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Methanotrophic activity in the water column above shallow gas flares west of Prins Karls Forland, Arctic Ocean

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Numerous gas flares, interpreted to be streams of methane bubbles, were discovered in shallow waters (average water depth about 90 m) on the continental shelf west of Prins Karls Forland (Western Svalbard) in the Arctic Ocean. Gas is released from the seabed to the water column and potentially transferred into the atmosphere where it acts as a potent greenhouse gas.

In order to resolve the fate of dissolved methane in the water column, we carried out grid-pattern biogeochemical measurements in the study area of 30 x 15 km. Specifically, we measured concentrations of dissolved methane and microbial methane oxidation (MOx) rates at 8 water depths at 31 sampling stations and performed 16S rRNA sequencing analysis on selected samples to characterize the microbial community composition.

Availability of dissolved methane is essential for the process of microbial methane oxidation. However, our measurements reveal that high concentrations of dissolved methane in the water column do not necessarily lead to high MOx rates. Our results indicated that the presence of marine methanotrophic biomass as well as dissolved organic matter is of larger importance for the process of microbial methane oxidation. For example, we found MOx hot spots with values up to 13 nmol l^{-1} d^{-1} at bottom water depth with dissolved methane concentrations less than 160 nmol l^{-1}. In contrast, at stations where bottom methane concentration values reached 640 nmol l^{-1}, MOx rates were less than 0.7 nmol l^{-1} d^{-1}. To interpret observed interconnection between methane concentrations and MOx rates, we use vertical distributions of seawater temperature, salinity and properties of colored dissolved organic matter (CDOM). This information helps us characterize the oceanographic setting and circulation patterns in the area, which we believe has a major impact on the origin and distribution of methanotrophic microbial biomass and methane oxidation in methanerich bottom water.

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