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Acoustic imaging of the Dvurechenskii mud volcano in the Black Sea

M. Zillmer, J. Bialas, A. Ivanova, E.R. Flueh, L. Planert, G. von Gronefeld (1), C. Middag, L. Naudts (2)

(1) IFM-GEOMAR, Leibniz-Institute for Marine Sciences, Kiel, Germany (2) Renard Centre for Marine Geology, Ghent University, Belgium

In the CRIMEA project submarine gas emitting sites in the Black Sea are investigated in order to quantify methane transfer through the water column into the atmosphere. One target area is the Dvurechenskii mud volcano (DMV) in the Sorokin Trough south-east of the Crimea peninsula. The occurrence of gas hydrates and high methane concentrations in the sediment of this mud volcano are known. A seismic wide-angle experiment was performed at the DMV with twelve Ocean Bottom Hydrophones and Seismometers and a GI gun source with frequencies around 100 Hz. By using Kirchhoff depth migration the seismogram sections are transformed to images, which extent to 4 km laterally and 600 metres in depth. The images show the conduit of the DMV and the nearby sediment layers. The DMV has a diameter of 800-1000 m at the sea floor and its conduit has the same form and diameter up to 600 m depth. Several plane sediment layers are disrupted by the conduit, and strong reflectors are identified in 100 m and 400 m depth in the conduit. The lower bowl shaped reflectors are interpreted as collapsed parts of the disrupted sediment layers, which sunk in the lighter material of the conduit. This is also a possible explanation for the upper reflections. Compressional wave velocities are obtained from Kirchhoff migration, and the model is refined by using seismic ray tracing. Bulk density and shear wave velocity can also be obtained by analyzing the data. With the help of these elastic parameters and by using the Frenkel-Gassmann theory, the free gas saturation of the sediment pore space and the gas hydrate saturation can be quantified.