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Application of Geomagnetic depth sounding technique into Active Tectonic areas

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Abstract

The purpose of this work was to apply the Geomagnetic Depth Sounding (GDS) technique to study the conductivity of a small area of the Anti-Atlas chain with longitude between 7° and 8° W and latitude between 30.5° and 31.1° N. This technique allows providing a qualitative description of the distribution of conductivity in the area under investigation by measuring the variations of the Earth's magnetic field and successively defining the so-called Parkinson's induction arrows.
Therefore, we used two 3-axis vector magnetometers (mod. flux-gate Lemi018), which were located in 10 different sites within the area. Each station has measured the variation of the X, Y and Z components of the geomagnetic field for a period of 7-10 days, between June and November 2007.
Among the collected data we selected only those containing magnetic field variations with a frequency between 10^{-3} Hz e $3*10^{-5}$ Hz, in fact in this range the magnetic signal is higher than the instruments noise level. Parkinson's induction arrows estimated with these data have resulted in a coherent orientation toward North – North West in the direction of the High Atlas chain. Selected data have also been compared with those recorded by the magnetic observatory of Averroes (Casablanca) which is placed on the opposite side of the chain. Similarly, induction arrows points toward the High Atlas chain, in this case Southward.
From tectonic and gravimetric studies of the Atlas chain (Burkhard et al., 2006; Ayarza et al., 2005) it follows that the Moho discontinuity (crust-mantle) in this area seem to be located at a depth of about 30 km and that, possibly, the Atlas chain is not in a condition of isostatic balance with the mantle, thus making it possible to suppose the existence of uplifts from the astenosphere. Moreover, evidences of paleovulcanism (Ramdani, 1998) into the Atlas chain would be consistent with the presence of big magmatic bodies.
All this elements could explain the presence of strong conductivity contrasts along the High Atlas chain toward which the induction arrows are directed. Similar results have been obtained in an analogous study involving the tectonic area including the Appalachia chain (Bailey et al., 1974) where Parkinson's induction arrows point towards the chain.

In conclusion, the initial purpose of the work was to characterise a portion of the tectonic area of the Anti-Atlas from an electromagnetic point of view to put into evidence the presence of possible local conductivity anomalies. Obtained results point toward a substantial conductivity homogeneity on a regional scale. However, the comparison between the Parkinson arrows for the area under investigation and for the Averroes magnetic observatory shows an anomalous conducing structure outside the study area along the Atlas chain.