European Mineralogical Conference
Vol. 1, EMC2012-254, 2012
European Mineralogical Conference 2012

Synchrotron radiation analyses of heterogeneous mine-waste materials related to amd processes

C. Carbone (1), P. Marescotti (1), G. Giuli (2), and G. Lucchetti (1)

(1) DISTAV, Genova, Italy (carbone@dipteris.unige.it), (2) Scuola di Scienze e Tecnologie, Sezione di Geologia, Università di Camerino

Analytical techniques with high sensitivity and high spatial resolution, such as synchrotron based techniques, are crucial for understanding the mineralogical and chemical properties of complex environmental samples (Fenter et al., 2002). Mine-waste materials (such as those deposited in tailings and waste-rocks dumps) are characterized by heterogeneous aggregates of nanometric-sized particles, thus eluding the possibility of their study by single crystal diffraction techniques. For these types of samples, the powder diffraction techniques have to be used and the advantage of synchrotron radiation lies in the lateral resolution of the incident beam and in the high intensity of the X-ray beam, which enable the collection of diffraction patterns with excellent counting statistics. Moreover, the tunability of the synchrotron radiation also permits to avoid the fluorescence of a constituent atom in the sample and the choice of selection of energy range for probing the speciation of metal contaminants at the molecular level.
In this work, we studied the mineralogical and chemical variations of some representative mine-waste samples from the Fe-Cu sulphide Libiola Mine, by means of combined synchrotron-based μ-XRD, μ-XRF, and μ-XANES analyses performed at ESRF beamlines (Grenoble). Mine waste is acid generating and is characterized by a high amount of completely to partially altered sulphide-rich mineralizations. Other than acid generation, the major environmental problem is the mobilization of transition and heavy metals and other harmful elements that can be concentrated in waters and soils. We studied three different Fe-oxides and -oxyhydroxides rich samples representative of a) stratified crust formed by the ageing of stream sediments precipitated from acid mine waters discharged at mine adits, b) partially altered massive pyrite-rich mineralizations, and c) partially altered stockwork chalcopyrite-rich mineralizations, which contain the transition from the unaltered sulphides to the authigenic Fe-rich assemblages.
In this study, we demonstrated that the combined-use of micro-synchrotron-based techniques (performed at ID18f and ID21 beamlines) can be succesfully applied to the study of complex mineralogical systems such as those occurring in Acid Mine Drainage environment, where the thermodynamic equilibrium is rarely achieved and most of the mineral species are characterized by very low crystallinity.

Fenter P., Rivers M., Sturchio N., Sutton S. (2002) Applications of Synchrotron Radiation in Low-Temperature Geochemistry and Environmental Science. Rev. in Min. and Geochem. 49, eds