

The Lower Paleozoic oil/gas shale plays in the Central Europe

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During the last decade shale oil/gas potential was analyzed for a number of European petroleum basins. The major exploration efforts were concentrated on the European Lower Paleozoic organic-rich shale. Such shale formations are developed on the western slope of the East European Craton (EEC) within Caledonian foredeep basins, *i.e.*, Baltic Basin (BB), Lublin-Podlasie Basin (LPB), and Volyn-Podillya-Moldavia Basin (VPMB), as well as on other adjacent tectonic blocks, *i.e.*, the Malopolska and Moesia (MP).

Within the EEC a diachronism in deposition of organic-rich shale is observed – in the southwest BB it begun during the Middle/Upper Cambrian, in the central BB during the Caradoc, in the Eastern BB and northern LPB during the Llandovery, while in the southern LPB and in the VPMB during Wenlock time. On the ECC flexural basin, the belt of organic-rich shale deposition was replaced to the east, *i.e.*, towards shallower part of the basin, by sedimentation of carbonates, while in the west it was limited by the influx of detritus derived from Caledonian collision zone.

TOC contents of the analyzed shale formations is highly variable both laterally and vertically. Within the EEC the highest average TOC is observed in the central BB (Caradoc and Llandovery), and in the western BB (Alum Shale), where is rich 3–5% and 5–10%, respectively. In the LPB and VPMB the TOC contents is lower (mostly in a range of 1–1.5%), while in the MP (Tandarei Fm) it ranges from 0.1 to 3.5%. Net reservoir thickness, defined only for the BB and LPB, is the highest also in the central BB and is equal to 20–40 m. Gross thickness of organic-rich shale in the whole analyzed is in a range of a few to several tens of meters. High thickness of TOC-lean shale is characteristic for the Wenlock in the eastern BB, LPB, and VPMB.

On the western slope of the EEC the burial depth to the Lower Paleozoic shale reservoir increases from the east and northeast towards west and southwest, while within the MP burial depth increases towards the north. The same direction thermal maturity of the reservoir changes. In the major part of the study area the shale reservoir is matured to the oil or liquids window. Gas window is limited and restricted to the deep part of the basin (>3500–4000 m). Due to early hydrocarbon generation and subsequent significant uplift, at the major part of the study area no overpressure is observed. Degree of tectonic deformation is low in the BB, and moderate in the remaining area.

The highest exploration activity so far took place in the BB and LPB, where ~70 wells were drilled. However, there was only 5 wells with representative production test results. None of these wells was located in the dry gas window, easier for production. So far no commercial flow was obtained. The key challenge for flow rate improvement remains joint fracturing at a given location of at least two individual reservoir formations (*e.g.*, Caradoc and Llandovery) simultaneously.