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Circum-neutral Weathering of REE Containing Minerals

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Microbes have profoundly affected Earth's surface over geologic time by playing critical roles in weathering of minerals. This project assessed the potential of microbial weathering processes at circumneutral pH to extract rare earth elements (REE), which are critical in medical machinery, satellite communications, and renewable energy systems and are found in a variety of sources. We investigated United States sourced coals, clay, and Australian reference standard in bioreactors inoculated with *Shewanella oneidensis*. Individual 250ml bioreactors were set up with 15.0 grams of ore, purged with nitrogen gas at 0.5 sL/H, rotor speed 200 rpm, and temperature of 37°C. Three abiotic controls and five experimental bioreactors were used for each ore. ICP-MS was used for REE quantification, including U and Th content, in the resultant liquid leachate. Coal, clay, and reference standard samples had 671.6ppm, 53.25ppm/15 g, and 258.46ppm/15 g of total REEs, respectively. Bioreactors inoculated with *S. oneidensis* extracted significantly more REEs than abiotic controls from the minerals. *S. oneidensis* extracted on average 450.87 ppb for a total efficiency of 0.6% in clay, and 0.34% in reference standard, respectively. The experiments indicate that microbial weathering of clay feedstocks at circumneutral pH has the potential to offer an alternative, sustainable method to extract REEs that may be further enhanced and investigated to prepare for scaled up extractions as well as bioremediation applications.