Paper

Effect of Profile Angle and Strike Extent of the Vertical Sheet in One Loop Transient Induction Method (Modelling)

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The effect of (a) profile angle β with respect to the strike, and (b) the limited strike extent of a vertical sheet conductor on the response of one loop transient induction method was studied by physical modelling. The results indicate that 95% of the maximum response can be obtained when β = 85°, while at least 40% of the maximum response can be obtained if the edge of the sheet conductor is covered by 0.5 L of the loop.

Introduction

One loop version of Transient Pulse Induction Method (TPMO) based on the investigation of non-stationary magnetic field is being widely used for conductive ore prospecting. The Transient responses of thin sheet like conductive non-magnetic bodies were studied by several workers using mathematical as well as Physical Modelling Studies (Velikin and Bulgakov 1967, Kamnetsky 1963, Ramaprasada Rao and Bhimasankaram 1973). However, certain aspects which have yet to be understood in detail are (1) the effect of the azimuth of TPMO profile with respect to strike direction of the body, and (2) the effect of the limited strike extent of the body. The results of physical modelling dealing with these aspects have been discussed in this article.

Modelling

While solving electrodynamic problems in inductive electrical prospecting, neglecting displacement currents, the criterion for modelling a non-magnetic system on a reduced scale turns out to be,

SL = Constant

Where S is the longitudinal conductance and L characteristic linear dimension of the body, and assuming the time of measurement t is same in nature and the model.

In the present investigation of the scale has been selected as 1 : 2,000, so that a square loop of the side 12.5 cms represents a transmitter-cum-receiver loop of 250 m x 250 m in nature. Aluminium sheet of 50 cm x 50 cms x 4 mm dimension is used to simulate the response of a thin sheet like body. The sheet is suspended below the plane of transmitter-cum-receiver loop at a depth h = 0.25 L and preselected profile angle β (with respect to strike direction) equal to 90°, 80°, 70°, 60°, 50°, 40°, 30°.

The block scheme shown in Fig. 1a of the modelling set up consists of a d.c. source, rectangular pulse generator, transmitter-cum-receiver loop which can be moved horizontally, transistorised sampling device, amplifier, differential integrator, indicator and controlling unit to synchronise the functions of the generator and sampling device. The e.m.f. induced in the receiver loop at 3 m.sec time was measured across the vertical sheet conductor for different profile positions of Y/L= 0, 0.5,1.0, 1.5,2.0,2.5 (Y being the horizontal distance from the centre of the body measured along the line of strike of the body, Fig. 1b). For Y/L = 0, profiling curves were obtained for different values of β.

Results

The observed e.m.f. value normalized with respect to the current I in the transmitter loop was plotted against the point of observation in order to study the behaviour of the response along profiles.

The response curve, along a profile perpendicular to the strike of the vertical sheet conductor, as is well known, shows two symmetrical maxima on either side of the central zero, which coincides with the centre of the body. As the profiling along (β) is varied from 90° to 30°, the symmetrv is retained but the responses become proges-

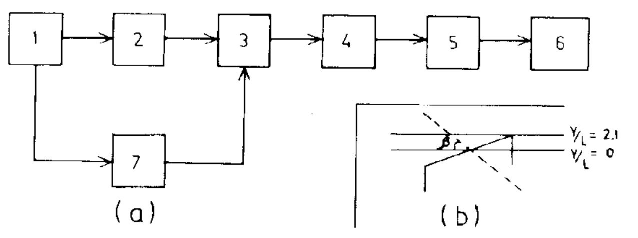

FIGURE 1a
Block diagram of the equipmental set-up (1) Generating unit, (2) Transmitter-cum-receiver coil, (3) Input switch, (4) Amplifier, (5) Integrator, (6) Indicator, (7) Controlling unit.

FIGURE 1b
Geometry of the profiles with respect to strike of the model.

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sively broader and the peaks shift apart Fig. 2. The results show that the response ratio η, where $\eta = (E/I)_\beta/(E/I)_{\beta=90°}$, decreases successively as the profile angle is varied from 90° to 45° and increases to its normal value from 45°. In Fig. 3 are shown the variation of η with β for the Transient one loop version along with the Slingram Profile (Zakharov, 1961). It is evident from the figure that the Transient response is more sensitive to the variation in profile angle than in the case of Slingram. The response falls to 95% of the maximum when $\beta = 85°$ whereas in the case of Slingram the same can be obtained even when $\beta = 60°$. However, due to symmetry in TPMO, more than 80% of the maximum response can be obtained when $\beta = 45°$ while in Slingram the response falls rapidly below 70% level when $\beta = 30°$.

