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Role of iron(II)-oxidizing microorganisms in organic carbon sequestration within a thawing permafrost system

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Permafrost soils hold a large amount of the global soil organic carbon (1,330 - 1,580 Pg [1]). Within these systems, up to 20% of the organic carbon is associated with reactive iron minerals, termed the rusty carbon sink, making the carbon less bioavailable. Due to climate change, substantial amounts of permafrost will thaw, creating reducing conditions in the soil. This will lead to microbial dissolution of iron(III) minerals. Consequently, this will release the associated organic carbon, making it more prone to mineralization, thereby enhancing greenhouse gas emissions. Additionally, within this complex system, there might also be microbial Fe(II)-oxidizing processes contributing to the re-formation of the rusty carbon sink. The aim of this study is to identify such microorganisms by enrichment and isolation from different locations within a permafrost field site (Stordalen Mire) in northern Sweden.

Here, we focused on the fully thawed, inundated fen stage, as thawing in several permafrost areas is expected to form more of this kind of landscape in the future. Fens provide many potential niches for iron(II)-oxidizing microorganisms, such as in the anoxic bulk soil, in the rhizosphere of the dominant cotton-grass plants, and in loose iron-carbon associations (flocs) in thaw ponds. Enrichment cultures of nitrate-reducing, microaerophilic, and anoxygenic phototrophic iron(II)-oxidizers (12, 7 and 7 transfers, respectively) have been successfully obtained from these locations. The anoxygenic phototrophic iron(II)-oxidizing cultures showed the most extensive oxidation of the provided iron(II). Oxidation of up to 1.95 ± 0.01 mM iron(II) (92.2%) within 10 days was observed. By 16S rRNA gene amplicon sequencing dominant members of the microbial cultures are currently being identified and will be compared to the *in-situ* abundance of those taxa at the field site. The results of this study will help to understand which iron(II)-oxidizing microbes might contribute to the re-formation of the rusty carbon sink and sequestration of organic carbon, thereby decreasing greenhouse gas production.

[1] Schuur et al. (2015), *Nature* 520(7546), 171-179