Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7808

Cooperative weathering of Fe(II)-silicate minerals by chemolithotrophic and organotrophic bacteria

STEPHANIE A NAPIERALSKI AND ERIC E RODEN
University of Wisconsin-Madison
Presenting Author: snapieralski@wisc.edu

Microorganisms have long been recognized for their capacity to catalyze the weathering of silicate minerals. The vast majority of studies on microbially-mediated silicate weathering focus on organotrophic metabolism linked to nutrient acquisition. However, we have recently demonstrated that chemolithotrophic ferrous iron [Fe(II)] oxidizing bacteria (FeOB) are capable of coupling the oxidation of silicate mineral Fe(II) to metabolic energy generation and cellular growth, dramatically accelerating the rate of mineral-bound Fe(II) oxidation[1]. Metagenomic analysis of Fe(II)-silicate oxidizing enrichment cultures established using an inoculum obtained from the subsurface bedrock-saprolite interface of the Rio Blanco Quartz Diorite (DIO), Luquillo PR, indicates the involvement of extracellular electron transport (EET) in the oxidative weathering process. Multiple metagenomic bins were recovered which contained homologs to the Cyc2 model EET system as well as RuBiCO, indicating chemolithotrophic growth. We also demonstrate that the activity of FeOB results in surficial mineral alteration (Figure 1[1]) that render the redox active components of the DIO more susceptible to proton promoted dissolution *in vitro*. In natural systems, however, complex microbial consortia, with varying metabolic capacities, can exist and interact to influence biogeochemical reactions. Additional work utilizing outcropping near-surface DIO demonstrates that the activity of FeOB results in greater efficiency of organotrophically driven mineral weathering, as indicated by the enhanced release of rock forming cations from microbially oxidized DIO than unoxidized control DIO[2]. Our results suggest that chemolithotrophic and organotrophic microorganisms are likely to coexist and contribute synergistically to the overall weathering of the *in-situ* bedrock outcrop according to the conceptual cartoon in Figure 2[2].

[1] Napieralski, S. A. *et al.* Microbial chemolithotrophy mediates oxidative weathering of granitic bedrock. *PNAS* **116**, 26394-26401, doi:10.1073/pnas.1909970117 (2019).

[2] Napieralski, S. A. & Roden, E. E. The Weathering Microbiome of an Outcropping Granodiorite. *Frontiers in Microbiology* **11**, doi:10.3389/fmicb.2020.601907 (2020).