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Henryk KUCHA[1]

EUGENITE, $Ag_{11}Hg_2$ — A NEW MINERAL FROM ZECHSTEIN COPPER DEPOSITS IN POLAND

Abstract. $Ag_{11}Hg_2$ occurs in grains up to 4 mm in size in the Zechstein copper deposits on the Fore-Sudetic monocline, Poland. In reflected light the mineral is white with a yellow tinge. Its reflectance in air is: 546 nm — 80.1%, 589 nm — 82.7%, 656 nm — 85.6%, VHN_{15g} — 96.2± ±6 kG/mm². It has a cubic structure and is optically isotropic, $a_o = 10.02 \pm 0.02$ Å, space group $I\bar{4}3$ (the structure of γ_2-brass, $D8_2\gamma$), $Z = 4$. $D_{meas.} = 10.75 \pm 0.03$ g/cm³, $D_{calc.} = 10.45$ g/cm³. The strongest diffraction lines are: *2.37(10)*, *2.10(8)*, *1.457(7)*, *1.233(7)*, *1.193*(6), *1.033(5)*, *0.950(8)*, *0.925(8)*.

INTRODUCTION

On the Fore-Sudetic monocline, copper occurrences of economic value are confined to the white sandstones (0—42 m in thickness), the boundary dolomite (0—20 cm in thickness), black shale (0—100 cm), and the bottom part of the overlying dolomites. The average thickness of the mineralized horizon is about 4 m. Horizontally sulphides show zonal distribution round the Rote Fäule (Rydzewski 1976). Cu and other transition elements (Ni, Co, U, Mo, Re, As, Bi, Se, PGM, Au) occur in the vicinity of the Rote Fäule. The central zone is mineralized with lead, and the outer zone with zinc (Cd). In the vertical section, heavy metals concentrate mainly in the bottom part of black shale, the boundary dolomite, and in a few top centimetres of white sandstone.

The contact zone between the copper-bearing and lead-bearing shales shows an increased concentration of noble metals on the copper-bearing side, and high contents of Ag and Hg on the lead-bearing side. The shales can be facially replaced by organogenic dolomite, which may contain Pt-bearing gold, sobolevskite, native palladium, native lead, and $AuPb_2$ in paragenesis with kerogen-thucholite and clausthalite (Kucha 1981).

Rich mercury mineralization has been found at the contact of Cu and Pb zones, on the side of lead-bearing shales. The principal minerals are silver amalgams,

[1] Institute of Geology and Mineral Deposits, Academy of Mining and Metallurgy in Cracow (Kraków, Al. Mickiewicza 30).

occurring in the bottom of shales and in the top of white sandstones. They generally appear in two parageneses:

1. Pb—Zn—Cu—Ag—Hg, widespread in the lead-bearing shales on the contact with the copper-bearing zone. The content of Ag in the shale, boundary dolomite and in the top part of sandstone runs up to 1500 ppm, while Hg content may rise to 1000 ppm. Silver amalgams contain from 8.6 to 22.2 wt % Hg. From the mineralogical point of view, the amalgams in question are mainly represented by kongsbergite, a phase of the native silve. type, and by eugenite, $Ag_{11}Hg_2$. The Hg content in silver sulphides (Ag_2S, AgCuS) averages 0.75 wt %, sometimes running up to 2 wt % in sphalerite.

2. Calcite-eugenite-gypsum-haematite. Eugenite forms grains up to 4 mm in size and usually occurs at the calcite-gypsum boundary in the boundary dolomite. Gypsum has increased contents of transition metals: 0.5 wt % Mn and 0.3 wt % V Ni, Co and Fe.

Four minerals are known to occur in the Ag—Hg system:

1. Moschellandsbergite, described as Ag_2Hg_3 (Harcourt 1942), γ — Ag_2Hg_3 (Palache *et al.* 1962), and recently described again as the ideal γ phase — Ag_5Hg_8 (Ramdohr 1975). Space group *Im3m*, specific gravity 13.5—13.7 g/cm³ (Palache *et al.* 1951—1962), or 15—12 g/cm³ (Ramdohr 1975). The latter range, however, is too wide as it comprises the data for kongsbergite (Ramdohr 1975).

Our knowledge of the structural properties of the γ phases belonging to the Ag—Hg system is still unsatisfactory. The γ field of the Ag—Hg system is very limited (Hansen, Anderko 1958), corresponding to the composition Ag_3Hg_4, though the ideal composition is Ag_5Hg_8. The γ phase in question has an electron concentration of 1.57, that is much lower than other γ (phase Hume-Rothery *et al.* 1952).

