Integrated Electrical and Electromagnetic Exploration at the M'Deek Geothermal Field, British Columbia, Canada

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SUMMARY

The M'deek geothermal field is an extensional, fracture-controlled, geothermal system with surface expressions of hot springs and lake floor pockmarks. Heat is derived from past subduction on the west coast of North America that resulted in delamination of the lithosphere. The shallow structure was investigated with direct-current (DC) resistivity, seismic exploration, and geologic mapping in the 1980s. An airborne time-domain electromagnetic (TDEM) survey was flown over the entire geothermal field in 2019. Near-surface resistivity models were obtained by inverting the TDEM and DC resistivity datasets. These models showed a near-surface conductor approximately 100 m thick in the valley bottom, where glacial marine sediments had been mapped. The low resistivity of this layer limited the depth of investigation of the TDEM survey and created 3D effects due to its irregular shape.

The location of the fluid supply at depth was not constrained by these studies. To image the deeper structure of the geothermal field, including the fluid supply, broadband MT data were acquired in 2020 and 2022. Some MT data were collected over the frozen lake using high-impedance electric field sensors. MT data analysis began with robust time-series processing that reduced the effects of intense cultural noise from the nearby city of Terrace. The MT data were inverted in 3D using a variety of starting models created by interpolating the TDEM and DC resistivity models onto the MT inversion mesh.

The final 3D MT inversion resistivity model of the M'deek geothermal field shows a number of sub-vertical low resistivity features. These features were interpreted to be the fault system that is a conduit for the thermal waters that supply the hot springs. The fault system is the target for ongoing geothermal exploration by Kitselas Geothermal Inc. Incorporating near-surface information reduces the uncertainty in the deeper resistivity structure, ultimately reducing exploration risk.

Keywords: Geothermal, Canada, Direct-Current, Time-Domain, Magnetotellurics