

The Effects of Lithofacies on Oil Enrichment in Lucaogou Formation Fine-Grained Sedimentary Rocks in Santanghu Basin, China

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Abstract : For more than the past ten years, oil and gas production from marine shale such as the Barnett shale. In addition, in recent years, major breakthroughs have also been made in lacustrine shale gas exploration, such as the Yanchang Formation of the Ordos Basin in China. Lucaogou Formation shale, which is also lacustrine shale, has also yielded a high production in recent years, for wells such as M1, M6, and ML2, yielding a daily oil production of 5.6 tons, 37.4 tons and 13.56 tons, respectively. Lithologic identification and classification of reservoirs are the base and keys to oil and gas exploration. Lithology and lithofacies obviously control the distribution of oil and gas in lithological reservoirs, so it is of great significance to describe characteristics of lithology and lithofacies of reservoirs finely. Lithofacies is an intrinsic property of rock formed under certain conditions of sedimentation. Fine-grained sedimentary rocks such as shale formed under different sedimentary conditions display great particularity and distinctiveness. Hence, to our best knowledge, no constant and unified criteria and methods exist for fine-grained sedimentary rocks regarding lithofacies definition and classification. Consequently, multi-parameters and multi-disciplines are necessary. A series of qualitative descriptions and quantitative analysis were used to figure out the lithofacies characteristics and its effect on oil accumulation of Lucaogou formation fine-grained sedimentary rocks in Santanghu basin. The qualitative description includes core description, petrographic thin section observation, fluorescent thin-section observation, cathode luminescence observation and scanning electron microscope observation. The quantitative analyses include X-ray diffraction, total organic content analysis, ROCK-EVAL.II Methodology, soxhlet extraction, porosity and permeability analysis and oil saturation analysis. Three types of lithofacies were mainly well-developed in this study area, which is organic-rich massive shale lithofacies, organic-rich laminated and cloddy hybrid sedimentary lithofacies and organic-lean massive carbonate lithofacies. Organic-rich massive shale lithofacies mainly include massive shale and tuffaceous shale, of which quartz and clay minerals are the major components. Organic-rich laminated and cloddy hybrid sedimentary lithofacies contain lamina and cloddy structure. Rocks from this lithofacies chiefly consist of dolomite and quartz. Organic-lean massive carbonate lithofacies mainly contains massive bedding fine-grained carbonate rocks, of which fine-grained dolomite accounts for the main part. Organic-rich massive shale lithofacies contain the highest content of free hydrocarbon and solid organic matter. Moreover, more pores were developed in organic-rich massive shale lithofacies. Organic-lean massive carbonate lithofacies contain the lowest content solid organic matter and develop the least amount of pores. Organic-rich laminated and cloddy hybrid sedimentary lithofacies develop the largest number of cracks and fractures. To sum up, organic-rich massive shale lithofacies is the most favorable type of lithofacies. Organic-lean massive carbonate lithofacies is impossible for large scale oil accumulation.

Keywords : lithofacies classification, tuffaceous shale, oil enrichment, Lucaogou formation

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