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2D inversion of magnetotelluric data from Al-Mubazzarah geothermal area, Al-Ain, United Arab Emirates

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Magnetotelluric (MT) data were acquired around Al-Mubazzarah (Al-Ain, UAE), a low-enthalpy geothermal field, in June 2017. The objective of this study is to understand the subsurface electrical characteristics of the study area and its relationship with the local geothermal manifestations.
Both dimensionality and strike analysis were performed using the phase tensor ellipse approach. The orientations of the MT data phase tensor ellipses indicated the dominant flow direction of induced currents and reflected lateral resistivity variations of the subsurface structures. The phase tensor ellipses for most stations have small skew values and consistent orientation of the principal axis direction, which implies that the subsurface can be accurately modelled in 2D. The rose diagram of the strike angles showing strike estimated from 2D/3D regional strike and azimuth of phase tensors shows a N5E dominant strike direction.
The data was inverted using Occam inversion code with 24 periods (0.003 s – 23 s) after rotating 5 degrees to the NW to achieve minimum diagonal and maximum off-diagonal elements of the impedance tensor. The starting model was a homogenous half space of 100 ohm-m and 5% error floor were used for bi-modal inversion of the TE and TM modes. The thickness of the first layer was 50 m and subsequent deeper layers increased logarithmically. The final model achieved the RMS data fit of 1.5 after 20 iterations.
The inversion results show a succession of high and low resistivity at shallow depths (500m-1000m), reflecting the horst-graben structure of the subsurface geological layers. These results are in agreement with known geology and may indicate a fault structure (45o) dipping to the north, impacting the geological structures below 1000m.
The comparison of MT model with 2D inverted gravity data from the same profile shows a good correlation, indicating the horst-graben structure of the study area. The detected structures may control the flow path of geothermal fluids emerging in the Al-Mubazzarah geothermal field.