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Estimation of shortening and slip rates using 2D/3D restoration techniques: Alhama de Murcia–Alcantarilla segment of the Alhama de Murcia Fault (Murcia, SE Spain)

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The Alhama de Murcia - Alcantarilla segment, northeastern end of the Alhama de Murcia Fault, is one of the structures of the Eastern Betic Shear Zone (SE Iberia). This is a low strain region whose faults show low slip rates, so they do not provide clear evidence of their seismogenic activity. Quantifying the net slip of each segment of the Alhama de Murcia Fault is essential for seismic hazard assessment using faults as seismogenic sources.

The kinematics of the Alhama de Murcia Fault in Alhama de Murcia – Alcantarilla segment is oblique, with a main sinistral component of the slip and a component of shortening, both related to the positive tectonic inversion experienced in the Neogene Fortuna Basin from the Late Miocene. In order to know the role of shortening in the net slip and its influence on the changing relief along the strike of the basin-bounding, we have built a 3D geological model of the area. The structural model is based on seismic reflection profiles which have been later input in MOVE, a structural modelling software.

The first approach to estimate an amount of horizontal shortening is provided by conventional area-balance methods applied to a harpoon-shaped inversion anticline associated with the reactivation of the fault. The estimated shortening is between 465 and 671 m, which means a shortening rate of 0.09 - 0.26 mm/yr during the last 5.3 Ma. This data constitutes one of the inputs to test a 2D and 3D forward model from an original horizontal stratigraphy and reproducing the extensional sequence prior to the tectonic inversion.

On the other hand, at the SW end of the Alhama de Murcia - Alcantarilla segment, a more prominent relief (La Muela Range) is uplifted in comparison with the rest of the segment. This difference in the relief could be associated with an increase in shortening in this area, a change in the response of the local materials to the deformation, a change in the direction of the fault or an interaction with other structures. We have constructed a 3D model in detail that reproduces La Muela anticlinal fold based on a DEM and the stratigraphy defined in the previous model. This allows a 3D restitution of the structure and evaluating the amount of slip and its obliquity angle.