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Calcium Precipitation and Trace Metal Co-Precipitation During Fluid Flow and Mixing

This project observes calcium precipitation and trace metal co-precipitation during fluid flow and mixing. Observations are made by utilizing a dual influent flow cell system, which mimics subsurface conditions. The environment being recreated for the analysis simulates the remediation of contaminated groundwater using microbial induced calcium carbonate precipitation (MICP). The fluid flow and mixing within the flow cell represent the interaction between groundwater contaminated with heavy metals, and the injected remediation solution containing urea and microbial nutrients. The metals examined include two alkaline earth metals, strontium (Sr) and barium (Ba). In addition to being common contaminants of hydraulic fracturing, Sr and Ba radionuclides are the product of uranium fission, and are present in nuclear waste. By comparing crystal size and formation of the precipitate within the flow system, results suggest that more calcium/heavy-metal precipitate formed when flow rates were similar throughout the system. Optimal flow conditions for the remediation of contaminated groundwater through MICP were evaluated using precipitation rates and a parameter for the removal of trace metals from the liquid phase into the solid phase relative to calcium precipitation. These results will be presented.
These results have the potential to aid in the optimization of MICP and its use in the field of environmental remediation. Ultimately this research asks the question of how simultaneously operating varied flow rates in a dual influent flow cell during MICP affects calcium, strontium, and barium precipitation rates and the occurrence of precipitation spatially within the system.