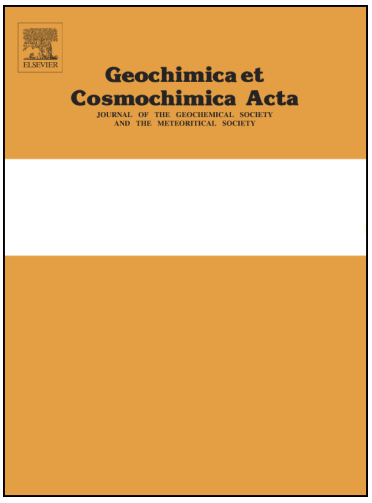

Chalcopyrite dissolution: Scanning photoelectron microscopy examination of the evolution of sulfur species with and without added iron or pyrite

Yubiao Li, Gujie Qian, Paul L. Brown, Andrea R. Gerson

PII: S0016-7037(17)30291-0
DOI: http://dx.doi.org/10.1016/j.gca.2017.05.016
Reference: GCA 10285

To appear in: *Geochimica et Cosmochimica Acta*

Received Date: 25 August 2016
Accepted Date: 12 May 2017

Please cite this article as: Li, Y., Qian, G., Brown, P.L., Gerson, A.R., Chalcopyrite dissolution: Scanning photoelectron microscopy examination of the evolution of sulfur species with and without added iron or pyrite, *Geochimica et Cosmochimica Acta* (2017), doi: http://dx.doi.org/10.1016/j.gca.2017.05.016

Chalcopyrite dissolution: Scanning photoelectron microscopy examination of the evolution of sulfur species with and without added iron or pyrite

Yubiao Li[a,b], Gujie Qian[b], Paul L. Brown[c], Andrea R. Gerson[d*]

[a] School of Resources and Environmental Engineering, Wuhan University of Technology, Wuhan, 430070, Hubei, China;

[b] The Natural and Built Environments Research Centre, School of Natural and Built Environments, University of South Australia, Mawson Lakes, SA 5095, Australia;

[c] Technology and Innovation, Rio Tinto, 1 Research Avenue, Bundoora, Vic 3083, Australia;

[d] Blue Minerals Consultancy, Middleton, SA 5213, Australia.

* Email: Andrea.Gerson@bigpond.com; Tel: +61 422 112 516

Abstract

Dissolution and oxidation processes of sulfide minerals play key roles in both acid and metalliferous rock drainage and supergene enrichment. Surface speciation heterogeneity, critical to understanding mechanisms of mineral sulfide dissolution, has to date largely not been considered. To this end synchrotron scanning photoelectron microscopy (SPEM) was employed to examine freshly fractured and partially dissolved chalcopyrite ($CuFeS_2$) surfaces (pH 1.0 $HClO_4$ solution, redox potential 650 mV relative to a standard hydrogen electrode, 75 °C). S^{2-} (bulk), S_2^{2-} and S_n^{2-} were found to be present on all samples at varying concentrations. Oxidation was observed to take place heterogeneously at the sub-micron scale. As compared to chalcopyrite partially dissolved for 5 days, extended dissolution to 10 days did not show appreciably enhanced oxidation of surface species; however surface roughness increased markedly due to the growth/overlap of oxidised sulfur species. On addition of 4 mM iron both S^0 and SO_4^{2-} were observed but not SO_3^{2-}, indicating that the greater Fe^{3+} activity/concentration promotes heterogeneous sulfur oxidation. On contact of pyrite (FeS_2) with chalcopyrite, significantly greater chalcopyrite surface oxidation was observed than for any of the other systems examined, with S^0, SO_3^{2-} and SO_4^{2-} being identified heterogeneously across the surface. It is proposed that chalcopyrite oxidative dissolution is