Geophysical Research Abstracts
Vol. 14, EGU2012-5607, 2012
EGU General Assembly 2012

Electrical signature of the Marrakech High Atlas: new insights from the TopoMed broad band magnetotelluric experiment.

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In autumn 2009, a broadband magnetotelluric (BBMT) SSW-NNE striking profile crossing the Marrakech High Atlas was acquired as a part of the TopoMed Coordinated Research Project within the TOPO-EUROPE EUROCORES (http://www.esf.org/activities/eurocores/runningprogrammes/ topo-europe.html). The main purpose was to obtain information on the crustal structure in a poorly investigated area of the Atlas system [D. Frizon de Lamotte et al. 2008]. A total of 19 soundings were acquired allowing the estimation of the MT and the geomagnetic transfer function in the period range from 0.001 s to 1000 s. The data quality is not uniform along the profile and generally not as high as desired due to the combination of mainly two factors: low solar activity and the presence of strong cultural noise sources like those affecting the northern soundings, near Marrakech.
Directionality analysis, made using all the soundings, indicates a strike direction NE-SW until periods of few hundred seconds (i.e. crust to upper mantle depths). The strike was determined from the geomagnetic transfer function and then, considering also the middle-low quality of the tipper data, confirmed by applying the distortion decomposition method of Groom and Bailey (1989) following the scheme of McNeice and Jones (2001).
A preliminary analysis of subsurface resistivity distribution along the original profile was inferred by the so-called Niblett–Bostick (N–B) transform of the determinant apparent resistivity and phases, considering that they are rotationally invariant. This first stage data modeling shows a well distinct electrical signature among the Marrakech High Atlas with respect to the adjacent basins (Souss and Haouz) throughout the crust.
Taking into account the electrical strike (NE-SW) the MT transfer functions were corrected for distortion and derived in the appropriate strike direction; sounding sites were projected on a transect line orthogonal to the strike (NW-SE). Joint TM and TE mode data were inverted using the non-linear conjugate 2D inversion algorithm of Rodi & Mackie [2001]. Inversion results were checked with respect to the inversion parameters and to different starting model (homogeneous half space and 1D determinant modeling). Such modelling confirms the low resistivity values imaged in the upper crust below the High Atlas also showed in a previous work (Ledo et al., 2011) for further to the east. Crustal scale faults are also evidenced in the same area.