Paper Number: 2196

Analysis on charging process of lacustrine tight oil in Ordos Basin, China: Evidence from fluid inclusions

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Tight oil has become a hotspot in the field of petroleum exploration and development. However, previous studies have predominantly focused on the tight oil in marine basins and barely in lacustrine basins. In China, tight oil is mainly distributed in the lacustrine basins. Triassic Yanchang Formation of Ordos Basin, as the typical lacustrine tight oil in China, has advantageous tight oil accumulation conditions, proved that it has good exploration potential in the production practice.

Fluid inclusions, entrapped in the minerals with the diagenetic process in the evolution of sedimentary basins, recorded the geological and geochemical information of diagenetic environments. They are the assertive evidence of hydrocarbon charging episodes and times, fluid charging temperature and pressure, and hydrocarbon charging intensity.

In this study, on the basis of sufficient collection and application of geological data in the study area, we collect core samples, conduct geochemical experiments and analyze the data, combining with the methods of physics, organic geochemistry and accumulation dynamics. The characters of petrography, micro-beam fluorescence spectra, micro-thermometry, and paleo-pressure simulation of fluid inclusion have been analyzed in detail. Then the charging episodes, times and power of lacustrine tight oil have been ascertained. The conclusions are as follows.

1)The characters of micro-thermometry show five episodes of brine inclusions and two episodes of hydrocarbon inclusions have been developed in the tight reservoir beds of Yanchang Formation. The 4^{th} and the 5^{th} episodes of brine inclusions were developed with the 1^{st} and the 2^{nd} episodes of oil inclusions, respectively.

2)Petrographic characters show that hydrocarbon inclusions were developed in the fractures across the quartz grains and in the fractures of the quartz grains. The inclusions have the yellow-green and blue-green fluorescence, which represents a relative low-maturity oil charging and a relative high-maturity oil charging respectively.

3)The peak wavelength of micro-beam fluorescence spectra has two peaks (500 nm and 540 nm). The inclusions with peak wavelength of 500 nm have the yellow-green fluorescence and the value of Q_{F535} is 0.8-1.2. The inclusions with peak wavelength of 540 nm have the blue-green fluorescence and the value of Q_{F535} is 1.2-1.6.

4)Two episodes of oil charging (128-122 Ma and 114-106 Ma) developed in the tight reservoir beds, which were the same with the main generation (expulsion) times of source rocks approximately. Pressure difference between source rocks and reservoir beds, calculated by the paleo-pressure simulation, provided the main expulsion and charging power for crude oil in the main

charging period. It was the power guarantee of non-buoyancy migration and accumulation of lacustrine tight oil.