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Effects of labile carbon on anaerobic decomposition processes in permafrost wetlands

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Climate warming and permafrost thaw are exposing the large carbon (C) pools of northern wetlands to enhanced decomposition, potentially increasing the release of the greenhouse gases carbon dioxide (CO_2) and methane (CH_4). Permafrost thaw is usually associated with changes in hydrology and vegetation: Ground collapse leads to the formation of new, productive thermokarst wetlands, and active layer deepening allows plant roots to penetrate to deeper soil layers. These processes promote interaction between old permafrost carbon and recent plant-derived carbon, but the effect of this interaction on anaerobic decomposition processes is poorly known.

Here, we report the preliminary results of a 1+-year-long soil incubation experiment where we investigated the role of fresh organics on anaerobic decomposition in arctic wetlands. We sampled mineral subsoil of Greenlandic wetland sites and the active layer and permafrost peat in a Swedish palsa mire, and incubated them with and without repeated amendments of ^{13}C enriched glucose and cellulose. We determined the rate and isotopic composition of CO_2 and CH_4 with an isotopic laser, and estimated the contribution of soil organic matter decomposition vs. added carbon to the total C gas release. These results represent new understanding on how plant-derived organics change the magnitude and composition of C gas, thus affecting the climatic feedbacks from permafrost wetland C pool.