Application of iron-oxidizing archeaon to biohydrometallurgy of enargite

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Microbial oxidation of Fe^{2+} and reduced sulfur species is a basic reaction to dissolve sulfides in biohydrometallurgy. Although chalcopyrite ($CuFeS_2$) is known as a main Cu resource, arsenic-bearing copper sulfides like enargite (Cu_3AsS_4) are often accompanied in deep copper ore deposits. To recover Cu even from arsenic-bearing coper sulfides, arsenic immobilization should be considered. *Acidianus brierleyi*, which is an iron-oxidizing hyperthermophilic archeaon, was applied to bioleaching of enargite at 70˚C in the presence of Fe^{2+} ions as an energy source in a lab scale to find the optimal condition and elucidate the mechanism under the optimal condition. By controling Fe^{2+} concentrations and pulp density of enargite, 91% of Cu recovery with immobilizing 94% of arsenic species was concurrently achieved. According to the comprehensive interpretation of XANES As K-edge, XRD, and SEM-EDX, the main storage of arsenic was scorodite ($FeAsO_4$), which is in the most ideal form because of high stability and high density of arsenic. Although the released species from enargite is arsenite and *A. brierleyi* does not oxidize arsenite into arsenate, arsenic was mainly immobilized as scorodite under the optimized condition. Based on spectroscopic and microscopic observation of not only bulk reaction but also interface reaction involving biological tissues, the reaction mechanism is discussed.

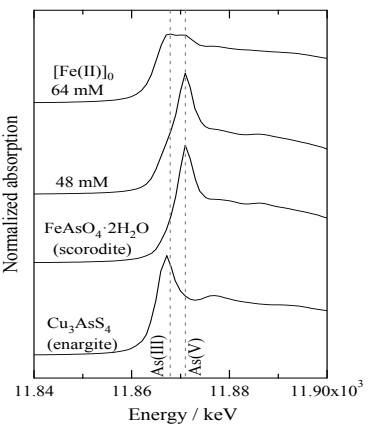

Figure As K-edge XANES spectra for enargite, scorodite and the solid residues after bioleaching of enargite under 48 mM and 64 mM Fe^{2+}.