COMPUTER MODELLING AND DETECTABILITY ASSESSMENT OF THE TRANSITION ZONE IN THE BASEMENT COMPLEX TERRAIN OF SOUTHWEST NIGERIA

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ABSTRACT

The main objective of this research was to theoretically model a basement profile containing the transition zone with varying thicknesses and resistivities as a means of assessing the detectability of this zone. This was because the zone has the tendency to be suppressed on the Vertical Electrical Sounding (VES) curve due to its intermediate resistivity and often thin thickness.

A research approach that involved the development of a forward modelling computer software had been adopted for generating theoretical Schlumberger VES curves for a typical basement complex profile containing the transition zone while varying its thicknesses and resistivities. An inversion software was also developed to serve as a useful tool in the subsequent interpretation of Schlumberger VES data. The forward modelling software was tested for accuracy by comparing the resistivity curves generated through it with those obtained from two pre-existing software, RESIST 1.0 and WGeoSoft/WinSev. 5.1. The accuracy of the inversion software was also tested using existing VES data with corresponding borehole logs.

The results from the accuracy tests showed that BABRES 1.0 had 99.9% accuracy while the depth prediction efficiency of BABRES 2.0 ranged between 87.7% and 99.2%, with an average of 94.0%, thereby showing that the two software were highly reliable. From the series of four-layer HA-type model curves generated by variously keeping the resistivities of the topsoil, weathered layer, transition zone and basement bedrock constant at 500 ohm-m, 150 ohm-m, 300 ohm-m, 1000 ohm-m with thicknesses of lm for topsoil, 10 m for the weathered layer, and varying the thickness of the transition zone between 2 m and 50 m, it was observed that the transition zone became detectable with a thickness ratio (between it and the overlying layers) greater than or equal to 0.73. Similar model study involving the KHA-type model curves with the topsoil, lateritic layer, weathered layer, transition zone and basement bedrock resistivities at 200 ohm-m, 750 ohm-m, 150 ohm-m, 250 ohm-m and 10000 ohm-m respectively and thicknesses of 1 m

for topsoil, 2.5 m for the lateritic layer, 10 m for the weathered layer, while the transition zone thickness was varied between 5 m and 80 m, showed that the zone became detectable at thickness ratio greater than or equal to 1.11. It was discovered that the resistivity ratios (between it and immediate overlying layer) permitting detectability ranged between 1.67 to 3.67 for the HA-type, and 1.67 to 4.33 for the KHA-type curves. Below these ranges the zone became undetectable. These resistivity ratio limits were valid only when the minimum thickness ratio was obtained.

It was concluded that the basement transition zones were only detectable within certain limits of thickness and resistivity ratios.