided into uniaxial segments, or show polysynthetic birefringent twinning lamellae. The optical anomalies have been described by Bertrand (1881). The x-ray powder diffraction effects, however, are completely accounted for on the basis of a hextetrahedral structure, as shown by Menzer (1931), and any departure from isometric symmetry must be slight. The calculated specific gravity, 6.82, is considerably greater than the observed values. The writer obtained 6.61 for yellow eulytite crystals and 6.63 for massive agricolite (= eulytite), using a microbalance. Menzer obtained 6.6 ± 0.2 and Rath (1869) gave 6.106 for eulytite. Agricolite of Frenzel (1873) has been thought to be a monoclinic polymorph of eulytite. The supposed monoclinic character was based on very inconclusive evidence (see Groth cited by Frenzel (1873)). The writer examined several specimens of agricolite from both Schneeberg and Johanngeorgenstadt, Saxony. This material comprised radial, semi-globular aggregates and answered the original description in all details. The x-ray powder pattern proved to be completely identical with that of eulytite. Optically, agricolite is very weakly birefringent. The mean index of both agricolite and eulytite varies slightly in different specimens but for the most part is about 2.04. Eulytite as presently constituted and agricolite must be accepted as identical. The possibility exists that agricolite represents a primary occurrence of the inversion product (?) of a truly isometric eulytite. The name eulytite (eulytin), proposed by Breithaupt in 1827, has priority. The mineral from Schneeberg later named agricolite was known to Breithaupt in 1827 and was, in fact, considered by him to be identical with eulytite.

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BISMOCLITE

Bismoclite, BiOCl , was described in 1935 by Mountain from Namaqualand, South Africa. The crystal structure of BiOCl together with the identity of the natural and artificial materials was established by Bannister (1935). More recently, Schaller (1941) has shown that the so-called crystallized bismite from Goldfield, Nevada, is bismoclite. Two additional localities for bismoclite may be mentioned. The mineral was found as dense grayish-green masses in a greisen-like rock from Bygoo, New South Wales. Under the microscope the substance appeared as indistinct shreds and plates with an occasional semblance of a square outline. The bismoclite is an alteration product of embedded masses of some other bismuth mineral. Bismoclite also was identified as grayish-green, compact masses from Tintic, Utah. This material was microcrystalline and admixed with limonite, quartz and other impurities. Daubreeite, $\text{BiO}(\text{OH}, \text{Cl})$, a mineral shown recently by Bannister (1935) to be a member of an isomorphous series with bismoclite, was doubtfully reported by Means (1916) from Tintic, Utah. Mean's original specimens were available for study but the particular substance to which he was referring could not be identified. His mineral probably was bismoclite.

KOECHLINITE

This species was described by Schaller in 1916 as an orthorhombic bismuth molybdate, Bi_2MoO_6 , from Schneeberg, Saxony. Part of the original material was available for study. The x -ray powder spacings are given in Table 1. The pattern is rather similar to that of tetragonal Bi_2O_3 . Two new localities may be reported. The mineral occurs as small lamellar aggregates of a yellow color embedded in massive milky quartz at the Dunallan gold mine, Coolgardie, Western Australia. The material is an alteration product, probably of tetradymite. Between crossed nicols some of the flakes of the mineral have a mottled appearance due to a variation in birefringence and seem to be altered. The original koechlinite from Schneeberg shows similar features, as described by Schaller. Koechlinite also was found as soft white to yellow masses associated with bismoclite on specimens from Bygoo, New South Wales. Here, too, the mineral has formed by the alteration of a pre-existing bismuth mineral.

BISMUTH ARSENATES

Five different arsenates of bismuth have been reported from nature: walpurgite, mixite, atelestite, rhagite, and arsenobismite. Walpurgite and mixite appear to be valid species although our knowledge of them leaves much to be desired. A new occurrence of mixite can be mentioned. The

mineral was found as thin, cross-fiber veinlets and needles in bismutite in specimens from Durango, Mexico.

Several non-type specimens of atelestite (Breithaupt, 1832) and of rhagite (Weisbach, 1874), both from the original locality at Schneeberg, Saxony, were available for study. The atelestite comprised adamantine sulfur-yellow crystals of characteristic habit. The rhagite formed yellowish-green mammillary crusts and otherwise answered the original description. The two minerals gave identical x -ray powder patterns. It proved impossible to measure the optical characters of rhagite, due to the finely fibrous nature of the mineral, but such data as could be obtained agreed with the properties of atelestite. The composition of the two minerals differs only in the ratios, which are based on quite unsatisfactory analyses. Rhagite may be accepted as identical with atelestite. The latter name has priority. The x -ray powder spacing data for atelestite are given in Table 1.

