

GEOCHEMOMETRIC WATER-ROCK INTERACTION EXPERIMENTS TO STUDY REE DISSOLUTION UNDER GEOTHERMAL CONDITIONS

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Experimental protocols are crucial for understanding processes involved in water-rock interaction (WRI) under different geological environments, such as geothermal reservoirs. Despite their high cost and time consuming, these experiments are fundamental to address some key challenges required in the geothermal industry such as: (i) the thermodynamic calibration of geothermometers for the accurate prediction of deep equilibrium temperatures; (ii) the evaluation of extraction technologies for some critical materials from geothermal brines (e.g., Li and Rare Earth Elements: REE); (iii) the study of the mobility of trace elements; (iv) the search of technical solutions to address scaling and corrosion problems; among others. The present study proposes an experimental approach to identify the main mechanisms of rock-mineral dissolution, precipitation and fractionation of trace elements. Special attention was focused on the behaviour of REE under simulated geothermal conditions.

The WRI experiments were performed in batch reactors under controlled pressure and temperature conditions for studying the dissolution of two volcanic rocks collected in the Hidden Geothermal System of Acoculco. Crushed samples of andesite and basalt-trachyandesite (grain size 500-1,000 µm) were reacted with an acidic solution (pH ~3) at 150°C and 72.5 psi for 6 months, using a mass ratio of 10:1 (W/R). In a general context, the WRI results showed a decrease in the concentration of nearly all REE. Andesite exhibited higher initial concentrations of La, Yb and Lu compared to basalt-trachyandesite. In addition, andesite showed a positive anomaly in three medium-REE (MREE: Tb, Dy, Ho) and three heavy-REE (HREE: Er, Yb, Lu), probably attributed to the precipitation of secondary minerals.

For the first time in Mexico, REE mobility under hydrothermal conditions was experimentally performed. The experimental findings highlight the crucial role of pH, temperature and fluid composition in REE behaviour, which control geochemical signatures already previously observed in some volcanic rocks and geothermal fluids. These results contribute to refine geochemical models and improving resource assessment strategies to be used in these unconventional geothermal systems worldwide.

Acknowledgments

We want to thank the financial support of the projects: (i) UNAM-DGAPA-PAPIIT: IN108322 and (ii) CONAHCYT: CF-2023-G-490.

