The Growth and Rise of Tibet: A Consequence of East Asian Extrusion Tectonics

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How the Tibet Plateau rose to an elevation of ≈ 4800 m over a surface area of ≈ 3 million km^2 is a subject of enduring controversy. While such topography results chiefly from the India-Asia collision, models differ on fundamental issues, particularly the strength of the crust and mantle. Late Cenozoic extension and volcanism have inspired "Soft Tibet" models. Tibet would be "hot", with a weak lower crust ("waterbed") and no mantle lid. "Delamination" and "collapse" would have caused volcanism and extension, with transfer of the lower crust ("Channel flow") towards the edges of the plateau. A "soft Tibet", however, is incompatible with most available geophysical/geological evidence. Down to ≈ 400 km depth, Tibet's mantle shows faster seismic velocities than adjacent Precambrian shields, while crustal Vp/Vs ratios are "continental average". Crustal extension is only 5% of collision-induced deformation. M ≥ 8 earthquakes commonly rupture strike-slip and thrust faults in and around the plateau, whose surface was smoothed by internal drainage at various epochs.

An alternative model violating none of these observations integrates crustal thickening with the stepwise extrusion that orchestrated SE Asian Tectonics since the Eocene. Tibet grew and rose obliquely northeastwards as left-lateral faults sliced farther into the Asian lithosphere, shifting the northern/eastern edges of the plateau towards the continent interior. Damming of rivers by Tibet's outer rims held much of the eroding highlands debris captive within high-level basins. Coupled with SW-directed, "blind" subduction of Asian lithospheric mantle along re-activated sutures and broad crust/mantle decollements, such processes account for the uneven crustal structure and regionally variable surface smoothness of Tibet. The high plateau is actually best understood as a mosaic of "bathtub" basins, with mantle Plate Tectonics hidden beneath thick crust. There is little evidence, if any, for a weak lithosphere, or for delamination, channel flow and orogenic collapse.