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Predicting the aquifer characteristic within the major towns in Ndokwa land

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ABSTRACT

The aquifer characteristics within the local government headquarters of Ndokwa land (Kwale, Obiaruku and Aboh) were achieved by obtaining the geoelectric section of the area. The study revealed that the first layer of aquifer is at an average depth of 6 m in the study area, this aquifer has a small thickness in Aboh, followed by Obiaruku, while the thickness in Kwale is about 25 m and it is confined in Obiaruku and Aboh but unconfined in Kwale. Hence in the event of pollution, ground water within Kwale will be highly contaminated. The section also revealed that a second layer of aquifer is found at a depth of 25 m, this aquifer has a small thickness in Obiaruku about 30 m, while the thickness in Kwale is 40 m while the aquifer is not found in Aboh. Hence the aquifer in Kwale can be exploited easily due to its thickness. Meanwhile appreciable quantity of ground water could be exploited within Kwale at a depth of 35 m. While in Obiaruku and Aboh, 45 m to 50 m are convenient depth for ground water exploitation. This depth must not be exceeded in Aboh due to the presence of fine grain sand which is not a suitable aquifer characteristic.

Keywords: groundwater, geoelectric section, confined and unconfined aquifers.

INTRODUCTION

Ndokwa land consists of three local government areas namely, Ndokwa East, Ndokwa West and Ukwuani. It is in the south eastern region of Delta State situated in the south southern part of Nigeria and lies between latitude $5^0\ 48^1$ and $5^0\ 60^1$ and longitude $6^0\ 08^1$ E and $6^0 32^1$ E. It has common boundaries in the north with Ika south and Aniocha south local government areas. It is bounded in the South by Isoko South and Isoko North local government areas, and Edo state as well as River Niger in the west and east respectively. The important rivers in the region are Niger, Ethiope, Adofi and Umu (Oseji, et al, 2005).

Ndokwa land is within the Niger Delta basin of Nigeria. The Niger-Delta in this project applies to the entire 3-Dimensional bodies of continental, transitional and marine deposits formed by sediments from Rivers Niger and Benue. The continental deposit forms the land area otherwise

called the sub aerial regions. The marine deposits are the water filled region otherwise called the sub aqueous region, while the transitional deposit forms the swampy (mangrove) regions (Hospers. J, 1965)

The structure of the continental geologic framework directed River Niger and Benue towards the present site of the Delta. Hence the geology of Niger-Delta, like other parts of the earth has undergone different changes right from the tectonic setting through the paleogeographic evolution to the present day. This development of the Delta has been dependent on the balance between the rate of sedimentation and subsidence. The balance and the resulting sedimentary patterns appear to have been influenced by the structural configuration of tectonics of the basement (Short, K. C. and Stauble, A. J. 1967).

The geology and Geomorphology of the Niger delta have been described in detail by various authors (Allen, J.R.L.1965; Asseez. L. O. 1976; Avbovbo, A. A.1970; Akpokodje, E. G. 1979; Edward, A. K. 1981; Burke, K. K. 1972; Merki, P. J. 1970; Oomkens, E. 1974; Rement, R. A.1965; Short, K. C. and Stauble, A. J. 1967).

The formation of the present day Niger delta started during early Palaeocene and it resulted mainly from the build-up of fine-grained sediments eroded and transported by River Niger and its tributaries (Etu-Efeotor, J. O and Akpokodje, E. G. 1990).

The sub-surface geology of the Niger Delta consists of three Lithostratigraphic units (Akata, Agbada and Benin formations), which are in turn overlain by various types of Quaternary deposits. The Quaternary deposit of Ndokwa land consists mainly of Coastal Plain Sands, Sombreiro – Warri deltaic Plain deposits invaded by mangrove, wooded back Swamps, Fresh water Swamp and Meander belts. The important rivers in the region are Rivers Niger, Ethiope, Adofi and Umu while the Ase creek is the major creek. However many ponds and streams are found within the area.

Groundwater is the water that is found under the ground in soil, rocks etc. it exists in pore spaces and fractures in rock and sediment beneath the earth's surface (Robert. M. 1997; Stephen A.N. 2003) It originated as rainfall or snow, and moves through the soil into the groundwater system, where it eventually makes its way back to the surface streams, Lakes or oceans. Ground water is stored in, and moves slowly through moderately to highly permeable rock called aquifers (Oseji, et al, 2005). It flows from point of higher energy to a point of lower energy in the direction of the hydraulic head and governed by the permeability, porosity of the medium and the geology of the area (Philip. W.G. 1991)

MATERIALS AND METHODS

Drilling to many people is the only activity above the ground that can be seen. Various techniques are used by drillers in the process of drilling holes. These include rotary drilling, percussion drilling and hand driving.

