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Geomorphic analysis of the Sierra Cabrera, an active pop-up in the constriction domain of conjugate strike-slip faults: the Palomares and Polopos fault zones (eastern Betics, SE Spain)

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Segments of the Quaternary sinistral Carboneras and Palomares fault zones, striking NE-SW and NNE-SSW, respectively, terminate in the Sierra Cabrera antiform together with the conjugate dextral WNW-ESE striking Polopos fault zone. In the constriction domain between these fault zones a pop-up structure occurs formed by the North and the South Cabrera reverse faults that bound the northern and the southern hillslopes, respectively. In order to test the Quaternary activity and relief control of these fault zones, here we present new qualitative and quantitative geomorphic analyses for the Sierra Cabrera using the following indices: mountain-front sinuosity, valley floor width-to-height ratio, drainage basin asymmetry factor, basin hypsometric curve and integral, and the SLk index. These analyses were performed with the aid of several maps such as the SLk and the minimum bulk erosion map.

Qualitative observations carried out on the drainage network highlight the existence of a Late Miocene fold-related drainage network and a following late Miocene to Plio-Quaternary fault-related one. Integrating the mountain-front sinuosity and the valley floor width-to-height ratio for each mountain front we estimated the uplift rates associated to each of them. Fault-related mountain-fronts with a N50-60ºE strike have reverse kinematics and uplift rates larger than 0.5 m ky-1 (e.g. North and South Cabrera reverse faults), whereas those with N20-30ºE and N90-100ºE strikes show oblique strike-slip kinematics and show lower uplift rates, between 0.05 and 0.5 m ky-1 (e.g. the Palomares and the Polopos fault segments). Furthermore, these faults produce knickpoints, complex basin hypsometric curves, high SLk anomalies and highly eroded basins above the fault traces.

The estimated uplift rates are larger than those obtained from other authors for strike-slip faults in the eastern Betics that range between 0.1 and 0.05 m ky-1 (e.g. Palomares and southern Carboneras strike-slip fault segments). These larger uplift rates with our geomorphic and structural dataset indicate that the relief of the Sierra Cabrera antiform is controlled by reverse faults. The obtained dataset highlights the occurrence of a pop-up structure formed by the North and South Cabrera reverse faults in the constraining domain between the larger Palomares-Polopos conjugate strike-slip faults. Existing GPS geodetic data suggest that the North and South Cabrera faults probably accommodate large part of Africa-Iberia convergence in the region.