Geophysical Research Abstracts
Vol. 13, EGU2011-13558, 2011
EGU General Assembly 2011

The lithosphere-sublithospheric upper mantle system beneath the Atlantic-Mediterranean Transition Region: advances and limitations from recent multidisciplinary approaches

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The Atlantic-Mediterranean Transition Region (AMTR) consists of two main large-scale tectonic domains: the Gibraltar Arc System and the Atlas Mountains. It is a complex region characterized by a diffuse transpressive contact between the African and Eurasian plates, including a wide band of active deformation. Several competing tectonic scenarios have been proposed to explain the tectonic and magmatic evolution of the region (e.g. Neogene subduction and slab roll-back, active subduction, delamination of the lithospheric mantle, convective removal, etc). Most of these models rely in turn on models of the present-day lithospheric structure beneath the AMTR. However, the crustal geometry still is poorly constrained in many areas and mantle images rely solely on either seismic tomography with poor spatial resolution or 1D-2D numerical modelling.

With the aim of obtaining a more complete and reliable image of the lithosphere/sublithospheric upper mantle beneath AMTR, we have recently applied two different but related methods based on the simultaneous fitting/inversion of multiple geophysical and geochemical observables (surface heat flow, gravity and geoid anomalies, absolute elevation, xenolith data, seismic data). Our results (some still preliminary) reveal large variations in the depth of the Moho and the lithosphere-asthenosphere boundary (LAB), as well as a lack of spatial correlation between the thicknesses of these two boundaries. While the Moho tends to mimic the observed topography, the LAB is shallower beneath the central and eastern Alboran Basin ($\sim$70 km) and all along the High, Middle and Anti Atlas (<100 km), coinciding with the loci of Cenozoic volcanism. Deeper LAB depths are found along the central and western Betics and the Moroccan Atlantic margin (>140 km) with values exceeding $\sim$230 km beneath the Rif and the Sahara Platform. We find for most of the region, the best-fitting average bulk composition of the lithospheric mantle corresponds to that of a typical Tecton (i.e. Phanerozoic) domain, in agreement with the age of the overlying crust. However, the shallow lithospheric mantle of the Sahara Platform, the Alboran Basin, and Atlas Mountains require different compositions, suggesting distinct processes.

In this contribution we will discuss the strengths and limitations of our results/methods and possible tectonic scenarios for the evolution of the AMTR from Jurassic times to present.