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ARSENATE MINERALS FROM HUNGARY

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ABSTRACT

In this paper we introduce some arsenate minerals found recently in the ore deposits and ore indications in Hungary. The essential demand of their formation was the presence of arsenopyrite or the members of the tetrahedrite group. Under such circumstances it was generally possible to identify arsenate minerals from the oxidized zone of the ore deposits. Arseniosiderie, segnitite, scorodite and probably arsenbrackebuschite were found in the hydrothermal polimetallic ore veins at Nagybörzsöny, Börzsöny Mts. Olivenite, mimetite, beudantite and a tyrolite-like arsenate mineral were found in the hydrothermal-metasomatic iron ore deposit with accessory at Rudabánya, Rudabánya Mts. In a limestone quarry near Pécs, Mecsek Mts. olivenite, conichalcite and tyrolite were found. Talmessite and picropharmacolite were identified in dolomite concretions in the sedimentary infiltrated uranium ore deposit at Kővágószőlős, Mecsek Mts. Scorodite and pharmacosiderite were observed in the epithermal alunite veins of the limnoquartzite at Mád, Tokaj Mts. Pharmacosiderite was identified in the epithermal mineral assemblage of hydroquartzite at Gyöngyössolymos, Mátra Mts.

INTRODUCTION

Arsenate minerals have recently ben discovered in Hungary. Annabargite from the serpentinite at Helesfa (Mecsek Mts.) was referred to by SZEDERKÉNYI (1962).

According to the literature (KOCH 1985, PAPP and WEISZBURG 1986) the members of the tetrahedrite group are widely distributed, in small quantity though. A lot of microprobe analyses were made on them (DOBOSI 1976, 1979, 19880, 1982, 1983, 1984) which showed that the As content could reach up to 20 percent in some cases.

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It could be expected that in the oxidized zone of the ore deposits arsenate minerals would appear. The same is the situation at the Nagybörzsöny ore veins being the only place in Hungary where arsenopyrite is found. It is long been known that arsenopyrite is one of the dominant sulphide in the ore veins at Nagybörzsöny (KOCH and GRASELLY 1952, PANTÓ and MIKÓ 1964).

The detailed description shows that the arsenates have the same type of occurrence – they are found in the oxidation zone of the deposits containing arsenopyrite and/or the members of the tetrahedrite group (Table 1. *Fig. 1*)

TABLE 1

Arsenate minerals from Hungary

LOCALITIES / SPECIES	Nagy-börzsöny	Ruda-bánya,	Pécs	Kővágó-szőlős	Mád	Gyöngyös-solymos	Helesfa
Annabergite							+
Arsenbrackebuschite ?	+						
Arseniosiderite	+						
Beudantite		+					
Conichalcite			+				
Mimetite		+					
Olivenite		+	+				
Pharmacosiderite					+	+	
Picropharmacolite				+			
Scorodite	+				+		
Segnitite	+						
Talmessite				+			
Tyrolite			+				

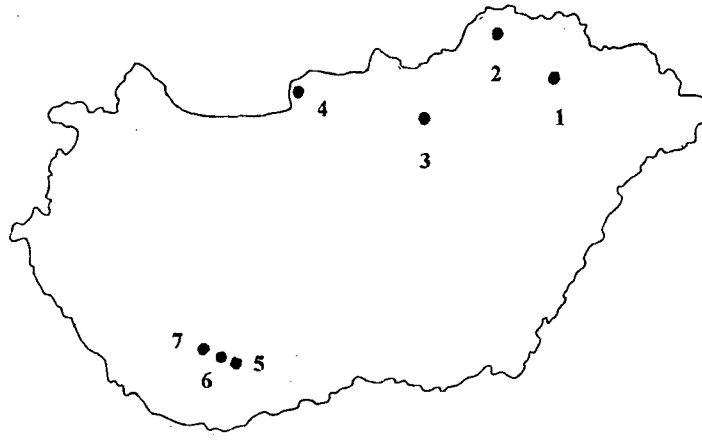

Fig. 1. Occurrences of arsenate minerals from Hungary
1. Mád 2. Rudabánya 3. Gyöngyössolymos 4. Nagybörzsöny 5. Pécs 6. Kővágószőlős 7. Helesfa

EXAMINATION METHODS

X-ray powder diffraction test: SIEMENS D500 diffractometer, Si sample container, Cu K_α radiation. 35 kV accelerating voltage, 30 mA tube current, 0,05–1,00 gard/sec goniometer speed. Diffrac. computer aided elaborating system. The tests were made at the Dept. of Mineralogy of the Steiermärkisches Landesmuseum Joanneum, Graz, Austria. (Some of the test were made elsewhere, this are named at the place of reference).

