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Possible effects of Quaternary glaciations on thermogenic methane release from reservoirs in the Hammerfest Basin, SW Barents Sea: an integrated approach of observations, measurements and modelling.

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The SW Barents is an active area for petroleum exploration, with virtually all reserves found to be dominated by gas. The tectonic and paleo-climatic history during the Cenozoic played an important role in the accumulation and redistribution of hydrocarbon reserves, due to tilting and exhumation of traps, cooling of source rocks, phase change and seal failure. Here we present the results from the integration of interpretation of 3D seismic reflection data, geochemical analysis of gravity core samples, and numerical modelling, in order to study the possible processes controlling methane leakage, quantify the possible volumes released and determine the timing of the leakage events during the Quaternary glaciations in this area.

Results from our 3D petroleum system model of the Hammerfest suggest that significant reservoir over-pressure fluctuations occurred during glacial loading and unloading, which may have triggered episodic release of thermogenic methane from these reservoirs. The main gas loss peaks from the reservoirs coincide with the glacial unloading and we estimate a total of ca. 250 Mt of lost gaseous hydrocarbons to model top during the last 1 Ma. Possible evidences of this process were identified in an industry 3D seismic cube from the Snøhvit and Albatross gas fields, which reveals the presence of an active hydrocarbon plumbing system (Ostanin et al., 2012b). The area investigated is characterized by a high density of pockmarks (100-300 m wide) as well as mega-pockmarks (<1 km wide) identified on the present-day seafloor and on the top Cenozoic glacial erosive surface (URU), connected to a polygonal fault network, deep regional faults and seismic pipes (Ostanin et al., 2012a). Evidence of glacial erosion processes on seabed and URU suggests that the fluid escape took place during the ice retreat, where the pockmarks and seismic pipes are thought to have been formed by the decomposition of gas hydrates.

Additionally, 350 sediment cores (2.5 m long) were taken inside and outside of seafloor pockmarks in the Loppa High area, to study fossil and present day microbial communities thriving on seeping fluids. Overall, 35 cores, sampled at 10 depth intervals were selected for a detailed microbiological and geochemical analysis. Marginal amounts of free, occluded and adsorbed gas as well as low sulfate reduction rates and low microbial activity imply that the present day pockmarks are inactive. However, in a deeper core section an increase of hydrocarbons and microbial markers is detectable which might indicate that the fluid seepage was taking place in the past (Nickel et al., 2012).

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