Geophysical Research Abstracts
Vol. 21, EGU2019-602-2, 2019
EGU General Assembly 2019

Seismic Tomography of the Lithosphere beneath the Nepal Himalayas and Geodynamic Implications for 2015 Gorkha Earthquake

Javed Raoof (1,2), Javed N Malik (1), and Sagarika Mukhopadhyay (2)

(1) Department of Earth Sciences, Indian Institute of Technology Kanpur, Kanpur, 208016, Uttar Pradesh, India, (2) Department of Earth Sciences, Indian Institute of Technology Roorkee, Roorkee, 247667, Uttarakhand, India

3-D seismic tomography reveals the variations of the crustal thickness beneath the Nepal Himalayas. A low-velocity anomaly in the upper part of the model down to depths of $\sim$40 to 80 km represents crust. Lower limit of this anomaly represents variations 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. There is also some correlation with magnetic field: higher magnetic values correspond to major areas of thicker crust. 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 $\geq$7) occurred on April 25, 2015 and May 12, 2015 in the eastern Nepal at the underthrusting interface along the Himalayan arc between the Indian and Eurasian plates. It is found that they occur at/or near the junction of the two anomalous zones of high/low seismic velocities. The patterns of the observed low-velocity anomalies may correspond to the alignments of faults and the high-velocity anomalies may represent the rigid blocks. It is observed that first earthquake of magnitude >7 initiated in a zone where crustal thickness is relatively lower and the 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. This imply that the first earthquake led to increase in strain in the more rigid body that ruptured when it was strained beyond its elastic limit. Correlation of the velocity and crustal thickness models with the earthquake locations of Nepal that occurred in 2015 solves the enigma why the second earthquake of magnitude > 7 occurred in this region at the eastern end of the rupture zone of the first earthquake.