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The effects of subduction termination on the continental lithosphere: Linking volcanism, deformation, surface uplift, and slab tearing in central Anatolia

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The lithospheric evolution of Anatolia is largely defined by processes associated with the terminal stages of subduction along its southern margin. Central Anatolia represents the transition from the subduction of oceanic lithosphere at the Aegean trench in the west to the Arabian – Eurasian continental collision in the east. In the overriding plate, this complicated transition is contemporaneous with uplift along the southern margin of central Anatolia (2 km in ∼6 Myr), voluminous felsic-intermediate ignimbrite eruptions (>1000 km3), extension, and tectonic deformation reflected by abundant low-magnitude seismic activity. The addition of 72 seismic stations as part of the Continental Dynamics – Central Anatolian Tectonics project, along with development of a new approach to the joint inversion of receiver functions and dispersion data, enables us obtain a high-resolution 3D shear wave velocity model of central Anatolia down to 150 km. This new velocity model has important implications for the complex interactions between the downgoing, segmenting African lithosphere and the overriding Anatolian Plate.

These results reveal that the lithosphere of central Anatolia and the northern Arabian Plate is thin (<50 to 80 km). The Central Taurus Mountains, which have experienced ∼2 km of uplift in the past ∼6 Ma, are underlain by the fastest shear velocities in the region (>4.5 km/s), indicating the presence of the Cyprean slab beneath central Anatolia. Thus, uplift of the Central Taurus Mountains may be due to slab rebound after the detachment of the oceanic portion of the Cyprean slab beneath Anatolia rather than the presence of shallow asthenospheric material. These fast velocities extend to the northern margin of the Central Taurus Mountains, giving way to a NE-SW trend of very slow upper mantle shear wave velocities (<4.2 km/s) beneath the Central Anatolian Volcanic Province. These slow velocities are interpreted to be shallow, warm asthenosphere in which melt is present. The combination of a shallow asthenosphere and lithospheric-scale weaknesses associated with relict tectonic structures formed during the assembly of Anatolia are responsible for the spatial distribution of volcanism in the Central Anatolian Volcanic Province. Finally, we present a model for the evolution of central Anatolia that brings together the volcanism, extension in the Kirsehir Block, uplift of the southern margin of central Anatolia, and our seismic images.