



New seismological evidence for fragmentation of the Tethys slab beneath Anatolia

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When oceanic basins close after a long period of convergence and subduction, continental collision and mountain building is a common consequence. The eastern Mediterranean basin is the last remainder of a once hemispherical neo-Tethys ocean that has nearly disappeared due to convergence of the India and Africa/Arabia plates with the Eurasia plate.

New results from full waveform inversion for Anatolia give an unprecedented view on the crust and the upper mantle of the region. Based on highly accurate spectral-element simulations of seismic wave propagation in heterogeneous Earth models, full waveform inversion exploits complete seismograms – including body and surface waves – for the benefit of improved resolution. Furthermore, 3D structure in both crust and mantle is constrained jointly, thereby avoiding contamination from commonly applied crustal corrections. Second-order adjoint techniques provide quantitative estimates of direction- and position-dependent resolution length, which is essential for the interpretation of the model.

The images connect major structures in the crust as documented in the geology, to features in the upper mantle that reflect the remnants of the convergence and collision. The results show a major discontinuity between western Anatolia lithosphere and the region to the east of it. It is the imprint of syn-collisional segmentation of the neo-Tethys slab, and separates the Aegean and west Anatolia regions from central and east Anatolia. While convergence between Africa and Europe continued, this initiated a period of lithospheric extension in the west and flat slab subduction in the east that set the stage for earthquake and volcanic activity in the region today. Slab segmentation is expected to have been relatively common just prior to closure of other oceans in the geological past, and may explain some of the complexity that geologists have documented in, for instance, the Tibetan plateau also.