APPLICATIONS OF LIGHT HYDROCARBONS IN MIXED OIL STUDIES: AN EXAMPLE FROM TARIM BASIN, CHINA

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Introduction

Light hydrocarbons (LHs) are the principal ingredient of crude oils and contain much geochemical information. Their compositional characteristics can be utilized in petroleum geochemistry studies, especially with respect to the mixing of oils.

Bashituo Oilfield is located in the Southwest Depression of Tarim Basin, where five potential source beds are deposited (the Cambrian-Ordovician marine rocks, the Carboniferous-Permian marine-terrestrial-alternating clastics, the Lower-Middle Jurassic terrestrial coal-bearing clastics, the Upper Cretaceous-Paleogene and the Neogene marine sediments). The produced oils accumulated mainly in the Devonian and Carboniferous reservoirs. Although significant amount petroleum has been discovered and many research works have been done, the origin of Bashituo oils remains to be confirmed.

Results

The Bashituo oils from the Devonian and Carboniferous reservoirs share similar biomarker compositions, indicating a same source origin. Many geochemical characteristics, such as relatively high abundance of C_{21}-C_{22} pregnanes, C_{27} sterane and tricyclic terpanes, and high ratios of dibenzothiophene/phenanthrene, C_{29}/C_{30} hopane, C_{31} R/C_{30} hopane and C_{26}/C_{25} tricyclic terpane, support a marine source rock. Geochemical evidence, as well as light carbon isotopes, suggests that the Bashituo oils are mainly sourced from the Cambrian-Ordovician marine rock.

However, the Bashituo oils from different reservoirs have distinct LHs compositions. As shown in Figure 1a, the oils from Carboniferous reservoir are characterized by more abundant cycloalkanes relative to those from Devonian reservoir. The relative contents of cycloalkanes in oils strongly reflect source rock lithology, which is also reflected in the active catalysts complements of asphaltenes and kerogens (Chung et al., 1998; Thompson, 2006). Oils from marine sources have been found to contain the lowest amounts of these compounds, while those bearing terrestrial organic matter contain the highest. The relatively high content of cycloalkanes in the oils from Carboniferous reservoir probably indicates a terrestrial organic matter input. The Bashituo oils have also been plotted on a similar diagram of C_7 series (Fig. 1b, after Dai, 1992). The abundant $MCyC_6$ in the Carboniferous oils also support a terrestrial organic matter input. The contents of cycloalkanes and $MCyC_6$ in the Qu1, Qu3 and Q002 oils are the highest, suggesting a high proportion of terrestrial organic matter contribution. Additionally, in the three oil samples, typical biomarker compositions of terrestrial organic matter have also been detected, such as high abundance of C_{24} tetracyclic terpanes and β-carotane. β-carotane is assumed to be associated with highly anoxic restricted setting (Jiang and Fowler, 1986; Irwin and Meyer, 1990), which is consistent with the depositional condition of the Carboniferous-Permian rocks (mixed of terrestrial and marine organic matter).

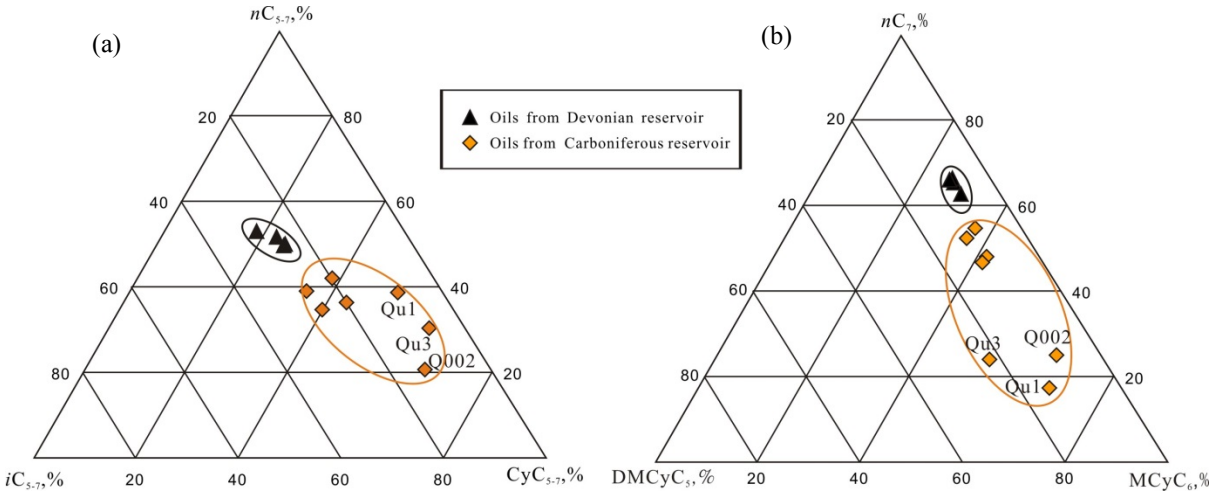

Figure 1 *Ternary diagrams of C_5-C_7 light hydrocarbon composition (a) and C_7 series (b, after Dai, 1992). nC_{5-7}, C_5-C_7 n-alkanes; iC_{5-7}, C_5-C_7 isoalkanes; CyC_{5-7}, C_5-C_7 cycloalkanes; nC_7, n-heptane; $DMCyC_5$, dimethylcyclopentane; $MCyC_6$, methylcyclohexane.*

Conclusions

In general, the Bashituo oils are mainly sourced from the Cambrian-Ordovician marine source rocks. While, the Carboniferous-Permian rocks with mixed terrestrial and marine organic matter also contribute to the oils from Carboniferous reservoir.

In Bashituo oils, biomarker information derived from marine organic matter have covered up those originated from terrestrial organic matter. However, most of the LHs in the early charged marine oils have lost and the residual LHs should mainly come from the late charged oils. Therefore, LHs compositions can reflect the geochemical information of late charged oils. Generally, LHs are of particular significance for researching those mixed source oils with light and heavy compositions which are possibly generated from different source rocks.

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