The International Journal Of Engineering And Science (IJES)
|| Volume || 4 || Issue || 5 || Pages || PP.53-57|| 2015 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Mapping Of Subsurface Fracture Systems within Bowen University Permanent Site, Iwo.

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ABSTRACT: *One of the problems that may be facing any community as large as Bowen University is the location of portable sources of water and also to locate perfect sites for engineering purposes. The electromagnetic profiling method was employed to delineate fracture zones within the Bowen University permanent site so as to assist in the determination of the positions of the deepest fracture zones where productive boreholes could be constructed and also shallow fracture zones where buildings of any size could be erected. The contour map constructed from the VLF data showed Southwestern, Northwestern, Central and some parts of the Northeastern parts of the study area are considered feasible for engineering purposes while the Northeastern parts remain the best site for groundwater and any other hydrogeologic development*

Date of Submission: 15-February-2014 Date of Accepted: 05 June-2015

I. Introduction

Buildings are expected to have certain characteristics that make them attractive for many uses which may be residential, commercial, educational and industrial to meet people’s needs. Characteristics of a good building including provision of security, safety to lives and properties, convenience, in addition to social, psychological and economic satisfaction derived by occupiers. In some cases, building that are expected to meet the people’s daily need have become sources of great concerns to occupiers, owners, developers, governments and physical development planning authorities, consequent upon their incessant failure and collapses (Oladejo, 2012).

Mapping of bedrock configuration is important for both civil engineering and hydrogeological purposes (Ugwu et.al, 2009). In civil engineering, it helps to determine the appropriate and safest depth to place the foundation of our buildings. The geological importance of distribution of fractures in an area cannot be overemphasized. It determines the competency or otherwise of the underline rocks. Areas that is extensively fractured and where the factures are deep are considered as weak zones. But areas that is slightly fractured and where fractures are not deep are considered as competent zones (Sunmonu et.al, 2011).

The purpose of this study is to use a method of very low frequency (VLF) electromagnetic profiling to map and study the bedrock configuration of the study area. This method of analysis is expected to possibly reveal the distribution of fractures within the area. Fractures are basically defined as a break in a rock or mineral, across which there is a separation, while lineaments are naturally occurring alignment of soil, topography, stream channels, vegetation’s or a combination of these features that are visible on remotely sensed imagery aerial photographs.

II. MATERIALS AND METHODS

The instrument used for the VLF profiling is the Abem Wad; . A total of six transverse were established in either west to east or north to south directions. The reading was recorded at an interval of 20metres. The recorded values of the filtered real from the VLF were used to produce 2D profiling and contour maps of the study area.

III. THE STUDY AREA

The study was conducted within Bowen University Permanent site in Iwo Southwestern Nigeria, located between latitude $7°50'$ to $8°00'$ and longitude $4°00'$ to $5°00'$ in south western Nigeria precambrian basement complex comprising predominantly migmatized and undifferentiated gneisses, schist and quartzite.

Locally, the rock sequence in the study area consists of fine grained biotite gneiss, quartzite’s schist complex of Precambrian age (jones and hockey 1964). The gneiss complex underlain the northern and southern part of the study area and constitute a considerable larger area with rock exposures. The rocks appear to be readily weathered and give rise to an undulating topography dipping in a north-south direction and cross cutting by numerous bands and lenses of pegmatites at several locations. The topsoil association of the site is the Fasola and Ajawa groups with great fertilities, which support good agricultural practice. They have fine texture and are of variety of colour ranging from brown to brownish red, fairly brownish yellow and white clay, and are of average thickness of 50mm (Akinloye, et al, 2002). Generally Iwo is located in southwest Precambrian basement complex of Nigeria, predominantly composed of; oldergranite, migmatite gneiss complex, dolorite dykes and charnockitic rocks

IV. RESULTS AND DISCUSSION

The results were presented as VLF electromagnetic profiles. The graphs of filtered real values were plotted against distance measured in metres and these revealed variations in conductivity along the profiling lines. The positive peaks represent the conductive (fractured) zones while the negative peaks are indicative of non-conductive or competetent zones. The series of positive peaks alternated with negative peaks along the six profile lines revealed that the study area is fractured and that these fractures are well distributed across the area. The result of the VLF profiling were discussed qualitatively.