Quantitative microprobe analyses: CAMECA CAMEBAX SX50. Tests circumstances: 25 kV accelerating voltage, 0,1 mA test current. Standard materials: wollastonite (Si, Ca), jadeite (Na), synthetic $KTaO_3$ (K), hematite (Fe), corundum (Al) benitoite (Ba), galena (Pb), sphalerite (Zn), metallic copper (Cu), metallic manganese (Mn), fluorapatite (P), arsenopyrite (As). The test were made at the Dept. of Mineralogy of the Museum of Victoria, Melbourne, Australia (measurements in order to determine H_2O content were not made).

Scanning electron microscope examinations, qualitative microprobe analyses: AMRAY 1830 I., connected EDAX 9900 energy dispersive microprobe analyser. Test circumstances: 20 kV accelerating voltage, 10^{-10}. A test current, SiLi detector, incline angle 35 DEG, W cathode, EDAX-EDS system. Examinations were made at the Dept. of Metallurgy, University of Miskolc, Hungary.

RESULTS

NAGYBÖRZSÖNY

The mineralogical description of the hydrothermal ore veins at Nagybörzsöny was based upon the studies of KOCH and GRASSELLY (1952) and PANTÓ and MIKÓ (1964). These papares revealed that one of the dominant minerals of the ore deposit is arsenopyrite. The minerals of the tetrahedrite group are much less distributed. Therefore the formation of arsenates is generally to be connected to the occurrence of arsenopyrite. We found samples on the waste dumps at Altáró, Afelső-Rózsa and Alsó-Rózsa adits which show that the primary sulphides dissolved, and the secondasy sulphates oxides and smaller quantity of arsenates were formed. The cavities of the quartz veins contain scorodite, arseniosiderite, segnitite and probably arsenbarckebushite accompanied by quartz, gypsum, goethite and anglesite. Right next to the cavities arsenopyrite, pyrite and galena can be observed.

Arseniosiderite

Forms rounded masses crust built up from brown crystals smaller than 1 milimeter on the waster dump of Altáró. Its accessory minerals are rhombohedral segnitite and lamellar crystals of a mineral thought to be arsenbrackebuschite. Their structure can clearly be seen on the SEM micrograph (*Fig. 2*). Its powder diffraction examination (Table 2) shows that the strongest reflections distinctly appear, the intensity ratios are somewhat different compared to those of the correspondant JCPDS card. Its quantitative microprobe analysis (Table 3) revealed that the arseniosiderite from Nagybörzsöny contains more As and less Fe than theat introduced in the study of DANA (1920).

TABLE 2

X-ray powder diffraction data of arseniosiderite from Nagybörzsöny

arseniosiderite Nagybörzsöny		arseniosiderite JCPDS 13-134	
d(Å) (obs.)	I/I_0	d(Å)	I/I_0
8.93	100	8.95	100
2.96	67	2.95	80
2.78	42	2.77	100
2.50	19	2.50	90
2.22	32	2.20	70
1.355	12	1.350	70

Made in Steiermärkisches Landesmuseum Joanneum, Graz

TABLE 3

Chemical composition of arseniosiderite from Nagybörzsöny (Wt%)

CaO	15.04
Fe_2O_3	31.90
PbO	0.30
P_2O_5	0.23
As_2O_5	45.50
Total	92.97

Analyst: BIRCH, W. D. (Museum of Victoria, Melbourne)

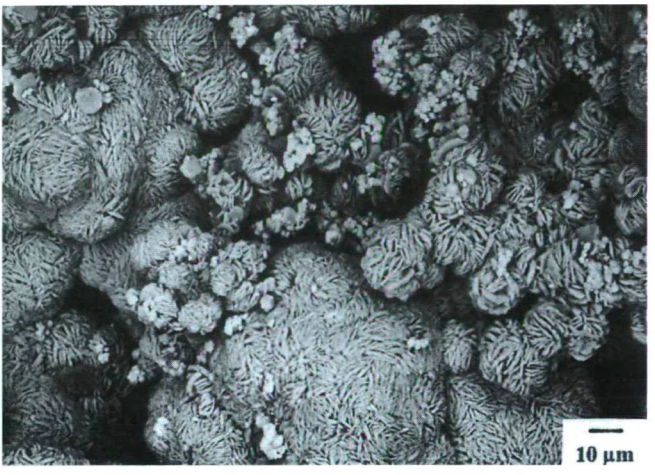

Fig. 2. Arseniosiderite, globular crystal groups, Nagybörzsöny. Scanning electron micrograph

Segnitite

It is found in the same environment as brownish-yellow crusts and sometimes forms 0,X mm rhombohedrals. The SEM micrograph shows that the crystals are built up from (1011) planes, the (0001) plane appears as well (*Fig. 3*). Segnitite was still referred to as baudantite in the study of SZAKÁLL (1992), since there was not quantitative chemical analysis made on the sample that time. Its powder diffractions record (BIRCH *et al.* 1992) (Table 4) gave no clear evidence for the identification. Eventually its quantitative microprobe analysis (Table 5) clarified that the sample was segnitite, as hardly any (0,55% and 2,36%) SO_3 was found in it.

