4.3.P04

Siderophores may simultaneously influence iron and phosphorus bioavailability in soils

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Introduction

Iron (Fe) and phosphorus (P) are essential nutrients to all of life, and thus are in high demand in terrestrial ecosystems. In soils, these nutrients are often sequestered into low-solubility mineral phases such as strengite ($FePO_4.2H_2O$, orthorhombic), phosphosiderite ($FePO_4.2H_2O$, monoclinic), and other Fe-bearing phosphate minerals. The purpose of our work is to understand how soil microorganisms facilitate the dissolution of these sparingly-soluble minerals, thereby making Fe and P bioavailable. Geochemical modeling suggests that siderophores may be important in this process due to their ability to form very stable solution complexes ($30 < pK_c < 52$) with trivalent iron.

Experiments

Using novel hydrothermal methods, we synthesized a mixture of crystalline strengite and phosphosiderite, confirmed by powder X-ray diffractometry. We have measured the steady-state dissolution rate of this material as a function of pH (4 – 6) and temperature (10, 25, and 37°C) in the presence of oxalic acid and the common trihydroxamate siderophore desferrioxamine-B (DFO-B). We have conducted adsorption experiments to characterize the interaction between the DFO-B molecule and the mineral surface.

Results

Our results indicate that mineral iron phosphate dissolves stoichimetrically under our experimental conditions. We observed increased steady-state dissolution rates with increase in siderophore concentration. Dissolution rates also increased with increase in temperature and decrease in pH. This work supports the hypothesis that ligands traditionally believed only to be important to Fe bioavailability also influence P cycling.

4.3.P05

The lichen-granite interface in different lichen growth forms

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Introduction

An important part of our culture is chiselled in stone. This heritage of past and present human creativity is slipping away at an apparently increasing rate. As lichens rapidly colonize exposed rock-art panels, and often detract from their visual impact, this has raised questions about the deterioration effect of the lichens, and if a rock surface that is encrusted by lichens weathers at a slower or faster rate than an identical but lichen-free surface.

The study site is situated in the southern border region between Norway and Sweden, within the Iddefjord/Bohuslen batholith. This is the region in Northern Europe with the most rock carvings from the Bronze Age, and has been entered up on the UNESCO's World Heritage List. Many of the rock carvings documented within the few last years are disappearing.

The studied lichens were *Lasallia pustulata* (umbilicate growth form), *Lecidea fuscoatra* (crustose growth form), and *Xanthoparmelia conspersa* (foliose growth form). These taxa were chosen because they are common in Norway.

Results and Discussion

The bedrock is medium–grained granite, predominantly and composed of feldspar and quartz and minor amounts of biotite/chlorite. The thickness of the weathering rind shows local variations (0.3-1.2 cm). A network of microfractures, formed by late- or post-magmatic hydrothermal activity, constitutes planes of weakness, and these are therefore an important controlling factor, both of chemical, physical and biological weathering processes. Opening of microfractures and pores due to chemical dissolution of low resistant mineral phases and a further expansion due to physical and biological processes results in fragmentation of the rock surface.

Crustose lichens are in general the lichen growth form with more and deeper open microfractures, the relatively highest amount of biological material, and the deepest penetration of fungal hyphae within the weathering rind. With more hyphae within the weathering rind, more biologically mediated physical and chemical weathering is possible.

Because crustose lichens usually get much older than other lichen growth forms it can be assumed that crustose lichens in general are more efficient weathering agents than foliose and umbilicate lichens.