Data Article

Geoelectrical resistivity data set for characterising crystalline basement aquifers in Basiri, Ado-Ekiti, southwestern Nigeria

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**Abstract**

This article consists of data sets for thirty (30) vertical electrical sounding (VES) and four (4) traverses of 2D electrical resistivity imaging (ERI) collected within, Ado-Ekiti, southwestern Nigeria using an ABEM Terrameter (SAS 1000/4000) system. Win-Resist computer program was used to process the apparent resistivity data sets for the VES to determine the geoelectric layers and their respective parameters (resistivity and thickness). The observed data sets for the 2D ERI were processed using RES2DINV software to obtain 2D inverse model resistivity distribution of the subsurface. The resistivity soundings and the 2D ERI were combined to delineate and characterise the crystalline basement features associated with basement aquifers.

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How data was acquired
Geoelectrical Resistivity Survey using ABEM Terrameter (SAS1000/4000) system.
Data format
Raw, Processed
Experimental factors
The observed apparent resistivity data sets were processed so as to
delineate and characterise basement features associated with base-
ment aquifers.
Experimental features
Geophysical survey involving vertical electrical sounding (VES) and
2D electrical resistivity imaging (ERI) was conducted.
Data source location
Ado-Ekiti is between latitude 7°33’ – 7°42’N and longitude
5°11’ – 3°20’E in the crystalline basement complex, southwestern
Nigeria.
Data accessibility
All the data sets are with this article.

Value of the data

• The geoelectrical resistivity datasets can be used for subsurface characterisation, determination of
lithologic layers and delineation of crystalline basement features that are of environmental, geo-
technical and hydrogeological/hydrological importance.
• The datasets can be used for geoelectrical characterisation of the weathering profile, and deli-
neation of regolith thickness and fractured and weathered zones which are useful in groundwater
potential studies as well as foundation and geotechnical investigations in crystalline basement
complex terrain.
• The data sets can be used for the determination of the spatial variability of basement aquifers as
well as zones of significant degree of weathering and fracturing which are areas of preferential
accumulation of groundwater; these are useful for siting boreholes and wells in groundwater
resource development basement terrain [e.g. [1,2]].
• The geoelectrical resistivity data sets can be integrated with other geophysical data sets such as
induced polarization, magnetic, electromagnetic, ground penetrating radar, gravity and seismic
data for detail subsurface characterisation.
• The data set can be used for educational purposes, and for future research in hydrogeological,
environmental and geotechnical studies. Similar data articles can be found be found in Refs. [3–6].
• The data can be compared with those obtained from similar geologic environment.

1. Data

The attached files (Appendices A and B) consist of geoelectrical resistivity data sets (vertical
electrical soundings (VES) and 2D electrical resistivity imaging (ERI)) used for the delineation and
characterisation crystalline basement aquifers. The raw data sets are presented in “dot DAT” format
(DAT files) for both VES and 2D ERI surveys. The processed VES data sets are presented in ‘dot RST’
format; the processed 2D ERI data are presented in ‘dot INV’ format.

2. Experimental design, materials and methods

2.1. Study area

The study area is located Basiri, Ado-Ekiti, Ekiti State, southwestern Nigeria; Ado-Ekiti lies between
latitude7°33’ – 7°42’N and longitude 5°11’ – 3°20’E. The topography is gentle sloping lowland with
several sparsely distributed hills and knolls; mean elevation is about 440 m above mean sea level. The
natural vegetation is tropical rain forest. The climate is tropical humid marked by distinct dry and rainy
seasons. Precipitation is generally heavy rainfall which distinguishes the climatic seasons. Annual mean
Fig. 1. Geological map of Ado-Ekiti and environs showing the location of the study area.
rainfall is greater than 2300 mm and forms the main sources of groundwater recharge in the area; monthly temperature ranges from 23 °C in July to 32 °C in February. The area is mainly drained by Rivers Ireje, Elemi, Omisanjana and Awedele which generally flow parallel to the strike of the basement rocks as the rivers and streams are structurally controlled. The area is underlain by crystalline basement rocks of Precambrian age, which are mainly granitic intrusions and highly deformed metamorphic rocks [7–9]. The dominant rocks are pegmatite, quartz and quartz-schists, biotite granite and undifferentiated gneiss complex (Schist). The weathering of these rocks commonly results in a thick lateritic overburden. Fig. 1 shows the location and geological map of the study area.

