**ASSESSMENT OF AQUIFER LEVEL AND LITHOLOGY UNITS USING COMBINE ELECTRICAL RESISTIVITY LOG WITH GAMMA IN IKEJA, LAGOS STATE, NIGERIA.**

**BY**

**ADEBAYO RASHEED TUNDE**

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**A PROJECT PROPOSAL SUBMITTED TO THE DEPARTMENT OF PHYSICS WITH ELECTRONICS IN PARTIAL FULFILLMENT FOR THE REQUIREMENTS OF AWARD OF A BACHELOR DEGREE IN PHYSICS IN LEAD CITY UNIVERSITY, IBADAN.**

## **INTRODUCTION**

Water is life, without water life cannot be sustained, it is vital to human and it is the fluid that lubricates the working of cell in living things. Most rocks contain several pores known as Interstices that retain water, the interstices act as a water storage and passage. The subsurface water in interstices that are fully saturated is known as Groundwater (Gass, 1987), while subsurface water above saturation zone is known vadose water (Guyod, 1957). The groundwater can only be accessible if the rocks in the saturation zone are well porous to supply sufficient water to its outlet. One of the ways of obtaining groundwater is drilling of borehole, which involves drilling of holes deeply into the ground and clearing the debris that converge from the drilling to access the underground water (Oteri, 1986, 1988, Ilugbo *et al.,* 2018). Geophysical well logging also known as borehole geophysical log, involves all techniques of lowering sensing devices in a borehole and recording physical observation that is related to the rock, the contents of the rock and the construction of the well. Geophysical logs can be used to determine the resistivity, lithology, geometry, formation resistivity factor, e.t.c. More so, to determine the movement, source, physical and chemical properties of the water. Continuous recording values from well to well at different period can also be obtained using Geophysical well logging, if the instrument calibration is accuracy (Keith, 1998). Logs are majorly used in groundwater hydrology to define the lithology and geometry of aquifer systems, more so, to estimate the quality of groundwater. The resistivity of a material is the measure of the amount of opposition the material can resist electric current (Keys and MacCary, 1971, Peart, 1975). The electrical resistivity of a formation is directly proportional to the quantity, quality, distribution and nature of the formation water, since all these parameters are varies from one formation to another, measurement of resistivity in a borehole can be used to determine formation boundaries and details on the nature of the beds transverse by the drill (Keller and Frischknecht, 1966). Resistivity logging instruments measure the electrical resistivity of a known volume of earth materials under the application of either electric current or induced electric current.

**Problem Statement**

The most widespread uses of logs in groundwater hydrology are to define the lithology and geometry of aquifer systems and to estimate the quality of contained water. The resistivity of a material is that property which characterizes its opposition to the electrical current. The electrical resistivity of a formation is directly related to the nature, quantity, quality, and distribution of the formation water. In as much as these factors vary appreciably from one formation to another, resistivity measurements made in a borehole can be used to determine formation boundaries and to obtain information on the nature of the beds traversed by the drill. However, the research will serve as measure to determine the aquifer levels across the study area.

## **Justification**

Manual logging is technically possible at a small scale. But because logging is made up of many processes from collecting and aggregating logs to monitoring and analyzing lithologies, it’s hard to keep up with all the tasks necessary for effective logging. It’s simply not an efficient use of time. At this point, even casual users can typically afford an automated tool, and it’s a must-have for lithology identification. Logging tools are designed for easy lithology identifications. With availability of logging tools, identification of aquifer units can be automated, saving time, and yielding better results.

**Aims and Objectives**

The overall aim of this research is to determine the aquifer level and lithology units of the area. The specific objectives are to:

1. determine the depth and thickness of the lithology indicators;
2. classification of the sand that contain aquifer of relevant geological formation;
3. correlation of all the log lithologies;
4. determine the range of aquifer level across the study area.

## **Site Description and Geology**

The study area falls within the Dahomey Basin, Ikeja, Lagos state, Nigeria. The geology of the area is underlain by sedimentary rocks with no basement outcrop (Figure 1). The Dahomey Basin was formed following the break-up of the African and South American plates (Kogbe, 1974) and it is partially separated from the Niger Delta and the Eastern Nigeria sedimentary basin by a bridge of crystalline rocks. The earliest sediments in the area were deposited as a result of the first major marine transgression in South Western Nigeria (Kampsax and Sshwed, 1977). The upper sediments in the Dahomey Basin are recent. This is underlain by Coastal Plain Sands of the Quaternary Age. Basically the geologic sequence in the Dahomey Basin extends from Precambrian to Recent. Three distinct sequences, which are closely related to the geology of the sediments, are identified from past studies of South-Western Nigeria (Oteri, 1986).

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Figure 1. Map of Lagos State showing study area (Ikeja)

## **Literature Review**

Adiat, 2018 carried out application of geophysical borehole logs For aquifer Characterization in coastal environment of Lagos, Southwestern Nigeria. A total of nine composite logs comprising of Resistivity and Gamma Ray logs were used for the study. Three correlation panels trending in different directions were prepared. Each panel consists of series of well logs arranged horizontally in accordance with the spatial distribution of the wells on the field. This assisted in carrying out litho-stratification delineation that was used to identify fluid types obtainable in the area. Two parameters (aquifer potential and vulnerability) were used to characterize the delineated aquifer in the area. The aquifer thickness was used to produce the aquifer potential map for the area. The GALDIT-Index (GI) score was computed for each borehole and this was used to evaluate the aquifer vulnerability The formation stratification sequence comprises predominantly of sand and clay with intercalations of both occurring as clayey sand and sandy clay. Three distinct fluid types were delineated and these were: saline water, brackish water and fresh water. It was concluded that the groundwater system within the region is under pressure and boreholes in the area are vulnerable to saline water contamination if left without necessary monitoring.