TABLE 4

X-ray powder diffraction data of segnitite from Nagybörzsöny

segnitite Nagybörzsöny		segnitite BIRCH *et al.* (1992)		beudantite JCPDS 19-689	
d (Å) (obs)	I/I_0	d(Å)	I/I_0	d(Å)	I/I_0
5.99	64	5.966	50	5.99	80
5.69	13	5.719	10	5.72	20
				5.13	5
3.68	44	3.678	40	3.67	70
3.54	13	3.530	5	3.54	20
		3.119	5		
3.09	100	3.092	100	3.08	100
		3.011	10		
2.96	15	2.987	5	2.97	30
2.84	24	2.849	20	2.84	50
2.55	18	2.550	10	2.54	50
2.38	9	2.382	5	2.37	20
		2.334	2		
2.31	9	2.318	3	2.31	20
2.27	25	2.283	30	2.27	60
2.25	12	2.254	15	2.24	15
				2.12	10
		2.011	5	2.09	10
1.990	20	1.992	30	1.979	60
1.840	14	1.840	25	1.829	60
1.772	6			1.768	10
				1.745	5
				1.706	20
				1.694	10
1.687	10	1.688	15		
				1.678	40
				1.641	10
				1.560	20
1.545	10	1.546	8	1.536	40
1.503	7	1.508	10	1.499	40

Made in Steiermärkisches Landesmuseum Joanneum, Graz

TABLE 5

Chemical compositon of segnitite from Nagybörzsöny (Wt%)

CuO	0.10	– 0.09
BaO		0.09
SrO	–	0.08
PbO	28.45	28.27
Fe_2O_3	31.62	35.17
Al_2O_3	0.19	0.15
P_2O_5	0.41	0.16
As_2O_5	26.17	29.01
SO_3	2.36	0.55
Total:	89.48	93.48

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

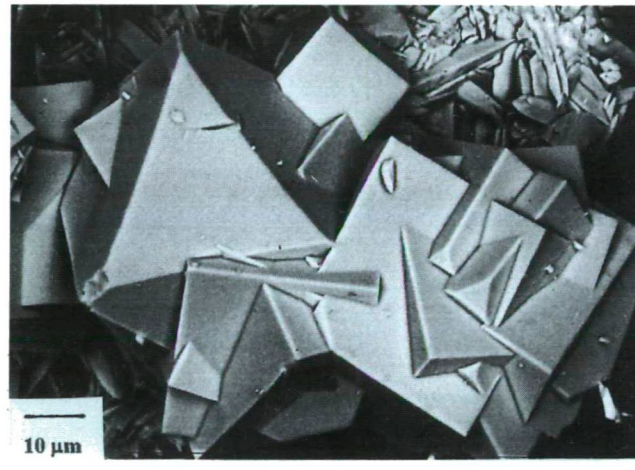

Fig. 3. Segnitite, rhombohedral crystals. Nagybörzsöny. Scanning electron micrograph

Arsenbrackebushite (?)

Accompanying segnitite and arsenbrackebuschite, 10–15 μm large lamellar aggregates with Pb, Fe content were observed (*Fig. 4*). Analysing the arsenates samples we found phases with a chemical composition that best correspond with arsenbrackebuschite (Table 6). The essential difference comes from the smaller Zn and higher Fe content in them. Its powder diffraction tests have not been made yet, because of the very smal quantity of the samples, so its presence is not proved. ABRAHAM *et al.* (1978) described this mineral first from a similar paragenesis with anglesite and beudantite.

TABLE 6

Chemical composition of arsenbrackebuschite (?) from Nagybörzsöny (Wt%)

CuO	–	–
ZnO	0.19	0.14
CaO	–	–
Fe_2O_3	12.78	16.26
Al_2O_3	0.45	0.21
P_2O_5	0.32	0.27
As_2O_5	29.25	30.53
SO_3	1.37	1.05
Total	97.56	97.08

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

Fig. 4. Arsenbrackebuschite (?), lamellar crystals with segnitite, Nagybörzsöny. Scanning electron micrograph.

Scorodite

It is most distributed arsenates mineral at Nagybörzsöny. Its found on the waste dunps of Altáró adit, Felső-Rózsa adit and Allsó-Rózsa adit. It occurs in diverse appearance in the cavities of quartz veins. It forms green, yellowish-green crusts, rounded masses and several mm thick earthy covering. Sometimes it also forms banded structures. On the waste dump of Alsó-Rózsa adit it also appears as light green earthy masses in the fissures of arsenopyrite. For it always accompanies arsenopyrite, its formation can be derived from the weathering of that mineral. According to the SEM examinations the surface of the rounded masses is made out from lamellar crystals (*Fig. 5*) The powder diffraction data correspond well with that of its JCPDS card, so it is not needed to present them in this paper. Its microprobe analysis (Table 7) data nearly identical with those in the literature (DANA 1920) apart from somewhat more Fe.

