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Title: Biogeochemical and biomarker signatures of microbial anaerobic methane consumption in marine and fresh water environments

#### METHANE CYCLING IN THE OCEAN AND IN LAKES

In anoxic marine and lacustrine environments, the final step in the cascade of microbial organic matter degradation reactions is the methanogenesis, the formation of methane by microbes known as methanogens. A fraction of the microbial methane is oxidised to carbon dioxide by different types of microbes, either with oxygen or anaerobically with sulphate. Both microbial methane production and consumption is accompanied by marked stable carbon (C) isotope fractionation, so that the analysis of C isotope ratios can be used to trace these processes in modern environments as well as in the geological record. Radioisotope assays are used for the quantitative assessment of CH<sub>4</sub>-driven metabolic activities. We are particularly interested in the coupling of the methane and the sulfur (S) cycles in marine sediments. S plays an important role at oxic-anoxic interfaces where large amounts of sulphide with an enormous reducing power are oxidised.

#### Methane cycling and chemo-autotrophic primary production at cold seeps

Recent ocean margin research has provided evidence for a variety of ecosystems associated with fluid, gas and mud escape structures. These so-called cold seeps are colonized by an enormous mass of bacterial mats, chemosynthetic fauna and a variety of seep- as well as non-seep related animals. Subsurface seep sediments harbor a great diversity of hydrocarbon-degrading communities of anaerobic bacteria and archaea along fluid and gas conduits. Metabolic activities of seep-related micro- and mega-fauna maintain concentration gradients of electron donors and acceptors, e.g., those of methane and sulphide as well as of oxygen and sulphate, respectively. Highly adapted symbiotic archaea and sulphate reducing bacteria, mediating the anaerobic oxidation of methane (AOM) with sulphate, are of particular importance because the activity of these communities reduces the efflux of methane to the ocean water column and ultimately to the atmosphere, where it would strongly contribute to the green house effect. Furthermore, through their high chemosynthetic primary production, cold seeps may provide an important nutrition source in the generally food-starved deep sea, analogous to oases in terrestrial deserts

Our group is interested in quantifying methane oxidation- and sulphate reduction rates in various cold seep system, using radioisotope approaches. In addition, we use lipid biomarkers and their stable carbon isotope signatures in order to assess carbon fixation pathways of microbial communities as well as carbon transfer between trophic levels. Investigated habitats include Mud Volcanoes at the Norwegian-Svalbard continental margin, the Gulf of Cadiz and the eastern Mediterranean, cold seeps in the North Sea, Gulf of Mexico, the Costa Rica continental margin and the western Weddell Sea.