VLF PROFILES

PROFILE 1

The profile has a lateral extent of 350m (figure1), the station positions 50m, 120,180 and 300metres exhibit negative peaks which are indicative of competent or non-fractured zones along the profile while the station positions 90,150 and 200metres exhibit positive peaks which are indicative of fractured or weak zones. The very sharp inflection point at station position 260metres indicates contact between two rocks along the profile line.

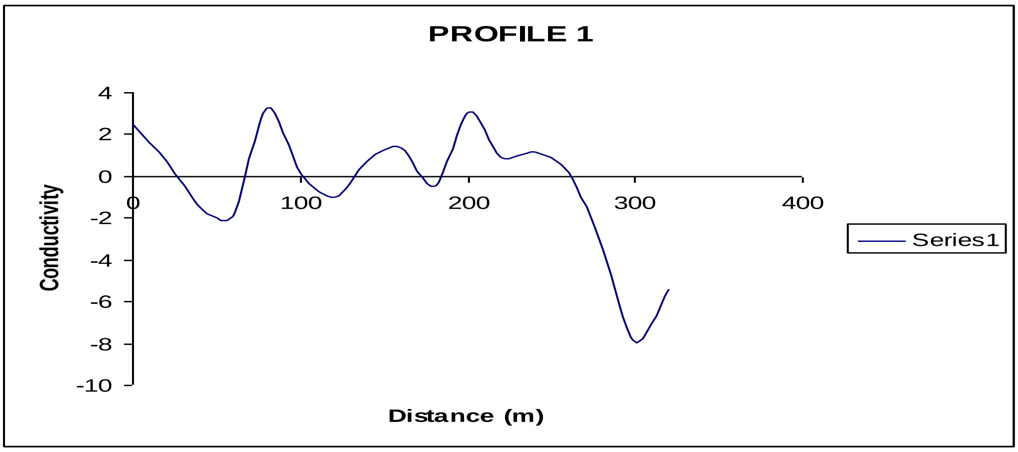

Figure 1: Profile 1

PROFILLE 2

The profile covers a total of 350m (figure 2). The profile shows negative peaks at station position 20, 100, 180, 270 and 320metres which are indicative of competent zones along the profile. Positive peaks which are interpreted as fracture zones are observed at station positions 50,130,200 and 300metres along the profile line.

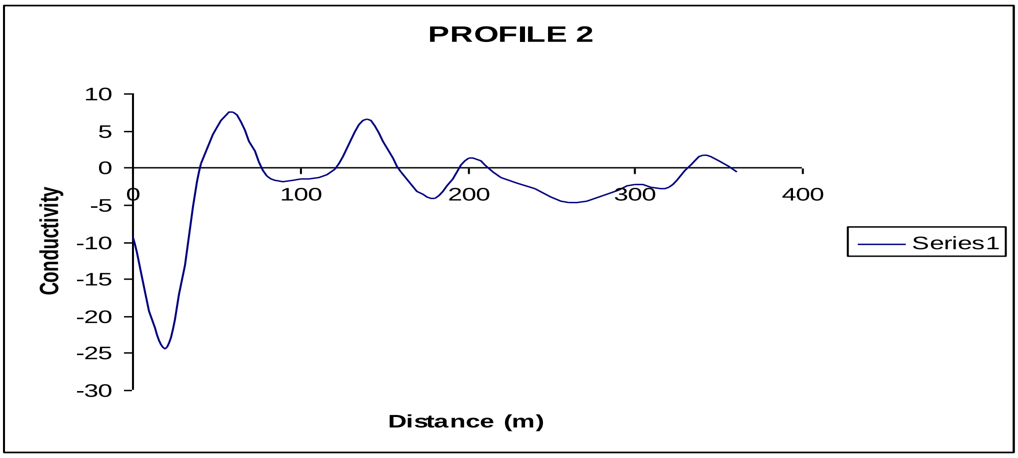

Figure 2: Profile 2

PROFILE 3

This is shown in figure 3. It covers a length of 300metres. Negative peaks are observed at station positions 30,120, 180, and 120metres. These points are again interpreted as competent zones along the profile line. Very sharp positive peaks are observed at station positions 50, 150, and 270metre and these points remains the most fractured zones along the profile line and within the study area.

