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In situ measurements of microbial activities and transport phenomena on the Haakon Mosby Mud Vulcano (Barents Sea)

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In situ measurements of microbial activity were performed on sediments of the Haakon Mosby Mud Vulcano in the Barents Sea. A lander was deployed with a benthic chamber to measure CH_4 and O_2 exchange and a profiling unit for microsensors (O_2, H_2S, pH and temperature). The volcano area consists of a central area where mud is expelled, surrounded by large fields of the sulfide oxidizing bacteria *Beggiatoa*. The outer rim of the HMMV is dominated by the symbiotic methane-oxidizing *Pogonophora* tubeworms. With microsensors the microenvironments in the zones of the main metabolic processes, anaerobic methane oxidation (AOM) and sulfide oxidation, were characterized. From the microprofiles local activities and diffusive interfacial fluxes were determined. The benthic chambers allowed total (advective + diffusive) oxygen uptake rate measurements. The process rates in *Beggiatoa* fields are mainly controlled by diffusion, in *Pogonophora* fields by bioventilation by tubeworms. AOM is particularly high under the *Beggiatoa* fields in a narrow zone at 2 cm depth, characterized by a steep sulfide peak. All methane diffusing upwards is oxidized in a zone less than 5 mm thick. AOM was tightly coupled to aerobic sulfide oxidation by *Beggiatoa*. Diffusive oxygen uptake rates measured on retrieved cores from the central site and *Beggiatoa* site were much lower than those measured with the lander. This unusual phenomenon (normally an increase is observed, as we confirmed at an external reference site) can be explained by an upward porewater flow through the mud volcano. We estimated an upward flow in the central site of 0.4 μm s^{-1}, in the *Beggiatoa*

site of 0.1 μm s^{-1}. The mass transfer phenomena determine the distributions and rates of microbial processes, which demonstrates the importance of *in situ* measurements.