Pearson (1958) distinguished three space groups in the structure of γ_{1-3}: $D8_1$ — *Im3m*, $D8_2$ — $I\bar{4}3m$, and $D8_3$ — $P\bar{4}3$. Bradley and Jones (1933) were the first to describe the structure of γ-brass using the term of atom clusters, consisting of 26 atoms each. Recently Nyman and Anderson (1979) presented a very useful structural model of γ-brass, using an ideal tetrahedron and triangle and introducing "stella quadrangula". Phases with the structure of γ-brass belong to the 21/13 electron compounds (Hume-Rothery *et al.* 1952). The structures of γ phases are not identical, yet they are very similar to one another. They have large unit cells and are usually ordered. Some positions in the γ structure are occupied by the solute and others by the solvent (Barret, Massalski 1966). The γ structures tolerate vacant lattice sites rather than excess electrons in the unit cell (*ibidem*). Therefore, when the electron concentration attains a value of 1.70, the atoms begin to drop out of the lattice to maintain constant electron concentration (Hume-Rothery *et al.* 1952). In consequence, vacancies are produced.

There are, however, γ phases which do not comply with the rule of electron compounds, for example, Ag_3Li_{10} (Hume-Rothery *et al.* 1952).

2. Schachnerite described as the ε phase in the Ag—Hg system, with the composition $Ag_{1.1}Hg_{0.9}$. It is hexagonal with $a_o = 2.97$, $c_o = 4.84$ Å, $Z = 2$ (Seeliger, Mücke 1972), $R\% = 72$ for orange light, $D_x = 13.52$ g/cm³.

3. Paraschachnerite, $Ag_{1.2}Hg_{0.8}$, is a phase of the discrasite type (Seeliger, Mücke 1972). It is orthorhombic with $a_o = 2.96$, $b_o = 5.13$, $c_o = 4{,}83$ Å, $Z = 2$, $D_x = 12.98$ g/cm³, $R\% = 70.9$—73.7 for orange light. It is anisotropic and shows pronounced bireflectance.

4. Kongsbergite is a phase of the native silver type (α phase in the Ag—Hg system) and may contain up to 48 wt % Hg at about 0°C (Seeliger, Mücke 1972).

EXPERIMENTAL

Investigations were carried out on samples containing silver amalgams from the Lubin, Polkowice and Rudna mines.

Their chemical composition was determined with an ARL SEMQ electron probe operated at a voltage of 20 kV, a probe current of 150 μA, a sample current of 9 nA, counting time 40 s. The following spectral lines, synthetic compounds and specture standards were used: SK_α (PbS), FeK_α, CoK_α, NiK_α, CuK_α, AsK_α, AgL_α, TeL_α, AuL_α, HgL_α (HgS), PbM_α (PbS), BiM_α. The calculated intensities of characteristic radiation were corrected for absorption (Philibert 1965) and atomic number difference (Philibert, Tixier 1968). The samples were cooled with liquid nitrogen.

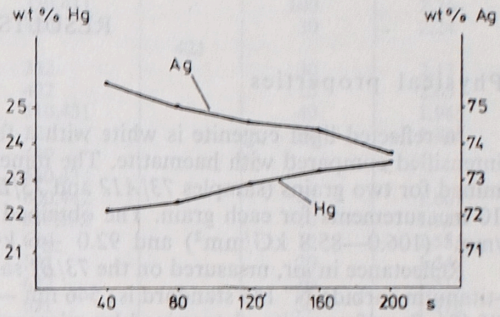

Fig. 1. Microprobe composition of silver amalgam (wt %) plotted against time counting (s). Grain *73/A2* with chemical formula $Ag_{11.00}Hg_{1.78}$

The probe-determined chemical composition was studied as a function of counting time (Fig. 1). As a result of the diffusion of sample components (sample *73/A2*, Fig. 1), effected by the electron beam, Ag concentration decreased from 75.7 to 73.7 wt % (by 1.95 wt %) during 200 s, while Hg content increased from 22.2 to 23.5 wt % (by 1.30 wt %). The observed changes in chemical composition are presumably due to the diffusion of mercury towards the sample surface and its evaporation under the influence of the electron beam. During the first 10—40 s, the changes in the chemical composition of a sample cooled with liquid nitrogen fall

Table 1

Microprobe composition of Ag—Hg alloys from boundary dolomite, Lubin mine, Poland

