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Influence of Confinement on Phase Behavior in Unconventional Gas Condensate Reservoirs

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Abstract : Poland is characterized by the presence of numerous sedimentary basins and hydrocarbon provinces. Since 2006 exploration for hydrocarbons in Poland become gradually more focus on new unconventional targets, particularly on the shale gas potential of the Upper Ordovician and Lower Silurian in the Baltic-Podlasie-Lublin Basin. The first forecast prepared by US Energy Information Administration in 2011 indicated to 5.3 Tcm of natural gas. In 2012, Polish Geological Institute presented its own forecast which estimated maximum reserves on 1.92 Tcm. The difference in the estimates was caused by problems with calculations of the initial amount of adsorbed, as well as free, gas trapped in shale rocks (GIIP - Gas Initially in Place). This value is dependent from sorption capacity, gas saturation and mutual interactions between gas, water, and rock. Determination of the reservoir type in the initial exploration phase brings essential knowledge, which has an impact on decisions related to the production. The study of porosity impact for phase envelope shift eliminates errors and improves production profitability. Confinement phenomenon affects flow characteristics, fluid properties, and phase equilibrium. The thermodynamic behavior of confined fluids in porous media is subject to the basic considerations for industrial applications such as hydrocarbons production. In particular the knowledge of the phase equilibrium and the critical properties of the contained fluid is essential for the design and optimization of such process. In pores with a small diameter (nanopores), the effect of the wall interaction with the fluid particles becomes significant and occurs in shale formations. Nano pore size is similar to the fluid particles' diameter and the area of particles which flow without interaction with pore wall is almost equal to the area where this phenomenon occurs. The molecular simulation studies have shown an effect of confinement to the pseudo critical properties. Therefore, the critical parameters pressure and temperature and the flow characteristics of hydrocarbons in terms of nano-scale are under the strong influence of fluid particles with the pore wall. It can be concluded that the impact of a single pore size is crucial when it comes to the nanoscale because there is possible the above-described effect. Nano- porosity makes it difficult to predict the flow of reservoir fluid. Research are conducted to explain the mechanisms of fluid flow in the nanopores and gas extraction from porous media by desorption.

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