



Characterization of Marine Shales of the Wufeng-Longmaxi Formations, Upper Yangtze area, South China

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Abstract: With the rapid development of domestic economy and deterioration of air pollution, the demand for clean energy is dramatically increasing in China. However, national natural gas supply in China is largely relied on the import from other countries. Therefore, exploration and mass-production of new clean energy in China is urgently needed. Research on shale gas exploration and exploitation in South China, especially the research on sedimentary evolution, petrological and geochemical characteristics of Wufeng-Longmaxi formations in different localities of the upper Yangtze region, has been conducted for over 10 years (Zou, et al., 2010). However, comprehensive investigation in the whole upper Yangtze basin is lacking. To evaluate the shale gas potential of the upper Yangtze basin, we compiled all of the available geochemical and petrological data from Late Ordovician to Early Silurian mudstones/shales in the Wufeng-Longmaxi formations (Figure 1). Based on comprehensive analysis of distributional patterns of TOC values, thickness, thermal maturity and burial depth of organic-rich mudstones/shales, we selected potential areas for further shale gas exploration.

Paleogeographic reconstruction shows that the upper Yangtze basin was in a semi-confined shallow sea during the Late Ordovician (Lie et al., 2014). The water depth in the middle region of the basin was relatively deep, and became deeper

northward. Black mudstones/shales of the Wufeng Formation (Fm.) were formed in this low energy basin. This formation is relatively thin in thickness and stable in distribution. During the following period of the Late Ordovician, affected by Duyun Movement, a set of marls/limestones/siltstones were deposited as the Guanyinqiao Fm.. It varies from centimeters to tens of centimeters in thickness. During the Early Silurian, the distribution of basins and paleolands significantly changed. The Khamdian Oldland and the Qianzhong Uplift grew larger, and the sea shrank. Silty mudstone/shale and sandy siltstone of the Longmaxi Fm. was deposited during this period. Shales/mudstones in the studied area generally have a high brittle mineral proportion and acceptable porosity and permeability, representing a favorable physical condition for future exploration of shale gas. Organic-rich mudstones/shales of Wufeng-Longmaxi formations mainly appear in the upper part of the Wufeng Fm. and the lower part of the Longmaxi Fm.. The regions with high TOC values are mainly located in three areas around Luzhou and Wulong. The thickness of organic-rich shales (TOC>2.0%) varies from 138.5 to 5.1 m and gradually decreases northwards and southwards from the depocenter. The distributional patterns of TOC and organic-rich shale thickness are generally consistent with the lithofacies and paleogeographic maps of the Late Ordovician and Early Silurian epochs. Thermal

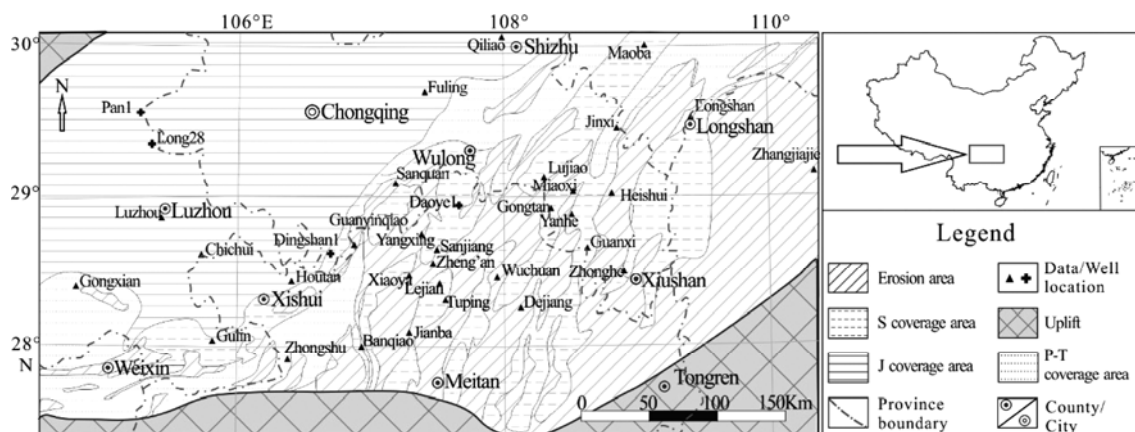


Fig. 1. Geological map of the studied area with distribution of collected samples

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evolution degree of the black mudstone/shale in the study area is generally high. Mudstones/shales in Wanxian-Daxian-Shizhu and Xishui-Luzhou are highly matured with R_o values larger than 3.0%. This implies that the organic matter in this formation has been in the dry-gas phase. The burial depth of targeted formation in most of the southeastern Sichuan Basin and southern Chongqing, and part of western Hubei are <4000 m, mostly <3000 m. In order to comprehensively evaluate shale gas resources and reservoir of Wufeng-Longmaxi formations, we have compiled TOC and R_o distributional patterns, effective thickness of organic-rich mudstones/shales, and burial depth together. Three favorable zones (I-III) for further shale gas exploration have been selected. Area I located at the western part of the study area, including a large area from Luzhou to Xishui, is about 27 850 km². Area II located at west of Chongqing, is about 6 700 km². Area III located at Wulong-Shizhu is about 8 775 km².

Key words: shale gas, Wufeng-Longmaxi formations, upper Yangtze area, paleoredox condition

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