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Identification and Correlation of Structural Parameters and Gas Accumulation Capacity of Shales From Poland

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Abstract : Shales are a type of fine-grained sedimentary rocks, which are composed of small grains of several to several dozen μm in size and consist of a variable mixture of clay minerals, quartz, feldspars, carbonates, sulphides, amorphous material and organic matter. The study involved an analysis of the basic physical properties of shale rocks from several research wells in Poland. The structural, sorption and seepage parameters of these rocks were determined. The total porosity of granular rock samples reached several percent, including the share of closed pores up to half a percent. The volume and distribution of pores, which are of significant importance in the context of the mechanisms of methane binding to the rock matrix and methods of stimulating its desorption and the possibility of CO_2 storage, were determined. The BET surface area of the samples ranged from a few to a dozen or so m^2/g, and the share of micropores was dominant. In order to determine the interaction of rocks with gases, the sorption capacity in relation to CO_2 and CH_4 was determined at a pressure of 0-1.4 MPa. Sorption capacities, sorption isotherms and diffusion coefficients were also determined. Studies of competitive sorption of CO_2/CH_4 on shales showed a preference for CO_2 sorption over CH_4, and the selectivity of CO_2/CH_4 sorption decreased with increasing pressure. In addition to the pore structure, the adsorption capacity of gases in shale rocks is significantly influenced by the carbon content in their organic matter. The sorbed gas can constitute from 20% to 80% of the total gas contained in the shales. With the increasing depth of shale gas occurrence, the share of free gas to sorbed gas increases, among others, due to the increase in temperature and surrounding pressure. Determining the share of free gas to sorbed gas in shale, depending on the depth of its deposition, is one of the key elements of recognizing the gas/sorption exchange processes of CO_2/CH_4, which are the basis of CO_2-ESGR technology. The main objective of the work was to identify the correlation between different forms of gas occurrence in rocks and the parameters describing the pore space of shales.

Keywords : shale, CH_4, CO_2, shale gas, CO_2 -ESGR, pores structure
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