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Enrichment Mechanism of Source & Seal Coupling Shale Gas of Upper Ordovician Wufeng Formation - Lower Silurian Longmaxi Formation in Sichuan Basin

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In recent years, the commercial exploration and development of shale gas has made important progress in Jiaoshiiba, Weiyuan and Changning districts of Sichuan Basin, which provide geological instances for understanding the enrichment mechanism of shale gas. By combining the theory of

“source-seal coupling hydrocarbon accumulation” and the development characteristics of shale gases in the upper Ordovician Wufeng Formation and lower Silurian Longmaxi Formation in Sichuan Basin, the main controlling factors for shale gas enrichment have been revealed. The “source rock controlling hydrocarbon accumulation” is mainly expressed by some basic parameters of high quality shale controlling the ability of hydrocarbon generation and reservoir (organic-matter pores, micro-cracks and bedding fissures). Those basic parameters include the thickness, distributive area and TOC values, etc., The shale of Wufeng formation and the lower part of the first member of Longmaxi formation (WF2-LM4 Graptolite segment) have features of slow deposition rate, favorable type of organic matter, high TOC values, and high hydrocarbon generation ability etc., which consist of a favorable material basis for hydrocarbon generation. Organic precursor from planktonic algae is beneficial to the generation of hydrocarbon and organic-matter pores. Moreover, the high content of total organic carbon ensures a large amount of organic-matter pores’ development, and these pores form a three-dimensional interconnected network that provides good seepage channel, as well as storage space for natural gas. The cap rock in the theory of “cap rock constraining hydrocarbon accumulation” can be divided into direct cap rock and indirect cap rock (regional cap rocks). The direct cap rock refers to the middle and upper shale of the first member of Longmaxi formation (LM5 and the above Graptolite segment) which seals the shale of Wufeng formation and the lower part of the first member of Longmaxi formation (WF2-LM4 Graptolite segment). The indirect cap rock refers to the gypsum and mudstone of the Lower-Middle Triassic which guarantee a certain amount of enclosed pressure in the systems. The enclosed pressure encouraged the effective enrichment of shale gas and the formation of high pressure gas reservoir in the lower Wufeng and Longmaxi formation (like Jiaoshiiba and Changning gas reservoir). In the area that the gypsum and mudstone of the Lower-Middle Triassic is absent, the pre-existed high pressure system was destroyed so that the shale gas with low-normal pressure conditions can be preserved, such as Pengshui and zhaotong gas reservoir, etc. Therefore, the collocation’s quantity (static match) and quality (dynamic match) of source and seal determine the location and degree of shale gas enrichment.

