Semi-airborne electromagnetic exploration for deep earth resources - large scale multi source 3D imaging of a graphite deposit

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Abstract
The transition towards renewable energies demands secure supply with critical raw material and requires efficient non-invasive methods for deep earth resources exploration. The novel DESMEX (Deep electromagnetic sounding for mineral exploration) semi-airborne electromagnetic (semi-AEM) exploration concept aims at efficient exploration of resources down to 1 km depth. Here we present a large-scale semi-AEM exploration study in a graphite mining district in eastern Bavaria, Germany. At the ground, several horizontal electrical dipole transmitters were deployed and helicopter-towed magnetic field sensors measure the EM fields along flight lines within several overlapping flight areas, providing a fast data acquisition and a high spatial coverage. Imaged shallow high conductivity structures can be correlated with graphite-rich zones and match well with existing helicopter-borne EM results. The presence of graphite leads to significant induced polarization (IP) effects with considerably high chargeabilities superposing electromagnetic induction. We include these effects in a realistic 3D inversion using a synthetic data study to analyse, if the IP effect alters the overall conductivity structure and demonstrate that the obtained 3D model is reliable.

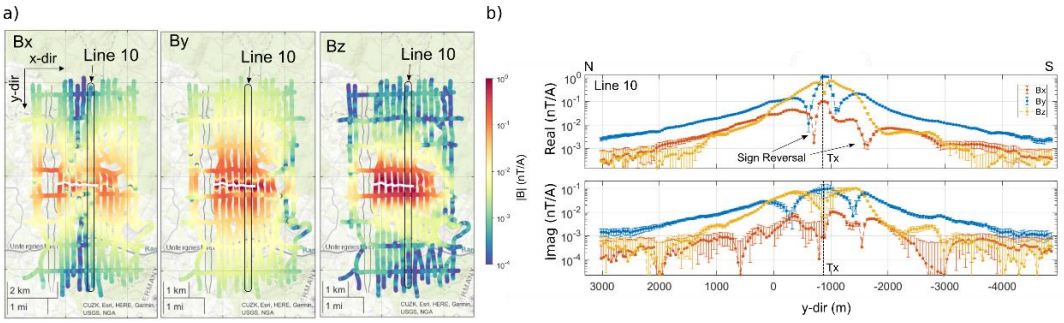

Figure 1: a) Data example displayed as color-coded amplitudes for one flight patch at 1024 Hz (Transmitter marked white). (b) Transfer functions for one flight-line.

Reference / more information
Mörbe, W., Yogeshwar, P., Tezkan, B., Kotowski, P., Thiede, A., Steuer, A., Rochlitz, R., Guenther, T., Brauch, K., Becken, B: Large-scale 3D inversion of semi-airborne electromagnetic data - topography and induced polarization effects in a graphite exploration scenario. Accepted 05.2024 in Geophysics.