# TDIP and SIP characterization of disseminated ores

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The aim of this work is to show complementarity of temporal and spectral induced polarization, applied to ore body detection and differentiation. This study had been performed into well-known geological background through borings, geochemical measurements, and also through some electrical resistivity tomographies.

Time-domain induced polarization (TDIP) had been carried out with SYSCAL PRO equipment (Iris Instrument, Ltd.) transformed into ELREC PRO, by differentiating transmitter device (VIP generator manufactured by IRIS) from receiver one. The main interests are (i) to avoid internal coupling effects and between transmitter / receiver cables on soil, and (ii) to obtain higher electrical power (until 3000 W) necessary to reach 30-40 m depth. Voltage measurement is done through non-polarisable electrodes. Electrical chargeability and resistivity tomographies had been obtained by lateral array displacement. Pole-dipole array is selected because it offers the best compromise between minimizing coupling effects, getting enough power to reach wanted depth, and necessary lateral resolution.

Spectral induced polarization (SIP) was performed using SIP FUCHS II equipment (Radic Research). As the device is not configured into a multichannel way, and as one sounding is very time consuming (about 7 h), only 2 soundings had been performed, located on major chargeability anomalies.

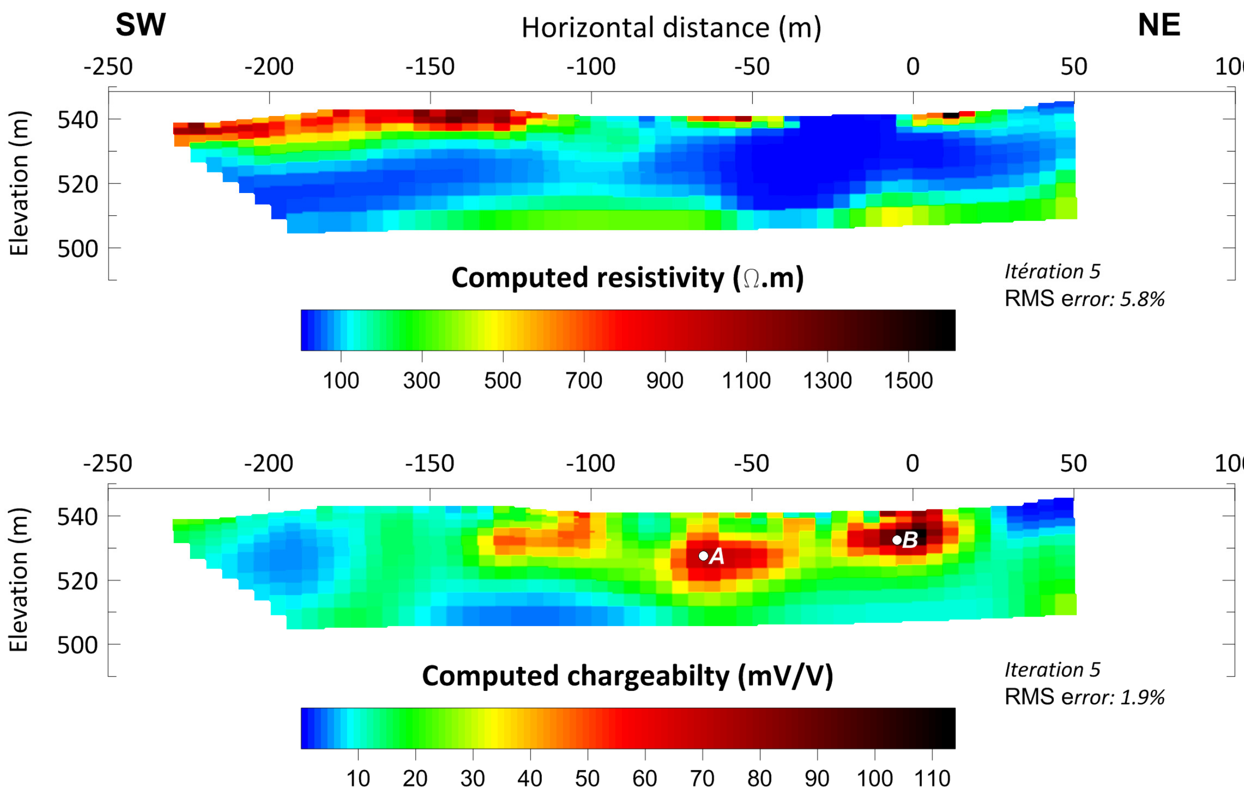


*Fig. 1: Computed resistivity and chargeability sections (pole-dipole array, 10 m inter-electrode spacing). A and B indicate chargeability anomalies.*

