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Deep electromagnetic investigation to study the geological and structural setting of the epicentral area of the April 6, 2009 Abruzzo earthquake

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Deep electromagnetic investigation, using magnetotelluric (MT) and Deep Electrical Resistivity Tomography (DERT) methods, has been carried out across the Aterno Valley, in the epicentral area of April 6, 2009 (Mw=6.3) Abruzzo earthquake, with the aim to study the geological and structural setting of the subsurface.
The L'Aquila Basin is a 60 Km long intermountain depression of the Central Apennines, with a NW-SE-trending, bounded to SW by Monti Sirente-Monte Ocre and by Gran Sasso to NE. This depression is filled in Quaternary continental sediments of the Aterno River while the bedrock is composed by Mesocenozoic calcareous of platform. In the middle part of the basin, from Bagno (SW) to Paganica village (NE), along a profile about 9 km long were carried out 10 MT soundings with site separations of about of 1 km. The acquisition of MT data were obtained with MT24-LF systems (Schlumberger/EMI). The frequency of data recording was set to 6.25 Hz for at least 24 hours and during night-time we launched high frequency sampling acquisition events (500 Hz) for at least 2 hour. Time series data were analyzed using the processing based on Egbert's robust code (Egbert, 1997) to compute estimates of the MT transfer function in the period range 0.00931-238.313 s. Applying an inversion 2D model we have obtained the distribution resistivity of subsoil, as function of depth. The apparent resistivity and phase for TE and TM mode (in all investigated period range) were inverted by using an algorithm developed by Rodi & Mackie, 2001.
Almost coincident with MT profile, a DERT with "dipole-dipole" array configuration has been carried out along a profile of 8Km, using 21 stations with an electrode spacing of 400 m and a maximum distance between current and potential probes 7-8 times the basic spacing. In this way, the electrode array geometry allows us to obtain a an exploration depth of about 900 m. The acquisition system consists of a transmitting stations which injects the current (mA) into the ground and a new multichannel receive devices which record the generated voltage signals (mV). The receiving system is composed by a 4 remote multichannel dataloggers connected with radio communication system to a personal computer. Therefore, at the same time 8 voltage recording from 5 to 20min were acquired for each current injection, obtaining 116 voltage recordings, related to different positions of the electrodes along the profile. The second step consisted in the extraction of useful signal from voltage recordings, using advanced statistical tools for removing the cultural noise, and to calculate the apparent resistivity values. Finally, we used the inversion algorithm RES2Dinv to determine a 2D resistivity model.
The deep electromagnetic exploration allowed to characterize the thickness and the geometric relationships between the Quaternary deposits and the deeper mesocenozoic bedrock.

References

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