Broadening airborne time-domain electromagnetic bandwidth using a multiple pulse approach

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Airborne time-domain electromagnetic (TDEM) methods have been very successful at finding and resolving conductive targets at hundreds of metres below surface. To achieve these results, a powerful half-sine transmitter is used to generate a high dipole moment pulse capable of penetrating the near surface to reach deep targets. The half-sine waveform allows for maximum peak dipole moment but in exchange has a relatively slow turn-off. The slow turn-off limits the high frequency content of the TDEM system and consequently is a better choice for mapping bigger and deeper geological targets. In contrast a square transmitter waveform has a very fast turn-off but in exchange can only achieve a relatively low peak dipole moment. The fast turn-off generates more energy at high frequency and is able to illuminate smaller and shallower geological targets. Past techniques in successfully mapping both shallow and deep geology have required a two-pass approach which can be slow and costly to explorers. We present a multiple pulse time-sharing system whereby multiple waveforms are used to obtain both the low and high frequency information in one pass thereby broadening the bandwidth of TDEM systems. Although frequency-domain electromagnetic (FDEM) configurations produce the highest resolution of the near-surface, it is shown that this multiple pulse technique allows explorers to choose a single system to map both shallow and deep targets with very little compromise. Combining properties such as apparent chargeability derived from TDEM with multiple pulses and acquiring data on a fixed-wing multi-sensor platform is shown to be an extremely useful set of tools for one-pass complete geological mapping. Expanding the geological footprint is what matters to explorers. New work completed on a test survey over the Kamiskotia area near Timmins, Ontario, Canada using multiple sensors (airborne magnetic, gamma-ray spectrometry (AGS), gravity gradiometry (AGG), and TDEM is presented including modelling, inversions, and interpretations.