Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7163

Methane dynamics in a seasonally hypoxic coastal marine basin

OLGA M. ZYGADLOWSKA[1], WYTZE K. LENSTRA[1], NIELS A.G.M. VAN HELMOND[1], THOMAS RÖCKMANN[1], JESSICA VENETZ[2], ANNA J. WALLENIUS[2], PAULA DALCIN MARTINS[2], ANNELIES J. VERAART[2], MIKE S. M. JETTEN[2] AND CAROLINE P. SLOMP[1]

[1]Utrecht University

[2]Radboud University

Presenting Author: o.m.zygadlowska@uu.nl

Methane (CH_4) is a key greenhouse gas. Coastal areas account for a major proportion of marine CH_4 emissions. Eutrophication and associated bottom water hypoxia enhance CH_4 production in coastal sediments worldwide. This can lead to a shoaling of the sulfate methane transition zone (SMTZ) in the sediment, less efficient anaerobic CH_4 oxidation and increased escape of CH_4 to the overlying water. The pathways of microbial CH_4 removal in the sediment and water column of such coastal systems are still not well explored.

In this study, we assess the fate of CH_4 produced in coastal sediments at a site in a seasonally hypoxic coastal marine basin (Scharendijke, Lake Grevelingen, the Netherlands) in March and September 2020. The site is characterized by high rates of sediment CH_4 production and a shallow SMTZ (~5-10 cm depth). We find that, in March, when the water column is fully oxygenated, most CH_4 produced is removed in the sediment through anaerobic and aerobic oxidation pathways. When waters below 35 m depth are anoxic and sulfidic, as observed in September, the SMTZ in the sediment shoals further and substantial CH_4 escapes from the sediment and accumulates below the redoxcline. Methane isotope profiles ($\delta^{13}C$- CH_4, δD-CH_4) indicate limited removal of CH_4 in the sediment and in the anoxic part of the water column in September. Most CH_4 removal takes place at the redoxcline, likely through aerobic oxidation. Elevated CH_4 concentrations in near-surface waters (140 nM) point towards potential release of CH_4 to the atmosphere in this coastal area.