Suite 6 / 9 The Avenue
Midland, W.A. 6056
AUSTRALIA
Ph: +61 8 9250 8100
Fax: +61 8 9250 7100

EMIT
ElectroMagnetic Imaging Technology

Tri-axial Fluxgate Magnetometer

Ground and Borehole TEM Sensors

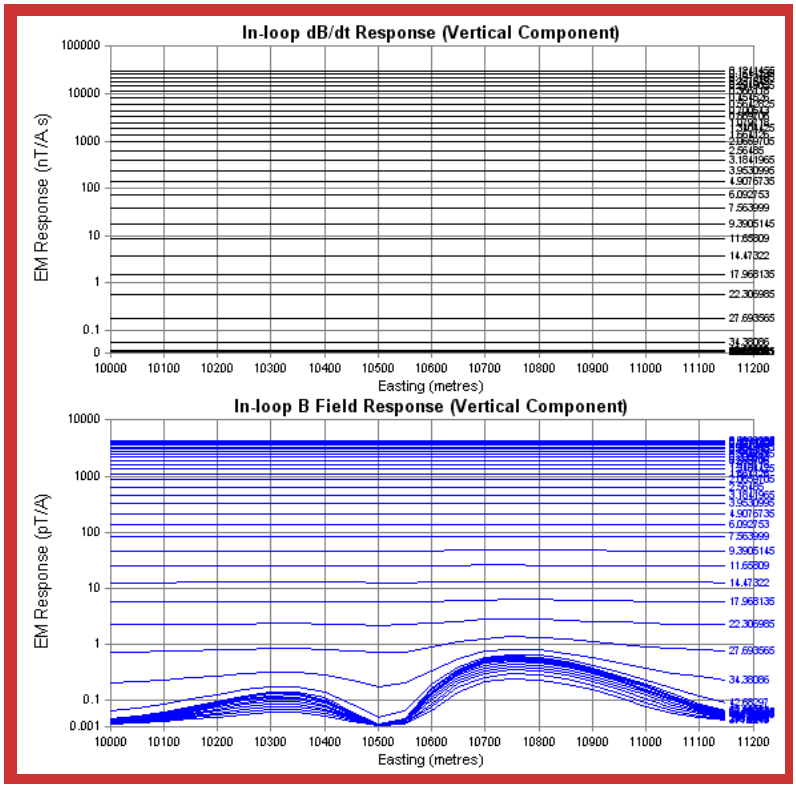
B-FIELD MEASUREMENTS IN TEM SURVEYS

The conventional sensor type used in TEM surveys is a coil. It measures the time-derivative of the magnetic field resulting from electric currents induced in the ground. With a square transmitter waveform, this conventional measurement of dB/dt is an approximation of "impulse response".

By measuring TEM responses with a B-field sensor such as a Fluxgate Magnetometer or SQUID Magnetometer, one measures the time-integral of impulse response which is called "step response". The time-integral is an important "filter" and attenuates decays which are rapid (from weaker or unconfined conductors) in preference to decays which are slow (from strong conductors).

As a result of the preferential attenuation of fast decays in a B-field TEM survey, it is easier to observe the response of a good conductor in the presence of a weaker conductor such as a host, overburden or less conductive bedrock feature. The response of a good conductor is observed in a B-field TEM survey earlier in time than it is in an equivalent dB/dt survey which means that it is more likely to be above the noise floor of the TEM system.

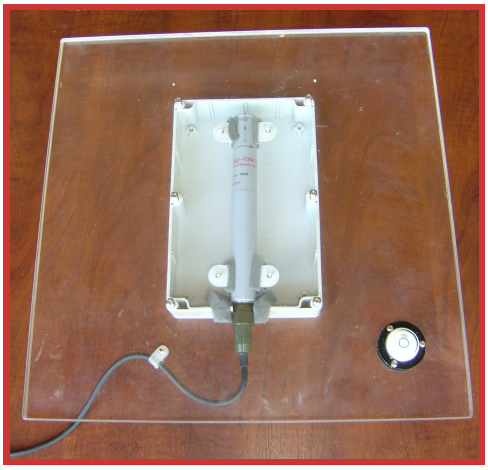
A plate model was used to generate B-field and dB/dt responses from a conductive target beneath overburden. Calculated were vertical-component in-loop responses from 200m moving transmitter loops. Buried target plate has conductance 15000S, dimensions 300m x 300m and depth of burial 300m. The plate is dipping 70 degrees to the East. A 1 km x 1 km 50S thin sheet overburden model was used. Delays from 0.1 msec to approximately 400 msec are plotted in profile form. The B-field response of the plate is clearly visible after 20 msec delay but is invisible on the dB/dt data at that delay time. The dynamic range of the B-field response is smaller than that of the dB/dt data, another important advantage.



