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Variability of mineral protection of organic matter in thawing permafrost peatlands

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Permafrost preserves huge amounts of carbon in Arctic soils including peatlands, which are common in high latitudes. The potential for carbon release from these peatlands upon permafrost thaw is still a big uncertainty for climate predictions. Protection of organic matter against microbial degradation by association with minerals such as iron minerals has been identified as an important stabilization mechanism for organic carbon in soils [1]. In a permafrost peatland in northern Sweden (Stordalen mire) up to 20% of organic carbon was found associated with iron minerals in oxic peat layers [2]. However, upon thaw and collapse of frozen peat, reducing conditions cause microbial iron reduction and dissolution of minerals, therefore releasing associated carbon. Despite the prevalence of peatlands in the permafrost zone, little is known about the variability and overall importance of mineral protection in permafrost peatlands, and it is still uncertain how this will change upon collapse of palsas (frozen peat mounds). Following optimization of a protocol for Fe-OC quantification from peat, we sampled peat cores and pore water from different thawing palsas in the Torneträsk area of northern Sweden to quantify iron-carbon associations across different sites and estimate the changes in geochemistry upon permafrost thaw. Understanding these changes and differences between peatlands will help to predict the role of permafrost peatlands for carbon emissions triggered by permafrost thaw across larger geographical areas.

[1] Kaiser and Guggenberger (2000), Org. Geochem., 31, 711-725. [2] Patzner et al. (2020), Nat. Commun., 11, 6329.