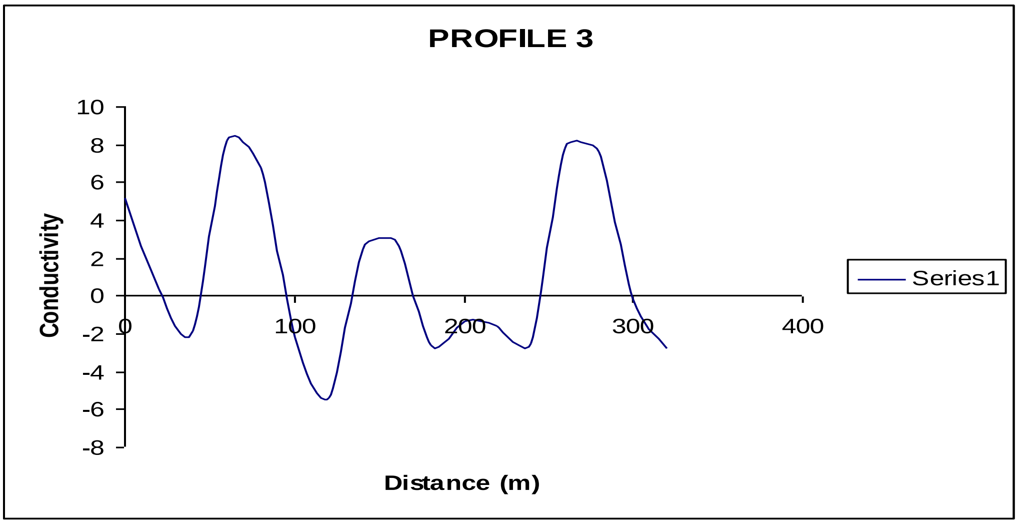

Figure 3: Profile 3

PROFILE 4

Profile 4 (figure 4) has a total length of 380metres. Negative peaks which are indicative of component zones are exhibited at station positions 70, 120, 180, and 320metres. The broad nature of the negative peaks at station position between 110 and 220metres is perhaps due to an un-differentiated rock of very large area of extent.

The positive peaks observed at station positions 30, 90, 130,260 and 360metres along the profile line are attributed to fracture or weak zones along the profile line. The very sharp positive peaks observed at station points 30 and 260metres could be an extension of fractures in profile 3.

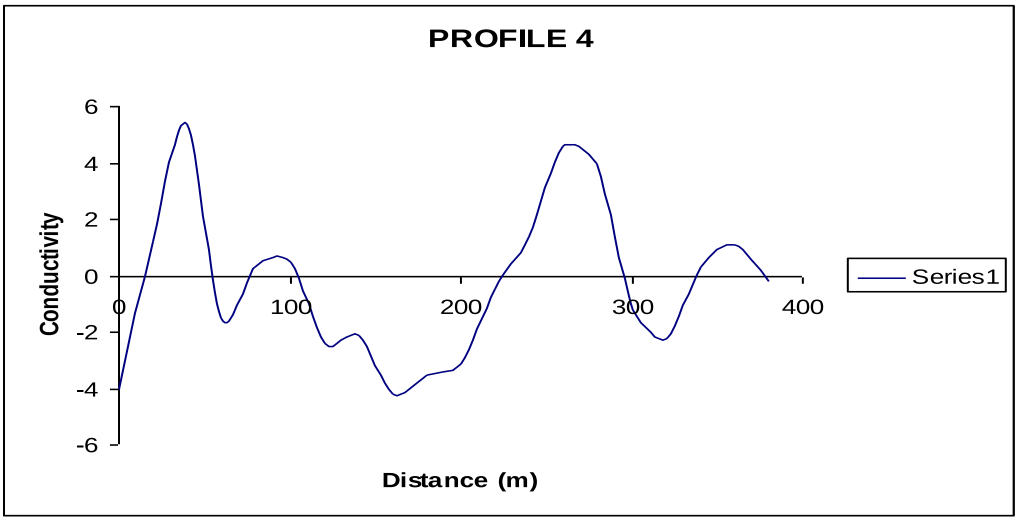

Figure 4: Profile 4

PROFILE 5

Profile 5 (figure 5) has a lateral extent of 350metres. The station positions 50, 110 and 280metres exhibit negative peaks which are indicative of competent zones along the profile line while positive peaks were exhibited at station positions 20, 180, 250 and 320metres along the profile line and these points are interpreted as competent zones along the profile line.

