Geophysical Research Abstracts
Vol. 12, EGU2010-8973, 2010
EGU General Assembly 2010

Secondary iron sulphates in AMD: a minerochemical analysis on jarosite supporting the valorization of its geoenvironmental contribution

Teresa Silva and Maria-Ondina Figueiredo

INETI/LNEG, Unity of Mineral Resources and Geophysics, Apartado 7586, 2721-866 Amadora, Portugal (teresa.pena@ineti.pt)

Currently, iron sulphates formed in abandoned sulphide-ore mines have a very negative connotation within acid mine drainage (AMD) because in general these secondary hydroxilated and/or hydrated minerals concentrate a large span of toxic elements. However, this apparently penalizing feature may occasionally turn out to be a positive contribution, once sequestering such elements under the form of stable minerals significantly reduces their spread in soils and rivers, as occurs for jarosite in what concerns lead.
The application of an exergetic analysis to resources consumption and sustainability assessment [1] provides a means of evaluating the degradation of mineral resources on Earth and a life cycle assessment (LCA) recently performed on some secondary iron sulphates has emphasized their exergetic contribution [2]. With the purpose of further exploring this positive aspect, and focusing on jarosite, a synopsis is presented on the structural features and geochemical tendencies of secondary iron sulphates liable of being exploited to promote their possible role. Jarosites (s.l.) - with general formula AB3(OH)6(SO4)2, where A is mainly K+, Na+, plus minor Ag+, Tl+, NH4+, Pb2+, Bi3+, and B is essentially Fe3+ (jarosite s.s.) or Al3+ (alunite) - have a trigonal crystal structure [3] and display Kagomé-type layers of corner-sharing B octahedra, [Fe/AlO2(OH)4], that give rise to unique magnetic properties [4]; the large cation A stays in pseudo-icosahedral coordination by 6 O-atoms from [SO4] tetrahedra and 6 hydroxyls shared with A octahedra [5].
A synopsis is presented on the crystal-chemistry and geochemical tendencies of jarosite and the geochemistry of sediments in the abandoned mine of S. Domingos (southern Portugal, Iberian Pyrite Belt of polymetallic sulphide ores), is briefly described to illustrate the positive environmental role of jarosite as energy-saver within the particularly aggressive environment of abandoned sulphide-ore mines.

[1] B. de Meester et al. An improved calculation of the exergy of natural resources for exergetic life cycle assessment (ELCA). Environ. Sci. Technol. 40 (2006) 6844-6851.
[2] M.O. Figueiredo, T.P. Silva & J. Mirão (2007) How does the uptake of lead along acid mine drainage processes affect the chemical exergy of jarosite in Exergetic Life Cycle Assessment (ELCA)? IEEES-3, 3rd Internat. Energy, Exergy & Environment Symp. (2007), CD-ROM, 4 pp., Edt. A.F. Miguel et al. (ISBN 978-989-95091-1-5).
[3] B. Hendricks. The crystal structure of alunite and jarosite. Amer. Inst. Min. Metallurg. Engr. Technical Publ. 22 (1937) 773-784.
[4] A.S. Wills et al. Magnetic properties of pure and diamagnetically doped jarosites: model kagomé antiferromagnets with variable coverage of the magnetic lattice. Phys. Rev B 61 (2000) 6156-6169.
[5] S. Menchetti & C. Sabelli. Crystal chemistry of alunite series: crystal structure refinement of alunite and synthetic jarosite. Neues Jahrb. Miner. Monatsch. Heft 9 (1976) 406-417.