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Sulfate reduction and methane cycling at pockmark areas in Nyegga and Vestnesa Ridge

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Nyegga is located north of the northern Storegga Slide escarpment, Mid-Norwegian margin. Numerous fluid expulsion features – pockmarks are widespread at the seabed in Nyegga, which are associated with the region bottom simulating reflector (BSR). The Vestnesa Ridge is located on the west of Svalbard at 80˚N. A large number of pockmarks are concentrated on the crest of the ridge, with a prominent BSR along the W-Svalbard margin. These two pockmark areas are targeted to study the gas hydrate distribution, geochemical processes, methane generation and consumption, and the spatial geochemical differences within a pockmark and among pockmarks.

The gravity cores ranging from 0.8 to 3 m long, were collected along transects from center to the rim of the pockmarks. Pore water geochemical data (SO_4^{2-}, $\sum H_2S$, dissolve inorganic carbon-DIC, $\delta^{13}C_{DIC}$, Cl^- and $\delta^{18}O$) and sediment headspace hydrocarbon gas composition were obtained from 10 and 5 gravity cores collected in the summer of 2008 in Nyegga and the Vestnesa Ridge, respectively. We successfully recovered methane hydrate samples from two gravity cores from G11 pockmark in Nyegga. The hydrate gas was analyzed for $\delta^{13}C_{CH4}$ and δD isotopes. The maximum methane hydrate saturation was estimated to be 10% of the pore volume based on the Cl^- concentration variation. The sulfate-methane transition (SMT) zones are 0.2-8.7 mbsf and 2.0-18.3 mbsf, in Nyegga and Vestnesa, respectively. Minimum $\delta^{13}C_{DIC}$ values of -57.0 $\sim$ -62.4 ‰occurred at SMT strongly suggest active anaerobic oxidation of methane (AOM) throughout the Nyegga area. Mostly the methane in the shallow sediments in Nyegga and Vestnesa is microbial one generated just below SMT. We also notice that sulfate flux in the sediments is surprising lower in the center than those in the wall or the rim of a pockmark, which is consistent with the heaviest $\delta^{13}C_{DIC}$ in the center.