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# New unconventional potential of the mature petroleum provinces – a case study of Poland

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The historical peak oil/gas concept is recently challenged mainly by exploration and development of different unconventional hydrocarbon fields. The large global resources of such oil/gas recently became acknowledged. Its possible vast impact on petroleum production was demonstrated so far in some of the mature petroleum provinces of USA. The models of unconventional petroleum systems, developed there, are now applied to numerous mature basins across the World, including Poland.

A few individual petroleum provinces in Poland are all characterized by very mature exploration and systematic production decline. However new unconventional exploration concepts applied here revealed a significant new upscale potential. The highest attention was focused so far on the Upper Ordovician and/or Lower Silurian shale oil/gas in the Baltic-Podlasie-Lublin Basin. Nearly 70 new wells drilled last years in the basin proved the concept, though maximum gas test flow rates (14.000 $m^3$/d) are not at the commercial level. The key exploration risk factor is a low thickness of the net pay.

A few unconventional plays are recognized within the Permian-Mesozoic Polish Basin. The Rotliegend (Upper Permian) tight gas is associated mainly with the reservoir eolian facies in the deep part of the basin. Results of several new wells encourage further exploration, and the maximum initial production from vertical well with single frac job was 180.000 $m^3$/d, indicating a commercial flow rate. At the shallower stratigraphic level tight oil accumulations in the Main Dolomite reservoir (Zechstein, Upper Permian) are recognized in the Western and the Northern part of the basin. A first hydraulic fracturing of vertical well shall soon be performed there. In the central part of the Polish Basin the Jurassic to Lower Cretaceous shale oil paly is identified. The best potential of the play is related to synclines developed between salt structures due to elevated thermal maturity.

The Variscan basins in Poland also reveal new unconventional petroleum potential. In the deep part of the Upper Silesian Basin favourable conditions for development of the basin-centered gas system is identified, sourced with gas generated from coal seams buried down to 4000-5000 m and potentially trapped by permeability jail seal mechanism. However the basin so far lacks any well deep enough to verify the play concept. The key risk factor remains an uncertain timing of gas generation, having an impact on gas preservation potential. In the Southern and Western Poland the Upper Devonian–Lower Carboniferous shale is currently explored for unconventional gas. Results of the first 3 exploration wells were not conclusive, although high tectonic deformation rate is here a concern.

In the Outer Carpathians, producing oil and gas from the mid of nineteenth century, the first attempts to stimulated by hydraulic fracturing the oil and gas production from both shale and tight sandstone reservoir were successful. In the Miocene Foredeep of the Outer Carpathian tight biogenic gas is produced at a commercial flow rate from the thick pile of mudstone reservoir without stimulation. Shallow depth allows for limited cost of drilling and ascertains production commerciality.

Large amount of hydrocarbons might still be trapped in the mature petroleum provinces in Poland, which several years ago were out of any consideration. Their resources remain yet uncertain and requires further testing. A cost of new technology impacts significantly commerciality of these exploration projects, so their further development remains dependent on oil and gas prices.