Geophysical Research Abstracts
Vol. 20, EGU2018-14094, 2018
EGU General Assembly 2018

Rheological constraints on slab tearing in the Gibraltar Arc: insight from 3D thermo-mechanical modelling

Kittiphon Boonma (1), Daniel Garcia-Castellanos (1), Ivone Jiménez-Munt (1), Jonas Ruh (1), and Taras Gerya (2)

(1) Institute of Earth Science Jaume Almera (CSIC-ICTJA), Barcelona, Spain, (2) Institute of Geophysics, ETH, Zurich, Switzerland

The closure of the marine gateways across the Gibraltar Arc during the Late Miocene caused massive salt accumulation in the Mediterranean basin during the Messinian salinity crisis. This major geographic change has been linked to the vertical motions associated to subduction between Iberia and Africa. Gibraltar Arc is a complex portion of the Africa-Eurasia plate boundary, marked by slow oblique convergence and intermediate and deep focus seismicity. Tomographic studies of the region show a 3D arcuate slab structure under the region – the Rift-Gibraltar-Betic slab. The concept of lithospheric slab breakoff comes from the analysis of seismic tomography data, where positive seismic velocity anomalies are observed beneath collision zones are often interpreted as detached slab segments. Most of the previous slab-breakoff studies involve the evolution of an already subducted slab, and the 'breakoff' is associated with the symmetrical breakoff behaviour, i.e. the tears initiate from both sides and propagate towards the centre of the slab. We investigate the process and different parameters that could lead to 'slab-tearing' and lateral tear propagation of an already subducted and hanging lithospheric slab. To this purpose, we use a fully-coupled 3D thermo-mechanical numerical code (I3VIS) to study the crustal and mantle deformation in the Gibraltar Arc region. Our model setup considers a continental crust overriding a subducting oceanic crust with a microcontinent approaching the subduction zone. The subducting plate is decoupled by transform faults on both sides. Our preliminary results address the tectonic settings and rheological properties that could potentially favour the tearing of the lithospheric mantle. Specifically, we look at: (i) different rheological mantle flow-laws and which deformational style does each allow the sinking lithospheric slab to undergo, (ii) the effect of sudden slow-down of subduction rate on stress states within the hanging slab, and (iii) the effect of different density calculation on the sinking slab. This is a SUBITOP (674899-SUBITOP-H2020-MSCA-ITN-2015) and MITE (CGL2014-59516) contribution.