Sample number	Weight %				Atomic prop.
	SK_α	AgL_α	HgL_α	Σ	
68/A1	0.06	76.00	24.60	100.66	$Ag_{11.00}Hg_{1.92}$
73/A1	0.10	69.00	28.20	97.30	$Ag_{11.00}Hg_{2.39}$
73/A2	0.10	76.20	22.80	99.10	$Ag_{11.00}Hg_{1.78}$
73/A12	0.15	74.00	25.50	99.70	$Ag_{11.00}Hg_{2.10}$
73/B1	0.10	70.10	27.50	97.70	$Ag_{11.00}Hg_{2.32}$
73/B3	0.15	70.00	27.40	97.60	$Ag_{11.00}Hg_{2.32}$

Sought for but not detected: Fe ⩽ 0.09, Co ⩽ 0.09, Ni ⩽ 0.11, Cu ⩽ 0.14, As ⩽ 0.38, Te ⩽ 0.10, Au ⩽ 0.57, Pb ⩽ 0.46, Bi ⩽ 0.67

within the error limits of the method; therefore, such counting time was selected to study the chemical composition of silver amalgams.

X-ray diffraction analysis was made twice for Co/Fe radiation in a 114 mm and 180 mm diameter Debye-Scherer camera. The investigations were carried out on the samples *73/A1*, *A2*, *A12* and *B1* (Table 1).

Electron diffraction patterns were obtained with a JEM 100B microscope operated at 100 kV. Gold on carbon film placed beside the sample studied was used as standard. The measuring accuracy of lattice constants under such conditions is about 1% of the measured value (Hirsh *et al.* 1965). The particles to be investigated were taken under the ore microscope from the samples *73/A12* and *73/B1* from the areas subjected to electron microprobe analysis.

RESULTS

Physical properties

In reflected light eugenite is white with a faint yellow tinge. The yellow tinge is intensified compared with haematite. The mineral is isotropic. The *VHN* was determined for two grains (samples *73/A12* and *73/B1*, Table 1) at a load of 15 g, making 10 measurements for each grain. The obtained values are respectively 91.5 ±6 kG/mm² (106.0—85.8 kG/mm²) and 92.0 ±6 kG/mm² (100.3—88.8 kG/mm²).

Reflectance in air, measured on the *73/B1* sample (Table 1) for the Zeiss tungsten-titanium carbide N° 143 standard is: 546 nm — 80.1%, 589 nm — 82.7%, 656 nm — 85.6%. Specific gravity, determined by microscopic method (Kucha, Salamon 1972), is $D_{meas.} = 10.75 \pm 0.03$ g/cm³ for the samples *73/A1*, *A2*, *A12* and *B1* (Table 1).

Chemical composition

The chemical composition of the silver amalgams studied differs markedly from the ideal phase — Ag_5Hg_8, varying from $Ag_{11.00}Hg_{1.78}$ to $Ag_{11.00}Hg_{2.39}$ (Table 1). The observed differences in chemical composition are presumably reflected in the structure, namely in the presence of two different types of centring of the unit cell — the dominant body-centred type and subordinate primitive unit cell.

X-ray diffraction studies

The X-ray diffraction pattern of eugenite differs markedly from that of moschellansbergite (Table 2). On the one hand, it shows the absence of some strong peaks, and on the other hand, the presence of some reflections that are not displayed by moschellandsbergite (Table 2).

Marked differences can also be observed in the intensity of some strong and weak diffraction lines. The former are presumably due to the essential difference in the chemical composition of moschellandsbergite, Ag_5Hg_5, and eugenite, $Ag_{11}Hg_2$, which changes substantially the value of the structural factor |F|. The latter are most likely associated with the differences in the structure of γ_1 (moschellandsbergite) and γ_2 ($Ag_{11}Hg_2$), which lead to the strengthening of some reflections with the characteristic Miller indices and the weakening of the others (Betterton, Hume-Rothery 1951).

Eugenite is cubic, space group $I\bar{4}3m$, $a_o = 10.02 \pm 0.02$ Å, $Z = 4$. The number

Table 2

X-ray powder pattern of *73/A1*, *A2*, *A12* and *B1* material (Table 1) close to $Ag_{11}Hg_2$, compared with moschellandsbergite (Palache *et al.*, 1962)

