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Metagenomics in methane seep detection and studies of the microbial methane sediment filter

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Metanotrophic prokaryotes with their capacity to oxidize methane to biomass and CO_2 contribute considerably in reduction of the global methane emission from oceans. Metagenomic studies of seabed sediments represent a new approach to detect marine methane seeps and to study whether the inhabiting microbial consortium represent a microbial methane filter. We have used next generation high throughput DNA sequencing technology to study microbial consortia and their potential metabolic processes in marine sediment samples from the Håkon Mosby mud volcano (HMMV) in the Barents Sea, the Tonya Seep in the Coal Oil Point area in California and from the pockmarked area at the Troll oil and gas field in the North Sea.
Annotation of archaeal reads from the HMMV metagenome resulted in hits to all enzymes supposed to be involved in the anaerobic oxidation of methane (AOM) carried out by anaerobic methanotrophic archaea (ANME). The presence of several ANME taxa at HMMV has previously been well described (1).
The stratification analysis of the Tonya seep sediment showed that both aerobic and anaerobic methanotrophs were present at both layers investigated, although total archaea, ANME-1, ANME-2 and ANME-3 were overabundant in the deepest layer. Several sulphate reducing taxa (possibly syntrophic ANME partners) were detected. The Tonya Seep sediment represent a robust methane filter where presently dominating methanotrophic taxa could be replaced by less abundant methanotrophs should the environmental conditions change (2).
In the Troll pockmarked sediments several methanotrophic taxa including ANME-1, ANME-2 and candidate division NC10 were detected although there was an overabundance of autotrophic nitrifiers (e.g. Nitrosopumilis, Nitrococcus, Nitrospira) using CO_2 as the carbon source. Methane migrating upwards through the sediments is probably oxidized to CO_2 in AOM resulting in an upward CO_2 flux. The CO_2 entering the seafloor may contribute to maintain the pockmark structure and represent a carbon source for the autotrophic nitrifying community. In this way the sediments at Troll probably contributes to reduce the methane emissions to the water body and further to the atmosphere (3).

References:
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