S. O. OGUNADE

"Numerical Models and Scale Model Experiments involving Cylinders of High Conductivity embedded in a Low Conducting Host"

The electromagnetic response of a conducting cylinder buried in a poorly conducting host, due to the inducing fields of uniform and line current sources has been studied imploying numerical models and analogue model experiments.

INTRODUCTION

The problem of the source effect in regions of localized source fields has been of considerable interest for almost three decades. The question raised has been related to the validity of Cagniard's (1953) theory in the interpretation of magnetotelluric data in regions of localized source fields, such as the auroral and equatorial electrojets. The present study was under taken with a view to shedding more light on the practical application of Cagniard's theory in regions of localized source fields. The mathematical model which is adapted from D'Yakonov (1959) analytical solution to the problem of a buried cylinder in a uniform half-space is shown in Fig.1. It consists of a cylinder of high conductivity with its axis parallel to the x-axis, buried in a half-space of low conductivity. The fields are evaluated at points on the surface of the half-space.

Two inducing source fields are employed in the present work, namely: a uniform source (representing a global field) and a line source (representing a localized source field). Numerical results for a number of geophysical parameters of interest, such as, the source frequency, cylinder radii, cylinder to host medium conductivity contrast and depths of burial were obtained. As a check of the validity of the calculated results, numerical results for some cases for a uniform source are compared with analogue model measurements.

A detail description of the analogue model as well as the mathematical model have been given earlier by Ogunade and Dosso (1980a,b).

RESULTS

Only the summary of the results will be given here since the detail results have been given by Ogunade and Dosso (1980a,b). It was found that for a uniform source, the conductivity and depth of burial of a horizontal conducting cylinder buried in a host of low conductivity can best be determined from a measurement of the amplitude of the horizontal electric field E_x, the horizontal magnetic field H_y, the vertical magnetic field H_z and the phases ψ_x and Φ_y. The results also indicate that the limitations in the application of Cagniard's theory are only severe for periods greater than 100s, and that for line current heights greater than 500 km, apparent resistivities are significantly smaller for line current excitation than for uniform field excitation for periods grater than 10^3s.

REFERENCES

CAGNIARD,L.: Basic theory of the Magneto-telluric method of geophysical prospecting, Geophysics, 18, 605-635, 1953.

D'YAKONOV,B.P.: The Diffraction of Electromagnetic Waves by a Cylinder in a Homogeneous Half-space, (Izv) Acad. Sci. U.S.S.R. Geophys. Ser. No.9. 950-955, 1959.

OGUNADE,S.O. and H.W.DOSSO: The Inductive response of a horizontal conducting cylinder buried in a Uniform Earth for a Uniform Inducing Field. (In Press) Geophysical Prospecting 1980.(a).

OGUNADE,S.O. and H.W.DOSSO: The Response of a Horizontal Conducting Cylinder Embedded in a Uniform Earth for Uniform and Line Current Sources, (In Press) Pure and Applied Geophysics (PAGEOPH), 1980 (b).

