Recent Tectonics and Crustal Rheology in the Gibraltar Arc

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The Gibraltar Arc region constitutes a broad area of active deformation and scatter seismicity in the western Mediterranean, reflecting that current oblique convergence between the Eurasian and African plates is accomplished within a diffuse plate-boundary. To characterize the current geodynamics of the Gibraltar Arc region we have integrated different data sources. Firstly, we have built up a robust seismicity data set, selecting those seismic events developed within the crust, removing those seismic events with no accurate location or with low magnitude (period 1992-2005 and md<2.5).

To interpret both vertical and horizontal distribution of seismicity in the region we have conducted an interactive geophysical modelling that reproduce the most suitable lithosphere configuration that explain surface elevation, based on the regional heat flow pattern and assuming local isostasy. With this lithospheric model we have developed a thermal and rheological model, characterizing crustal yield strength and the depth of the brittle-to-ductile transition (BDT) within the crust. We have found that long-term rheology matches focal depth distribution of the crustal seismicity since >60% of the shallow seismicity is placed within the upper brittle crust, decaying exponentially below the BDT zone.

A comprehensive map with the location of quaternary faults throughout the Gibraltar Arc compared with the present-day stress field, demonstrates that active deformation in the arc is driven by a major left-lateral (transpressional) strike-slip fault system that run NE-SW from eastern Betics to the Rif, in the Alhoceima region. This fault system, together with a conjugate, WNW-ESE trending, right-lateral (transtensional) strike-slip fault system, determines the current escape of the Gibraltar Arc to the west and the simultaneous extension in those areas with a thicker crust (e.g., central Betics).

Key words: active tectonics, strike-slip faults, seismicity, rheology, Gibraltar Arc.