$Ag_{11}Hg_2$			*hkl*		γ-Ag_2Hg_3	
I	d(Å)$_{meas.}$	d(Å)$_{calc.}$	*BCC*[1]	*PC*[2]	*I*	d(Å)
		4.09	211		10	4.08
1	3.50	3.54	220		10	3.53
3	2.88	2.89	222		30	2.88
		2.68	321		40	2.67
2	2.43	2.43		410		
10	2.37	2.36	330,411		100	2.36
2	2.23	2.24	420		30	2.24
4	2.19	2.19		421		
8	2.10	2.136	332		30	2.13
1	2.06	2.05	422		10	2.05
2	1.96	1.96	510,431		40	1.965
1	1.84	1.83	521		20	1.828
1?	1.783	1.770	440			
1?	1.718	1.718	530,433			
		1.670	600,442		40	1.667
1	1.622	1.625	611,532		10	1.629
3	1.586	1.585	620		10	1.583
		1.546	541		20	1.547
		1.511	622		10	1.512
		1.477	631		30	1.478
7	1.457	1.466	444		40	1.447
		1.431		700		
		1.417	710,543		40	1.419
		1.364	721,552		70	1.365
4	1.353	1.339	642		20	1.341
3	1.272	1.273	651,732		50	1.275
		1.243				
7	1.240	1.233	811,741	810	60	1.236
		1.215	644		5	1.217
6	1.193	1.198	653		20	1.199
		1.181	660		20	1.185
1?	1.167	1.165	750		30	1.168
2	1.147	1.149	662		20	1.152
		1.135	752		5	1.137
3	1.126	1.120	840		5	1.122
		1.107	833		10	1.110
4	1.096	1.093	842		5	1.096
		1.080	761		20	1.083
		1.056	851		10	1.059
5	1.033	1.033	932		30	1.036
		1.012	941		30	1.014
2	1.007	1.007		933		
		1.002	860		20	1.002
		0.983	862		20	0,985
		0.973	950		10	0.976
		0.964	10.22		10	0.968
8	0.950	0,955	765		+18 lines to	
8	0.925	0.923	961		0.784	

[1] *BBC* — body-centered cube, [2] *PC* — primitive cube.

of molecules in the unit cell, calculated for the composition $Ag_{11}Hg_2$ is $Z=4.10$. The calculated density $D_x=10.48$ g/cm^3.

The slight heterogeneity in the material studied results in certain inconsistencies in the X-ray diffraction data (Table 2). The overall data point to the body-centred structure (*I*, *BCC*, γ_2). There are, however, a few reflections — (*410*) (*421*) and (*933*) — odd for $h+k+l$ which are indicative of the primitive unit cell (type *P*).

Table 3

Electron diffraction pattern of *73/B1* sample (Table 1)

No	*hkl*	$d_{meas.}$ (Å)	$d^1_{calc.}$ (Å)
1	110	6.98	7.09
2	200	4.97	5.01
33	211	4.05	4.09
4	220	3.54	3.54
5	310	3.20	3.17
6	222	2.88	2.89
7	400	2.47	2.51
8	330	2.36	2.36
9	420	2.24	2.24
10	422	2.06	2.05
11	521	1.81	1.83
12	440	1.79	1.77
13	442	1.70	1.67
14	532	1.62	1.63
15	541	1.56	1.55
16	622	1.50	1.51
17	631	1.47	1.48
18	444	1.46	1.45
19	640	1.40	1.39
20	633	1.35	1.36
21	800	1.23	1.25
22	811	1 23	1 23
23	820	1.19	1.22
24	660	1.17	1.18
25	662	1.15	1.15
26	752	1.14	1.13
27	844	1.03	1.02
28	10.11	0.995	0.992
29	666	0.968	0.964
30	965	0.839	0.841
31	12.02	0.830	0.824
32	12.62	0.740	0.739
33	12.64	0.718	0.716
34	10.86	0.708	0.709
35	15.42	0.643	0.640

[1] Values calculated for cubic $a_0=10.02$ Å.

Electron diffraction studies

Electron diffraction was used to solve the problem of crystal symmetry of eugenite. Investigations were carried out on the samples *73/B1*, *73/A12* and *73/A2*. The samples of a composition close to $Ag_{11}Hg_2$, i.e. *73/B1* and *73/A12*, show body-centred symmetry (*I*, *BCC*, $I\bar{4}3m$) for the basal orientations *100* (Phot. 1), *110* (Phot. 2) and *111* (Phot. 3). The sum of squares of indices is *2n*, *4n* or *6n*, which corresponds to the *BCC* structure (Andrews *et al.* 1967).

