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Long-term observation of sediment temperatures reveals high temporal variability of fluid seepage at Håkon Mosby mud volcano, Barents sea slope

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Located on the Barents sea slope, Håkon Mosby mud volcano (HMMV) is an exceptional example of an active mud volcano and a unique natural laboratory for studying the interaction of geological, geochemical, biological and microbiological processes. Previous investigations have shown that the lateral variability of fluid flow and gas seepage controls the distribution of different habitats on the seafloor and gas hydrates in the surface sediments. Repeated in-situ temperature measurements during three cruises in 2003, 2005, and 2006 have shown evidence of persistent fluid seepage and suggest that the focus of activity is located at the geometric center of HMMV. In order to investigate the temporal variability of fluid flow, a gravity corer instrumented with temperature sensors was deployed close to the active center of the mud volcano in the course of the ARK-XXI/1b cruise in 2005. The position of this gravity temperature lance was documented and five additional short temperature lances were deployed a few weeks later using the ROV Victor 6000 during the AWI-ROV cruise in 2005. The gravity temperature lance and three of the shorter temperature lances were recovered during the VICKING cruise in 2006. The remaining two short temperature lances could not be found. All recovered instruments recorded temperature measurements at a sampling interval of 30 minutes over a period of nine months.

The gravity temperature lance recorded in-situ sediment temperatures at eight different depths with 5 to 15 meters below the seafloor. The resulting profiles show sediment temperatures between 16 and 30 °C and reveal a rapid temperature drop of almost 10 degrees throughout the observed interval of the sediment column within less than 2

weeks at the beginning of December 2005. Both convex- and concave shaped temperature profiles found at several times throughout the observation period indicate a high variability of fluid flow at the position of the gravity temperature lance and suggest a three dimensional flow regime. The three short temperature lances recorded variations in sediment temperature at 25 and 55 centimeters below the seafloor at three different positions within the central area. The observed temperatures range from -0.2 to 2.5 °C for the upper sensors and from 1.3 to 2 °C for the lower sensors, corresponding to temperature gradients varying between 4 and 5 °C per meter. Even though the time series show different general temperature trends at the three locations, all relative maxima and minima of the temperature gradient occurred at the same time. With few exceptions, a relative minimum of the gradient was correlated with a temperature increase and vice versa, suggesting that the variations are caused by pulses upward flow of relatively warm porewater, affecting the entire central area of the mud volcano.