



The unconventional hydrocarbon potential in the central part of the Baltic Basin

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The Baltic Basin is an intracratonic Phanerozoic sedimentary basin, situated on the Western margin of the East European Craton. The unconventional hydrocarbon potential is mostly related to the several organic-rich source rock complexes within the Early Palaeozoic section. In the south-eastern part of the Baltic Basin the Cambrian shales (Alum shales and Middle Cambrian), Ordovician black shales of the Caradocian age and Silurian Llandovery shales are considered as the major potential shale oil/gas plays. The depth of the the base of the Silurian shales varies from 2120 to 1125 m in the Lithuanian part of the basin. The thickness of the Lower Silurian shales in - varies from 110m to 160 m. The organic matter of the source rocks is of similar composition - predominantly „oil-producing” sapropel (type II) and mixed “oil-gas liquids producing” type II-III. Pyrolysis yields (32 – 76(~100) kg HC/ton rock) suggests a good hydrocarbon generation potential. Total organic carbon content varies from 0.2-3 to 8-11%. Maximal values of the total organic carbon (up to 17%) have been recorded near the base of the Silurian (2-11 m Middle Llandovery interval) and its content generally decreases upwards the section.

The Rock-Eval screening pyrolysis, biomarker data, reflectance of vitrinite-like macerals and conodont colour alteration index show considerable variations of the source rocks maturity through the basin. Maturity of the organic matter increases southwestwards from 0.6 up to 1.94% (Ro). Thermal maturity in this area ranges from immature in the Eastern part of Lithuania and to “oil window” in the Western Lithuania. In some places in central part of the basin (wells Ramučiai-1, Pajūris-1 and others) 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.

Llandovery shales are clay-rich, an average values range from 28–59vol.% (mean - 47vol.%); the mineralogical composition is dominated by chlorite, illite and mica and illite-smectite, kaolinite is rare. Quartz content ranges from 18–34 vol.% (mean - 30 vol.%), calcite and dolomite content ranges from 0.3–38vol.% (mean - 10vol.%); pyrite content (0.3 – 3.7 vol.%). Brittleness factor – 0.3–0.7 (mean - 0.46), suggesting moderately brittle to moderately ductile geo-mechanical properties of shales.

The Early Silurian - Uppermost Ordovician black graptolite shales have been defined as being prospective for the unconventional shale gas potential in the Baltic Basin. New organic geochemistry data, incorporated with well logs and core data were used to reveal the potential for shale gas in the central part of the basin. Unconventional hydrocarbon potential is mostly related to the Llandovery-Upper Ordovician shale formation. The amount of TOC is high, but vitrinite reflectance data imply the thermal maturities of shales for liquid, rather than gaseous unconventional hydrocarbons generation. Volume of generated unconventional hydrocarbons in SW Lithuania for the Late Ordovician-Early Silurian section of 110 m thick might comprise: shale oil resources in place – 3,6-18,3 bill. m³; shale gas in place – 1,03-5,13 tril. m³.