A case study of realgar and stibnite weathering in an iron-deficient environment: the abandoned Lojane flotation tailings dump, North Macedonia

TAMARA ĐORĐEVIĆ[1], UWE KOLITSCH[2,1], TODOR SERAFIMOVSKI[3], GORAN TASEV[3], MICHAEL STÖGER-POLLACH[4], AND BLAŽO BOEV[3]

[1]Institut für Mineralogie und Kristallographie, Universität Wien, Althanstr. 14, 1090 Wien, Austria (tamara.djordjevic@univie.ac.at)
[2]Mineralogisch-Petrographische Abteilung, Naturhistorisches Museum, Burgring 7, 1010 Wien, Austria
[3]Department of Mineral Deposits, Faculty of Natural and Technical Sciences, University "Goce Delčev"-Štip, Goce Delčev 89, 2000 Štip, North Macedonia
[4]University Service Centre for TEM, Technische Universität Wien, Wiedner Hauptstr. 8-10, 1040 Wien, Austria

Realgar and stibnite are the primary sources of As and Sb contamination of the waters and soils at the Lojane mining site, where an Sb-As-Cr deposit was mined until 1979. The waste material comprises waste dumps, flotation tailings dump, and arsenic smelter. We have studied the association of As and Sb in realgar and stibnite oxidation products from material sampled at the (sub)surface of the fine-grained (20 to 100 μm), porous flotation tailings. XRD and Raman spectroscopy, combined with SEM-EDX, TEM-SAED, TEM-EDX, and TEM-EELS, have been used to determine chemistry, mineralogy and element distribution in the weathering products.

The weathering of the Fe-poor and realgar-rich tailings (~60 wt% realgar), containing significant amounts of stibnite (up to 13.5 wt%), produces a mixture of Fe^{3+}-rich nanocrystalline roméite-group minerals (RMG) and X-ray amorphous As-dominant RGM-like phases, in which both Sb and As, and partly also Ni, are hosted. Weakly Sb-bearing scorodite is another important product of realgar and stibnite oxidation. As further secondary phases we observed As-bearing sulfur, arsenolite, limonite, pickeringite (Ni- and Fe-bearing), alunogen, and annabergite.

The variable or unknown (RGM phases) solubilities of the identified secondary phases is expected to influence mobility of As and Sb in the near-surface environment.

We acknowledge the financial support of the Austrian Science Fund (FWF): [P 30900-N28].