Joint Transientelectromagnetic and Magnetotelluric characterization of deep aquifers in North Jordan

German -Jordanian Cooperation Project

BGR
Bundesanstalt für Geowissenschaften und Rohstoffe

G. Kapinos[1] (gerhard.kapinos@bgr.de), **N. Jahed**[2], **N. Atteyat**[2], **F. Lindenmaier**[1], **A. Margane**[1], **P. Yogeshwar**[3], **M. Toll**[1], **F. Brückner**[1]
[1]Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany,
[2]Ministry of Energy and Natural Resources (MEMR), Amman, Jordan,
[3]Institute of Geophysics and Meteorology, University of Cologne, Germany

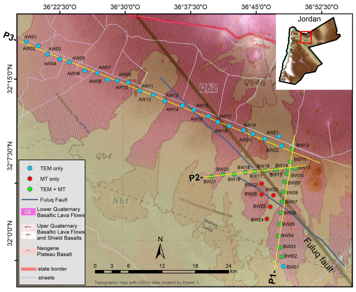

Fig. 1.: Study area in North Jordan

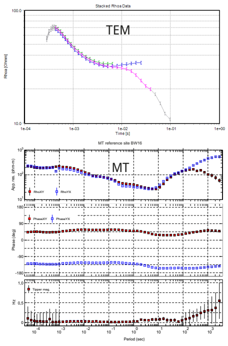

Fig. 2.: Example of TEM and MT data.

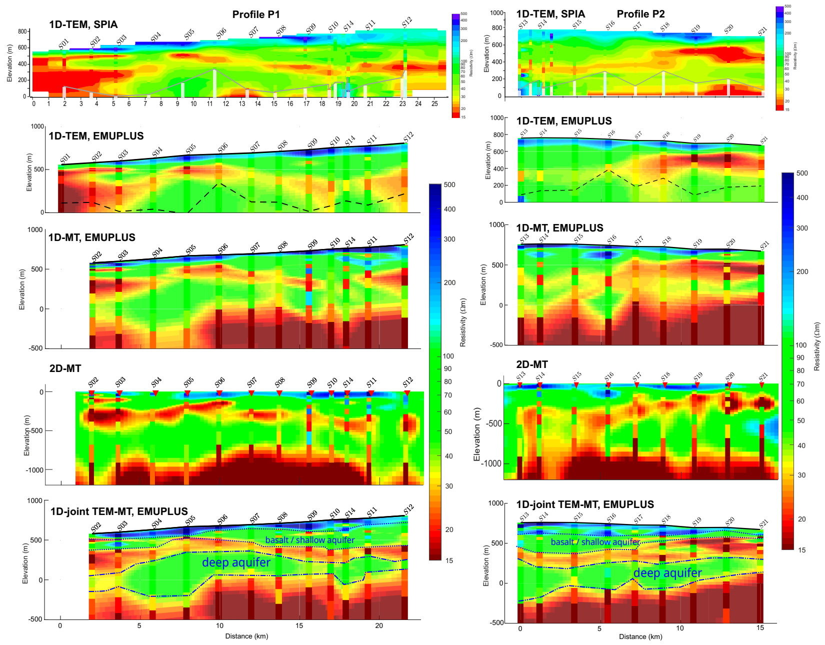

Fig. 3.: Conductivity models along profiles P1 (left) and P2 (right) (Fig.1) derived from separate inversion of TEM (1D) and MT data (1D and 2D) and joint inversion.

Target of electromagnetic exploration

Deep aquifers at depths of 300 m to 1000 m have rarely been the focus of groundwater research.
We combined transient electromagnetics (TEM) and magnetotellurics (MT) to investigate in northern Jordan (Fig. 1) the distribution of electrical conductivity in relation to hydrogeological structures and to quantify the location, extent and size of deep aquifer systems.

TEM-, MT-, joint Inversion

The models show that TEM and MT method complement each other (**Fig. 3**). MT resolves structures below 600m and the depth of investigation (DOI) of TEM, which is necessary to explore the thickness of the deeper aquifer system (along with its base), and is sensitive to lateral conductivity variations. The MT data (Fig.2) indicate in the period range between 10^{-4} and 10^{1} s a one-dimensional (1D) underground, allowing correction for the observed static shift in MT transfer functions with TEM (**Fig. 4**) and 1D joint inversion for the target depths.
Another added value of the combined application of two methods is the strengthening of the robustness of the results by applying of joint inversion. The 1D joint inversion confirms and complement the results of separate inversion of TEM and the static shift corrected MT data.

Results

The basaltic overburden appears as a heterogeneous sequence in all models with resistivity values between 10 and 500 Ωm. The heterogeneity of the basalt layer can be attributed to the formation process with several lava extrusions that formed different basalt groups in the Cenozoic phase during the last 10 million years. The relatively low resistivity values and zones of enhanced conductivity in the basalt layer are probably caused by presence of water/groundwater aquifers and the salinity contamination, which are observed in borehole data and groundwater wells. The deep aquifer appears as a layer with moderate resistivity.

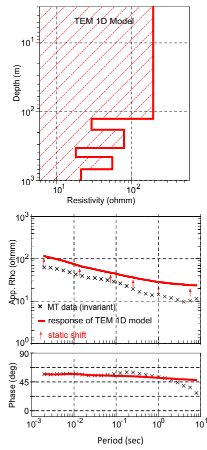

Fig. 4.: Correction of static-shift in MT data

BMZ Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung

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