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Microbial methane oxidation in the Arctic Ocean offshore Svalbard

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Large amounts of methane are released from ocean sediments, most importantly at cold seep environments. Aerobic methanotrophic bacteria in the ocean water column consume a significant fraction of this biogenic methane, preventing its emission to the atmosphere. The understanding of key environmental factors controlling the efficiency of this biological methane-filter is still incomplete. In order to elucidate possible environmental constraints on methane turnover in the ocean, we investigated the temporal and spatial variation of aerobic methane oxidation (MOx) rates at active cold seeps at water depths between 150 and 400 m, located off the coast of Svalbard. In the study area, methane concentrations were consistently elevated in bottom waters (up to 825 nM) and decreased towards the sea surface. Highest MOx rates of up to 3.1 nM/day were typically observed at $\sim$30 m above the sea floor. Despite the constant supply of methane substrate, MOx rates displayed a high temporal variability. Comparison of the distribution of MOx rates and water temperature revealed consistent spatio-temporal patterns suggesting an oceanographic control on the magnitude of MOx: Cool Arctic bottom waters containing a comparably large standing stock of methanotrophic bacteria are episodically displaced by the warmer W-Spitsbergen current, which meanders along the Svalbard continental margin and is depleted in methanotrophic biomass. As a consequence, methane is injected into warmer water masses containing fewer methanotrophs, and overall methane oxidation is reduced. While the primary cause for the observed discrepancy in methanotrophic activity between the different water masses is still uncertain, our preliminary data indicate that MOx fluctuations in the ocean water column above the Svalbard cold seeps are modulated by ocean circulation patterns and the associated differential supply of bacterial stock.