



## Anaerobic methane oxidation may be more prevalent in surface soils than was originally thought

Mathieu Gauthier (1), Robert L. Bradley (1), and Miloslav Šimek (2)

(1) Département de biologie, Université de Sherbrooke, 2500 boul de l'Université, Sherbrooke, Québec, J1K 2R1, Canada  
(mathieu.gauthier3@usherbrooke.ca, robert.bradley@usherbrooke.ca), (2) Institute of Soil Biology, Na Sádkách 7, 370 05  
České Budějovice, Czech Republic (misim@upb.cas.cz)

Anaerobic oxidation of methane ( $\text{CH}_4$ ) (AOM) is a process that was first reported to occur in deep anoxic marine sediments. In this environment,  $\text{CH}_4$  is oxidized with sulphate ( $\text{SO}_4^{2-}$ ) as the terminal electron acceptor. It is mediated by a syntrophic consortium formed by  $\text{SO}_4^{2-}$  reducing bacteria and anaerobic  $\text{CH}_4$  oxidizing Archaea, or by the latter alone. Since this landmark discovery, AOM was found to occur in other environments including freshwater lake sediments and water columns, mud volcanoes, landfill leachate, deep buried Holocene sediments and hydrocarbon contaminated aquifers. All of these situations are very specific and point to AOM as being primarily occurring in highly reducing conditions. Thus, observations of AOM in surface soils with fluctuating REDOX conditions are relatively scarce, although a few independent studies have reported AOM in surface peatlands as well as in a forest soil. Furthermore, AOM may follow different pathways, such as via the coupled oxidation of  $\text{CH}_4$  and reduction of manganese (Mn(IV)) or iron (Fe(III)), or by a lone denitrifying species that converts nitrite to nitric oxide in order to generate  $\text{O}_2$  that is then used internally to oxidize  $\text{CH}_4$ . Thus, the goal of our study was to determine whether AOM is more prevalent than was thought in hydromorphic surface soils across different environments, and whether the addition of  $\text{NO}_3^-$  or  $\text{SO}_4^{2-}$  as alternative electron acceptors may stimulate the process. We collected samples from 3 peatland soils in Scotland, 2 acid-sulphate soils in Finland, and shore sediments of 15 drained fish ponds in the Czech Republic. Subsamples were incubated in the absence of  $\text{O}_2$  and amended with either  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ , or left unamended (control). The net flux of  $\text{CH}_4$  and  $\text{CO}_2$  were assessed by gas chromatography after 2, 20, 40 and 60 days. We also used a  $^{13}\text{C}$ - $\text{CH}_4$  isotope dilution technique to determine gross production and consumption rates of  $\text{CH}_4$ . We detected AOM in all of our soils, with oxidation rates ranging between 0.001 and 37.28 nmol  $\text{g}^{-1}$  day $^{-1}$ , suggesting that AOM may be more ubiquitous than was originally thought. On the other hand, no clear patterns emerged as to the effects of  $\text{NO}_3^-$  or  $\text{SO}_4^{2-}$  amendments on this process.