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Microbial growth and carbon partitioning during peatland methane oxidation

CARLOS PALACIN[1], JONNA TEIKARI[2], DHIRAJ PAUL[3], NISHADI THALAGAHAWATTA GAM ACHARIGE[3], ANULIINA PUTKINEN[2], MARI KÖNÖNEN[4], HENRI M. P. SILJANEN[3] AND **LUKAS KOHL**[5]

[1]Center for Advanced Studies of Blanes (CEAB-CSIC), Department of Ecology of Inland Waters
[2]Department of Agricultural Sciences, University of Helsinki
[3]Department of Environmental and Biological Sciences, University of Eastern Finland
[4]Natural Resources Institute Finland (LUKE)
[5]University of Eastern Finland

Methane oxidation is a critically important, though highly variable, process regulating peatland methane emissions. A recent model of the peatland methane cycle stresses the importance of microbial biomass dynamics in predicting emissions[1,2] Such models require knowledge of the amount of biomass produced per unit of methane oxidized, which has not been measured under field conditions. Similarly, it remains unresolved which fraction of oxidized methane is retained in peat in the form of microbial biomass and as other solid or dissolved carbon species.

Here, we report on a microcosm isotope labelling experiment with samples collected at the fen and bog subsites of the Siikaneva mire in Central Finland (10-20cm depths, three spatially different replicates per subsite). These samples were then incubated from up to 12 weeks with 5% or ambient methane in the headspace and either an ^{18}O-H_2O (to quantified microbial growth) and ^{13}C-CH_4 (to determine the fate of methane-derived carbon) label.

We find that across all samples 58.1±1.8 (2 SE) % of methane carbon was converted to CO_2 (1-4 weeks), and 14.2±3.6% to solid peat (bulk carbon; 12 weeks), which included 7.9±1.0% as microbial biomass (based chloroform-fumigation-extraction; 1-4 weeks) and 0.56±0.13% as dissolved organic matter (0.5M K_2SO_4 extraction; 1-4 weeks). These proportions remained consistent over at least first four incubation weeks, indicating marginal conversion of carbon to secondary pools. The microbial growth rates at 5% methane were 0.88±0.21% day^{-1} with 6.8±11.6% (range 3-18%) of de-novo DNA from methane-derived carbon. Growth was only marginally smaller in incubations at ambient methane (0.80±0.25% day^{-1}).

Our results demonstrate the retention of a significant fraction of carbon from oxidized methane in various carbon pools and provide key parameters for a next generation of peatland methane models.

1 Chang, K.-Y. *et al. Biogeosciences* 17, 5849–5860 (2020)

2 Ricciuto, D. M. *et al. Journal of Geophysical Research: Biogeosciences* 126, e2019JG005468 (2021)

[CL1]You mean: this one: https://www.nature.com/articles/s41467-025-57386-5
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