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The petroleum system of the lower Palaeozoic strata in the central part of the Baltic basin

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The Baltic Basin is an intra-cratonic sedimentary basin with conspicuous Early Palaeozoic sections. In terms of hydrocarbon prospectively, the it has been perceived as a classical oil basin with several tens of relatively small oil and gas fields occur there over a wide stratigraphic interval, ranging from the crystalline basement through the entire Lower Palaeozoic succession. Until now conventional oil has been predominantly produced in the basin, i.e. only few conventional gas accumulations have been found in the Polish Baltic Sea offshore. Petroleum potential within the basin also is associated with Silurian reefogenic and carbonate build-ups. New organic geochemistry data as well revealed the potential for shale gas/oil in the basin.

The analysis of the composition of the organic matter and crude oils from Kaliningrad region (Russia) and Lithuanian revealed genesis and the general trends of the migration of hydrocarbons in the Baltic Basin. The organic matter of the source rocks is of similar composition and represents typical marine type II, showing considerable variations of the maturity thought the basin: ranging from immature in the eastern Lithuania and Kaliningrad region of Russia to oil window to the south-west. In some places the anomalously high maturity of organic matter, indicating the lower part of the wet gas/condensate window have been recorded, most probably being related to the locally increased paleo-temperatures. Oils of the Baltic Basin have low densities (< 31,1 API; 790.5–870.0 kg/m3), and low asphaltene (<2.2%) and sulphur (<0.44%) contents. The saturated hydrocarbon content varies from 35.3 to 77.8%, and the ratio of saturate to aromatic hydrocarbons ranges in 2.1–5.2, indicating long-distance hydrocarbons migration or high thermal maturities. Oils of the Baltic Basin are not biodegraded, despite their early emplacement (e.g. by the Lower Palaeozoic age) and the relatively low present reservoir temperatures. Results of biomarker and stable carbon isotope analyses allow three genetic oil groups to be distinguished in the Kaliningrad region. These oils appear to be confined to tectonically distinct areas suggesting that the hydrocarbons were derived from different kitchens. The hydrocarbon generation in the Baltic Basin started by the end of Silurian, while the basic phase is thought to occur in Devonian and Permian. Different source rocks contributed to the hydrocarbon expulsion. Slow deposition and tectonically stable regime ensured slow formation of the oil and gase-condensate fields with replenishing oil portions incoming with time: e.g. Cambrian oil traps could accumulate also Ordovician and Silurian oils.