Accepted Manuscript

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PII: S0883-2927(17)30415-8

DOI: 10.1016/j.apgeochem.2017.12.027

Reference: AG 4022

To appear in: *Applied Geochemistry*

Received Date: 25 August 2017

Revised Date: 25 December 2017

Accepted Date: 27 December 2017

Please cite this article as: Knight, R.D., Roberts, S., Cooper, M.J., Investigating monomineralic and polymineralic reactions during the oxidation of sulphide minerals in seawater: Implications for mining seafloor massive sulphide deposits, *Applied Geochemistry* (2018), doi: 10.1016/j.apgeochem.2017.12.027.

Investigating monomineralic and polymineralic reactions during the oxidation of sulphide minerals in seawater: Implications for mining seafloor massive sulphide deposits

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Abstract

Seafloor massive sulphide (SMS) deposits are rich in metals, particularly Cu and Au, and are attracting the attention of mining companies. However, there are various environmental concerns associated with the potential extraction of these deposits, which includes the release of heavy metals following the crushing and grinding of these deposits on the sea-floor as sulphide mineral surfaces are exposed to, and oxidised by seawater. A series of monomineralic and polymineralic sulphide mineral, batch reactor, abiotic oxidation experiments were completed in an effort to assess the geochemical impacts of mining SMS deposits in situ. Pyrite, chalcopyrite, sphalerite, and mixtures thereof, were reacted with synthetic seawater under conditions similar to that of the seafloor at between 2-3 km depth (2 °C, pH 8.2), but under atmospheric pressure and equilibrated with air. Galvanic effects are evident in the polymineralic experiments, predominantly the cathodic protection of pyrite by the preferential oxidation of chalcopyrite and sphalerite. However, the reaction between sphalerite and chalcopyrite remains unclear. Rates of reaction could not be quantitatively