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Airborne EM MobileMTm – technical details and applications

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Summary

MobileMT is an airborne electromagnetic (EM) system that utilizes natural EM fields in the frequency range from 26 to 21,000 Hz to understand subsurface conductivity structure over a wide range of depths. To emphasize the inductive response from comparatively near-surface structures and discrete targets, a modified version of the system, called MobileMTm, was developed, which is primarily focused on data at higher frequencies. The primary differences between the two systems include: MobileMTm acquires data over a slightly higher frequency range, from 90 to 27,000 Hz, the tow cable is half the length, allowing lower ground clearances, and the bird is equipped with a GPS antenna and orientation gyroscope. In addition, the airborne component of the system is outfitted with two magnetic sensors to precisely measure the horizontal gradient of the magnetic field.

To test the capabilities of the modified system, two test blocks were planned over two known kimberlite pipes in the Lake Timiskaming kimberlite field of northeastern Ontario (KL-01 and KL-22). Both kimberlites are known to form positive magnetic anomalies, as they consist dominantly of volcaniclastic kimberlite with subordinate late-stage cross-cutting hypabyssal kimberlite. In the absence of a clear magnetic signature, EM data has proven useful for kimberlite exploration. Conductive anomalies often develop in crater facies kimberlite because of weathering of ultrabasic kimberlite minerals, as well as high porosity in tuffaceous and brecciated parts of the pipe that may act as a conduit for groundwater flow. In addition to the crater, the kimberlite pipe can also differ from the host rocks in terms of resistivity. The output apparent conductivities of the MobileMTm system for the test blocks, particularly at higher frequencies, clearly delineate the locations of the kimberlites at the surface. Inversion results illustrate conductivity structure to depths of 700 m and elucidate the ‘pipe-like’ shape of the kimberlites at depth.

This case study demonstrates the potential of the MobileMTm system to aid in the identification of discrete targets including kimberlites, located at the surface and ranging up to several hundreds of meters depth, through acquisition of magnetic and EM data. In addition to the greater depth of investigation, the passive field technology can detect superconductors and distinguish between rock types with high resistivities, i.e., in excess of thousands and tens of thousands of ohm-m, and is free of distortions from parasitic IP and SPM effects inherent to systems with impulse type, artificially driven transmitters.