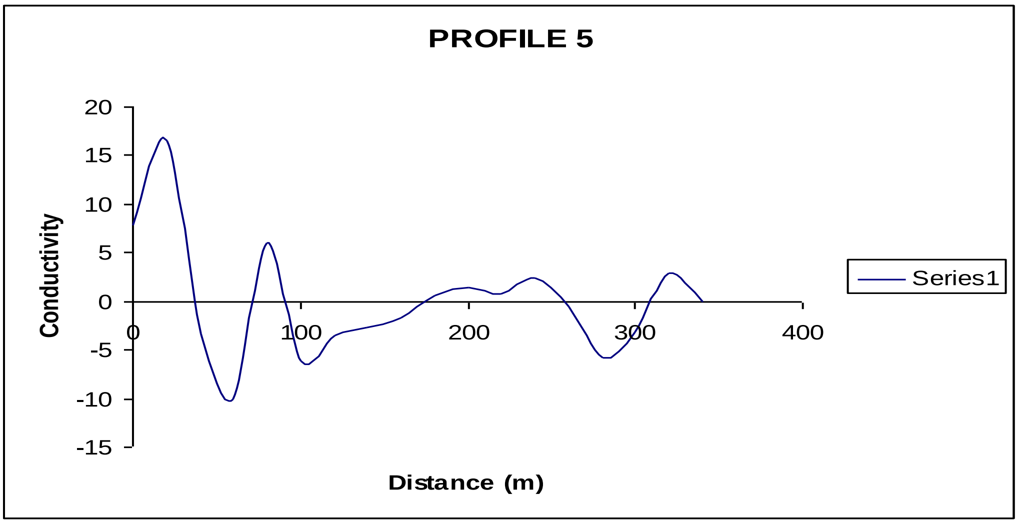

Figure 5: Profile 5

PROFILE6

Profile 6 (figure 6) has a total length of 270metres. Negative peaks which are indicative of competent zones are observed at station points 20, 120 and 200metres. The broad negative peak observed along station 200metres is perhaps an extension of the undifferentiated rock observed at profile 4 (figure 4). The positive peaks are observed at the station points 75, 150 and 250metres are interpreted as fracture or weak zones along the profile line. The broad positive peaks on profile 6 may not be due to deep fractures, but may be due to shallow fracture of large area of extent while the inflection point at station point 260metre could be interpreted as contact between two different rocks along the profile line.

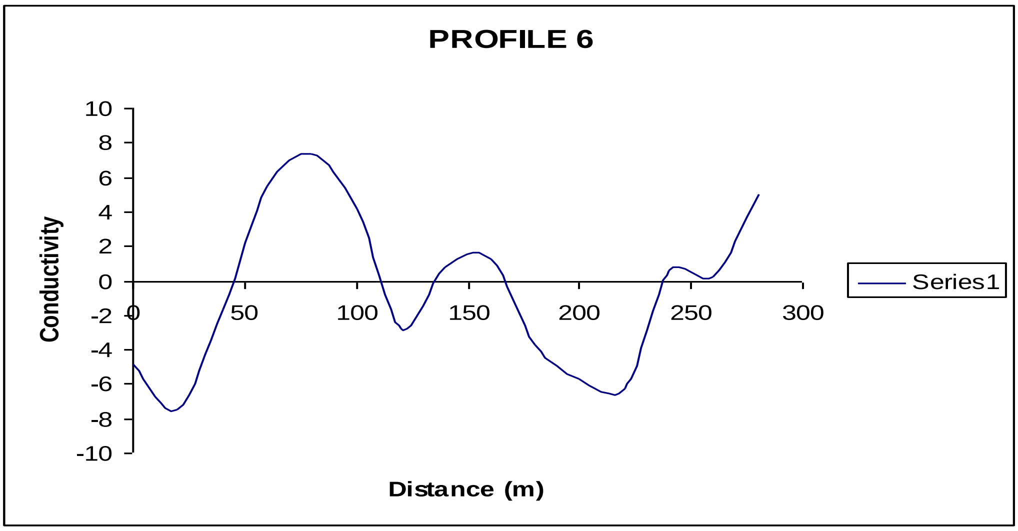

Figure 6: Profile 6

V. CONDUCTIVITY CONTOUR MAP

The conductivity contour map constructed from the VLF data obtained from the study area is as shown in figure 7. The constructed, colored map showed low and negative conductivities between -24σ to -16σ (green colour), -16σ to -8σ (yellow colour) and -8σ to 0σ ; these zones are interpreted as competent zones with probably undifferentiated basement rocks. The zone with conductivity values between -24σ and -16σ (green colour in the Southwestern part of the study area) is observed to have the least conductivity values and so, remain the most competent zone within the study area.

