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Late Miocene east- to southeast-directed extension in the Betics and its role in the development of the Algero-Balearic basin (Southeastern Betics).

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Late Miocene extension in the eastern Betics has normally been interpreted as related to local transtensional settings in a general context of continental transcurrent and contractive tectonics. Here we show for the first time the presence of low-angle brittle extensional detachments and associated listric faults produced during Middle Miocene to Tortonian large-scale upper-crustal extension. The main detachment shows low-angle ramp geometry and cuts down into the Nevado-Filabride complex exhuming graphite schist of the Calar-Alto HP/LT unit in the Lomo de Bas mountain range. Strongly tilted rocks of the Maláguide, Alpujárride and Nevado-Filabride complexes form the hanging-wall of the detachment. These rocks are cut by a system of high-angle normal faults with SE to ESE shear sense that bound the southeastern hillslopes of the main mountain ranges in the southeastern Betics. The normal faults cut Tortonian marine sediments, producing syndepositional progressive unconformities typical of synrift sedimentary sequences. There is strong time and space correlation between upper-crustal extension and the emplacement of Si-K rich dacitic volcanic and subvolcanic rocks that locally intrude the fault zones. The extensional system is locally segmented by WNW-ESE strike-slip transfer faults like the dextral Moreras fault in the Mazarrón basin. Extension seems to have propagated from east to west where the younger syndepositional sediments occur.
Extensional faults at the western end of the Algero-Balearic back-arc basin show an eastward component of extension, observed on deep seismic reflection lines and share the activity timing with the onshore structures described above. Thus, the transition between the Algero-Balearic oceanic crust and the southeastern continental Betic margin that occurs abruptly along the E-W Mazarrón escarpment might be characterized by a sinistral transform fault system. Coeval extension in the adjacent oceanic and continental domains probably occurred by related mechanisms, slab retreat beneath the Algero-Balearic basin and edge delamination and lateral tearing of the subducted south Iberian continental slab under the continental margin. Late Miocene extension in the Betics was strongly heterogeneous with westward directed extension occurring in great part of the Betics and Alboran sea, whilst eastward-directed extension occurred to the east of the Alboran volcanic arc in the Algero-Balearic basin and the Easternmost Betics. Continued NW-SE convergence between Africa and Iberia during the latemost Miocene to Quaternary produced tectonic inversion of the extensional structures, which were folded or underwent a change in their kinematics from normal to strike-slip or reverse.