Short Note

Potential-Drop-Ratio IP

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Potential-drop-ratio IP is a variation of an old electrical prospecting method; the use of three receiving electrodes distinguishes it from conventional IP systems. The voltage ratio and phase difference between the two voltages received at adjacent pairs of electrodes are measured in an R-C bridge. A field example from W.A. compares P-D-R IP with conventional IP.

Potential-drop-ratio is a method of electrical prospecting which measures resistivity variations and polarisation phenomena with an unconventional three-electrode receiving array.

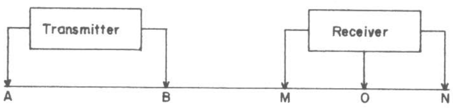

Figure 1
General P-D-R IP array

P-D-R IP depends on the same polarisation phenomena and uses the same transmitting equipment and electrodes as do conventional frequency and time-domain IP.

P-D-R IP differs from conventional IP in the parameters measured, resistivity ratio and phase difference, and in the receiving equipment required to measure these parameters.

Heiland (1940) pointed out the superiority of the potential-drop-ratio resistivity method over conventional resistivity techniques in the detection of conductive and resistive steeply-dipping tabular bodies.

As with conventional IP, both interrupted D.C. and sine wave transmitted power can be utilized in making P-D-R IP measurements. In an instrument which has been built and field tested, an interrupted D.C. signal was used. For the array shown in Figure 1, the waveforms at the transmitting and receiving electrodes appear as in Figure 2.

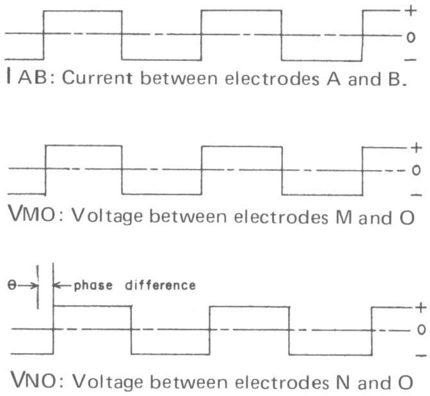

Figure 2
Typical P-D-R IP waveforms

These waveforms indicate visually the two parameters measured in P-D-R IP. The ratio of V_{NO}/V_{MO} is directly proportional to the ratio of the two apparent resistivities, ρ_{NO}/ρ_{NO}, which can be calculated for electrode pairs NO and MO respectively. The phase difference, Θ, between V_{MO} and V_{NO} is related to the conventional IP effects in the frequency- and time-domains.

The receiver, Figure 3, compares the two voltages at electrode pairs MO and NO in a resistance-capacitance bridge.

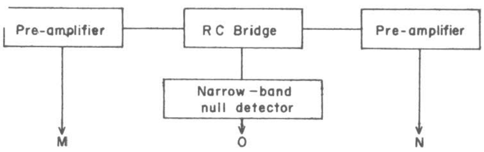

Figure 3
Block diagram of P-D-R IP receiver

The ratio of the two voltages is measured directly by nulling resistances; the phase difference between the two voltages is obtained from the value of capacitance inserted in one arm of the bridge to shift one of the voltages in phase relative to the other. The ratio has no units; the phase difference is expressed in degrees.

A typical field set-up could be as in Figure 4.

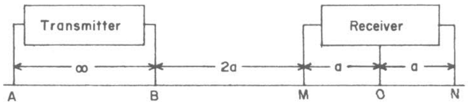

Figure 4
Typical P-D-R IP field set-up

The normalising factor of the resistivity ratio for this array is 2 : over homogeneous ground, the voltage ratio, V_{NO}/V_{MO}, must be increased by a factor of 2 to obtain a ratio of unity.

A field example of P-D-R IP is presented in Figure 5; frequency and time-domain IP are included for comparison and a geological section at the bottom of the figure shows the position of the sulphide lens.

Potential-drop-ratio IP seems more sensitive than conventional IP to vertical, steeply-dipping bodies; it could be made relatively less sensitive to electromagnetic coupling than conventional IP by using appropriate electrode arrays and measurements at more than one frequency. Recent work by McPhar and Scintrex on phase measuring systems points out the value of making phase measurements in separating polarization from inductive effects.

Both writers worked, at different times, for the Anaconda Company where they were first exposed to the P-D-R IP technique. The support of INAL for the present project and their permission to publish this paper is gratefully acknowledged; I.R. Donaldson, of INAL's Perth office, drafted the figures.

References

HALLOF, P.G. (1974) The IP phase measurement and inductive coupling: McPhar internal publication, 25 pp.

HEILAND, C.A. (1940) *Geophysical Exploration*: Prentice-Hall Inc., New York, pp. 744-757.

