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The Gibraltar Arc System: Miocene formation and Plio-Pleistocene deformation from seismic images, Vp models, and magnetoteluric data

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The Gibraltar Arc System (GAS) has been deformed during the Plio-pleistocene deformation driven by the NW–SE, slow 4-5 mm/yr convergence of Africa and Iberia. However, the GAS is formed by four large-scale geological units with a basement and sediment structures that appear unrelated to recent plate kinematics.
The GAS is an arc-shaped structure fronted in the Gulf of Cadiz by a large imbricated wedge of tectonically piled rock slices, and formed several extensional basins east of the structural arc, in the Mediterranean portion of the region. The Western Alboran Basin is located on the rear of the Gibraltar stacked units, and displays little-deformed sediment infill. The Eastern Alboran Basin is characterized by ridges and promontories that appear volcanic in origin . To the east the South Balearic – North Algerian Basin with a generally lower relief displays crustal features typical of back arc crust.
The different tectonic elements of the GAS are floored by poorly known basement, and their age, evolution and geodynamic origin are still debated. The uncertainty arises from the lack of deep-penetration modern geophysical data in much of the region.
In the last 8 years, 4 successive experiments have produced an extensive coverage of the structures of those geological units. In 2006 the WestMed cruise with German R/V Meteor collected five wide angle seismic profiles in the eastern Alboran and South Balearic basins. Two multichannel seismic reflection cruises with the R/V Sarmiento de Gamboa in 2011 collected about 6000 km of deep reflection images across the South Balearic, West and East Alboran and Gulf of Cadiz. Two marine magnetotelluric cruises in the Alborán basin (Amelie project) collected complementary data in 2009 and 2011.
The goal of this contribution is to present a summary of results recently produced from models and images from the data collected in the 4 marine experiments. We present P-wave velocity models across key regions of the system and new reflection images of tectonic and sediment structures of the crust. Further we present magnetotellutic 3D models of the lithospheric structure. These results are use to interpret the GAS in the context of a geodynamic model of eastward Miocene subduction, and Plio-Pleistocene continent collision that might explain the crustal-lithospheric structure.