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Chemosynthesis-influenced trophic relationships and community structure at Barents Sea cold seeps

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Cold seeps where methane and other reduced compounds emerge at the seabed can form the basis of chemosynthetic habitats and seafloor communities. We examined methane cold-seeps at three distinct locations in the Barents Sea in order to characterize the community and trophic structures. The seeps supported high densities (up to 3212 individuals 0.1 m^{-2}) of chemosymbiotic polychaetes (Siboglinidae, Frenulata), and thyasirid bivalves, *Mendicula* cf. *pygmaea* (up to 477 individuals 0.1 m^{-2}). These two taxa represent the defining fauna of cold seeps at these locations.

Stable carbon isotopic analysis showed that chemosymbiotic polychaetes generally displayed a low $\delta^{13}C$ signature ($\delta^{13}C$ = -38.2‰ and -47.1‰), suggesting syntrophy and chemosynthesis-based nutrition for these taxa. Furthermore, we detected low $\delta^{13}C$ signatures (-26.1‰ to -31.4 ‰) in three species of non-chemosymbiotic polychaetes, indicating input of chemosynthesis-based carbon derived from seeping hydrocarbons. A 2-source mixing model revealed that up to 28-41 % of the nutrition of these polychaetes originates from chemosynthesis-based carbon.

We documented large community variations and small-scale variability within and between the investigated seeps. Moreover, we observed aggregations of heterotrophic macro, - and megafauna associated with characteristic seep features such as microbial mats, carbonate outcrops and chemosymbiotic worm-tufts. Cold seeps in the Barents Sea are unique habitats with a potentially high relevance for the Arctic-Barents Sea ecosystem, with increased habitat complexity and three-dimensional structure to seafloor systems. Seeping hydrocarbons and associated chemoautotrophy add a supplementary energy source to benthic habitats at Barents Sea seeps, challenging the paradigm of Arctic ecosystems as fueled solely by photosynthesis and benthic-pelagic coupling.