

Organic Geochemical Response to the Sequence Boundary Developed During the Depression Stage of the Big Songliao Lacustrine Basin and Its Paleo-environmental Significance: Evidence from Well SK1 of the Continental Scientific Drilling

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The Songliao Basin is one of the biggest lacustrine basins in the world, over an area of about 2.6×10⁵km². The filling sequence of its depression stage is confined by the two first-grade sequence boundary, namely SB3 at the bottom and SB03 at the top. Within them, another three second-order sequence boundary, which are the SB2, the SB1 and the SB06, and seven third-order sequence boundary can be recognized according to the evidence from the seismic reflection, the well coring and the logging.

Well SK1 is China's first continental scientific drilling well with the Cretaceous strata as the target and a continuous coring from lower to the upper Cretaceous. The total length of the coring is 944.23m and the recovery rate of the cores is up to 99.73%. A vertical organic geochemical profile (covering the abundance and type of the organic matter and its biomarker), an elementary geochemical profile (covering the abundance of Uranium, Thorium and Potassium) and an isotopic geochemical profile (covering carbonate and oxygen) are constructed through a high density sampling at a one-meter interval. Geochemical responses of the sequence boundary and the significance of the paleo-environmental variations have been evaluated in detail.

The organic geochemical responses are characterized by an abrupt change of the types and abundance of the organic matters and the biomarkers. It can be illustrated by the geochemical change at the second-order sequence boundary of SB2. The abundance of the organic matter is low in the Quantou formation below and high in Member 1 of the Qingshankou formation above. The organic matters from the Quantou formation are of kerogen type III, while those from the Qingshankou formation are of kerogen type I. The biomarkers change abruptly between organic matters from above and below the sequence boundary of SB2 as indicated by tricyclic terpane/ hopane, regular sterane/ hopane, rearranged sterane/ sterane and Gammacerane/C30-hopane. Carbon isotope. The carbon isotope undergoes an abrupt transition from heavy carbon isotope compositions below (>-25.0‰) the sequence boundary of SB2 to the light ones (<-30.0‰) above it.

The geochemical profile of Well SK1 responds well to different orders of sequence boundary and also to the inner composition of different orders of sequential stratigraphy. It can be treated as a supplementary tool with which to make a sequential stratigraphy analysis and reconstruct the paleo-environment.