response becomes clearly discernible at a delay time beyond approximately 2 ms. However, in contrast with the anomaly observed for the Elura deposit, the TEM profiles for both Case Study No 2 and No 3 show an asymmetrical double-peaked anomaly. This indicates the target is a thin dipping dyke. Hence, results can be interpreted with the aid of the analogue modelling results for thin dipping dykes described below.

2. Apparent Resistivity Pseudo-sections

Transient voltage levels at any given delay time can be transformed to apparent resistivity values via the asymptotic formula for a half-space (Fokin, 1971 and Lee and Lewis, 1974), or via a more accurate formula involving a series of terms (Spies and Raiche, 1979). The first term of this series yields the asymptotic formula.

Fig. 2 shows an example of a pseudo-section for the Elura deposit. The apparent resistivity values have been obtained by transforming the voltage values of the profile presented in Fig. 1. The resistivity of the overburden is approximately 15 Ωm, while that of the localised anomaly at 50750N is approximately 9 Ωm.

3. Analogue Modelling Results

A TEM modelling programme has been initiated at CSIRO to model responses from thin dipping dykes, occurring in conductive media. A SIROTEM unit is used to collect the data. Fig. 3 shows an example of results obtained from a model of a thin dipping dyke occurring in conductive host rock covered with conductive overburden. Any scaling factor can be applied to this model. For example, with a scaling factor of 1000, the model corresponds to a field case of 50 m coincident loops over a conductive overburden of 25 m thickness covering of body of width 6 m and dipping at 60°. The model results show an asymmetrical double-peaked anomaly, as is observed in the field.

IV. Conclusion

The results presented here show that the high signal-to-noise ratio of SIROTEM measurements enables effective location of conductive targets, even in weathered terrain where considerable conductive overburden covers the target. In conjunction with extensive data interpretation aids provided by modelling, the parameters of the target can be deduced. The ability to produce apparent resistivity values from the transient voltages indicates the potential use of SIROTEM for stratigraphic mapping.

V. References

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THE EFFECT OF HOST ROCK ON TRANSIENT ELECTROMAGNETIC FIELDS

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The presence of a conducting material about an orebody modifies the transient electromagnetic field in two ways. First, at the early stages by strongly directing the primary field and secondly, at the later stages by swamping the secondary field.

Figure 1 shows an arrangement for a transmitting loop that is capable of being able to control the direction of the fields in the ground. Figure 2 shows the variation in the locus of the maximum when the, f, parameter is varied, a, is set to 20.

The swamping of the secondary, electromagnetic transients can best be understood in terms of the singularity expansion of the primary and secondary transients. We show that the swamping occurs because both the primary and the secondary fields are both controlled by the same singularity — a branch cut from the origin and along the positive imaginary axis. We also argue that much more attention should be paid to the early stages where other singularities are know to be important.

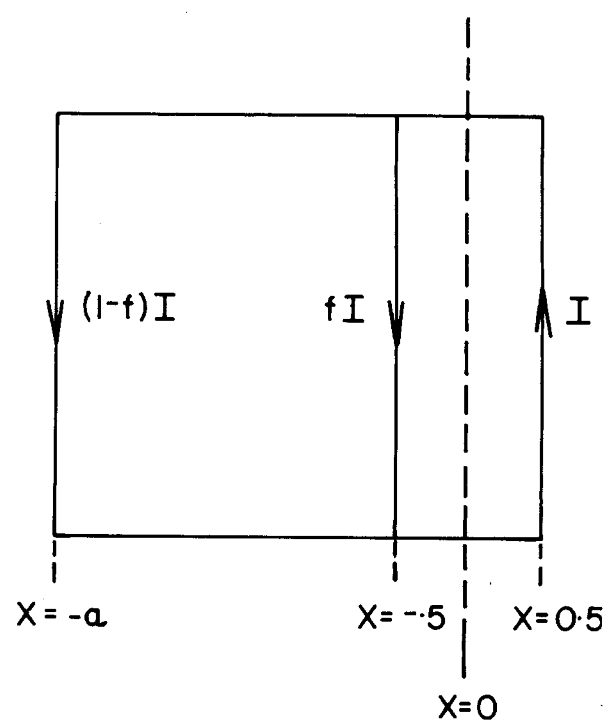

FIGURE 1

Arrangement for the transmitting loop so as to direct the electromagnetic transient.

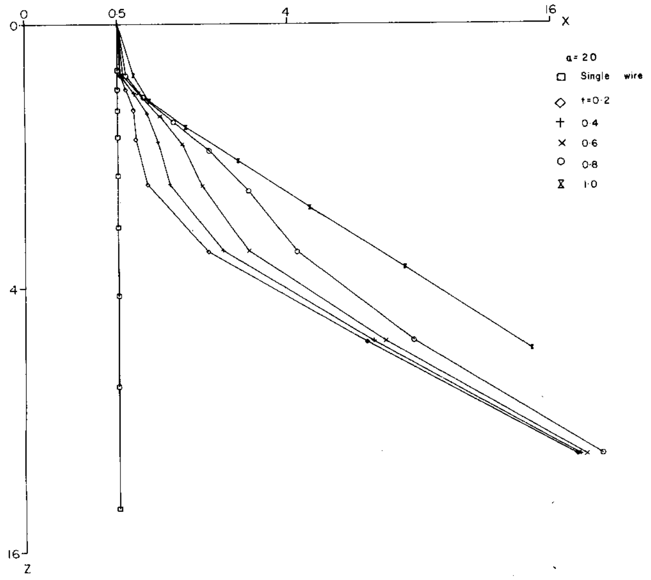

FIGURE 2

Loci of maximum emf produced by the circuit in Figure 1. As *a* increases, the possible deviation also increases.

