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Differential methane oxidation activity and microbial community composition at cold seeps in the Arctic off western Svalbard

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Most models considering climate change related bottom water warming suggest that gas hydrates may become destabilized, leading to the mobilization of methane into seabed and water column ecosystems, and, eventually, into the atmosphere. However, the capacity of methanotrophic microbes retaining methane in sediments and the hydrosphere is not well constrained. Here, we investigate the microbial utilization of methane in sediments and the water column, focusing on cold seeps discovered at the arctic continental margin of western Svalbard. We measured *ex situ* rates of methane oxidation and sulfate reduction in two active gas flare sites with different geological settings at the Vestnesa Ridge (1204 m water depth) and within a pingolike feature area southwest off Svalbard (PLF; 380 m water depth).

Our results show contrarily situations at our two sampling sites: At Vestnesa Ridge we find high methane oxidation rates with values up to 2055 nmol cm^{-3} d^{-1} at the sediment surface where the sediments are oversaturated with methane. Whereas, methane concentration and oxidation rates are low in the overlying water column (2 pmol cm^{-3} d^{-1}). In contrast, at the sediment surface at PLF methane concentration and oxidation rates are considerably lower (up to 1.8 nmol cm^{-3} d^{-1}). While the overlying bottom water contains high concentration of methane and shows oxidation rates with values of up to 3.8 nmol cm^{-3} d^{-1}. The data on methane oxidation and sulfate reduction activity are compared to the sediment geochemistry and to data from metagenomic analysis identifying the methanotrophic community composition. These results provide unique insight into the dynamic responses of the seabed biological filter at cold seeps in the Arctic off western Svalbard.

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