JIANG Zhenxue, TANG Xianglu, LI Zhuo, JI Wenming, YANG Wei, YUAN Yuan, WANG Pengfei and XIONG Fengyang, 2015. Critical Controlling Factors of Shale Gas Enrichment and Accumulation, and Remaining Uncertainties. *Acta Geologica Sinica* (English Edition), 89(supp.): 251-252.

Critical Controlling Factors of Shale Gas Enrichment and Accumulation, and Remaining Uncertainties

JIANG Zhenxue[1,2,*], TANG Xianglu[1,2], LI Zhuo[1,2], JI Wenming[1,2], YANG Wei[1,2], YUAN Yuan[1,2], WANG Pengfei[1,2] and XIONG Fengyang[1,2]

1 Key State Laboratory of Petroleum Resources and Prospecting, China University of Petroleum (Beijing), Beijing 102249, China
2 Unconventional Gas Research Institute, China University of Petroleum (Beijing), Beijing 102249, China

Shale gas exploration have yielded remarkable achievements recently in China, and four national demonstration areas for shale gas exploration and production have been established respectively as Fuling-Jiaoshiba, Changning-Weiyuan, Zhaotong and Yanchang. During recent few years, nearly 400 wells have been drilled including 143 exploratory wells (vertical wells) and 130 evaluation wells (horizontal wells), however presenting dramatical differences in production. This implies that conditions, mechanism and critical controlling factors of shale gas enrichment are still poorly constrained, which significantly restricted further exploration and development of shale gas. On basis of geochemical analysis, observation of thin section, X-Ray Diffraction (XRD), low-pressure nitrogen adsorption analysis, scanning electron microscope (SEM) observation, desorption canister tests etc., the Lower Silurian Longmaxi Formation in southeastern Sichuan and adjacent areas are targeted in this paper to investigate shale lithofacies, micro-nano scale pore-throat structures, occurrence and preservation conditions of shale gas to reveal the critical controlling factors of shale gas enrichment and accumulation. The results show that:

(1) Abundance of organic matter and content of brittle minerals are dominantly controlled by shale lithofacies. Shale lithofacies, main component of sedimentary facies, refers to shale or a series of shale association deposited in certain sedimentary environment. Total organic carbon (TOC) content, mineral compositions and mechanical characteristics are key parameters to characterize shale lithofacies. According to TOC and mineral compositions, 12 lithofacies could be recognized and possess great distinction in abundance of organic matter, content of brittle minerals and gas capacity etc. The deep shelf deposits from the bottom of the Longmaxi Formation in Fuling area is mainly composed of organic-rich siliceous shale, and characterized by high value of total organic carbon (TOC), high brittleness index, effective porosity and gas content. The high TOC and brittleness index respectively indicate a great hydrocarbon generation potential and a high fracability, which are interpreted to be conducive to shale gas accumulation and development.

(2) Shale gas occurrence and content depends on the multi-scale pore structures. Pores developed in Longmaxi shale in Fuling area could be divided in primary pores mainly of intercrystalline and intergranular pores, and secondary pores, mainly including secondary intergranular pores, dissolved pores and organic pores. Numerous micro -nano scale pores comprise the largest group, and amongst which organic matter contributes to micropores and mesopores (<50nm) most, whose specific surface area account for over 90% of that of total pores, mainly controlling adsorption and diffusion of shale gas. While development of macropore (>50nm), accounting for over 90% of pore volume of total pores, is mainly controlled by brittle minerals such as the quartz, and plays a conclusive role in infiltration of shale gas and accumulation of free gas.

(3) Occurrence of shale gas varies with adjustment of geological conditions during the evolution process. According to burial history and hydrocarbon generation process, evolution of shale gas occurrence in Fuling and southeastern Chongqing area can be divided into four stages, respectively as biogenic free gas of an early phase, pyrolysis adsorbed gas, pyrolysis free gas and late phase free gas. Occurrence of shale gas would change with different stage. And later amplitude of tectonic uplift

* Corresponding author. E-mail: jiangzx@cup.edu.cn

determines present occurrence and gas content of shale gas, the more the uplift amplitude is, the less the free gas and total gas exists. With burial depth increasing, content of free gas in general grows. A better understanding of shale gas occurrence can provide important information for evaluation of resources potential, establishment of development scheme and estimation of productivity.

(4) Structural preservation condition is one of the most critical factors for optimization of favorable shale gas blocks. When intra basin uplifts gently, the preservation condition of intra basin is prior to that of basin margin areas. Gentle synclines and gently-dipping monocline are inferred to be the favorable regional structural styles for shale gas enrichment, accumulation and preservation, and characterized by a low density of fissure, a small thickness of erosion, a great thickness of individual bed, as well as a low diffusion coefficient. The preservation conditions are thus regarded as an important index for optimization of favorable shale-gas blocks in Southern China. However, further researches will definitely be necessary to address the shale heterogeneity and multi-scale pore-throat structures and their controlling mechanism for shale gas occurrence, the “Sweet Spot” predication, as well as the evaluation of target areas.