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Pn tomography of the Eastern Mediterranean Region

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The eastern Mediterranean is a transient tectonic setting: plate boundary zone is reorganized by fast lateral motion of the buoyant continental microblocks, migrating slab detachment and subduction to transform transitions, transition from subduction to collision. Likewise, the eastern Mediterranean is one of the fastest deforming regions on Earth. Here, there are opportunities to study the relationships between deeper processes and the surface (e.g. mantle circulation and plate motions, dynamic topography and plateau formation, slab tears).

Aforementioned transient events may provide insight into the lithospheric–scale processes that drive the development or collapse of a plate boundary zone. Space geodetic technologies provide adequate dataset for the surface processes in the region, however sub-lithospheric structure is poorly resolved. In order to develop a working explanation, we need higher resolution images. This can only be resolved by regional tomography.

In this study, we used Pn traveltimes to determine lateral velocity variations of uppermost mantle in the eastern Mediterranean region. Between 2000 and 2018, more than 450 000 Pn arrivals are compiled from 6600 regional earthquakes recorded by 2880 seismic stations of permanent and temporary networks. The results reveal features that correlate well with the heterogeneous lithospheric architecture of the region. Large perturbations of Pn velocities are observed from continental to oceanic areas. Mediterranean, Black Sea, Aegean Sea, Ionian Sea and Adriatic Sea display high Pn velocities (> 8 km/s) while the majority of Anatolia and mainland Greece shows low Pn velocities (< 7.8km/s). The increased station density and large number of earthquakes allow to delineate the smaller scale features along the Hellenic and Cyprus arcs. The small scale lateral variations of Pn velocity along the arc are consistent with the slab tears known from the teleseismic tomography. Especially, a tear between the oceanic portion of the Nubian plate and the Arabian plate, right below the Dead Sea fault shows characteristics of a slab tear (or window).