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Geodetic slip rate estimates for the Alhama de Murcia and Carboneras faults in the SE Betics, Spain

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The Alhama de Murcia and the Carboneras faults are the most prominent geologic structures within the Eastern Betic Shear Zone (EBSZ), located in SE Spain. Using continuous and campaign GPS observations conducted during the last decade, we were able to confirm the continuing tectonic activity of these faults by quantifying their geodetic slip-rates and comparing the estimated values with the geological (including paleoseismological) observations. We find that the bulk of the observed deformation is concentrated around the Alhama de Murcia (AMF) and the Palomares (PF) faults. The geodetic horizontal slip rate (reverse-sinistral) of 1.5±0.3 mm/yr calculated for the AMF and PF fault system is in good agreement with geological observations at the AMF, as well as, the focal mechanism of the 2011 Lorca earthquake, suggesting a main role of the AMF. We also find that the geodetic slip rate of the Carboneras fault zone (CFZ) is almost purely sinistral strike-slip with a rate of 1.3±0.2 mm/yr along N48º direction, very similar to 1.1 mm/yr geologic slip-rate, estimated from recent onshore and offshore paleoseismic and geomorphologic studies. The fact the geodetic and the geologic slip-rates are similar at the AMF and CF faults, suggests that both faults have been tectonically active since Quaternary, slipping at approximately at constant rate of 1.1 to 1.8 mm/yr. Since the existing GPS data cannot discern whether the CFZ is slipping seismically or aseismically, we have intended to relate the on-going seismic activity to the slip-rates estimated using GPS. For this reason we compared seismic and geodetic strain rates, where the latter are larger than seismic strain rates, suggesting the presence of aseismic processes in the area. Nevertheless, due to the large earthquake recurrence intervals, we may be underestimating the seismic strain rates. The direction of the P and T average stress axes are in good agreement with geodetic principal strain rate axes. To summarize, in eastern Betics, Alhama de Murcia and Carboneras left-lateral faults are the most active faults and they play an important role in the regional plate convergence kinematics.

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