The methane cycle in the epilimnion of Lake Constance

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With 10 figures and 1 table

Abstract: During summer, methane concentrations measured in the surface water layers of Lake Constance were oversaturated by as much as forty times. Although methane concentrations were less than saturated in the upper water column during the winter of 1994/95, the concentrations increased to more than 2000 nl/l (90 nM) in July. The observed spatiotemporal distribution patterns strongly suggest biogenic production of methane in oxic epilimnetic water layers whereas advective transport from the littoral to the pelagic region or from allochthonous river inputs had apparently less impact on pelagic methane concentrations. Statistically significant correlations of methane concentrations with biomass parameters (e.g. phaeophytin, particulate phosphorus) hint at lake-snow as a potential site of epilimnetic in situ production of methane. In contrast, field data did not provide compelling evidence of methanogenesis in the intestinal tract of zooplankton. In diel cycles, high nocturnal methane concentrations alternate with low concentrations of \textsuperscript{13}C-enriched methane during the daytime. This happens due to the phenomenon of oscillating oxygen concentrations in littoral water and sediment, which is affected by the antagonism of photosynthetic and respiratory activity.

Due to the observed oversaturation, epilimnetic methane levels in summer and methane concentrations below saturation in winter, Lake Constance provided a sink for methane from January to April, but for the rest of the year a considerable methane flux to the atmosphere was calculated.

Key words: Methanogenesis, epilimnion, lake-snow, advective transport.

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