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Response of nitrogen isotopes in different fractions of marine crude oil to hydrocarbon-generating organisms and paleoenvironment in Tarim Basin, NW China

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Nitrogen isotope ($\delta^{15}N$) are routinely used for sedimentary rocks to reconstruct paleoenvironment and N-biogeochemical cycle. However, the studies on the $\delta^{15}N$ characteristics of nitrogen-containing components in crude oil are still limited. In this paper, we document the $\delta^{15}N$ data of Paleozoic marine crude oil from Tarim Basin, NW China, and analyse the difference of $\delta^{15}N$ values in the nitrogen-containing components (i.e., nonhydrocarbons and asphaltenes) in marine crude oil from Bashituo (BST) area and Halahatang (HLHT) area. The results show that the $\delta^{15}N$ values of asphaltenes ($\delta^{15}N_{Asp}$) are invariably higher than those of nonhydrocarbons ($\delta^{15}N_{NSOs}$), which caused by the effects of organic matter thermal evolution and isotopic fractionation. The hydrocarbon-forming organisms of BST oils are dominated by benthic algae, and the proportion of planktonic algae in the hydrocarbon-forming organisms of HLHT oils is significantly higher than that of BST oils. The $\delta^{15}N_{Asp}$ values can record more information about hydrocarbon-forming organisms than $\delta^{15}N_{NSOs}$, which is due to the fact that the more nitrogen of hydrocarbon-forming organisms is remained in asphaltenes during the thermal evolution. The parent material of BST oils is deposited under the strong anoxic environment, while the oxygen content in the water column during the parent material deposition of HLHT oils is higher than that of BST oils. The $\delta^{15}N_{Asp}$-$\delta^{15}N_{NSOs}$ values have a significant positive correlation with the oxygen content of water column. Accordingly, the $\delta^{15}N$ values of nitrogen-containing components in crude oil can be used as a reliable indicator for determining hydrocarbon-forming parent material and paleoenvironment.