THREE NEW AMMONIUM-IRON-SULFITE PHASES FROM A BURNING DUMP OF THE VASAS ABANDONED OPENCAST COAL MINE, PÉCS, MECSEK MTS., HUNGARY

FEHÉR, B.[1], SAJÓ, I.[2], KÓTAI, L.[3], SZAKÁLL, S.[4], ENDE, M.[5], EFFENBERGER, H.[5], MIHÁLY, J.[3], SZABÓ, D.[6] & KOLLER, G.[7]

[1]Department of Mineralogy, Herman Ottó Museum, Miskolc, Hungary
[2]Szentágothai Research Centre, University of Pécs, Pécs, Hungary
[3]Institute of Materials and Environmental Chemistry, Research Centre for Natural Sciences, Budapest, Hungary
[4]Institute of Mineralogy and Geology, University of Miskolc, Miskolc, Hungary
[5]Institute of Mineralogy and Crystallography, University of Vienna, Vienna, Austria
[6]Department of Mineralogy, Eötvös Loránd University, Budapest, Hungary
[7]Pilisborosjenő, Hungary
E-mail: feherbela@t-online.hu

Introduction

Sulfites are substances used as regulated food additives. However, the sulfite anion [$(SO_3)^{2-}$] is very rarely incorporated into minerals, so far only seven sulfite-bearing minerals are known: scotlandite, hannebachite, gravegliaite, orschallite, hielscherite, albertiniite and fleisstalite.

In October 2009, one of the authors (GK) collected red, brown, and yellow efflorescences on one of the burning waste dumps of the Vasas open-pit coal mine, near Pécs, Mecsek Mts., Hungary. In this material, three unknown ammonium-iron-sulfite (AIS) phases can be detected: AIS-1 is a trigonal $(NH_4)_9Fe^{3+}(SO_3)_6$, AIS-2 is a trigonal $(NH_4)_2Fe^{2+}(SO_3)_2$ and AIS-3 is an orthorhombic $(NH_4)_2Fe^{3+}(SO_3)_2(OH) \bullet H_2O$. AIS-1 and AIS-2 are metastable phases that break down in a few weeks and a few years, respectively. However, AIS-3 is a stable phase, which was approved as a new mineral species under the name kollerite by the Commission on New Minerals, Nomenclature and Classification of the International Mineralogical Association (IMA CNMNC) with IMA no. 2018-131. Synthetic analogues of the three AIS phases were studied by ERÄMETSÄ & VALKONEN (1972).

Short description of the AIS phases

AIS-1 forms red, hexagonal, stubby columnar to thick tabular crystals up to 0.2 mm in length. Its crystals are quite simple, only a hexagonal prism and a basal pinacoid can be observed. Its X-ray powder diffraction pattern is identical to ICDD 00-070-1539 card. The structure of synthetic analogue of AIS-1 was described by LARSSON & NIINISTÖ (1973). AIS-1 is very hygroscopic, it dissolves even in humid air and then flows off.

AIS-2 appears as brown tabular to rhombohedral crystals up to 0.1 mm in diameter. The crystals, which are the combinations of a rhombohedron and the basal pinacoid, often form columnar intergrowths. XRPD pattern of AIS-2 corresponds to ICDD 00-007-0427 card. The structure of synthetic AIS-2 was solved by single-crystal X-ray diffraction: space group $R\bar{3}m$, a = 5.3879(8) Å, c = 19.980(4) Å, V = 502.3 Å^3.

Sprays of AIS-3 (kollerite) up to 1.5 mm are composed of yellow, long-prismatic or lath-like crystals up to 0.7 mm, elongated along [001] and usually flattened on {100} with crystal forms {100}, {110} and {001}. The mineral is translucent with pale yellow streak and vitreous lustre. Its Mohs hardness is about 2. Density, measured on synthetic material, is 2.07(2) g/cm^3. Kollerite is brittle, cleavage is not observed. Its fracture is uneven. The mineral dissolves easily in water. XRPD pattern of AIS-3 corresponds to ICDD 00-030-0059 card. The structure of natural kollerite was solved by single-crystal X-ray diffraction: space group *Cmcm*, a = 17.803(7) Å, b = 7.395(4) Å, c = 7.096(3) Å, V = 934.2(7) Å^3, Z = 4. Thermal properties of synthetic AIS-3 were described by KOCSIS *et al*. (2018).

Occurrence, origin, associated minerals

Coalbeds of Liassic age occur in the Jurassic sedimentary formations in the Mecsek Mts. They have been mined since the 18th century. AIS phases were found only once on a burning dump of the Vasas abandoned opencast coal mine, near Pécs. AIS phases were deposited on the surface of the debris, not deeper than 10 cm. They formed by the interaction of organic matter and the decomposition products of iron sulfides. They are rare intermediate products of oxidation between iron sulfides and sulfates. Probably the formation of sulfites was facilitated by the locally suppressed oxidation of spontaneous slow combustion. There are numerous secondary ammonium minerals (sulfates, chlorides) in near-surface position, especially in the open pits. The accompanied minerals of AIS phases are anhydrite, gypsum, hannebachite, clairite, mohrite and ammoniomagnesiovoltaite.

References

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