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The role of manganese oxides in peatland organic carbon transformation

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Peatlands are important contributors to the global carbon cycle, storing around one third of the terrestrial organic carbon on Earth . Their waterlogged conditions create anoxic environments, slowing down the decomposition of organic matter. However, rising temperatures and changes in soil moisture are among the key drivers affecting peatland carbon stocks, leading to increased CO_2 and CH_4 emissions. As a result, peatlands are expected to shift from carbon sinks to carbon sources this century [1]. In organic carbon-rich soils, minerals such as iron (oxyhydr)oxides (FeOx) have been shown to significantly impact carbon transformation [2], while the role of manganese oxides (MnOx) remains largely unexplored. MnOx have a large specific surface area, high adsorption capacities, and strong oxidation potential, making them important in carbon degradation and immobilization in soils. Given the similar potential of MnOx to FeOx minerals in trapping and transforming organic carbon [3], it is essential to investigate their influence on peatland carbon transformation as part of future climate change projections.

To this end, we conducted field analyses of an alpine peatland, in Lech (Austria). We measured the physicochemical parameters, the carbon content and the concentrations of iron and manganese in porewater and solid phases. Additionally, we synthesize the Mn oxide mineral birnessite-like structure with varying crystallinity and use peatland dissolved organic carbon (DOC) from the field site to simulate peatland DOC transformation by MnOx. To ensure realistic conditions, we replicate the physicochemical parameters measured on-site. During the incubations the pH, redox potential, CH_4 and CO_2 (GC-PDD), MnOx identity and structure (XRD, Raman, electron microscopy), dissolved Mn(II) (ICP-MS), and DOC (TOC analysis) are monitored. In this presentation, we will present data on how MnOx crystallinity affects DOC sorption and/or degradation, which will help to quantify the influence of MnOx on soil organic carbon. These are the first steps of a research project which will explore the OC-MnOx response to anoxic-oxic cycles to clarify the role of MnOx in peatland carbon cycling.

[1] Loisel *et al.* (2021), *Nature climate change*, 70-77.

[3] Patzner *et al.* (2020), *Nature Communications*, 6329.

[4] Li *et al.* (2021), *Environmental science & technology, 12136-12152*.