TABLE 7

Chemical composition of scorodite from Nagybörzsöny (Wt%)

CaO	0.07
Fe_2O_3	38.43
Al_2O_3	0.19
P_2O_5	–
As_2O_5	51.65
Total	90.34

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

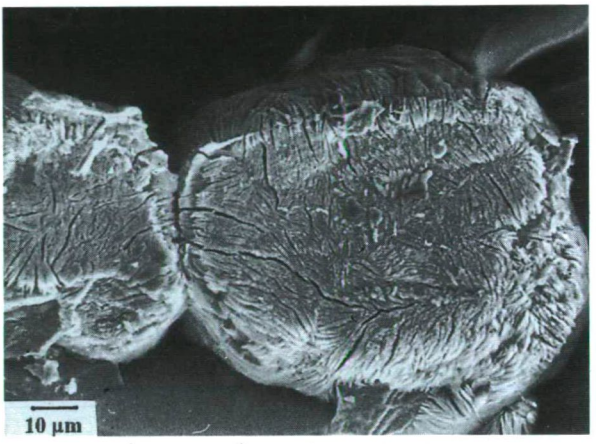

Fig. 5. Scorodite, lamellar crystal groups, Nagybörzsöny. Scanning electron micrograph.

RUDABÁNYA

The presence of arsenic as a trace element has long been well known in th primary and secondary zones of the hydrothermal metasomatic iron ore depostit with sulphide minerals (PANTÓ 1956). Based upon the microprobe analyses conducted by DOBOSI and NAGY (1982), found first an As containing mineral (Hg-tennantite) from a siderite body in the oxidation zone of the deposit. As containing minerals of secondary origin (olivenite and mimetite) from the oxidation zone were first described by SZAKÁLL (1992, 1994).

Beudantite

Its found as a member of a mineral association rich in species with Cu, Ag, Sb, S, Cl, Br, I elements in the silicious limonite orebodies in the Adolf area of the deposit. The rock primarily consists of quartz, and cerussite can often be found in it as xenomophous or isomorphous grains reaching 1 cm. Beudantite was observed in the cerussite as minute – 10 μm grains – (*Fig 6.*) and in 1–3 mm crystalline patches surrounded by

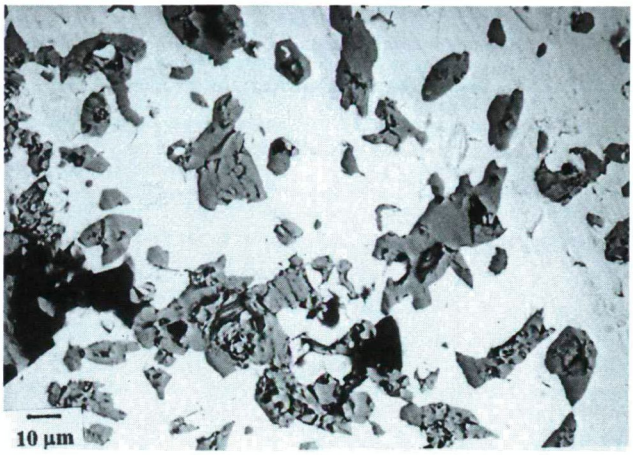

Fig. 6. Beudantite, inclusions in cerussite, Rudabánya, Adolf mine. Scanning electron micrograph.

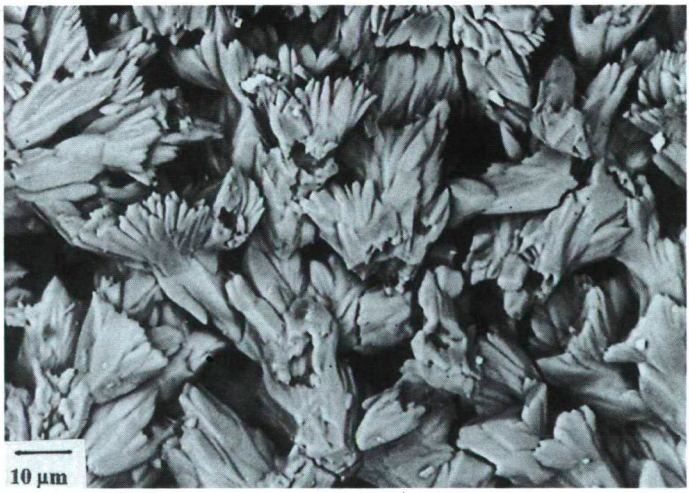

Fig. 7. Beudantite, finger-like aggregates, Rudabánya, Adolf mine. Scanning electron micrograph.

cerussite. The yellow finger-like aggregates make up 0,X mm crystals groups (*Fig. 7*). The 0,X mm large, short, columnar mimetite crystals can often be observed in the beudantite aggregates. Its X-ray examination show good correspondance not only with the reference card of beudantite but that of segnitite as well (Table 8). Having regard to be fact however that the quantitative microprobe analysis pointed out its nearly 10% SO_3 content (Table 9.), it can only be beudantite.

