Paleocene-Eocene Lhasaplano paleoaltimetry: Implications for mass balance in the India-Asia collision

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Was the Tibetan plateau at high elevation prior to Indo-Asian collision (~56 to ~40 Ma [east to west]) or rise en masse more recently in the Neogene? If the plateau was at high elevation prior to collision, >30% of the original crustal mass is missing from our collisional mass balance accounting.

We reconstruct the ~55 Ma paleo-elevation of the Penbo Basin, southern Tibetan plateau by coupling carbonate-derived oxygen stable isotope measurements ($\delta^{18}O_c$) with temperatures derived from the Δ_{47}-'clumped' isotope paleothermometer ($T(\Delta_{47})$). We estimate a pre- to early syn-collisional (~54 ± 2 Ma) paleo-elevation of the Penbo region of >4100 ± 550 meters. This provides the first well-constrained elevation estimate of the pre-collisional Linzizong Volcanic arc in the southern Tibetan Plateau, and supports previous suggestions that the Linzizong arc part of the plateau was high prior to India-Asia collision based on structural evidence and oxygen-isotopic data alone.

We perform numerical calculations of post-collisional crustal mass balance using the newly constrained pre-collisional elevation and crustal thickness, and the recently reconsidered diachronous collisional age of India-Eurasia. We find that ~50% of the collision-related crustal mass cannot be accounted for by the mass preserved in the excess crustal thickness, southeast Asian tectonic escape, and exported eroded sediments. This implies large-scale subduction of continental crust during this continent-continent collision. Crustal contamination of the mantle may be more significant than previously thought and may be responsible for crustal geochemical anomalies in mantle-derived melts.