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Spatial variations of bacterial communities and related biogeochemical activity of cold seep sites in the Eastern Mediterranean deep sea

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Cold seeps ecosystems, characterized by emissions of the potential greenhouse gas methane, and often associated with vast repositories of gas hydrates, represent patchy and isolated deep-sea oases of life. They host highly dynamic habitats that are spatially fragmented and temporarily variable. Microorganisms mediate all major geochemical processes at cold seeps i.e. anaerobic oxidation of methane and sulphide oxidation, which in turn enables high biomasses and biodiversity of chemosynthetic organisms to be sustained. Cold seeps are also characterized by high habitat heterogeneity and by dynamic geological, geochemical and biogenic processes influencing seep biodiversity.

The deep Eastern Mediterranean sea, encompassing numerous geologically different cold seep sites, offers a unique opportunity for the study of habitat heterogeneity and effects on microbial communities at various spatial scales in relation to their biogeochemical environment. A combined approach, using molecular (ARISA and 454 pyrosequencing) and geochemical techniques (porewater analysis, ex situ radiotracer incubations and in situ quantifications of methane, oxygen and sulphide fluxes), was applied to investigate the biogeochemical activity and related bacterial diversity of hydrate-bearing seep-habitats. Here we present data on the comparison on large (> 100 km) and small (0.01 - 100 m) spatial scales, i.e. between and within different cold seep ecosystems, such as the Amon mud volcano, the Amsterdam mud volcano and the Central Pockmark area.

Methane effluxes, sediment AOM rates and total oxygen uptake differed by an order of magnitude among habitats within a single cold seep structure, indicating high sediment heterogeneity on small (100 m) spatial scales. Conversely, similar geochemical conditions prevailed at seep-habitats separated by hundreds of kilometers. The bacterial community structures followed similar patterns, and highest variations could be detected at cold seeps with contrasting geochemical conditions. Moreover, the changes in the community structure were found to be mostly related to spatial stratification and variability in methane and sulphide fluxes, the major sources of energy at cold seeps.

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