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Structural and geomorphic fault segmentations of the Doruneh Fault System, central Iran

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The active tectonics of Iran results from the northward Arabia–Eurasia convergence at a rate of ∼22±2 mm/yr at the longitude of Bahrain (e.g., Sella et al., 2002). At the southwestern and southern boundaries of the Arabia-Eurasia collision zone, the convergence is taken up by the continental collision in the Zagros Mountains, and the active subduction of Makran, respectively. Further north, the northward motion not absorbed by the Makran subduction is expressed as the N-trending right lateral shear between central Iran and Eurasia at a rate of ∼16 mm/yr (e.g., Regard et al., 2005; Vernant et al, 2004). This shear involves N-trending right-lateral fault systems, which are extended at both sides of the Lut block up to the latitude of 34°N. North of this latitude, about 35°N, the left-lateral Doruneh Fault separates the N-trending right-lateral fault systems from the northern deformation domains (i.e., the Alborz, Kopeh Dagh and Binalud mountain ranges). At the Iranian tectonic scale, the Doruneh Fault represents a curved-shape, 600-km-long structure through central Iran, which runs westward from the Iran-Afghanistan boundary (i.e., the eastern boundary of the Arabia-Eurasia collision zone) to the Great Kavir desert. Nevertheless, east of the longitude of 56°45'E, the fault is expressed as an E-trending ∼360-km-long fault (hereinafter the Doruneh Fault System - DFS) having a geological evolution history different from the western part (the Great Kavir Fault System). In this study, we look for characterizing geomorphic and structural features of active faulting on the DFS. Detailed structural and geomorphic mapping based on satellite Imageries (SPOT5 and Landsat ETM+) and SRTM digital topographic data, complemented with field surveys allowed us to establish structural and geomorphic segmentations along the DFS. According to our observations, the DFS is comprised of three distinct fault zones: (1) The 100-km-long, N75°E-trending western fault zone, which is characterized by the left-handed step-over geometry and its associated geomorphic features such as pull-apart basins, (2) The 100-km-long, E-trending central fault zone characterized by pure left-lateral offsets recorded by alluvial fan and drainage systems incised in, and (3) The 160-km-long, N115°E-trending eastern fault zone along which the active faulting is distributed into a 24-km-wide (maximum) fault zone characterized by Quaternary reverse faulting and thrust-parallel folding. At the regional scale, the eastern fault zone likes a horsetail fault termination for the DFS. Our results indicate that the central fault zone is a pure left-lateral strike-slip fault. Taking the northward convexity of the DFS into account, such a pure strike-slip faulting on the central fault zone involved (1) the eastern fault zone in a compressional regime, and (2) the western fault zone in a transtensional tectonic regime. These structural relationships led us to propose a tectonic model in which the central fault zone controls the deformation pattern and faulting mechanism on both terminations of the DFS.