Bacteria-mineral interactions at sulfide surfaces in carbonate-bearing waste rock

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Acidophilic bacteria are often observed in sulfide-bearing mine wastes that generate bulk circumneutral pH drainage. However, their contribution to sulfide-mineral oxidation under these conditions remains poorly constrained.

To address this knowledge gap, samples of various waste rock lithologies (i.e., marble-hornfels, intrusive, exoskarn) were collected from experimental waste rock piles at the Antamina Cu-Zn-Mo mine, Peru. Enumerations of relevant neutrophilic and acidophilic bacteria were performed. The presence of *Acidithiobacillus* spp. was probed using fluorescence in situ hybridization (FISH). Scanning electron microscopy (SEM), powder X-ray diffraction (XRD) and X-ray absorption spectroscopy (XAS) were used for mineralogical characterization and to examine bacteria-mineral interactions.

Neutrophiles dominated in all samples, however, elevated populations of acidophiles were observed for the intrusive waste rock samples. The presence of *Acidithiobacillus* spp. was confirmed in the intrusive samples, which were characterized by bacterially-colonized crusts of schwertmannite [$Fe_8O_8(OH)_{6\text{-}4.5}(SO_4)_{1\text{-}1.75}$], lepidocrocite [γ-FeO(OH)] and jarosite [$KFe_3(OH)_6(SO_4)_2$] at sulfide-mineral surfaces. Exposed sulfide surfaces also exhibited evidence of direct celluar attachment (pitting) sites. The combined occurrence of schwertmannite, jarosite and pitting suggests that localized acidic microenvironments developed at sulfide-mineral surfaces. These results indicate that acidophilic bacteria can play an important role in sulfide-mineral oxidation within bulk circumneutral pH environments.