

Astronomically Forced Climate Change Recorded in Late Middle Eocene-Early Oligocene Lacustrine Sediments, China

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The Early Eocene Climatic Optimum ended with a long interval of global cooling that began in the early Middle Eocene and ended at the Eocene-Oligocene transition. During this long-term cooling, a series of short-term warming reversals occurred in the marine realm. Here, we investigate corresponding continental climate conditions as revealed in the Qianjiang Formation of the Jiangnan Basin in central China, which consists of more than 4000 m of lacustrine strata. The main lithologies of the Qianjiang Formation include a halite-rich rhythmic sediment succession, with dark mudstone, brownish-white siltstone and sandstone, and greyish-white halite. Alternating fresh water (humid/cool) - saline water (dry/hot) deposits reflect climate cycles driven by orbital forcing. High-resolution gamma ray logging data from the basin center captures the pronounced lithological rhythms throughout the formation. Three halite-rich intervals are recognized as three short-term warming events within the Middle Eocene to Early Oligocene, and may be expressions of coeval warming events in the global marine oxygen isotope record. Power spectral analysis of the gamma log indicates strong eccentricity cycling during the warm/hot episodes, and obliquity forcing during the cooling intervals, especially at the Eocene-Oligocene transition. Astronomical tuning indicates a duration of 8.8 to 8.9 Myr for the entire formation. The durations of the three warming events from Middle to Late Eocene are 800 kyr, 800 kyr, and 2.6 Myr; the durations of the two intervening cooling intervals are 1.2 myr and 1.0 myr.