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Geomorphic response to Carboneras fault activity in Sierra Cabrera (SE Betics, Spain)

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Here we present new geomorphic data from Sierra Cabrera in the northernmost outcrops of the Carboneras fault zone. In order to detect present tectonic activity in the area and to define the tectonic control on the current relief qualitative and quantitative geomorphic analyses were conducted.
The most important recent faults in the southeastern Betics are the sinistral strike-slip Carboneras and Palomares faults, with NE/SW and NNE/SSW strike, respectively, and the conjugate Gafarillos dextral that has an E/W to WNW/ESE strike. All these faults merge in the Sierra Cabrera area and have been active since the latest Miocene until present in response to NW-SE convergence between Africa and Iberia. Displacement along the westernmost segments of the Palomares fault has been accommodated by the Cabrera reverse fault in the Sierra Cabrera northern mountain slope. The northern termination of the Carboneras fault in the southeastern Sierra Cabrera mountain front also produces important relief, suggesting an active transpressive regime for this segment of the fault zone.
Qualitative observations were carried out on the drainage network, spatial distribution of drainage basins and their geometric relationships, and, finally, on topographic and longitudinal stream profiles. Quantitative geomorphic analyses were done employing the following geomorphic indices: mountain front sinuosity, basin asymmetry factor, basin hypsometric curves and integral, ridge-line profiles and finally SLk index. These analyses were performed with the aid of several maps such as the SLk and the minimum bulk erosion map. The geomorphic analyses conducted suggest that the faults that bound the northern and southern mountain fronts of Sierra Cabrera are tectonically active.
The Cabrera reverse fault, producing an important uplift of its southern block, and thus of the Sierra Cabrera northern slope, seems to be responsible for the occurrence of a high SLk anomaly that bounds the northern front of the ridge. The geomorphic evidence of such tectonic activity along the Cabrera reverse fault are: a) the northwards asymmetry of the entire ridge, b) low Smf index values of the northern front, c) southward advance of the northern slope drainage basins, d) the occurrence of basins with complex and S-shaped hypsometric curve shape, e) “foot-rejuvenation” of the northern slope streams that locally present nick points, f) and finally basin showing high bulk erosion values just to the south of the fault.
The high SLk anomaly located at the southern slope of the ridge should be associated to transpressive fault segments belonging to the Carboneras fault system that produce an uplift of its northern block. This tectonic activity is confirmed by the occurrence of drainage basins with S-shaped hypsometric curve shape and streams characterized by nick points.