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Interactions between biotic and abiotic processes associated with methane release and habitat structures at a submarine mud volcano - a multidisciplinary approach

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Methane release from the submarine Haakon Mosby Mud Volcano (HMMV) is strongly related to the habitats found at its sediment surface:

Large amounts of gaseous methane is discharged north of the center, where grayish soft muds are expelled from the interior of the HMMV and strong fluid advection from below prohibits the penetration of methanotrophic communities. Upon release, methane bubbles are immediately coated by a methane hydrate layer. Protected by this mechanism, a large portion of the methane bubbles rises to the upper water column. Within the plume, the rising bubbles induce an upwelling of the ambient water mass which takes the methane further up towards the sea surface. Both methane oxidation rates as well as stable isotope data suggest that only few methane is directly oxidized in the water column. We propose that via this pathway several hundred tons of methane are released per year to higher water layers and may potentially escape to the atmosphere.

In contrast, different habitats situated around the center of HMMV are characterized by lower fluid advection from below allowing methanotrophic organisms to function as bio-filters removing methane at the sediment water interface. Large amounts of methane are oxidized under anoxic conditions by ANME II microbial consortia in the

sediments next to the center. White bacterial mats at the sediment surface (*Beggiatoa sp.*) benefiting from the sulfur metabolites of this process allow to identify areas of anoxic oxidation of methane (AOM).

In the outer regions of HMMV pogonophoran worms inhabited by methanotrophic symbionts dominate the benthic habitats. Sulfate-rich bottom water is drawn down into the sediment by bioventilation fuelling AOM. Adapted to the lower fluid advection at the mud volcano's outer rim, these communities also remove methane from the upward flow but cannot entirely prevent methane escaping through fault structures at the outer rim. Thus, higher amounts of methane are released from the rim area than from *Beggiatoa* fields.

The talk emphasizes the necessity for multi-disciplinary approaches to comprehend such complex systems. Acoustic and visual seafloor and water column observations were combined with *in situ* measurements and ROV-based sampling during several field trips to HMMV (please see also contribution EGU06-A-07133).