

Terrestrial Sedimentary Responses to Early Cenozoic Climate Warming: Geochemical, Biological, and Mineralogical Evidence from the Bohai Bay Basin, East China

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The early Cenozoic was marked by a series of rapid climate warming events triggered by increased atmospheric CO₂ concentrations, leading to profound changes in terrestrial ecosystems. During this period, organic-rich shales developed in multiple lake basins, which not only serve as key target formations for shale oil exploration but also provide valuable records for studying sedimentary responses to extreme climate events. This study analyzes lacustrine core samples from the Bohai Bay Basin, East China, employing a suite of geochemical techniques, including major and trace element analysis, carbon and oxygen isotope measurements, and gas chromatography-mass spectrometry. These methods were used to characterize the geochemical, biological, and mineralogical signals of climate change preserved in the lake sediments and to reconstruct the paleoenvironmental evolution during the Late Paleocene-Eocene epoch.

The results reveal that climate warming significantly altered the hydrological cycle of the lake system, driving changes in evaporation rates, precipitation patterns, and weathering processes, leading to the transition from freshwater to saline lake systems. These transformations had a profound impact on material fluxes, water chemistry, and biological activity. Ecological responses were manifested in shifts in species composition, with temperature-sensitive taxa being replaced by heat-tolerant groups, indicating broad-scale changes in lake biodiversity. The mineral composition of the sediments also shifted from dominance by detrital minerals to carbonates. These changes controlled sedimentary processes and organic matter enrichment, with the enrichment mode transitioning from one primarily driven by primary productivity to one dominated by redox conditions, with terrestrial input being a key influencing factor. This study not only provides valuable sedimentary records of early Cenozoic climate warming in East Asia but also offers geological insights into carbon cycling under extreme climatic conditions, enhancing our understanding of the complex interplay between global warming, environmental change, and biological processes.