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Organic matter and pore structure properties of Paleozoic shales in Sichuan Basin, and insights into shale gas potential

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Statement of the Problem: Marine black shales were widely developed during the Early Cambrian (Niutitang Formation), Late Ordovician (Wufeng Formation), and Early Silurian (Longmaxi Formation) periods. Discovery of the Jiaoshiba shale gas field in southeastern margin of the Sichuan Basin marks a significant progress in the shale gas exploration in the Wufeng-Longmaxi Formation and has a guiding significance for shale gas exploration in China. Compared with the Upper Ordovician-Lower Silurian shales, the Lower Cambrian Niutitang shales are more widely and stably distributed throughout southern China, and contain higher TOC with greater thermal maturity levels. Therefore, the Lower Cambrian black shales also have a promising potential of shale gas.

Methodology & Theoretical Orientation: In this study, Lower Paleozoic shale samples collected from Lower Cambrian Niutitang Formation, Upper Ordovician Wufeng Formation, and Lower Silurian Longmaxi Formation in different regions in the Sichuan Basin were analyzed using geochemical and petrophysical methods to characterize the difference in organic matter properties (including abundance, type and thermal maturity), pore development, mineralogy to shale gas resources potential.

Findings: The total porosity of the lower Paleozoic marine shales displays a roughly decreasing trend with increasing age. The Lower Cambrian shales with higher TOC have pore sizes skewed toward smaller pores and lower total pore volumes, most notably pore sizes with a distribution range of less than 50 nm, whereas in the Lower Silurian shales, the pores are almost uniformly distributed over different pore sizes (micropores, mesopores and macropores).

Conclusion & Significance: The negative relationship was observed between the total porosity and the TOC and quartz contents in the three Paleozoic marine shales suggests that re-precipitated pyrobitumen (coke) created by oil cracked to gas in overmature source rocks may have led to the lowest porosity level and minimum pore sizes in the most aged but most TOC-abundant shales.

Biography

Jincai Tuo is a Professor at Key Laboratory of Petroleum Resources Research, Chinese Academy of Sciences. His main research areas are oil & gas geology, application of organic geochemistry, and unconventional oil and gas resources. In recent years, more than 80 papers were published in domestic and international academic journals, including 25 papers cited by SCI and 16 papers cited by EI. He was awarded American Association of Petroleum Geologists (Foundation AAPG) Grants-in-Aid scholarship twice. He has made important achievements and great progress in hydrocarbon source rock evaluation, natural gas accumulation and shale oil and gas exploration.

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