

THE LAKE EVOLUTION AND THE MOLECULAR FOSSILS IN PALEOGENE SHAHEJIE FORMATION OF DONGYING DEPRESSION, BOHAI BAY BASIN, CHINA

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The Dongying Depression is a Mesozoic and Cenozoic terrestrial rift basin in the east of China. During Eocene to early Oligocene of Shahejie Formation deposition, Dongying Lake experienced successively from playa, saline, brackish to fresh lake (Liu et al., 2004; Zhang et al., 2005). In this article, molecular fossils and elemental characteristics with related to the sedimentary environments, are studied under framework of sequence stratigraphy. It provides detailed molecular data for petroleum geologists to map oil source rocks and consider the petroleum systems in this basin.

Based on sedimentology, element geochemistry and organic geochemistry study, the lake evolution of Shahejie Formation can be divided into 4 stages (Fig. 1). The lower to middle part of Member 4 constitute the lowstand sequence system tract, and dominated by dark gypseous mudstones intercalated with gypsum and salt. It show strong molecular fossils association characteristics of playa lake environment, including low pristine/phytane ratios, medium to high gammacerane, high 3-methyl sterane, etc. These characteristics are consistent with the relatively high Sr/Ba and Mg/Ca in sediments. The Upper part of Member 4 constitute the transgressive system tract. Oil shales, calcareous shales, calcareous mudstone and marl occur extensively. The Unit shows relatively high iso-alkanes and isoprenoids, low pristine/phytane ratios, medium to high gammacerane, high C₃₅/C₃₄ hopane, high dehydroxyl vitamin E, low diasterane etc., and the individual n-alkanes are relatively enriched in ¹²C. The ratios of Sr/Ba and Mg/Ca show a significant decrease. These features indicate that the lake had relatively high water salinity, permanent water stratification and bottom water anoxia. The lower part of Member 3 belongs to condensed section and early highstand system tract deposits. The lithology associations are dominated by calcareous oil shales, shales and laminated mudstones. The unit shows relatively low iso-alkanes and isoprenoids, pristine dominance, low gammacerane, very high 4-methyl steranes, and the individual n-alkanes are enriched in ¹³C. These changes suggest the lake water salinity has been greatly decreased. The middle and upper part of Member 3 and the lower part of Member 2 belongs to highstand system tract and regressive system tract individually, and are

dominated by poorly laminated to massive mudstone and silty mudstones. The whole profiles of the molecular fossils are similar to the lower part of Member 3, but some significant differences do exist, including low 4-methyl steranes and high diasterane. These characteristics suggest the permanent water stratification disappear, and dominated by dysoxic to oxic conditions.

The study shows there are great distinctness on the molecular fossils characteristics in different lake stage of Dongying Depression, and the organic molecular fossils can serve as important criterions in classification of lacustrine sequence stratigraphy.

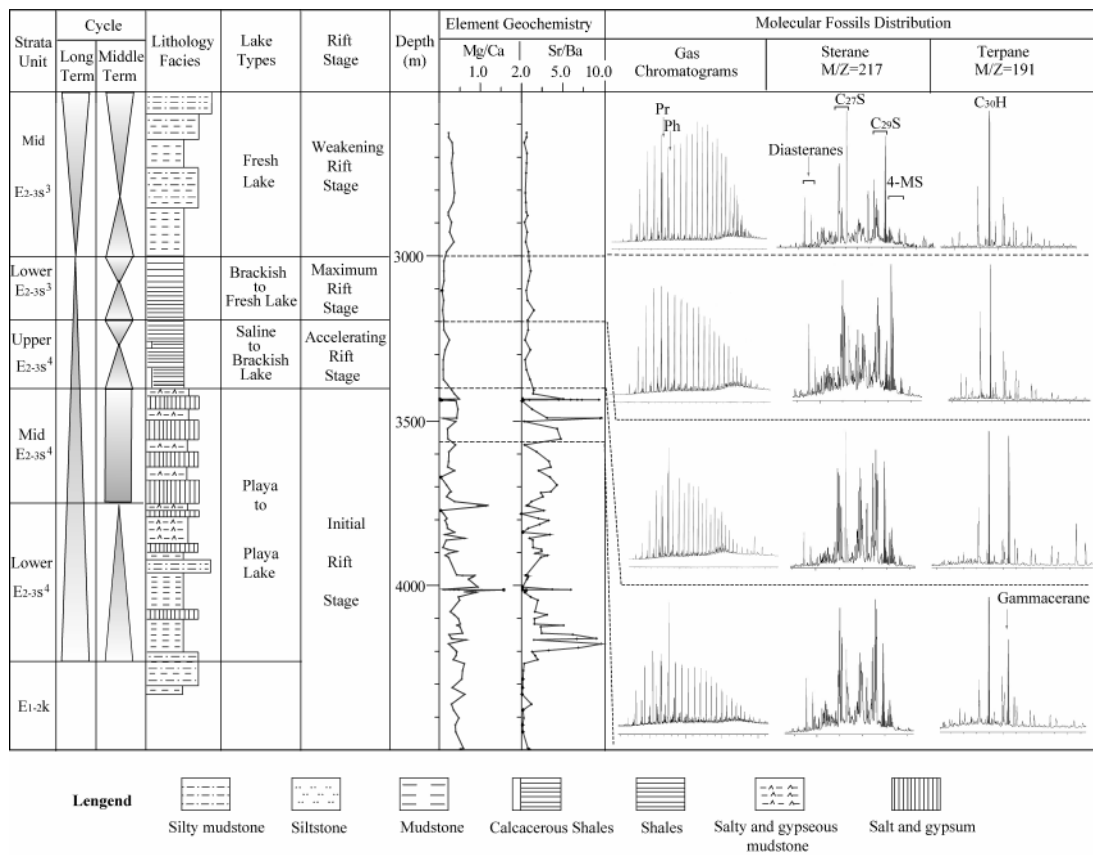


Figure 1. The lake evolution and molecular fossils characteristics of the Dongying Depression
 Pr: pristinic; Ph: phytane; C₂₇S: C₂₇ steranes; C₂₉S: C₂₉ steranes; 4-MS: 4-methyl steranes;
 C₃₀H: 17 α , 21 β -C₃₀hopane

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