Olivine dissolution by a model consortium: biological impact and analytical methodology considerations

RUBEN GERRITS [1,2], RASESH POKHAREL [3], FRIEDHELM VON BLANCKENBURG [3,4], ANNA A. GORBUSHINA [1,2]

[1]BAM - Federal Institute for Materials Research & Testing, Department 4 (Materials & Environment), Berlin, Germany
[2]Free University of Berlin, Department of Biology, Chemistry & Pharmacy, Berlin, Germany
[3]GFZ- German Research Centre for Geosciences, Section 3.4 Earth Surface Geochemistry, Potsdam, Germany
[4]Free University of Berlin, Department of Geological Sciences, Berlin, Germany

Microbiological biofilms on rocks are ubiquitous in nature and their influence on soil formation through rock weathering has been shown (Gorbushina 2007). However, most previous studies on rock weathering are limited to understanding the physical and chemical aspects overlooking the impact of biota. Due to the enormous amounts of variables that come with a biological process, the quantification of its influence is only possible by using well-controlled and simplified laboratory models. Thereby gaining more insight on the impact of rock inhabiting biofilms on mineral weathering. This presentation will show the impact of biotic weathering in terms of olivine dissolution rates

Natural forsterite was incubated in batch reactor flasks with and without a model consortium consisting of the phototrophic cyanobacterium *Nostoc punctiforme* and the rock-inhabiting ascomycete *Knufia petricola,* and submerged in a growth solution (pH 6). The flasks were incubated for 30 days under 25°C, 90 µmol photons/m^{2}s and were shaken at 150 rpm. qPCR was performed to quantify the cell number of both organisms, BET to gather the specific surface of the used olivine and ICP-OES to follow up the change of concentration of the leached out metals.

Our results show that our model consortium, especially *K. petricola* does increase the dissolution rate of olivine. The pH increased from the initial 6 to around 7.2 for all setups. Initially Mg was preferentially released over Si (Mg/Si of 3.5), until after two days the ratio starts equilibrating around stoichiometric dissolution. During this timeframe the dissolution rate drops by nearly two orders of magnitude, just as observed by Daval et al., (2011). The difference in dissolution rates between the different setups is initially non-existent, but increases over time. After 30 days the setup with K. petricola gives a dissolution rate of 1.08 10^{-13} moles/cm^{2}s, compared to 9.23 10^{-14} moles/cm^{2}s for the abiotic setup.

We expect this study to cause awareness on the impact of microbiology on mineral weathering. Additionally it is a starting point for other, more complicated experiments using for instance flow through or drip flow reactors or other minerals.

The research leading to these results has received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007-2013/ under REA grant agreement n° [608069].

References

Daval, D., O. Sissmann, et al. (2011). "Influence of amorphous silica layer formation on the dissolution rate of olivine at 90 degrees C and elevated pCO(2)." Chemical Geology **284**(1-2): 193-209.
Gorbushina, A. A. (2007). "Life on the rocks." Environ Microbiol **9**(7): 1613-1631.