The effect of the limited strike extent of the body is studied by establishing a relation between peak to peak responses (ξ) at $Y/L \neq 0$ and $Y/L = 0$. Fig. 4 shows that there is no significant change in the level of the response up to $Y/L = 1.0$, but falls down rapidly as the edge is nearing. The response falls to 40% of its maximum value when one side of the loop crosses the edge and further fails to detect any considerable signal when the loop is beyond the edge.

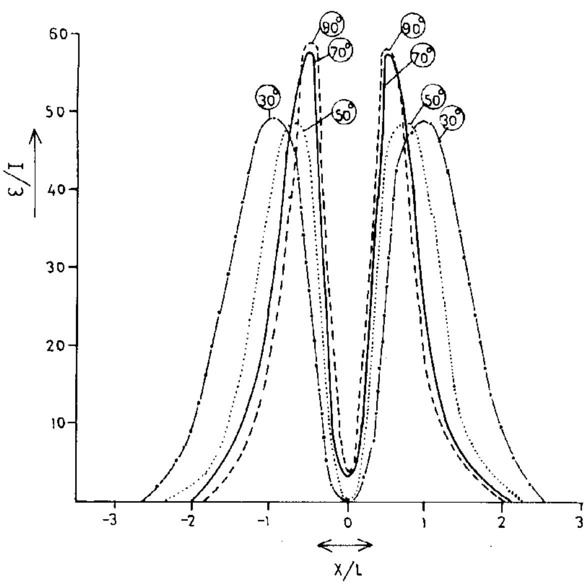

FIGURE 2
TPMO (Modelling) curves over vertical sheet conductor for different profile angles (β).

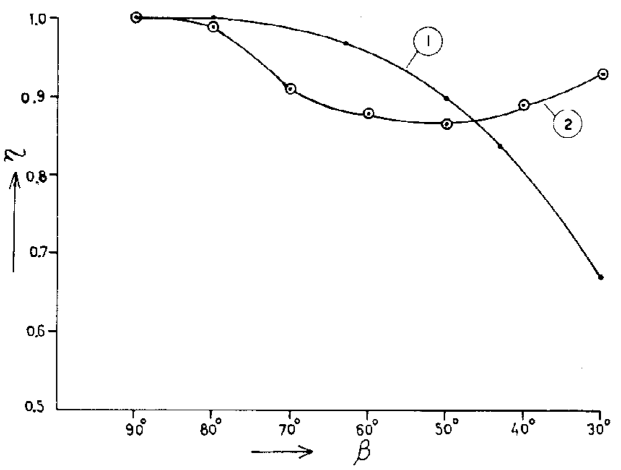

FIGURE 3
Dependence of TPMO response on profile angle (1) Slingram response (After Zakhrov, 1961), (2) TPMO response.

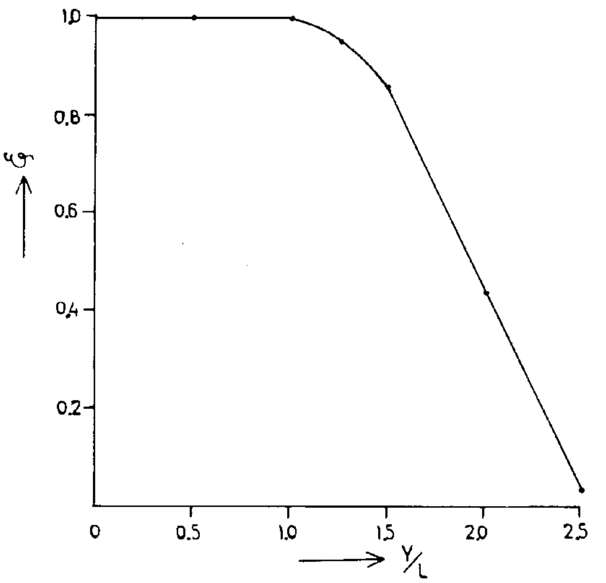

FIGURE 4
Dependence of TPMO response on strike extent of the body.

Conclusions

1. The Transient EM response in the one loop version is more sensitive to the variations in the profiling angle when compared to Slingram (harmonic) method.
2. The edge of the body should be covered by more than 0.5 L of the loop so as to detect at least 40% of the maximum response possible.

Acknowledgements

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