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Predicting the Aquifer Characteristic in the Headquarters of Ndokwa Land

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Abstract: The aquifer characteristics within the local government headquarters of Ndokwa land (Obiaruku, Kwale and Aboh) was achieved by obtaining the geoelectric section of the area. The data was used to determine areas with confined and unconfined aquifer and also the area having the highest water basin in the headquarters of Ndokwa land, the research also enabled one to recommend the depth at which boreholes could be to drilled for appreciable quantity of groundwater exploitation.

Key words: Groundwater, geoelectric section, confined and unconfined aquifers, Ndokwa land, Nigeria

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°48' and 5°60' and longitude 6°08' E and 6°32' 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. It has 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).

One of the greatest oil producing areas in Nigeria is the Niger Delta basin. The study area Ndokwa land is within this zone. 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 deposits form 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 deposits form the swampy (mangrove) regions (Hospers, 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.

The geology and geomorphology of the Niger-Delta have been described (Allen, 1965; Merki, 1970; Akpokodje, 1979, 1987; Asseez, 1970, 1976; Avbovbo, 1970; Oomkens, 1974; Burke, 1972; Rement, 1965; Short and Stauble, 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 and Akpokodje, 1990).

The sub-surface geology of the Niger-Delta consists of three Lithostrati graphic 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.

Ground water 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.

It originated as rainfall or snow and moves through the soil into the ground water 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 (Barry and Gayle, 2001) and it flows from one point of higher energy to a lower point of energy in the direction of the hydraulic head governed by the permeability, porosity of the medium and the geology of the area.

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MATERIALS AND METHODS

Drilling to many people is only the 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. Hand driving work best at 40 ft. or less. In this research, the rotary technique was used in the drilling of holes because the region is found to be clayey in topography. In this region, large depths about 100 ft. is drilled before obtaining portable water. In the rotary technique various equipments such as a drilling bit (drilling machine) of various inches, water pump, pipe and measuring tape are used.

Table 1: Drillers log from the headquarters of the L.G.A's in Ndokwa land

	Ukwuani L.G.A. (Obiaruku)	Ndokwa west L.G.A. (Kwale)	Ndokwa east L.G.A. (Aboh)
Distance (m)	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

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 which are measured with a measuring tape, show measures in various feet.

The drill pipes are connected to the water pump which start to pump out the substances from the ground ranging from clay sand stone (gravel). In the various drill sites within Ndokwa land headquarters (Obiaruku, Kwale and Aboh) that was drilled, different depths in meters were taken and various logs otherwise known as driller's logs were found at these depths as shown in Table 1.

RESULTS AND DISCUSSION

The geoelectric section revealed that the first layer of aquifer is at an average depth of 6 m in Ndokwa land. 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 contaminated. In the geoelectric section, it also revealed that a second layer of aquifer is found at a depth of 25 m in Ndokwa Land. 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 (Fig. 1).

Hence, the aquifer in Kwale is easy to exploit, due to its thickness. Fairly portable water is also obtained. Meanwhile, appreciable quantity of ground water could be exploited within Ndokwa west (Kwale) at a depth of 35 m.

While in Ukwuani (Obiaruku) and Ndokwa east (Aboh), 45-50 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.

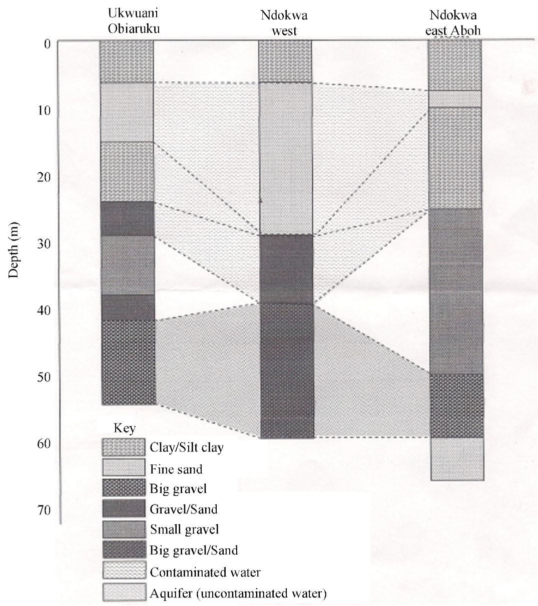

Fig. 1: The geoelectric section of Ndokwa land

CONCLUSION

The data used in this research, using drillers' logs from the headquarters of Ndokwa land (Ukwuani) Obiaruku, Ndokwa east (Aboh) and Ndokwa West (Kwale). Based on the geoelectric section, appreciable quantity of water could be obtained at depths of between 40-60 m below the ground level.

RECOMMENDATION

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 45-50 m to get appreciable quantity of water.

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