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Segmented African Lithosphere Beneath Anatolia Imaged by Teleseismic P-Wave Tomography

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Anatolia, a part of the Alpine-Himalayan orogenic belt, is shaped by a variety of complex tectonic processes that define the major tectonic provinces across which different deformation regimes exist. Collision related plateau formation dominates the present lithospheric deformation to the east and slab roll-back related back-arc extension takes place in the west. The two zones are connected at the northern part of the region by strike-slip faulting along the right-lateral North Anatolian Fault Zone. Recent seismological studies show that the Eastern Anatolian Plateau (EAP) is supported by hot asthenosphereric material that was emplaced beneath the plateau following the detachment of subducted Arabian lithosphere. The westward continuation of the deeper structure of Anatolia was previously less well constrained due to the lack of geophysical observations.

In order to study the deeper lithosphere and mantle structure beneath Anatolia, we used teleseismic P-wave tomography and data from several temporary and permanent seismic networks deployed in the region. A major part of the data comes from the North Anatolian Fault passive seismic experiment (NAF) that consists of 39 broadband seismic stations operated at the north central part of Anatolia between 2005 and 2008. We also used data collected from permanent seismic stations of the National Earthquake Monitoring Center (NEMC) and stations from the Eastern Turkey Seismic Experiment (ETSE). Approximately 34,000 P-wave travel time residuals, measured in multiple frequency bands, are inverted using approximate finite-frequency sensitivity kernels.

Our tomograms reveal a fast anomaly that corresponds to the subducted portion of the African lithosphere along the Cyprean Arc. This fast anomaly dips northward beneath central Anatolia with an angle of approximately 45 degrees. However, the anomaly disappears rather sharply to the east beneath the western margin of the EAP and to the west beneath the Isparta Angle. The western segment of the subducted African lithosphere appears as a continuous fast anomaly beneath the Aegean Sea separated from the eastern segment by a sub-vertical tear. The tear between these segments is occupied by slow velocity anomalies that underlie the Kula Volcanic field in western Anatolia. In this respect, it appears that the current segmented configuration of the subducted African lithosphere plays important role in the tectonic configuration of Anatolia