8th International Conference on Seismology & Earthquake Engineering
11-13 Nov. 2019, Tehran, Iran

INVESTIGATION OF MANTLE KINEMATICS BENEATH NW IRAN WITH THE COMPARISON OF TELESEISMIC DIRECT S WAVES AND SKS

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Keywords: seismic anisotropy, upper mantle deformation, shear wave splitting, direct S wave

The present tectonics of Iran results from the continental convergence of the Arabian and Eurasian plates. Our study area, NW Iran and West Alborz, is located in the central part of Arabia-Eurasia collision zone, consists of an assemblage of distinct lithospheric blocks such as part of the central Iranian plateau, the South Caspian Basin, Talesh Mountains, Alborz Mountains. In order to understand the kinematics and dynamic of continental deformation, the state of deformation and understand how upper mantle deform in between of each tectonic parts and in the transform boundaries between them along continental collision, it is important to have a very good estimate of the mantle flow and the mantle deformation. Earth's mantle deformation, can be inferred from observation of seismic anisotropy, revealed by the polarization of shear waves travelling through an anisotropic medium. Splitting in teleseismic shear waves such as SKS, ScS, and S, with steep arrival angles beneath the receiver, provides excellent lateral resolution in the upper mantle, and thus allows for the direct comparison of anisotropy with surface tectonic and geologic features possessing typical continental dimensions. The broadband seismic data used in the study were recorded by 68 seismic stations belong to the temporary seismic network in the NW Iran installed and operated by the Institute for Advanced Studies in Basic Sciences (IASBS). The IASBS network include three linear profiles with different time duration of recording data. The average interstation distance in each profile was 13 km. The stations were repositioned during the deployment and the recording span at individual stations varied between 4 and 31 months. We carried out SK(K)S splitting analysis using the SplitLab software (wustefeld et al., 2008) simultaneously applied the rotation correlation (RC) (Bowman and Ando, 1987) and the transverse component minimization methods (SC) (Silver and Chan, 1991) (both based on a grid search) to identify the best fitting splitting parameters. We present results obtained via the SC method as it is more stable. For the direct S waves splitting analysis we are using the Reference Station Technique introduced by Eken and Tilmann (2014). This technique uses two horizontal components at two different stations (refers as a target and a reference station) which should be near enough together (<300 Km), thus the ray path in the source side region and the deeper part of mantle for both station would be almost the same. So the most important benefit of using this method is to overcome the potential contamination of source side anisotropy by minimizing the misfit function between the corrected seismic waveforms at the reference and target stations. This method relies on the presumed knowledge of seismic anisotropy at the reference stations, ergo the knowledge of receiver-side seismic anisotropy, which could be obtained from conventional SKS splitting measurements.

The overall results for the splitting parameters obtained from both shear waves, SK(K)S and direct S, are almost similar together. The Delay time parameters derived 0.81 sec to 1.8 sec for SK(K)S splitting and 0.92 sec to 2.0 sec for direct S splitting. There is a slight differences between the Delay times obtained by both shear waves, the direct S waves shown larger delay time (an average amount of 0.2 sec) than the SK(K)S waves, the difference in time delays measurements may be expected since direct S-waves travel longer than SKS along a non-vertical propagation path through an anisotropic layer. The fast direction observed in this study, show consistence NW-SE trend. In the Alborz, Talesh, Tarom Mountain and NW Iran there is a very good consistency of the fast polarization direction (anisotropy direction) in all stations, also remarkable consistency exist between S and SKS results. There are some station at the end of each profiles which show some rotation in the fast polarization directions and also have a large difference between fast polarization directions in both phases in each stations. This variation indicating important changes in style of deformation across the different anisotropic structure. The differences could be caused by the local heterogeneity in upper mantle beneath those stations. This heterogeneity may cause by a diffuse boundary which is caused by flow organization in the mantle. As the SKS can detect anisotropy exactly below the station but S tracks the more long way around the station and somehow gives the mean of anisotropy of those local heterogeneities. We compared splitting parameters with APM, GPS, and structural and topographical features and also with other splitting parameters obtained from previous study in Iran and Turkey. The lithospheric thickness in this area is about 85-100 Km and is thin, so lithosphere has a small contribution for causing the observed anisotropy. We suggest a main and unique asthenosphere flow moving to NW beneath Anatolian plate and Iranian plate.

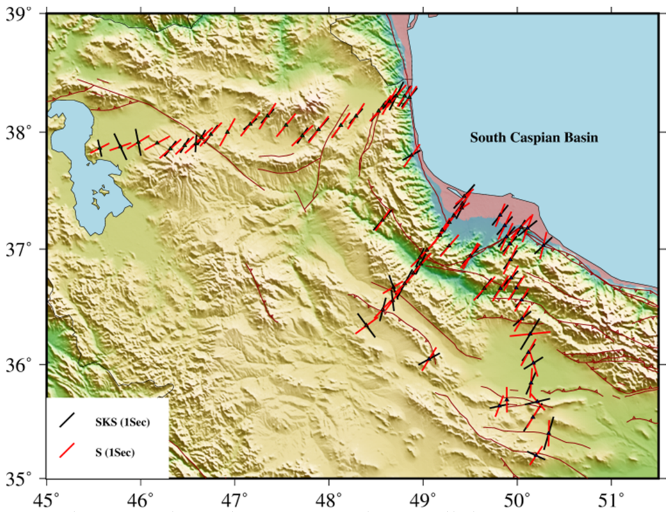

Figure 1. Direct shear wave and SKS splitting parameters.

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