The Quest for Entrained Continental Crust during Collision

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Straightforward calculations show that the negative buoyancy of subducted oceanic lithosphere should be able to entrain up to about 200 km of continental crust during subduction. Results from recent, large-scale seismic deployments showed that this indeed might be the case beneath the Pair-Hindu Kush region, a process linked with the recurrence of large, intermediate-depth earthquakes there.

Even more impressive is the prospect that Indian cratonic crust may have accompanied its mantle keel as the entire Indian lithosphere underthrusts beneath Tibet. Based on finite-frequency, multi-scale traveltime tomography and a multitude of supporting geophysical evidence, the Indian mantle front (IMF), or the northern, leading edge of underthrust Indian mantle keel ("Greater India"), is now situated over 600 km farther north of the Himalayan collision front.

Along the IMF, the transition from a very thick crust (~70 km in thickness) to the upper mantle is complex, and ongoing work on large-scale variations of crustal thickness suggests that the IMF may also be the Indian crustal front (ICF). This work is largely based on the method of virtual deep seismic sounding (VDSS) in which strong signals of wide-angle reflection are generated near seismic stations by natural earthquakes from afar (1). In addition to its simplicity and high signal-to-noise ratios, VDSS, when combined with the Birch's rule of scaling compression-wave speed and density of crustal rocks, gives a robust estimate of crustal buoyancy (2), thus isolating contributions from the mantle in supporting high elevations.

References

Tseng, T.-L., W.-P. Chen and R. L. Nowack, Geophys. Res. Lett., doi:10.1029/2009GL040457, 2009.
Yu, C., Chen, W.-P. , and van der Hilst, R., J. Geophys. Res., doi:10.1002/2016JB013046, 2016.

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