Some 30 specimens of the sandstone collected within the area yield an average density of 2.31 tonne m^{-3} for the Gosford Formation. Six specimens of soil (mainly fine silt) give an average density of 1.36 tonne m^{-3}. This value is considered to be very low and a value of 1.7 tonne m^{-3} may be more realistic bulk density of compacted sediments. A density contrast of 0.6 tonne m^{-3} is thus chosen in quantitative interpretations.

A quantitative interpretation has been carried out along two profiles AB and CD, one of which is described here. Forty six stations along and close to profile CD were used in obtaining 44 interpolated values at a constant spacing of 100 m along the line. The mean and RMS values of the original anomalies were 0.88 and 4.41 GU respectively and these statistics for the equispaced values were 0.88 and 4.36 GU respectively. A three point Hamming filter (weights: 0.23 0.54 0.23) was applied to the latter values and end points were saved by assigning to a single neighbour, the weight for two neighbours. The mean and RMS values of the smoothed anomalies were 0.87 and 4.30 GU respectively. These smoothed anomalies are shown in Fig. 2.

An interpretation of the anomalies using a density contrast of 0.6 tonne m^{-3} between the young sediments and the Gosford Formation is carried out with the application of an iterative computer programme and shown in Fig. 2. The maximum inferred thickness of sediments is 58.3 m under point 21 at the base of the gravity low. It should be noted that the vertical exaggeration of the section is about 20 and the dip of the floor does not exceed 5° anywhere along the section. While small scale step faulting at the flanks of the valley cannot be entirely excluded, the low dip is indicative of the erosional processes responsible for the carving out of the valley floor and later filling in of the depression by young sediments. The prominent ridge on the valley floor occurs in the vicinity of the Blackwall Mountain. Point D occurs close to the rip at Bucher Bay where bedrock is at shallow depth.

Uncertainty in the value of chosen density contrast is probably the biggest source of uncertainty of the quantitative interpretation of the anomalies. While this interpretation needs to be corroborated perhaps with a few boreholes, the present study does show the applicability of the gravity method in a built-up area where many other geophysical methods cannot be applied. It also shows that a detailed gravity survey of a small area can make a significant contribution both to local and regional geology. While contribution in the local case is largely confined to a shallow depth, it may be possible to extract some deeper information as well.

CASE HISTORY EXAMPLES COMPARING DIPOLE-DIPOLE INDUCED POLARIZATION AND DUAL HORIZONTAL LOOP TRANSIENT ELECTROMAGNETIC SURVEYS IN AUSTRALIA

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This paper presents a selection of geophysical results across various conductive and/or chargeable targets encountered in routine base metal exploration. Its main purpose is to allow immediate visual comparison between the effectiveness of dipole-dipole IP and the Crone Pulse EM (PEM) transient EM system in a variety of differing contexts.

Example 1:

A vertical sheet of massive copper-zinc-lead mineralization in the Lachlan Geosyncline shows a classic response which gives a symmetric slowly decaying PEM anomaly and symmetric triangular shaped apparent resistivity low and chargeability high. The deposit responds well to SP, is not magnetic and gives a definite but extremely low amplitude INPUT response.

Example 2:

In many ways this example from the Pilbara region of Western Australia gives similar responses to the mineralization of Example 1, except the source of the anomalies is magnetic. Drilling encountered relatively small amounts of low grade pyrrhotite which conductivity studies showed to have a similar conductivity thickness product to the more abundant mineralization of Example 1 and even with the commercial Woodlawn ore body. Small amounts of pyrrhotite, whose existence is indicated by magnetic anomalies, can give deceptively intense IP and PEM anomalies.

Example 3:

