ABITIBI GEOPHYSICS

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Geo-Echoes

# Better Interpretations for more efficient drilling:

## Drilling a TDEM anomaly

**Our newest geophysicist at Abitibi Geophysics**

*Ms Circé Malo-Lalande, M.Sc.A. (École Polytechnique de Montréal), a geophysicist specializing in TDEM methods, has recently joined us. Circé will head the TDEM services section at Abitibi Geophysics.*

The shape of a TDEM anomaly being a direct function of the electrical properties as well as the geometry of the target, a quantitative interpretation of this anomaly can yield very pertinent information that will assist in locating a follow-up DDH. 2D or 3D inversion of TDEM data is not available yet, and comparing field data with theoretical methods is a rather drawn-out process.

In this Geo-Echo, Abitibi Geophysics will use a method able to develop simple, accurate and direct interpretative equations based on numerical modeling as well as statistical methods: multiple linear regression. The end goal of the method is to make the connection between the measured geophysical signal (the profile) and the physical parameters of the buried target.

The following example uses a single loop configuration along with a thin plate in a resistive host-rock. This configuration was developed and is currently used in Australia. However, it is not well known in North America. Moreover, this interpretation method can be used for other configurations that are not described in this treatise.
As a first step, a numerical modeling using the EMVision™ Leroi algorithm will enable us to calculate the responses of a large number of geological models of different dip (θ), conductance (*S*) and depth (z). Afterwards, the profile parameters: i.e. asymmetry (*AR*), peak-to-peak distance (*DAR*) and the time constant (*TAU*) are quantified (see **figure 1**).

Each variable change with time and two channels of the secondary field ($\partial B_S/\partial t$) are used. In the equations, indices *i* and *j* are indicative of the channel that was used.

As a final step, for each of the thin plate parameters ($\theta$, *S* and z) to be calculated, a set of simple equations containing the profile parameters are devised from a multiple linear regression. For a single loop, the results read as follows:

$$\ln(\boldsymbol{S}) = 3.51 + 1.28 \ln(TAU_j) - 0.48 \ln(DAR_j) \quad (1)$$

$$\mathbf{z} = a \cdot [-0.83 + 0.58\,(DAR_i) - 0.11 \ln(AR_i) + 0.45 \ln(TAU_j) + 0.10\,(DAR_j)] \quad (2)$$

where **a** is the length of the side of the loop.

$$\theta^\circ = 92.7 - 22.42 \ln(AR_i) + 8.09\,(\ln(AR_i) \cdot \ln(DAR_j)) \quad (3)$$

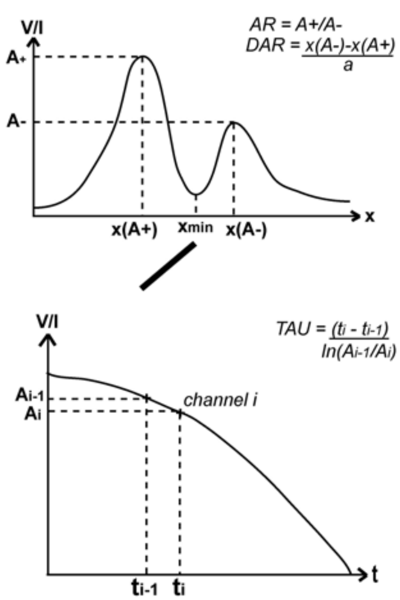


figure 1

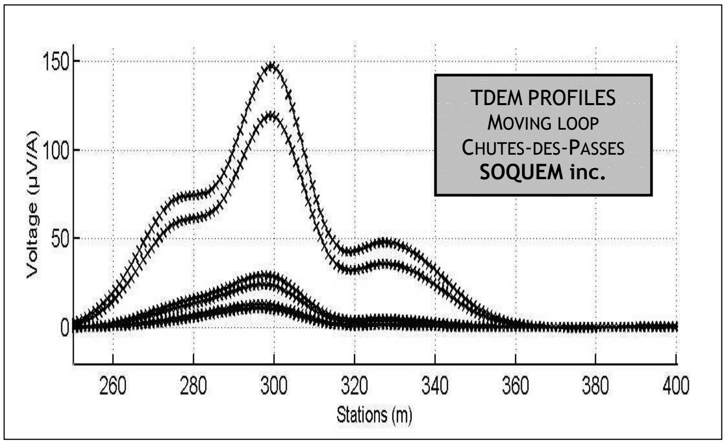


figure 2

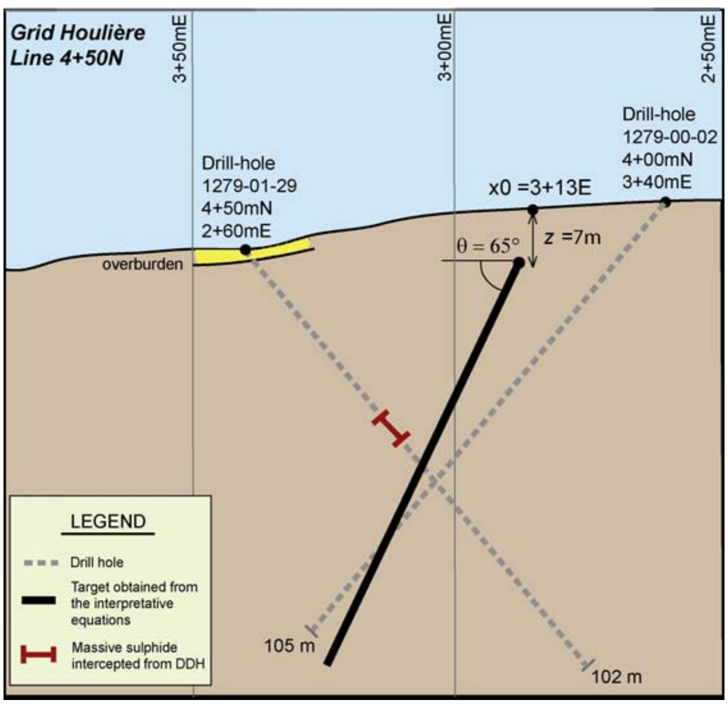


Figure 3

A linear regression adjusts the plate parameters (*θ, S and z*) by a least-squares method, based on the profile parameters (*AR*, *DAR* and *TAU*).

The interpretative equations were used on field data obtained on a SOQUEM inc. property (see **figure 2**). Information obtained from the DDH campaign confirmed the accuracy of the interpretation (see **figure 3** and **table 1**). Subsequently the interpretation was found to be accurate to within 15%.

The interpretative equations are simple, accurate and easy to apply. They do not require any more information than what is given by the measured data profile.

***As a reminder, this method can be used for any other configuration or geophysical methods where the shape of the profile is directly related to the physical parameters of the target. The interpretative equations can be developed for your specific needs.***

Table 1: Interpretation

| S' (S) | z' (m) | $\theta$' (°) | $X_0$' (m) |
|---|---|---|---|
| 180 | 7 | 65 | 3+13E |

REFERENCES :

Malo-Lalande, C., 2003, Application de la méthode électromagnétique transitoire en boucle simple pour l'exploration de gisement de type plaque. M.Sc. Memoir, École Polytechnique de Montréal, Québec, Canada.