

New Model of the Tectono-Sedimentary Evolution of the Lower Paleozoic Basin Developed Above the East European Craton in Poland and its Bearing on the Petroleum System

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Abstract

The Lower Paleozoic Basin, located above the SW edge of the East European Craton in Poland, has recently been the focus of intensive shale gas exploration activity. This article presents new findings regarding complex tectono-sedimentary history of this sedimentary basin and its petroleum system. These findings are based on new and archive reprocessed seismic data calibrated by deep wells. Within the Baltic sub-basin, Cambrian - Ordovician passive margin succession is unconformably covered by the Silurian Caledonian foredeep sequence. Quantitative reconstruction based on seismic data has provided estimates of approx. 6-7 km as the minimum source rock burial depth during the Caledonian orogeny. Hitherto undocumented Late Triassic normal faulting affecting the entire cratonic edge, including the Lower Paleozoic shale gas reservoir, has been also documented. Within the Podlasie sub-basin, indications of sediment supply from the distal basin margin of the Silurian foredeep have been observed. The Lublin Sub-Basin is characterized by very complex Early and Late Palaeozoic evolution. Following generally continuous Neoproterozoic - Devonian sedimentation it was subjected to a very intense Late Devonian/Early Carboniferous mostly reverse faulting and block uplift related to reactivation of the Precambrian fault zones during the Bretonian tectonic phase. These tectonic movements might have been genetically linked to widespread tectonic activity within the cratonic plate farther to the East (formation of the Prypiat and Dnipro-Donietsk Basins etc.). The Lublin sub-basin was inverted in Late Carboniferous during the Variscan tectonic movements that can be correlated with the main phase of orogenic activity within the Variscan thrust-and-fold belt located to the West. During this tectonic phase complex system of thin-skinned compressional structures formed such as triangle zones, fore- and back-thrusts, detached either above top of the basement, or at the base of the Silurian shaly complex, or within the mid-Frasnian evaporites. One of the most prominent Variscan compressional structures is the so-called Kock Fault Zone that formed above significant basement step, similarly to the so-called Mushwad structures known from the Appalachians. Formation of Bretonian and Variscan structures significantly impacted potentially gas-prone Lower Palaeozoic section.

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