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Microscopic Pore Structure and Heterogeneity Quantitative Characterization of Shale Reservoir-Take in Chongqing Southeast Longmaxi Shale Case

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At present, shale gas exploration in China has made a significant progress, and we have established four state-level shale gas demonstration areas that include the Fuling Jiaoshi dam, Changning—Weiyuan, Zhaotong and Yanchang. Shale gas production in last year has reached 13 * 108m3, which the yield of Fuling Jiaoshi dam reached the highest 12.4 billion m3.The main storage space for Shale gas is micro nano scale pore. A huge difference of shale gas production also fully reflects the different area developed different type of pore structure in shale reservoirs and heterogeneity, which controls the shale gas content. This paper regard the marine Silurian Longmaxi group typical organic rich shale samples of Chongqing southeast in China Southern as the research objects, through the shale geochemical analysis, whole rock X-ray diffraction experiment, carbon dioxide adsorption experiments, nitrogen adsorption, high pressure mercury injection experiment, and scanning electron microscopy (SEM) experiments method, at the same time, we introduced the fractal dimension to characterize the heterogeneity of shale microscopic pore structure distribution. Based on these ways, we researched the shale reservoir characteristics, pore structure, micro pore size and distribution and characterization of heterogeneity. The results showed that ① the Longmaxi shale has a high abundance of organic matter and brittle mineral content. Bottom in Longmaxi group of Chongqing Southeast developed the deep-water shelf organic rich siliceous shale facies, the content of organic carbon is more than 2%, brittleness index, effective porosity and gas content are also high. The highcontent of organic carbon content mean the high hydrocarbon generation potential, and can cause a large number of organic pore development, and brittle index indicate high quartz, feldspar and other brittle mineral content, easy to fracture. ② The variety of microscopic pore structure type are developed in Southeast Longmaxi shale, in which the main distribution is organic pore, followed by inter-native crystal pore and primary intergranular pore, and distribution of a minimum are secondary dissolution pores and secondary intergranular pore. Longmaxi shale developed a large number of micro-nano pores, in which the quantity of organic pore is high, a good connectivity, pore size between 5~200nm, play a decisive role for the enrichment of free gas and the occurrence of adsorbed gas and seepage flow of shale gas; the second is primary intergranular pore, pore size between 0.5~2um, determines the enrichment of free gas; followed by primary intergranular pore, pore size is mostly between 0.5 ~2um, determine the enrichment of free gas; the quantity of dissolution pore and primary intergranular pore are less, has a small aperture and poor connectivity, cannot control the occurrence of shale gas; ③The microscopic pore distribution in Longmaxi shale include macro pores(> 50nm), mesoporous (2~50nm)and micro pores(<2nm). Through CO2, N2 gas adsorption isotherm experiments, high-pressure mercury injection experiment, and combined with the full aperture analysis shows that the main contribution of micro pore volume is supplied by macro pore (> 50 nm), control the free gas of shale; followed by mesoporous (2~50 nm), and while the micro hole (<2 nm) supply the least contribution of the pore volume. ④ The brittle mineral quartz content, TOC content of Longmaxi shale play a decisive role in control of the distribution of microscopic pores in the shale reservoirs. The data of N2 adsorption experiments, high pressure mercury experimental can be treated by fractal theory, and fractal dimension of reflecting the pore size distribution are obtained, combined with shale reservoir geochemical data,

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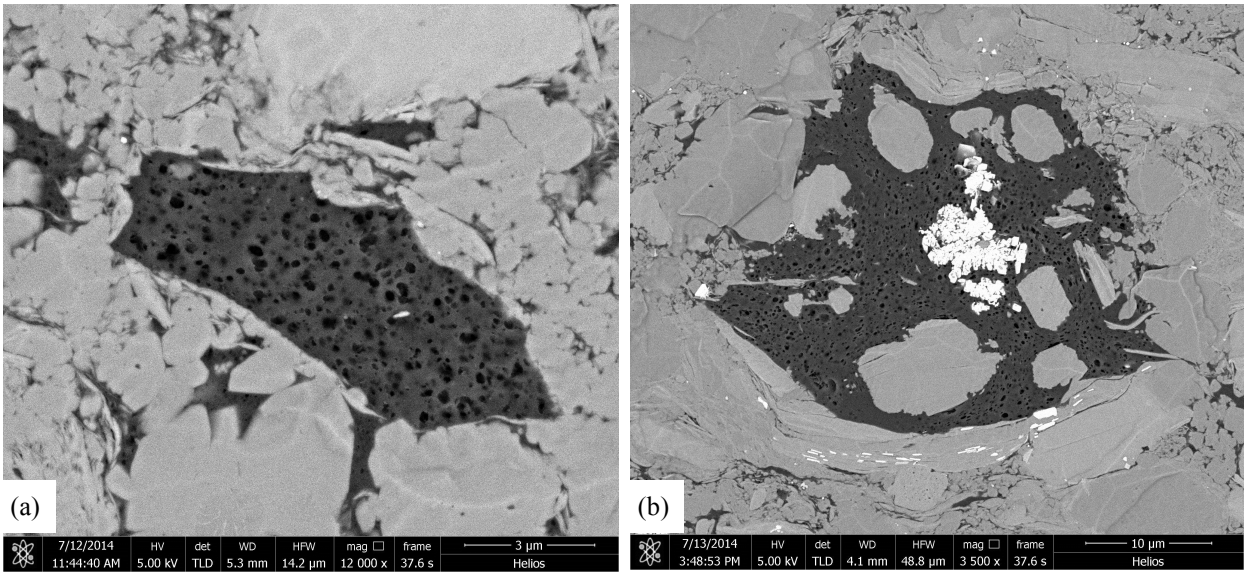

Fig. 1 Organic pore of Longmaxi shale in Chongqing Southeast (a) YC4 well 743.3m core SEM; (b) YC4 well 752.2m core SEM

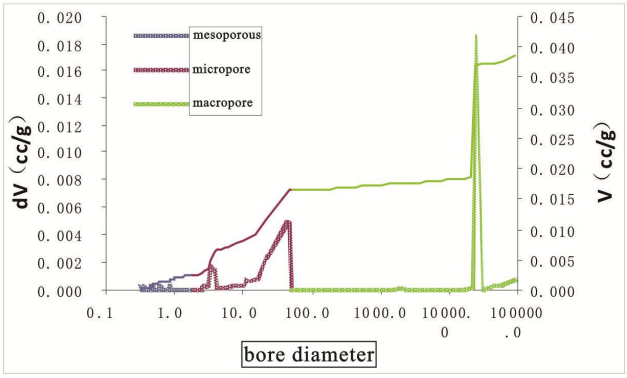

Fig. 2 Microscopic pore distribution of the full aperture in shale

concluded that brittle minerals such as quartz mainly control the macro pores (> 50 nm) development, and TOC content of the shale control the organic pore development.

Therefore, based on the Shale Characteristics analysis and adsorption experiment, scanning electron microscope (SEM), fractal theory and other means, we can accurately characterize the shale pore structure and heterogeneity characteristics and has a guiding role of shale gas resources evaluation.

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