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Geophysical investigation of aquifer vulnerability and protective capacity of overburden rocks in part of Ajaokuta, Kogi State, North Central, Nigeria

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Abstract

Geophysical investigation was carried out in some part of Ajaokuta metropolis to identify the rock types and their conditions in relation to groundwater prospectivity of the area. The geophysical survey was carried out using Vertical Electrical Sounding (VES) on 10 (ten) sounding points. The acquired data were interpreted with results showing four to five lithologies consisting of the topsoil, with resistivity values ranging from 37.9 to 515.9 Ωm and an average thickness of 0.8 m. The weathered layer below the topsoil has range of resistivity values from 42.3 to 415.8 Ωm with average thickness of 3.0 m while the resistivity values of the highly weathered granites/fractured basement range from 41.7 to 274.8 Ωm with thickness values varying between 5.0 and 27.0 m. Due to the significant aquifer thickness around this area, it is considered very promising for groundwater development. The bedrock (fresh basement) underlies the study area and is characterized by resistivity values

ranging from 880.7 to 66,860.3 Ωm . The VES curve types typical of the area are HA, AA, HK, and KHA, with the HA curve type being the most predominant. The computed resistivity contrasts at the interface of the fresh basement rock, and reflection coefficients indicated that the study area is most likely characterized by fractures that are highly saturated with water since their resistivity contrast and reflection coefficient values are less than 19 and 0.9, respectively. Longitudinal conductance (S) and total transverse resistance (T) were also determined for the area. The highest T values were determined at VES location 2 (35,491.7 *[Math Processing Error]*) and VES location 8 (23,240.8 *[Math Processing Error]*), and this therefore means that the water bearing rocks at these VES locations most likely have the highest transmissivity around the study area. The computed S values were used to infer the overburden protective capacity of the area. The results indicated that, apart from VES 1 location with S value of 0.655 mho, which has a moderate protection, the study area generally has poor to weak overburden protective capacities (within the range of < 0.1 mho and 0.1–0.19 mho), thereby making the aquifer around the area exposed to contamination or pollution in the event of hydrocarbon pollution, percolating fluids or movement of contaminants from adjacent contamination sites.

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- **Longitudinal conductance**

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