Slip-sense inversion in Iran: Implications for Eurasian tectonics

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The left-lateral Doruneh Fault System (DFS) bounds the north margin of the Central Iranian microplate, and has played an important role in the structural evolution of the Turkish-Iranian Plateau and of Afghanistan. The western termination of the DFS is a sinistral synthetic branch fault array that shows clear kinematic evidence of having undergone recent slip sense inversion from a dextral array to a sinistral array in the latest Neogene or earliest Quaternary. Similarly, kinematic evidence from the Anarak Metamorphic complex at the southwestern most branch of the DFS terminal fault array suggests that this core complex formed at a transpressive left stepping termination and that it was inverted in the latest Neogene to a transtensional fault termination. The recognition that the DFS and possibly other faults in NE Iran were inverted from dextral to sinistral strike slip in the latest Neogene, and the likely connection between the DFS and the Herat Fault of Afghanistan suggests that the evolutions of Afghanistan and the Indo-Asian collisional system are linked to the tectonic evolution of the Turkish-Iranian Plateau. This speculative model explains the Late Neogene tectonic realignment of the Arabia-Eurasia collision zone in terms of the interaction between the Afghan blocks that were extruding west from the Indo-Asian collision and the Turkish Iranian collision zone that was evolving to the east as Arabia sutured diachronously with Eurasia. The collision of the Afghan blocks with East Iran effectively locked the respective eastern and western free boundaries for the Arabia-Eurasia, and Indo-Asian collisional belts and forced them to diverge away from one another. If confirmed, this explains the Late Miocene to Pliocene tectonic reorganization that is recognized across the Middle East and has implications for geologic process models across the region. Regional tectonic reorganization and/or inversion may (1) invert and possibly breach older Cenozoic structures while forming a younger generation of post-Miocene structures, (2) reorganize drainage and sediment supply networks, and sealing and obscuring older structural and stratigraphic bodies under younger sediments, (3) rejuvenate existing structures and trigger secondary fluid migration, and (4) increase exhumation, sediment supply, and subsidence in late Neogene basins across the region.