Middle Miocene Reorganization of Faulting and Depositional Patterns in Northeastern Tibet

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Variations in the direction and timing of range growth demonstrate how India-Asia convergence was manifest in northeastern Tibet (near 36°N, 103°E) throughout the Cenozoic. We detect a >45° change in shortening direction in middle Miocene time by examining (i) thermochronological relief transects from contractional ranges in combination with (ii) stratigraphic successions from adjacent foreland basins. Apatite (U-Th)/He and fission-track age-elevation relationships suggest an onset of rapid exhumation in the east-west trending Laji Shan at ~22 Ma. Rapid exhumation of the adjacent north-trending Jishi Shan, however, did not commence until ~13 Ma. Further support for this diachronous Miocene range growth emerges from records of subsidence, provenance, and paleoclimatic change from magnetostratigraphically dated sections in adjacent Xunhua and Linxia basins. Emergence of the east-west trending Laji Shan is highlighted in Xunhua basin by a doubling of sediment-accumulation rates between 24 and 21 Ma and by the introduction at 20 Ma of fluvial facies for which detrital zircon U/Pb age spectra show were sourced from basement terranes within the Laji Shan. In contrast, growth of the north-trending Jishi Shan is expressed by a 50% acceleration in Xunhua accumulation rates between 12 and 9 Ma and a doubling of detrital zircons derived from Jishi Shan sources by 11.5 Ma in the Linxia basin. Additionally, the divergence of Linxia and Xunhua oxygen isotopic values signals topographic isolation of these two basins by surface uplift of the intervening Jishi Shan by 11 Ma. Together these diverse observations document a middle Miocene change in the kinematic style of plateau deformation from initial north-south contraction along a trajectory that mimicked the India-Asia collision to the later onset of east-west contraction. This kinematic shift in northeastern Tibet coincides with expansion of the plateau margin in southeastern Tibet, as well as the onset of normal faulting in the high-elevation plateau interior, and may suggest a common geodynamic cause.

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