Imaging deep massive sulfide deposits with multiple grounded sources and UAV-towed scalar and vector magnetic field receivers - Part 1: Data

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SUMMARY

The utilization of uncrewed aerial vehicles (UAVs) as carriers of diverse sensory equipment is already widespread today, and the scope of their application is still growing. However, when implementing such vehicles for magnetic or electromagnetic (EM) methods, certain constraints arise, such as a limited payload, restricted flight duration and electromagnetic interference fields caused by the operation of the vehicle. In semi-airborne electromagnetics, just the mobilization of a passive sensor system is required, with controlled EM transmitters deployed on ground - a circumstance favorable for UAV application. High-power transmitters and low-suspended sensor platforms facilitate good signal-to-noise ratio up to several kilometers from the EM source. Based on this concept and incorporating scalar and vector magnetometers, we investigated two massive sulfide deposits (Hope Mine in Namibia and Mina La Poderosa in Spain) and modeled conductivity distribution in the subsurface. Multiple grounded horizontal electrical dipoles were set up in the respective areas of interest and surveyed individually leading to an intersecting data set. EM fields were excited by injecting rectangular currents with a fundamental frequency of 1 Hz and 32 Hz and amperage and field response were sampled at 1 kHz and 32 kHz. Conductivity models are based on the fitting of transfer function estimates relating recorded current strength and measured flux density in frequency space. We could demonstrate that both UAV-towed magnetometers provide a complementary, consistent data set which enables imaging of conductive bodies down to a depth of several hundred meters. Our results could be validated with models from other independent methods and borehole probes.

Keywords: semi-airborne electromagnetics, mineral exploration, UAV application