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Scanning photoelectron microscopic (SPEM) examination of sulfur evolution on acid leached chalcopyrite with and without added pyrite or soluble iron

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Chalcopyrite (CuFeS_2) is the most abundant copper-bearing mineral. The dissolution of chalcopyrite in mine waste environments is considered to contribute to the serious environmental issue of acid and metalliferous drainage (AMD) through release of toxic aqueous copper, particularly in the presence of microbes, dissolved O_2 , aqueous Fe^{3+} and pyrite, with the latter two being associated with enhanced chalcopyrite dissolution rates. However, to date few studies have attempted to show the spatial distribution of the surface species formed as well as their evolution as means to better understand the dissolution mechanisms. High resolution, both in terms of energy and spatially, scanning photoelectron microscopy (SPEM), has been applied to the evolution of sulfur species on chalcopyrite surfaces leached in pH 1.0 HClO_4 solution at 650 mV (SHE) and 75 °C for 5 - 10 days, in the absence and presence of pyrite or with added aqueous iron. Bulk S^{2-} , S_2^{2-} and Sn^{2-} were found to be present on all samples and oxidation was observed to take place heterogeneously at the sub-micron scale. As compared to chalcopyrite leached for 5 days, surface oxidation did not appear to be increased on extended dissolution to 10 days, however surface roughness increased markedly. Both S^0 and SO_4^{2-} , but no SO_3^{2-} , were observed when 4 mmol soluble iron was added indicating greater oxidation occurred with greater Fe^{3+} activity. The greatest surface oxidation was observed when chalcopyrite was in contact with pyrite due to formation of a galvanic couple, with S^0 , SO_3^{2-} and SO_4^{2-} being identified.

Keywords or phrases (comma separated)

SPEM; chalcopyrite; oxidation; dissolution; sulfur species, galvanic interaction

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