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Microbial Influences on the Dissolution of Sulfide Mixture: Monosulfide vs. Disulfide

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Generation of acid mine drainage (AMD), a serious environmental problem, results from oxidation of sulfide minerals upon exposure to atmospheric oxygen and water and involves a series of complex biological and chemical reactions. The mineralogical composition of sulfides (e.g., monosulfides and disulfides) affects their dissolution kinetics and thus regulates the extent of AMD formation under various geochemical conditions. Despite our current understanding mostly based on single sulfide minerals, how sulfide mixtures interact in the presence and absence of microorganisms remains poorly unknown. Furthermore, galvanic protection is already known to inhibit the oxidation of sulfide minerals with high rest potentials. However, there is limited research on how microbial activity influences such chemical reactions. Here, we aim to investigate how Fe(II) and S-oxidizing bacteria, *Acidithiobacillus ferrooxidans*, affect dissolution of sulfide mixtures comprising of different sulfide minerals (i.e. pyrite and galena).

Experimental sets were prepared with different sulfide mineral ratios: Mix1: galena:pyrite = 2:1, Mix2: pyrite:galena = 2:1, and abiotic and biological experiments were performed under aerobic and anaerobic conditions by using O_2 and Fe(III) as oxidizing agents, respectively.

Regardless of sulfide ratios, the initial and fast dissolution of galena dominated the solution chemistry both in abiotic and biotic conditions. While an increase in pH (4.39-5.74) with the formation of elemental sulfur was detected under aerobic conditions, a decrease in pH (0.80-1.34) with small but significant amount of sulfate was determined under anaerobic conditions. Galvanic interaction between pyrite and galena lead to enhanced galena dissolution but a decrease in pyrite oxidation under both conditions and mixtures. Increasing pyrite amount and the presence of microbial activity diminished the galvanic protection of pyrite after ca. 120 days and caused enhanced Fe and sulfate release into the solution and decrease in pH. Our preliminary results showed that galvanic protection can be overcome by *A. ferrooxidans* and the exact mechanism deserves further studies in order to develop proper remediation strategies for AMD formation in polymetallic sulfide mines.