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Seismic analysis reveals the three-dimensional geometry of the active caldera of Håkon Mosby mud volcano, Barents Sea slope

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Located in the southwestern Barents Sea (72 º N, 14º 44´ E; 1250 m water depth) in the Bear Island slide, Håkon Mosby mud volcano (HMMV) is a 1 kilometer diameter active cold seep linked to a complex chemosynthetic ecosystem. The subsurface geometry of the mud volcano is derived from shallow seismic lines and compared to in-situ sediment temperature data in order to provide a more profound insight into the three-dimensional structure and inferred dynamics of HMMV.

High-resolution sediment echosounder data (Chirp) collected during both the R/V Jan Mayen cruise (2005) and VIKING cruise (2006) have revealed three conical features pointing towards the geometrical center of the volcano. Stratigraphical analysis shows that the conical features are probably associated to the three main seismic discontinuities identified in the region (D1, D2 and D3), which divide the four main seismic units (U1, U2, U3 and U4) from bottom to top. Whereas U1, U2 and U3 are covering practically the whole study area, the youngest seismic unit U4 is confined to the area of the volcano and to the defined mud flows from the side side-scan sonar data. We propose U1, U2 and U3 are infilling units in the Bear Island slide scar. Since U4 correlates with the boundaries of the defined mud flows, we suggest that this seismic unit is an autochthonous mud flows unit.

At the caldera of the mud volcano, seismic profiles reveal an area where reflections are absent, probably related to episodic mud, gas and fluid expulsion of still unknown frequency. The conical features described by D1, D2 and D3 are affected by acoustic masking in the central area suggesting a vertical pathway which connects both deeper

and shallower sections. Regionalized maps of those seismic discontinuities reveal that the path in the central area differs in both shape and dimensions depending on the cone projected such as circular in D1 and oval in both D2 and D3. The diameter in D1 is $\sim$400 m and the length of the maximum axis in both D2 and D3 are $\sim$300 m and $\sim$200 m respectively. We suggest the conical features are the boundaries of the feeder channel. The overlapped projection of those cones reveals an oval conduit of $\sim$180 m of maximum axis.

The extension of the defined conduit roughly matches the central area of the mud volcano, which is dominated by "fresh" mud. The active centre of the cone correlates with maxima in the thermal anomaly revealed by sediment temperature observations during the ARK-XIX/3b (2003) AWI-ROV (2005), and VICKING (2006) cruises showing a persistent dynamic upflow regime during the 3 years of continuous observations.