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HIGH RESOLUTION 3D VELOCITY MODEL FOR THE MAKRAN SUBDUCTION ZONE

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Makran subduction zone is formed by subduction of the Arabian oceanic plate under the southern coasts of Iran and Pakistan. It is one of the world's least well documented subduction zones while it contains exceptional geological structures, such as a big Accretionary prism, fore-arc depressions (i.e., Jaz-Murian and Hamun Mashkel) and a sparse volcanic arc. There are a lot of open questions for the Makran like different seismicity between eastern and western Makran, radically low angle dip for the slab, lack of a trench and potential seismic hazard caused by the subduction mega-thrust faults. These encouraged our department to install a dense seismic array in the region and carry out different seismic analysis. Here, we report the result of a teleseismic surface wave tomography.

We extracted fundamental mode Rayleigh waves recorded by 13 permanent stations of Iranian Seismological Center (IRSC), five permanent stations of International Institute of Seismology and Earthquake Engineering (IIEES), and 29 temporary stations installed by Institute for Advanced Studies in Basic Sciences (IASBS) between June 2016 and April 2018 (Figure 1). We selected 109 teleseismic events with magnitudes larger than 5.5, epicentral distance between 30^{o} and 120^{o} and depth less than 50 km. These events generated dense ray coverage for the study region leading to high-resolution phase velocity maps for period range of 25–143 s.

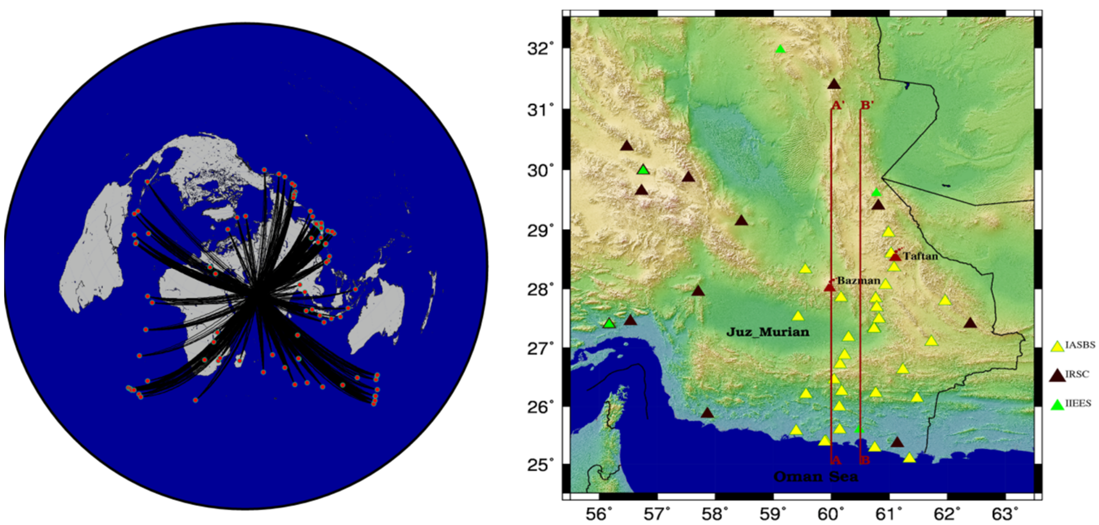

Figure 1. Azimuthal coverage of teleseismic events (left). Station distributions (right). Red lines show location of two velocity cross sections shown in Figure 2.

Instrument response, mean and trend of each seismogram were removed from vertical components of seismograms. To extract the fundamental mode Rayleigh waves dispersion the waveforms were filtered by a series of narrow band-pass filters at periods ranging from 25 s to 143 s. Rayleigh waves were then isolated from other seismic phases by cutting the filtered seismograms using boxcar time windows with a 50 s half cosine taper at each end. The filtered and windowed seismograms were converted into the frequency domain to obtain amplitude and phase measurements for each frequency. The measured data were then used for a surface wave tomography developed by Yang and Forsyth (2006). This method is based on a two plane wave tomography which models each incoming wave field by combining two plane waves (Forsyth and Li, 2005). The obtained local phase velocity dispersions were inverted into Vs models using Bayesian Monte Carlo Markov Chain method (Manu-Marfo et al., 2019) to generate a 3D velocity model for the Makran subduction zone.

Figure 2 shows shear wave velocity structure down to depth of 250 km along two south-north oriented profiles shown in Figure 1. The subducted oceanic slab is clearly observed as a dipping high-velocity anomaly (Figure 2). Low velocity anomalies are also observed in the mantle wedge above the slab. The slab is flat under coastal Makran and dipping down with a small angle (~10^{o}) until north of Jaz-Murian. It is located under the Bazman and Taftan volcanoes at depth of 120 km and 150 km, respectively.

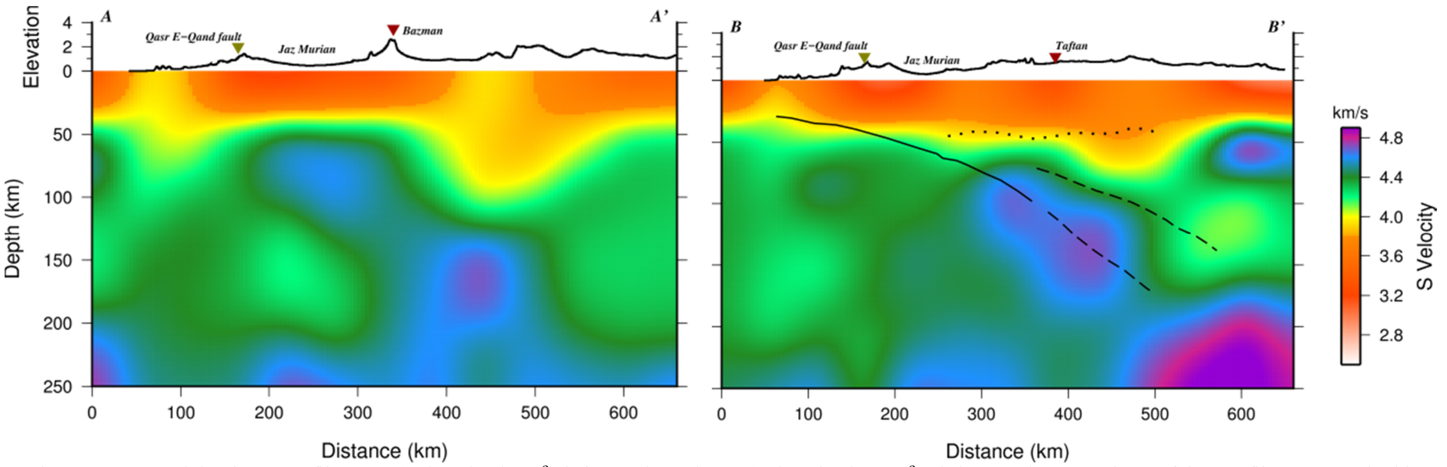

Figure 2. Vs models along profiles AA' (at longitude 60^{o}, left panel) and BB' (at longitude 60.5^{o}, right panel). Locations of the profiles are marked in Figure 1 by red lines. Solid and dash lines show top of the slab while dot line mark base of continental crust. The marked boundaries are obtained from a P receiver function study over the profile BB' (unpublished results).

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