Imaging deep massive sulfide deposits with multiple grounded sources and UAV-towed scalar and vector magnetic field receivers - Part 2: Inversion

R. Rochlitz[1], T. Günther[1], P. Kotowski[2], M. Becken and A. Wilhelm
1) LIAG Institute for Applied Geophysics, Hanover, Germany
2) Institute of Geophysics, Department of physics, University of Münster, Germany
3) terratec geophysical services, Heitersheim, Germany
Contact: raphael.rochlitz@leibniz-liag.de

SUMMARY

We consider modern measurement systems based on uncrewed aerial vehicles (UAV) for semi-airborne electromagnetic (SAEM) exploration of massive sulfide deposits. The SAEM method makes advantage of combining strong signals emitted by large dipole or loop sources installed on the Earth's surface with airborne receivers to cover large survey areas and overcome accessibility problems on the ground. UAVs can provide a cost-effective alternative to helicopters as carrier for receiver systems that match the total payload limitations of 25 kg . They can also help to reduce logistical efforts and provide a greater flexibility in survey layouts and scales. In this work, we present and compare inversion results of data recorded with two different receivers, a scalar and a vector magnetometer, acquired in two mining areas in Namibia and Spain. Whereas the first demonstration site is easily accessible with almost no vegetation and topography, the test site in Spain is characterised by poor accessibility, height undulations up to 300m, and strong vegetation. Accordingly, the recorded data set and corresponding inversion results exhibit different characteristics in terms of data coverage and resolution capabilities. Being able to include a total frequency range between 1 and 1024 Hz of magnetic field data provides, compared with single-receiver analysis, the great advantage of combining enhanced near-surface resolution with large depth penetration. Furthermore, the presented results indicate that the resolution capabilities of comparatively small conductive targets can be essentially enhanced by considering multiple transmitter locations and repeated measurements in the same flight area due to the significantly increased data density and coverage. We assess the reliability of our inversion results by performing resolution analysis as well as comparing the appearance of conductors with existing geophysical and geological information. Both test sites demonstrate the capabilities of our measurement design to recover comparatively small but elongated dyke-like conductors matching locations of know massive sulfide deposits.

Keywords: controlled-source; electromagnetic; numerical solutions; inversion; semi-airborne