Geophysical Research Abstracts
Vol. 19, EGU2017-18990, 2017
EGU General Assembly 2017

Analysis of Induced Polarization effects in airborne TEM data – a case study from central East Greenland

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Data from a high-resolution airborne SkyTEM time-domain electromagnetic survey conducted in central East Greenland were analysed. An analysis based on utilization of a Self Organizing Map procedure for response curve characterization and analyses based on data inversion and modelling are presented.
The survey was flown in 2013 along the eastern margin of the Jameson Land basin with the purpose of base metal exploration and with sulphide mineralization as target. The survey area comprises crystalline basement to the East and layered Early Triassic to Jurassic sediments to the West. The layers are dipping a few degrees towards West. The Triassic sequence is 1 to 2 km thick and mostly of continental origin. The fluviatile Early Triassic arkoses and conglomerates, the Upper Triassic grey limestone and black shale beds and overlying gypsiferous sandstones and mudstones are known to host disseminated sulphides. E-W oriented lines were flown with an average terrain clearance of 30m and a separation of 300m. The data were initially processed and inverted by SkyTEM Aps.
The conductivity models showed some conductive layers as well as induced polarization (IP) effects in the data. IP effects in TEM data reflect the relaxation of polarized charges in the ground which can be good indicators of the presence of metallic particles. Some of these locations were drilled during the following field season but unfortunately did not reveal the presence of mineralization. The aim of this study is therefore to understand the possible causes of these IP effects. Electrical charge accumulation in the ground can be related to the presence of sulphides, oxides or graphite or to the presence of clays or fibrous minerals. Permafrost may also cause IP effects and is then expected to be associated with a highly resistive subsurface.
Several characteristics of the transient curves (IP indicators) of the SkyTEM survey were extracted and analysed by using the Kohonen Self-Organizing Map (SOM) technique. SOM is a type of neural network algorithm developed for analysis of non-linear relationships in multivariate data. The basic idea of SOM is to provide a method for easy visualizing of multi-dimensional data. The SOM may be viewed as a two-dimensional grid onto which multi-dimensional input data are projected or mapped from a multi-dimensional space. The space dimension is equal to the number of analysed variables containing the geo-referenced IP indicators that characterise the transient curves. Input data that are similar or close to each other, irrespectively of their geographic location, are mapped to the same or adjacent position in the SOM. Data that belongs to a particular cluster in the SOM space are afterwards mapped into a geographical space. Characteristics of the IP effects can therefore be mapped and spatially compared with the geology of the area. Once IP were identified and located, Cole-Cole parameters were recovered from the airborne TEM data in specific locations by inversion of the TEM data. An interpretation of the derived models is discussed in relation to possible causes of the observed IP effects.