# 'TELLURICS' IN THE EXPLORATION OF KIMBERLITE PIPES—AN EXPERIMENTAL STUDY

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## ABSTRACT

Besides the influence of weathering, the complex nature of host rock and the presence of numerous basic dykes and Amphibolites in the Wajrakarur, Lattavaram area, Andhra Pradesh make the study of geophysical picture in this area more complex from the point of view of identification of individual anomalies associated with hidden kimberlite pipes, if any. Against this background with a view to examining the possibility of obtaining yet another, and independent geophysical signature of kimberlite pipes, 'telluric method' has been tried in the Wajrakarur-Lattavaram area on an experimental basis. Under this programme, telluric measurements covering two frequency bands *viz.* 0.02–0.05 Hz representing the PC, 3, 4 pulsations and 7–9 Hz signals falling in the Schumann resonance band were carried out across four known kimberlite type pipes in this area. Results of this investigation have been found highly promising, in that, they reveal that the kimberlite pipes find a clear and distinct expression in the telluric field profiles, mainly in the form of a characteristic 'low' or a 'high' depending upon the nature of contrast in the electrical resistivity. It is shown that 'Tellurics' holds immense potential for its introduction as a prospecting technique for exploration of kimberlites.

## INTRODUCTION

AREAS around Wajrakarur and Lattavaram in Andhra Pradesh and Panna diamond belt in Madhya Pradesh are the two important regions in India known for the occurrence of volcanic pipes similar in composition to kimberlites. With the establishment of possible diamond potential of the pipe rocks near Wajrakarur particularly due to systematic sampling and testing studies undertaken by the Geological Survey of India, there has been renewed activity in the exploration of hidden pipes, using geological, geochemical and geophysical techniques during the past several years.

Amongst the several types of geophysical techniques available it is known that magnetics, resistivity and electromagnetics together play a major role in the exploration of kimberlite pipes. Detailed resistivity, magnetic and gravity surveys conducted over the known pipes in the Wajrakarur-Lattavaram areas[2,3] have brought out the corresponding geophysical signatures of these pipes. It is seen that the degree of weathering that an individual pipe suffers, influences greatly the nature as also the amplitude of the geophysical anomaly observed over these pipes[4] and this has been observed in other areas too[1]. It may be added that in the case of Wajrakarur-Lattavaram pipes, in addition to the influence of weathering, the host rock namely the granites/gneisses as also occasionally occurring Amphibolites and the numerous dolerite dykes present in the area make the geophysical picture more complex from the view point of identification of individual anomalies associated with hidden pipes, if any. In a situation such as this, it is advantageous to adopt an integrated approach and with this objective in view, an additional geophysical tool namely "Tellurics" has been tried in the Wajrakarur-Lattavaram area on an experimental basis to examine the response of known kimberlite pipes in the telluric field picture.

## DATA ACQUISITION AND ANALYSIS

The telluric field data acquisition in the present studies was accomplished by conducting a split spread survey along select profiles, traversing across the known pipes in the Wajrakarur-Lattavaram area. Figure 1 shows the location map of these five pipes, together with some details of local geology. Telluric field recording across pipe No. 1 could not however be obtained mainly because of its location inside the

