

THE CHARACTER AND ORIGIN OF ABNORMAL HEAVY CARBON ISOTOPE COMPOSITION IN SEDIMENTARY ORGANIC MATTER

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Introduction

Sedimentary organic matter with high total organic carbon (TOC), high hydrogen index (HI) and heavy carbon isotope composition has been found from Shahejie formation in Qikou sag and Dongpu sag, Bohai Basin, east China. Their kerogen types are type I and II, with the TOC ranges from 1 to 7wt.%. The heaviest carbon isotope composition can reach -22.1‰, which is much heavier than the adjacent coal-bearing strata. This is different from the geochemistry regular pattern that the sapropel-type kerogen is usually rich in light carbon isotopes, generally less than -26‰ in China (Galimov, et al., 1985; Jinxing Dai, et al., 2000).

Results

Based on the analysis of organic petrology and geochemistry, some factors that lead to the abnormal enrichment of heavy carbon isotopes in lacustrine sediments are discussed. Qikou sag is a typical freshwater lake in the middle of Bohai bay basin. In this area, the carbon isotope composition of sedimentary organic matter ranges from -28.6‰ to -21.1‰, being heavier as the increase of TOC. Abundant laminae algal can be found under microscope. Dongpu sag is a typical salt lake in the southwest of the Bohai bay basin. Samples with both heavy isotope composition ($\delta^{13}\text{C}_{\text{org}}=-22.0\text{‰}$) and light carbon isotope composition ($\delta^{13}\text{C}_{\text{org}}=-29.5\text{‰}$) have been found when TOC is high (TOC>3wt.%). So there is no obvious correlation between the carbon isotope composition and TOC. However, in this place, with the increase of Sr/Ba value, heavy carbon isotopes are enriched relatively. According to the GC-MS analyse, aryl-isoprenoids was detected in the samples with high gammacerane content, which probably represents the presence of green sulphur bacteria.

Conclusions

Combining with experimental results and modern lake research, it is believed that when the rate of CO₂ dissolved in lake water is insufficient to meet the biological photosynthesis, organisms will consume more HCO_3^- which enriches heavy carbon isotopes. As a result, the higher the productivity is, the heavier the carbon isotopes composition will be. However, this phenomenon is subject to the extent of nutrients abundance in water, and eutrophication of water is the basis of algae flourishing. When the rate of CO₂ dissolved in lake water is enough to meet the biological photosynthesis, the environment of sedimentary water has obvious control effect on carbon isotope composition of sedimentary organic matter. Hot-dry climate and shallow water may lead to heavy carbon isotope composition, while humid climate and deep water may lead to light carbon isotope composition. For the saline lake, the large number of green sulphur bacteria in the stratified water interface may also lead to the heavy carbon isotope composition of the sedentary organic matter.

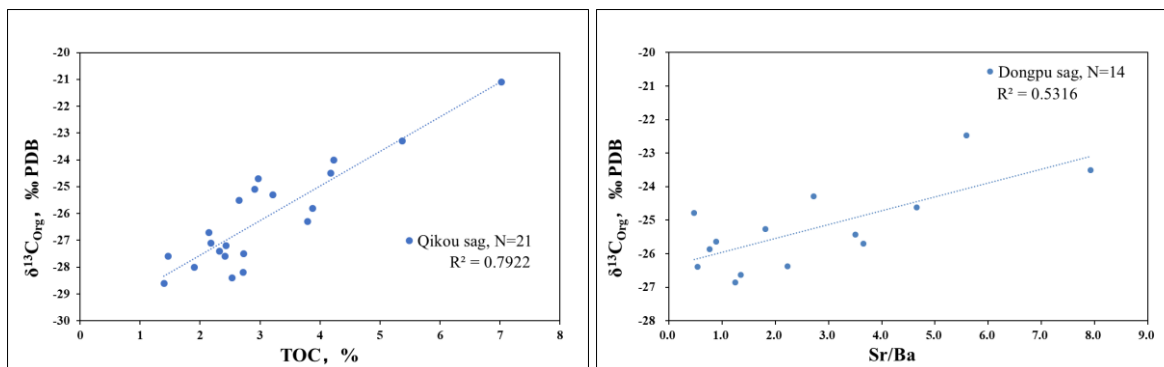


Figure 1 Factors affecting carbon isotope composition of sedimentary organic matter in Qikou sag and Dongpu sag

Reference

- Galimov, Mikhailovich E. 1985. The Biological Fractionation of Isotopes[M]. Academic Press.
- Jinxing Dai, Xigu Pei, Houfa Qi. 2000. Selected works of natural gas geology and geochemistry (Vol.2) [C]. Petroleum Industry Press. (in Chinese).