Geophysical Research Abstracts
Vol. 19, EGU2017-15059, 2017
EGU General Assembly 2017

Methane oxidation in anoxic lake waters

Guangyi Su, Jakob Zopfi, Helge Niemann, and Moritz Lehmann
University of Basel, Switzerland (guangyi.su@unibas.ch)

Freshwater habitats such as lakes are important sources of methante (CH4), however, most studies in lacustrine environments so far provided evidence for aerobic methane oxidation only, and little is known about the importance of anaerobic oxidation of CH4 (AOM) in anoxic lake waters. In marine environments, sulfate reduction coupled to AOM by archaea has been recognized as important sinks of CH4. More recently, the discorvery of anaerobic methane oxidizing denitrifying bacteria represents a novel and possible alternative AOM pathway, involving reactive nitrogen species (e.g., nitrate and nitrite) as electron acceptors in the absence of oxygen.

We investigate anaerobic methane oxidation in the water column of two hydrochemically contrasting sites in Lake Lugano, Switzerland. The South Basin displays seasonal stratification, the development of a benthic nepheloid layer and anoxia during summer and fall. The North Basin is permanently stratified with anoxic conditions below 115m water depth. Both Basins accumulate seasonally (South Basin) or permanently (North Basin) large amounts of CH4 in the water column below the chemocline, providing ideal conditions for methanotrophic microorganisms. Previous work revealed a high potential for aerobic methane oxidation within the anoxic water column, but no evidence for true AOM. Here, we show depth distribution data of dissolved CH4, methane oxidation rates and nutrients at both sites. In addition, we performed high resolution phylogenetic analyses of microbial community structures and conducted radio-label incubation experiments with concentrated biomass from anoxic waters and potential alternative electron acceptor additions (nitrate, nitrite and sulfate).

First results from the unamended experiments revealed maximum activity of methane oxidation below the redoxcline in both basins. While the incubation experiments neither provided clear evidence for NO_x– nor sulfate-dependent AOM, the phylogenetic analysis revealed the presence of members of the Methylomirabiliaceae family (NC10 phylum), known to perform AOM with nitrite as terminal electron acceptor. Interestingly, albeit the similarly favorable conditions in both basins, the South Basin showed nearly two-fold higher CH4 oxidation rates, but the Methylomirabiliaceae abundance appeared to be much higher in the meromictic North Basin. Ongoing work will attempt to verify whether the apparent difference in the abundance of Methylomirabiliaceae is a permanent feature. We will further seek to determine the relative contribution of bacterial nitrite-dependent AOM to total methane oxidation, as well as the environmental controls that may explain the differential importance of Methylomirabiliaceae in the two connected lake basins.