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Exhumation history of the Min Shan, northeastern-most Tibetan Plateau, constrained by low-temperature thermochronology

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The growth of the Tibetan Plateau has been at the centre of debates in the past 50 years. Its northeasten-most topographic front is coincident with the Min Shan, a north-trending and high-standing mountain range which masks the significant relief (∼3500m) over a short lateral distance (∼60-80 km). Three faults—Min Jiang Fault (MJF) on the west, Hu Ya Fault (HYF) on the east and Xue Shan Fault (XSF) across it—are considered to control the formation of Min Shan, providing an important natural laboratory to study the evolution of topography at the margin of the plateau.

Because of the geodetic and geophysical researches in recent years, Min Shan has been regarded as a Cenozoic rapid-uplifting zone related to the continental escarpments along the eastern Tibetan Plateau. However, the initiating time, stages, and amount of uplift in northeast Tibet is still unclear. This study utilized fission tracks (FT) and (U-Th)/He (He) on detrital apatites and zircons, on samples located across Min Shan and particularly on both sides of MJF to constrain its near-surface exhumation history. Results show that the northeastern-most plateau experienced three phases of cooling: widespread and relatively fast Late Jurassic (∼160 Ma) to Late Cretaceous (∼105Ma) cooling (at a rate of ∼0.7–1.6°C/Ma), then slow cooling (∼0.3°C/Ma), followed by Late Oligocene enhanced cooling (∼1–2.7°C/Ma) mainly along the western edge of Min Shan. Besides, AFT and AHe ages decrease from west to east across the two branches of MJF. The age-temperature plots for MJF suggests that the Cenozoic activity of the Western Min Jiang Fault (WMJF) is earlier than the Eastern Min Jiang Fault (EMJF), which is significant to elucidate the kinematic sequence of MJF. From low-temperature thermochronological data and inverse modeling, our study suggests that the high relief of northeast Tibet had existed before the Indo-Asian collision. This temporal-spacial distribution is crucial for the explanation to development of northeast Tibetan Plateau.