Anaerobic oxidation of methane in hypersaline cold seep sediments

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Life in hypersaline environments is typically limited by bioenergetic constraints. Microbial activity at the thermodynamic edge, such as the anaerobic oxidation of methane (AOM) coupled to sulphate reduction (SR), is thus unlikely to thrive in these environments. In this study, carbon and sulphur cycling was investigated in the extremely hypersaline cold seep sediments of Mercator mud volcano. AOM activity was partially inhibited but still present at salinity levels of 292 g L-1 (c. eightfold sea water concentration) with rates of 2.3 nmol cm-3 day-1 and was even detectable under saturated conditions. Methane and evaporite-derived sulphate comigrated in the ascending geofluids, which, in combination with a partial activity inhibition, resulted in AOM activity being spread over unusually wide depth intervals. Up to 79% of total cells in the AOM zone were identified by fluorescence in situ hybridization (FISH) as anaerobic methanotrophs of the ANME-1. Most ANME-1 cells formed monospecific chains without any attached partner. At all sites, AOM activity co-occurred with SR activity and sometimes significantly exceeded it. Possible causes of these unexpected results are discussed. This study demonstrates that in spite of a very low energy yield of AOM, microorganisms carrying this reaction can thrive in salinity up to halite saturation.
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