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The Greater India beneath Tibet: A detailed new seismic mapping

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The Greater India is a continent that existed before the India-Asia collision and comprised today's Indian subcontinent and its extension to the north, by now consumed in the collision. The size, shape, and evolution of the Greater India are a matter of a heated debate, from its place in the make-up of Gondwana to its rapid northward drift and evolution following the break-up of the supercontinent and to its eventual collision with Eurasia. How the India-Asia collision has been accommodated (how much of the continental Indian lithosphere has been consumed and what happened to it) is an important unresolved problem in itself, the proposed solutions including: underthrusting of India beneath Tibet; northward subduction of India; viscous thickening of the Indian and Asian lithospheres beneath Tibet; viscous thickening followed by convective removal; lateral extrusion of chunks of Greater India eastwards; slicing and sinking of the Greater India's lithosphere beneath the Himalayas.

Body-wave seismic tomography shows the remnants of the subducted lithosphere of the ancient Tethys Ocean, now in the lower mantle, and the more recently subducted lithosphere of the Indian Plate around the transition-zone depths. In the lithosphere-asthenosphere depth range, however, the properties and even the presence of Indian lithosphere in the upper mantle beneath Tibet are debated. Whereas surface-wave tomographic models typically show a high-velocity anomaly beneath much of Tibet at around 200 km depth, many body-wave models do not show high-velocity anomalies under most of the plateau, prompting very different interpretations.

Here we determine the morphology of the Indian lithosphere beneath Tibet using a combination of large-scale waveform tomography (based on a new, unprecedentedly large global dataset) and of surface-wave array analysis in Tibet. The Greater Indian lithosphere is present (underthrusting or subducting) beneath much of Tibet. There are marked differences in the properties of the Greater Indian lithosphere and in the mechanism of its descent beneath different parts of the plateau. In the west, cratonic Indian lithosphere underthrusts the Tibetan crust and collides with the Tarim Craton to the north of it. In the central part of the plateau, Indian lithosphere underthrusts Tibet form the Himalayas up to the Bangong-Nujiang Suture and then, further north, subducts at a relatively steep angle. Indian lithosphere now under the east-central Himalayas is not cratonic (not as thick and cold as in the west). Beneath eastern Tibet, the Indian lithosphere has subducted, at a shallow angle, hundreds of kilometers northwards to under the Qiangtang and Songpan-Ganzi Terranes.

The detailed new seismic images provide new constraints on the size of the Greater India continent and on lateral variations in the properties of its lithosphere. The size and shape of the Greater India as evidenced by the seismic data are consistent with the recent plate-tectonic models in which the India-Asia hard continental collision commences more recently than previously thought.

References

Agius, M. R., S. Lebedev. Tibetan and Indian lithospheres in the upper mantle beneath Tibet: Evidence from broadband surface-wave dispersion. Geochem. Geophys. Geosyst. 14, doi:10.1002/ggge.20274, 2013.

Schaeffer, A. J., S. Lebedev. Global shear-speed structure of the upper mantle and transition zone. Geophys. J. Int. 194, 417-449, 2013.

Van Hinsbergen, D. J. J., et al., Greater India Basin hypothesis and a two-stage Cenozoic collision between India and Asia., Proc. Natl. Acad. Sci. USA 109, 7659-64, 2012.

Zahirovic, S., et al., Insights on the kinematics of the India-Eurasia collision from global geodynamic models, Geochem. Geophys. Geosyst. 13, doi:10.1029/2011GC003883, 2012.