Evidence for microbial methane oxidation and sulfate reduction at Marmara Sea cold seeps: A multi-parametric approach

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The North Anatolian Fault in the Sea of Marmara (Turkey) is a spectacular example of a seismically active fault where, in recent years, numerous sites of active fluid venting have been discovered and explored. During the MARSITECruise expedition in November 2014 on board the *RV* Pourquoi pas?, multidisciplinary sampling was carried out with the ROV Victor 6000 in order to investigate biogeochemical processes taking place at cold seep environments. Pore water and sediment samples were collected from shallow push cores
(< 20 cm) at several sites, on both basins and highs in the Marmara Sea. Elemental and isotopic analyses (C, S, O) of carbonates, organic matter, sulfate and sulfide as well as lipid biomarkers and their stable carbon isotopic composition were investigated to assess processes associated with coupled methane and sulfur cycling by indigenous microbial communities in these methane-rich settings.

Archaeal lipids diagnostic for anaerobic methane oxidizers (*e.g.* archaeol, sn2-hydroxyarchaeol, crocetane and unsaturated pentamethylicosenes) are highly depleted in ^{13}C (from –87‰ to –114‰) just as bulk organic carbon (down to –62‰). This indicates that anaerobic oxidation of methane (AOM) is a primary process occurring in the shallow part of the sediment. Moreover, AOM is inducing the precipitation of authigenic carbonate in the sediments as revealed by negative carbonate carbon isotopes (as low as –37‰). Abundant ^{13}C-depleted fatty acids assigned to sulfate-reducing bacteria and pore water sulfide and sulfate concentrations and their sulfur and oxygen isotopes strongly suggest that sulfate reduction is associated with AOM. The lipid biomarker distribution suggests that ANME-2 archaea and the deltaproteobacterial clades (sulfate-reducing bacteria) are the major AOM assemblages.