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Late Eocene obliquity domination and impact of the Eocene/Oligocene climate transition on central Asian climate at the northeastern margin of the Tibetan Plateau

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At the boundary between the Eocene and Oligocene epochs, approximately 34 million years ago (Ma), the Earth experienced a significant change from a greenhouse world to an icehouse world. The present understanding of the triggering mechanisms, processes and environmental effects of this climatic event is mostly based upon ocean sediment records and climatic modeling results. Terrestrial records of the critical interval are rare and, where available, often poorly constrained in time. Here, we present a continuous continental record (Tashan section) from the Xining basin at the northeastern edge of Tibetan Plateau, covering the period between ∼35 to 33 Ma. Lithology supplemented with high-resolution magnetic susceptibility (MS), median grain size (MGS) and color reflectance (a*) records show clear Late Eocene basic cyclicity of ∼3.5 m in length. Our detailed magnetostratigraphic age model indicates that this cycle was most likely forced by the 41-kyr obliquity cycle driving drier and wetter periods in northern hemisphere Asian interior climates already 1 million year before the Eocene-Oligocene Climate Transition (EOCT). Detailed comparison of the E/O boundary interval in the Tashan section with marine records show that the most pronounced lithofacies change in the Xining Basin corresponds to the first of two widely recognized steps in oxygen isotopes making up the EOCT. This first step is reported to precede the major and second step (base of the Oi-1 phase) by around 0.2 to 0.3 Myr and has recently been suggested to be mainly related to atmospheric cooling rather than ice volume growth.