

TEM modeling of Dead Sea salt water intrusion

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SUMMARY

We present one-dimensional resistivity results from Transient Electromagnetic (TEM) exploration in the very well-known Ghor Al-Haditha area, located in the Dead Sea region of Jordan. Future plans are aimed at establishing a UNESCO Geopark to preserve the unique landscape of the area. Our key aims are (1) to map the current lakewater interface within environments characterized by varying aquifer salinities—such as brine, brackish, and freshwater—and (2) to identify potential subsurface salt layers as well as geological barriers to better understand sinkhole developments due to salt layer dissolution.

A total of 185 TEM soundings of varying sizes (25 m², 50 m²) were conducted sparsely and along profiles across the 5 km x 8 km study area. A dense survey was conducted between two boreholes (BH1, BH2), as well as in Ibn Hammad and Al-Mazra'a fluvial channels. These channels are the main hydrogeological systems that transport fresh water to the Dead Sea.

We used synthetic models of a six-layer structure created around the borehole to validate the detectability of salt layers within the aquifer system, where the resistivities of the salt layer range from 1 to 2 Ω m. The study shows that salt layers were detectable at thicknesses exceeding 5 m and at depths less than 30 m. However, the presence of an upper thick conductive clay layer (i.e., 5 m) hinders the detection of thinner or deeper salt layers.

The mapped saline lakewater interface has a very gentle slope that extends several hundred meters into the terrestrial aquifers and is characterized by resistivities in the range of 0.1–0.7 Ω m. The interface was identifiable in Ibn Hammad and BH1–BH2 models but not clear in the Al-Mazra'a model at the downstream area.

The study's outcomes provide valuable insights into the hydrogeological dynamics and geological structures influencing aquifer salinity and sinkhole formation in the area.

Keywords: Dead Sea, Ghor Al-Haditha sinkhole, 1D TEM resistivity, Jordan
