

Is There Petroleum in the Olga Basin? New Information From Deep Seismic and Geochemistry Data

Peter Klitzke¹, Philipp Weniger¹, Rüdiger Lutz¹, Martin Blumenberg¹, Dieter Franke¹, Kai Berglar¹, and Axel Ehrhardt¹

¹Energy resources, Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany.

ABSTRACT

The Barents Sea experienced multiple changes of the stress regime including Paleozoic continental collision, multi-stage late Paleozoic to Mesozoic rifting and late Cenozoic uplift and erosion. Academic as well as industry-driven studies led to a comprehensive database and numerous oil and gas discoveries in the southern Barents Sea. On the contrary, potential petroleum systems of the northern Barents Sea are only poorly investigated. It is widely agreed that late Cenozoic uplift and erosion episodes were more pronounced to the north. As a consequence, potential Triassic source rocks are at shallow depth and only locally covered by Jurassic and Cretaceous strata. We acquired new geophysical and geological data in the area of the Olga Basin southeast of Svalbard in 2015 to reconstruct the basin evolution and its petroleum systems. The obtained data include ~1750 km of 2D multi-channel seismic lines, ~350 km of wide angle seismic lines by means of sonobuoys, sediment echosounder data, multi-beam data and potential field data. First interpretation of the seismic profiles reveals a locally dense network of Triassic normal faults bordering the Olga basin and partly reaching to the acoustic basement. In particular, north of the Olga Basin this Triassic fault system seems to have experienced post-glacial reactivation as indicated by sediment echosounder data. Near surface sediments were sampled by use of gravity and multi coring. The concentrations of hydrocarbon gases are generally low ($\text{CH}_4 < 100$ ppb) and exclude active seeping at present-day for the studied spots. However, stable carbon isotope values ($\delta^{13}\text{C CH}_4$ -38 ‰ - -48 ‰) of samples with elevated concentration of bound gases detected south of Spitsbergen and near the Olga Basin indicate a thermogenic origin, most likely from source rocks of oil window maturity. Lowest measured methane concentrations in the bound fraction of hydrocarbon gases occur in the center of the Olga Basin and imply that the Jurassic strata is impermeable and could act as a potential seal for hydrocarbons. Elevated methane concentrations on the other hand have been determined at the southern basin edge where Jurassic sediments crop out and additionally, above a reactivated fault in the North, which suggests that these faults are potential pathways for hydrocarbon leakage.