

# **Mechanisms of Environmental Effects of Extreme Heat Events: The Karatal Formation of the Eocene Tarim Basin as an Example**

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## **Abstract**

The Paleocene to Early Eocene was an important climatic transition period in the Cenozoic, accompanied by several extreme thermal events, which led to multiple fluctuations in sea level. Since the Oligocene, marine sedimentation has been preserved in only three areas in China (the remaining two are located in the southern Tibetan Himalayas and the Qiongnan Deep Sea), and the Karatal Formation in Tasinan has preserved a complete record of marine intrusion, which is an important stratum for the study of the Cenozoic palaeoclimate and palaeotethyan oceanic evolution. In this paper, we focus on the developmental characteristics of the Karatal Formation under extreme climatic conditions. It is shown that: 1) the Karatal Formation records a plausible astronomical cyclonic cycle with a depositional duration of 6.6 Myr, which is consistent with the Lutetian Order; 2) five components of the storm sequence, i.e., grainy laminations, parallel laminations, mounds of interbedded laminations, undulating laminations, and blocky mudstone beds, are observed in the Karatal Formation, which corroborates that the regional depositional period was in a storm-frequent tropical-subtropical low-latitude zone; 3) 10 types of ooids: radial ooids, concentric ooids, tabular ooids, compound ooids, ellipsoidal ooids, and eccentric ooids of primary sedimentary origin; and mud crystal ooids, deformed ooids, negative ooids, and dolomitized ooids of posterozoic modification origin, whose distributions are governed by both phase zones and hydrodynamics. In the middle Eocene, anomalous climatic events drove sea level rise and seawater into the Tarim Basin, which lasted until the end of the Lutetian. During the depositional period, storm action was frequent under the control of the greenhouse effect, CO<sub>2</sub> concentration increased, seawater evaporation became larger, continental weathering intensified, and the prolonged deterioration of the environment led to opportunistic selection of fossil organisms. This paper adds the evidence of marine profiles in the Central Asian region to the Cenozoic studies of anomalous climate.