Geophysical Research Abstracts
Vol. 13, EGU2011-4829, 2011
EGU General Assembly 2011

Pliocene to Present-day stress field along the western Gibraltar orogenic arc and geodynamics implications

Antonio Pedrera, A. Ruiz-Constán, J. Galindo-Zaldívar , A. Chalouan, C. Sanz de Galdeano , C. Marín-Lechado, P. Ruano, M. Benmakhlouf, M. Akil , A.C. López-Garrido, A. Chabli , M. Ahmamou, and L. González-Castillo
Instituto Geológico de España, Granada, Spain (a.pedrera@igme.es)

In the western Mediterranean, mantle lithosphere delamination and oceanic lithosphere subduction/slab roll-back have been proposed to explain the development of the Betic-Rif thrust belt along with the evolution of the Alboran Basin. Recent seismic tomography reveals a high velocity slab dipping to the East from the Gibraltar Strait up to 600 km depth bellow the Alboran Sea that could be interpreted as subducted oceanic lithosphere. Although most of the authors agree that the eastward subduction and the back-arc extension were mainly operating during the Early and Middle Miocene, their continuity since the Upper Miocene and the present-day activity/inactivity is under a vigorous debate.

We present a new set of brittle microtectonic measurements carried out in the Pliocene and Quaternary rocks outcropping in several key sectors of the Gibraltar orogenic arc. This data set, along with available earthquake focal mechanisms and borehole breakouts, allowed to compile the Pliocene and Quaternary stress map of this area. This map provides new constraint about the tectonic models and the present-day tectonic activity of the proposed active eastward subduction of oceanic lithosphere beneath the Gibraltar arc and roll-back. The horizontal maximum compressive stress (SHmax) is NW-SE in the Betics Orogen and N-S/NNW-SSE in the southern Rif Cordillera. There is a significant consistency between SHmax and the displacements field recently obtained from GPS measurements, with respect to African plate. Both appear to reflect the NW-SE convergence between the African and the European plates that is perturbed in the Rif. We propose that part of the eastern Rif behaves as a quasi-rigid block welded to the stable African plate. This block is bounded by important faults that localized most of the deformation disturbing the stress and surface displacement field. The displacement rate enhances westward of the Alboran Ridge where is accommodates by a seismogenic left-lateral SSW-NNE fault zone that connect to the south with the Al Hoceima seismic swarm. This fault zone transfers most of the deformation to the SW toward the frontal Ridges Prerifain and toward the Arbaoua sector where the deformation is resolved by thin-skinned tectonics, detached from its basement along Triassic gypsum and clays.

Three-dimensional reconstruction of available seismic tomography plotted against the intermediate seismicity allows determine which segments of the subduction remain active under this Pliocene and Quaternary stress field. The remnant oceanic subducted slab now has a N20ºE to N100ºE direction and a very limited activity, only has associated seismicity in a sector N30ºE to N40ºE oriented that is orthogonal to the regional convergence. Therefore, the subduction responsible for the Gibraltar Arc development could be considered deceased and switched to a collision. Pliocene to Quaternary N-S to NW-SE Africa-Europe plate convergence seem to be associated to the reorganization of the remnant Early Miocene subduction system in a continental-continental collision framework between the two major plates and their interaction with the Alboran deforming block. While some sectors of the Alboran Domain concentrate the most part of the deformation, some sectors are essentially welder to the major plates.