

The influences of mantle-derived fluids on biomarkers in the Dongying Sag, Eastern China

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Abstract

A large number of mantle-derived fluid activities occurred in the Dongying Sag. On the basis of the studies on the geochemical characteristics of these fluids in this sag, the spatial distribution of biomarkers in petroleum and their relationships with the parameters of mantle-derived fluids were studied, to reveal the influence of mantle-derived fluids on the biomarkers and to evaluate the reliability of these biomarkers when applied to oil-source correlation and maturity analysis.

Through crude oil testing, plenty of data is analyzed here to discuss the evolution of biomarkers which have been affected by mantle derived fluids.

Most biomarkers used in oil correlation kept the characteristics of their sources during burial thermal evolution. Even some of them were not influenced by mantle derived fluids, such as the relative content of C₂₇-C₂₉ steroid ($\alpha\alpha\alpha 20R$) and C₂₁/C₂₃ tricyclic terpane. However, Pr/Ph and C₃₅/C₃₄ hopanes were sensitive to both heat energy and material input by the mantle-derived fluids. γ -waxane/C₃₀ hopanes and C₂₄ tetracyclic terpanes / C₂₆ tricyclic terpanes responded only to thermal influence by mantle-derived fluids. They did not chemically react with the mantle-derived fluids. Fluorene series compounds reacted with hydrogen and / or carbon dioxide from the mantle.

On the other hand, mantle-derived fluids affected most maturity indexes. The huge thermal energy with mantle-derived fluids weakened the relationship between the maturity parameters and depth. Among them, pregnane/C₂₇₋₂₉ steroid and Ts/(Ts+Tm) were more sensitive to the heat of the fluids. $\alpha\alpha\alpha 20S/(20S+20R)$ took the second place. But $\alpha\beta\beta/(\alpha\alpha\alpha+\alpha\beta\beta)$ and 22S/(22S+22R) were not thermally influenced by the mantle-derived fluid. Besides, the substance of mantle-derived fluids reacted with fragrances, hopanes or moretanoids and thus altered the values of MPI₁, MPI₂, MPR, C₃₀ hopanes/(C₃₀ hopanes + moretanoids) and alkyl-dibenzothiophene/dibenzothiophene. The thermal alteration of phenanthrene series and their spatial distribution show that the heat energy carried by mantle-derived fluids was not fierce but spread widely in Dongying Sag, which is favorable to hydrocarbon generation with little

destroy.

In sum, mantle-derived fluids affected biomarkers through thermal energy and chemical reactions and changed the values of oil-source correlation and maturity parameters in the deep-seated fault belts. Therefore, in the deep-seated fault belts, oil-source correlation should be restudied and the new parameters need to be explored.