Mobility of major, trace, and rare earth elements due to hydrothermal alteration in the Los Azufres geothermal field, Mexico

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A B S T R A C T

To investigate the effects of hydrothermal alteration on the chemistry of volcanic rocks, we analyzed the chemical composition (major and trace elements, including rare-earth elements – REE) of two distinct portions of a drill well core sample from Los Azufres geothermal field, Mexico. This highly hydrothermally-altered sample allowed us to study, for the first time, the mineralogical and chemical effects imposed by the hydrothermal alteration on the mm scale in this important geothermal system. Mineralogically, hydrothermal alteration in the sample is built up by a banded intergrowth of chlorite and quartz, with important presence of epidote and hematite. The altered part of the sample contains a remnant of the fresh rock, which shows intense silicification, hematization, and dissolution boundaries. Most major and trace elements were mobilized from the original rock. Major element composition reflects the silicification, chloritization, and epidotization processes taking place in the geothermal system. The rare-earth elements La and Ce, as well as Yb and Lu were partially re-deposited during alteration. The positive anomaly of Eu may suggest that Eu is being concentrated in hydrothermal epidote after its release from plagioclase to the geothermal fluid. The high-field strength elements such as Zr, Ti, and P, show significant hydrothermal alteration-related changes as well. The geothermal fluid responsible for this hydrothermal alteration was probably oxidizing, of high temperature (> 250 ºC), and enriched in REE and other trace elements. The manuscript based on these results is under review with the *Revista Mexicana de Ciencias Geológicas.*