Self-generation and self-preservation of tight oil in diamictite formations and prediction of sweet spots

Bai Bin[1], Zhu Rukai[1,2], Li Tingting[1]

[1] PetroChina Exploration and Development Research Institute, Beijing 100083, China
[2] State Key Laboratory of Enhanced Oil Recovery, Beijing, 100083, China

In contrast to the near-source tight sandstone oil in the Chang 7 Member of the Ordos Basin and in the Qingshankou Formation of the Songliao Basin, the tight oil in diamictite formations is self-generated and self-preserved. Specifically, both the source rocks and the reservoir rocks are hybrid sediments of terrestrial clay, siliceous minerals and marine carbonate minerals, showing multiple types of rock minerals, frequent intercalations of lithologies, and complex microstructural characteristics, which result in relative difficulties in the source-reservoir evaluation, accumulation law, and sweet spot prediction. In this paper, the Cretaceous tight oil in the Qingxi depression of the Jiuquan Basin was discussed by using several methods to test microscopic structure of tight reservoir and based on microscopic structure of source rocks and source rock evaluation. It is clarified that the Cretaceous tight oil in the Qingxi depression represents the characteristics of self-generation and self-preservation, namely, generation in dolomitic mudstone and argillaceous dolomite, preservation in argillaceous dolomite and dolomitic siltstone. Moreover, the source-reservoir characteristics and major controlling

This abstract is too long to be accepted for publication. Please revise it so that it fits into the column on one page.

factors were identified to facilitate the prediction of tight oil sweet spots.

In the study area, there are hybrid sediments of terrestrial clastics and lacustrine carbonate minerals, involving 18 types of lithologies, such as argillaceous dolomite, dolomitic mudstone, dolomitic siltstone, silt-bearing argillaceous dolomite, and mud-bearing silty dolomite. The argillaceous dolomite and dolomitic mudstone present as the major source rocks for the maximum thickness, TOC content universally higher than 1% and the highest hydrocarbon generation potential (1.8–13 mg/g, averaging 6 mg/g). The argillaceous dolomite and dolomitic siltstone act as the main reservoir rocks, with their pore diameters in "bimodal" distribution, namely, the primary intragranular (intergranular) micro-pores (12–1080 nm) with diameter less than 1 um and the micro-fractures and dissolved secondary pores (59 nm in width – 65 nm in length) with diameter more than 1 um. The pores of argillaceous dolomite are dominated by intergranular micro-pores and micro-fractures in dolomite and feldspar, and 90% of the pore volume is contributed by micro-fractures and dissolved pores with diameter more than 2 um. The dolomitic siltstone and argillaceous dolomite show relatively high porosity (2–8%). Dolomite and quartz determine the porosity and permeability of reservoirs, and they may form micro-fractures with diameter more than 2 um; the large-diameter pores and factures correspond to higher oil saturation. The pore space of dolomitic mudstone is dominated by intragranular (intergranular) micro-pores in clay minerals and micro-pores in organic matters, of which the micro-pores with

This abstract is too long to be accepted for publication. Please revise it so that it fits into the column on one page.

diameter of 15–530 nm account for 44.26%, thus suggesting poor reservoir properties. Macroscopically, tight oil in diamictite formations is mainly generated in dolomitic mudstone and argillaceous dolomite and preserved in dolomitic siltstone and argillaceous dolomite. Microscopically, the source rocks and reservoir rocks contain organic matter laminae, clay laminae, and carbonate laminae; the hydrocarbon generation potential in local laminae reaches 25.72–6.53 mg/g. The tight oil is generated in organic matter laminae and then migrates along carbonate laminae, clay laminae, silica laminae and factures to non-organic matter layers in the same formation or adjacent rocks. Oil has been found in pores/fractures with different diameters, especially the large pores comprising intergranular micro-pores in dolomite and feldspar and micro-fractures.

According to the evaluation of source-reservoir characteristics, the reservoir is characterized by large facture, small pore and thin throat, and its physical properties are jointly controlled by the mineral composition and microstructure. Furthermore, the systematic organic geochemical and mineral X-diffraction analysis of 460 cores (cutting) taken through standard drilling, together with planar well logging prediction, indicates that the porosity and permeability are above 2% and 0.01 mD respectively. The study area is adjacent to the fault belt, with TOC >1%. The tight oil sweet spots are supposed locating in the center of lacustrine basin and near the eastern provenance, with an area of about 17.6 km^2.