Canadian Mineralogist,
Vol. 11, pp. 978-984 (1973)

ALLEMONTITE * AND ITS ALTERATION PRODUCTS FROM THE ODD WEST PEGMATITE, SOUTHEASTERN MANITOBA

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ABSTRACT

Allemontite was found in the central parts of the Odd West pegmatite, associated with montebrasite and quartz. Its formula is $As_{.495}Sb_{.505}$, and it contains exsolved arsenian antimony, $As_{.17}Sb_{.83}$. Arsenian stibnite $Sb_{2.03}(As_{.20}S_{2.77})$ replaces allemontite along cleavage. Senarmontite, probable arsenolite, and stibiconite were formed by supergene oxidation of the above minerals.

The *c* parameters of natural allemontites (10.80-10.85Å), lower than those of synthetic AsSb phases (10.98-11.00Å), are confined to a narrow range of values despite the different origin of individual specimens. This, together with changes of *c* induced by heating of homogeneous allemontites, suggests that their *c* periods are not inflluenced by an admixture of Fe alone but also by some structural effects.

INTRODUCTION

Allemontite, a natural stoichiometric AsSb alloy, was found in the Odd West pegmatite, about 1 km north of the western end of Rush Lake, in the Bird River area of southeastern Manitoba. The paragenesis of the pegmatite, located in metasediments of the Archean Rice lake group, is briefly described by Cerný & Harris (1972). Allemontite occurs here in lenticular aggregates up to 10 x 15 x 25 mm, located along the contacts of montebrasite and dark grey quartz in the central parts of the pegmatite body. It is partly altered to arsenian stibnite, and oxidized to senarmontite, probable arsenolite, and stibiconite.

ALLEMONTITE

The allemontite contains exsolved arsenian antimony, and shows the same textural characteristics and general appearance as the similar Sb-bearing allemontite from Varuträsk (Quensel 1956, Fig. 5, « Type I »). The

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* In this article, the term allemontite is used for natural AsSb (1:1) alloys; these commonly contain blebs of arsenian antimony or antimonian arsenic exsolved from original homogeneous non-stoichiometric (As, Sb) alloys. The natural AsSb phase has been referred to as stibarsen by Ramdohr (1955), Strunz (1970), and Leonard *et al.* (1971).

typical basal and rhombohedral cleavages, producing triangular striations and fracture on basal fragments, are well developed. In polished section, exsolution lamellae and blebs of the arsenian antimony are clearly visible in the darker matrix of allemontite.

The chemical composition and unit cell dimensions of the Rush Lake allemontite are shown in Tables 1 and 2, respectively. They agree very well with all the values published to date, also shown in the quoted tables. Unit cell dimensions of the arsenian antimony could not be established since the number and quality of its *x*-ray powder reflections were not sufficient for their calculation. However, the observed small shift of individual *d*-values from values for pure antimony towards those for arsenic confirms qualitatively the composition of this phase, as established by microprobe analysis.

It has been noted by earlier workers that the unit cell dimensions of natural AsSb phases do not correspond to those of their synthetic counterparts. Quensel *et al.* (1937) and Leonard *et al.* (1971) have suggested that the contraction of *c* and the decrease in volume is caused by a small admixture of Fe, which is found in most natural samples but mostly not quantitatively determined. Considering the different parageneses from which the natural AsSb alloys come, the different media from which they crystallized, the rather narrow range of *c* parameters they show (Fig. 1), and the increase of *c* in the homogeneous Varuträsk and Příbram allemontites upon heating (Table 2, Fig. 1), we question the influence of Fe as the only factor. Some variations in the AsSb structure, unknown to date, could be partly responsible for the observed discrepancies ; the existence of the recently-discovered monoclinic species paradocrasite $Sb_2(Sb,As)_2$ (Leo-

TABLE 1. CHEMICAL COMPOSITION OF ALLEMONTITE, ARSENIAN ANTIMONY AND ARSENIAN STIBNITE FROM THE ODD WEST PEGMATITE

	allemontite wt. %	unit cell content *	arsenian antimony wt. %	unit cell content *	arsenian stibnite wt. %	unit cell content *
Sb	62.91	3.03	87.74	4.99	70.93	8.12
As	38.01	2.97	10.87	1.01	4.33	.80
S	—	—	—	—	25.62	11.08
Fe	n.d. **	—	—	—	—	—
	100.92	6.00	98.61	6.00	100.88	20.00

* Hexagonal unit cell content.
** N.d. — not detected.

