"Tidal dynamics control microbial methane oxidation in the water column above an active cold seep (Doggerbank, North Sea)"

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Ocean CH_4 is most dominantly produced in sediments from where it may escape to the overlying water column. Yet, the microbial aerobic CH_4 oxidation (MOx) can mitigate CH_4 release from the ocean to the atmosphere. To gain a better understanding of the temporal dynamics of the water column CH_4 filter, we conducted a 48 hours time-series experiment in a stratified water column above an active CH_4 seep in the North Sea (Doggerbank, 41m water depth). We detected gas flares during echosounder surveys and visually observed bubbles at the sea surface. CH_4 concentrations were highly elevated with up to 2800 nM in bottom and 450 nM in surface waters. Dissolved CH_4 $\delta^{13}C$-values (<-65 ‰) indicate a microbial CH_4 origin, and seismic data suggest a gas pocket at >50 m sediment depth. CH_4 concentrations maxima showed a ~12h periodicity, indicating that the flux of CH_4 from the seep was linked to tidal dynamics with the lowest CH_4 concentrations at rising tide and enhanced flux at falling tide. MOx activity showed a similar temporal behaviour suggesting that tidal dynamics are an important control on the efficiency of the microbial CH_4 filter in the water column. MOx rates were highest in bottom waters (<7.6 nM/day), however we also found high MOx rates in near-surface waters (3.2 nM/day) at times of elevated seep activity. This unusual finding suggests that methanotrophs were transported upwards (possibly induced by the drag of rising bubbles), through the pycnocline into the epilimnion.