Microbial iron cycling at the oxic-anoxic interface in acidic peatlands

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Microbial reduction of Fe(III) can be an important process in minerotrophic peatlands that receive Fe(II) from anoxic groundwater flow. Water table fluctuations can lead to an oxygenation of upper peat layers and renewal the pool of Fe(III). At slightly acidic conditions, the microbial oxidation of Fe(II) might compete successfully with chemical Fe(II) oxidation and the formed Fe(III)-hydroxides could be subjected to subsequent Fe(III) reduction. In this study, we investigated the effect of changing redox conditions on microbial iron cycling in an acidic fen (pH ~4.8) located in northern Bavaria, Germany.

FeS probes indicated that the oxygenated zone reached down to 20 cm depth in the field followed by highest dissolved Fe(II) concentrations of up to 160 µM in the porewater. Numbers of aerobic Fe(II)-oxidizers determined by MPN technique were most abundant (10^4 cells per gram peat) in 10-to-20 cm depth indicating that microaerophilic Fe(II) oxidizers used the opposing gradients. Microelectrode measurements showed that a fast growing enrichment of Fe(II) oxidizers cultured at pH 5 in opposing gradient tubes was highly active at 30 percent oxygen saturation. The enrichment culture increased Fe(III) accumulation rates by 1.5 times; and the amorphous Fe(III) oxides formed were smaller than those formed under sterile conditions. From this enrichment culture, strain CL21 was isolated that was related to *Sideroxydans lithotrophicus* (98%) [1]. Cells of CL21 were not encrusted with Fe(III). Our results demonstrated that (i) the activity of Fe(II) oxidizers seemed to enhance Fe(III) accumulation in surface peat layers, and (ii) Fe(III) reducing bacteria present in this peatland (mainly *Acidiphilium*- *Geobacter*- and *Acidobacteria*- related bacteria) [2] might profit from the increased and easily bioavailable Fe(III) pool. Thus, a tight coupling between microbially induced Fe(II) oxidation and Fe(III) reduction appeared to occur at oxic-anoxic interfaces in this fen.

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Constraining the composition and thermal state of the Moon from inversion of seismic data

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A combined geophysical-geochemical methodology to study the thermal, compositional, density, and seismic structure of the lunar mantle is presented. Based on self-consistent thermodynamic approach, we discuss the temperature distribution models in the lunar mantle obtained from P- and S-wave velocities and geochemical constraints. For the computation of phase equilibrium relations, we have used a method of minimization of the total Gibbs free energy combined with a Mie-Grüneisen equation of state [1]. Our forward calculation of phase equilibria, seismic velocities and density and inverse calculation of temperature include anharmonic and anelastic parameters as well as mineral reaction effects [2]. The results of our inversion procedure indicate that upper and lower mantle compositions are strikingly different. Geophysical constraints and modeling lend support to a chemically stratified lunar mantle [1, 3, 4]. General increase in seismic velocities from the upper to lower mantle is consistent with a change in bulk composition from a dominantly pyroxenite upper mantle depleted in Al and Ca (~2 wt% CaO and Al_2O_3) to a dominantly fertile lower mantle enriched in Al and Ca (~4-6 wt% CaO and Al_2O_3). A pyrolitic model cannot be regarded as a geochemical-geophysical basis for the entire mantle of the Moon. Our results indicate that the mantle composition of the Moon is different from that of the Earth's upper mantle. Compositional effects play a dominant role in determining the temperatures from seismic models. A probable law of temperature distribution in the lunar mantle is proposed: $T\ (°C) = 351 + 1718[1 - \exp(-0.00082 \cdot H)]$. The inferred temperatures are well below the probable solidus condition, in accord with seismic evidence for a rigid mantle.

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