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Structural controls on basin development during Miocene to recent extension of the Menderes Massif in western Turkey

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The conceptual understanding of crustal extension and rifting is largely based on the premise of structural continuity along strike, even though architecture and strain in extensional provinces can vary substantially. Here we present an example of such along-strike variation: the extension of continental crust in the Menderes Massif of western Turkey.

The Menderes Massif is a metamorphic basement complex comprising the structurally lowest tectonic units of the Alpine orogenic belt in western Turkey. The exhumation of the Menderes Massif is mainly due to tectonic denudation since the earliest Miocene. The most prominent extensional structures in western Turkey are Miocene to recent E-W trending grabens. Two of these grabens – the Gediz graben in the north and the Büyük Menderes graben in the south – delimit the Central Menderes Metamorphic Core Complex (CMCC). The area north of the CMCC – the northern Menderes Massif – displays a pattern of NE-striking basins bounded by basement domains. South of the CMCC similar basins strike NNW rather than NE. Both the NE – and the NNW – striking basins appear to have formed contemporary with early manifestations of the E–W graben, but are much shallower. Previous studies have suggested that bounding faults or basal detachments controlled the NE-striking basins, but there is little direct evidence to support either of these claims.

We propose that shearing during sinistral strike slip has caused transtensional folding with a wavelength of tens of kilometers in the Menderes Massif. Folding caused uplift of basement in the anticlines, while providing accommodation space for the Miocene basins in the synclines. Transtensional folding was accompanied by the early stages of tectonic denudation of the CMCC, which also appears to have accommodated higher extensional strain towards its western limit. This combination of folding and faulting is likely to have accommodated a gradient in crustal extension between western Turkey and the Aegean Sea region. Whereas the Hellenic subduction zone retreated in the Aegean since the earliest Miocene, this apparently did not occur in western Turkey, where instead there is evidence for a tear in the slab. Our model provides an explanation for the geometry and timing of Neogene basins in the Menderes Massif, and may be applicable to extension geometry at marginal zones of other continental backarcs.