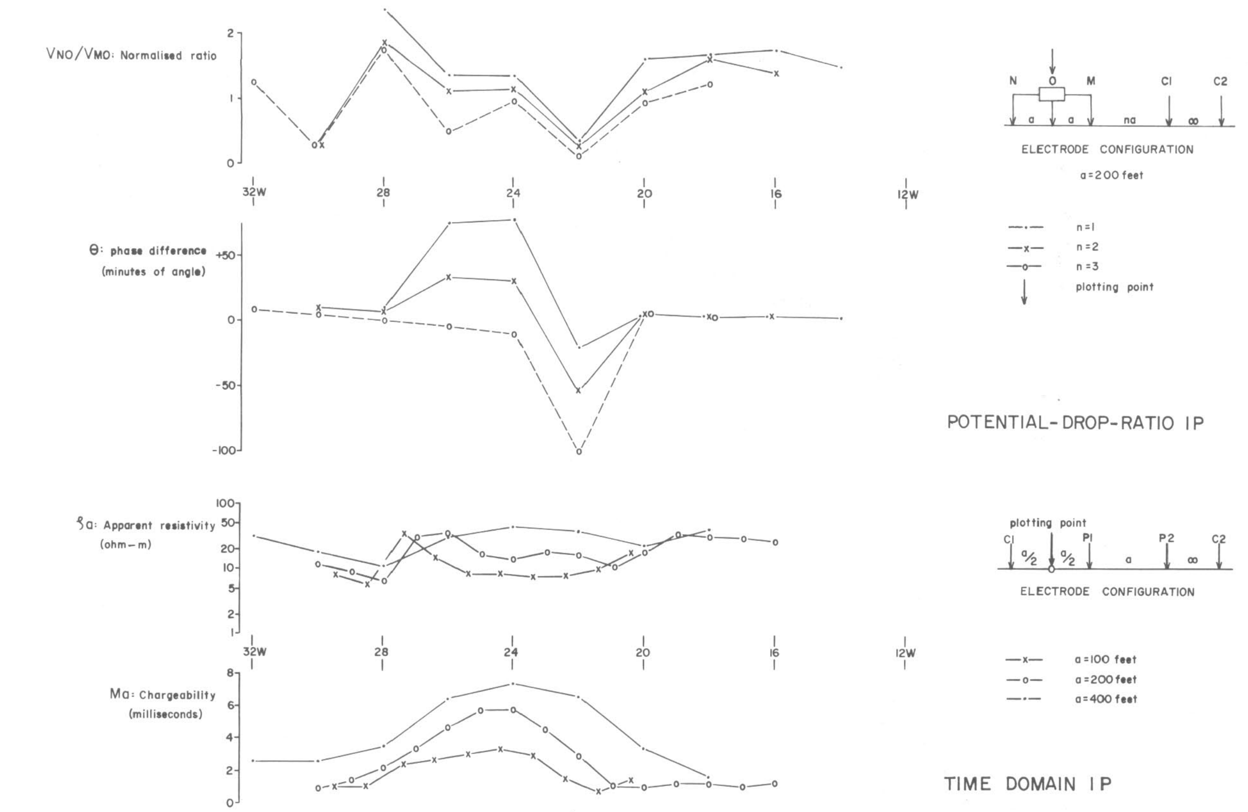

Fig 5: Line 224N, INAL Hannan Lake II property, Kalgoorlie, W.A.

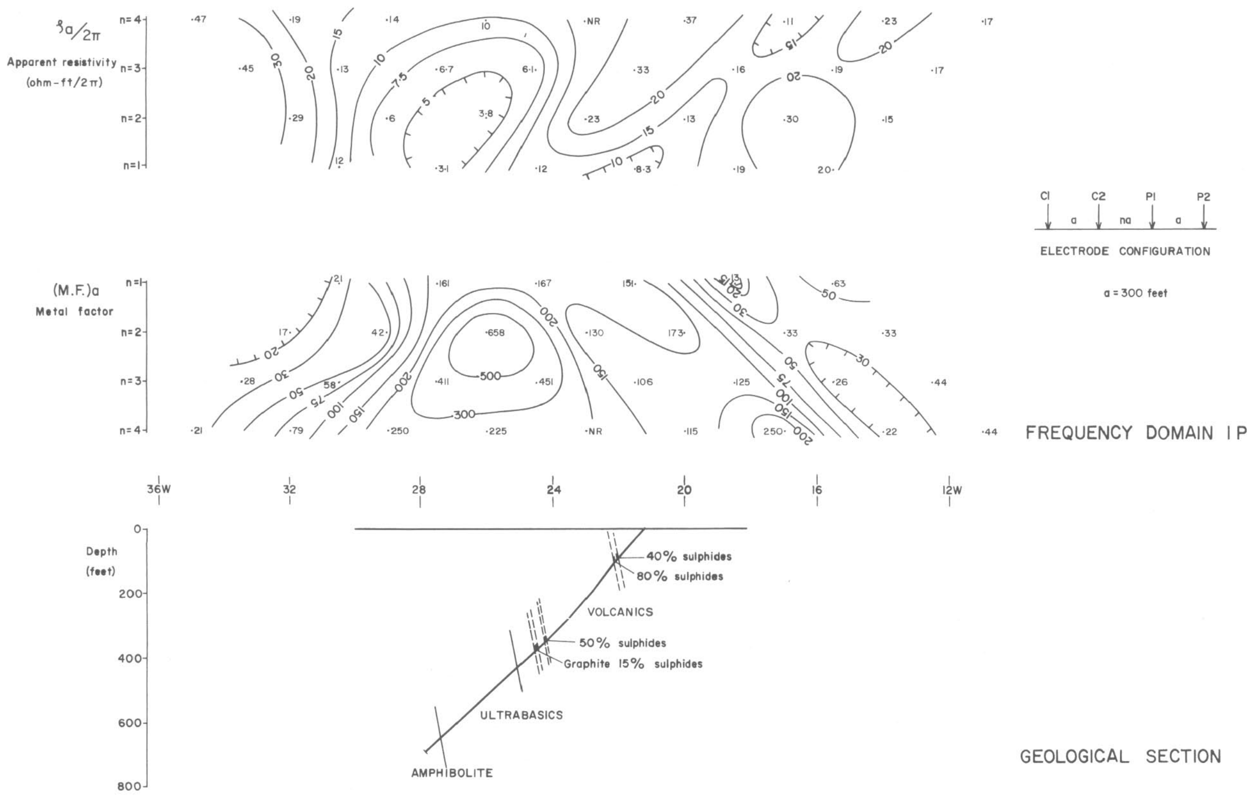

Fig 5a: Line 224N, INAL Hannan Lake II property, Kalgoorlie, W.A.