Electromagnetic study of deep permafrost in Central West Greenland

H. Vanhala[1*], T. Ruskeeniemi[1], J. Engström[1], J. Lehtimäki[1], K. Korhonen[1], A. Lehtinen[2], L. Claesson Liljedahl[3], R. Pettersson[4] and J-O. Näslund[3]

[1] *Geological Survey of Finland, P.O. Box 96, 02151 Espoo, FINLAND (*correspondence: heikki.vanhala@gtk.fi)*
[2] *Posiva Oy, 27160 Eurajoki, FINLAND*
[3] *SKB AB, Box 250, 10124 Stockholm, SWEDEN*
[4] *Uppsala University, 75236 Uppsala, SWEDEN*

A series of electromagnetic (EM) soundings were made in Western Greenland to test the applicability of the method for studies of deep permafrost in crystalline bedrock terrain. The study area consists of different geological and hydrological settings from the foreland and the ice margin areas onto the ice sheet. The analysis of the geophysical data is supported by the chemical and temperature data collected by the Greenland Analogue Project (GAP) from boreholes penetrating the ca. 350 m thick permafrost.

We applied a ground-based wide-band frequency-domain electromagnetic sounding system called SAMPO. A transmitter loop is used to generate a magnetic primary field at 82 discrete frequencies between 2 Hz and 20 kHz. For qualitative interpretation, the measured vertical-to-radial electromagnetic field component ratios are transformed into curves of apparent resistivity as a function of depth. For modelling the data we used 1D layered earth inversion.

The modeling provided a consistent cryogenic structure both for sublacial (4 layers) and proglacial areas (3 layers). The presence of deep permafrost could be confirmed, although the actual base of the permafrost was not detected due to too small electrical conductivity contrast. The weak conductor found at 550-750 m depth is located too deep to be the base of the permafrost, and the most likely explanation is saline groundwater.

References:

Ruskeeniemi, T., Engström, J., Lehtimäki, J., Vanhala, H., Korhonen, K., Lehtinen, A., Claesson Liljedahl, L., Pettersson, R. & Näslund, J-O. Subglacial permafrost evidencing late–Holocene re-advance of the Greenland Ice Sheet over frozen ground at Kangerlussuaq, West Greenland (in prep.)