Stability of methane oxidising communities in Siberian permafrost soils in the context of global climate change

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Wet tundra environments of the Siberian Arctic are considerable natural sources of methane, a climate relevant trace gas. The Arctic is observed to warm more rapidly and to a greater extent than the rest of the earth surface. It is suggested, that the tundra in Alaska and Russia has changed from a net sink to a net source of atmospheric carbon. The potential impact on the terrestrial methane oxidation is likely to be influenced by the level of diversity and specialisation within the methane oxidising (methanotrophic) community (MOC). Presently, however, little is known about how these factors determine the stability of microbial communities.
Incubation experiments on soil samples from the Lena Delta, Siberia, using $^{14}CH_4$ as a radiotracer showed shifting temperature optima of the potential methane oxidising activity with increasing depth of the seasonally thawed permafrost layer (‘active layer’). In deep layers close to the permanently frozen ground maximum rates were detected at 4°C. These results contradict the idea of a ‘community of survivors’ in permafrost soils but indicate ‘cold loving’ MOC in constantly cold permafrost layers. Moreover, cell counts determined by fluorescence *in situ* hybridisation showed highest abundance of methanotrophs in soil layers with potential methane oxidation rates that were independent of the temperature. In contrast, cell counts were significantly lower in soil layers exhibiting a distinct temperature optimum. In combination with the analysis of structure and diversity of the active layer MOC as reflected in bacterial clone libraries, these results give first insights into the correlation between specialisation and diversity with regard to microbial stability in extreme habitats.