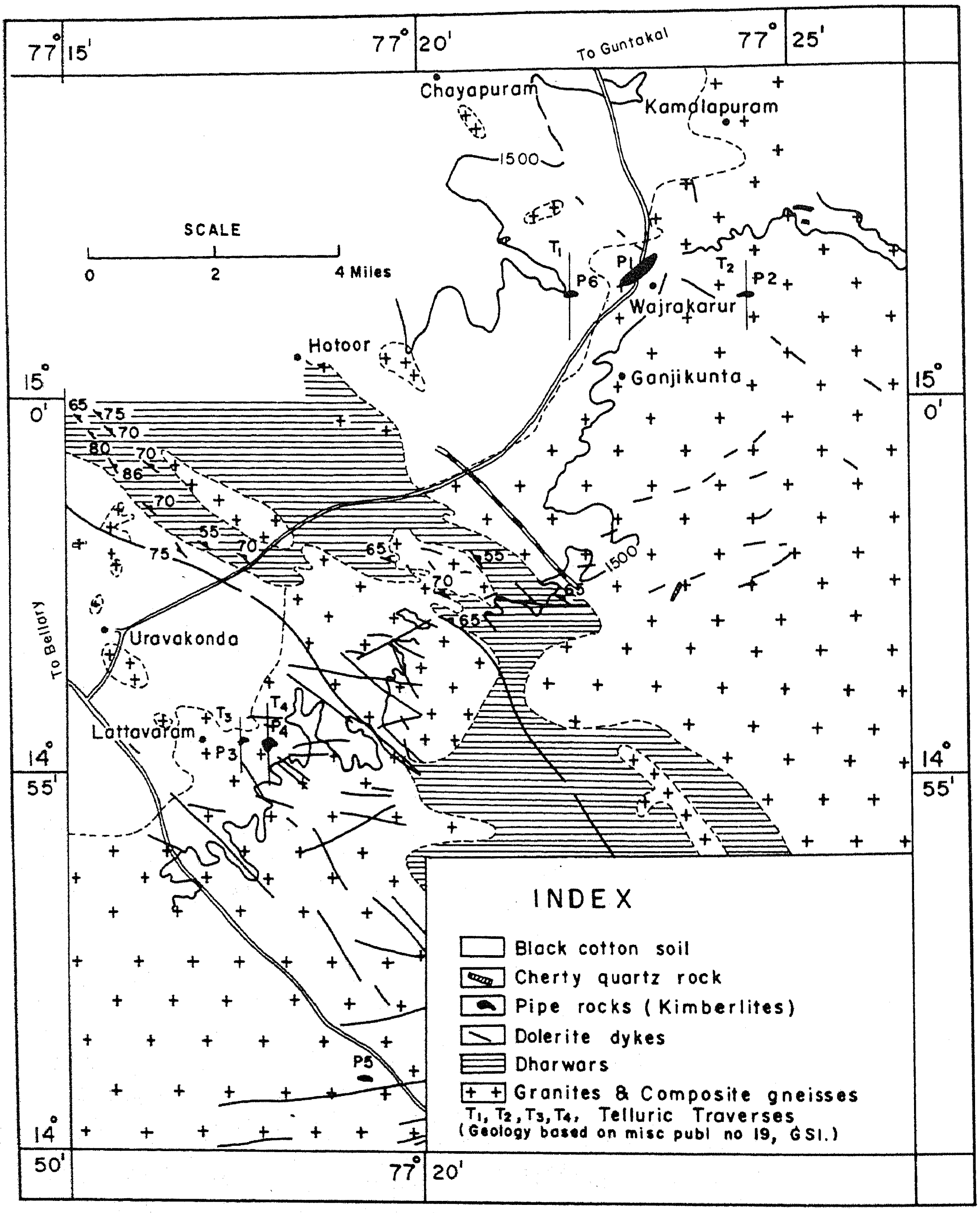


**Figure 1.** Geological map of the Wajrakarur-Lattavaram area, Ananthapur district, Andhra Pradesh, India.

village due to which there was interference of the local powerline noise. However traverses across the remaining four pipes, which are free from any noise, two in the Wajrakarur area (Pipe Nos. 2 and 6) and two in the Lattavaram area (Pipe Nos. 3 and 4) were covered using the NGRI Telluric field recording units. A dipole length of 100 m which corresponds to a station internal of 100 m was used for the split spread survey. Telluric signals were recorded in 0.02–0.05 Hz range.

In the second phase of the field investigations, measurements were extended to high frequency range also so as to sample the telluric signals in the Schumann Resonance band at 8 Hz., and these measurements were conducted across pipe No. 2 in Wajrakarur area and across pipe No. 4 in Lattavaram area. Besides these, D. C. resistivity measurements were also conducted using a Wenner array traverse across pipe Nos. 3, 4 and 6, with an electrode separation of 50 metres.

All the telluric field data were analysed to get the telluric field ratio "ER" using the method of computing amplitude ratios of synchronized signals[5]. Figure 2 shows the "ER" profiles thus obtained for pipes 3, 4, 6 and 2. Also shown in this figure are the d.c. apparent resistivity profiles for pipes, Nos. 3, 4 and 6.