THE TRANSIENT EM TECHNIQUE – NEWMONT'S SYSTEM IN AUSTRALIA

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The Newmont Electromagnetic Pulse (EMP)

Newmont Proprietary Ltd. has been operating a transient EM system in Australia since August 1976, and has surveyed more than 100 line km, in that time. In Australia the system has successfully located massive sulphides at depths in excess of 120 m, and in Canada orientation surveys indicate that mine size targets can be detected at depths approaching 300 m. The experience gathered to date strongly suggests that detection of mine size targets at depths in excess of 200 m, is possible even in areas of conductive overburden.

For the summary which follows some understanding of the normal operating mode of the equipment is required. Briefly a rectangular loop of uninsulated aluminium cable, 800 m by 400 m is laid out on the ground, with the long side parallel with the regional strike. The exact location of the loop depends on the attitude of the targets to be illuminated. A transmitter drives a current into the loop and abruptly breaks that current every 750 msecs. The loop current may be varied between 20 and 100 A. Typically 80 A are used when about 13 KVA are dissipated in the loop, and the current required about 1 msec to fall to zero. A switch allows the pulse width to be set at 20, 40 or 80 msec. The 750 msecs cycle is a compromise between operational speed and reasonable transmitter battery life.

The secondary magnetic field is detected by a 5 feet by 3 feet air cored coil connected to a receiver by a 10 m cable. The coil is sensitive and yet practical for one man to carry the coil has legs, spirit levels and a compass, and may be oriented in any one of 3 mutually perpendicular directions. The directions are related to the grid with Z recorded as positive down. The receiver amplifies and samples the decaying voltage in the coil at 16 discrete points in time, after the transmitter pulse cut-off. Four overlapping windows allow the voltage to be sampled between 0.6 and 70 msecs; two windows cover the range with four common samples. The signal is stacked 14 times and then recoreded on tape for later processing by computer, and on paper tape for field scrutiny. A minimum of two readings is required, but as many readings as desirable may be taken. These data are then stacked, in a more intelligent way by computer during data processing.

The Half Space Response

The interpretation of transient EM, where the receiving coil is not coincident with the transmitting loop, required an understanding of the current distribution in the ground and its variation with time after current turn off.

Both Nabighian (1978) and Lewis and Lee (1978) have computed the electric field within the earth resulting from a current step in the transmitter loop. Briefly the resulting electric field can be compared to a "smoke ring" which moves downwards and outwards from the loop centre at an angle of 30° at late times. Also at late time the response of the vertical and horizontal fields created by the current flow vary as $\tau^{-2.5}$ and $\tau^{-3.0}$ respectively. Lee (1978) also described an equivalent "current axis" propagating in the half space where is radius varies as $\sqrt{\tau/\sigma}$

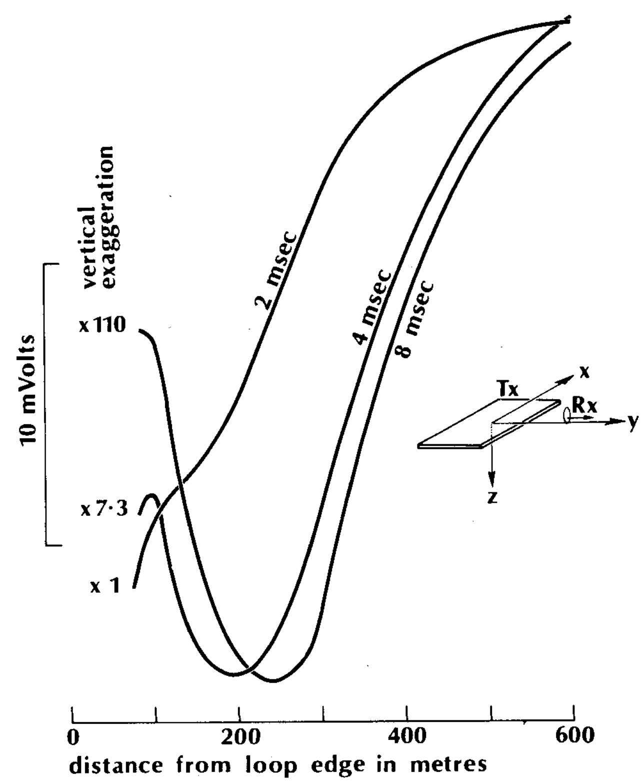

FIGURE 1

Half Space Response For Horizontal Component.