Crustal and lithospheric imaging of the Atlas Mountains of Morocco inferred from magnetotelluric data

Duygu Kiyan[1,2], Alan G. Jones[1], Javier Fullea[1], Colin Hogg[1], Juanjo Ledo[3], Agata Siniscalchi[4]
Joan Campanya[3], and the PICASSO Phase II Team

[1] Dublin Institute for Advanced Studies, School of Cosmic Physics, Dublin, Ireland
[2] National University of Ireland, Galway, Department of Earth and Ocean Science, Galway, Ireland
[3] University of Barcelona, Department of Geodynamics & Geophysics, Barcelona, Spain
[4] University of Bari, Department of Geology & Geophysics, Bari, Italy

The Atlas System of Morocco is an intra-continental mountain belt extending for more than 2,000 km along the NW African plate with a predominant NE-SW trend. The System comprises three main branches: the High Atlas, the Middle Atlas, and the Anti Atlas. We present the results of a very recent multi-institutional magnetotelluric (MT) experiment across the Atlas Mountains region that started in September, 2009 and ended in February, 2010, comprising acquisition of broadband and long-period MT data. The experiment consisted of two profiles: (1) a N-S oriented profile crossing the Middle Atlas through the Central High Atlas to the east and (2) a NE-SW profile crossing the western High Atlas towards the Anti Atlas to the west. The MT measurements are part of the PICASSO (Program to Investigate Convective Alboran Sea System Overturn) and the concomitant TopoMed (Plate re-organization in the western Mediterranean: Lithospheric causes and topographic consequences – an ESF EUROCORES TOPO-EUROPE prroject) projects, to develop a better understanding of the internal structure and evolution of the crust and lithosphere of the Atlas Mountains.
The MT data have been processed with robust remote reference methods and submitted to comprehensive strike and dimensionality analysis. Two clearly depth-differentiated strike directions are apparent for crustal (5-35 km) and lithospheric (50-150 km) depth ranges. These two orientations are roughly consistent with the NW-SE Africa-Eurasia convergence acting since the late Cretaceous, and the NNE-SSW Middle Atlas, where Miocene to recent Alkaline volcanism is present. Two-dimensional (2-D) smooth electrical resistivity models were computed independently for both 50^{o} and 20^{o} E of N strike directions. At the crustal scale, our preliminary results reveal a middle to lower-crustal conductive layer stretching from the Middle Atlas southward towards the High Moulouya basin. The most resistive (and therefore potentially thickest) lithosphere is found beneath the Central High Atlas. The inversion results are to be tested against other geophysical observables (i.e. topography, geoid and gravity anomalies, surface heat flow and seismic velocities) using the software package LitMod. This software combines petrological and geophysical modelling of the lithosphere and sub-lithospheric upper mantle within an internally consistent thermodynamic-geophysical framework, where all relevant properties are functions of temperature, pressure and composition.