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Quantifying post-Tortonian relief change at the southern margin of the Central Anatolian plateau (Turkey)

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The Central Anatolian plateau in Turkey is a part of the largest continental collision belt on Earth, extending from the Turkish-Iranian-Caucasus orogen to the Himalayan-Tibetan orogen, and resulting from collision of Arabia and India with Eurasia. Changing relief in the region is mainly due to the different geodynamic processes responsible for the development of the collision belt and the uplift of the orogenic plateau. The peak elevations along the southern margin of the Central Anatolian plateau reach close to 4,000 m (Demirkazik Dağ, 3,756 m; Emler Dağ, 3,723 m; Kizilkaya Dağ, 3,725 m) to the SE, and less than 3,000 m (Dipoyraz Dağ, 2,976 m; Dökük Dağ, 2,405 m) to the SW. In contrast, the elevation of the plateau interior is between 1,000 and 1,500 m. Using geologic relations, geomorphology, and biostratigraphy of uplifted marine sediments, we quantify early (pre-Tortonian) topographic relief along the southern margin of the plateau that resulted from an orogenic phase of relief growth, as well as additional relief developed during a later and likely continuing phase of plateau development.

The present relief of the southern margin of the Central Anatolian plateau is due to a complex succession of geological processes that affected this region from late Eocene to present time. The Taurus orogeny, which affected the area starting from the late Eocene, as well as the kinematics of some restraining bends along the Ecemiş Fault and possibly also the Kirkkavak Fault, are responsible for the first occurrence of topography at the southern margin of the Anatolian Peninsula (orogenic phase of relief growth). The paleorelief grew in the area following the closure of the Neotethyan Ocean at the southern margin of the Tauride block. Oligocene-Lower Miocene continental deposits, mainly coarse-grained clastics, sedimented on top of a regional erosive surface throughout the southern margin, which testifies to the presence of an Oligocene-Lower Miocene land area with some relief. This ancient relief is further demonstrated by a network of paleovalleys that incises into a paleosurface currently perched at 1,500-2,200 m. The occurrence of Late Miocene (upper Tortonian) shallow marine deposits at an elevation of ca. 2,000 m along the southern margin suggests that additional relief along the southern margin was achieved during uplift events younger than 8 Ma.

The onlap termination of Late Miocene (most likely lower Messinian) shallow marine strata onto the highly deformed Tauride units of both SE and SW margins suggests that pre-Tortonian paleorelief was still present in the form of two high ridges at the end of the Miocene epoch. Using palaeoshoreline indicators (mainly wave-cut platform and lithophaga-bored pebbles), which at the SW margin point to an early Tortonian shoreline resting at ca. 1,500 m above the present sea level, we were able to reconstruct the pre-Tortonian relief as characterized by mean elevations of 1,000 m and maximum peaks of ca. 1,500 m. In contrast, the central part of the southern margin was below sea level from Middle Miocene to at least lower Messinian time, as indicated by widespread shallow marine sedimentation.

A second phase of relief growth began at the end of the Messinian stage (5.45 Ma), as testified by the thick (> 1 km) upper Messinian clastic deposition in the Adana Basin (Handere Fm.) and the end of marine sedimentation throughout the region. This latter uplift phase, which most likely is still active, is responsible for the dramatic change of the relief of the whole Anatolian Peninsula and the formation of the Central Anatolian plateau. This second phase of relief growth added 1,500-2,000 m to the topography of the southern margin of the Central Anatolian plateau, with a long-term surface uplift rate of ca. 0.27-0.37 mm/a.