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On the Correlation of Area of Consistently-Low Resistivity at Depths with Slope of the Landform of a 4 km^2 Tranche of the Gidan Kwano Campus Development Phase II, Federal University of Technology, Minna, Northcentral Nigeria

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Abstract

Even though it is not an infallible rule, slopes of landforms of the areas of studies for geoelectrical surveys at the local Basement Complex geology should correlate strongly with areas of consistently-low resistivities at depths. This is due to the fact that such low-resistivity portions are more often than not pointers to groundwater accumulation. This study is simply a validation of this predominant fact based on detailed field survey. It is observed that the slope of the landform of the wider 8 km^2 Phase II Development of which this 4 km^2 tranche is a part indicates a resultant north-south east-west tilt; also, comparatively thick overburden materials can be discerned at this slope. Furthermore, the result of interpretation of a two-dimensional vertical electrical sounding data for groundwater prospects over this 4 km^2 Phase II Development tranche indicates a generally northeast (NE)-southwest (SW) diagonal trend of the subsurface fault-traces that are oriented toward the slope of the landform and these are the key parameters for groundwater prospects in the first place. Thus, in conformity to the norm, the area of consistently-low resistivity at depths correlates strongly with the slope of the landform of the 4 km^2 tranche of the Gidan Kwano Campus Development Phase II.

Keywords: Resistivity; fault-trace; groundwater; landform; slope

Introduction

The idea of the title of this paper conforms to the expected norm even though fracturing of the rock-mass at depth is the dominant controlling factor of aquifer formation at the local Basement Complex geology of which the Federal University of Technology Minna is a part. The layout of the grid of the 4 km^2 tranche of the Gidan Kwano Campus (GKC) Development Phase II against the backdrop of the existing Phase I is shown as Figure 1; this grid layout, at 100 m spacing, was the schedule of survey for a dual vertical electrical sounding (VES)-induced polarisation (IP) investigation to map groundwater potentials and possible mineralisation signatures at this 4km^2 tranche. Conclusions drawn from the interpretation of the VES data-field at this 4 km^2 tranche indicate that the segment that is colour-coded in Figure 2 is characterised by consistently-low resistivity values at depths. The dual VES-IP study completed at this 4km^2 tranche was actually a

2km x 2km survey representing the Schlumberger array of the VES mode. The survey trend was an east-west (or transverse traverse, TT) sense for individual stations and a south-north profile, thus defining a two-dimensional configuration. The station-designation format for this study also follows a two-dimensional spatial awareness: principal profile lines are in the north-south direction, with the first profile line being the westernmost line of longitude; numerical station-designation is from west to east. Thus, the first assigned station of survey based on this format is the most extreme southwestern point in the 2km by 2km grid appropriately called P1-1; that is, Station 1 of Profile 1. Station 2 of Profile 1 (P1-2) is exactly 100m to the north of Station 1; Station 3 of Profile 1 (P1-3) is exactly 100m to the north of Station 2 and exactly 200m north of Station 1, and so on. P2-1 means Station 1 of Profile 2; this is exactly 100 m to the east of P1-1; P3-1 is exactly 100m to the east of P2-1 and exactly 200 m to the east of P1-1. Based on this format, the portion of consistently-low resistivity values at depths, where data-density fidelity is high and where seasonal streams criss-cross the area of study, is P1-1 to P10-1 through P1-17 to P10-17. With respect to geoelectrical studies that have been carried out at the local Basement Complex of which the location of this study is a part, the following works are cited: Abdulrashid (2005); Salako *et al.* (2010); Jonah *et al.* (2013); Jonah *et al.* (2014A); Jonah *et al.* (2014B); Jonah *et al.* (2014C); Jonah *et al.* (2015A); Jonah *et al.* (2015B); Jonah *et al.* (2015C); Jonah *et al.* (2015D); Jonah *et al.* (2015E); Jonah *et al.* (2015F).

Discussion

The slope of the landform of the wider 8 km^2 Phase II Development of which this 4 km^2 tranche is a part indicates a resultant north-south east-west tilt and this is shown as Figure 3 (Jonah *et al.*, 2015B). Furthermore, comparatively thick overburden materials can be discerned at the slope of the landform of the 4km^2 Phase II Development, as can be made out in the digital elevation model (DEM) of the isopach map of this 4km^2 tranche (see Figure 4). In fact, Jonah (2016) states that: "overburden thickness of the sub-5m depth range predominates except at a scattering of isolated locations mostly in the southern half and favouring the southwest where overburden thicknesses of between 5 m and 12 m can be discerned." The result of interpretation of a two-dimensional vertical electrical sounding data for groundwater prospects over this 4km^2 Phase II Development tranche (Jonah and Olasehinde, 2016) indicates a generally northeast (NE)-southwest (SW)

diagonal trend of the subsurface fault-traces that are the key parameters for these groundwater prospects in the first place (see Figure 5).