Some of the obtained electron diffraction patterns with high zone axis indices show mixed indices, indicative of the primitive unit cell. Yet this type of symmetry is subordinate and has been noted so far for high zone axis indices only. For thta reason, it has not been possible to determine unequivocally the position of the *P*-type symmetry in relation to the basic $I\bar{4}3m$ structure. The suggested second component of the amalgams studied, i.e. the one with simple cubic symmetry, is to be associated with some significant deviations in chemical composition from the formula $Ag_{11}Hg_2$. Such deviations were noted in the sample *73/A2* (Table 1). It seems that the component with simple cubic symmetry has also a large unit cell, close to 10 Å, because for this value of a_0 the electron diffraction patterns were indexed correctly. However, further chemical and structural studies are required to explain satisfactorily the question of the second phase with primitive symmetry. It seems feasible that this phase is responsible for the presence of odd-indexed reflections in the X-ray diffraction pattern (Table 2).

DISCUSSION

Eugenite has presumably the structure of γ-brass. Phases of this type have the value of the *e/a* ratio (number of electrons per atom averaged in relation to the unit cell composition) equal to 1.54—1.70 (Barret, Massalski 1966). The *e/a* ratio for the eugenite studied is much lower than the typical values. There are three alternatives that would account for this:

1. Eugenite, like Ag_3Li_{10}, is a γ phase that does not comply with the rule of electron compounds (Hume-Rothery *et al.* 1952).
2. Eugenite has a defect structure in which some lattice sites are vacant. It is generally held that such compounds may behave like electron phases (Barret, Massalski 1966).
3. About one half of Ag atoms are bivalent.

On the basis of the data obtained it is difficult to say which alternative is correct, and further studies are required to solve this problem.

The results obtained for eugenite, $Ag_{11}Hg_2$, show certain similarities to the data presented for the Fe—Zn and Ni—Zn systems, in which the following γ phases are known: Fe_2Zn_{11}, Fe_3Zn_{10}, Ni_2Zn_{11} and Ni_3Zn_{10} (Johansson *et al.* 1968, Brandon *et al.* 1974). The crystal structures of T_2Zn_{11} (*T* — transition metal) and T_3Zn_{10} are different despite only small differences in chemical composition, although they both occur within the known field γ—*T*—Zn (Brandon *et al.* 1974). A similar situation is possible within the natural γ phases in the Ag—Hg system.

CONCLUSIONS

Eugenite differs from moschellandsbergite in chemical composition, space group and specific gravity. The X-ray diffraction pattern of eugenite differs essentially from that of moschellandsbergite.

The presented data for silver amalgams suggest the necessity of studying the Ag—Hg system again, with special emphasis placed on the fields of γ phases.

The new mineral $Ag_{11}Hg_2$ and its name "eugenite" have been aproved by the Commission of New Minerals and Mineral Names, IMA. The name was given to do honour to Professor Eugen F. Stumpfl, Austria, for his great contribution to the studies of noble, mainly platinum metals. The typical material is kept at the Institute of Geology and Mineral Deposits in Cracow, Poland, reference number MAR 73.

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REFERENCES

ANDREWS K. W., DYSON D. J., KEOWN S. R., 1967: Interpretation of electron diffraction patterns. Helger and Watts LTD, London, 188 pp.

BARRET C., MASSALSKI T. B., 1966: The structure of metals and alloys. 3d ed., McGrow-Hill, 654 pp.

BRADLEY A. J., JONES P., 1933: An X-ray investigation of the copper aluminium alloys. *J. Inst. Metals*, 51, 131—162.

BRANDON J. K., BRIZARD R. Y., CHIEH P. C., McMILLAN R. K., PEARSON W. B., 1974: New refinements on the γ-brass type structures Cu_5Zn_8, Cu_5Cd_8 and Fe_3Zn_{10}. *Acta Cryst.*, B.30, 1412—1417.

BETTERTON J. O., HUME-ROTHERY W., 1951: The equilibrium diagram of the system copper-gallium in the region 30—100 at % gallium. *J. Inst. Metals* 80, 458—468.

HANSEN M., ANDERKO K., 1958: The constitution of binary alloys. McGraw-Hill, New York, 1305 pp.

HARCOURT G. A., 1942: Tables for the identification of ore minerals by X-ray patterns. *Amer. Miner.* 27, 63—113.

HIRSH P. B., HOWIE A., NICHOLSON R. B., PASHLEY D. W., WHELAN M. J., 1965: Electron microscopy of thin crystals. Butterworths, London, 549 pp

HUME-ROTHERY W., BETTERTON J. O., REYNOLDS J., 1952: The factors affecting the formation of 21/13 electron compounds in alloys of copper and of silver. *J. Inst. Metals*, 80, 609—616.

JOHANSSON A., LJUNG H., WESTMAN S., 1968: X-ray and neutron diffraction studies on γ-Ni, Zn and γ-Fe, Zn. *Acta Chem. Scand.*, 22, 2743—2753.

