A biogeochemical curiosity in sediments of an active pockmark (Vestnesa Ridge, Svalbard)

S. SAUER[1], J. KNIES[1,2], A. LEPLAND[2], H.YAO[1], S. KLASEK[3], W.L. HONG[2], F. EICHINGER[4], M. KLUG[2], G. PANIERI[1], T. HIMMLER[2], I.H. STEEN[5], H. DAHLE[5], F. VULCANO[5], C.J. SCHUBERT[6]

[1]CAGE – Center for Arctic Gas Hydrate, Environment an Climate, Department of Geosciences, UiT The Arctic University of Norway, Tromsø, Norway
[2]NGU – Geological Survey of Norway, Trondheim, Norway
[3]Oregon State University, Corvallis, OR, United States
[4]Hydroisotop GmbH, Schweitenkirchen, Germany
[5]Department of Biological Sciences and K. G. Jebsen Centre for Deep Sea Research, University of Bergen, Bergen, Norway
[6]Eawag, Swiss Federal Institute of Aquatic Science and Technology, Kastanienbaum, Switzerland

We investigated push core samples from an active methane seepage system on Vestnesa Ridge, offshore W-Svalbard, in water depths of ca. 1200 m. Surface expressions of methane seepage include pockmarks, seep carbonates, bacterial mats and siboglinid tubeworms. Sediments sampled below the bacterial mats were gas-charged and exhibited a very shallow sulphate-methane-transition-zone (SMTZ) between 2 and 15 cm below the seafloor. Using XRF-scans of the push cores and seep carbonate distribution we assessed the stability/variation of the SMTZ depth over time.

The major proportion of hydrocarbons feeding the gas hydrate system of Vestnesa Ridge is believed to originate from deep subsurface thermogenic sources of Miocene age. Nevertheless, gas analysis from push cores suggest significant proportions of microbial methane ($\delta^{13}C\text{-}CH_4$ values -77 to -52 ‰ VPDB). High total organic carbon (TOC) content of up to 2 wt% is probably the basis for the microbial methane production. The $\delta^{13}C$-TOC value of the organic material in the push cores is unusually low (down to -34 ‰ VPDB) indicating a contribution from methanotrophic biomass. Usually, the highest amount of methanotrophic biomass is expected at the SMTZ due to a consortium of anaerobic methanotrophic archaea (ANME) and sulphate reducing bacteria (SRB) performing the anaerobic oxidation of methane (AOM). Surprisingly, in our push cores the lowest values of $\delta^{13}C$-TOC are found below the present-day SMTZ. In addition, microbiological data show higher relative abundances of ANME and SRB below the SMTZ.