Microbial iron cycling during permafrost thaw

MONIQUE-SEZANNE PATZNER[1], MIROSLAVA MALUSOVA[1], VERENA NIKELEIT[1], ANDREAS KAPPLER[1], CASEY BRYCE[1]

[1]Geomicrobiology, Center for Applied Geoscience, University of Tübingen, Germany (monique-sezanne.patzner@student.uni-tuebingen.de)

A large portion of carbon stored on Earth is locked away in the permanently frozen soils of high latitude and high altitude regions. Given current trends and future predictions of climate warming, significant concern exists regarding the consequences of permafrost thaw for carbon mobilization and greenhouse gas emissions. However, ice is not the only factor which can control carbon mobilization. Iron minerals strongly bind carbon compounds, thus carbon bioavailability and CO_2/CH_4 emissions also depend on formation, transformation and dissolution of iron minerals, in particular iron(III) (oxyhydr)oxides. Despite a wealth of literature relating to microbial iron transformations, there remains very little investigation of microbial controls on iron cycling in regions vulnerable to permafrost thaw.

We have investigated changes in the concentration and availability of iron, as well as the presence of Fe-metabolizing bacteria, across a thaw gradient in Abisko (Northern Sweden), where wetlands are expanding rapidly due to permafrost collapse. We observed high concentrations of iron (up to 20 mg/g) in the top 60-100 cm at all thaw stages, which becomes less easily extractable (i.e. not extractable by 0.5 M HCl) as the extent of thaw progresses. We have also observed that microaerophilic Fe(II)-oxidizing and thus iron(III) mineral precipitating bacteria exist at all sites, yet Fe(III)-reducers could only be enriched from the waterlogged sites.

These results give a promising indication that carbon stabilization in thawing permafrost could be regulated, in part, by microbial iron mineral formation, transformation and dissolution.