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ARSENATE MOTTRAMITE FROM THE STARA GÓRA DEPOSIT (KACZAWA MTS., POLAND) – PRELIMINARY REPORT

Abstract: During exploration of the oxidation zone of Stara Góra polymetallic deposit (Radzimowice, Kaczawskie Mts., Poland) mottramite was found. The mineral occurs in the outermost part of the oxidation zone. It forms small segregations at the border of goethite and chrysocolla. Microprobe analyses revealed, that the mineral is an arsenic-bearing mottramite with formula close to: $Cu_{0,95}Pb_{0,88}Ca_{0,08}Bi_{0,03}[(V_{0,47}As_{0,27}P_{0,15})O_4]_{0,89}(OH)_{1,36}$. On the basis of negative correlation between vanadium and arsenic it was ascertained, that the analysed mineral is an intermediate member of the mottramite – duftite series. A small part of lead was replaced by calcium and bismuth.

Keywords: mottramite, duftite, vanadate, arsenate, Stara Góra, Radzimowice

INTRODUCTION

The Stara Góra polymetalic deposit is located in so-called Radzimowice unit, a part of Kaczawskie Mts., about 20 km north of Jelenia Góra. This unit is build up mostly of quartz-sericite-graphite shales. These shales are cut by rholites and kersantites. Several ore veins occur on the border of shales and magmatic rocks. The veins consist of rich assotiation of ore minerals (pyrite, arsenopyrite, chalcopyrite, galena, sphalerite, tetrahedrite, bournonite, boulangerite and other) and gangue minerals (quartz, kutnahorite, rhodochrosite, dolomite, calcite and other). Different groups of supergene minerals (native elements, oxides and oxyhydroxides, carbonates, sulphates, arsenates, phosphates, silicates) are products of weathering processes. In the oxidation zone no secondary vanadium minerals were observed until now. Increased concentrations of this element, reaching up to 1.56 wt% V_2O_5, were detected in pseudomalachite only (Siuda 2005).

METHODS

The qualitative chemical compositions of minerals were measured with CAMECA SX-100 electron microprobe at the Inter-Institution Laboratory for Microanalysis of Minerals and Synthetic Substances (Faculty of Geology, Warsaw University). Fe_2O_3 (Fe), sphalerite (Zn), rhodochrosite (Mn), orthoclase (Al), chalcopyrite (Cu), galena (Pb), diopside (Ca and Si), Bi_2Te (Bi), vanadium metal (V), synthetic GaAs (As) and apatite (P) were used as standards. The water content was assumed as the difference between 100% and the sum of the other oxides weight percent.

Ca-BEARING ARSENATE MOTTRAMITE

Small, reaching up to 20 μm in size segregations of mottramite, were found on the first level of Stara Góra mine. This level is at about 30 m below the ground surface.

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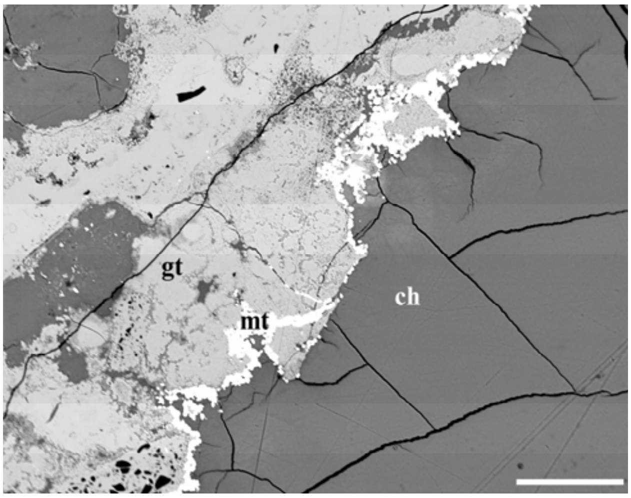

Mottramite occurs here at the border of goethite and chrysocolla (Fig. 1). Sometimes, it also fills thin cracks cutting goethite. The chemical composition of mottramite from Radzimowice was established on the basis of the microprobe analyses. The composition corresponds to Ca-bearing arsenate mottramite.

Fig. 1. Mottramite (mt) between goethite (gt) and chrysocolla (ch). Scale bar is 100 μm.

Table. 1. Chemical analyses of mottramite from Radzimowice (wt %).

