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Sediment temperature distribution, sea floor morphology, and gas hydrate stability at Dvurechenskii mud volcano

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The Dvurechenskii mud volcano (DMV) is located in the Sorokin trough, Black Sea, at a water depth of around 2075 m. The steep flanks of this elliptical structure are cut off at about 20 m above the surrounding seafloor, forming a plateau of 700 to 1000 m in diameter. The thermal structure of this mud volcano was investigated in detail during the M72/2 and M72/3 cruises of the RV Meteor with the ROV Quest 4000 to provide new insights into its activity and the distribution of gas hydrates.

In-situ temperature profiles from up to 50 m sediment depth were obtained using temperature loggers mounted on the gravity corer. An ROV-operated short temperature lance provided in-situ measurements from up to 0.6 m below the seafloor. The sediment data were complemented by high resolution bottom water temperature logging during all ROV dives. Compared to temperature gradients of 0.038 and 0.057 °C/m on the southern and northern flank, respectively, a strong temperature anomaly of more than 11 °C/m in near-surface sediments was found approximately 100 m NW of the geometrical center of the mud volcano. The measurements confirmed a temperature increase to more than 20.5 °C at less than 5 m below the seafloor. Below, the gradient was negative and the profile returned to values of around 16.8 °C at 50 m sediment depth. The center of this isolated volume of warm sediment coincides with the highest point of the plateau, suggesting a recent mud eruption. The temperature anomaly in the sediment is accompanied by a positive bottom water temperature anomaly of approxi-

mately up to 0.02 °C, affecting an area of around 50 m in diameter, which also shows high backscatter in an acoustic map. With increasing distance from the hotspot, the temperature gradients within the upper 10 m of the sediment column decrease rapidly to approximately 0.3 °C/m at the edge of the plateau. At more than 10 m below the seafloor, the profiles approached temperatures of around 16.3 °C. The presence of gas hydrates outside the hotspot of the DMV was confirmed by gravity coring and autoclave piston coring. The temperature data was combined with chemical analyses of gas and porewater composition in order to map the limits of the gas hydrate stability field for this mud volcano.