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Hydrocarbon migration mechanism and accumulation model of ultra-deep carbonate rocks: a case from China



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The great exploration potential of ultra-deep reservoirs has been demonstrated again according to the discovery of Yuanba large gas field in Sichuan basin of China. Its hydrocarbon migration mechanism and accumulation model of ultra-deep carbonate rocks is established by the analysis of the origin of natural gases, hydrocarbon migration pathways and migrate directions in different stages. The origin of natural gases is studied based on the source-reservoir contacting relationship, the natural gas composition, carbon isotope and noble gas isotope. According to the core observation, thin section and imaging logging analysis, the types of hydrocarbon migration pathways are classified, the configurations in different periods are also discussed. The directions along which the natural gas may migrate are tracked according to natural gas composition and carbon isotope.

The results show that the natural gas in the study area is oil cracking origin, and the crude oil come from the underlying source rock of Longtan Formation in Upper Permian. The pathways of hydrocarbon migration are classified into fractured pathway, fractured-vuggy pathway and intercrystal pore pathway. The oil migrates vertically along the above three pathways under the control of relatively flat structure in Middle Jurassic, and finally leads to the oil accumulation. In Late Jurassic, the oil cracked into gas, and then under the influence of uneven structural uplift formed in Cretaceous-Neogene, the migration of natural gas began. The gas migrates towards the structural high part in free phase or water-dissolving phase along the fractured pathway and fractured-vuggy pathway. The hydrocarbon accumulation model in Yuanba large gas field is as follows. In Middle Jurassic, oils were migrated vertically and then accumulated. In Late Jurassic, oils were cracked into natural gases in situ, and then natural gases were adjusted by laterally migration in Cretaceous-Neogene.