As results, a 3-layer model can be observed (Fig. 1): very a resistive level between 0 and 5 m depth (up to 1000 Ω m), a more conductive one between 5 and 20-25 m depth (50 Ω m), and finally an increasing resistivity for the bottom layer. A finer analysis indicates some highly conductive zone 50 m wide (50 Ω m) from surface until 30 m depth. This could be explained by clay or ore body presence.

Induced polarization analysis indicates very high chargeability values at resistivity anomaly zone (up to 100 mV $V^{-1}$), whereas everywhere else values are less than 10 mV $V^{-1}$. Such high chargeability may only be explained by disseminated ore. At first sight, there should correspond to sulphide ore (geochemical analysis will indicate 2 different types).

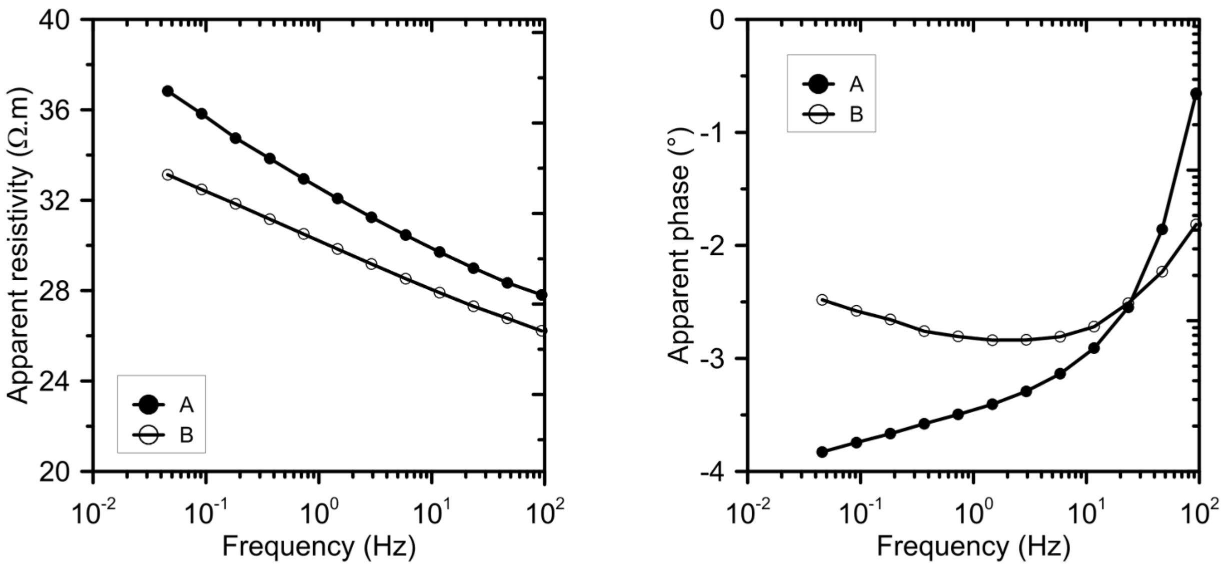


*Fig. 2: SIP spectra for A and B positions.*

Two SIP soundings have been done vertically above chargeability anomalies A and B (Fig. 2). There is no difference for the resistivity values, but the phase diagrams are very different (maximum absolute phase is 3 Hz for measurement B and less than 0.1 Hz for measurement A). Some SIP characterization has now to be done to better characterize the nature of the ore body.

As a conclusion, time and frequency domain measurements are actually complementary (speed for TD chargeability / strong capability of differentiation for SIP).