In the rotary method, a bit is attached to the end of a length of drill pipe; additional pieces of pipe can be attached as the hole deepens. A stabilizer is attached just above the bit to provide extra weight and keep the drill hole straight. The drill pipe is hollow and air or mud is circulated down the pipe out of the holes in the bit. The air or mud then carries the cuttings up the side of the hole to the surface. The bit is typically a tri-cone bit which is actually three bits that work together to cut into the material.

The percussion method is also known as cable tool drilling. The drill operates by raising a drill using a cable and dropping it in the drill hole. The drill head rotate slightly with each drop to maintain a circular hole. The impact breaks up clay and rock. The debris is mixed with water to create slurry, which is then removed by a bailing device.

In areas where ground water is close to the surface, it is possible to hand drive the hole by using a post hole digger to create a hole as deep as you can. A weighted driver is then used to drive casing into the ground using a percussion method.

In this work the rotary technique was used in the drilling of holes, because the region is found to be clayey in the nature of subsurface material.

In the rotary technique various equipments such as a drilling bit (drilling machine) of various inches, water pump, pipe, measuring tape are used. The bit is attached to a length of connected pipes; the drill bit is made of tough metals, such as tungsten. As the drill is rotated, the bits ground up the rock with water, which is pumped out onto the surface from the surface water pump, in order to soften the ground.

The drills are measured with a measuring tape. The drill pipes are connected to the water pump, which start to pump out the substances from the ground ranging from clay to sandstone (gravel).

RESULTS AND DISCUSSION

In the various sites within the area (Obiaruku, Kwale, and Aboh) that were drilled, different depths in meters were taken and the drillers logs were generated as presented in table 1 below.

Table 1: Drillers Log from the Headquarters of the L.G.A's in Ndokwa Land

DISTANCE IN METERS	UKWUANI L.G.A(Obiaruku)	NDOKWA WEST L.G.A (Kwale)	NDOKWA EAST L.G.A (Aboh)
	Drillers log	**Drillers log**	**Drillers log**
0 - 3	Red clay	Red clay	Clay sand
3 – 6	Red clay	Red clay	Clay sand
6 – 9	Smooth sand	Smooth sand	Smooth sand
9 – 12	Smooth sand	Smooth sand	Smooth sand
12 – 15	Sharp sand	Sharp sand	Black clay
15 – 18	Sharp sand	White clay	Swelling clay
18 – 21	Sharp sand	White clays	Swelling clay
21 – 24	Sharp sand	Smooth white clay	Swelling clay
24 – 27	Sharp sand	Gravelling sand	Swelling clay
27 – 30	Sharp sand	Gravelling sand	Lateral stone
30 – 33	Gravel/sand	Short gravel	Lateral stone
33 – 36	Gravel/sand	Short gravel (lateral stone)	Lateral stone
36 – 39	Gravel/sand	Short gravel	Lateral stone
39 – 42	Big gravel/ sand	Gravelling sand	Lateral stone
42 – 45	Big gravel/sand	Big gravel	Lateral stone
45 – 48	Big gravel/sand	Big gravel	Lateral stone
48 – 51	Big gravel/sand	Big gravel	Lateral stone
51 – 54	Big gravel/sand	Big gravel	Big gravel
54 – 57	Big gravel/sand		Big gravel
57 – 60	Big gravel /sand		Big gravel
60 – 63			Sharp sand
63 – 66			Sharp sand