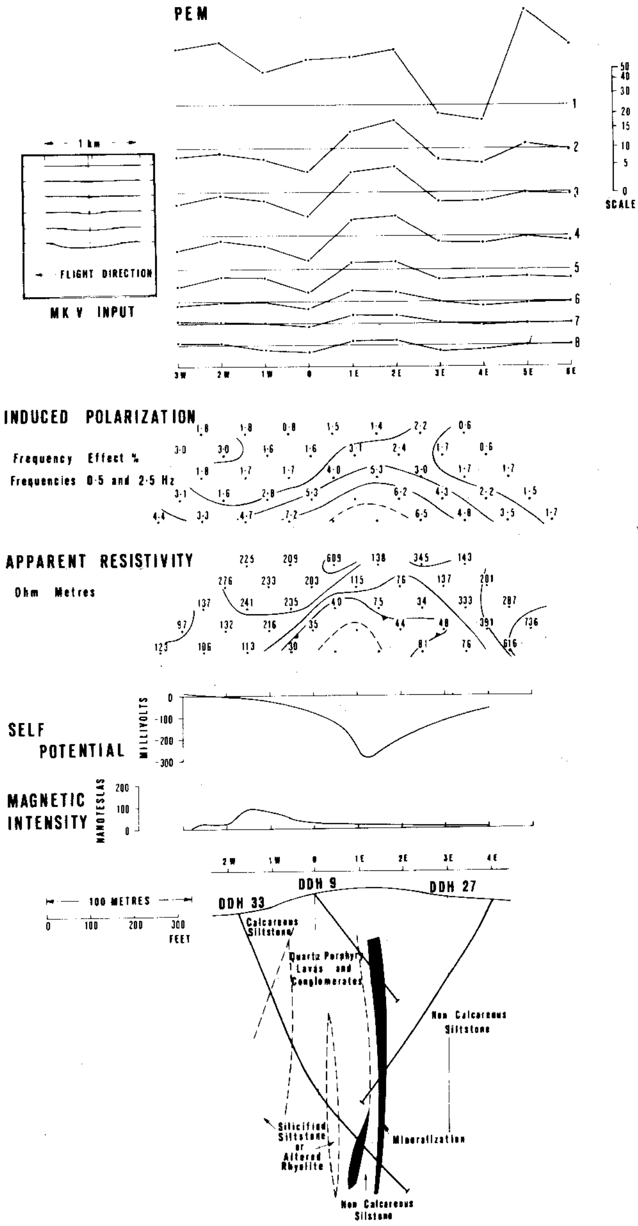
A sheet of disseminated sulphide in the Pilbara region gives distinct dipole-dipole IP and magnetic induced polarization (MIP) responses. The apparent resistivity data recorded with the IP data shows that this mineralization is not conductive. The PEM basically does not respond to this zone although rapidly decaying early channel perturbations which correlate with features on adjacent lines are probably an associated response.

Example 4:

Various geophysical methods were tried over this target in the Lachlan Geosyncline which was originally identified as an INPUT conductor. Turam and PEM surveys located the conductor on the ground but the strange forms and extreme variability of the anomalies suggested that it was not a classic massive sulphide body. An IP survey showed that no chargeable material was present. The dipole-dipole resistivity low results had the form caused by a horizontal conductive body. The source of the anomalies was identified as a buried channel containing conductive ground waters and clays.

Example 5:

Areas with lateral changes of conductivity can cause interpretation problems because of spurious anomalies caused by edge effects. A study from the Yilgarn Block of Western Australia illustrates these points. INPUT defines different conductive bodies but lacks the resolution necessary to determine their form. PEM and dipole-dipole resistivity data must be interpreted carefully to decide if anomalies are due to mineralization or merely conductivity boundaries. Gradient array apparent resistivity data is extremely useful as it provides a simple reflection of the resistivities of underlying rocks. Despite complexities with conductivity changes IP results indicate the lack of sulphides in an area by simply not showing any anomalies.



CLASSICAL ELECTRICAL & ELECTROMAGNETIC RESPONSES OVER A VERTICAL SHEET OF MASSIVE SULPHIDE MINERALIZATION

Both dipole-dipole IP and dual small horizontal loop transient EM systems have well defined responses which allow the attitude and position of conductive and chargeable sheets to be defined. A knowledge of these responses allowed most of the above anomalies to be satisfactorily explained prior to drilling.

IP provides information on chargeability as well as conductivity. PEM provides conductivity information only which is sometimes insufficient to determine whether a target may be economic. As PEM surveys are significantly faster and cheaper than dipole-dipole IP surveys, an optimum investigative approach appears to be to outline a target with PEM and then to check it with one or two dipole-dipole traverses.

SPECTRAL IP – PAST, PRESENT AND FUTURE

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These has been considerable research and development into Spectral IP over the last five years. Some of the earliest claims have been found to be erroneous. The dominant influence on IP spectra is rock texture and grain size and not the particular electrochemical reactions taking place at the metallic-ionic interface. In spite of the inability of Spectral IP to directly identify chemical reactions and thus, specific minerals, it has been found to be a useful tool in indirectly identifying minerals through their characteristic habit. The long time constant spectra associated with the typically large effective grain size of graphite is readily distinguished from the short time constant spectra of typical "sugary" volcanogenic massive sulfide Py-Cp-Sp-Pb mineral mineralization.

The raw spectra obtained over different types of mineralization can only be directly compared if the measurements were made with small arrays in an open pit mine, where the geometry approaches the ideal homogeneous earth case. In usual exploration applications, the apparent time constant and the apparent chargeability will both be smaller than their true values due to the dilution effects of overburden and surrounding host rock. It is possible to correct for dilution effects, when host rock and overburden polariz-

SPECTRAL IP FIELD SET-UP