

Microbially mediated alteration of crystalline basalts as identified from analogical reactive percolation experiments

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Alteration in the ocean crust through fluid circulation is an ongoing process affecting the first kilometers and at low temperatures some alteration may be microbially mediated. Hydrothermal activity through the hard rock basement supports diverse microbial communities within the rock by providing nutrient and energy sources. Currently, the impact of basement hosted microbial communities on alteration is poorly understood. In order to identify and quantify the nature of microbially mediated alteration two reactive percolation experiments mimicking circulation of CO₂ enriched ground water were performed at 35 °C and 30 bar for 21 days each. The experiments were performed using a crystalline basalt substrate from an earlier drilled deep Icelandic aquifer. One experiment was conducted on sterile rock while the other was conducted with the addition of a microbial inoculate derived from groundwater enrichment cultures obtained from the same aquifer. μ CT on the experimental basaltic substrate before and after the reactive percolation experiment along with synchrotron radiation x-ray tomographic microscopy and the mineralogical characterization of resulting material allows for the comparative volumetric quantification of dissolution and precipitation. The unique design of this experiment allows for the identification of alteration which occurs solely abiotically and of microbially mediated alteration. Experimental results are compared to natural basaltic cores from Iceland retrieved following a large field CO₂ injection experiment that stimulated microbial activity at depth.