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Soil organic matter mineralization of permafrost peat lands and sensitivity to temperature and lack of oxygen

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Globally, a significant pool of soil organic carbon (SOC) (Tarnocai et al. 2009) is stored in arctic peatlands where extensive permafrost prevents the decomposition of old soil organic matter (SOM). Vulnerability of ancient organic depositions in changing environment becomes a considerable issue in future climate models. Palsa mires, a typical cryogenic peatland type in subarctic tundra, are not only an important SOC pool but also have been reported as a source of nitrous oxide (N2O) (Marushchak et al. 2011). Microbial SOM mineralization and its sensitivity to changing environmental conditions are crucial to understand future C losses and greenhouse gas (GHG) fluxes in this abundant landform of subarctic region.

The purpose of this experiment was to determine potential SOM mineralization in different layers of deep soil cores from an Arctic peatland. First, we aimed to define a response of C losses and GHG exchange rates to temperature and aerobic/anaerobic conditions in different peat layers down to the permafrost and beyond. Secondly, we sought for relations among SOM mineralization, nutrient availability and parameters of indigenous microbial community. Finally, we attempted to link the potential SOM mineralization of the different peat layers with surface GHG fluxes from a proceeding study conducted with the same, intact soil cores.

Five deep peat soil cores were separated into five layers (0∼20, 20∼40, 40∼60 cm, permafrost interface and permafrost layer). Homogenized peat was incubated in a factorial set-up of three temperatures (4, 10, and 16 °C) under aerobic and anaerobic conditions. At the beginning and the end of the total 5.5-months incubation period, we determined C and N availability, microbial biomass and potential activities of extracellular enzymes. Heterotrophic respiration (CO_2), methane (CH4) and nitrous oxide (N2O) emissions were monitored weekly at the initial phase and biweekly later during the incubation.

First results show that C-loss from aerobic decomposition dominated over C-loss from anaerobic decomposition with clear temperature sensitivities in different peat layers. Moreover, the peat layers showed definite patterns especially to N2O losses, less for CO_2 losses.

This study addresses the essential question to which extent deeper soil horizons of subarctic organic depositions contribute to the total soil GHG fluxes, and whether the nutrient availability, microbial community and environmental factors (i.e. temperature, O_2 availability) constrain the SOM mineralization.

REFERENCES

Marushchak ME, Pitkämäki A, Koponen H, Biasi C, Seppälä M, Martikainen PJ (2011) Hot spots for nitrous oxide emissions found in different types of permafrost peatlands. Global Change Biol 17:2601-2614

Tarnocai C, Canadell JG, Schuur EAG, Kuhry P, Mazhitova G, Zimov S (2009) Soil organic carbon pools in the northern circumpolar permafrost region. Global Biogeochem Cycles 23