![Location and geological map of the study area](image)

**Fig. 2.** Base map of the study area indicating topography, VES points, 2D traverses and borehole points.

**Table 1**

| VES  | VES1   | VES2   | VES3   | VES4   | VES5   | VES6   | VES7   | VES8   | VES9   | VES10  |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Easting | 5.20693 | 5.20534 | 5.20516 | 5.20501 | 5.204566 | 5.203932 | 5.20328 | 5.20390 | 5.20223 | 5.20306 |
| Northing | 7.64066 | 7.63994 | 7.64079 | 7.64165 | 7.642412 | 7.641819 | 7.64140 | 7.64080 | 7.64197 | 7.64241 |
| Elev. (m) | 421.0  | 424.0  | 441.0  | 375.0  | 412.0  | 412.0  | 418.0  | 413.0  | 421.0  | 433.0  |

| VES  | VES11  | VES12  | VES13  | VES14  | VES15  | VES16  | VES17  | VES18  | VES19  | VES20  |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Easting | 5.20434 | 5.20755 | 5.20469 | 5.20452 | 5.209027 | 5.208667 | 5.20841 | 5.20811 | 5.20769 | 5.20669 |
| Northing | 7.64142 | 7.64125 | 7.64048 | 7.63984 | 7.640196 | 7.641171 | 7.64204 | 7.64297 | 7.64367 | 7.64354 |
| Elev. (m) | 428.0  | 398.0  | 416.0  | 425.0  | 421.0  | 421.0  | 421.0  | 423.0  | 421.0  | 428.0  |

| VES  | VES21  | VES22  | VES23  | VES24  | VES25  | VES26  | VES27  | VES28  | VES29  | VES30  |
|------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Easting | 5.20841 | 5.20736 | 5.20815 | 5.20644 | 5.207913 | 5.207727 | 5.20727 | 5.20649 | 5.20607 | 5.20630 |
| Northing | 7.63915 | 7.63909 | 7.63997 | 7.63907 | 7.640849 | 7.641709 | 7.64242 | 7.64242 | 7.64326 | 7.63961 |
| Elev. (m) | 419.0  | 408.0  | 403.0  | 419.0  | 419.0  | 424.0  | 424.0  | 411.0  | 404.0  | 413.0  |
| Location | Resistivity (Ωm) | Thickness (m) | Bottom Depth (m) | Resistivity (Ωm) | Thickness (m) | Bottom Depth (m) | Resistivity (Ωm) | Thickness (m) | Bottom Depth (m) | Resistivity (Ωm) | Thickness (m) | Bottom Depth (m) |
|----------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|-----------------|---------------|-----------------|
| VES 1    | 92.8            | 1.4           | 1.4             | 59.3            | 5.8           | 7.2             | 17.4            | 11.7          | 18.9            | 788.8          | QH            |                 |
| VES 2    | 239.7           | 0.9           | 0.9             | 75.5            | 10.7          | 11.6            | 34.9            | 20.5          | 32.1            | 642.9          | QH            |                 |
| VES 3    | 213.5           | 0.8           | 0.8             | 60.3            | 5.8           | 6.7             | 28.7            | 14.1          | 20.8            | 512.0          | QH            |                 |
| VES 4    | -               | -             | -               | 42.4            | 17.7          | 17.7            | 122.4           | 15.4          | 33.1            | 887.4          | A             |                 |
| VES 5    | 122.2           | 6.5           | 6.5             | 41.1            | 12.0          | 18.5            | 328.5           | 8.4           | 26.9            | 780.9          | HA            |                 |
| VES 6    | 101.8           | 8.0           | 8.0             | 15.4            | 10.2          | 18.2            | 450.7           | 6.0           | 24.2            | 973.7          | HA            |                 |
| VES 7    | 68.8            | 4.8           | 4.8             | 14.4            | 7.6           | 12.4            | 119.6           | 10.1          | 22.5            | 1119.2         | HA            |                 |
| VES 8    | 53.2            | 4.9           | 4.9             | 17.0            | 12.9          | 17.8            | 336.1           | 8.0           | 25.8            | 830.4          | HA            |                 |
| VES 9    | 55.7            | 3.8           | 3.8             | 15.0            | 14.7          | 18.5            | 199.5           | -             | -               | -              | H             |                 |
| VES 10   | 141.9           | 9.0           | 9.0             | 36.8            | 19.9          | 38.9            | 163.8           | -             | -               | -              | H             |                 |
| VES 11   | 161.6           | 3.3           | 3.3             | 342.5           | 6.4           | 9.6             | 28.1            | 14.0          | 23.6            | 325.5          | KH            |                 |
| VES 12   | 136.0           | 4.3           | 4.3             | 408.4           | 6.0           | 10.3            | 37.0            | 11.0          | 21.3            | 346.7          | KH            |                 |
| VES 13   | 61.1            | 2.0           | 2.0             | 197.4           | 5.3           | 7.4             | 67.6            | 10.9          | 18.3            | 260.6          | KH            |                 |
| VES 14   | 190.5           | 5.4           | 5.4             | 389.1           | 6.9           | 12.2            | 37.7            | 10.0          | 22.2            | 716.9          | KH            |                 |
| VES 15   | 128.6           | 5.6           | 5.6             | 135.1           | 9.9           | 15.6            | 262.0           | -             | -               | -              | A             |                 |
| VES 16   | 78.8            | 6.2           | 6.2             | 329.5           | 8.4           | 14.6            | 674.2           | -             | -               | -              | A             |                 |
| VES 17   | 49.7            | 1.0           | 1.0             | 227.4           | 2.5           | 3.4             | 277.7           | 7.9           | 11.3            | 3180.1         | KH            |                 |
| VES 18   | 203.1           | 2.9           | 2.9             | 79.4            | 9.0           | 11.9            | 217.0           | 9.3           | 21.2            | 882.0          | HA            |                 |
| VES 19   | 107.8           | 6.9           | 6.9             | 193.4           | 8.8           | 15.7            | 24.3            | 14.5          | 30.2            | 257.5          | KH            |                 |
| VES 20   | 67.5            | 2.7           | 2.7             | 247.4           | 5.2           | 7.8             | 77.3            | 6.7           | 14.6            | 364.4          | KH            |                 |
| VES 21   | 74.9            | 11.0          | 11.0            | 175.2           | 7.0           | 18.0            | 22.3            | -             | -               | -              | K             |                 |
| VES 22   | 137.3           | 1.4           | 1.4             | 10.2            | 3.3           | 4.7             | 430.2           | 5.0           | 9.8             | 4476.5         | HA            |                 |
| VES 23   | 155.9           | 2.2           | 2.2             | 42.6            | 11.0          | 13.2            | 188.5           | -             | -               | -              | H             |                 |
| VES 24   | 129.6           | 1.6           | 1.6             | 109.9           | 11.2          | 12.8            | 39.4            | 12.2          | 29.9            | 657.8          | QH            |                 |
| VES 25   | 135.9           | 3.1           | 3.1             | 80.0            | 4.4           | 7.5             | 27.6            | 7.4           | 11.9            | 1012.2         | QH            |                 |
| VES 26   | 86.5            | 6.0           | 6.0             | 20.5            | 18.0          | 24.0            | 255.2           | -             | -               | -              | H             |                 |
| VES 27   | 28.2            | 0.8           | 0.8             | 208.0           | 2.1           | 2.9             | 12.3            | 9.0           | 12.0            | 353.9          | KH            |                 |
| VES 28   | 51.8            | 5.3           | 5.3             | 126.1           | 4.1           | 9.7             | 11.6            | 20.1          | 29.8            | 368.5          | KH            |                 |
| VES 29   | 134.7           | 3.8           | 3.8             | 84.3            | 3.2           | 7.0             | 12.8            | 15.1          | 22.1            | 530.8          | QH            |                 |
| VES 30   | 58.7            | 2.7           | 2.7             | 7.3             | 8.7           | 11.4            | 92.6            | 4.8           | 16.2            | 1299.2         | HA            |                 |
2.2. Data acquisition

