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The effect of fungal iron uptake on olivine weathering studied by genetic approaches in the rock-inhabiting fungus *Knufia petricola*

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Fungi are known to accelerate silicate weathering and therefore, not only affect soil formation, but are also relevant to terrestrial enhanced weathering (EW). Knowledge of the mechanisms by which fungi accelerate weathering is vital if we are to exploit their EW potential. By deleting certain genes in fungi, their individual roles in weathering reactions can be disclosed. Our previous research has indicated that (1) iron oxidation at the surface of olivine ($Mg_{1.8}Fe_{0.2}SiO_4$) inhibits its dissolution and (2) attachment of the rock-inhabiting fungus *Knufia petricola* is able to prevent this inhibition through iron sequestration. Here we explored whether these effects are related to iron uptake by *K. petricola*. Genes encoding a putative siderophore synthetase and a ferric reductase were deleted. These mutants or the wild type (WT) of *K. petricola* were incubated in flow-through dissolution experiments buffered at pH 4 or 6, running an abiotic control in parallel. Olivine dissolution kinetics was quantified based on bulk fluid chemical analyses. Aqueous iron isotopic fractionation was studied using MC-ICP-MS, siderophore production using HPLC-MS and olivine's surface chemistry and structure using XPS and FIB-TEM, respectively.

Preliminary results show that the WT and the mutants sequestered equal amounts of iron and dissolved olivine at a similar rate. Interestingly, the WT and mutants enhanced olivine dissolution compared to the abiotic control at pH 6 but not at pH 4. Furthermore, the concentration and isotopic fractionation of dissolved iron suggest that olivine-released iron stayed in solution at pH 4. At pH 6, by contrast, these bulk fluid analyses imply that iron precipitated under abiotic conditions but was kept in solution in the presence of fungi. However, using XPS, no iron oxide precipitation was detected on the olivine surface from the abiotic control at pH 6. Altogether, these results show that (1) a different set of deletion mutants is needed to study the effect of fungal iron uptake and (2) the slow iron oxidation kinetics at pH 4 prevents *K. petricola* from enhancing dissolution. The latter indicates the importance of fungal iron sequestration in silicate dissolution and the accelerating effect of fungi on EW in pH-neutral soils.