TABLE 8

X-ray powder diffraction data of beduantite and mimetite from Rudabánya

Beudantite Rudabánya		Beudantite JCPDS 19-689		Other minerals
d(Å) obs	I/I_0	d(Å)	I/I_0	
5.97	41	5.99	80	
5.69	2	5.72	20	
4.44	3			M
4.26	9			Q
3.67	43	3.67	70	
3.55	5	3.54	20	
3.34	44			M, Q
3.09	100	3.08	100	
3.05	24			M
3.01	30			M
2.98	19	2.97	30	
2.96	14			M
2.85	14	2.84	50	
2.55	14	2.55	50	
2.38	8	2.37	20	
2.31	8	2.31	20	
2.28	23	2.27	60	
2.25	8	2.24	30	
2.12	5	2.12	10	
2.11	6			M
2.09	4	2.09	10	
1.988	31	1.979	60	
1.965	8			M
1.936	4			M
1.907	9			M
1.837	27	1.829	60	
1.817	11			Q
1.713	5	1.706	20	
1.687	7	1.678	40	
1.574	4	1.560	20	M
1.543	12	1.536	40	
1.506	7	1.499	40	
1.416	3	1.409	20	
1.383	3	1.385	20	
1.349	8	1.344	40	

Made in ALUTERV-FKI (Budapest)
(M=mimetite, Q=quartz

TABLE 9

Chemical compostition of beudantite from Rudabánya (Wt%)

ZnO	0.32
PbO	30.71
Fe_2O_3	32.71
Al_2O_3	0.11
As_2O_3	13.47
SO_3	8.35
Total	85.68

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

Ca-Cu containing arsenate mineral

In the fissures and cavities of the altered siderite ore of the Andrássy III area of the deposit turquoise-blue spherical aggregates of a tyrolite-like mineral reaching 0,X mm were observed. According to the SEM images the aggregates are made up from tabular crystals (*Fig. 8*). Its X-ray test revealed that its structure is resemble to tyrolite, but there are a lot of difference and it cannot be matched to any arsenate known so far. Its detailed examination has not been finished yet.

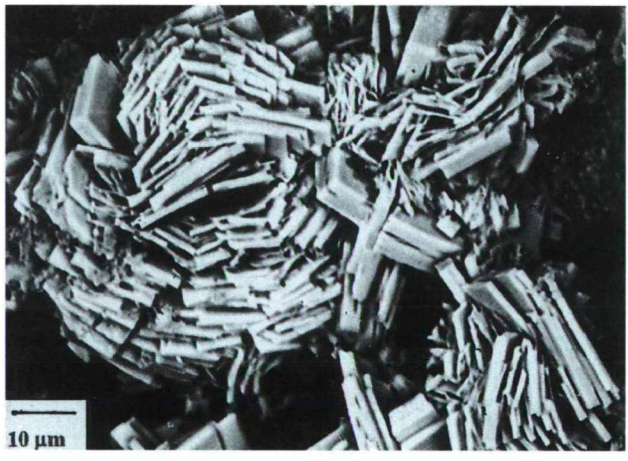

Fig. 8. Tyrolite-like mineral, Rudabánya, Andrássy III. mine. Scanning electron micrograph.

PÉCS

There is a copper indicating locality described by TOKODY (1952) in a limestone quarry near the Kozári hunting lodge. Small quantity of arsenate minerals has recently been observed with azurite and malachite. Sulphides producing secondary Cu-minerals were also found in the brecciated zones. These are chalcocite and tennantite idetified

with X-ray and microprobe tests. Both sulphides appear as small massive patches reaching some mm in the breccias and if often infiltrates into the limestone. The weathering processes of tennantite produced the observed arsenates: conichalcite, olivenite and tyrolite.

Conichalcite

It generally appears as yellowish-green crusts, mostly on the surface of calcite crystals. It was also observed in pseudomorphous columnar habit. We suppose it had encrusted azurite crystals then the azurite dissolved and left behind the conichalcite crust. It rarely can be found as tufted masses accompyying malachite and olivenite (*Fig. 9*). The four strongest reflections appeared on the X-ray diffraction record (Table 10). The results of the microprobe analysis (Table 11) show good correspondance with those of other tests (DANA 1920).

