

A vibrational spectroscopic study of the oxidation of pyrite by ferric iron

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ABSTRACT

The step-wise oxidation of the disulfide group during pyrite oxidation by ferric iron was investigated using in situ attenuated total reflectance (ATR) Fourier transform infrared (FTIR) spectroscopy. Pyrite oxidation by ferric iron was investigated at pH 2.0, in the dark, and with both ultraviolet and visible wavelength illumination. We concluded that the spectra collected during pyrite oxidation are consistent with the existence of more than a single sulfur species at the pyrite surface. Exact assignment of all of the sulfur species was not realistic. However, the assignment of sulfate in an outer-sphere complex and thiosulfate in a monodentate complex was possible. The presence of multiple sulfur species at the pyrite surface directly confirms the step-wise oxidation of the disulfide group, and the presence of sulfate suggests that this species is the surface release group. Photochemical experiments verify an increase in the rate of pyrite oxidation with illumination and suggest that either the mechanism or the rate of sulfur oxidation is affected by illumination.