# *Spectral IP*

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ClearView Geophysics Inc.
12 Twisted Oak Street
Brampton, ON
L6R 1T1  Canada
Phone: (905) 458-1883
Fax: (905) 792-1884

general@geophysics.ca

www.geophysics.ca

ClearView specializes in providing **spectral induced polarization (IP) surveys** for gold exploration. The most common surface IP surveys carried out by ClearView consists of injecting an electrical current into the ground for two seconds. The transmitter current is then turned off for two seconds, during which time an IP receiver records the decaying voltage at pre-defined intervals. One transmitter electrode is placed at the end of the potential electrode spread and the second is located at electrical 'infinity'. ClearView used stationary high power 10 kW and mobile 3 kW transmitters. Borehole IP surveys utilize multi-conductor cables for multiple dipoles per reading.

For descriptive purposes, surface IP surveys are carried out as follows: The line current electrodes are moved along the survey line and maintained a distance of 25 metres to 100 metres ("a"=25 m to "a"=100 m) apart and from the nearest receiver electrode. There are typically seven (6 dipoles) or ten (10 dipoles) receiver electrodes placed at equal or combo-array configuration intervals down the survey line. The potential receiver electrode, which is nearest the transmitter current electrode, is called "P1". The furthest electrode down the line is called "P7" or "P11". Six or ten dipoles are read for every position except at the end of the completed survey line segments where dipoles are dropped.

Voltage drops are measured between adjacent receiver electrode pairs, also called "dipoles". The transmitter operator measures the contact resistance and electric current passing through the current electrodes during the readings. These current measurements are relayed to the receiver operator and entered into the IPR12 instrument for subsequent apparent resistivity calculations. As the dipoles increase in distance from the transmitter current electrodes, they obtain decay information from deeper features. Therefore, the results are displayed as "pseudosections".

The transmitter operator also writes down field notes relayed by the line workers. These notes are related to topography and obstacles encountered along the survey line (e.g., cliffs, swamps, etc.) that could be relevant to interpretation of the data.

IP surveys are mostly completed on adjacent survey lines so that lateral trends and anomalies can be detected. The data are presented as plates which include a number of panels presenting IP, apparent resistivity, magnetics and topographic data if available. Inversion models for the IP and apparent resistivity data are also presented as depth sections on these plates. Pseudosection panels are presented for the Mx chargeability (690 ms – 1050 ms decay slice), apparent resistivity, Spectral *M-IP*, Spectral *Tau* and Spectral *c*.

Inversion models are completed and presented as stacked sections on the pseudosection plates. Inversion parameters and results are preserved for future reference. Colour contour plan maps for the pseudosection n=2 cut are also presented.

The selected chargeability slice of 690 ms to 1050 ms is the industry standard slice used by the *Scintrex* IPR11 receiver. This was done so that experience gained during the past few decades could be applied more readily to the present data.

Spectral data for ***Tau, M-IP*** and ***'c'*** are calculated from a modified version of *Scintrex' Spectrum* software. This software matches the IP data to a suite of master curves. Readings with poor matches are screened and not plotted.

Detailed information about Spectral IP can be found in the following technical paper: *Geophysics, Vol. 49, No. 11, (November 1984), P. 1993-2003 "Spectral induced polarization parameters as determined through time-domain measurements"*. A brief description of Spectral IP follows:

The spectral parameters calculated from the IPR12 data provide an increased dimension to IP interpretation. The time constant *Tau* and exponent *c* are measurable physical properties which describe the shape of the decay curve. *Tau* can be used to discriminate between fine and coarse-grained polarizable mineralization. For a 2-second pulse, it ranges between 0.01 s for fine-grained sulphides, to 100 s for coarse-grained sulphides. *Tau* is important in gold exploration as gold is often associated with fine-grained sulphide mineralization.

Spectral *Tau* is a useful signature parameter for helping to correlate anomalies that likely originate from the same geologic source. For example, anomalies with different *Tau* values likely belong to separate zones.

Exponent *c* is diagnostic of the uniformity of the grain size of the target. It ranges from 0.1 for non-uniform grain size to 0.8 for uniform grain size and 1.0 for inductive coupling effects. Low *c* means that there is less certainty to the calculated *M-IP* and *Tau* values because there are likely multiple chargeable sources contributing to the response. The Cole-Cole models are based on theoretical decay curves for a uniform source.

The *M-IP* is the relative residual voltage which would be seen immediately after the shut-off of the transmitted pulse. It is expressed as mV/V and its amplitude relates to the quantity of the polarizable mineralization.

*M-IP* is very useful because theoretically it is not affected by ground resistivity. Normally, low resistivity tends to suppress the measured (apparent) chargeability decreasing its amplitude. A problem in areas of very high resistivity is that the apparent chargeability moves sympathetically with high resistivities. Therefore, when a high chargeability anomaly correlates with a resistivity high, it is impossible to know when the anomaly is solely caused by sulphides unless the *M-IP* parameter is used.

It allows for the selection of chargeability anomalies associated with resistivities that have a high probability to be associated with sulphides. In gold exploration this is very important because highly silicified areas are usually associated with gold mineralization. However, sulphide zones are the most favourable gold exploration targets within the zone of silicification.

The procedure for determining the spectral parameters plotted on the pseudosections is the result of Cole-Cole model curve matching. Matches that have a poor RMS standard deviation fit are not plotted. Poor fits to the model curves can result from inductive coupling, which is usually seen in the early decay slices, lack of significantly chargeable response, or noisy readings.