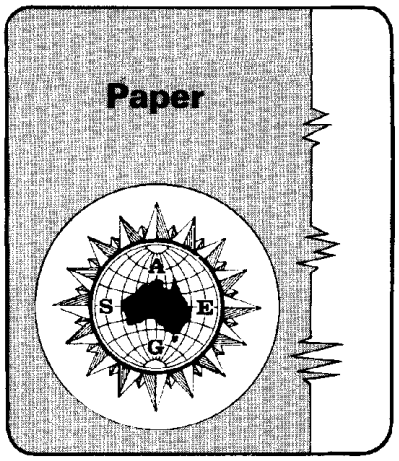

Comparison of Anomalous Effects determined using Telluric Fields and Time Domain I. P. Technique (Test Results)

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Some characteristics of telluric activity at different frequencies were found to be anomalous over a mineralised quartz vein, also exhibiting a self-potential (S.P.) anomaly. Subsequently equipment capable of measuring the telluric field at 9.5 Hz and 22.5 Hz was developed and tested, together with time domain I.P. over a mineralised zone in Madhya Pradesh, India. The results of the telluric field data agreed qualitatively with time domain I.P. data. The results suggest a basis for a natural-field approach to I.P. techniques.

Introduction

Frequency-domain methods for measuring induced polarisation response are common in prospecting for sulphide mineralization. This technique normally involves sensitive measuring equipment and in addition a variable frequency generator for excitation, which may be cumbersome, complex and expensive. The depth of investigation may be limited by the output power of the generator. Using a natural source for various frequencies of excitation energy may dispense with the need for an artificial generator. Such a suitable source may be found at the lower end of the ELF range in the earth's natural magneto-telluric field (Bleil, 1964; Balser and Wagner, 1962). Telluric field measurements are commonly made along a single direction coinciding with the profile for computing apparent resistivities (Slankis *et al* 1972) at a given frequency. If measurements are carried out at two frequencies, then the corresponding apparent resistitivities could provide a way of estimating the change in conductivity with frequency. The frequency wise dispersion of conductivity may be attributed, among other things to changes in earth polarisability (Wait 1960 and Raemer 1961).

To investigate the possible application to mineral exploration of I.P. effects on telluric currents, the authors have measured telluric activity at different frequencies over some mineralised areas for comparison with time-domain I.P. data. This paper presents the experimental details and the results obtained.

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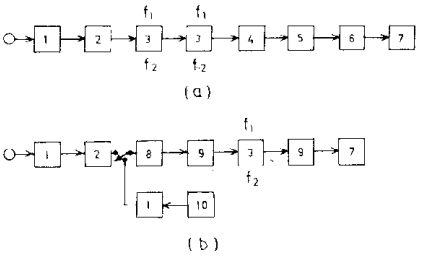
Equipment and Field Procedure

(i) *Case 1:*

The equipment employed by the authors for measurement of the relative strengths of the telluric field at 8 Hz (ΔU_L) and 33 Hz (ΔU_H) is shown in Fig. 1a. Using this equipment the telluric field was measured along a profile near Sleemnabad area, Madhya Pradesh, India (Latitude 23° 30′ and Longitude 80° 25′) in Nov, 1977. The local geology consists of thick alluvium in which occasional exposures of phyllites, quartzites and dolomites are found trending in a ENE-WSW direction. A quartz vein containing sporadic sulphide mineralisation is also known to exist in the area. Observations of the telluric field were carried out, and the intensities at the two frequencies were measured in relative units, along a profile extending in a SW-NE direction across the quartz vein. Self-potential voltages were also recorded along the same profile with reference to a distant base station. The results are shown in Fig. 2a. Defining a telluric parameter by $P = \frac{\Delta U_L}{\Delta U_H}$ it is observed that a rise in the level of P occurs over the location of the quartz vein coincident with an S.P. "low" of 40 m.V.