KUCHA H., 1981: Precious metal alloys and organic matter in the Zechstein copper deposits, Poland. *Tschermaks Min. Petr. Mitt.* Vol. 28, 1—16.

KUCHA H., SALAMON W., 1972: Microscope method of determining specific gravity of minerals in small amounts. *Prz. Geol.*, 4, 195—198 (in Polish).

NYMAN H., ANDERSSON S., 1979: On the structure of Mn_5Si_3, Th_6Mn_{23} and γ-brass. *Acta Cryst.*, A 35, 580—582.

PALACHE C., BERMAN H., FRONDEL C., 1951: 1962 — The system of mineralogy of J. Dana and E. S. Dana. 7th ed., Vol. 1, J. Wiley.

PEARSON W. B., 1958: A handbook of lattice spacings and structure of metals and alloys; V. 4. [*In*:] Raynor, G. V. (Ed.) Int. ser. of monographs on metal phys. and physical metallurgy. Pergamon Press.

PHILIBERT J., 1965: L'Analyse Quantitative en Microanalyse par Sonde Electronique. Publications de IRSID. Ser. B, 51. Fevier.

PHILIBERT J., TIXIER R., 1968: Electron penetration and the atomic number correction in electron probe microanalysis. *Brit. J. Appl. Phys.* (*J. Phys. D*), ser. 2, Vol. 1, 685—694.

RAMDOHR P., 1975: Die Erzmineralien und Ihre Verwachsungen, Akad. Verlag, Berlin, 1277 pp.

RYDZEWSKI A., 1976: The origin of the Zechstein polimetallic mineralisation. *Prz. Geol.*, 4, 176—182 (in Polish).

Henryk KUCHA

EUGENIT, $Ag_{11}Hg_2$, NOWY MINERAŁ Z CECHSZTYŃSKICH ZŁÓŻ MIEDZI W POLSCE

Streszczenie

$Ag_{11}Hg_2$ występuje w ziarnach wielkości do 4 mm w cechsztyńskich złożach miedzi na monoklinie przedsudeckiej w Polsce. W świetle odbitym minerał jest biały z odcieniem żółtym. Zdolność refleksyjna mierzona w powietrzu wynosi: 546 nm — 80,1%, 589 nm — 82,7% i 656 nm — 85,6%, $VHN_{15g} = 96{,}2 \pm 6$ kG/mm². Minerał jest regularny, optycznie izotropowy, $a_o = 10{,}02 \pm 0{,}02$ Å, grupa przestrzenna $I\bar{4}3m$ (struktura γ_2-mosiądzu, $D8_2$), $Z = 4$. $D_{meas.} = 10{,}75 \pm 0{,}03$ g/cm³. $D_{calc.} = 10{,}45$ g/cm³. Najsilniejsze linie dyfrakcyjne: *2,37(10)*, *2,10(8)*, *1,457(7)*, *1,233(7)*, *1,193(6)*, *1,033(5)*, *0,950(8)*, *0,925(8)*.

Nazwa eugenit i nowy minerał zostały zatwierdzone przez Komisję Nowych Minerałów i Nazw Minerałów IMA. Nazwę nadano, aby uhonorować Prof. dr Eugen F. Stumpfla, Loeben, Austria, za jego istotny wkład w badanie metali szlachetnych, głównie platynowców.

OBJAŚNIENIE FIGURY

Fig. 1. Zależność składu chemicznego (% wag.), amalgamatu srebrowego, oznaczonego za pomocą mikrosondy elektronowej, od czasu pomiaru (s). Ziarno *73/A2* (tab. 1) o wzorze chemicznym $Ag_{11,00}Hg_{1,78}$

OBJAŚNIENIA FOTOGRAFII

Fot. 1. Elektronogram amalgamatu srebrowego o składzie *73/B1* (Tab. 1) *uvw* = [*100*], $h+k+l$ parzyste, $h^2+k^2+l^2 = 2n$, komórka regularna przestrzennie centrowana

Fot. 2. Elektronogram stopu *73/B1* (Tab. 1) o składzie zbliżonym do $Ag_{11}Hg_2$, *uvw* = [*110*], $h+k+l$ parzyste, $h^2+k^2+l^2 = 4n$ i *6n*. Komórka regularna przestrzennie centrowana.

Fot. 3. Elektronogram stopu *73/B1* (Tab. 1) o składzie zbliżonym do $Ag_{11}Hg_2$. *uvw* = [*111*], $h+k+l$ parzyste, $h^2+k^2+l^2 = 6n$. Komórka regularna przestrzennie centrowana.

