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Using shallow seismicity and stress field to characterize active wrench systems in the Gibraltar Arc (Western Mediterranean)

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The Gibraltar Arc in the western Mediterranean is characterized by shallow seismicity (90% of the crustal earthquakes at $<$15 km) and abundant scattered seismic swarms, resulting in a diffuse boundary between the African and Eurasian plates. Four types of stress indicators (wellbore breakouts, earthquake focal plane mechanisms, young geologic fault slip data, and hydraulic fracture orientations) evidence a regional NW-SE compressive stress field imposed by the ongoing plate convergence.

In some particular regions it is observed deviations of the maximum horizontal stress (S_{Hmax}) with respect to the regional stress field. They correspond to moderate and significant (36º-78º) clockwise rotations located around a major left-lateral wrench system. This is a broad fault zone composed by different left-lateral strike-slip fault segments that run from eastern Betics to the Alhoceima region in the Rif, resulting in a major bathymetric high in the Alboran Sea (the Alboran Ridge fault zone) with active transpressive faulting. Oblique to this, two major fault systems with NW trend and right-lateral strike-slip faulting (the Maro-Nerja and the Yussuf faults) have associated transtensive deformation. Stress perturbations around these faults zones provide a cue to confirm that these major strike-slip systems may have low frictional strength.

The overall pattern of stress and the inferred motion of the two fault systems suggest the lateral escape in opposite directions of two domains. The Gibraltar Arc itself is thought to escape to the West (NW in External Betics and S-to-SW in External Rif) while eastern Betics and the East Alboran Basin are probably moving to the E and NE. These two fault systems thus represent key elements to understand the present-day deformation partitioning in the western Mediterranean.