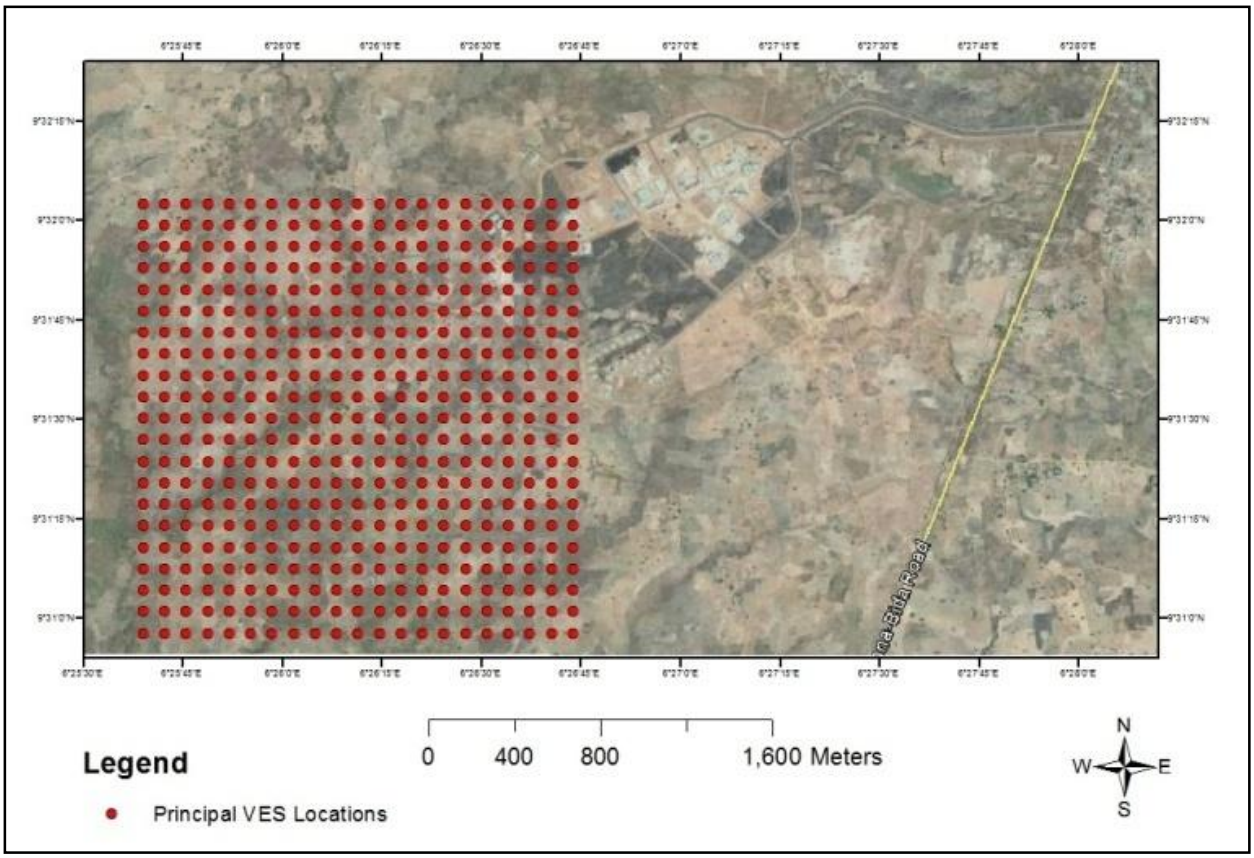

Fig.1. Grid of the 4 km^2 tranche of New Development of the GKC. (The tadpole-shaped feature is Phase I, the present developed portion of the GKC, seen to the northeast of the red-dotted grid of the 4 km^2 areal extent; the Minna-Kateregi-Bida Road is seen as the linear slope to the far east of the grid.)