Хенрык КУХА

ЭЙГЕНИТ, $Ag_{11}Hg_2$, НОВЫЙ МИНЕРАЛ ИЗ ЦЕХШТЕЙНОВЫХ МЕДНЫХ МЕСТОРОЖДЕНИЙ В ПОЛЬШЕ

Резюме

В цехштейновых медных месторождениях на Предсудетской моноклинали $Ag_{11}Hg_2$ присутствует в зернах размером до 4 мм. В отраженном свете белый с желтым оттенком. Отражательная способность в воздухе составляет: 546 нм — 80,1%, 589 нм — 82,7% и 656 нм — 85,6%, $VHN_{15г} = 96{,}2 \pm 6$ кГ/мм². Минерал оптически изотропен, принадлежит к кубической сингонии, $a_0 = 10{,}02 \pm 0{,}02$ Å, пространственная группа решетки $I\bar{4}3m$ (структура γ_2—латуни, $D8_2$), $Z =$

$=4$. $D_{изм.}=10{,}75\pm0{,}03$ г/см^3, $D_{рас.}=10{,}45$ г/см^3. Наиболее интенсивные дифракционные линии: *2,37 (10), 2,10 (8), 1,457 (7), 1,233 (7), 1,193 (6), 1,033 (5) 0,950 (8), 0,925 (8).*

Название эйгенит и новый минерал $Ag_{11}Hg_2$ утверждены Комиссией новых минералов и названий минералов ММА. Наименование в честь профессора д-ра Эйгена Ф. Штумпфля из Леобен в Австрии за его важный вклад в изучении благородных металлов, в частности платиноидов.

ОБЪЯСНЕНИЯ К ФИГУРЕ

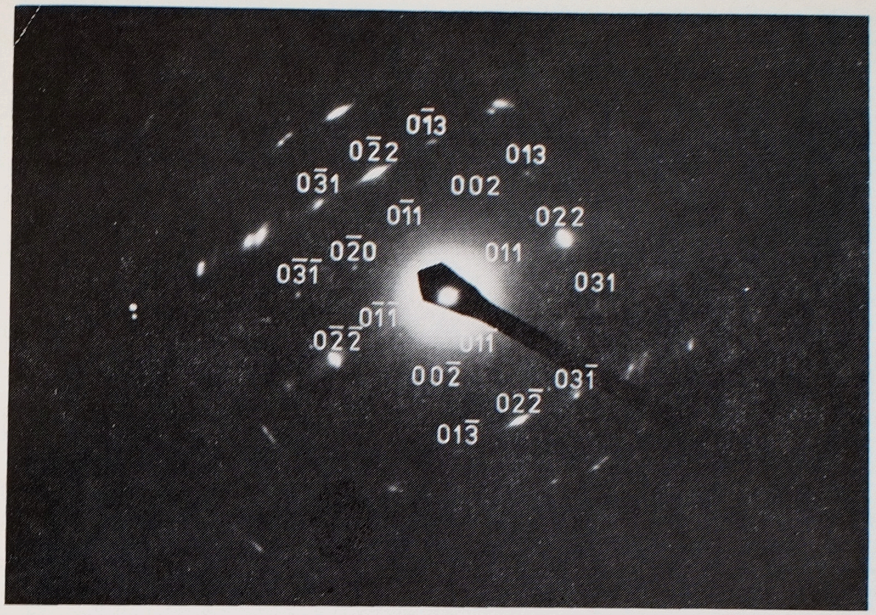
Фиг. 1. Зависимость химического состава (вес. %), определенного на микрозонде, амальгамы серебра от времени измерения (сек). Зерно *73/A2* (табл. 1) с химической формулой $Ag_{11}Hg_{1,78}$

