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Changes in biogeochemical activity and habitat zonation associated with mud displacement (Haakon Mosby Mud Volcano, Barents Sea)

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The Haakon Mosby Mud Volcano (72°N, 14°43' E, 1250 m water depth) is an active gas hydrate system emitting large amounts of methane to the water column. Here we report changes in this deep water chemosynthetic ecosystem before and after a major mud displacement observed with the ESONET long-term observatory LOOME in 2009-2010. The HMMV hosts different chemosynthetic communities such as thiotrophic bacterial mats and siboglinid tubeworm assemblages. It was previously shown that benthic activity and habitat zonation at HMMV is strongly regulated by fluid flow rates. We defined and observed the following habitats: At high fluid flow rates in the center, methane emission and temperature gradients are high, and benthic activity and biomass is low due to limitation in electron acceptors. This zone is associated with fresh mud flows. At intermediate fluid flow rates, benthic activity and biomass is high, as both methane and sulfate are available to support high sulfide production rates, fueling a chemosynthetic food chain. This zone is marked by dense mats of sulfide-oxidizing bacteria. At low fluid flow rates, temperature gradients are low, as is methane flux, limiting microbial methanotrophic activity to subsurface horizons, but supporting high biomasses of deep-dwelling megafauna (siboglinid tubeworms and associated animals). Until now, little was known on the temporal variations in mud volcanism and its consequences on habitat zonation and benthic activity. This presentation summarizes observed changes in space and time in the activity of chemosynthetic communities at the HMMV caused by a catastrophic mud flow event recorded by the LOOME observatory. We recorded the displacement of chemosynthetic communities and their subsequent shifts in activity such as total benthic oxygen consumption and microbial methane oxidation, consistent with changes in seafloor temperature gradients. The monitoring of habitat zonation at HMMV was carried out with the ROVs QUEST (MARUM) and GENESIS (University of Gent). In addition, the use of the AUV Sentry (WHOI) equipped with a multibeam, subbottom profiler, CTD and photographic unit as well as with a mass spectrometer provided an overview of changes associated with mud volcanism. This study was sponsored by the EU-Projects ESONET "European Seas Observatory Network" (Demonstration Mission LOOME "Long term observations on mud volcano eruptions"), HERMIONE "Hotspot Ecosystem Research and Man's Impact on European Seas" and WHOI's Arctic Research Initiative.