The observed positive conductivities ranges between 0σ to 8σ (blue color) and 8σ to 16σ (cyan color). The highest conductivity is observed in the Southeastern parts of the study area and ranges between 8 σ and 16 σ (cyan color). So, by implication remains the most fractured zone though might not be a deep fracture as shown in profile 6.

Since low or negative conductivities values are associated with shallow fractures which are interpreted as competent zones, the South Western point of the study area remain the only feasible zone for the errection of heavy structures. This justified the siting of the university worship center (chapel), new female hostel and the new university library in the Southwestern part of the university permanent site. Other areas that are still good for engineering works includes the Northwestern, central, and some parts of Northeastern parts of the study area. Other zones or parts with high conductivity values and positive peaks especially in Northeastern parts of the study area are better sites for hydrogeological purposes.

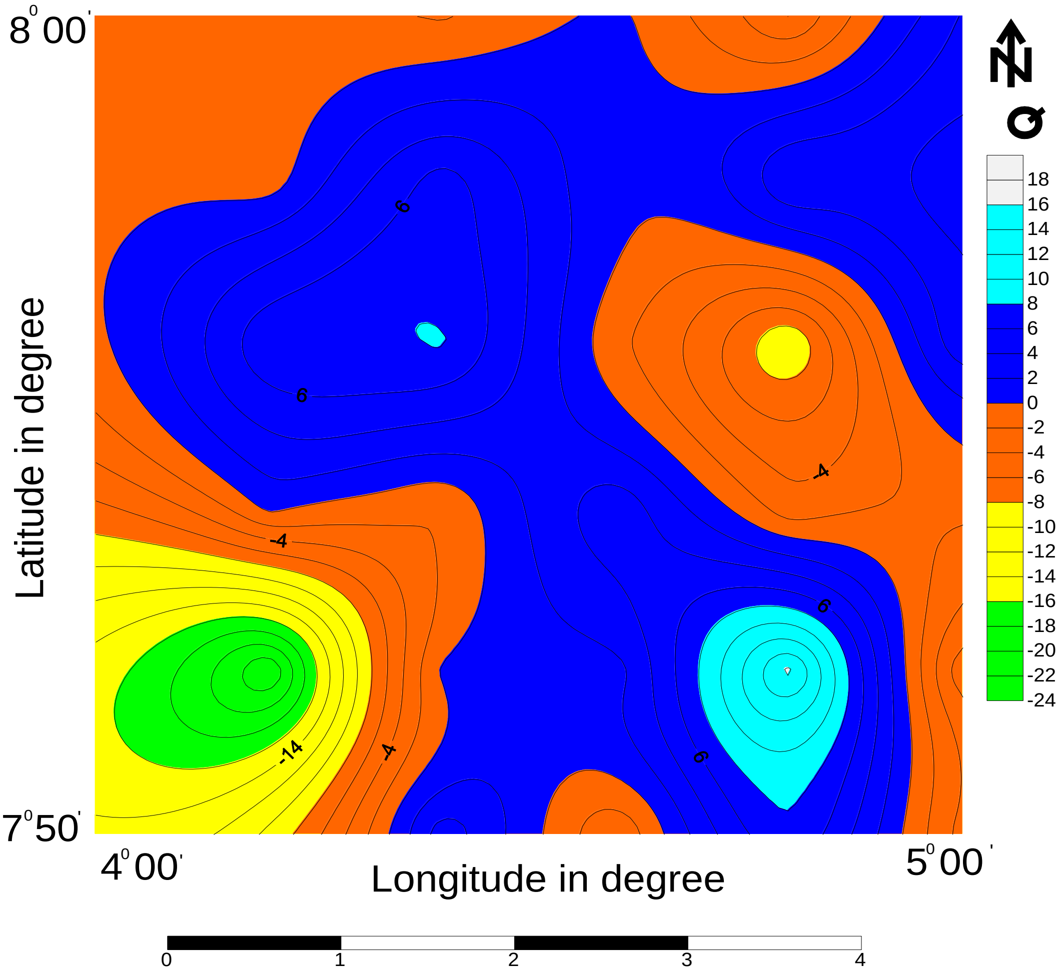

Figure 7: Conductivity contour map of the study area

VI. CONCLUSION

The VLF method of analysis of the data from Bowen University permanent site was carried out. The study revealed a network of geologic features which are the reflections of the basement pattern within study area. The south western, Northwestern, central and some parts of Northeastern parts of the study area are considered feasible for any engineering purposes while the Northeastern parts remain the best site for ground water development.

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