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Characterization of Microscopic Pore Structures and Its Effect on Methane Adsorption Capacity in Continental Shales

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The study of microscopic pore structures is of great significance to the assessment of gas adsorption capacity of shale reservoirs. Characterization of microscopic pore structures and its effect on methane adsorption capacity in marine shales have been investigated widely, however, there is little study on continental shales. In view of this, continental shales from the fifth member of Upper Triassic Xujiahe Formation in the western Sichuan Depression were taken as the research object, an experimental study was performed of the microscopic pore structures by use of the low-temperature nitrogen gas adsorption method. In this case study, the specific surface area, pore size distribution, pore volume, average pore diameter, etc. were all calculated; then we did the high-pressure methane adsorption analysis to obtain the parameters of Langmuir volume and Langmuir pressure. Finally, we discussed the effect of microscopic pore structure characteristics on the methane adsorption of shales. The following findings were obtained: ①the average pore diameter of shales ranges from 7.81~9.49 nm; there are mostly mesopores while some micro– and macro-pores also exist; slit-like pores are the main pore types in shales, and there are also a small amount of ink-bottle-like pores; ②the specific surface area of shales are much greater than those of conventional reservoir rocks, which is good for gas adsorption in shales; the mesopores with the pore diameter between 2 and 50 nm provide the dominating pore volume, which constitute the major space for gas adsorption and storage in shales; ③under the condition of 85℃, the Langmuir volume of methane adsorption in shales ranges from 1.21 to 4.99 m^3/t, methane adsorption capacities of different shale samples vary obviously; ④there is positive correlation between Langmuir volume and specific surface area of shales, furthermore, similar relationship between specific surface area and clay minerals content exists in shales. However, there is no correlation between specific surface area and TOC; ⑤there are positive correlations between Langmuir volume and micropores, mesopores volume, moreover, the organic matter in shales is an important control on micro– and meso-pores, shown by positive correlations between micropores, mesopores volume and TOC. However, clay minerals paly a more important role on the pore volume of micro– and meso-pores.

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