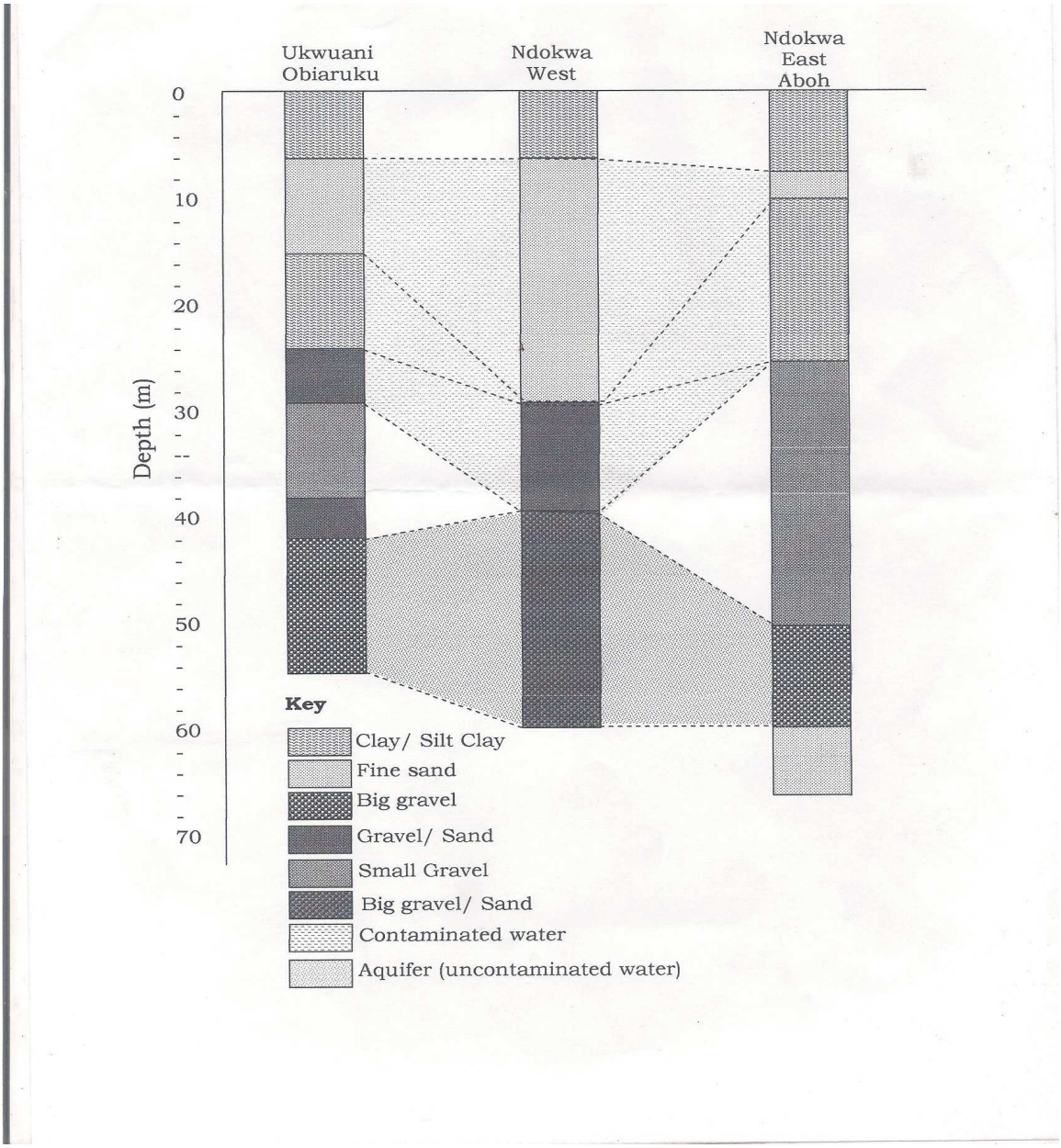

Fig 1: The geoelectric section of Ndokwa Land

The geoelectric section (Figure: 1) revealed that the first layer of aquifer is at an average depth of 6 m in the study area. This aquifer has a small thickness in Aboh, followed by Obiaruku, while the thickness in Kwale is about 25 m; this aquifer is also confined in Obiaruku and Aboh but unconfined in Kwale. Hence in the event of pollution, ground water within Kwale will be highly affected. The section also revealed that a second layer of aquifer is found at a depth of 25 m. The aquifer has a small thickness in Obiaruku, at a depth of 30 m, while the thickness in Kwale is at a depth of 40 m. This aquifer is not found in Aboh. Hence the aquifer in Kwale can be exploited easily due to its thickness. Meanwhile appreciable quantity of ground water could be exploited within Kwale at a depth of 35 m. While in Obiaruku and Aboh, 45 m to 50 m are convenient depth for ground water exploitation.

This depth must not be exceeded in Aboh due to the presence of fine grain sand which is not a suitable aquifer characteristic.

CONCLUSION

The drillers log was used to study subsurface materials and also predict groundwater aquifer zones, whether confined or unconfined in an area.

Based on the geoelectric section and the driller's log, appreciable quantity of water could be obtained at depths of between 40 m to 60 meters below the ground level in the study area.

It is therefore recommended that in Ndokwa West (Kwale), boreholes should be drilled to a depth of 35 m, while in Ukwuani (Obiaruku) and Ndokwa east (Aboh) it should be drilled to a depth of between 45 m to 50 m to get appreciable quantity of water.

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