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Geomorphic evidences of recent tectonic activity in Sierra Nevada dome (Betic Cordillera, SE Spain)

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The physiography of the Betic Cordillera consists in a number of basins and ranges, mainly resulting from extensional tectonics active since the Miocene; the ranges correspond to large-scale open antiforms, while the basins correspond to open synforms. The Sierra Nevada dome, located in the central part of the Betic cordillera, is one of the largest antiform and it includes the highest peaks on the Iberian Peninsula (e.g., Mulhacén, 3482 m). It formed since the late Miocene in the foot-wall of a core-complex-type extensional detachment system related to the extensional collapse of the Betic-Rif orogenic belt. In detail, the Sierra Nevada dome was developed by the interference between two orthogonal sets of NNE-SSW and E-W open folds. The NNE-SSW folds have been interpreted as isostatic folds related with the unloading of the extensional detachment foot-wall, whilst the E-W folds have a contractional origin related with the Europe-Africa convergence. The western and southern border of the Sierra correspond to W-SE normal faults and W-E strike-slip faults and bound the foot-wall of the extensional structures and they depict prominent mountain fronts separating metamorphic rocks of the Sierra from the Neogene sediments of the surrounding basins.

We carried out a geomorphologic study with the aid of checking the recentmost tectonic activity in this mountain range. On this purpose, we have calculated several geomorphic indexes in Sierra Nevada. Mountain front sinuosity (Smf) systematically varies from the southern and southwestern mountain fronts (1.12-1.14) to the northern mountain front (1.45-2.05). These data suggest that active faulting is more important in the southern and southwestern borders of Sierra Nevada, as also evidenced by other geological features. Ratio of width of valley floor to valley height (Vf) shows the same variation pattern as the Smf. This index ranges between 0.01 and 1.14 with the lower values in the southern and southwestern mountain fronts. The drainage network in the Sierra is tectonically controlled by booth NNE-SSW and W-E folds. Nevertheless, river profiles indicate that maximum linear erosion is concentrated in the western border of the sierra, thus pointing to maximum uplift related with the NNE-SSW isostatic folds. This fact is also visible in basin asymmetries, which are influenced mainly by the NNE-SSW folds. The hypsometric curves describe younger and more active basins along the southern border of the Sierra. All these indices indicate that the recent tectonic activity in the Sierra is mainly controlled by the extensional tectonics in the west and contractional tectonic in the east, where the extensional system became inactive.