SUMMARY

Marine CSEM data have been collected in 2014 onboard R/V M.S. MERIAN over seismically inferred submarine gas hydrate targets in the Danube delta fan, western Black Sea, with the goal to derive the sub-seafloor gas hydrate distribution and to provide saturation estimates. The Black Sea is a quasi-closed marginal sea with thick sediment layers. Anoxic conditions and water depths exceeding 1000 m favor the generation of methane and extensive gas hydrate deposits along the continental margins of the Black Sea. Methane venting at the landward edge of the gas hydrate stability zone and the observation of multiple bottom simulating reflectors in the deeper parts of the margins are further expressions of a major hydrocarbon potential. First results of the CSEM data analysis from a profile (P1) using BGR’s seafloor-towed electric dipole-dipole system have been presented at the EMIW 2016. Two-dimensional inversion of this data set revealed highly anomalous resistivities which are partly attributed to low pore water salinities due to sea level low stands in the past, but also require an additional resistive phase, i.e. gas hydrate. Recently measured pore water salinities from piston cores down to a depth of 30 m from the edge of the hydrate stability field vary between 1 and 4 ppm. Comparison with conductivities derived from short offset CSEM data arrive at a better fit for salinities of 4 ppm.

Data analysis has been going on towards inclusion of continuously towed data in addition to stationary data using Key’s 2D inversion code MARE2DEM. The code also allows incorporation of structural constraints from coincident seismic profiles which have been applied to the data. Higher resistivities are observed below a prominent seismic reflector at intermediate depth of 50 m below seafloor which may be a lithological interface. CSEM data from two additional profiles (P2 and P3) have been processed and are now available for the inversion and interpretation. P2 is located close to P1 within a channel levee system in the Bulgarian sector, but shows generally lower resistivities which are still open for discussion. P3 is located further North in the Romanian sector in a slump area at the edge of the hydrate stability field. Even though the gas hydrate stability layer is much thinner, the inverted resistivity values are comparable high to P1. The area was also the focus of a cruise in late 2017 using the MeBo mobile drilling platform, which for the first time provided core samples and physical data down to a depth of 147 m.

In the paper we present new 2D inversion models from the three CSEM profiles using stationary and continuous data as well as structural constraints from seismic. We also derive gas hydrate saturation estimates based on Archie’s relation including salinity data from shallow bore holes, porosity information from seismic velocity data, and information available from the MeBo drill sites.

Keywords: marine CSEM, submarine gas hydrates, western Black Sea, 2D inversion