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Recent Airborne EM System (helicopter VTEM and fixed-wing ZTEM) Development for Near-surface and Regional Applications for Oil and Gas Exploration

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2010-2011 has seen significant advances being made to the VTEM (versatile time-domain electromagnetic) system and the ZTEM (z-axis tipper electromagnetic) systems for improved near-surface electrical imaging and regional reconnaissance resistivity mapping for hydrogeological and oil & gas applications. Notably the inception of a new early channel VTEM helicopter system as well as a new Fixed Wing ZTEM system.

The helicopter-borne VTEM system is a geophysical instrument, which has been in continuous development since 2002, for increased detection of a broad variety of conductive targets, primarily for mining. However, although the VTEM system has progressively achieved marked improvements in its deep penetration characteristics (>300-500m), at the same time its near-surface imaging capability has been limited by its early time data. This is significant because early time or high frequency airborne electromagnetic data (AEM) are desirable for shallow sounding or mapping of resistive areas. Yet many time-domain AEM system have problems obtaining quantitative early-time data due to a variety of issues, namely system bandwidth.

In an effort to address this issue, Geotech has embarked on a system design strategy aimed at improving the early-channel VTEM data and achieving fully calibrated, quantitative measurements closer to the transmitter current turn-off. This development has led to new model of VTEM system designed specifically for near-surface, high resolution applications, while maintaining reasonably optimal deep penetration characteristics. Results have shown a significant improvement in quantitative VTEM data at earlier times than previously achieved, approaching 5μseconds after the current turn-off.

The development of the helicopter-borne ZTEM system in 2007 represented the first airborne application capable of deeply penetration EM (>1-2km) and mapping of geologic units, structure and alteration based on lateral resistivity contrasts. The ZTEM airborne AFMAG system measures the anomalous vertical secondary magnetic fields that are created by the interaction between electrical heterogeneities in the earth and naturally occurring, plane wave audio frequency EM fields that are from worldwide thunderstorm activity. It is therefore a unique airborne deep resistivity mapping tool that is capable of exceeding the 200-300m depth penetration limits of traditional AEM systems in sedimentary oil and gas environments.

The standard ZTEM acquisition system obtains vertical (Z) component data using an aircoil receiver, suspended below the aircraft. The vertical component data (Hz) are then ratioed to fixed horizontal field measurements (Hx-Hy) obtained using identical reference coils. The tipper transfer functions are derived, between 30-730Hz, using Fourier-based, digital signal processing. The new Fixed-Wing ZTEM for 2011 employs a newly designed receiver coil deployed from a Cessna Grand Caravan for improved efficiency.