

Rock-fluid Interactions in Geothermal Reservoir Systems

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Where Geothermal Energy is associated with areas of volcanic activity, CO₂ and H₂S gases are often released via the energy extraction process. Previous research primarily conducted in basaltic rock systems has demonstrated the feasibility of dissolving the gases into the formation fluids and reinjecting this into the subsurface for gas sequestration via carbonate and sulphate mineral formation[1]. The present study uses 100°C batch experiments, at neutral and acidic pH's (using HCl), to investigate dissolution/precipitation reactions with rocks from active geothermal wells. The fluids and solids are analysed pre and post experiment to assess divalent cation release and therefore whether carbonisation reactions are likely under these conditions. Water adsorption isotherms are obtained to assess sample adsorption capacity.

The mineralogy of the obtained Indonesian volcanic cores include high concentrations of quartz and feldspars, alongside chlorite, anhydrite and minor zeolite and clay fractions, determined with PXRD, XRF, Optical Microscopy and Microprobe analysis. The pH variations through the experiments suggests feldspar dissolution is taking place, as acidic pH fluids are rapidly buffered to near neutral. ICP-OES results show ppm concentrations of cations are being released into the fluids, and some secondary mineral formation is taking place, as Al concentrations subsequently decrease. Water adsorption isotherms indicate differences in mineralogy have a significant effect on the adsorption capacity of the samples. A sample with 6% clay content has an adsorption capacity of around 4 cm³/g and a sample with 14% clay content has a capacity of around 10 cm³/g. These results indicate reactions to release cations suitable for CO₂ sequestration (such as Ca²⁺) are likely when using samples with this mineralogy, and also that the presence of certain hydrothermal alteration minerals could be used as a prediction tool for a systems geothermal energy potential.

[1] Gíslason et al. (2018), *Energy Procedia*, **146**, 103-114