Deformation of Tibetan Plateau from Recent Seismic Images: "Thin Skinned" or Lithospheric Tectonics

SONG Xiaodong[1, 2]

[1] *Department of Geology, University of Illinois at Urbana-Champaign, Champaign, IL, 61820 USA*
[2] *School of Geodesy and Geomatics, Wuhan University, Wuhan, 430079, China*

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Abstracts: Mechanisms for deformation and growth of the Tibetan Plateua (TP) have been debated for decades. Among them, the channel flow model has been popular, which suggests that the growth of the TP has been driven by material flow in the mid-lower crust and the deformation in the upper crust is decoupled from the lithosphere mantle, thus we may call it a "thin skinned" model. Here I present high-resolution seismic velocity images from our recent studies in the margin of the TP as well as in the Indian-Eurasia collision front, which suggest lithosphere-scale deformation throughout the TP. In NE margin of the TP, Deng YF et al. (GRL, 2018) found crustal low-velocityzones (LVZs) with variable strengths, anomalous Vp/Vs ratios that are correlated with LVZs, a large Moho jump, and other abrupt changes near major faults, strong mantle lithosphere anomalies, and correlation of crustal and mantle velocities. The results suggest a lithospheric-scale deformation of continuous shortening as well as localized faulting, which is affected by the strength of the lithosphere blocks. The thickened mantle lithosphere can be removed, which facilitates the formation of middle-lower crustal LVZ and flow. However, such flow is likely a consequence of the deformation rather than a driving force for the outward growth of the TP. The proposed model of TP deformation and growth can reconcile the continuous deformation within the blocks and major faults at the surface. In Southern TP, Li JT and Song XD (PNAS, 2018) found clear images of the Indian mantle lithosphere (IML) from high-resolution P and S tomography, which suggest that the subducted IML is torn into at least four pieces. Intermediate-depth earthquakes in the lower crust and mantle are located almost exclusively in the high-velocity (and presumably strong) part of the Indian lithosphere. The tearing of the IML provides a unified mechanism for Late Miocene and Quaternary rifting, current crustal deformation, and intermediate-depth earthquakes in the southern and central.

Tibetan Plateau and suggests that the deformations of the crust and the mantle lithosphere are strongly coupled.

* Corresponding author. E-mail: xiao.d.song@gmail.com