Oxidation of methane in seawater. Laboratory biodegradation rates as input to modelling frameworks

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Methane (CH4) is considered a potent greenhouse gas with a warming influence on the climate. CH4 in the marine environment, is generated basically from thermogenic or biogenic processes, and seafloor seeps of methane can have significant impacts on climate change. The formed methane may reach the overlying water column in gas bubbles or in a dissolved form, where the methane will be subject to microbial oxidation processes.

Estimates of the fate of methane from seafloor seeps depend on what assumptions are made about the biodegradation rates. However, several studies have shown highly variable methane oxidation rates in seawater, with half-lives ranging from a few days to several years.

In this work two ex-situ methods have been evaluated. Stable isotope analyses (13CH4) and analyses using tritium-labelled methane (3H-CH4) were applied, to obtain methane oxidation rates for the marine water column, in conditions relevant for the Norwegian Continental Shelf. A parameter fit to the results of the tritium experiments found the most likely range of half-lives between 9-16 days.

The oxidation data were used in model simulations to estimate the fractions of methane from seeps at different seep depths that will eventually reach the atmosphere. However more work is needed both regarding the biodegradation of methane to allow more reliable input to published models for estimating methane release to the atmosphere, and to the models to further accurately estimate the flux of methane from seeps to the atmosphere.