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Active Gas Venting Through Hydrate-Bearing Sediments on the Vestnesa Ridge, Offshore W-Svalbard

Stefan Bünz, Jürgen Mienert, Sergey Polyanov, Sunil Vadakkepuliyambatta, and Chiara Consolaro
University of Tromso, Deptartment of Geology, Tromso, Norway (stefan.buenz@uit.no, 47 77645600)

Gas hydrate systems offshore western Svalbard are far more extensive (∼4000km̂2) than previously assumed and include the whole Vestnesa Ridge, an elongated sediment drift north of the Molloy Transform and just east of the Molloy Ridge, one of the shortest segments of the slow spreading North-Atlantic Ridge system. The crest of the Vestnesa Ridge at water depth between 1200-1300 m is pierced with fluid-flow features. Seafloor pockmarks vary in size up to 1 km in diameter. Pockmarks are generally larger at the onset of the Vestnesa Ridge than at its western termination. A recent cruise with R/V Jan Mayen discovered methane flares in the water column above the pockmark field at the onset of the Vestnesa Ridge. Over a period of one week at least 4 pockmarks were continuously active and methane flares in the water column reached a height of approximately 800 m. The extent of the active gas venting is much stronger than discovered earlier and it is still unclear what has triggered the increase in gas expulsion from seafloor sediments. Any connection to hundreds of active gas vents further to the east at the shelf edge in water depth of 250-400 m remains speculative at this point but cannot be ruled out.
High –resolution 3D seismic data acquired in 2007 and 2010 also show significant dissimilarities of the sub-seafloor expression of these fluid leakage systems. At the western end of the Vestnesa Ridge, sub-seafloor fluid flow features resemble well-described pipe structures. However, the seismic expression of the active fluid flow features is much broader, much more chaotic, dome-shaped and is not very similar to a typical chimney structure.
The Vestnesa Ridge gas-hydrate and free- gas system occurs within few km of a mid-oceanic ridge and transform fault, which makes this gas hydrate system unique on Earth. The close proximity to the spreading centre and its hydrothermal circulation system affects the dynamics of the gas-hydrate and free-gas system. The high heat flow together with the high tectonic activity of this region, a thick sedimentary cover, a shallow maturation window and an accelerated rate of biogenic and thermogenic gas production cause substantial disturbance to the free-gas system leading to high variability in gas supply, gas migration and gas hydrate build up and dissociation. This young and dynamic system allows studying free-gas migration, fluid expulsion and gas-hydrate formation in marine sediments, their governing parameters and their relationship with each other in great detail.