## ABSTRACT

The present work embodies the results of theoretical, model and field studies on the development of convenient electromagnetic depth sounding techniques for the solution of hydrogeological problems. Variable frequency sounding replaces conventional resistivity method in highly resistive formations. Central Frequency Sounding (CFS) involving measurement of the vertical component of the magnetic field induced at the centre of a horizontal loop and Dipole Frequency Sounding measuring the same component due to a vertical magnetic dipole (abbreviated as DFS) are considered. Theoretical, laboratory model and field studies are carried out for homogeneous, two-layer and threelayer structures with the aim to develop CFS and DFS svatema. Theoretical response curves are computed for the systems and presented in convenient forms for interpretation with reference to a single observed parameter. Relative performances of CFS and DFS are studied comparing nature of response under similar situations. Effect of magnetic permeability

on the response is considered. A generalised approach to interpretation of observed frequency sounding data is discussed along with the proposal of a rapid three frequency sounding for CFS. Model studies are carried out in the laboratory to test the performance and applicability of the methods and to confirm the proposed interpretation procedure using sets of theoretical master curves presented. Applicability of CFS and DFS is studied through interpretation of observed data under actual field conditions.

Multifrequency response characteristics of CFS and DFS systems for a layered earth structure confirms the applicability of the methods and the interepretational approach for observed frequency sounding data with the help of theoretical curves. A comparative study of CFS and DFS response for similar conditions, indicates that relative superiority of a method is controlled largely by the nature of stratified earth and hence on the particular hydrogeological conditions under consideration. Effect of magnetic permeability on CFS

- iv -

and DFS response has been found to be significant and should be taken care of whenever necessary. The three frequency method for CFS has been established with the help of a theoretical model. This serves as a rapid depth sounding technique in addition to the detailed multifrequency investigations. Model studies supported by field observations with CFS and DFS confirm the applicability of the methods with success for shallow ground water exploration problems under different hydrogeological conditions.