Anaerobic methanotrophy coupled to ferric iron reduction in an Australia coal mine

MAIJA J. RAUDSEPP[1,2]*, PAUL N. EVANS[3], GENE W. TYSON[3], SUZANNE D. GOLDING[2], SIOBHAN A. WILSON[1] AND GORDON SOUTHAM[2]

(*correspondence: raudsepp@ualberta.ca)
[1]Department of Earth and Atmospheric Sciences, The University of Alberta, Edmonton, Canada
[2]School of Earth and Environmental Sciences, The University of Queensland, Brisbane, Australia
[3]Australian Centre for Ecogenomics, The University of Queensland, Brisbane, Australia

Terrestrial methane seeps account for between 13–29 Mt of the 60–80 Mt/year of CH_4 that is naturally released into the atmosphere from geologic reservoirs [1]. A further 122–168 Mt/year of CH_4, is currently being released from geologic reservoirs due to anthropogenic activity, which is important as methane has 28 times the atmospheric global warming potential of CO_2 [2]. At marine seeps, Archaea can oxidize CH_4 to CO_2 with SO_4. However, relatively little work has been completed on microbial anaerobic oxidation of methane (AOM) in terrestrial environments. In the present study, a microorganism closely related to "*Candidatus* Methanoperedens nitroreducens" (97% 16S rRNA gene identity; previously ANME-2d) [3] was a dominant member of the microbial community in water collected from an abandoned section of a central Queensland coal mine over a 3 year period. After the final sampling, water was incubated for ~2.5 years with ^{13}C-labelled CH_4 and we demonstrated that this microbial community has the capacity for anaerobic oxidation of methane with ferric hydroxide (AOM-Fe) reduction. No methane was oxidized in incubations with nitrate or sulphate as electron acceptors. This research demonstrates that a microbial community that uses AOM–Fe is very stable in the terrestrial deep subsurface and that it may influence terrestrial methane pools over geologic timescales.

[1] Etiope (2012) *Nature Geoscience* 5, 373-374. [2] Schwietzke *et al.* (2016) *Nature* 538, 88-91. [3] Raudsepp *et al.* (2016) *Geobiology* 14, 163-175.