Exploring for graphite using a high-resolution ground-based time-domain electromagnetic system: Modeling and case study

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The unique combination of physical and chemical properties of graphite for industrial applications makes it an irreplaceable material. As a result, graphite is used in numerous applications such as refractories, steelmaking, brake linings, foundries, batteries, and lubricants. The U.S. produced no natural graphite in 2013 and relies on imports for its consumption, and Canada is one of the principal global import sources. The worldwide demand for graphite has steadily increased throughout 2012 and 2013. Graphite occurs in metamorphic rocks such as marble, schist, and gneiss, and is often disseminated through certain layers of the host rock sequences. The high electrical conductivity of graphite (on average 10^3 S/m) makes it a good target for electromagnetic (EM) exploration methods. Airborne EM systems have been designed to detect the large graphite deposits; their large footprints may miss smaller, yet still economical, graphite deposits. Ground-based EM systems have higher resolution which allows them to either detect smaller deposits or to be used in follow-up operations to further delineate the shape and location of an interesting anomaly identified on airborne data. The IMAGEM system is a new ground-based time-domain EM (TDEM) survey system with a high spatial resolution capable of precise detection of high-conductivity man-made and natural targets. The system generates a primary EM field using a semi-sinusoidal waveform and records the induced secondary field at a base frequency of 30 Hz. It can be operated on foot by two operators or towed by a vehicle for rapid and inexpensive surveys. Forward modeling has shown that the system can detect conductive graphite layers with a thickness of a few metres in a resistive host rock to depth of approximately 25 m, even in the presence of a conductive overburden. In addition to modeling results, the poster will feature a case study from Lac Tétépisca, Québec, where the IMAGEM system was used to survey a prominent anomaly interpreted to coincide with graphite deposits.