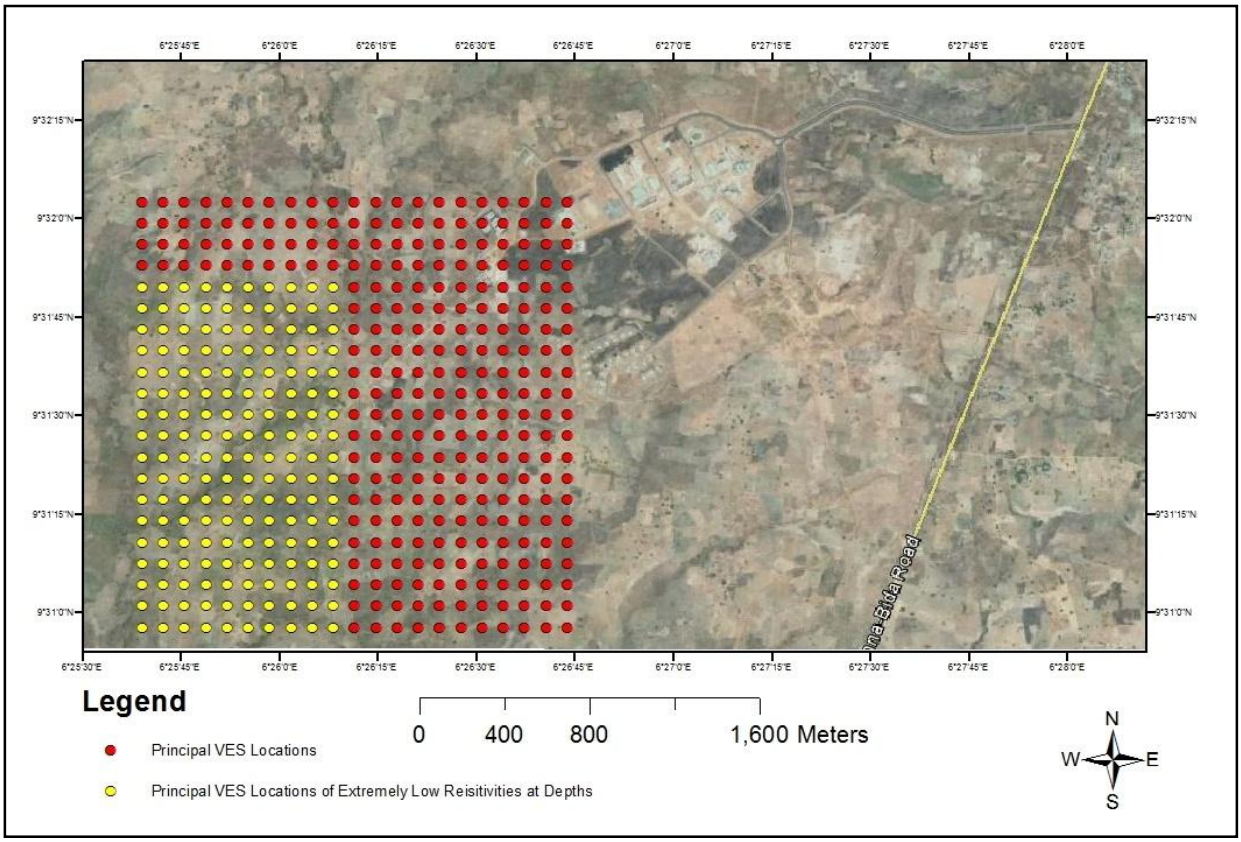

Fig.2. Segment of the 4km^2 tranche of New Development of the GKC characterised by consistently-low resistivity values at depths

