DATA ON SOME RARE SULPHOSALTS

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The typically subvulcanic epithermal veins extending in the young Tertiary rhyolites and andezites of the mines of the Gutin Mountains in Roumania always contain besides the dominating silverferous zinc- and lead-ores antimony sulphosalts too. These sulphosalts which formed towards the end of the hydrothermal phase and partly displace the dominating ores may be ranged among the interesting mineralogical curiosities of these mines. Of them semseyite, andorite, fizelyite and fülöppite have been discovered in the above mines.

In the following, data concerning the sulphosalts collected in 1942—43 from the Kereszthegy of Nagybánya (Baia Mare), Kapnikbánya (Capnic) and Kisbánya (Herja) will be reported.

SEMSEYITE

Semseyite described by *Krenner*[1,2] as a new mineral which be found in Felsőbánya (Baia Sprie) could later also be detected in Kisbánya[3] (Herja), Óradna[4] (Rodna Veche), Nagybánya[5] (Baia Mare) and recently in Kapnikbánya (Capnic), as well developed overgrown crystal groups. Its overgrown crystals and crystal groups occur relatively rarely in these mines, however, in polished ore sections, as the mineral displacing galena, they can be often observed.

In the sections prepared from ores originating from the above mines semseyite was generally found beside galena displacing it, but it also occurred in single granules in addition to sphalerite and pyrrhotite. Semseyite which always displaces galena lobately has a very light greenish-grey colour, a shade darker than that of a galena. In oil the difference is more striking the greenish-grey colour of semseyite becomes more apparent. Beside it galena shows a light pink shade, as mentioned by *Ramdohr* in his text book. Semseyite is somewhat harder than galena which is revealed by the fact that the less strong scratches occurring in galena do not extend further in semseyite. Its lamellae having always a lamellar and never a columnar or needlelike shape are frequently mosaic crystals usually forming fanlike groups. Twinning intergrowth or cleavages could not be detected on the samples examined. Under crossed

nicols appreciable anisotropy can be observed. The results of the etching experiments were in good agreement with the establishment of *Murdoch*. Concentrated hydrochloric acid does not attack the fine fibrous spindle-shaped ore inclusions, so that they are well visible. In the polished sections examined semseyite often forms a transition between galena and jamesonite. Galena is lobately displaced by semseyite, whereas the needlelike crystals of jamesonite penetrate into semseyite (Fig. 1.). It is interesting that if jamesonite displaces galena it penetrates into the latter as frost flower-like aggregations of very fine needles, whereas in semseyite it is found in the form of well deweloped single crystals.

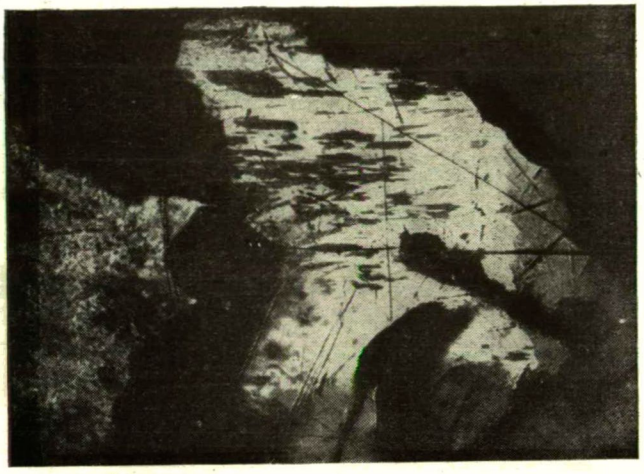

Fig. 1. Jamesonite needles (dark grey) intruding semseyite (white). On the right side of the photomicrograph galena (grey). Crossed nicols. 200 ×

The overgrown crystals of semseyite were found on corroded galena, sphalerite or quartzous gangue. The crystals tabular according to *(001)* were always elongated according to the crystallographic axis *b*. Single thin tabular crystals are rare, usually fanlike crystal-groups or half-spheric-spheric agglomerations of these groups may observed overgrown on the above minerals. In the two best deposits, Kisbánya (Herja) and the Kereszthegy of Nagybánya (Baia Mare) the size of these agglomerations may exceed one cm.