PbO	51,71	47,96	52,59	51,17	48,60	50,45	49,24	47,47	49,86	51,97
CuO	19,96	21,65	19,99	20,23	20,82	19,58	20,93	21,19	19,75	19,80
CaO	1,02	1,40	0,89	0,99	1,33	1,32	1,15	1,80	1,27	1,10
Bi_2O_3	1,90	2,04	1,53	2,13	2,29	2,12	2,01	2,78	2,06	1,74
ZnO	0,09	0,06	0,00	0,06	0,00	0,14	0,10	0,00	0,00	0,07
V_2O_5	12,62	10,77	13,03	12,49	10,53	11,88	11,32	9,23	11,91	12,39
As_2O_5	7,37	8,78	6,75	7,22	9,06	8,08	8,54	11,37	8,18	7,50
P2O5	2,88	2,76	2,71	3,09	2,85	3,09	2,92	3,09	2,96	3,02
Total	97,54	95,43	97,48	97,38	95,48	96,65	96,22	96,93	95,98	97,61
content of ions										
Cu	0,97	0,90	0,98	0,96	0,93	0,95	0,99	0,99	0,96	0,88
Pb	0,90	0,81	0,78	0,81	0,85	0,79	0,89	0,93	0,75	0,81
Ca	0,08	0,08	0,12	0,08	0,09	0,09	0,07	0,06	0,09	0,06
Bi	0,03	0,03	0,04	0,03	0,03	0,04	0,04	0,03	0,03	0,03
Zn										
$(VO_4)^{3-}$	0,53	0,47	0,37	0,46	0,49	0,42	0,53	0,56	0,42	0,49
$(AsO_4)^{3-}$	0,25	0,26	0,36	0,27	0,27	0,29	0,24	0,23	0,27	0,23
$(PO_4)^{3-}$	0,17	0,15	0,16	0,15	0,16	0,15	0,17	0,15	0,14	0,14
$(OH)^-$	1,03	1,61	1,25	1,53	1,40	1,80	1,13	1,09	1,78	0,96

Approximate formula of this mineral is as follows: $\mathbf{Cu_{0,95}Pb_{0,88}Ca_{0,08}Bi_{0,03}[(V_{0,47}As_{0,27}P_{0,15})O_4]_{0,89}(OH)_{1,36}}$ (based on 5 oxygen atoms per formula unit).

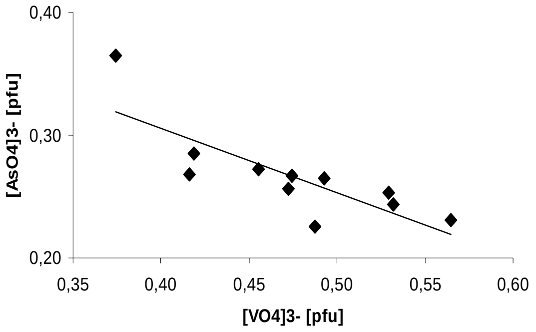

Fig. 2. Correlation between $[VO_4]^{3-}$ and $[AsO_4]^{3-}$ ions in mottramite from Radzimowice. R^2 = - 0,80

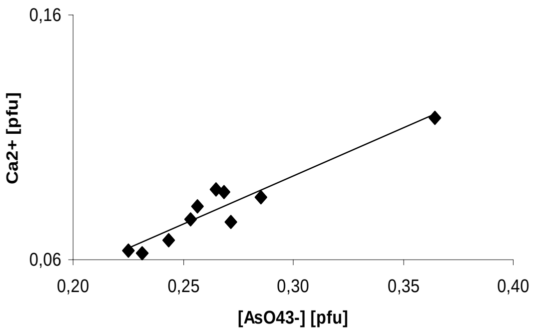

Fig. 3. Correlation between Ca^{2+} and $[AsO_4]^{3-}$ ions in mottramite from Radzimowice. R^2 = 0,95

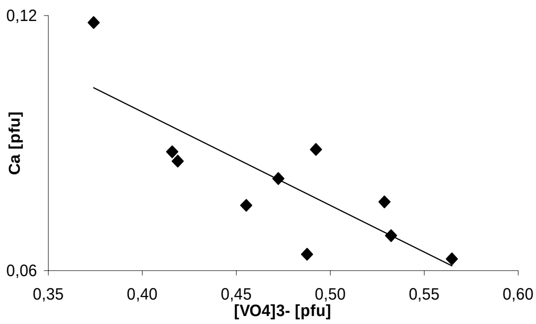

Fig. 4. Correlation between Ca^{2+} and $[VO_4]^{3-}$ ions in mottramite from Radzimowice. R^2 = - 0,81

Distinct negative correlation between vanadium and arsenic was observed for the analyzed mineral (Fig. 2). It indicates, that vanadate ions are partially replaced by arsenate ions. Similar dependence can be observed in the Pb – (Ca+Bi) assemblage. Such kind of replacement may be compared to the one in bismuth – calcian variety of mottramite, called duhamelite (Krause *et al.* 2003). A good negative correlation (R^2 = 0,95) between Ca^{2+} and $[AsO_4]^{3-}$ (Fig. 3) could indicate, that the analyzed mottramite is an intermediate member of conichalcite ($CaCu(AsO_4)(OH)$) – mottramite series (*i.e.* Basso et all 1989). However, amounts of Ca and Bi (replacing Pb) are much smaller than amounts of As (replacing V). Diadochy in Pb – (Ca+Bi) assemblage seems to be minor here. Thus, the analyzed mineral should rather be placed in the mottramite – duftite series. Brugger *et al.* (2001) suggests existence of mottramite – tangeite (CaCu(VO4)(OH)) solid solution. But negative correlation between Ca^{2+} and $[VO_4]^{3-}$ (Fig. 4) excludes - in case of mottramite from Radzimowice, belonging of these mineral to mottramite – tangeite series.

Confirmed cases of the presence of solid solutions between mottramite and minerals belonging to adelite group are rarely found in literature (Lazebnik, Zajakina 1988). Chemical composition of mottramite from the oxidation zone of Stara Góra deposit in Radzimowice confirms existence of such kind of isomorphous series. Mottramite belonging to this series was also identified in the oxidation zone of ore mineralization in Rędziny (Gołębiowska 2003).

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