Geochemical Characteristics of Ordovician Natural Gas and Its Applications in the Division of Hydrocarbon Accumulation Assemblages in Sichuan Basin

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In Sichuan Basin, more than 40 wells are drilled through Ordovician, with only 4 wells got industrial gas flow. The main producing formations are Upper Ordovician Baota Formation and Lower Ordovician Tongzi Formation. Because of the complex origins, resources and distribution of natural gas, the next exploration targets and future exploration directions are unclear. In this article, available composition analysis and carbon isotope data of natural gas samples from Ordovician producing formations are compared with natural gas from other formations of Sichuan Basin, natural gas generated from type III kerogen or type II kerogen in other basins. The results show that the gas from both Baota and Tongzi formations are genetically crude oil cracking gas. But the compositions and carbon isotopes of gas from these formations are different, showing different sources. The gas of Baota formation is from the source rocks of Upper Ordovician Wufeng Formation and Lower Silurian Longmaxi Formation. The gas of Tongzi formation is from the source rocks of Lower Cambrian Qiongzhusi Formation. Meanwhile, the above-mentioned results are combined with source-reservoir-seal assemblages studies, to serve in division and comprehensive evaluation of hydrocarbon accumulation assemblages in Ordovician. Two hydrocarbon accumulation assemblages are proposed existing in Ordovician Sichuan Basin. The lower assemblage, which is a lower-source upper-reservoir combination, should be combined with Cambrian and Sinian, serving as a member in a combination in future. The integral arrangement should be focused on the paleo-uplift and its surrounding areas, the Cambrian hydrocarbon generation center, and deep-faulted reservoir areas. The upper assemblage, which is an upper-source lower-reservoir combination, should be combined with Carboniferous and Silurian formations. The target areas are generally fracture-pore type reservoir belts with favorable tectonic backgrounds in future gas exploration in the upper assemblage.