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Role of strain partitioning on along-strike major relief segmentation. A case study of Western Betics

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Along-strike and traverse variations of the structural relief can be explored as the result of the coexistence of deformation structures with very different local tectonic regimes. Neotectonic regions with dominant conformable reliefs make easier to establish the relationships between structural and topographic relief and the combined use of geomorphic and structural methods. This is the case of the Western Gibraltar Arc (WGA), Western Mediterranean, where Neogene strain partitioning modes show the coexistence of arc-perpendicular shortening and arc-parallel stretching structures.
We have analyzed a major along-strike relief discontinuity in the southwestern end of the Serrania de Ronda ranges in Western Betics. These topographic NE-SW lineaments, with altitudes about 1300-1400 m, sharply drops to a morphostructural province with minor ranges (about 700-800m) and/or relative flat sectors with small hills, not surpassing 200 m in height. The transition between the two provinces spatially coincides with three main structural features: a) general SWwards plunge of Neogene fold axis; b) SW end of most fold axial traces (northern province); and c) location of two major fault zones: the so called Colmenar normal Fault and the strike-slip Gaucín Fault Zone, this being the SW boundary of the Betic Internal Zones.
The structural revision of the Colmenar Fault sector shows that a former normal fault (the Colmenar Fault s.str.), Middle Miocene in age, has been gently folded by Upper Miocene to Pliocene NE-SW open folds and later faulted by high angle NW-SE normal faults. Downthrow (southwestern) block of the late fault system closely coincides with the former one of the Colmenar Fault, thus amplifying the structural level drop of the SW province.
The NW-SE trending Gaucin Fault Zone crops out along 20 km and appears as a deformation band in which brittle deformation structures and/or the reorientation of reference markers (bedding, foliation, lineations) systematically occurs. Width of the fault zone is very variable (0,5 to 5 km), thickening toward the NW fault tip zone. Minor structures and map scale criteria (strike separation of cutoff lines along the main faults, and the counterclockwise rotations) indicate a dominant left lateral slip sense. The SE third of the outcropping fault trace shows an oblique, left lateral-normal slip sense, indicating that the downthrow block is located in the SW side.
Calculations of SLk geomorphic indices indicate a general NW-SE anomaly that encloses both the Colmenar and the Gaucin fault traces. Highest anomaly values are detected in the Colmenar sector, although significative anomalies can be also identified near the Gaucin Fault, together with low values of Vf indices.
Our results suggest that along-strike segmentation of the structural and topographic relief is essentially due to arc-parallel stretching accommodated both by normal and strike-slip faults. These fault systems have been probably active from the Upper Miocene up to the Pliocene or later, according to structural and geomorphic data. These results illustrate the relationships between characteristic relief patterns and the dominant strain partitioning modes in Western Betics, where arc-parallel stretching is related both to outward divergent thrusting and to the progressive tightening of the WGA.