HIGH RESOLUTION IMAGE OF UPPERMOST MANTLE BENEATH ZAGROS CONTINENTAL COLLISION

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ABSTRACT

We invert 7671 relative P wave arrival times using the ACH damped least square method of Aki et al. (1977) to study upper mantle structure beneath the north of Zagros continental collision zone, west of Iran. The data for this study were recorded by 63 three component broad-band stations operated from September 2013 to October 2014 along a profile from Ilam, near the western political border of Iran with Iraq, extending across Zagros, Sanandaj–Sirjan Zone (SSZ), Urumieh–Dokhtar magmatic arc (UDMA), Central Iran and Alborz Mountains. Our results confirm two velocity contrasts at both sides of Central Iran block relative to Zagros mountains and Alborz mountains. A deep higher velocity anomaly can be observed beneath SSZ and UDMA. This anomaly might be interpreted as a signature of the thickened lithosphere beneath suture zone between Arabian Plate and Eurasia in NW Iran.

INTRODUCTION

Convergence of Arabian plate towards Eurasia at a rate of ~ 25 mma^{-1} (Vernant et al., 2004) is primarily accommodated across the Iranian Plateau and the surrounding mountain ranges and results in different styles of deformation in various parts of this continental collision zone. About half of this convergence (~10 mm/y) is accommodated by shortening in the Zagros Mountains (Tatar et al., 2002) and the remnant is mainly accommodated across Alborz and Kopeh Dagh Mountains as well as South Caspian Sea (Vernant et al., 2004).

To investigate deep structures of Zagros continental zone in west of Iran, we operated 63 broadband seismographs along a profile from Ilam, near the western political border of Iran with Iraq, extending across Zagros, Sanandaj–Sirjan Zone (SSZ), Urumieh–Dokhtar magmatic arc (UDMA), Central Iran and Alborz Mountains from September 2013 to October 2014. The position of stations are shown by red triangles in Figure 1. We picked 7671 teleseismic P arrival time from 157 teleseismic events gathered during first nine months of the network operation from events of magnitude 5 and greater and epicentral distance range of 20^{o} - 95^{o} (Fig. 2). We calculated P travel time residual by subtracting theoretical P travel time of IASP91 travel time model (Kennett and Engdahl, 1991). Relative travel-time residuals then obtained by subtracting the associated mean for each event from all travel-time residuals.

The P-wave teleseismic relative residuals (7671 picks) were then inverted for upper mantle structures using the ACH damped least square inversion method of Aki et al. (1977). Calculated relative P-wave velocity tomogram show strong velocity contrast in crust and uppermost mantle (depth: 0-100 km) beneath Main Zagros Reverse Fault (MZRF) (~ x=0 km); the velocity is higher beneath Zagros (negative x) and lower beneath SSZ, UDMA and Central Iran (positive x). Moving north-eastward another transition (at ~ x=250 km) from lower velocity beneath Central Iran to higher velocity beneath Alborz Mountains is observed clearly in depth range of 0-100 km. This transition is almost between UDMA and Central Iran (at ~ x=170 km) at larger depth (100 – 200 km), showing larger lower velocity area in smaller depths. A strong deep higher velocity anomaly can be observed in 0 km < x < 100 km, beneath SSZ and UDMA. We interpret this anomaly as a signature of the thickened lithosphere beneath suture zone between Arabian Plate and Eurasia in NW Iran.