The original analyzed specimens of arsenobismite of Means (1916) from Tintic, Utah, were obtained through the courtesy of Prof. Walter H. Newhouse of the Massachusetts Institute of Technology. The qualitative composition of the mineral was verified by chemical tests. The x -ray pattern and optical characters are distinctive. Optically, arsenobismite is nearly or quite isotropic with an index of refraction above 1.86. The x -ray powder spacing data are given in Table 1. Arsenobismite must be considered as a valid species, but the formula is very uncertain. A second occurrence of arsenobismite was found as yellowish-brown ochreous masses from Tazna, Bolivia.

A new and distinct arsenate of bismuth occurs abundantly in association with arsenobismite at the Mammoth mine in the Tintic district, Utah. The mineral forms pulverulent masses of a dead-white color impregnating friable quartzose and limonitic gossan material. The mineral alters to arsenobismite. Under the microscope this mineral is extremely fine-grained with apparently a moderate birefringence and with indices above 2.04. It is attacked by sulfur-selenium melts and by phosphorus-methylene iodide liquids. The same mineral was found abundantly as pulverulent white to yellow masses in specimens from Tazna, Bolivia, and in one instance was outwardly altered to arsenobismite. A third occurrence was found as thin orange crusts on a specimen of pucherite from Schneeberg, Saxony. The x -ray powder spacing data for this new arsenate are given in Table 1. It is hoped to give a more complete description of this mineral and of arsenobismite at a later time. In connec-

TABLE 1. X-RAY POWDER SPACING DATA FOR KOEHLINITE, ATELESTITE, ARSENOBISMITE AND A NEW UN-NAMED BISMUTH ARSENATE

Copper radiation; filtered

Koechlinite		Atelestite		Arsenobismite		New Arsenate	
<i>I</i>	<i>d</i>	<i>I</i>	<i>d</i>	<i>I</i>	<i>d</i>	<i>I</i>	<i>d</i>
10	3.131	2	6.798	9	6.056	1	8.488
6	2.733	2	6.098	6	3.715	1	6.226
5	2.683	6	4.221	2	3.341	2	4.545
1	2.588	10	3.234	10	3.108	1	4.191
3	2.473	7	3.115	6	3.001	10	3.280
1	2.419	2	2.939	5	2.860	9	3.200
2	2.263	7	2.720	5	2.570	9	3.108
6	1.936	5	2.522	1	2.392	4	3.026
8	1.918	2	2.305	6	2.276	2	2.866
1	1.879	6	2.200	2	2.113	1	2.825
1	1.769	5	2.121	7	1.997	2	2.717
9	1.647	6	2.033	8	1.843	4	2.621
7	1.628	5	1.973	1	1.774	1	2.591
6	1.570	5	1.885	2	1.717	3	2.500
2	1.524	1	1.831	2	1.690	1	2.392
1—	1.486	4	1.803	3	1.568	2	2.282
1—	1.423	2	1.733	3	1.546	3	2.223
1	1.397	4	1.685	3	1.507	1	2.191
3	1.369	6	1.641	1	1.430	2	2.128
3	1.346	3	1.575	1	1.416	3	2.073
1	1.323	3	1.548	1	1.393	8	1.983
4	1.257	4	1.511	2	1.350	5	1.913
6	1.246	2	1.468	1	1.290	2	1.874
5	1.223	2	1.447	2	1.253	2	1.842
4	1.209	4	1.416	1	1.225	5	1.804
1	1.151	1	1.373	1	1.191	2	1.754
5	1.116	4	1.290	1	1.156	2	1.722
4	1.107	1	1.264	1	1.123	5	1.682
4	1.053	1	1.229	1	1.056	1	1.654
3	1.039	3	1.201	1	0.995	1	1.632
1	1.008	1	1.174	1	0.875	2	1.610
3	0.971	2	1.157	1	0.862	7	1.576
5	0.925	2	1.144			2	1.545
5	0.917	3	1.129			1	1.545
1	0.913	2	1.110			1	1.452
5	0.908	2	1.078			2	1.432
1	0.899	2	1.051			1	1.418
4	0.867	1	1.023			1	1.383
4	0.855	1	1.007			1	1.350
5	0.834	1	0.991			1	1.325
1	0.829	1	0.962			1	1.308
1	0.827	1	0.951			1	1.294
1	0.825	1	0.939			1	1.269
		1	0.925			1	1.246
		4	0.909			2	1.223
		2	0.896			2	1.095
		4	0.885				
		4	0.877				
		5	0.863				

tion with this work, the artificial compound BiAsO_4 was prepared by precipitating a weakly acid solution of bismuth nitrate with a slight excess of Na_2HAsO_4 . The air dried precipitate and samples that had been heated three hours at 750°C . gave identical x -ray powder patterns which differed from those of all of the natural bismuth arsenates.

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