Vol. 91 No. 1 pp. 373–374 ACTA GEOLOGICA SINICA (English Edition) Feb. 2017

Research Advances

Thermal Effects on Composition of Rearranged Hopanes in Hydrocarbon Source Rocks

ZHANG Min[1, 2, *], CHEN Julin[1, 2] and JIANG Lian[1, 2]

1 *Key Laboratory of Exploration Technology for Oil & Gas Research, Yangtze University, Ministry of Education, Wuhan 430100, Hubei, China*

2 *College of Resources and Environment, Wuhan 430100, Hubei, China*

Objective

The distribution characteristics and formation mechanism of rearranged hopanes in hydrocarbon source rocks are affected by various geological conditions. Among these geological conditions, thermal action has an important influence on the formation of rearranged hopanes, which has been however little documented previously. Taken the lacustrine source rocks in the Songliao Basin and coal source rocks in the Ordos Basin as examples, this work investigated the geochemical characteristics of rearranged hopanes under different sedimentary environments and biological sources and their relationship with thermal maturity. In addition, we studied the variation regularity of absolute concentration of diahopanes and their relative ratios with the increasing thermal evolution degree, in order to provide theoretical basis for the genesis of rearranged hopanes.

Methods

In order to study thermal effects on distribution characteristics of rearranged hopanes in source rocks under different sedimentary environments, a total of 87 hydrocaron source rocks with a wide range of vitrinite reflectance (R_o of 0.4%–1.8%) were collected from the Songliao and Ordos basins to analyze their macroscopic composition and molecular geochemical features. Based on qualitative and quantitative analysis of diahopanes in hydrocarbon source rocks, the change rules of absolute concentration of rearranged hopanes and maturity parameters (such as methylphenanthrene ratio) with the increase of R_o were reported comprehensively.

Results

Rearranged hopanes are found in both hydrocarbon source rocks with low abundance (C_{30} diahopane/C_{30} hopane < 0.2) and hydrocarbon source rocks with abnormal high abundance (C_{30} diahopane/C_{30} hopane > 1.0). As absolute concentration of molecular compounds is controlled by biological sources and maturity, absolute concentration of diahopanes in hydrocarbon source rocks in the Songliao Basin and Ordos Basin varies similarly. As shown in Fig.1a, the change rules of absolute concentration of rearranged hopanes are the same with each other, namely, the absolute concentration of diahopane reached its maximum in immature–low mature stage. With the increasing thermal maturity, the absolute concentration of diahopane in source rocks from both basins decreased greatly; it decreased from 3.0 μg/mg saturated hydrocarbon to 0.05 μg/mg saturated hydrocarbon for the lacustrine source rocks in the Songliao Basin, and decreased from 4.8 μg/mg saturated hydrocarbon to 0.08 μg/mg saturated hydrocarbon for the coal source rocks in the Ordos Basin. Our study shows that the variation of rearranged hopanes according to R_o or dibenzothiophene ratios (such as MDB and DMDB) is a normal distribution. Moreover, the data points of rearranged hopanes and methylphenanthrene index (MPI_1 and MPI_2) or methylphenanthrene ratio (F1 and F2) are normally distributed. It means that the relative abundance of diahopanes booms at its peak of oil generation (corresponding to 0.8%–0.9% R_o) and then gradually deceases (Figs. 1b and 1c).

Conclusions

(1) The absolute concentration of rearranged hopanes in hydrocarbon source rocks peaks before oil-generating window (R_o<0.8%) and subsequently decreases. Their relative abundances increase and reach the peak at R_o=0.8%–0.9% from immature stage to mature stage. However, a reversal occurs in mature–high mature stage, and the concentration of rearranged hopanes decreases.

(2) Compared with sedimentary environment and

* Corresponding author. E-mail: zmjpu@163.com

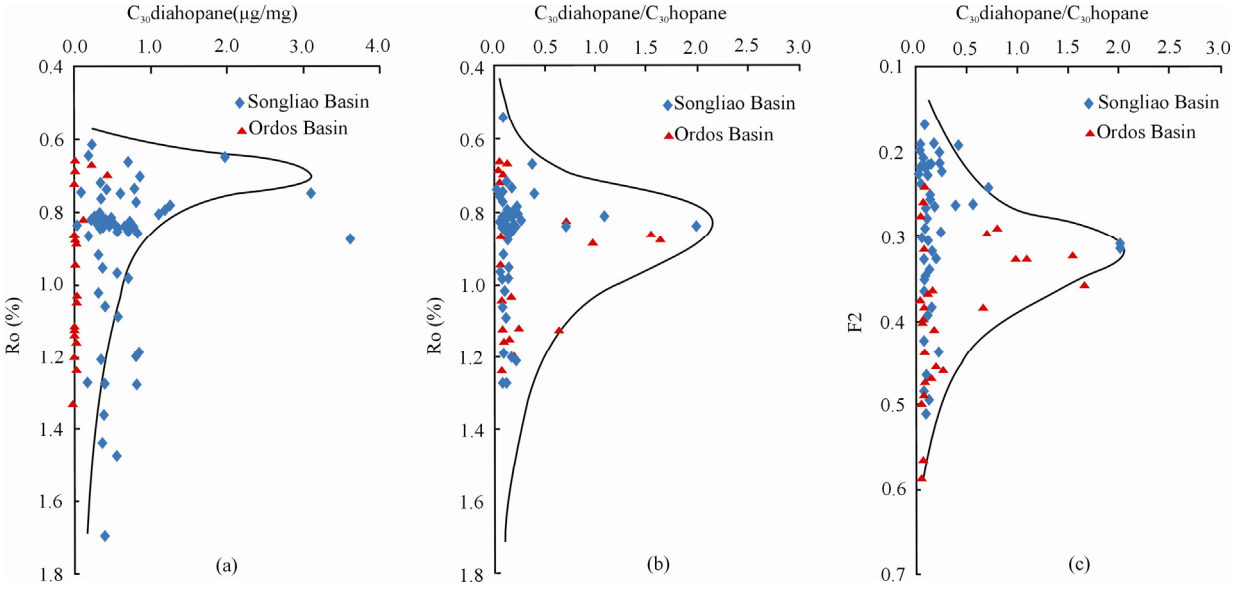

Fig. 1. Relationships of absolute concentration and relative ratio of rearranged hopanes and maturity parameters.

biological source, thermal action has a more important impact on distribution and composition of rearranged hopanes in hydrocarbon source rocks. That is to say, thermal action is one of the dominated controlling factors of the origin of rearranged hopanes.

Acknowledgments

This research was supported by the National Natural Science Foundation of China (grant No. 41272170) and the National Oil and Gas Major Project (grant No. 2016ZX05007-001).