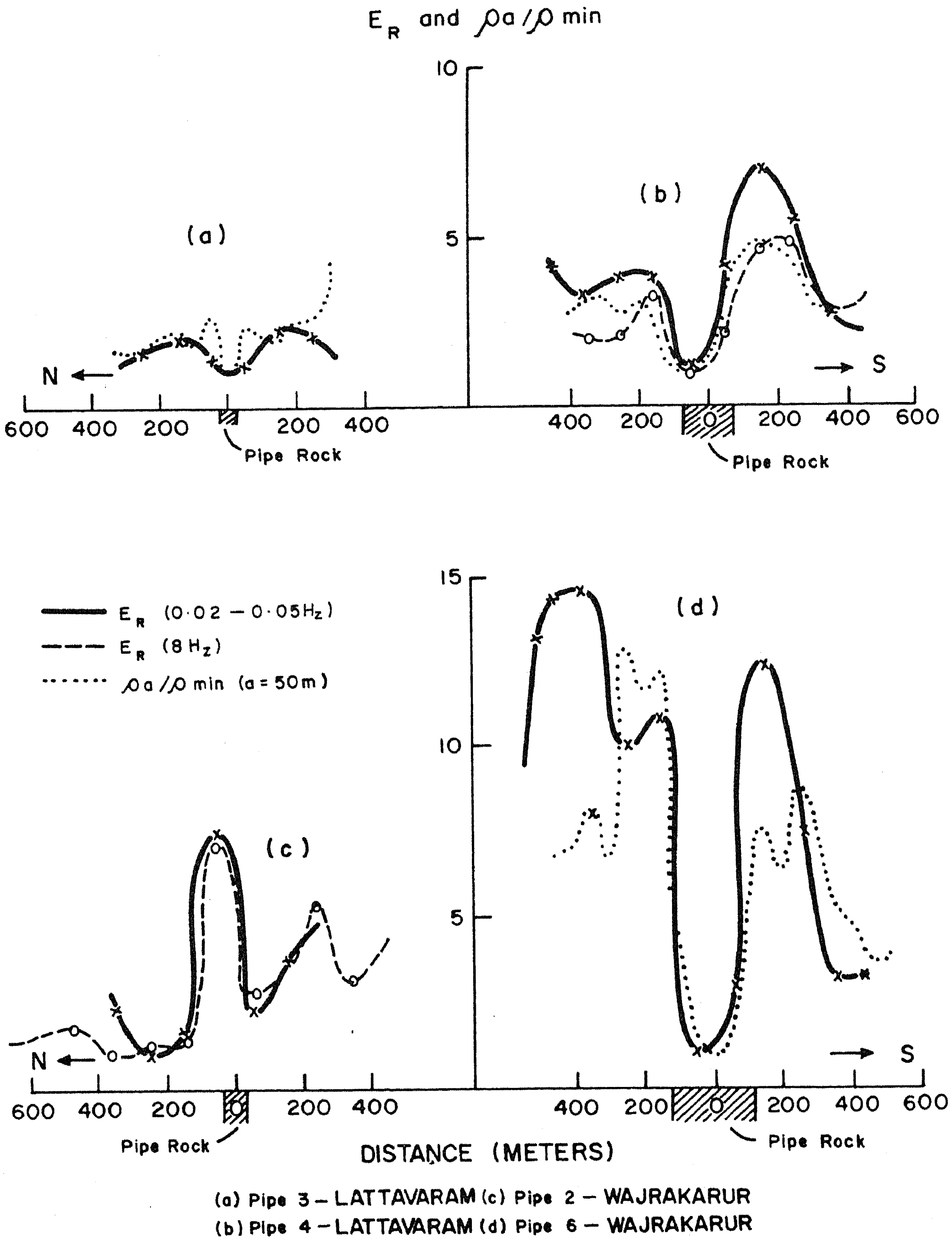


**Figure 2.** Telluric field ratio ($E_R$) and apparent resistivity ratio ($\rho_a/\rho_{min}$) profiles across kimberlite pipes in Wajrakarur-Lattavaram area, Andhra Pradesh, India.

## DISCUSSION

One of the features apparent from the "ER" profiles is the appearance of a fairly well-defined geophysical expression of the kimberlite pipes both in the low (0.02–0.05 Hz) and high (8 Hz) frequency bands indicating that the resistivity contrasts associated with these kimberlite pipes are reflected faithfully in the telluric field picture. It may be recalled that during the formation of kimberlite diatremes, it is common to find small basin-like features filled with epiclastic material derived from the host rock as well as from the walls of the pipe[6]. Minerals like montmorrillonite and other feldspars usually present in these basins, when weathered become clays which contribute significantly to the reduction of electrical resistivity. In the present area it is known that pipes 3, 4 and 6 are relatively more weathered and hence present electrically conducting material at the surface relative to the adjacent weathered granite and hence the appearance of telluric 'lows' over them. On the other hand pipe 2 exposes hard compact rock and hence of relatively high resistive nature accounting for a telluric 'high' over this pipe. It may also be noted from figure 2 that the "ER" parameter profiles over the pipes agree very closely with the d.c. resistivity measurements represented by $\rho_a/\rho_{min}$ profiles, thus further confirming that the telluric field parameter "ER" serves as an effective diagnostic parameter to study the electrical resistivity contrasts associated with kimberlite pipes.

It may be recalled that the "ER" parameter anomalies corresponding to both low (0.02–0.05 Hz) as well as high frequency (8 Hz) range signals are equally well defined. However for depths of investigation relevant to kimberlite exploration and from skin depth considerations, the 8 Hz telluric signals in the Schumann resonance band would be quite appropriate and can provide for the same dipole length, a much larger depth of subsurface sampling as compared to conventional D. C. resistivity techniques. The telluric method is simple and fast in its application and highly effective as is shown in the present study in detecting and delineating resistivity contrasts associated with kimberlite diatremes and thus holds considerable promise for its introduction as a geophysical tool in the exploration for identification of kimberlite targets.

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# NEWS

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The world's hardest material for metal-cutting tools has been developed by scientists of the Academy of Sciences of Byelorussia. It is stronger than diamond and several times cheaper. It eclipses by far, as to its properties, the earlier created material 'belbor' out of polycrystals of cubic boron nitride which was patented by the USA, the FRG, Sweden and other industrialised countries.

Byelorussian researchers have devised, specially for this purpose, unique equipment capable of developing huge pressure at a temperature of over 3,000 degrees centigrade. By using the new technology, the USSR has launched commercial production of tools (*Soviet Features*, Vol. XXIV, No. 154, 14 October 1985, USSR Embassy in India, P.B. No. 241, 25, Barakamba Road, New Delhi 110001.