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Batch and flow-through leaching of different metallic rocks under geothermal reservoir circumstances

Máté Osvald (1), Andrew D. Kilpatrick (2), Christopher A. Rochelle (2), János Szanyi (1), Tamás Medgyes (1), and Balázs Kóbor (1)

(1) University of Szeged, Department of Mineralogy, Geochemistry and Petrology, Egyetem u. 2. Szeged H-6722, (2) British Geological Survey, Nicker Hill, Keyworth, Nottingham NG12 5GG

The H2020 project "Combined Heat, Power and Metal extraction from ultra-deep ore bodies" (CHPM2030) aims to develop a novel technology which combines geothermal energy utilization with the extraction of metals in a single interlinked process. In order to improve the economics of geothermal-based energy production, the project investigates possible technologies for the exploitation of metal-bearing geological formations with geothermal potential at depths of 3-4 km or deeper. In this way, the co-production of energy and metals would be possible and could be optimized according to market demands in the future. This technology could allow the mining of deep ore bodies, particularly for critical metals, alongside power production while minimizing environmental impact and costs.

In this paper, laboratory leaching experiments conducted as part of this project are described. Experiments involved testing a variety of potential leaching fluids with various mineralised samples in order to assess leaching effectiveness. Specific size fractions of ground mineralised rock samples were investigated under geothermal reservoir circumstances (250 bar, 250°C). Each experiment was conducted using one of a wide range of fluids for a relatively long time (up to 720 h) in batch reactors and selected fluids were used in a flow-through reactor with shorter contact time (0.6 h). To ensure possible application in a real geothermal reservoir, only environmentally friendly fluids were considered, such as deionised water, acetic acid and dilute mineral acid.

The main findings of this study include fast reaction time, meaning that steady-state fluid compositions were reached in the first few hours of reaction and enhanced mobilisation of Ca, Cd, Mn, Pb, S, Si, Zn. Some critical elements, such as Co, Sr and W, were also found in notable concentrations during fluid-rock interactions. However, the amount of these useful elements is much less compared to the common elements found, which include Al, Ca, Fe, K, Mg, Mn, Na, Pb, S, Si and Zn. Even though concentrations of dissolved metals were increased during the tests, some remain low and this will present technical challenges for metal extraction. However, we are working towards getting actual deep fluids from depth to more tightly constrain parameters such as salinity which will also influence metal solubility.

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