

Growth, denudation and relief history of the Northern Tibet margin:

Thermochronological constraints

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Models of how high elevations formed across the northern Tibet margin predict: (a) the continuous thickening of a "viscous sheet"; (b) time-dependent, oblique stepwise growth; and (c) synchronous deformation across Tibet that accompanied collision.

Our new thermochronological observations may shed light on this issue. Here, we use $^{40}\text{Ar}/^{39}\text{Ar}$ and (U-Th)/He thermochronology from massifs in the hanging walls of thrust structures along the Kunlun Belt, the first-order orogenic range at the northern Tibetan margin, to elucidate the exhumation history. $^{40}\text{Ar}/^{39}\text{Ar}$ results dating indicate that the Eastern Kunlun Range was built-up and exhumated during the later Triassic initially, and a minimum overburden of ~11.7-14.0 km has been eroded since ~235 Ma. Vertical transect (U-Th)/He dating show that these massifs, and hence the plateau margin, were subject to slow, steady exhumation during the

Early Cenozoic, followed by a pulse of accelerated exhumation during 40-35 Ma. The exhumation rate increases westward (from ~ 0.22 to 0.34 and 0.5 mm/yr). The two-fold increase in exhumation in the western part (0.5 mm/yr) compared to the eastern part suggests westward increases in exhumation and compressional stress along the Kunlun Belt. We relate these observations to the mechanisms responsible for the oblique stepwise rise of Tibet. After collision, oblique subduction beneath Kunlun caused stronger compressional deformation in the western part than in the eastern part, resulting in differential growth and lateral extrusion.

Relief evolution and denudation history are modeled. Modeling outcome reveals the entire denudation and relief history of the northern Tibet from late Mesozoic to the present time. After prolonged denudation before 50 Ma, a low topography (~ 0.17 times the relief of the present) developed by 50 Ma. The highest relief (~ 1.82 times the relief of the present) of the Cenozoic time came into being at 40 Ma. Subsequently, the relief steadily decreased to the present level due to continued denudation. This suggests that deformation propagation from the continued convergence boundary between India and Eurasia was insignificant after the construction of the highest relief. This observation is broadly consistent with published accounts on the stratigraphic, cooling, and faulting histories of the northern Tibet margin.

Keywords: Northern Tibet, $^{40}\text{Ar}/^{39}\text{Ar}$ and $(\text{U-Th})/\text{He}$ dating, growth, relief and denudation history