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Aurihydrargyrumite from the Otakar (Otokar, Ottokar) vein near Gelnica, Spišsko-gemerské rudohorie Mts., Slovakia, a new occurrence of natural Au_6Hg_5

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Abstract

Aurihydrargyrumite, ideally Au_6Hg_5 was discovered at the dump of the Žigmund adit, Otakar (Otokar, Ottokar) hydrothermal siderite-type vein near Gelnica, Spišsko-gemerské rudohorie Mts., Gelnica Co., Košice Region, Slovakia. It occurs as anhedral grains up to 28 μm in size associated with cinnabar and tetrahedrite-(Hg). The average (n = 7) empirical formula of studied aurihydrargyrumite corresponds to $(Au_{5.96}Ag_{0.04})_{\Sigma 6.00}Hg_{5.00}$. This find is representing the third occurrence of this rare mineral in nature.

Key words: *aurihydrargyrumite, chemical composition, Gelnica, Gemeric Unit, Spišsko-gemerské rudohorie Mts., Slovak Republic*

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Introduction

Aurihydrargyrumite, a rare natural Au_6Hg_5, was first described from the placer gold deposit near Iyoki, Uchiko, Ehime Prefecture, Shikoku Island, Japan, by Nishio-Hamane et al. (2018). It occurs as up to 2 μm thick, anhedral to subhedral layer developed on the surface of placer gold particles. Formation of aurihydrargyrumite at the type locality is related to the natural weathering of Hg-rich placer gold and its self-electrorefining (Nishio-Hamane et al. 2018). The second locality of aurihydrargyrumite, Modderfontein ‚B' gold mine in South Africa, is listed on Mindat.org (https://www.mindat.org/min-51827.html).

A third occurrence of aurihydrargyrumite in the world was recently discovered at the Otakar (Otokar, Ottokar) vein near Gelnica in Slovakia and its description is presented in this short paper.

Geological setting

The ore samples with aurihydrargyrumite were collected on the dump of the Žigmund adit exploring the western section of the Otakar (Otokar, Ottokar) vein. This adit is located 300 m WSW of the Cenderling hill (780 m a.s.l.), around 1.7 km SSE of the Gelnica town, Gelnica Co., Košice Region, Slovakia. The GPS coordinates (WGS84) of the sampling spot/ore dump are: 48.837719° N and 20.940575° E, 708 m a.s.l.

The Otakar vein is one of principal hydrothermal siderite-type veins in the Perlová dolina (Grellenseifen) valley area. The host rock is Early Paleozoic, coarse-grained rhyolite metatuffs of the Drnava Formation, belonging to the Gelnica Group of Gemeric tectonic unit (Bajaník et al. 1984; Grecula et al. 1995). This E-W trending, subvertical vein is about 950 m long and mostly up to 5 m, but exceptionally up to 15 m thick. It was extensively exploited mainly for iron, but in minor extent also for copper and mercury ores. The mining at the Otakar vein finished in late 1950s (Papp 1919; Odehnal 1951; Hladík 1957; Grecula et al. 1995).

The dominant gangue minerals at the Otakar vein are siderite and quartz accompanied by minor amounts of baryte, minerals of the dolomite-ankerite series and accessory to rare muscovite, albite and the chlorite group minerals. Minerals of the tetrahedrite group, chalcopyrite and pyrite are the most common ore minerals accompanied by relatively abundant cinnabar and hematite (variety specularite) as well as accessory arsenopyrite, pyrrhotite, marcasite, magnetite, sphalerite, gold, bismuth and mercury (Odehnal 1951; Háber 1980). A well-developed supergene zone, represented by extensive *limonite* gossan, is typical for the Otakar vein. The main minerals in supergene zone are *limonite*, goethite, various Ba-Mn oxides and pyrolusite, associated with minor baryte, cinnabar, malachite and azurite (Števko 2022).