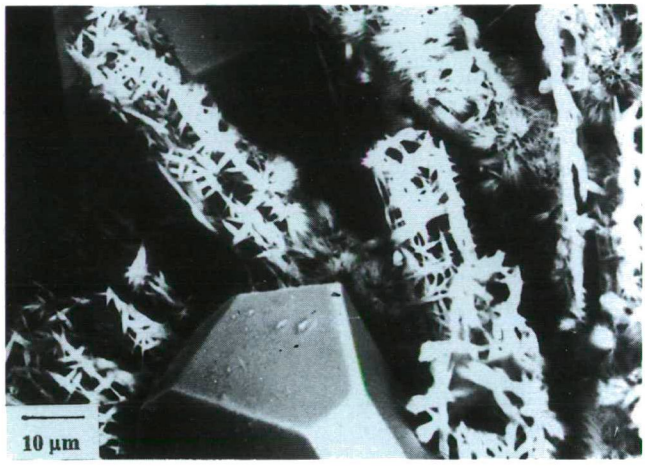

Fig. 9.
Conichalcite, sparys on needles olivenite crystals, Pécs, Kozári vadászház quarry.
Scanning electron micrograph.

TABLE 10

X-ray powder diffraction data of conichalcite from Pécs

Conichalcite Pécs		Conialcite JCPDS	
pos(DEG)	C I/I_1	Pos(DEG)	I/I_1
28.586	89.6	28.569	80
31.488	100.0	31.464	100
34.550	72.8	34.440	65
		34.660	55
35.156	64.8	35.108	45

Made in Steiermärkisches Landesmuseum Joanneum, Graz

TABLE 11

Chemical composition of conichalcite from Pécs (Wt%)

CuO_2	31.14
ZnO	0.44
BaO	0.17
Al_2O_3	0.23
PbO	0.46
CaO	19.66
P_2O_5	0.48
As_2O_5	37.32
Total	89.90

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

Olivenite

It was rarely been observed like conichalcite. It forms light green columnar crystals which make up tightly fitting groups. The SEM image of olivenite is shown on *Fig. 10*, on which the (110), (011) planes can be observed. 23 peaks appeared on the X-ray diffraction record and the intesnity rations correspond well with those of the JCPDS reference card, so it is not needed to present the test data. The microprobe tests showed high Zn content, therefore we consider the sample a Zn-olivenite (Table 12).

Tyrolite

Tyroloite is the rarest arsenate mineral of the locality. It forms thin blue crusts in the fissures of calcite. The EDX examination proved the presence of Ca, Cu and As in the sample. The below X-ray reflections are convincing for tyrolite. The strongest peaks are: 27,7 (100), 13,7 (80), 2,98 (70).

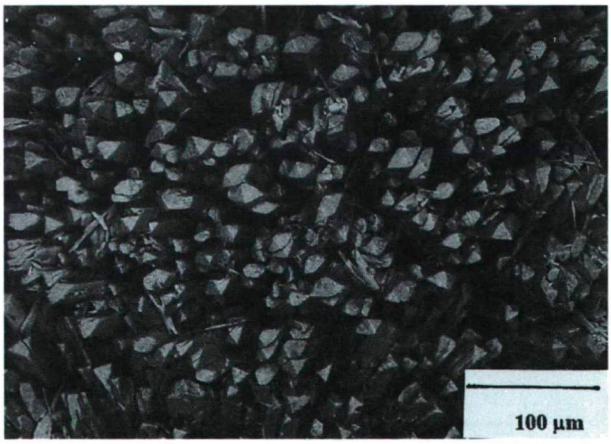

Fig. 10. Olivenite, columnar crystals, Pécs, Kozári vadászház quarry. Scanning electron micrograph.

TABLE 12

Chemical composition of olivenite from Pécs (Wt%)

CuO	37.71
ZnO	14.99
Fe_2O_3	–
Al_2O_3	–
P_2O_5	0.17
As_2O_5	39.69
Total	92.69

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

KŐVÁGÓSZŐLŐS

In the sedimentary, infiltrated uranium ore deposit rarely arsenate minerals have been observed in dolomite concentrations. At first VINCZE (1979) found tennantite that must have been the primary As containing mineral. We ourselves found 1–2 mm large tetrahedral crystals of tennantite in charred wood trunks.

Picropharmacolite and *talmessite*

These arsenates were found in the cavities of dolomite concentrations accompanied by calcite and dolomite. They form white crusts and radiating aggregates on the surface of calcite crystals. For they formed close together the presence of both minerals is supposed merely by X-ray diffraction tests. The test made on the sample taken from the radiating masses provides good correspond with JCPDS card. Most important peaks appeared on the X-ray diffraction record (Table 13).

TABLE 13

X-ray powder diffraction data of picropharmacolite from Kővágószőlős

Picropharmacolite Kővágószőlős		Picropharmacolite JCPDS 14-0222	
d(Å) obs.	I/I_0	d(Å)	I/I_0
13.47	100	13.50	100
9.25	36	9.20	60
		.	
		.	
		.	
3.19	30	3.18	80
3.05	32	3.06	60
2.92	21	2.92	50

Made in ALUTERV-FKI (Budapest).