The geoelectrical resistivity survey consists of VES and 2D ERI; the data sets were measured with ABEM Terrameter (SAS1000/4000) system during the onset of the rainy season (April, 2016). The base map showing the locations and distribution of the VES points and 2D ERI traverses is shown in Fig. 2. A total of thirty (30) VESs were conducted across the study area using Schlumberger array with maximum half-current electrode spacing (AB/2) of 100 m and 130 m. The VES survey was conducted so as to determine the subsurface lithologic layering and depth-to-basement at various points in the study area. The GPS coordinates and surface elevation for the VESs points are presented in Table 1. The 2D ERI survey was conducted along four (4) traverses using dipole-dipole array which is sensitive to vertical features such as faults, fractures and dykes of hydrogeological importance in basement terrain [10–14]; dipole separation factor ranging from 1–4 was used for the 2D survey. Traverse 1 was conducted in the west–east direction while Traverses 2 to 4 were in the south–north direction parallel to the main stream (Awedele stream) that drained the study area (Fig. 2). The profile length of Traverse 1 is 280 m; a dipole length ranging from 5 to 30 m in an interval of 5 m was used for the data measurements. Traverse 2 is about 55 m away from Awedele stream and is 200 m in length; the dipole length for the data measurements ranges from 5 to 65 m in an interval of 5 m. The profile length of Traverse 3 is 420 m and dipole length from 10 to 60 m in an interval of 10 m was used for the measurements. The profile length of Traverse 4 is 320 m and the dipole length used for the measurements ranges from 10 to 40 m in an interval of 10 m. Field techniques for geoelectrical resistivity survey have been discussed in several articles [e.g. 15–19].

2.3. Data processing

The observed apparent resistivity data sets for the VES were used to generate field curves which were curve-matched with theoretical master curves for Schlumberger array to estimate the geoelectric layers and their corresponding resistivity and thickness. The estimated geoelectric parameters were used as initial models for computer iteration on Win-Resist computer program to obtain model geoelectric parameters for the delineated layers. The delineated layers and their corresponding geoelectric parameters are shown in Table 2. Similarly, the 2D ERI data sets were processed and inverted using RES2DINV inversion code [11,18]; the code uses a non-linear optimization technique for determining inverse model of the 2D resistivity distribution. Least-squares inversion technique with standard least-squares constraint (L2-norm), which minimizes the square of the difference between the observed and the computed apparent resistivity data set through an iterative procedure, was used for the 2D data inversion. The least-squares equation for the inversion was solved using the standard Gauss-Newton optimization technique and appropriate damping factor was selected based on the estimated noise level on the measured data for each traverse.

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Transparency document. Supporting information

Transparency data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.05.091.
Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.dib.2018.05.091.

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