Analytical methods

The quantitative (WDS) chemical analyses of aurihydrargyrumite from Gelnica were performed using a Cameca SX100 electron microprobe (Department of Mineralogy and Petrology, National Museum, Prague, Czech Republic). The following conditions, standards and X-ray lines were used: 25 kV, 20 nA, 0.5 μm wide beam, Ag (Ag*L*α), Au (Au*M*α), Bi_2Se_3 (Bi*M*β), $CuFeS_2$ (Cu*K*α, S*K*α), FeS_2 (Fe*K*α), HgTe (Hg*L*α), NiAs (As*L*β), PbS (Pb*M*α), PbSe (Se*L*β), PbTe (Te*L*α), Sb_2S_3 (Sb*M*α), Sn (Sn*L*α) and ZnS (Zn*K*α). Contents of the above-listed elements, which are not included in the table, were analysed quantitatively, but

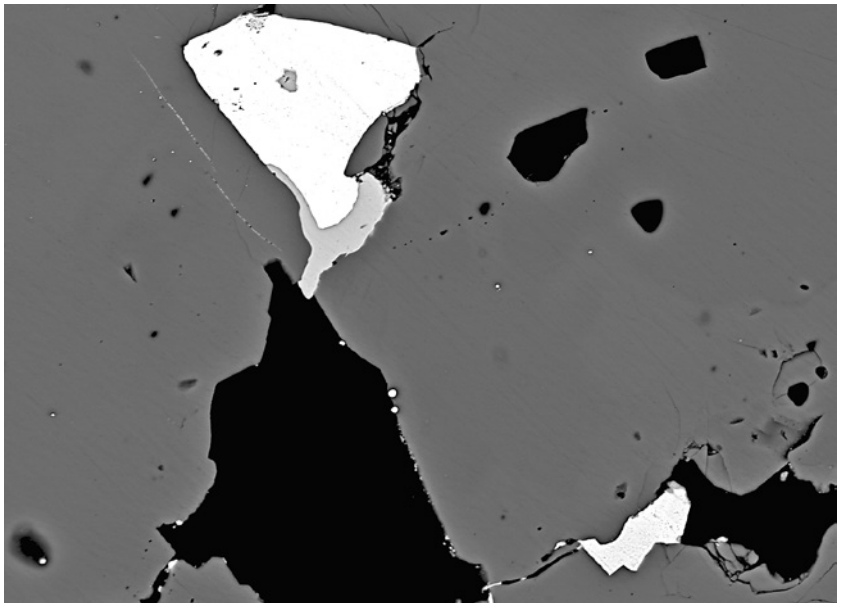

Fig. 1 *Anhedral grains of aurihydrargyrumite (white) associated with cinnabar (light grey), both embedded in tetrahedrite-(Hg) (dark grey). BSE image by T. Mikuš, FOV 100 µm.*

Table 1 *Quantitative WDS analyses of aurihydrargyrumite from Gelnica (wt.%)*

	1	2	3	4	5	6	7
Au	54.66	53.92	54.42	53.89	53.84	54.32	53.94
Ag	0.18	0.23	0.16	0.23	0.18	0.21	0.23
Hg	46.02	45.94	45.61	46.19	46.94	46.15	46.35
total	100.85	100.09	100.19	100.31	100.95	100.68	100.53
Au	6.002	5.965	6.017	5.948	5.907	5.975	5.941
Ag	0.036	0.046	0.032	0.046	0.035	0.041	0.047
Hg	4.962	4.989	4.951	5.007	5.057	4.984	5.012
total	11.000	11.000	11.000	11.000	11.000	11.000	11.000

their contents were consistently below the detection limit (ca. 0.03 - 0.05 wt. % for individual elements). Raw intensities were converted to the concentrations of elements using automatic "PAP" matrix-correction algorithm (Pouchou, Pichoir 1985).

Results

Aurihydrargyrumite has been discovered in quartz-siderite gangue containing abundant aggregates, veinlets and nests of cinnabar up to 2 × 2 cm in size, anhedral grains of tetrahedrite-(Hg) up to 7 mm and minor pyrite. It occurs very rarely as anhedral grains 28 × 20 µm in size (Fig. 1) embedded in tetrahedrite-(Hg). Other directly associated mineral is cinnabar.

Quantitative WDS chemical analyses of aurihydrargyrumite from the Otakar vein and the corresponding empirical formulae are shown in Table 1. Studied aurihydrargyrumite is chemically homogenous and except of Au and Hg it is containing only minor amounts of Ag (up to 0.05 *apfu*). Its average (n = 7) empirical formula based on sum of all atoms = 11 *apfu* is $(Au_{5.96}Ag_{0.04})_{\Sigma 6.00}Hg_{5.00}$.

Conclusions

A new occurrence of aurihydrargyrumite has been discovered at the Otakar hydrothermal siderite-type vein near Gelnica, Spišsko-gemerské rudohorie Mts., Slovakia. It is representing the third occurrence of this rare mineral in nature.

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