The microprobe analysis of this structure (Table 14) revealed that its chemical composition corresponds well with picropharmacolites from Richeldorf and Freiberg (DANA 1920), but not with talmesite analyses (BARIAND and HERPIN 1960). Based upon these data we consider the radiating aggregates as picropharmacolite. The SEM images clarified that the crystals are actually of lamellar habit (*Fig. 11*).

TABLE 14

Chemical composition of picropharmacolite from Kővágószőlős, (Wt%)

MgO	2.92
CaO	29.05
BaO	0.08
Al_2O_3	1.87
As_2O_5	48.60
Total	82.52

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

Fig. 11. Picropharmacolite, needles crystals, Kővágószőlős. Scanning electron micrograph.

The X-ray diffraction tests made on the sample taken from the powder-like crusts identified talmessite (Table 15). 21 peaks appeared on the record in godd correspondance with its reference card. Quantitative analysis has not been made so far, its qualitative test indicated Ca, Mg, As elements which are characteristic to talmessite.

MÁD

North of the village in a limnoquartzite outcropt 1 cm thick alunite veins fill in the fissures of quartzite and several mm large alunite crystals occur in the cavities of the

TABLE 15

X-ray powder diffraction data of talmessite from Kővágószőlős

Talmessite Kővágószőlős		Talmessite JCPDS	
d(Å)	I/I_0	d(Å)	I/I_0
6.468	w	6.43	5
5.149	vs	5.09	60
4.665	s	4.62	40
4.286	vvw		
4.004	vv	3.95	10
3.789	vvw		
3.597	m	6.56	60
3.341	m	3.34	40
3.225	s	3.21	80
3.101	s	3.07	100
3.014	w		
2.796	vs	2.77	100
2.611	w	2.67	5
		2.58	20
		2.51	5
2.465	vw	2.44	20
2.355	vvw	2.32	5
2.177	w	2.16	40
2.132	vvw	2.12	5
		2.07	10
2.040	vw	2.04	5
		2.01	20
1.905	vw	1.89	20
		1.829	20
1.800	vw	1.782	20
1.733	w	1.717	60
1.709	w	1.697	40
1.661	vvw		
1.601	vvw	1.608	5
1.572	vw	1.584	10
		1.538	20

vs→vvw: very strong → very weak
Made in British Museum Natural History, London

veins. Scorodite and pharmacosiderite were rarely been observed on the alunite crystals. Unlike the other arsenate localities, we have not found any sulphide so far can be considered the arsenic bearing primary sulphide. Only pyrite was found, but contained no As, not even in enclosures based upon the microprobe analyses. It has long been known however that As is a characteristic trace element in the limnoquartztes of the Tokaj Mts., so the presence of arsenates is not surprising (VETŐ 1971, SZAKÁLL, 1990).

DOBOSI (1980) found tetrahedrite in the neighbouring area (Király Hill) so it is possible that is could have also been formed in the right next environs of the locality in question.

Scorodite

It is most often found as light green yellow or brown crusts and spherical aggregates in the fissures, reaching some mm, built up from short, columnar crystals. Bypiramidal crystals were also found (*Fig. 12*) with the (111), (201), (120) planes on them (*Fig. 13*). The crystals are 0,X mm large, light green coloured. The X-ray examinations assured the corresponding with those of the ICPDS card. The quantitative microprobe analysis also proves the presence of scorodite (Table 16).

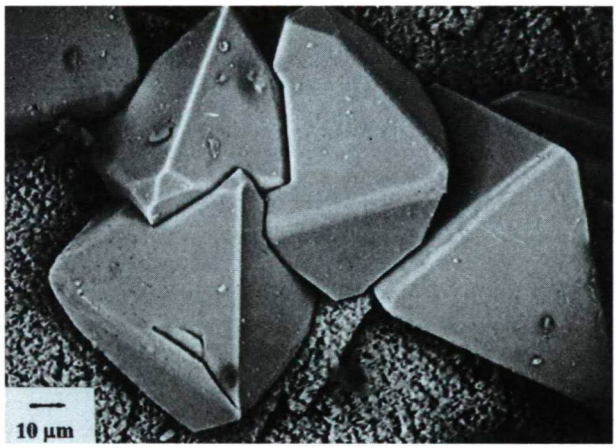

Fig. 12. Scorodite, bypiramidal crystals, Mád. Scanning electron micrograph.

