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S-WAVE QUALITY FACTOR TOMOGRAPHY IN NW IRAN

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Northwest Iran is one of the active tectonic regions in the Alpine Himalayan belt. This area includes important geological structures including the North Tabriz Fault, the south Caspian basin, Sahand and Sabalan volcanoes, Talesh Mountains and Lake Urumieh. Existence of active fault zones, the effects of volcano magnetism and sedimentary basins affects strongly on earthquake wave attenuation. This inspired us to investigate systematic amplitude residuals (observed amplitude – predicted amplitude by available attenuation relations) to carry out a tomography for upper crust in the study region in order to detect quality factor variations due to the heterogenic geological structures. Here, we analyze 2901 seismograms from 302 small and moderate events (Mw < 5.2), recorded by 11 permanent stations of Tabriz network (governing by Institute of Geophysics, University of Tehran), one permanent stations of International Institute of Seismology and Earthquake Engineering (IIEES) network and 23 temporary stations installed by Institute for Advanced Studies in Basic Sciences (IASBS), Zanjan. We prepare a data set composed of spectral amplitudes for different magnitudes and hypocentral distances. The difference between the logarithm of observed amplitude and the logarithm of predicted amplitude (i.e., residual) at a frequency of 1 Hz was considered as input data for a 2D quality factor tomography. The predicted amplitude is calculated by spectral ground-motion equations for the NW Iran calculated by Motaghi et al. (2016). The residuals show systematic pattern which inspire the idea that 2D attenuation coefficient variations might be observed in the region. We assume that the 2D variations are caused by lateral variations of quality factor and thus we perform a shear wave quality factor tomography using the weighted damped least-squares method. Our results (Figure 1) show a low (lower than average) quality factor anomaly (marked by A) north of the NTF and low quality factor anomaly south of Marand (marked by D). According to geological map (1:2,500,000), these are covered by thick Neogene and Quaternary sediments. Therefore, we attribute these anomalies to sedimentary basins. East of Marand, a high quality factor area (marked by B) is observed trending NW-SE which might be attributed to Cretaceous volcanic rocks with an age of about 100 ±40 million years. Another anomaly is observed with a high-quality factor in the southern mountains of Marand (marked by C). According to the geological map, this anomaly is attributed to the Precambrian metamorphic rocks with an age of ~540 million years. Under the Talesh Mountains (marked by E) and in east of the Sabalan (marked by F), we observed two anomalous features with high and low quality factors, respectively. These features are not consistent with the observable surface structures in mentioned geology map. Instead, we found out that the features are deep (depth > 15 km) because they are disappeared after removing rays generated by deep events (deeper than 15 km) beneath the Talesh mountains. These anomalies are observed in gravity maps and previous seismic velocity tomography studies (e.g., Bavali et al., 2016). We interpret the deep low quality anomaly in east of the Sabalan (marked by F) as a hot structure remained from the Sabalan young eruption. The deep high quality anomaly under the Talesh Mountains (marked by E) might be interpreted as a cold dense crust probably related to an oceanic-like crust beneath the Southern Caspian basin (Figure 2).

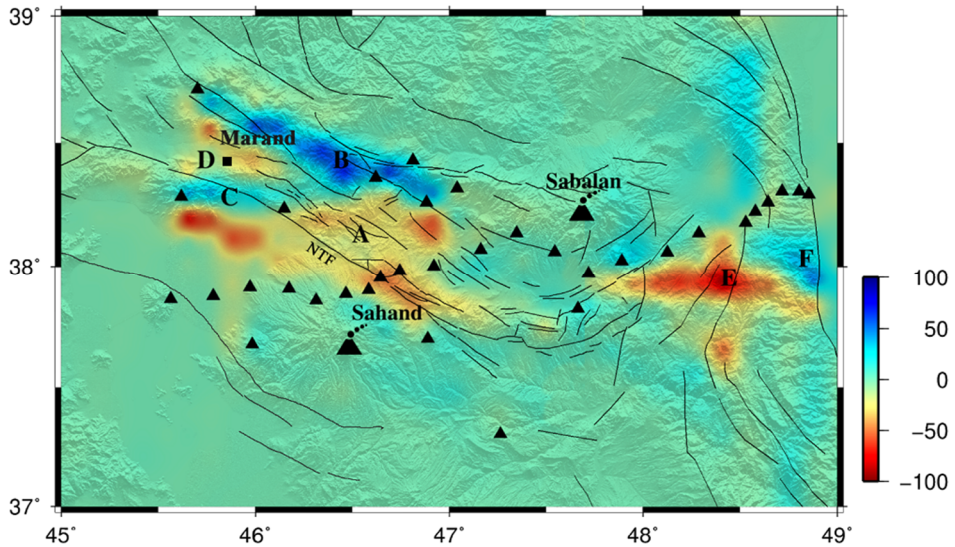

Figure 1. Quality factor tomogram for northwest Iran. Seismic stations are marked by black triangles. Black lines show main faults (Taghipour et al., 2018). NTF: North Tabriz Fault. A–F are anomalous features discussed in the text.

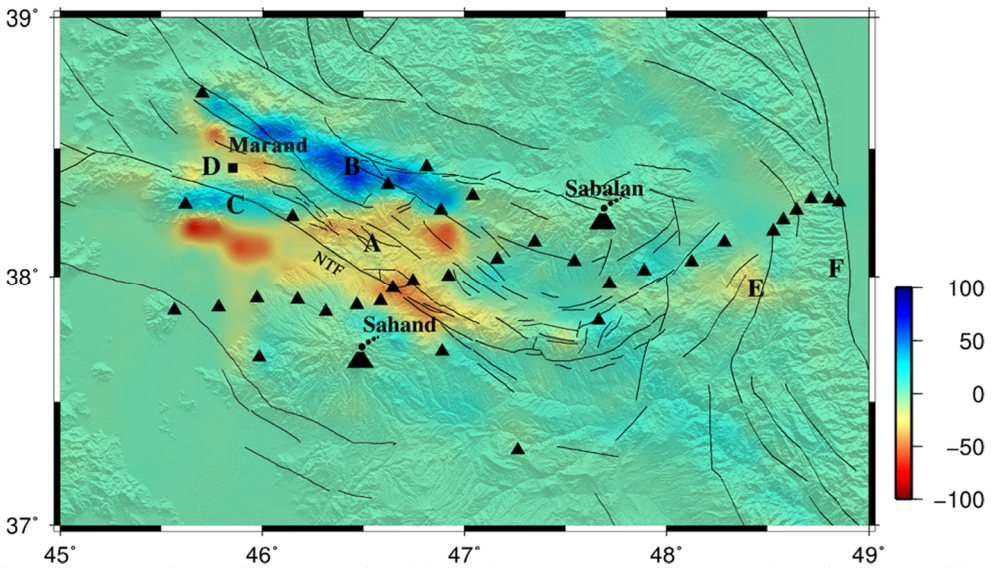

Figure 2. Quality factor tomogram for northwest Iran after deleting deep events (>15 km). Anomaly F disappears while anomaly E weakens considerably.

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