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Composition and reactivity of Fe-C aggregates along a permafrost thaw gradient

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Permafrost soils play an important role as the thawing of permafrost causes stored C to become more accessible for decomposition and thus produce greenhouse gases (CO_2 and CH_4). In Stordalen mire (Sweden), it has been known that the thawing and associated rewetting of the palsa soil leads to reducing conditions and releases dissolved organic carbon (DOC) and aqueous iron (Fe(II)). During progressive thaw along the gradient from palsa, bog, and fen, aggregates(flocs) form which are composed of varying mixtures of Fe minerals, organic matter (OM), metal ions, and microbes We hypothesize that the loss of reactive (microbially reducible) Fe from soils is contributing to the formation of flocs along the thaw gradient and that the subsequent transformation of flocs plays a role in greenhouse gas emission from these environments. The Fe minerals closely associated with OM in these flocs are thought to protect the OM from microbial degradation, a so-called rusty carbon sink. The formation of Fe-OM-rich flocs may decrease the microbial degradation of the OM, but the mechanisms are insufficiently understood and missing in current climate models. To this end, we sampled floc (<450 µm) from the representative field site and fractionated them by size. The different fractions are analyzed for their elemental composition, oxidation states of Fe, mineralogy, and particle size, etc. The characterization is complemented by laboratory incubation studies that will determine the bioavailability of the organic carbon within different fractions of the flocs and subsequent greenhouse gas formation. With this project, we aim to understand the complex interplay of formation, dissolution, and transformation of Fe-C flocs during transit from bog to fen that affects the concept of the rusty carbon sink.