In my paper[4] the semseyites of Felsőbánya (Baia Sprie) and of Kisbánya (Herja) were dealt with, in the present one the crystallographic and chemical examinations concerning semseyite of Kereszthegy and the hitherto unknown of Kapnikbánya (Capnic) will be reported.

According to *Zsivny*[5] in the mine of Kereszthegy in Nagybánya (Baia Mare) semseyite and fizelyite occur on the VIII-th leveel of the main vein. They are overgrown on sphalerite, whereas tiny crystals of sphalerite are overgrown on the crystal aggregations of semseyite. The surface of the crystal aggregations — the size of which is one cm — is dull. On some crystals limited by small lustrous planes — one mm in size — the planes

of the following forms could be established by goniometric measurings: the dominating form is *c(001)*, beside it the planes of the forms *a(100), x(111), n(112), X(111)* occur as narrow bands. The shape of the crystals corresponds exactly with the figures reported by *Krenner*[5] on pages 161—162 of the Centralbl. f. Min. 1930. Abt. A.

The result of the analysis of selected crystals:

Pb	52,02%
Sb	27,39
Fe	0,62
S	19,23
SiO_2	0,66
	99,92%

The formula $Pb_{8,88}Sb_8S_{20,88}$ obtained from the result is in good approximation with the formula $Pb_9Sb_8S_{21}$ which is at the present recognised as that of semseyite.

In polished sections from Kapnikbánya (Capnic) the author has several times observed semseyite as the ore displacing galena, however, its overgrown crystals have as yet not been found. In the hollows of a sample detected in 1942 in the József vein the author of the present paper found a characteristically fanlike group of small semseyite crystals — a few mm in size — associated with sphalerite, bournonite and stibnite. On the crystals covered by lustrous planes the following forms could be established by goniometric measuring:

beside the dominating planes *c (001)* the planes *a(100), p(011, x(111)* as well as *X(111)* occur.

The result of the analysis of the semseyite from Kapnikbánya:

Pb	47,72%
Sb	26,55
Fe	2,80
S	19,93
SiO_2	2,90
	99,90%

Besides a little quartz a small amount of iron sulphide and stibnite impurities were found. After subtracting the insoluble substance and the impurities the obtained formula: $Pb_{8,44}Sb_8S_{20,44}$ approximates that accepted for semseyite. Semseyite is a mineral which formed in the later period of the hydrothermal phase occurring mainly in the upper layers of the veins.

ANDORITE

So far, andorite occurring in the mines of the Gutin Mountains was only known from the main vein[6,8] and the Gyulaköz vein[7] of Felsőbánya (Baia Sprie). In the first volume of his book entitled Lehrbuch der Erzlagerstättenkunde, Jena 1941 *H. Schneiderhöhn* mentions on page 365 by mistake that andorite may be found in Kisbánya (Herja).

It was also observed in the thirties in the Kereszthegy mine of Nagybánya (Baia Mare) on the third level older than stibnite columnar andorite crystals, 3—5 mm long, occur ingrown in very fine fibrous concentrically

radiated stibnite associated with water-clear quartz crystals also older than stibnite. Their colour is lighter than that of stibnite. On two crystals covered with terminal planes the following forms could be established by goniometric measuring:

b(010), m(110), l(230), k(120), x(011), y(031)

The planes *(010)* and *(110)* dominate. The planes of the prism of the first order are well developed, the crystals have the shape of a chisel. It is interesting that on the contrary to the chisellike crystals occurring in Felsőbánya (Baia Sprie) too, on the crystals of Nagybánya (Baia Mare) the bipyramid planes which can so frequently be found on the crystals of the former place do not occur here.

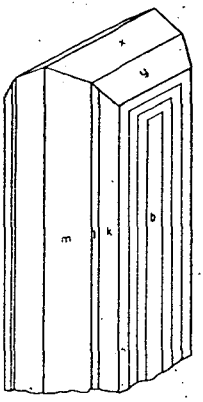

Fig. 2. Andorite crystal from Nagybánya

Under the ore microscope andorite shows a lighter colour than stibnite, beside it stibnite seems slightly greyish, its reflection is also weaker. In oil the difference is still more striking andorite is white, stibnite greenish-grey, its reflection is appreciably weaker. Under crossed nicols the anisotropy of andorite is significant, but its colours are far duller than the bright colours of stibnite. In oil the colours of andorite become a little lighter, light oil-green light pinkish-brown.

