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Analysis on Geochemical Characteristics of Hydrocarbon and Classification of Oil Groups in the Tazhong area, Tarim Basin, China

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Giant Ordovician condensate fields discovered in the Tazhong area, Tarim basin, western China, provide a rare opportunity to characterize the deeply buried(4500-6800m) condensate petroleum systems and explore their accumulating processes in the superimposed basin. Multi-stage tectonic movements of the Tarim basin greatly controlled burial and hydrocarbon generation history, resulting in multi-stage charging and secondary alteration of oil and gas in the Tazhong area (refs), where a variety of petroleum phases coexisted and geochemical properties varied a lot. The complex interaction between phases and hydrocarbon properties makes identifications of petroleum systems and restorations of their accumulating history difficult. Specifically, as a key to understand how condensate gas accumulated and reformed in such complex petroleum systems, analyzing multiple geochemical characteristics of oil and gas and classifying oil groups in the Tazhong area is absolutely very important.

A total of 135 crude oil samples and 106 gas samples from upper and lower Ordovician reservoirs (namely Lianglitage Formation and Yingshan Formation, respectively) were analyzed on their light ended and n-alkanes compounds, molecular biomarkers, stable carbon isotopes. Three groups of oil and gases can be classified on the basis of isotopic compositions, biomarkers, light hydrocarbon and n-alkanes contents of the oils, methane and ethane carbon isotope ratios, and dry coefficient of the gases. (1) Group 1 oil and gas is mainly distributed in the black oil reservoirs across the western Tazhong area, with the characteristics of C27dia/C27reg <0.8, Ts/(Ts+Tm) <0.68, low abundances of dinosterane, triaromatic dinosteroids and gammacerane, iC7index: 2.7~3.7, gas dry efficient<0.9, δ13Coils<-31.5‰, δ13Cmethane<-45‰, δ13C2-C1>11‰;(2) Group 2 oil and gas is mainly distributed in the condensate reservoirs across the western Tazhong area, with the characteristics of C27dia/C27reg >0.8, Ts/(Ts+Tm)>0.68, low abundances of aromatic biomarkers, iC7index: 2.9~4.5, gas dry efficient: 0.9~0.95, δ13Coils>-31‰, δ13Cmethane>-45‰, δ13C2-C1<11‰; (3)Group 3 oil and gas is mainly distributed in the condensate reservoirs across the eastern Tazhong area, with the features of C27dia/C27reg <0.7,Ts/(Ts+Tm)<0.55, low abundances of dinosterane, triaromatic dinosteroids and gammacerane, iC7index: 2.2~3.0, gas dry efficient>0.95, δ13Coils<-31.5‰, δ13Cmethane>-42‰, δ13C2-C1<10‰. It shows that Group 1 and Group 3 oils have relatively lower maturity than Group2. And also, it could be inferred from the biomarkers that Group 1 and Group 3 oils show more affinitive relations other than Group 2. On the other hand, the geochemical features of gases indicate that Group 2 and Group 3 gases have relatively higher maturity than Group 1, implies they have different sources or experienced different evolutionary history. The location of the three oil and gas groups is correlated with the regional tectonic settings as the three regions were bounded by two regional scale NE-SW direction strike-slip faults. It could be inferred that the three oil groups representing the products from different petroleum systems experienced different accumulating processes.

Key words: Geochemical characteristics, oil groups, strike-slip faults, Tazhong area, Tarim basin

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