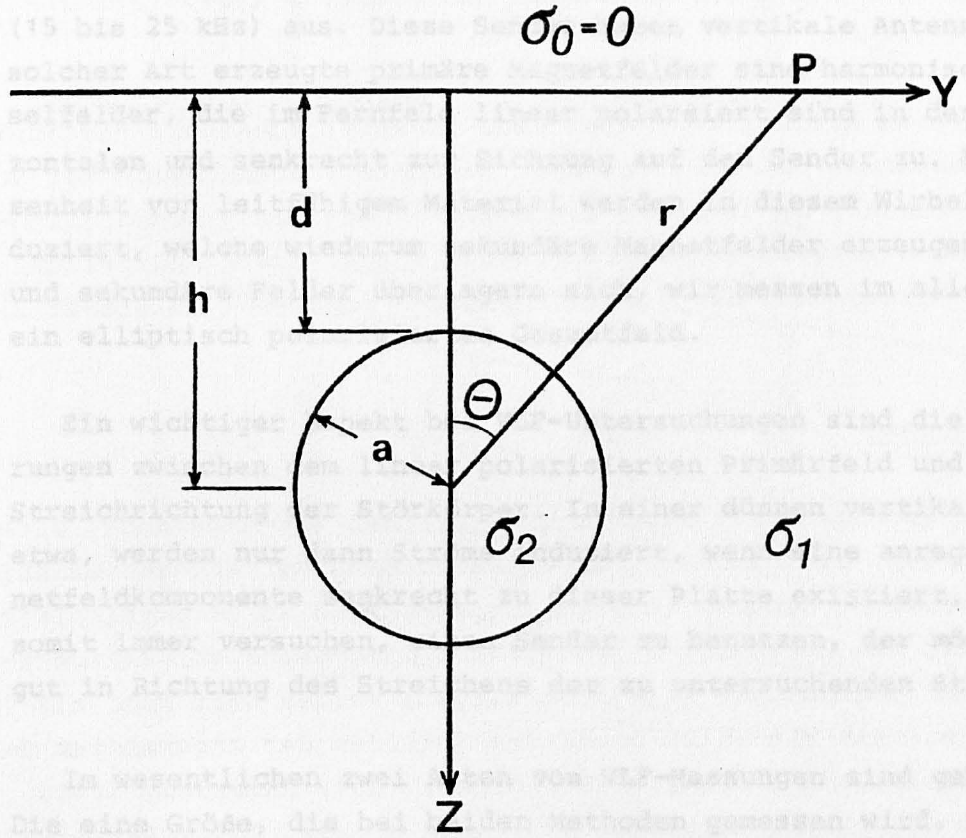

Fig.1: Mathematical Model

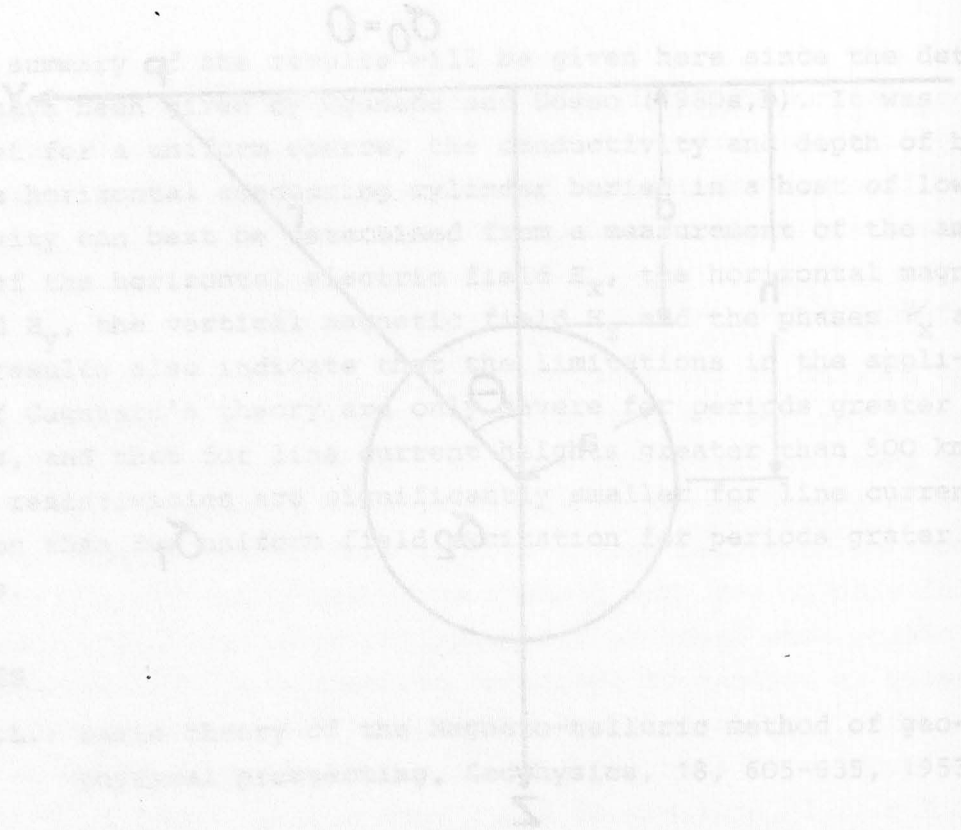

Fig. 1: Mathematical Model