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Investigation of Microbial Activity in Pockmarks of the SW-Barents Sea

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Widespread areas of the seabed in the southwestern Barents Sea are characterized by pockmarks, which are manifestations of hydrocarbon venting, as well as plough marks from rafting icebergs. Pockmarks received considerable interest as possible indicators for deeper hydrocarbon reservoirs. Concomitantly, submarine hydrocarbon seeps form habitats for specific microbial communities. These microbial ecosystems and its processes are in the focus of the current study using geochemical and microbiological approaches.

During a 10-day research cruise on the Norwegian research vessel HU Sverdrup in November 2009, funded by the Swedish oil company Lundin, 350 sediment cores of up to 2,5 m length were taken inside and outside of the pockmark structures, forming a local and regional grid. 35 cores were selected for detailed studies and sampled in 10 depth intervals. Except for direct turnover rate measurements with radiotracers (sulfate reduction, anaerobic oxidation of methane) samples were preserved or frozen for later analysis in the home laboratory. All other cores were only sampled for gas measurements.

In marine sediments, dissimilatory sulfate reduction is the quantitatively most important electron acceptor process in the degradation of organic matter (Jørgensen, 1982). We determined sulfate reduction rates by radiotracer incubations with $^{35}SO_4^{2-}$, followed by separation of the reduced inorganic sulfur compounds by the cold chromium distillation as described by Kallmeyer et al. (2004). Additionally, general geochemical parameter like pore water sulfate concentration, TOC and the total amount of methane (free, occluded and adsorbed gas) were measured.

Sulfate reduction rates in the entire sampling area are astonishingly low. This result is also supported by the analysis of methane concentrations, showing only marginal amounts of free and occluded gas and only slight concentrations of adsorbed gas. This indicates that the modern pockmark system is more or less inactive. Porewater sulfate profiles also show only a minimal decrease with depth, indicating very little net sulfate consumption. Microbial biomarkers are currently being analyzed with depth to investigate the history of the pockmarks. In this context the focus will be placed on specific biomarkers and its carbon isotopic signature indicating fossil microbial populations and its microbial processes in the past.

Geomicrobiological methods, studying biogeochemical processes are good indicators to evaluate the activity of fluid flow structures. Furthermore we can see that pockmarks are not necessarily indicators for active leakage but can also be manifestations of paleo-seepage. We hypothesize that the pockmark formation is most likely related to a paleo-event during last deglaciation (approx. 13 ka B.P.).

References

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