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Oil filling history of the Bashituo Oilfield in the Markit Slope, SW Tarim Basin, China

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Abstract: The Markit Slope is an important area for the petroleum exploration in the Tarim Basin. Elucidation of the oil filling history of discovered oilfields has great significance for recognizing the accumulation processes of the whole region. Using molecular geochemistry, fluid inclusion techniques and basin modeling, we studied the oil filling process of the Bashituo Oilfield that is located in the west of the Markit Slope. The molecular migration indexes, such as the methyldibenzothiophene ratio (4-/1-MDBT), trimethylnaphthalene ratio (TMNr) and pyrrolic nitrogen compounds content, decrease from west to east, indicating that the charging direction and migration pathways are from west to east. Lithological analysis and homogenization temperatures of saline fluid inclusions accompanied with oil fluid inclusions suggest that two charging periods occurred in the Devonian oil reservoir. Combining the burial history and heating history of well BT4, Basinmod 1D software modeling shows the two oil filling periods are from 290 Ma to 285 Ma and from 10 Ma to 4 Ma, respectively, and later oil filling dominates. This study may be helpful to understand the accumulation process and provide useful references for oil and gas exploration in the Markit Slope.

Key words: Oil migration direction, filling time, fluid inclusion, basin modeling, Tarim Basin

1 Introduction

Petroleum charging direction and accumulation period have been of great importance in petroleum accumulation studies in the North Sea Oilfield of Europe and Tahe Oilfield of the Tarim Basin in China (Larter et al, 1996; Li et al, 1994; 2000; Wang et al, 2008). Identification of charging direction mainly relies on molecular geochemistry and the principals are easily understood. One depends on the increasing maturity of source rocks, and the other is the differentiation between organic molecules on mineral surfaces during migration. Preconditions and limitation in the application of traditional methods include entrapment formation, main generation and expulsion period in source rocks, reservoir saturation pressure, oil-water interface tracing and event geology. A preferable way of interpreting and defining the accumulation period is combining fluid inclusions and single-well modeling.

National key scientific and technological projects have estimated the total petroleum resources of the Markit Slope to be between 38×10^8 t and 44×10^8 t while some experts suggest the resources could even be 67×10^8 t in the Southwest Depression of the Tarim Basin (Liu and Yuan, 2002). A number of scholars and oil companies have ranked the Markit Slope as the most prospective petroleum exploration plays in the Southwest Depression for multiple source layers and oil shows (Cui et al, 2012). However, only a few petroleum reservoirs have been discovered, including the Bashituo Oilfield and Hetian River Gasfield. The Paleozoic strata of the Markit Slope are deposited on a passive continental margin, but are quite different from other passive continental margin basins which have great petroleum resources, such as the North Sea Basin and the Mexico Basin (Dong and Xiao, 1998; Zhou et al, 2006). Multiple production layers, and diverse oil and gas occurrences make it quite complex to reconstruct the oil filling history and determine exploration targets. Studies of charging directions can only be seen in wells Qun4 and Qun5, and accumulation period study has also been questioned because of geothermal information constraints and few fluid inclusions measuring spots (Zhao and Zhang, 2007; Liu, 1997).

Our previous works show that oils from the Markit Slope can be divided into two oil families by molecular geochemistry and isotopic value. The oils from the Bashituo Oilfield are the same oil family, except for the oil from well Qu 1 (Cui et al, 2011). This paper focuses on the oil filling by molecular tracing research. Besides, combining

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