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Effects of pore structure on the reservoir gas capacity of Carboniferous shale from Qaidam Basin, China

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Shale adsorption and breakthrough pressure are important indicators of shale gas development and key factors in evaluating the reservoir capacities of shales. In this study, geochemical tests, pore-structure tests, methane adsorption tests, and breakthrough-pressure tests were conducted on shales from the Carboniferous Hurleg Formation in eastern Qaidam Basin. The effects of the shale compositions and pore structures on the adsorption and breakthrough pressures were studied, and the reservoir capacities of the shales were evaluated by analyzing the shale adsorptions and sealing effects. The results indicate that the organic carbon content was only one of factors in affecting the adsorption capacity of the shale samples while the effect of the clay minerals was limited. Based on the positive correlation between the adsorption capacity and specific surface area of the shale, the specific surface area of the micropores can be used as an indicator to determine the adsorption capacity of shale. The micro-fracturing of brittle minerals, such as quartz, create a primary path for shale gas breakthrough, whereas the expansion of clay minerals with water greatly increases the breakthrough pressure in the shale samples. Methane adsorption tests showed that maximum methane adsorption for shale samples Z045 and S039 WAS 0.107 and 0.09655 mmol/g, respectively. The breakthrough pressure was 39.36 MPa for sample S039, maintained for 13 days throughout the experiment; however, no breakthrough was observed in sample Z045 when subjected to an injected pressure of 40 MPa for 26 days. This indicates that sample Z045, corresponding to a depth of 846.24 m, exhibited higher adsorption capacity and a better reservoir-sealing effect than sample S039 (498.4 m depth). This study provides useful information for future studies of Qaidam Basin shale gas exploration and development and for evaluation of shale quality.