

Microbial acceleration of Fe-silicate mineral dissolution via siderophore production

MARK TORRES¹, A. JOSHUA WEST¹ AND KEN NEALSON¹

¹University of Southern California, Department of Earth Sciences, Los Angeles, CA, USA; marktorr@usc.edu, joshwest@usc.edu, knealson@usc.edu

Silicate minerals represent an important reservoir of essential nutrients at Earth's surface. Due to the slow kinetics of primary silicate mineral dissolution and the potential for nutrient sequestration by secondary mineral precipitation, the bioavailability of many silicate-bound nutrients may be limited by the ability of microorganisms to actively scavenge these nutrients via organic ligand production. In this study, the effectiveness of ligand production as a means to scavenge Fe from Fe-silicates is addressed through targeted *in vitro* and *in vivo* laboratory experiments using olivine as a model mineral and the microorganisms *Shewanella oneidensis*, *Pseudomonas aeruginosa*, and *Marinobacter aquaeolei*.

Preliminary results show that microbial Fe-binding ligands (i.e. siderophores) can accelerate olivine dissolution rates stoichiometrically by almost an order of magnitude in both *in vitro* and *in vivo* experiments buffered at circumneutral pH. In addition to higher reaction rates, the production of organic Fe-binding ligands fostered the accumulation of dissolved Fe in solution, which was below detection in the abiotic experiments due to the precipitation of secondary Fe minerals in the presence of O₂. Scaling these results to natural systems will require constraints on the rates of ligand cycling by microorganisms, which will be determined using mutant strains unable to produce ligands, but still capable of ligand uptake.