Seismic tomography of the Nepal Himalayas and Geodynamic implications for 2015 Nepal Earthquake

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3-D Seismic tomography using local and regional earthquake data reveals variations of crustal thickness beneath the Nepal Himalayas. A low-velocity anomaly in upper part of the model down to depths of ~40 to 80 km represents crust. Lower limit of this anomaly represents Moho depth variations. Thick transitional zone may represent underthrusting of one continental block underneath another one, which leads in doubling of Moho depth. The obtained variations of crustal thickness match fairly well with free-air gravity anomalies: thinner crust patterns correspond to lower gravity values and vice versa. We propose that elevated magnetic values can be associated with more rigid segments of the incoming Indian crust, which cause more compression in the thrust zone and lead to stronger crustal thickening. Several episodes of collisions and rotation of the Indian plate after collision may also lead to variation in crustal thickness along the tectonic trend of the Himalayas. We have also corroborated estimated seismic velocity structure and crustal thickness with the recent Nepal earthquakes (magnitude ≥7) occurred on April 25, 2015 and May 12, 2015 in the eastern Nepal. These earthquakes occurred at places where Main Central Thrust shows a very sharp bend and where faults/lineaments cut across the tectonic trend of the Himalayas. It is observed that first earthquake of magnitude >7 initiated in a zone where crustal thickness is relatively lower and rupture propagated eastward towards a region where both crustal thickness and S-wave velocity is higher, i.e. towards a more rigid part of the crust. This may have led to stress loading in the rigid part that subsequently led to occurrence of second magnitude >7 earthquake in that area within a month. The velocity and crustal thickness maps estimated in this study nicely explains why two earthquakes of magnitude >7 occurred within a short span of time within such close distance range.