TABLE 2. UNIT CELL DIMENSIONS AND COMPOSITION OF ALLEMONTITES

Locality (author)	Composition (at. %)	a_0(Å)	c_0(Å)	V(Å^3)
Allemont (Quensel *et al.* 1937)[a]	?	4.054	10.853	154.47
Příbram (Quensel *et al.* 1937)[d]	?	4.054	10.853	154.47
Allemont (Wretblad 1941)[e,d]	?	3.991	10.816	149.19
Příbram (Wretblad 1941)[e,a]	$As_{53.30}Sb_{46.70}$	4.011	10.811	150.62
Příbram (Wretblad 1941)[e,b]	$As_{53.30}Sb_{46.70}$	3.980	10.896	149.47
Varuträsk (Quensel *et al.* 1937)[c]	?	4.048	10.852	154.00
Varuträsk (Quensel *et al.* 1937)[a]	$As_{48.05}Sb_{51.95}$	4.014	10.823	151.01
Varuträsk (Quensel *et al.* 1937)[b]	$As_{48.05}Sb_{51.95}$	3.991	10.914	150.54
Varuträsk (Berry & Thompson 1962)[d]	?	4.020	10.800	151.14
Broken Hill (Leonard *et al.* 1971)[a]	$As_{52.00}Sb_{48.00}$	4.052	10.815	153.77
Rush Lake (this study)[c]	$As_{49.50}Sb_{50.50}$	4.048 (1)	10.829 (3)	153.69 (110)
Synthetic (Quensel *et al.* 1937)	$As_{50.00}Sb_{50.00}$	4.053	10.983	156.24
Synthetic (Skinner 1965)	$As_{49.99}Sb_{50.01}$	4.042 (1)	11.000 (3)	155.6

kX units recalculated to Å, and rhombohedral cell dimensions converted to hexagonal, where necessary; numbers in brackets denote standard deviations in 3rd decimal place.

[a] - homogeneous natural; [b] - homogeneous heated; [c] - heterogeneous, with Sb; [d] - heterogeneous, with AsS; [e] - quoted from Trzebiatowski & Bryjak (1938).

nard *et al.* 1971) suggests that such discrepancies could result from structural and bonding variations within the As-Sb system.

ALTERATION PRODUCTS

Arsenian stibnite replaced the aggregate of allemontite and arsenian antimony preferentially along cleavage planes, in tiny fibres arranged commonly in radiating aggregates. The chemical composition of this mineral shows up to one fifteenth of its sulphur substituted by arsenic (Table 1). *X*-ray powder diffraction patterns of arsenian stibnite, contaminated by allemontite and oxidation products, are sufficient for identification but do not permit a reasonably accurate calculation of unit cell dimensions. The slight shifts in *d*-values from spacings characteristic of pure Sb_2S_3 cannot be related to any simple pattern of changes in *a, b* and *c*.

