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Crustal thickness variations in Zagros and Alborz collision zones by using P receiver function technique

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Extended Abstract

Summary

Continental convergence between Arabia and Eurasia is taken up by distributed deformation in Alborz and Zagros collision zones in Iran. We applied P receiver function method to image the variations geometry of the crust–mantle boundary in two major mountain belts of the Alborz and Zagros in Iranian plateau. We used data from 65 seismic stations, which consists of 50 seismic stations of Institute of Geophysics, University of Tehran (IGUT), and 15 broadband stations of International Institute of Earthquake Engineering and Seismology (IIEES). Our results indicate that the average crustal thickness beneath central Iran domain (CD) is about ~48 km. The crustal thickness in this region varies between ~34 km beneath CHK station and ~55 km beneath IL3 station. We have found the Moho depth of about 45 km beneath the Zagros fold and thrust belt (ZFTB). Toward SE in ZFTB, we observe an increase in the Moho depth where it reaches ~59 km beneath BNDS and BNB stations. Crustal thickening (~54 km) has been observed beneath the central Alborz. We have also found strong thinning of the crust under the southern margin of Caspian Sea from ~33 km below KIA station to ~43 km below PRN station. Our data show a strong crustal thickening beneath the Sanandaj-Sirjan metamorphic zone (SSZ), with variations of ~53-66 km beneath BZA and KHMZ stations, respectively. Across the Urumieh–Dokhtar magmatic assemblage (UDMA), the crustal thickness varies between ~32 km below MEH station to ~62 km beneath CHMN station.

Introduction

P receiver function technique is especially a useful way to model the structure of the Earth by using the information from teleseismic earthquakes recorded at a three component seismograph. Iranian plateau is situated between Arabian shield in the southwest and Eurasian plate in the northeast. This region is extremely complex and an ideal area for studying different tectonic styles. The main goal of this study is to obtain new constraints on Moho depths of Zagros and Alborz collision zones.

Methodology and Approaches

We have used more than 1000 teleseismic events with $M_b \geq 5.5$ located at epicentral distances between 30° and 95°. The seismic data have been recorded from 2005 to 2015. The methodology used in this paper is to calculate P receiver functions in each station, and is the same as described by Sodoudi et al. (2006, 2009). Teleseismic events with relatively high signal-to-noise ratio (>4) have been selected at each station. The P waveforms have been separated in a time window between 10 s before the P-onset arrival time and 100 s after it. To broaden the response of instruments into a more useful teleseismic frequency band, the instrument response is deconvolved from the original records. ZNE component waveforms are rotated into the ZRT coordinate system, and then, rotated into the local LQT ray-based coordinate system (using theoretical back azimuth and incidence angle). In LQT system, L shows the direction of P wave incident to the surface, Q is perpendicular to L, and T is perpendicular to both L and Q forming the third axis of the right-hand LQT system. To isolate the P-to-S conversions on the Q component, the L component is deconvolved from the Q component. Deconvolution is used as a source-equalization procedure because it excludes the effects of the rupture process and of the ray-path below the converting interfaces. To increase the signal-to-noise ratio, PRFs are stacked for each station. Moho depths are obtained by using the velocity models presented by Hatzfeld et al. (2003); Abbassi et al. (2010); Paul et al. (2010); Shad-Manaman et al. (2011); Azhari et al. (2012); and Zamanian et al. (2012).

Then, we obtain the Moho depths using Zhu and Kanamori method (2000), which performs a grid search through the H and Vp/Vs space, and searches for the largest amplitudes at the predicted times of direct conversions and multiples. In this regard, we have used the weight factors of 0.5 and 0.25 for the Moho conversion and multiples, respectively.

Results and Conclusions

By applying P receiver function method in Zagros and Alborz collision zones, we find out that the average crustal thickness beneath central Iran domain (CD) is about ~48 km. The crustal thickness in this region varies between ~34 km beneath CHK station and ~55 km beneath IL3 station. We have also found the Moho depth of about 45 km beneath the Zagros fold and thrust belt (ZFTB). Toward SE in ZFTB, we observe an increase in the Moho depth where it reaches ~59 km beneath BNDS and BNB stations. Crustal thickening (~54 km) has been observed beneath the central Alborz. We have found strong thinning of the crust under the southern margin of Caspian Sea from ~33 km below KIA station to ~43 km below PRN station. Our data shows a strong crustal thickening beneath the Sanandaj-Sirjan metamorphic zone (SSZ), with variations of ~53-66 km beneath BZA and KHMZ stations, respectively. Across the Urumieh–Dokhtar magmatic assemblage (UDMA), the crustal thickness varies between ~32 km below MEH station to ~62 km beneath CHMN station.