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A Late Miocene terrestrial temperature history for the northeastern Tibetan Plateau's period of tectonic expansion

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During the Late Miocene, the climate patterns and ecosystems of continental land masses experienced crucial transitions, but whether the principal driver was regional tectonic forcing or a decline in CO₂ concentrations remains debated. Terrestrial paleotemperature records from tectonically active regions can conserve both paleoaltitudinal and global temperature changes which have occurred as a result of fluctuations in the levels of CO₂. However, high-quality quantitative data remain scarce, due to the lack of terrestrial paleotemperature reconstruction tools and well-dated continuous stratigraphic sequences. Based on a continuous sedimentary sequence with high precision dating from ~54-4.8 Ma in Xining Basin, northeastern Tibetan Plateau established, and evaluation of the potentiality of the branched glycerol dialkyl glycerol tetraethers (brGDGTs) in paleotemperature/paleoelevation reconstruction in Tibetan Plateau by our group, we present a terrestrial paleotemperature record spanning ~12.7-5.2 Ma based on tetraether lipids extracted from the northeastern Tibetan Plateau. Our results reveal a sharp cooling (~8°C) during ~10.5-8 Ma, asynchronous with minor fluctuations in global sea temperatures, suggesting a rapid tectonic uplift of ~1 km in extent. This event appears consistent with the simultaneous aridification and transitions of ecosystems experienced in adjacent regions. Moreover, the amplitude of the cooling over land is less than that which occurred over the ocean during the CO₂-dominated Late Miocene cooling event (~7-5.4 Ma). We therefore concluded that tectonic forcing, rather than a decline in CO₂ levels, most likely dominated continental climate patterns and ecosystem transitions during the Late Miocene.