Characterization of methane adsorption on shale and isolated kerogen under pressure up to 60 MPa

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A series of methane adsorption isotherms were measured at pore pressures up to 60 MPa and at 60 °C, 100 °C and 140 °C for dried and overmature Paleozoic shales and isolated kerogen from the Sichuan Basin. At first, the measured excess adsorption increases with increasing pressure, reaches a maximum value at pressures ranging between 8 – 18 MPa and then decreases. The rate of decrease reduces with increasing pressures from 18 to 60 MPa, which is attributed to the nonlinear increase of free methane density with pressure. Additionally, an unusual increase of excess adsorption at pressures from 48 to 60 MPa was observed. Both, the supercritical Dubinin-Radushkevich (SDR)-based and Langmuir-based excess adsorption models, represent the excess adsorption isotherms equally well. The fitted maximum absolute adsorption capacities, when based on raw data from 0 – 30 MPa, are larger by an average of 11.5 % when compared to the raw data from 0 – 60 MPa. This deviation indicates that experimentally derived gas adsorption characteristics can be biased with respect to the maximum pore pressure used in the respective experiments. The kerogen contribution to the methane adsorption capacity of studied Paleozoic shales sample under in-situ hydrostatic pressure and temperature conditions of main shale formations in the Jiaoshiba shale gas play is lower than 50%. However, this contribution should be larger under realistic geological conditions, especially as the effect of moisture will affect the methane adsorption capacity. The estimated GIP of Paleozoic shales under geological hydrostatic pressure and temperature conditions of main shale formations in the Jiaoshiba shale gas play is 5.36 – 6.64 cm3/g.

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