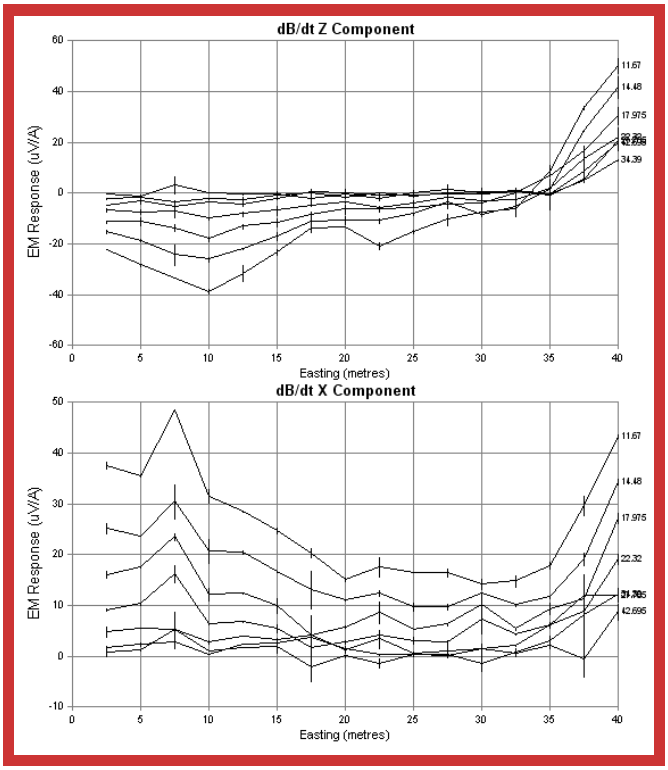
Matched with a SMARTem receiver and a high-powered transmitter system, Fluxgate Magnetometers make a powerful tool for deep exploration. Base frequencies as low as 0.1 Hz can be used for TEM surveys.

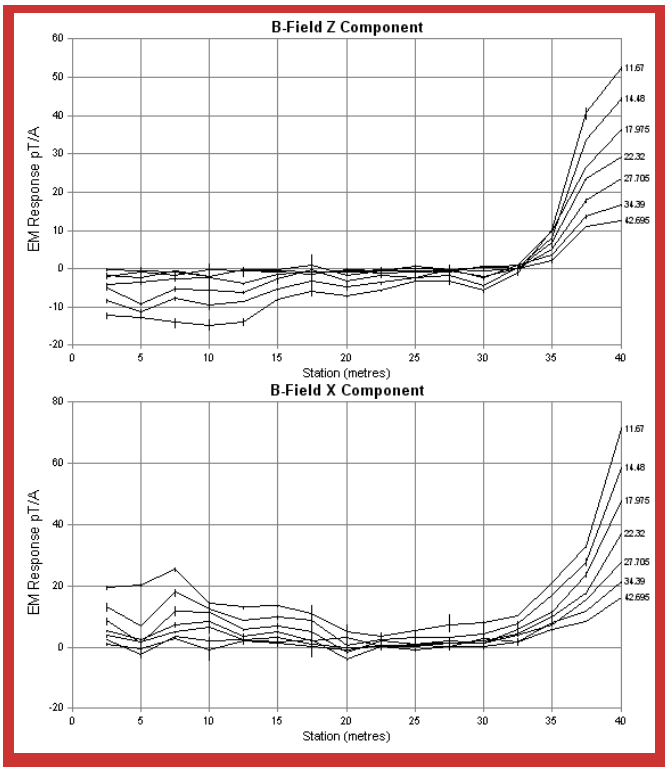
GROUND TEM SENSOR

A tri-axial fluxgate magnetometer is used as a receiver sensor for ground-based TEM surveys. The fluxgate is mounted on a solid, non-magnetic platform which is levelled for the measurement. A separate controller box provides power to the sensor, removes the DC geomagnetic signal from each component and amplifies the EM signals from the magnetometer. The 3 components can be measured simultaneously using the SMARTem receiver system. The fluxgate sensor is capable of measuring magnetic field in the frequency range from DC to 5 kHz.



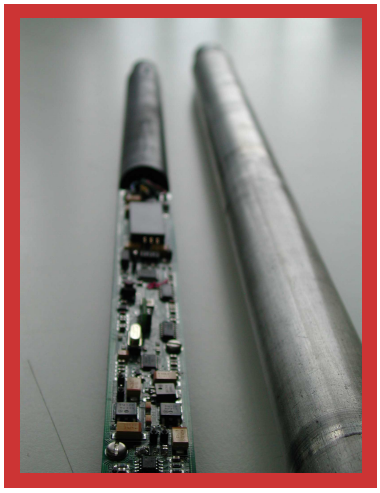
These profiles show a comparison of late-time dB/dt and fluxgate B-field responses in a high resolution moving-loop survey. Data acquisition parameters for both surveys are identical. A small, conductive nickel-sulfide target at the right-hand end of the survey line responds more strongly on the B-field profiles. The latest delay times on the dB/dt data are noisier than the B-field data and are affected by the presence of weaker conductors at the left-hand end of the survey line.





BOREHOLE TEM / MMR SENSOR

A tri-axial fluxgate magnetometer is housed in a slimline probe to be used as a receiver sensor for borehole TEM and other borehole geophysical survey types requiring the accurate measurement of magnetic EM fields in the frequency range from DC to 5 kHz. The probe is designed to carry out a range of automated operations, including the automatic nulling of the DC geomagnetic response from the magnetometer in order that the small AC signals desired can be isolated and amplified. An integral part of the probe electronics are tri-axial accelerometers for orienting the probe and a temperature sensor for calibration of the magnetometers and accelerometers. The probe runs on standard 4-core logging systems common in the geophysical industry.



A measurement of 3 components of magnetic field can be undertaken with specialised software developed for the SMARTem Receiver system. The probe houses its own CPU which is capable of accepting instructions from the SMARTem receiver or from a stand-alone computer. The SMARTem Receiver automates the process of taking a measurement - results of a measurement of the 3 components are automatically processed and rotated into borehole-referenced directions.