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# Methane anomalies in the oxygenated upper waters of the central Baltic Sea associated with zooplankton abundance

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Apart from the sediment as the dominant source of methane in the aquatic realm the process of methane production in well-oxygenated waters has received considerable attention during the last years. The paradox of methane accumulation in these relatively shallow waters, commonly termed as “oceanic methane paradox”, has been sporadically observed in lakes as well as in marine ecosystems like the Gulf of Mexico, the Black Sea, the Baltic Sea, Arctic waters or above the continental shelf off the coast of Spain and Africa. Even if this phenomenon has been described in the literature over the last decades, the potential sources of shallow methane accumulation are still controversially discussed.
We report on methane enrichments that were observed during summer in the upper water column of the Gotland Basin, central Baltic Sea. In the eastern part of the basin methane concentrations just below the thermocline (in about 30 m water depth) varied between 15 and 77 nM, in contrast to the western part of the basin where no methane enrichments could be detected. Stable carbon isotope ratios of methane (delta 13C-CH4 of -67.6‰ clearly indicated its in situ biogenic origin. This is supported by clonal sequences from the depth with high methane concentrations in the eastern Gotland Basin, which cluster with the clade Methanomicrobiacea, a family of methanogenic Archaea. Hydroacoustic observation in combination with plankton net tows displayed a seston enrichment (size >100 micro meter) in a layer between 30-50 m depth. The dominant species in the phytoplankton, Dinophysis norvegica, was concentrated at 10-20 m depth, and showed higher concentrations in the eastern Gotland Basin in comparison with the western part of the basin. In contrast to the western Gotland Basin, the zooplankton community in the eastern part was dominated by the copepod species Temora longicornis. Laboratory incubations of a T. longicornis dominated seston fraction (>100 micro meter) sampled in the depth of the subthermocline methane anomaly showed a clear correlation between seston concentration (i.e. abundance of copepods) and methane production rates.