

Improving quantification of iron-associated organic carbon in organic-rich soils

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Reactive iron (Fe) minerals can act as an important trap for organic carbon (OC) by coprecipitation and sorption and can therefore protect the associated OC against decomposition [1]. In organic-rich permafrost soils approximately 20% of OC has been found associated with Fe in oxic soil layers [2,3]. Upon transition to reducing conditions due to permafrost thaw, however, Fe-associated OC is released by microbial Fe(III)-reduction and dissolution of minerals. This carbon may then become available for microbial degradation [3]. The susceptibility of the rusty carbon sink to changing redox conditions and its importance for understanding the fate of OC under changing climate demonstrates a need for accurate quantification of Fe-associated OC, which so far is determined by extraction with dithionite. However, many different variations of dithionite extraction methods exist, mostly optimised for soils and marine sediments, with variations in parameters such as solid-to-solution ratio, dithionite concentration or ratio of dithionite to sample, temperature, pH (use of buffer or unbuffered extraction), extraction time, rinsing steps, etc.. Differences in extraction methods may lead to different extraction efficiencies and therefore concentrations of Fe-associated OC may not be comparable across studies. Here we compare the extraction of reducible Fe from peat mixed with ferrihydrite and synthetic Fe-OC coprecipitates in different ratios while varying dithionite concentration, extraction time, and rinsing methods in a citrate-bicarbonate buffered and non-buffered extractant. We test the necessary reducing power of dithionite to extract the target Fe fraction, the potential limits of Fe reduction and define the optimum extraction time. Furthermore, we evaluate the chemical modification of OC in a carbon-rich sample by the extractant and assess the potential to use a carbon-free extractant solution to be able to analyse both DOC in the extract and in the remaining solid. An improved extraction method for Fe-associated OC will contribute to a better understanding of Fe-associated OC in organic-rich soils and its accessibility for microbial degradation.

[1] Kaiser and Guggenberger (2000), *Org. Geochem.*, 31, 711-725. [2] Mu et al. (2016), *Geophys. Res. Lett.*, 43, 10,286–10,294. [3] Patzner et al. (2020), *Nat. Commun.*, 11, 6329.