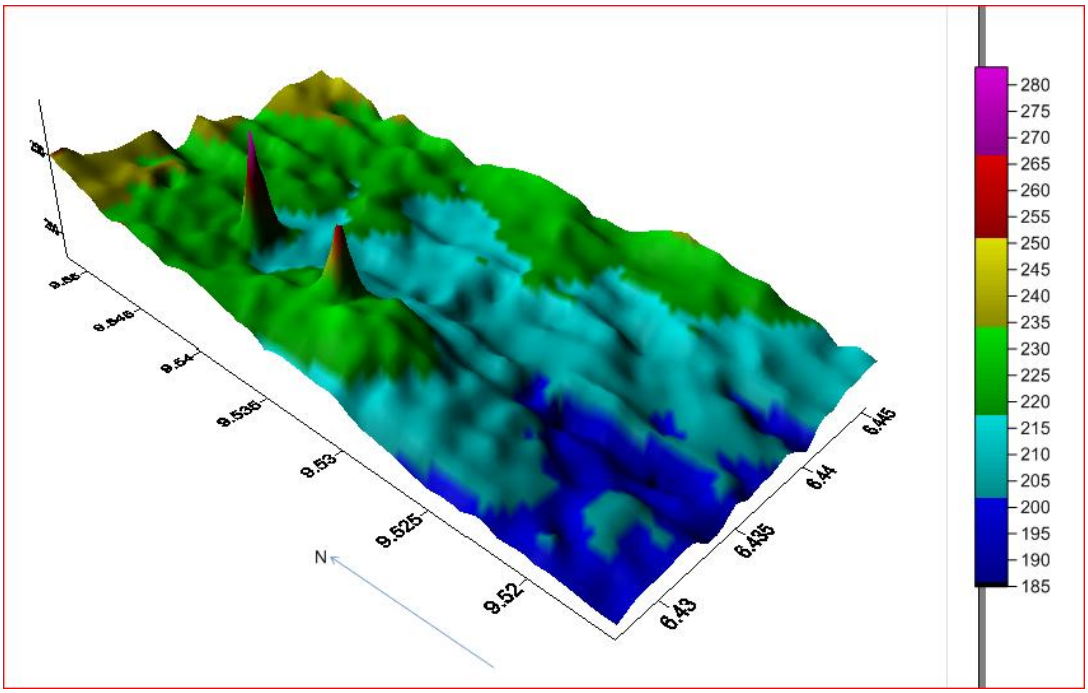

Fig.3. Site-specific geomorphic feature map of the wider 8km^2 Phase II Development

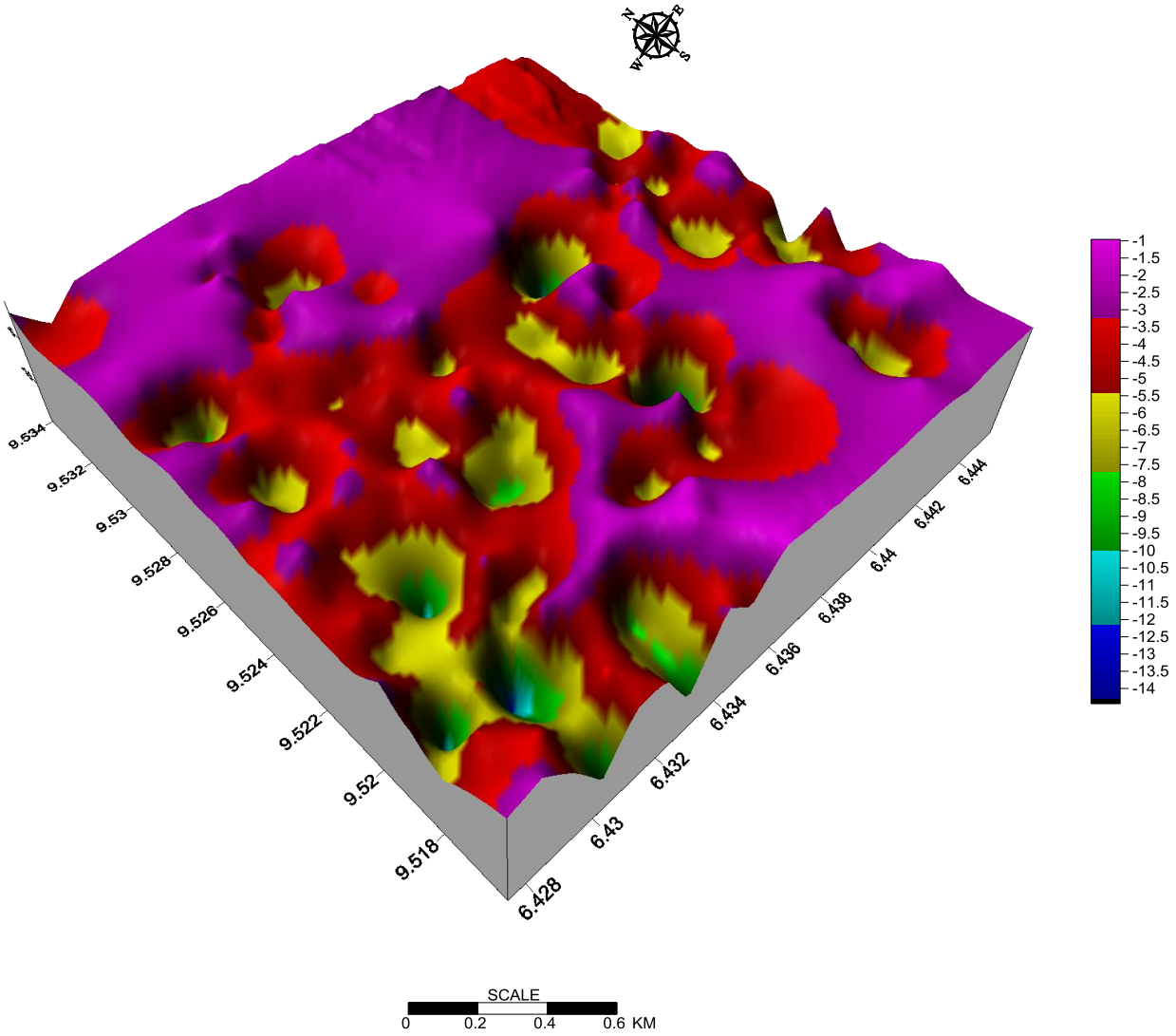

Fig.4. Comparatively thick overburden materials are discerned at the slope of the landform of the 4km^2 Phase II Development