(ii) *Case 2:*

In order to test the telluric phenomenon further an improved version of the equipment was developed (Fig. 1b) and tested in a different area in Jan. 1978. This equip-



1-ATTENUATOR 2-PRE AMPLIFIER 3-FREQUENCY SELECTOR 4-SQUARER
5-RECTIFIER 6-INTEGRATOR 7-PANEL METER 8-MAINS FREQUENCY SUPPRESSOR
9-AMPLIFIER 10-REFERENCE SOURCE

FIG 1. MEASURING TECHNIQUES FOR NATURAL ELECTRICAL FIELD METHOD

ment was designed for measuring the telluric field with band passes of 0.5 Hz at 9.5 Hz and 1 Hz at 22.3 Hz, and a full scale sensitivity of 10 μv. The equipment was tested in the Surajpur area (Latitude 24° 41′ to 24° 50′ and Longitude 79° 71′ to 79° 10′) where the local geology consists of highly resistive gneises intruded by quartz veins striking NE-SW and dolerite dykes, striking in NW-SE direction. Barite veins are also known to occur at a number of places in this area. It is expected that polymetallic mineralization is present in the region as evidenced by the occurrence of chalcopyrite in the contact zone of the barite with the host rock and the presence of gossanic material.

The results shown in Fig. 2b were obtained along five parallel profiles across the suspected zone where time domain I.P. (by the central gradient method with current electrode separation of 700 m and the potential electrode separation of 40 m using a charging time of 1 minute) and telluric field observations were carried out. The telluric field measurement consisted of the potential difference at 9.5 Hz (ΔUL) and 22.5 Hz (ΔUH) obtained with a measuring electrode separation of 100 m laid along the profile. The relative variations in the ratio $\frac{\Delta UL}{\Delta UH}$ and the apparent polarizability η_a% obtained from time-domain I.P. are plotted along each profile. It may be seen that some agreement exists between the time-domain I.P. and telluric field measurements, primarily regarding the shape of the anomaly and also, on some profiles, in the relative anomaly amplitudes.

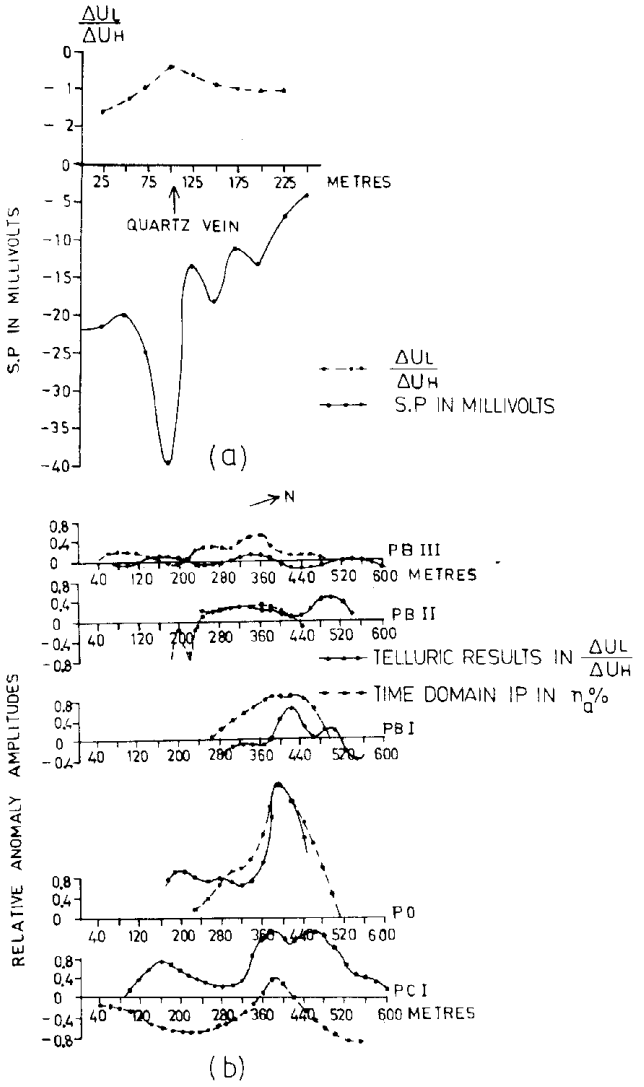


FIG.2 TELLURIC AND I P FIELD RESULTS

Conclusions

It is concluded from the foregoing that:

(i) Natural ELF fields at the required frequencies exist in measurable quantities in the areas surveyed.

(ii) The apparent agreement of the telluric results and the time-domain I.P. data suggests the possible use of ELF fields as sources for frequency-domain I.P. studies.

Acknowledgment

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