A polished section made parallel to the plane *(010)* from a larger andorite crystal showed under crossed nicols an extremely complicated twin structure. Twin lamellae run in the direction of the *c* crystallographic axis and also perpendicularly to it, the latter pinch out like the teeth of a comb (Fig. 3.).

Only the interior of the crystal shows a twin structure its border is homogeneous without twin lamellae. The interior of some of the crystals is cavernous.

The same complicated structure is described by *Ramdohr* concerning a larger ramdohrite[9] from Potosi (Bolivia) and by *Sztrókay* relating to his fizelyite[10] crystals from Kereszthegy of Nagybánya. Hence the three minerals show an entirely identical structure and cannot be distinguished from one another in this way.

Aqua regia attacks it quickly and a dark grey faint patch develops. Nitric acid exerts its effect only slowly, on the etched place a faint brown patch appears. Etching with other reagents is unsuccessful.

The results of the analysis of the andorite:

Ag	9,81%
Pb	19,22
Sb	44,30
Fe	2,04
Cu	traces
Zn	traces
S	24.34
	99,71%

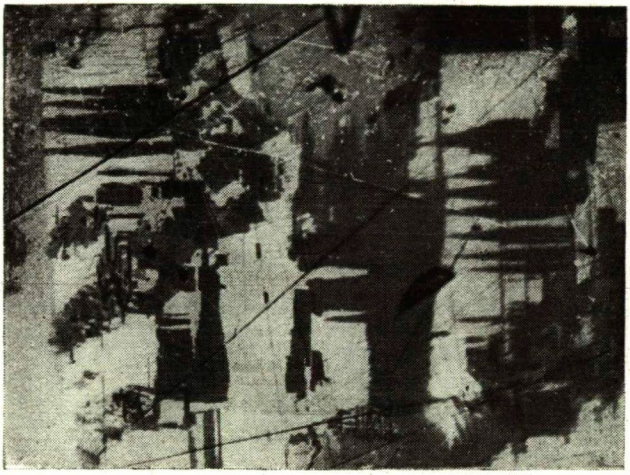

Fig. 3. Twinn lamellae parallel and perpendicular to the axis c in a polished ore section of andorite. Section is parallel to the (010) plane. Crossed nicols. 240 ×

The result of the analysis of the extremely finely fibrous stibnite associated with the andorite:

Sb	70,77%
Pb	0,43
Fe	0,74
S	28,05
SiO_2	0,47
	100,46%

ZINKENITE

Fülöppite occurs in the Kereszthegy mine of Nagybánya (Baia Mare) associated with a radiated finely fibrous mineral. The analysis showed that this mineral is zinkenite[11]. It was found ingrown in quartz, or in needle groups concentrically protruding from it, on the third level. On the zinkenite needles protruding from quartz very tiny almost black sphalerite crystals are deposited densely.

Under the ore microscope the fibers situated perpendicularly to the c axis have sexagonal cross-sections, the fibers running parallel to the c axis often have the shape of a spindle. Parallel extinction, considerable anisotropy may be observed, but the colours are not so vivid as in the case of stibnite or berthierite. Perpendicularly to the c axis its colour is slightly reddish-brown.

The results of the etching experiments were identical with the establishments of *Murdoch.*

The samples used for the analysis contained sphalerite impurities, as the needles could not be freed from the sphalerite crystals deposited on them.

The results of the analysis of needles taken from two different samples :

	I.	II.
Pb	19,83%	24,61%
Sb	28,69	36,49
Zn	22,38	13,46
Fe	1,88	1,34
Cu	traces	0,03
S	26,44	24,64
SiO_2	0,51	—
	99,73%	100,57%

On subtracting the zinc and iron as sphalerite and FeS respectively, furthermore the SiO_2 and recalculating the remainder to 100 per cent we have:

	I.	II.
Pb	31,52%	31,41%
Sb	45,61	46,57
S	22,87	22,02
	100,00%	100,00%

The formulae obtained on this basis $Pb_6Sb_{14,7}S_{28,1}$ (I) and $Pb_6Sb_{15,0}S_{27,1}$ (II) respectively, approximate the formula $Pb_6Sb_{14}S_{27}$ accepted for zinkenite.

