2.2.P05

Olivine surface dissolution with *Escherichia coli* cells

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Microorganisms, more specifically bacteria, greatly affect the iron cycle in natural environments. Although the surface dissolution of ferrous silicates has been considerably studied (even with molecules secreted by bacteria), the experimental dissolution with bacterial cells was less explored [1]. In order to identify some of its specificities relevant to sub-surface environmental conditions, San Carlos olivine powders and/or *E. coli* cells (0.1 DO_{600nm}) were introduced in soft and salted aqueous solutions, under aerobic conditions at 37°C, during 1 week. Solutions were stirred at different speed. Aliquots sampled during the experiments, filtered to be cell-free, were analyzed by inductively coupled plasma-atomic emission spectrometer (ICP-AES). The powders recovered at the end of the experiment were analyzed by X-ray photoelectron spectroscopy (XPS). Main results are summarized below.

Firstly, in the filtered solutions, the Mg/Si ratios vary similarly in the biotic and abiotic experiments. They remain below the stoechiometric ratio of the olivine and thus indicate a preferential release of Si that is stronger in the non-stirred or in the saline solutions. The Mg and Si contents are also systematically lower in the biotic experiments, all other conditions being equal, and in the non-stirred experiments. The Fe contents are higher in the solutions from the biotic experiments. In all cases, they are much lower than the expected value for a stoechiometric dissolution of the olivine. Kinetics is faster and the Fe contents are higher in the non-stirred solutions. Secondly, in comparison to the initial olivine powder, the powder surface recovered in the biotic experiments are, depleted in iron, contrary to those recovered in the abiotic experiments. In all cases, the ferric over ferrous iron ratios are higher than in olivine but lower than on the "biotic" surfaces.

The iron depletion coupled to a ferric iron enrichment is a general property of the ferrous silicate surfaces altered with bacterial cells. The similarity of these results and those observed between reducing and oxidizing abiotic experiments [2], suggests that main effect of the bacterial cells is to increase the reducing power of the solutions. The importance of these results for weathering processes will be discussed.

References

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2.2.P06

Kinetic fractionation of lithium isotopes during diffusion in water

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The mass-dependent fractionation of isotopes can occur during a number of processes, only some of which are well understood theoretically and well investigated experimentally. In particular, the kinetic fractionation of isotopes during diffusion, though understood for gaseous systems, is not well understood for condensed systems such as liquid water or silicate melts. As a compliment to diffusion experiments in silicate melts [1], we undertook experiments in aqueous solutions to better understand the phenomenon of kinetic fractionation during diffusion.

Diffusion experiments consisted of a small volume glass flask containing a LiCl solution immersed in a larger (~300x) container of high purity water. The flask communicates with the larger surrounding volume via a thin tube. Flask-container pairs were set up and allowed to exchange for times ranging from 31 to 99 days. At the end of an experiment, the concentrations and isotopic compositions of Li remaining in the flask and built up in the container were measured. $^{7}Li/^{6}Li$ measurements were made by MC-ICPMS (IsoProbe).

The longest duration experiment left 1.5% of the original amount of Li in the flask, producing a change of 9 per mil in the residual Li relative to the starting solution. Taking all of the experimental runs together, a coherent relationship is observed between 7Li/6Li and F, the fraction of Li remaining in the flask. In kinetic fractionation theory, the ratio of the diffusivities of two isotopes is proportional to the inverse ratio of the isotopic masses raised to the power of a factor, β. Observed $^{7}Li/^{6}Li$ fractionation during diffusion in silicate melts was ~10 x greater [1]. Though the aqueous data can be modeled with a β much less than the β (=0.215) for Li diffusion in silicate melt, an alternative is to consider that Li+ diffuses as a hydrated complex. With a mean hydration sphere of four water molecules [2], a β of 0.2 can be used to model the data. Isotopic fractionation during diffusion of Li across a membrane [3] is also significantly larger than diffusion in water.

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