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The Main Control Factors for Shale Gas Accumulation and Exploration Problems in Shale Gas of South China

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The shale gas exploration in China has achieved remarkable profits, and four national shale gas demonstration zones (Fuling Jiaoshiba, Changning - Weiyuan, Zhaotong, and Yanchang) have been established. Recently, nearly 400 drilling wells have been accomplished, including 143 vertical wells and 130 horizontal wells. But the shale gas production varies widely, as the main control factors of enrichment conditions and accumulation mechanism of shale gas is still not enough studied, which fundamentally restricts the shale gas exploration and development process.

In this paper, samples from the lower Silurian Longmaxi marine shale in South China were taken to investigate the main factors of shale gas accumulation. Shale pore structure characteristics, lithofacies, gas occurrence, and preservation condition were studied by using geochemical analysis, microscope image analysis, X -ray diffraction, low pressure N_2 isotherm analysis, and field emission scanning electron microscope (FE-SEM).

The results show that shale lithofacies controls the organic matter richness and brittle mineral content. Organic-rich siliceous shale, which occurred in deep shelf at the bottom of the Longmaxi formation in the study area, has a high organic carbon content, high brittleness index, high effective porosity, and high gas content. Moreover, the high organic carbon content means the high hydrocarbon potential, and the high brittleness index represents a favorable fracturing.

Multi-scale pore structure controls the shale gas occurrence and content. Mesopores (2~50nm) are well developed in organic matter, which impact the sorption and diffusion of shale gas. Macropores (>50nm) are well developed along with brittle minerals, which impact the storage and transfusion of shale gas.

Shale gas occurrence varies as geological conditions changes at the different evolution stages. Combined with burial history and hydrocarbon generation of organic matter, shale gas occurrence evolution is divided into 4 stages: early biological free gas, pyrolysis sorption gas, pyrolysis free gas, late period free gas.

Preservation condition is one of the most important control factors influencing target area optimization. Regional tectonic styles which are beneficial to shale gas accumulation are mainly wide syncline and small inclination monoclinic. The low fracture density, small erosion thickness, thick overlying strata, and low diffusion coefficient, are control the conservation of shale gas, which affect the accumulation of shale gas.

Currently, the researches of shale heterogeneity, multi-scale pore structure, target area prediction, and objective evaluation are still quite little.

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