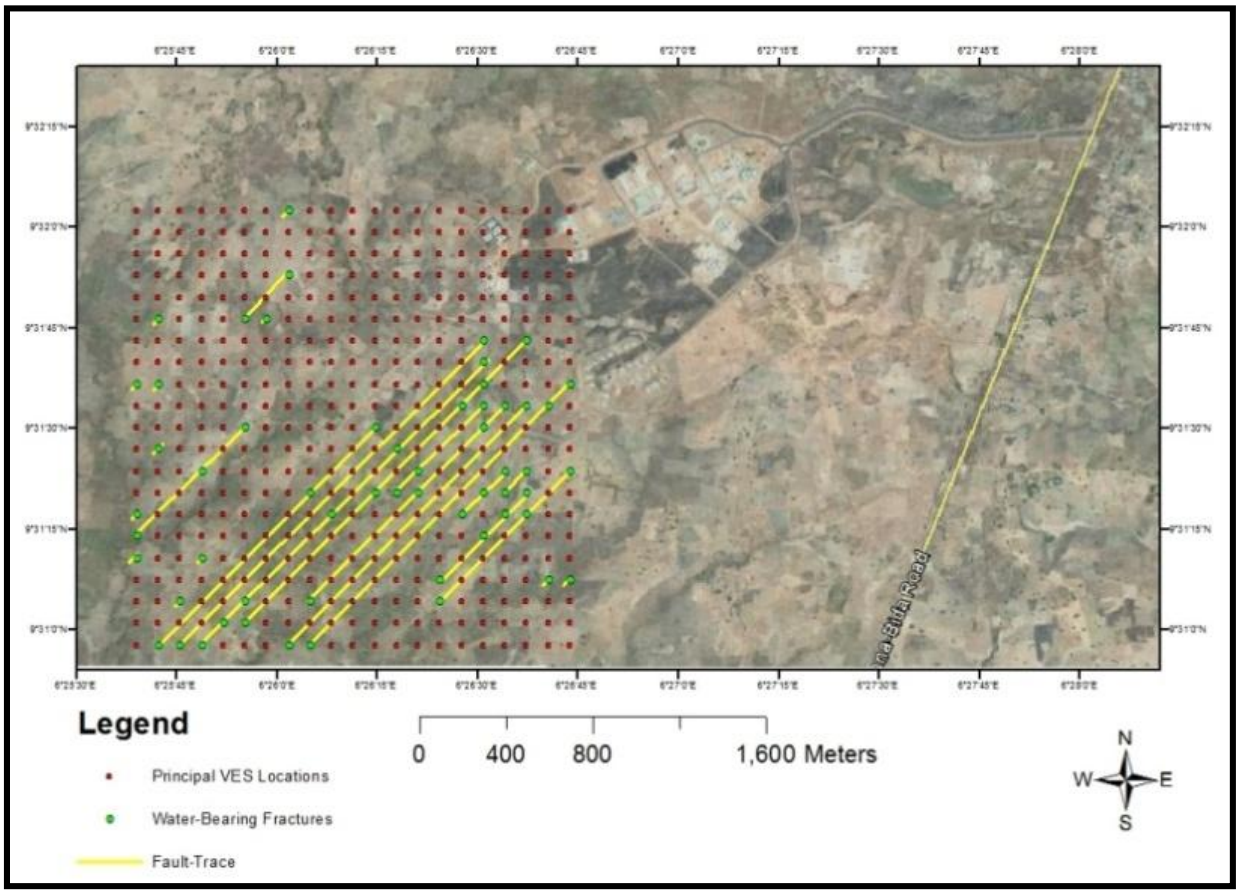

Fig.5. Result for groundwater prospect at the Phase II Development showing fault-trace of fracture signatures inferred from a combination of the geoelectric cross-sections and the induced polarisation tables on the satellite imagery map of the area of study with the developed Phase I in the background

Conclusion

The area of consistently-low resistivity at depths actually correlates strongly with groundwater prospects and these groundwater prospects correlate strongly with the slope of the landform of the 4km^2 tranche of the Gidan Kwano Campus Development Phase II.

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