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Elastic block model for the Betic-Rif Arc from inversion of GPS data

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This work provides an updated kinematic block model for the Betic-Rif region in western Mediterranean based on the compilation of the most recent GPS measurements. The study zone includes the tectonic plate boundary between the Nubia and Eurasia plates, where the exact boundary between the two plates is diffuse. The complexity of the plate boundary in the Betic-Rif arc is also evidenced by: i) broad spatial distribution of seismicity; ii) variety of focal mechanisms; iii) non-uniform crustal deformation field deduced from GPS observations.

In this study we compiled the GPS results obtained from the Topo-Iberia CGPS network consisting of 25 CGPS sites (21 in Spain and 4 on Morocco) with the previously published GPS velocities from the region. The GPS velocities from various sources were transformed into a common Eurasia reference frame using the VELROT routine of the GAMIT/GLOBK software from MIT. The resulting GPS velocities were complemented with the seismic and geologic information. A kinematic model of the elastic blocks was obtained by the inversion of these data using the TDEFNODE software. Specifically, we used the GPS derived horizontal velocities, geologic fault slip rates, transform fault azimuths, and earthquake-derived fault slip vector azimuths to invert for block angular velocities, creep and locking on block-bounding faults, permanent strain rates within the blocks. Our preferred model includes 5 blocks, from which the 2 blocks represent the stable part of the Eurasia and Nubia plates. The 3 remaining blocks roughly represent the following 3 domains: 1) Rif mountains, straight of Gibraltar and western Alboran sea (RAWB block); internal zone of the eastern Betics (EBET block) and external zone of the eastern Betics and the eastern Alboran sea (block ESTE). Our modeling results show that the majority of the deformation is absorbed between the blocks EBET and RAWB, where the estimated slip rates reach 3.9 mm/yr, indicating mainly right-lateral motion along the fault with a smaller component of extension.

We will present our interpretations of the elastic block modeling results taking into account the Eurasia-Nubia convergence, as well, as deeper geodynamic processes related to the subduction of the Betic-Albroran slab.