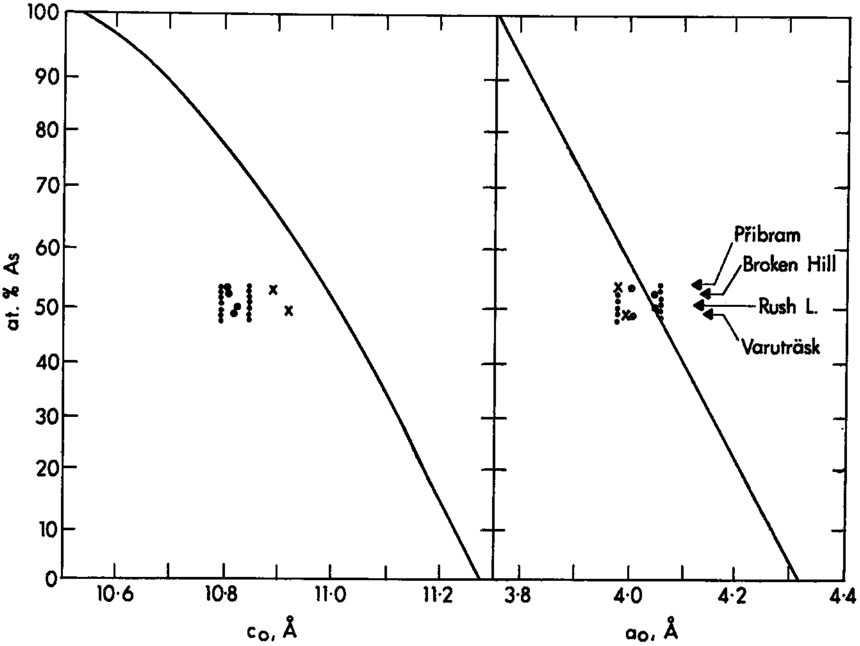

FIG. 1. Unit cell dimensions of analyzed natural homogeneous allemontites (dots; Table 2) compared with those of synthetic (As-Sb) alloys (full lines, after Skinner 1965). Crosses mark the unit cell dimensions of heated homogeneous allemontites from Varuträsk (470°C for 3 hrs., Quensel *et al.* 1937) and Příbram (400°C for 792 hrs., Wretblad 1941). Dotted vertical lines show the unit cell dimension ranges of other allemontites (Table 2).

Senarmontite and possible arsenolite are the only oxidation products found to directly replace the alloys. They form soft chalky white powdery aggregates that penetrate the primary alloys as thin films and flakes along the cleavage planes. The *x*-ray powder diffraction reflections are invariably broad, rarely split into indistinct doublets, and a portion of the chalky material shows *n* around 1.750, characteristic of arsenolite. Thus the cubic oxides of both Sb^{3+} and As^{3+} seem to form at the expense of the native metals.

A wide range of colors is characteristic of a fine-grained to amorphous-looking mineral showing a cubic *x*-ray powder diffraction pattern with a = 10.26 Å. Greenish-white, pale beige, rusty orange, yellow, and dirty brownish coatings of this mineral penetrate skeletal crusts of arsenian stibnite and fissures in adjacent quartz and montebrasite. The *x*-ray data can be correlated with those for stibiconite, but the colour variations and broad range of *n* (1.70-1.84) suggest the presence of more mineral species. Sodic romeite could possibly occur in the particular environment of the pegmatite, and substitution of As for Sb is possible (*cf.* arsenian stibiconite, Mason *in* Quensel 1956), but the available material does not permit any meaningful chemical tests.

ORIGIN

The occurrences of (As, Sb) alloys in pegmatites seem to be very rare. Native bismuth is a relatively frequent accessory phase in well-differentiated granitic pegmatites (*e.g.* Fersman 1940, Ódman 1942, Jahns 1953, Staněk 1954, 1957, Volborth 1960, Vorma & Siivola 1967, Forster *et al.* 1967, Crouse & Černý 1972), but allemontite is reported only from Varuträsk (Quensel *et al.* 1937, Wretblad 1941) ; finds of native antimony and bismuthian antimony also are exceptional (Laitakari 1957, quoted in Volborth 1960).

The Odd West pegmatite containing the described allemontite belongs to the Bernic Lake – Rush Lake group of pegmatites, as characterized by Černý & Turnock (1971). These pegmatites show a high degree of differentiation and enrichment in rare elements (Li, Rb, Cs, Ta, Sn, P, F) and most of them belong to a low pressure / high temperature petalite-bearing type of Li-rich pegmatites. Traces of native metals (Bi) and sulphides (sphalerite, arsenopyrite, chalcopyrite, bismuthinite) have been found in many of them, particularly in the Tanco pegmatite at Bernic Lake (Crouse & Černý 1972 ; the assemblage of native metals and sulphides is currently being studied). They seem to be confined to this pegmatite group, in contrast to other pegmatite types found in southeastern Manitoba.

ACKNOWLEDGEMENTS

The writers wish to express their thanks to Dr. A. C. Turnock and Mr. R. R. Good for help in the field, and to Mrs. I. Černá for handling the computerized part of the unit cell refinement. Dr. R. B. Ferguson kindly reviewed the manuscript. The study was supported by the Geological Survey of Canada and the National Research Council of Canada research grants to the first author.

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Manuscript received February, 1972.