Quantifying the DC effect of temporal lake changes at Inferno Crater, Waimangu Geothermal System, New Zealand

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SUMMARY

Electromagnetic methods may provide the opportunity to image temporal changes in the subsurface associated with imminent hydrothermal eruptions, which commonly occur without warning. A recent experiment at the Waimangu Geothermal System, New Zealand, was designed to use Controlled Source Electromagnetics (CSEM) to detect temporal changes in subsurface resistivity associated with changes in the hydrothermal system between Inferno Crater Lake. Inferno Crater displays quasi-regular changes in lake level (7 m) and temperature (~40 °C at lake low to ~80 °C when overflowing) on a six-week cycle, inferred to be due to changes in steam pressure below the lake. The experiment that aims to image these is presented in a separate poster in this workshop. However, the lake itself, being a shallow body with conductivity ~1 S/m, is likely to have a static (DC) effect on the electric fields which will complicate interpretation of the frequency-domain CSEM results. Here we show 3-D DC forward modelling results calculated using SimPEG to quantify this effect. The models incorporate topography and a simple background resistivity structure to simulate the DC electric fields that would be measured when the lake is full and when lake level is at a minimum. Changes in the normalized magnitude of the electric field (expressed as the 'total-field apparent resistivity') reach 0.8 Ωm, a 14 % difference in the modelled apparent resistivity. These changes are comparable to those observed in the *magnitude* of CSEM total-field apparent resistivity. Our results demonstrate that the DC or static effect must be carefully considered in interpreting the CSEM response.

Keywords: resistivity, forward modelling, hydrothermal, monitoring