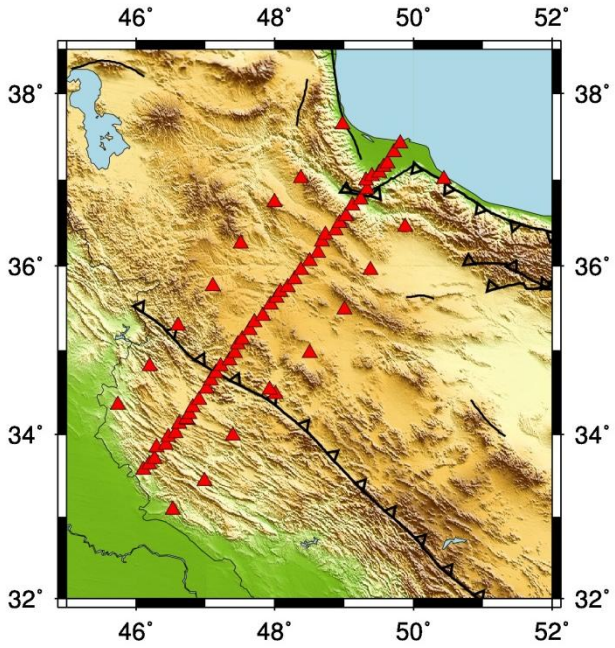

Figure 1. Location map of the seismological network

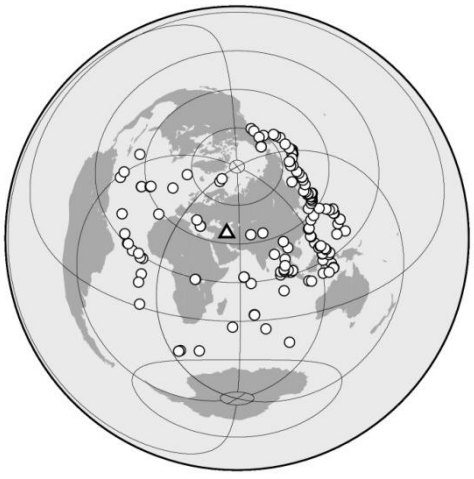

Figure 2. Distribution of the events used in this study (circles) in relationship to the studied area (triangle)

CONCLUSIONS

Teleseismic tomography results for P-wave relative arrival-time reveal two sharp transitions in the

velocity of uppermost mantle at depth range of 0-100 km. One transition is between Zagros and Central Iran block and another one is between Central Iran block and Albroz mountains. A deep higher velocity anomaly can be observed beneath SSZ and UDMA that is interpreted as a signature of the thickened lithosphere beneath suture zone between Arabian Plate and Eurasia in NW Iran.

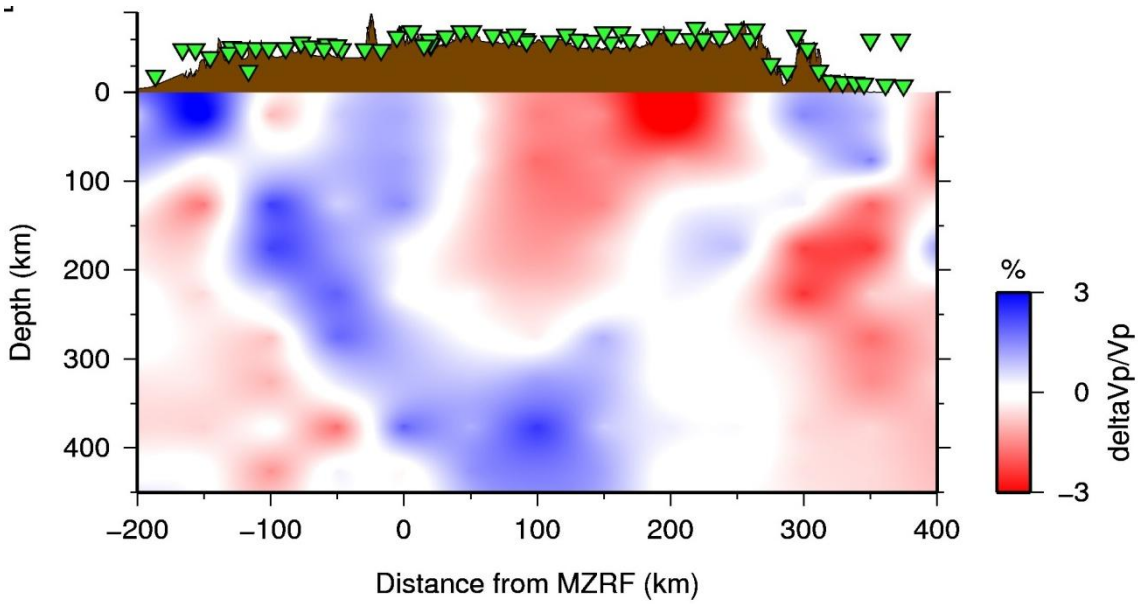

Figure 3. Depth cross-section along the middle line of seismic profile in the 3D model of P-wave velocity perturbations resulting from the inversion of residuals. Elevation variations along the profile are also shown on the top of the panel.

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