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Characteristics of secondary migration driving force of tight oil and its geologic effect: a case study of Jurassic in Central Sichuan Basin

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As the rising of its production, tight oil is becoming more and more important. Much research has been done about it. Some articles mention that buoyancy is ineffective for tight oil secondary migration, and abnormal pressure is the alternative. Others believe that overpressure caused hydrocarbon generation is the very force. Though opinions have been given, there are two inadequacies. Firstly, the points are lack of sufficient evidences. Mostly, they are only one or two sentences in the papers. Secondly, geologic effect of the change of driving force hasn't been discussed. In this context, analog experiments, physical property testing, mercury injection, and oil/source comparison were utilized to study 3 issues: origin and value of tight oil secondary migration resistance, values and effectiveness of different potential driving forces, and geologic effect of tight oil secondary migration driving force.

Firstly, resistance values of tight reservoir were detected by analog experiments. The value of tight limestone is 15.8MPa, while tight sandstone is 10.7MPa. Tiny size of pores and throats in tight reservoir is the main reason causing huge resistances. Over 90% of pores and throats in tight reservoir are smaller than 1μm. They form huge capillary force when oil migrating through them. Secondly, maximum of buoyancy in study area was confirmed, 0.09MPa, too small to overcome the resistances. Meanwhile, production data suggests that tight oil distribution pattern is not controlled by buoyancy. Conversely, analog experiment proves that overpressure caused by hydrocarbon generation can reach 38MPa, large enough to be the driving force. This idea is also supported by positive correlation between output and source rock formation pressure. Thirdly, is the geologic effect of tight oil secondary migration resistance and driving force. Tight oil can migrate only as non-darcy flow due to huge resistances according to percolation experiments. It needs to overcome the starting pressure gradient. As a result, it migrated a much shorter distance compared with conventional petroleum, coincident with the result of oil/source comparison. The effect of driving force is that boundary of tight oil profitable area is controlled by source rock. This boundary in the study area is the line of hydrocarbon generating strength of 40×104t/km2.

By confirming controlling factors of tight oil formation and their evaluation index, it is of great significance during tight oil exploration.