Arsenic Release Behavior in the Process of Interaction between Acidophilic Iron-Reducing Bacteria and Biological Oxidized Arsenopyrite Products

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Abstract: Arsenopyrite is a common arsenic-bearing sulfide mineral, with chemical formula of FeAsS. Its oxidation and reduction processes are closely associated with the arsenic release and retention. In this study, the *Thiobacillus ferrooxidans* and *A. CryptumJF*−5, which represent biological oxidization and reduction conditions, respectively, are adopted to have continuously reacted with fresh arsenopyrite for 30 days, in order to discuss the effect of reduction and oxidization processes on the arsenic release in terms of geochemical and mineralogical views. The results show that the content of arsenic released from the *Thiobacillus ferrooxidans* reacted arsenopyrite for 30 days is 3 times higher than that released from the abiotic oxidized arsenopyrite. The examination by using the infrared spectroscopy (FTIR)、X-ray diffraction (XRD), and scanning electron microscope (SEM) shows that the biological oxidized arsenopyrite contains secondary jarosite ($KFe_3(SO_4)_2(OH)_6$) with better crystallinity than that of the jarosite produced under abiotic condition. The oxidized arsenopyrite had then been attacked by the *A. CryptumJF*−5 for another 30 days. The content of arsenic released from the reacted arsenopyrite by the highly active JF−5 at pH of 2 is higher than that by the lowly active JF−5 at pH of 3. This implies that reduction process can result in the another release of arsenic, which was originally released and the adsorbed in the process of oxidation, from the secondary minerals. FTIR results of the reduced secondary minerals show that there is a weak vibration at 793 cm^{-1} in the spectra. The XPS results indicate that the arsenic valence was changed from +5 (As(V)) to +3 (As(III)) in the biological reduction process. The SEM results show that the morphology of secondary minerals was obviously changed in the process of reduction.

Keywords: *Thiobacillus ferrooxidans*; *A. Cryptum JF*−5; arsenopyrite; oxidation; reduction