ОБЪЯСНЕНИЯ К ФОТОГРАФИЯМ

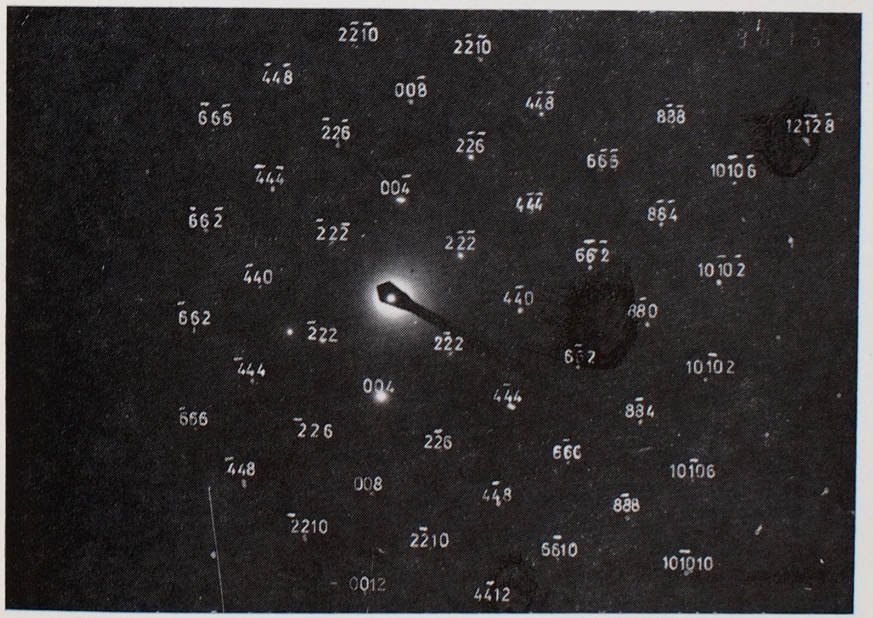
Фото 1. Электронограмма амальгамы серебра состава *73/B1* (табл. 1), $uvm=[100]$, $h+k+l$ четные, $h^2+k^2+l^2=2n$, объемоцентрированная кубическая решетка

Фото 2. Электронограмма сплава *73/B1* (табл. 1) состава сближенного к $Ag_{11}Hg_2 \cdot uvw=[110]$, $h+k+l$ четные, $h^2+k^2+l^2=4n$ и $6n$. Объемоцентрированная кубическая решетка

Фото 3. Электронограмма сплава *73/B1* (табл. 1) состава сближенного к $Ag_{11}Hg_2 \cdot uvw=[111]$, $h+k+l$ четные, $h^2+k^2+l^2=6n$. Объемоцентрированная кубическая решетка

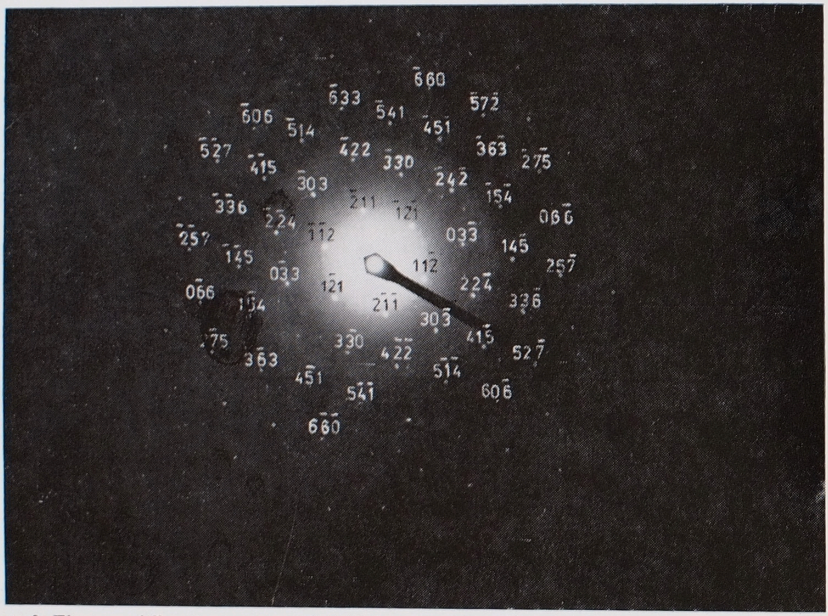


Phot. 1. The $uvw=[100]$ diffraction pattern of Ag-amalgam with *73/B1* composition (Tabl. 1). $h+k+l=$ even, $h^2+k^2+l^2=2n$. Body centeed cube



Phot. 2. Electron diffraction pattern of the alloy with 73/B1 composition (Tab. 1) very close to $Ag_{11}Hg_2$. Orientation $uvw=[110]$, $h+k+l$ even, $h^2+k^2+l^2=4n$ and $6n$. Body centered cube

Henryk KUCHA — Eugenite, $Ag_{11}Hg_2$ — A new mineral from Zechstein copper deposits in Poland



Phot. 3. Electron diffraction pattern of 73/B1 composition alloy (Tab. 1) a very close to $Ag_{11}Hg_2$. Orientation $uvw=[111]$, $h+k+l$ even, $h^2+k^2+l^2=6n$. Body centered cube

Henryk KUCHA — Eugenite, $Ag_{11}Hg_2$ — A new mineral from Zechstein copper deposits in Poland