GEOCHEMICAL CHARACTERISTICS OF UPPER TRIASSIC TERRESTRIAL SHALE GAS IN WESTERN SICHUAN DEPRESSION, CHINA

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Introduction

Western Sichuan Depression, located in the west of Sichuan Basin of China, is an area rich in continental shale gas. It should be noted that the the fifth member of Xujiahe Formation of Upper Triassic (T_3x^5) has a great amount of potential resources, and the total shale gas resources range from 8.4 to 33.5 Tcf. However, most researchers have mainly focused on marine shale, and studies on continental shales are very weak.

In this study, based on the characteristics of molecular composition, light hydrocarbon, heavy hydrocarbon and carbon isotope, we analysed the geochemical characteristics and genetic types of continental shale gas in T_3X^5 member for the first time. This research is of great significance to the effective understanding of the exploration and development of continental shale in Sichuan basin, and is also useful to expand the areas of exploration and development.

Results

Molecular composition shows that all natural gas in the desorption experiments is dominated by hydrocarbon gas, accounting for 85–99% in volume. Of this amount, the methane content comprises 73–98%, ethane approximately 1.2–9.9%, and propane about 2%. Non-hydrocarbon gases are mainly nitrogen and carbon dioxide, with no hydrogen sulfide. The dryness coefficient is less than 0.8, which categorizes as wet gas.

The $\delta^{13}C_1$ values of gases are in the range of −44.4‰ to −27.1‰ (average −35.7‰), $\delta^{13}C_2$ values range from −28.0‰ to −22.9‰ (average −25.4‰), while $\delta^{13}C_3$ values range from −24.9‰ to −21.6‰ (average −22.6‰); this represents a positive carbon isotopic series of alkanes ($\delta^{13}C_1<\delta^{13}C_2<\delta^{13}C_3$) typical of organic origin.

Conclusions

Carbon isotopes can be used in combination with molecular composition to provide information about the gas origin. In the Bernard diagram, all data points fall in the zone of a thermogenic gas outline, which is close to that of type III kerogen thermogenic gas (Fig. 1a). Additionally, as shown in Fig. 1b, all data points fall in the area of coal-derived gas, which together suggests that gas from the T_3x^5 member is mainly pyrolysis coal-derived gas.

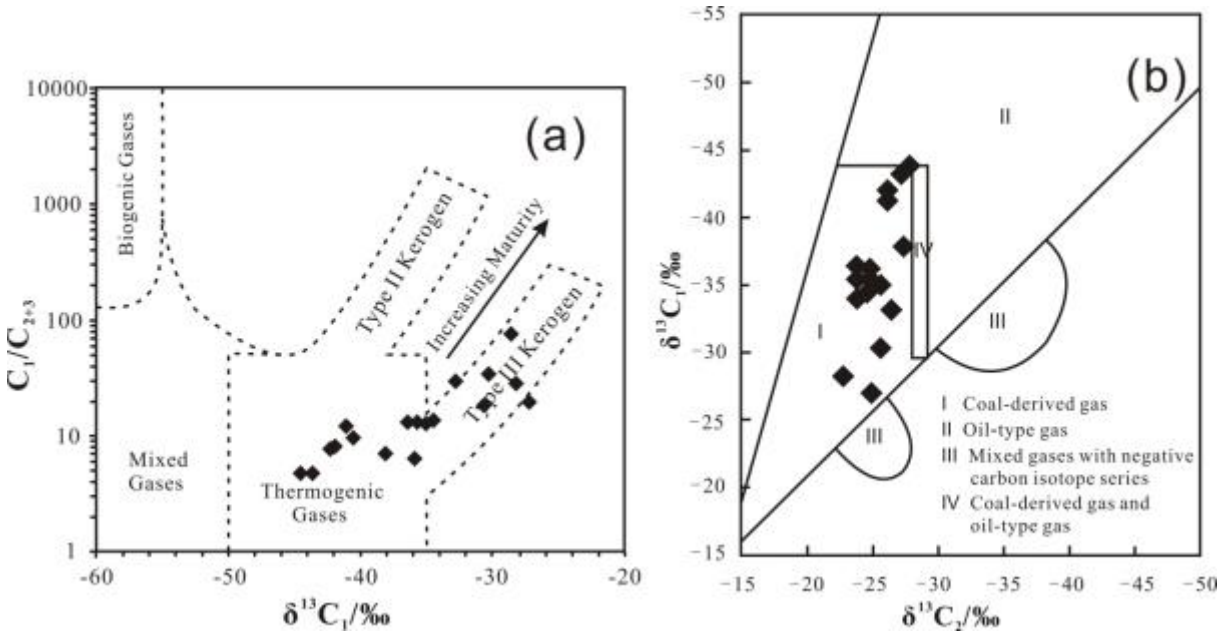

Figure 1a. *Plot of genetic types of natural gas (After Whiticar, 1999)* ***b.*** *Relationship of $\delta^{13}C_1$ and $\delta^{13}C_2$ of natural gas (modified after Dai et al., 2014).*

References

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