Geophysical Research Abstracts
Vol. 21, EGU2019-4306, 2019
EGU General Assembly 2019

Coupling between surface deformation and mantle dynamics in the Gibraltar Arc System

Chiara Civiero (1,2), Susana Custódio (2), João Duarte (2), Claudio Faccenna (3), Thorsten Becker (4), and Virgílio de Brito Mendes (2)

(1) Dublin Institute for Advanced Studies (DIAS), Dublin D02 Y006, Ireland (cciviero@cp.dias.ie), (2) Instituto Dom Luiz (IDL), Faculdade de Ciências, Universidade de Lisboa, Lisbon, Portugal (susanacustodio@campus.ul.pt, jdduarte@fc.ul.pt, vdmendes@fc.ul.pt), (3) Laboratory Experimental Tectonics, Università Roma TRE, Roma, Italy (claudio.faccenna@uniroma3.it), (4) Institute for Geophysics and Department of Geological Sciences, Jackson School Geosciences, The University of Texas at Austin, Austin, TX, USA (twb@ig.utexas.edu)

We discuss crustal surface velocities in the Gibraltar Arc System derived from around 150 GPS sites in Iberia and Morocco operating between 1995 and 2018. The estimated velocity field shows patterns that are strongly correlated with other geophysical constraints (tomographically imaged velocity anomalies, SKS-splitting, etc.) including seismicity patterns. Broad-scale surface uplift characterizes the Rif-Betics belts, which appear underlain by seismically slow, presumably relatively hot, mantle. Significant rates of subsidence are observed around Cartagena and east of El Hoceima where high-velocity seismic anomalies are imaged in the mantle. This abrupt change of the sign of vertical crustal motions coincides with the location of the Trans-Alboran Shear Zone (TASZ), which is marked by lineaments of mostly strike-slip and trans-tensional shallow earthquakes. We interpret the surface uplift as result of the quasi-toroidal mantle flow induced by the interaction of the retreating Gibraltar slab and the resulting sub-slab upwelling. The part of the Gibraltar slab that is still attached to the crust imaged east of the TASZ may contribute to the observed subsidence rates. The trend of the residual topography also suggests that topography may be controlled in part by mantle-driven processes. Around the Gibraltar slab the contrasting signal between the negative residual topography and positive vertical GNSS data is likely due to the fact that the surface, which was previously depressed by the load of the subduction, is now isostatically recovering. Our results on the Gibraltar Arc System suggest that both surface deformation along the arc and shallow earthquake activity are strongly controlled by coupling between the lithosphere and underlying mantle dynamics.