It should be remarked that the locality of the substance used for the analysis of the zinkenite described in Palache—Berman—Frondel's »Dana's System of Mineralogy« vol. I. 1946 (7th ed.) p. 477 is not Nagyág (Sacaramb) as mentioned there, but Nagybánya (Baia Mare). The locality of the fülöppite the analysis of which is likewise reported on p. 463 of the above book is also Nagybánya.

BERTHIERITE

Berthierite occurs in three different mines of the Gutin Mountains: Felsőbánya[12] (Baia Sprie), Kisbánya[13] (Herja), and the Kereszthegy[14] of

Nagybánya (Baia Mare). At Kisbánya, in the Salán-vein it was found in very abundant amounts in the thirties.

Its needles which are very fibrous and never covered by terminal planes form thready radiated dense groups the weight of which exceeds one kg, the length of the single needles sometimes attain 10—15 cm. The groups of needles are often covered by $-^1/_2$ rhombohedrons of uncoloured or white calcite, or by slightly yellowish crystalline globular dolomite. On the polished ore sections prepared of berthierite tarnished to dark steel blue, occasionally steel blue, or tombac-brown the single threads are swept apart, or have the shape of a spindle. Cleavages could not be observed on them. The characteristic reflective pleochroism mentioned by Ramdohr is extremely well visible. Under crossed nicols its anisotropy is vivid the colours are brighter than those detected in the case of jamesonite. In contradiction to Davy and Farnham in the case of our etching experiments on the action of concentrated hydrochloric acid a very weak grey patch appeared slowly, whereas if concentrated nitric acid attacked the surface a large amount of gas evolved, and at the place of attack a dark grey patch appeared.

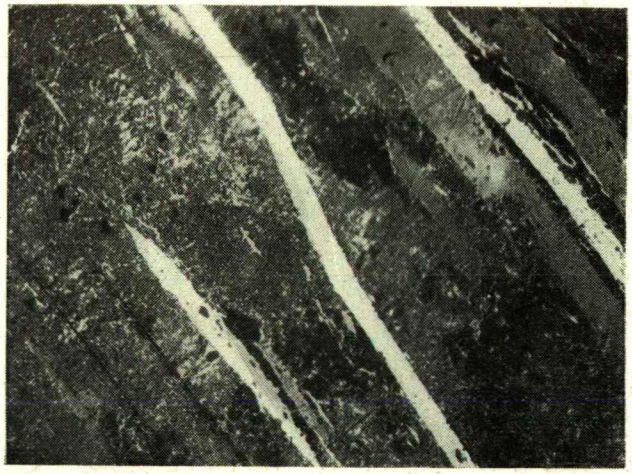

Fig. 4. Berthierite from Kisbánya. The interstices of the coarse-fibrous berthierite are filled up by plumositelike fine-fibrous berthierite. Crossed nicols. 200 ×

The coarsely thready aggregation is generally dense, some smaller hollows are filled up with extremely fine threaded, plumositelike berthierite (Fig. 4). This finely thready berthierite occurs in larger masses in caves formed of dolomite. The feltlike aggregation of its extremely fine threads always shows a slight brownish shade, whereas on the other hand, jamesonite-plumosite exhibits a dark grey colour, it is more brittle than the latter.

The result of the analysis of the plumositelike berthierite from Kisbánya is as follows:

Fe	15,13%
Pb	0,32
Sb	55,00
S	29,61
SiO_2	0,16
	100,22%

Berthierite occurs associated with black sphalerite in fine concentrically radiated needles the size of which amounts to one cm in the mines of the Kereszthegy of Nagybánya (Baia Mare). The hollows between the extremely brittle crystals having no terminal ending are filled out as may be seen from the analysis by jamesonite — plumosite. The fine threads of the latter are so strongly attached to the needles of berthierite that they could not be detached. The result of the analysis:

Fe	14,57%
Pb	2,81
Sb	54,41
S	28,72
	100,51%

The lead belongs to the jamesonite, whereas the somewhat high iron content in both analyses is due to very finely dispersed marcasite forming on the large surface of the finely fibrous berthierite.

The analyses reported in the present paper were made by *Gy. Grasselly*.

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Correction

Page 59, in the second line first caption instead of halloysite kaolinite is to be inserted.