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Surface oxidation of chalcocite (Cu₂S) under aqueous (pH = 2–11) and ambient atmospheric conditions: Mineralogy from Cu *L*- and O *K*-edge X-ray absorption spectroscopy

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ABSTRACT

We characterized the surface oxidation layer (~50 Å) of chalcocite reacted with air-saturated aqueous solutions at pH = 2–11 and with the ambient atmosphere. Copper *L*-edge and O *K*-edge X-ray absorption spectroscopy probes the unoccupied electronic states in the conduction band of the surface alteration phase that, in turn, enables us to identify the mineralogy of the surface layer. At low pH, the surface alteration phase is primarily cuprite (Cu₂O). At higher pH, tenorite (CuO) is the dominant phase. No evidence for sulfate or carbonate phases are present; however, chalcocite reacted only in air does develop a CuSO₄ surface phase in addition to cuprite and minor tenorite.