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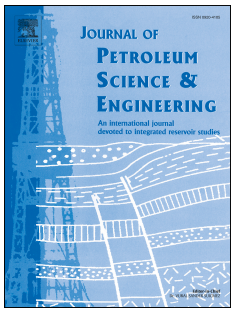

Pore structure characteristics of low- and medium-rank coals and their differential adsorption and desorption effects

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ABSTRACT

The pores and methane adsorption-desorption characteristics are different between low- and medium- rank coal. For this paper, mercury intrusion porosimetry and isothermal adsorption experiments were carried out on thirteen coal samples with $R_{o,max}$ between 0.22% and 0.98%. To evaluate the effect of the pore structure on coal permeability, we calculated the multi-scale fractal dimensions according to classic geometry models and discussed factors influencing pore fractals, including metamorphism degree, ash yield, and the content of vitrinite (huminite). Three key pressures in the stage of depressurization were calculated on the basis of Langmuir adsorption theory, and the influencing factors were discussed, including metamorphism degree, fractal dimension, and moisture content. The results show that pores of the coal can be divided into three types according to the pore diameter boundaries of 6,000nm and 100nm.The multi-scale fractal dimensions of coal pores (D_1, D_2, D_3) are in the range of 2.341 to 2.836, 2.041 to 2.476, 2.237 to 2.656, respectively. The pore fractal dimension (D_1) is controlled by the degree of metamorphism, and D_3 is mainly affected by ash yield, the content of vitrinite (huminite), and the degree of metamorphism. The adsorption of low- and medium-rank coal is a step-by-step control mode under the control of coal metamorphism, in which lignite mainly depends on the moisture content, and long-flame coal-gas coal mainly depends on the adsorption-diffusion hole (<100nm) pore structure. The lower the fractal dimension of adsorption pore, the better the adsorption. The higher the fractal dimension of the seepage pore, the better the seepage. Four desorption stages of the desorption process are subdivided according to three critical pressure points (starting pressure, transition pressure, and depletion pressure). The different critical pressure points are mainly affected by the degree of coal metamorphism, the pore structure characteristics of the primary seepage pore, and the moisture content. Larger Langmuir volume (V_L) and ratio of Langmuir constants ($1/P_L$) are beneficial to earlier advent of steady production stage, whereas it is also possible that the declining production stage may occur ahead of schedule.

Keywords: low- and medium-rank coal; fractal characteristics in different stages; adsorption and desorption difference; desorption stage