New chances to handle Airborne IP – Mount Milligan Case study

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Modelling IP parameters, including dispersive resistivity, from AEM data showing clear IP effects is possible nowadays. Using the spatially constrained inversion approach, with forward response that account for the full Cole and Cole model, we can recover realistic chargeability and "IP corrected "resistivities sections. The "IP corrected" resistivity sections often show better agreement with known geological features, while improving dramatically the data fit, with respect to those obtained without IP modelling. While the majority of the IP effect originate from shallow chargeable layers, there seems to be some positive correlation between an isolated deep chargeable anomaly and known base metal deposit location. The recent improvements in data acquisition (thanks to instrumentation characterized by high performance) and processing, allowed to resolve challenging targets (shallow and/or small), having a relevant importance for most of the engineering-geotechnical applications.

This case study refers to the Mt. Milligan is a large Cu-Au porphyry deposit located in central British Columbia. Multiple geophysical data sets were collected over Mt. Milligan, including airborne VTEM survey (EM and magnetic) in 2008. The EM data were inverted using Cole-Cole model in order to extract IP information, including chargeability of the subsurface using SCI concept. Further, the Magnetic TMI data were inverted using UBC-GIF approach. From geological evidence the Mt. Milligan deposit is a mineral occurrence within a porphyrite-monzanite stock (MBX), hosted within andesites and volcanites of the Takla group. Monzonite intrusives are often accompanied by intense hydrothermal alteration processes. In the case of the Mt. Milligan deposit there are two types of alteration present: potassic and propylitic. Potassic alteration produces chalcopyrite, bornite and magnetite, while propyllitic alteration produces pyrite and minor magnetite. These alterations affect different physical properties of the strata which is reflected in the inversion models. The 3D magnetic inversion can be useful in recovering information about the magnetite contents and therefore can be indicative of areas subjects to potassic alteration, while the chargeability of the rocks may be affected by presence of pyrite, chalcopyrite and bornite. Chargeability is a particularly important physical property sensitive to presence of gold in porphyry deposits, where faint magnetic or conductive EM anomalies may be detectable.

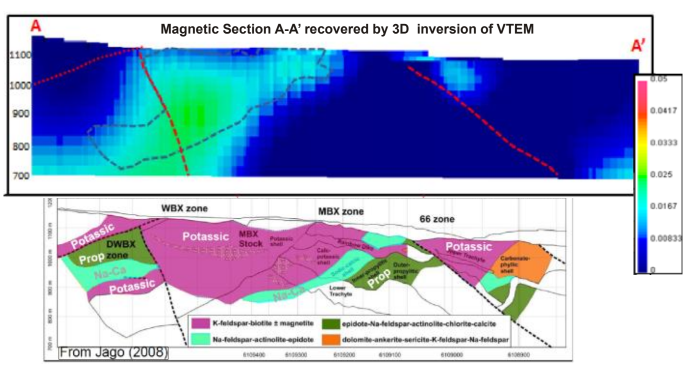

Figure 1

Figure 1 demonstrates the correlation between the potassic alterations and the distribution of magnetic susceptibility, along a cross-section. The EM data, retaining all the IP, was then inverted with SCI using the Cole-Cole model. The results of the inversions of Cole-Cole parameters are realistic, with peaks of chargeability corresponding to the location of the negative or very fast decaying transients. We further compare the inverted chargeability sections with available geological and geophysical ancillary information. Oldenburg et al., (1997) presented results of inversion of chargeability from ground IP data from this area. The central part of a VTEM line corresponds to a ground IP profile. Figure 2 presents the comparison between the airborne derived chargeability section and the chargeability recovered by Oldenburg from ground IP data. The comparison shows a positive correlation between the near surface chargeability recovered from the ground IP and the VTEM airborne derived chargeability section. The deeper chargeable anomalies from the ground survey associated with MBX stock are not recovered from this VTEM dataset. Oldenburg et al. showed that the chargeability maxima, including the shallower ones, are often correlated with gold mineralization. AEM derived shallow chargeability is mainly located on the western border of WBX and on DWBX.

The shallow chargeability is concentrated to the W, SW of the WBX stock. This seems to confirm the discussion by Oldenburg et al. where it was suggested that the strongest IP response might be manifested as a halo found outboard of the primary mineralization, associated to increase of pyrite concentration as one enters regions of propylitic alteration.

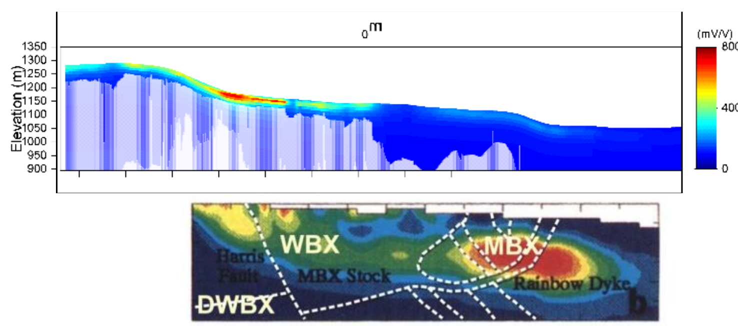

Figure 2