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The prelude to the Eocene-Oligocene greenhouse to icehouse climate transition: a continental record from the northeastern Tibetan Plateau

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Enhanced weathering rates due to the uplift of the Tibetan Plateau remains the primary suspect for declining atmospheric pCO2 levels towards triggering the Eocene to Oligocene climate transition. Here, we present a detailed sedimentological and stratigraphic study of late Eocene continental successions from the Xining basin (northeastern Tibetan Plateau), a key region to study the interaction of climate deterioration, plateau uplift, and Parathetys sea retreat.

Red beds (weakly pedogenised red-brown mudstones) alternate with nodular, laminated, and massive gypsum beds at meter-scale throughout the successions. A dominant bimodal grain size distribution centered at 30 μm fine silt and 2 μm clay fractions, without coarser material is found in red beds as well as in gypsum beds indicating a similar transport mechanism of siliciclastics in both lithologies. This peculiar distribution - comparable to loess - suggests an eolian origin although, at this stage, a distal floodplain origin of the siliciclastic material can not be excluded. Accordingly, the superimposed gypsum intervals most likely originate from elevated groundwater and lake levels during relatively wet periods.

A marked change from a succession characterized by massive gypsum beds with thin intercalating mudstones to thick red beds with thin gypsum beds is dated at 38 Ma using a refined magnetostratigraphic age model. Cyclostratigraphic analysis indicates that a change in the dominant orbital cycle forcing the paleoenvironment occurs simultaneously. Similar shifts are known from the prelude to the middle Miocene climate transition, suggesting global ice volume was dominating Asian interior climates before the Eocene-Oligocene climate transition. The entrance of high altitude pollen at the same time, further suggests a link between climate and uplift during this critical climate change.