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GEOCHEMICAL AND GEOPHYSICAL PROPERTIES OF GAS-RICH SEDIMENT IN THE ARKONA BASIN (BALTIC SEA)

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Free gas zones with "seismic turbidity" were detected in shallow marine sediments of the Arkona Basin, Baltic Sea, by seismic reflection investigations. These sites were used in a combined geochemical and geophysical approach as a "Natural Laboratory" (NATLAB) to study physical and chemical properties of marine sediment in relation to gas content in pore water. The knowledge of the sedimentological parameters contributes to the understanding of the nature of seismic reflectors as well as of compressional (P-) and shear- (S-) wave reflectors in terms of physical sediment properties. Gravity cores were used to recover up to 10m of muddy and clayey sediment in gas-rich areas from the center of the basin and in areas with low gas content from the basin rim. The geological data were completed by the acquisition of seismic P- and S-wave data in the sampling areas. Mean gas content of about 180ml/l pore water was measured in organic-rich sediment samples (0.5-4 m sediment depth) of the central basin. Methane, usually the main component, was formed by bacterial CO_2 reduction at anoxic conditions indicated by δ^{13}C-CH_4 values of about -90 ppm and δD-CH_4 values of about -150 , respectively. Free gas bubble formation in the uppermost anoxic sediment (0.4-0.6 cm) was confirmed by calculating the methane solubility equilibrium using in-situ temperature and pressure conditions. Furthermore, "BSR"-like reflectors have been identified in seismic profiles at the same sediment depth where free gas was assumed by solubility calculations. Gas bubble imaging was strongly frequency dependent indicated by changes of the reflection characteristics of the gas reflectors for different seismic sources. Susceptibility, bulk density and (P-) wave velocity of sediment cores were measured using a MSCL core logger. P-wave velocities showed reduced values in the muddy gas-rich surface sediment compared to the underlying consolidated clay. Adjusting sedimentological stratigraphy to boomer and echosound-

ing profiles also indicates low P-wave velocities of 930 m/s in zones with acoustic turbidity. Mechanically measured shear strength values are increasing with sediment depth from 0.4 to 2.4 kg/cm^2. The data correlates well with the shear wave velocity structure, which is derived from the dispersion of acoustic guided waves. The calculated velocities are rather low with values of 40-60 m/s in the uppermost 10 m. They increase strongly to about 300 m/s in the underlying bolder clay and to 400 m/s in the upper cretaceous layer.