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Uplift of the southern margin of the Central Anatolian Plateau (Turkey): A record of tectonic and upper mantle processes

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Deciphering the geodynamic mechanisms of topographic development is often thwarted by low-resolution paleotopographic reconstructions, poor constraints on deep earth processes, and limited integration of other evidence for geodynamic processes such as modes of structural deformation. The Mediterranean Basin offers particular challenges, as the complex tectonic plate boundaries and lithospheric slab geometries have changed substantially throughout the Cenozoic. The southern margin of the Central Anatolian plateau fortunately provides a rich record of geomorphologic, stratigraphic, and structural evidence for the timing, pattern, and mode of surface uplift. Combined with recently published tomography, the plateau margin provides detailed evidence of how tectonic and lithopheric slab processes have contributed to topographic growth through time.

We use detailed biostratigraphic analyses of uplifted marine sediments, interpretations of transient river profiles, and cosmogenic nuclide dating of fluvial strath terraces in the Mut Basin and adjacent areas to decipher the uplift history along the 2- to 3-km high southern margin of the plateau. Uplifted marine sediments reveal that surface uplift rates of 0.1 to 0.3 mm/yr throughout the plateau margin started between $\sim$7 and 5.5 Ma, followed by a phase of faster uplift (0.7 mm/yr) in the Mut Basin starting at 1.6 Ma. These faster uplift rates may have continued to modern times, as average river incision rates of 0.52 to 0.66 mm/yr along the Göksu River in the Mut Basin have occurred from ca. 130 ka to today. Transient river profiles in the region support the onset of a sudden increase in uplift rates, with quantitative interpretations of the river profiles reflecting an uplift history that is broadly consistent with the constraints from the uplifted marine sediments. Interestingly, the onset of uplift is generally coeval with a change from contractional to extensional deformation throughout the region, which appears to rule out the possibility of crustal shortening and thickening to explain the topographic growth.

Published P-wave and S-wave tomography provides additional constraints to help interpret our stratigraphic, geomorphic, and structural observations. Slow p-wave speeds occur in a broad band across southern Turkey, and have been interpreted as resulting from slab break-off beneath Eastern Anatolia (extending as far west as Cyprus), and possibly also from a slab tear between the Aegean and Cyprus slabs. While slab break-off or tearing alone can explain the pattern and magnitude of Late Miocene to Pliocene uplift, a different mechanism is likely responsible for the later, faster uplift of the Mut Basin, such as blockage of the subduction zone south of Cyprus when the Eratosthenes seamount entered the trench in early to middle Pleistocene time.