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Sub-crustal forcing on the tectonic and topographic evolution of collision-subduction transition zones: possible application to the eastern Tibetan margin

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The tectonic and topographic evolution of the eastern Tibetan margin is controlled by the India-Eurasia collision, gravitational collapse of the uplifted reaches and the dynamics of the Sunda and other western Pacific subduction zones, but their relative contributions remain elusive. Because crustal tectonics is the most serious contributor to the vertical ground motion and surface structures, previous models mostly focused on the partitioning between clock-wise rigid rotation or viscous eastward evacuation of the Eurasian crust in response to these driving mechanisms. Some authors further argued that large-scale mantle convection provides support to the topography of the Southeast Asia through vertical stresses and contribute to the overall India-Eurasia convergence. Minor attention, however, has been given to the potential forcing from the asthenospheric return flow owing to differential along-strike slab kinematics related to rollback and tearing of the Indian, Sunda and western Pacific slabs.

Here, we analyze 3D numerical geodynamic modeling results involving a collision-subduction system and show that vigorous asthenospheric flow due to differential along-strike slab kinematics may contribute to the surface strain and topography at the collision-subduction transition zone. We argue that protracted northward migration of the Indian slab and indentation front during south to south-westward rollback (late-Eocene to middle-Miocene) or stable (middle-Miocene to present) subduction along the Sunda and western Pacific margins may have produced a similar asthenospheric flow. This flow could have contributed to the Southeast Asia extrusion tectonics and uplift of the terrains around the eastern Himalayan syntaxis and protruding from southeast Tibet. Therefore, we suggest that the tectonics and topographic growth east and southeast of Tibet are controlled not only by crustal and lithospheric deformation but also by the asthenospheric dynamics.