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Fine Crustal Structure in the Northwestern Iranian Plateau Revealed by Ambient Noise Tomography

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Detailed information about the crustal and lithospheric structures is crucial for understanding the geodynamics processes of continental collision and subsequent mountain building. Being at the initial stage of continental collision, the Iranian Plateau has not been well studied due to the lack of high-resolution, robust images of the crustal and lithospheric structures. Along the Zagros Orogen in the NW part of the Iranian Plateau the Arabian Plate has collided with the Eurasian Plate since about 30 Ma ago, whereas in the Makran region to the southeast oceanic subduction underneath the Eurasian Plate is still an ongoing process. For better understanding the geodynamic processes from subduction to collision, we planned to deploy multiple dense seismic arrays sampling regions at different tectonic stages in the Iranian Plateau. Up to now, we have finished the first seismic array observation in NW Iran.

Based on the high quality data recorded, we conduct ambient noise tomography to investigate the fine crustal structure of the area from the south of the Zagros to the coast of the Southern Caspian Sea. Our results revel a salient decoupling between the upper crust and lower crust in the Zagros. The upper crust is slow, likely due to the effects of thick sediments, and displays a consistent anisotropy pattern with a NW-SE fast shear-wave direction, which is proximately parallel to the strike of the Zagros Orogen. The middle to lower crust, on the other hand, shows low-to-high velocity variations with depth and anisotropic fabrics trending to NE-SW, which is perpendicular to the strike of the orogen. Combined with the imaging results from receiver functions, we suggest that the collision between the Arabian and Eurasian Plates has caused strong crustal deformation and localized thickening of the lower crust beneath the Zagros. We also find a high velocity anomaly in the lower crust beneath the Alborz Mountain, isolated from the low velocities beneath the central Iran. The fast lower crust beneath the Alborz displays NE-SW trending anisotropic fabrics, similar to and even stronger than that observed in the Zagros region, whereas the upper crust of the Alborz doesn't show a consistent anisotropy pattern. This observation in combination with regional tectonics suggests that the lower crust of the Alborz probably preserved the structural and deformation features of the collisional orogens associated with the closure of both Paleotethys and Neotethys.