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Comparison of labeled tracer methods to measure methane oxidation rates in the water column

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The ocean is generally considered a minor source of methane (CH_4) to the atmosphere. Macro-seepage from geological sources at the seafloor is suggested to contribute the most from all of the oceanic sources, about 25 Tg CH_4/yr to the atmospheric CH_4 budget (4% of total sources), whereas the open ocean contributes only 0.4 Tg CH_4/yr (0.07% of total sources). However, most source estimates lack certainty due to a limited knowledge of the fate of CH_4 in the water column. CH_4 in the water column is mainly influenced by turbulent mixing, a process that spreads and dilutes CH_4, and microbial oxidation, the only process that limits the fraction of CH_4 in the water column and thus the fraction of CH_4 escaping into the atmosphere. Unfortunately, measurements of the rate of microbial oxidation are still rare. Only a few attempts have been made to quantify CH_4 oxidation in the water column. CH_4 oxidation rates were either measured indirectly by correlation with tracers such as ^{3}He, ^{222}Rn, CFC11 or directly by using $^{14}CH_4$ or $C^{3}H_4$-labeling/incubation techniques. A comparison of the two labeling/incubation techniques will be presented. The ease of use, time series experiments, kinetic experiments, and the effect of incubation temperature will be discussed and water column profiles compared. Our results indicate similar depth-profiles of turnover times using the two different labeled tracers. However, the data sets are offset. More rapid turnover times were measured using $C^{3}H_4$ and slower turnover of CH_4 was found using $^{14}CH_4$.