Geophysical Research Abstracts
Vol. 19, EGU2017-15439, 2017
EGU General Assembly 2017

Novel semi-airborne CSEM system for the exploration of mineral resources

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Within the DESMEX project (Deep Electromagnetic Sounding for Mineral Exploration), a semi-airborne CSEM system for mineral exploration is developed which aims to achieve a penetration depth of 1 km with a large areal coverage. Harmonically Time-varying electrical currents are injected with a grounded transmitter in order to measure the electric field on the ground and induced magnetic fields with highly sensitive magnetic sensors in the air. To measure the magnetic field and its variations, three-axis induction coils (MFS-11e by Metronix) and fluxgate sensors (Bartington FGS-03) are mounted on the platform towed by a helicopter. In addition, there is a SQUID based magnetometer, developed by IPHT and Supracon AG, available for future measurements. We deploy the different magnetometer sensors to cover a broad frequency range of 1-10000Hz. During the flight, the sensors encounter a broad variety of motion/vibration which produces noise in the magnetic field sensors. Therefore, a high accuracy motion tracking system is installed within the bird and a low vibrating system design needs to be considered in the airborne sensor platform. We conducted several flights with different source positions in a test area in Germany, which is already covered by ground based measurements. Based on the data, we discuss possible calibration schemes which are needed to overcome orthogonality and scaling errors in the fluxgate data as well as orientation errors. We apply noise correction schemes to the data and calculate transfer functions between the magnetic field and the source current. First 1-D inversion models based on the estimated transfer functions are calculated and compared to existing conductivity models from DC geoelectrics and helicopter electromagnetic (HEM) measurements.