Ilugbo *et al.,* 2018 carried out Evaluation of Groundwater Level Using Combined Electrical Resistivity Log with Gamma (Elgg) around Ikeja, Lagos State, Southwestern Nigeria. The subsurface geology of Lagos Main land is made up of complex lithologies of an alternating sequence of clay and sand deposits. The data available allows for delineation of subsurface into four aquifer horizons. Sand and gravel constitute the materials in the aquifer of recent sediments and Coastal Plain Sands. Four major fresh water bearing sand aquifers layers suggests that the deposits could be of fluvial usually estuarine deposits. The aquifers are very heterogeneous, as indicated by wide range of aquifer characteristics. In light of this information, it is recommended that due to the occurrence of the coastal plain sand in the study area the aquifer level is between the depths of 61m to 92m. Hence, if there is a need for industrial purpose, the aquifer should be tapped at the depth between 61m to 89m, and also screened for water supply. Relatively higher resistivity indicates significant formation fluid.

Aline *et al.,* 2017, carried out application of geophysical logging and straddle Packers for the investigation of a fractured aquifer in a contaminated area by chlorinated solvents in Sao Paulo State, Brazil. The investigation of contaminated areas in fractured aquifers represents a great technical challenge, due to the frequent conditions of heterogeneity and anisotropy of these environments, which often make it difficult to identify and predict pathways of subsurface contamination. This work aims to contribute to the development of this subject, through the presentation of the results of an investigation in which geophysical logging tools and straddle packers were used, which allowed the development of a more suitable hydrogeological conceptual model of the study area. Two boreholes were drilled and geophysical logging (gamma, caliper and high resolution acoustic televiewer) were used for the geological-structural characterization of the aquifer. Heat pulse flow meter and straddle packers were then used to obtain data on hydraulic potentials and flows and for the collection of discrete water samples for chemical analysis. Two types of gneiss rocks were identified below the weathering zone (thickness >30 m), one with predominance of mafic bands, more weathered and with a higher fracture density, up to 65 m, and another deeper one, with the predominance of felsic bands. Seven groups of fractures were defined, being those of Group 1, with low dip angles, the most frequent and important for flow until 65 m, and Group 2 (N to NE-SW with high dips to W and NW) more frequent in deeper felsic gneisses. Downward hydraulic potentials were identified down to 65 m and upward potentials from the bottom up to 65 m. A hydraulic test allowed identifying the occurrence of hydraulic connection between the shallow weathering zone and the underlying fractured aquifer.

## **Research Methodology**

Twenty (20) composite geophysical well logs will be obtained from twenty borehole locations in Ikeja, Lagos state. The composite log will consist of the resistivity and gamma ray measurements. The GPS coordinates will be gotten in UTM units showing the northing, easting and elevation of each location above sea level. In this study, one lithology detection log (gamma ray log) and one fluid detection log (resistivity) will be employed in interpreting the subsurface deposition of the wells. The subsurface layers (sand and clay) will be delineated and correlated stratigraphically. Delineation into aquifer horizons will be done from well to well by the use of lithologic logs and supplemented by geophysical logs. The interpretation of well logs will involves choosing the best models from the given data so as to obtain results which are geologically plausible. Well log interpretations are often quantitative and qualitative, but only the qualitative technique will be employed for facies analysis. The qualitative interpretation will involved the use of models which represent the characteristic log response to the formation parameters. The qualitative interpretations will involved identification of sand units from chosen top sand to the last water bearing sand using gamma ray log, classification of the sand that contain aquifer of relevant geological formation that juxtaposed it, and identification of water-bearing sand from resistivity log and identification of fresh water sand. A baseline will be drawn on the gamma log, which is midway between the maximum and minimum gamma signals. All signals to the left of the baseline will be regarded as sand while all signals to the right of the baseline are taken as clay. The resistivity log will be used to determine the sandy formation. Intervals of logs from different wells will be matched for similarity or for characteristic log responses to lithological markers. The borehole lithologic logs of the study area will be correlated along one direction. The subsurface layers will be correlated and delineated stratigraphically along the aforementioned directions and aquifer levels will be delineated

**Time Frame and Cost Analysis**

**Time Frame**

The research work is planned to follow the stages and schedules below;

**Phase 1( 2 weeks)**

This stage includes Literature review, Reconnaissance survey and collection of available journals, papers and reports on previous works within the area and other similar environments.

**Phase II (2 weeks)**

Procurement of resistivity and gamma logs, Software procurement, and training.

**Phase III (2weeks)**

Data processing and Interpretation

**Phase IV (2weeks)**

Report Writing and Submission of the Final Findings

**Duration of the Research Work: (2) months.**

**Cost Analysis**

**Table 1: Laboratory Expenses**

|  |  |  |
| --- | --- | --- |
| S/N | Research Expendables | Cost (Naira) |
| 1 | Procurement of borehole data | 60,000 |
| 6 | Software Training/printing | 10,000 |
| 7 | Binding of Thesis | 10,000 |
| **SUB TOTAL**  **(a)** |  | **80,000** |

**Expected Contributions to Knowledge**

The study is expected to make the following contribution to knowledge

1. The findings will enhance our knowledge of the subsurface lithologies and the hydrogeological characteristic of the study area
2. It will serve as a reliable guide to future groundwater development in the study area.
3. It will also provide a basis for the prediction of aquifer level in the study area.
4. The information gathered will serve as reference material for future researchers.

**Conclusion**

This research is expected to follow the workflow and give expected results to justify the aim of the study and necessary contributions to knowledge

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