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Degradation of permafrost carbon in the Kolyma River

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Soil temperatures in permafrost (i.e. perennially frozen ground) are rising globally. The increasing temperatures accelerate permafrost thaw and release of organic carbon, that has been locked in permafrost soils since the last glacial period, to the contemporary carbon cycle. The potential remineralisation of organic carbon to greenhouse gases can contribute to further climate warming. Particulate organic carbon (POC) in the Kolyma River is older than dissolved organic carbon (DOC) thus serves as a good tracer for abrupt permafrost thaw (i.e. river bank erosion and thermokarst) that dominantly releases old POC. While dissolved organic carbon (DOC) mobilised from the old Yedoma outcrops on the banks of the Kolyma River is shown to be highly labile, vulnerability of POC to biodegradation is not yet known. In this study we aim to constrain degradation rates for POC in the Kolyma River. To capture seasonal variability of the POC pool and its degradation rate the incubation was conducted both during the spring freshet and in late summer (2019 and 2018, respectively). We incubated whole-water samples over 9 to 15 days and quantified POC (and DOC) loss over time, as well as dissolved inorganic carbon (DIC). The incubation was carried out in the dark. We also tracked changes in POC composition and age with carbon isotopes (d^{13}C-OC, d^{13}C-DIC, Δ^{14}C). Preliminary results from 2018 suggest a decrease in POC concentrations of up to 30 % while those of DOC decrease by up to 11 %. The rate of POC degradation is nearly three times faster than DOC though the absolute amounts of DOC are in turn higher than those of POC (< 1 mg L^{-1} for POC and ~3 mg L^{-1} for DOC). Furthermore, the changes in d^{13}C of POC, DOC and DIC suggest ongoing microbial degradation and conversion of organic carbon into inorganic carbon. These first estimates show that POC degrades fairly rapidly while transported in the Kolyma River. A better understanding of POC degradation along lateral flow paths is critical for improving our knowledge of permafrost thaw and its possible climate impacts in the future.