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Anaerobic oxidation of methane in sediments of two boreal lakes

Antti J. Rissanen (1), Anu Karvinen (2), Hannu Nykänen (1), Promise Mpamah (1), Sari Peura (1,3), Marja Tiirola (1), and Paula Kankaala (2)

(1) Department of Biological and Environmental Science, University of Jyväskylä, Jyväskylä, Finland (Antti.J.Rissanen@jyu.fi), (2) Department of Biology, University of Eastern Finland, Joensuu, Finland, (3) Department of Ecology and Genetics, Uppsala University, Uppsala, Sweden

Anaerobic oxidation of methane (AOM) is a considerable sink for methane (CH_4) in marine systems, but very little is known about the occurrence and importance of the process in freshwater systems. In addition, much about the microbial communities involved in AOM is unclear. AOM coupled with sulfate reduction is the dominant AOM process in marine systems but the scarce existing data suggest that, in freshwater systems, AOM coupled with reduction of alternative electron acceptors (nitrate/nitrite, manganese, iron) is more important. In this study, potential for AOM coupled with metal reduction was studied in boreal lake sediments.

Slurries of sediment samples collected from two sites in southeastern Finland, i.e. from Lake Orivesi, Heposelkä, an vegetated littoral site, dominated by *Phragmites australis* (Sample Sa, sediment layer 0 – 25 cm) and from the profundal zone of a mesotrophic Lake Ätäskö (Aa, 0 – 10 cm; Ab, 10 – 30 cm; Ac, 90 - 130 cm), were incubated in laboratory in anaerobic conditions at *in situ* temperatures for up to 5 months. The samples were amended either 1) with $^{13}CH_4$, 2) $^{13}CH_4$ + manganese(II) oxide (MnO) or 3) $^{13}CH_4$ + iron(III) hydroxide ($Fe(OH)_3$), and the processes were measured by following the ^{13}C transfer to the carbon dioxide (CO_2) pool and by concentration measurements of CH_4 and CO_2. Changes in microbial communities were studied from DNA extracted from sediment samples before and after incubation period by next-generation sequencing (Ion Torrent) of polymerase chain reaction (PCR) - amplified bacterial and archaeal 16S rRNA and methyl coenzyme-M reductase gene (*mcrA*) amplicons.

Increase in ^{13}C of CO_2 gas confirmed that AOM took place in sediments of both study lakes. In general, $^{13}CO_2$ - production was significant both at the beginning (0 - 21 days) and at the end (84 - 151 days) of incubation period. Potential AOM rates (calculated based on $^{13}CO_2$ - production) varied considerably and were much lower in deep sediment (Sample Ac), 0.1 - 0.2 nmol CH_4 $d^{-1}g^{-1}_{wetsediment}$, than in surface sediment samples (Samples Aa, Ab and Sa), 0.2 – 12.3 nmol CH_4 $d^{-1}g^{-1}_{wetsediment}$. AOM took place without metal additions in every sample type. Addition of MnO increased potential AOM rates in surface sediment samples but not in deep sediment samples. Addition of $Fe(OH)_3$increased AOM significantly only in Aa samples. Molecular microbiological analyses are currently in progress and the results will be shown in the poster presentation.