Geophysical Research Abstracts, Vol. 7, 07074, 2005
SRef-ID: 1607-7962/gra/EGU05-A-07074

In situ studies on biogeochemical processes at seep structures

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Seeps are advective, non-steady-state systems with an extreme temporal and spatial variability. Different types of seep structures exist (e.g. hydrocarbon seeps, mud volcanoes, pockmarks) with different driving forces for fluid flow and gas emission. However, still little is known about the spatial and temporal distribution of fluid and gas flow in sediments around seep structures and their effect on related biogeochemical processes, and factors controlling fluid and gas flow. The expulsion and venting of hydrocarbon-rich fluids fuel a variety of geomicrobial processes such as carbonate precipitation and the growth of chemosynthetic communities. At active sites, bio-/geochemical reactions take place along sharp gradients (often on cm-scale) below the sediment surface. Constraining these reactions and the related chemical gradients thus require in situ technologies. So far, very few geochemical and microbiological investigations have been carried out based on in situ studies of methane seeping sediments and microbial habitats, mostly due to enormous difficulties in development of instruments which 1) can be used in targeted deployments (target areas are often only of square meter size), 2) functioning at high sulfide concentrations, 3) withstand high pressure and cold temperature and 4) retrieve undisturbed samples. Our poster presents innovative in situ technologies (profiler for high-resolution 1D microelectrode measurements, planar optodes for high-resolution 2D measurements, deepflow for fluid flow measurements with fluorescense dye injection and benthic chambers for total exchange rate measurements), operated under video-control by ROV's or submersibles, for targeted sampling at seep structures to investigate the sediment-water interface at high spatial (horizontal and vertical) and temporal resolution. Combing these in situ technologies/studies will help to understand and quantify mass-transfer phenomena, biogeochemical transformation of fluids and redox-active substances and

microbial processes, and finally results in an entire characterization of the seep sites.