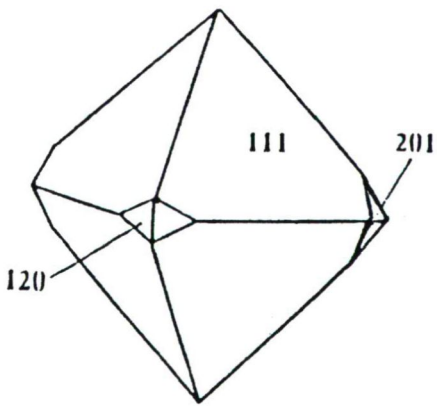

Fig. 13. Crystal drawing of scorodite from Mád

TABLE 16

Chemical composition of scorodite from Mád, (Wt%)

Fe_2O_3	33.12
MnO	0.10
Al_2O_3	0.51
CuO	0.13
As_2O_5	50.15
Total	84.01

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

Pharmacosiderite

It is found in the fissures of quartzite accompanied by scorodite. It forms light green or yellow hexahedral crystals (*Fig. 14*). There were 25 peaks observed on the X-ray record showing good correspondence with the reference card (Ba-pharmacosiderite) (Table 17). The only major peak that did not appear on the record is the one at 8.08 Å. According to the quantitative microprobe analyses there are two characteristic compositions, one of them is poor in K, the other is shown on Table 18. Ba-pharmacosiderite was first described by WALENTA (1966) as a newly discovered mineral, but it was later discredited by the IMA comitte. PEACOR and DUNN (1985) studied numereous Ba containing pharmacosiderites: comparing them with that in question the Ba/K ratio is nearly identical, the Fe content is similar. Therefore the mineral in queastion is Ba containing pharmacosiderite.

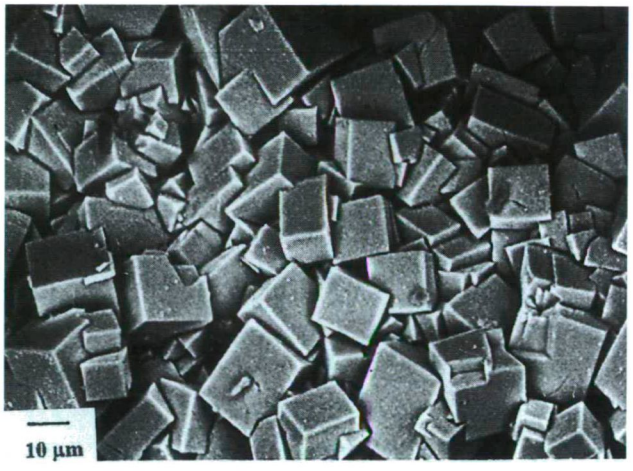

Fig. 14. Pharmacosiderite, cube-like crystals, Mád. Scanning electron micrograph.

TABLE 17

X-ray powder diffraction data of pharmacosiderite from Mád

Pharmacosiderite Mád		Pharmacosiderite – Ba JCPDS 34-154	
d(Å)	I/I0	d(Å)	I/I0
7.98	91	8.08	80
		7.95	95
		5.68	5
5.62	11	5.64	5
4.61	32	4.619	40
4.019	25	4.031	30
3.980	46	3.980	40
3.573	23	3.565	40
3.272	60	3.282	30
3.254	100	3.256	70
2.8241	80	2.833	100
		2.814	55
2.693	24	2.691	10
		2.6705	11
		2.6585	55
2.6540	38	2.6545	40
2.5727	20	2.5482	45
2.5336	40	2.5217	40
2.5164	48	2.5183	55
2.4458	58		
2.4182	31	2.4275	30
2.4009	46	2.4032	45
2.2910	?	2.3086	80
		2.2305	5
		2.1471	5
		2.1366	5
2.1302	9	2.1312	10
		1.9919	5
1.9520	10	1.9563	8
1.9460	5		
1.9388	14	1.9316	8
		1.8994	3
		1.8901	5
1.8749	28	1.8788	40
		1.8773	5
1.8306	12	1.8388	10
		1.8283	8
1.7939	22	1.8010	25
1.7815	30	1.7862	25

Made in Steiermärkisches Landesmuseum Joanneum, Graz

TABLE 18

Chemical composition of pharmacosiderite from Mád (Wt%)

K_2O	0.05
BaO	9.92
SrO	–
CaO	0.03
Fe_2O_3	39.37
Al_2O_3	1.91
P_2O_5	0.07
As_2O_5	43.26
Total	94.61

Analyst: BIRCH W. D. (Museum of Victoria, Melbourne)

GYÖNGYÖSSOLYMOS

The first description of the hydroquartzite with Sb traces on Asztagkő Hill was made by SZUROVY (1940). From the alteration of the Sb bearing primary minerals in a brecciated zone, a diverese secondary mineral association was formed. DOBOSI (1979, 1982) discovered members of the tetrahedrite group of various chemistry by microprobe tests made on samples from drillholes sunk in the neighbouring area.

Pharmacosiderite

In course of the examination of the Sb bearing mineral association, light yellow hexahedral crystals were observed. The surface of this very rarely found mineral reaching 2 milimeters in rugged, uneven as shown on the SEM images. By X-ray tests they turned out to be pharmacosiderite. According to its qualitative microprobe analysis the quantity of Ba and K are nearly the same.

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