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Determination of water well-sites at Durdieb locality, NE Sudan.

Fadlelsaid, A. Mohammed[1], Abboud, S. Ahmed[2]

1. Faculty of Earth Sciences, Groundwater Department 2. Faculty of Earth Sciences, Department of Geophysics, Red Sea University

Abstract

The main objective of these investigations is to determine suitable sites for drilling production wells in nine selected sites in Durdieb locality for avoiding random drilling. To achieve this objective; geological, geophysical, and hydrogeological investigations were executed. The collected data were processed and analyzed using appropriate computer softwares. The investigations reveal that the groundwater in the area is available only at water courses, and it is highly variable in quantity and quality in space and time, depending on the rainfall and runoff amount. The aquifer is unconfined, structurally controlled and composed of alluvial sediments and / or weathered basement rocks. The depth to basement is varied from 20 to 26 meters. The saturated thickness is ranged between 5 to 22 meters the water table is varied from 5 to 25 meters, and the aquifer resistivity is ranged from 5.8 to 96 ohm-m. It is recommended that seven boreholes should be drilled in Tahela, Durdieb, Tahasbob-Lashob, Delia, Saneat, Todopanop, and Adrot, where the investigations reveal occurrence of groundwater potentiality.

Keywords: Groundwater, Geophysical, Hydrogeological, Durdieb.

Background

The authors, were commissioned by Sudanese Red Crescent Society (SRCS) to carry out a hydrogeophysical investigations at nine selective sites in Durdieb locality to locate suitable sites for drilling boreholes. Fieldwork was carried out during July 2014.

Detailed informations on prospects of drilling production boreholes were done. The objectives of the present study are to assess the availability of

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groundwater, to recommend boreholes drilling

Sites, to delineate depth to potential aquifers, determine aquifer availability and type, and suggest possible yields and water quality. To achieve these objectives, the available hydrogeological information of the area have been analyzed, and a geophysical surveys were done.

The study involved geological, hydrogeological, geophysical field investigations and a detailed office work. Hence, the available relevant geological and hydrogeological data were collected, analyzed, and evaluated.

Scope of the Work

The main objectives of the present study are to assess the availability of groundwater, to recommend boreholes drilling sites and comment on aspects of depth to potential aquifers, aquifer availability and type, possible yields and water quality.

Location and Accessibility of the Study Areas

The present investigations covered about nine areas (Tahela, Durdieb, Lashob, Bratic-mean, Tahasbob-Lashob, Delia, Saneat, Todopanop, and Adrot) which are located at Durdieb locality, between longitudes: 35°20´E - 36°20´E and latitudes: 17°00´N - 18°40´N. The elevation is ranged between 420 to 571m.a.m.s.l, (Fig. 1.1). The study area is accessible via unpaved roads across hilly terrain and pediments of the Red Sea Hills.

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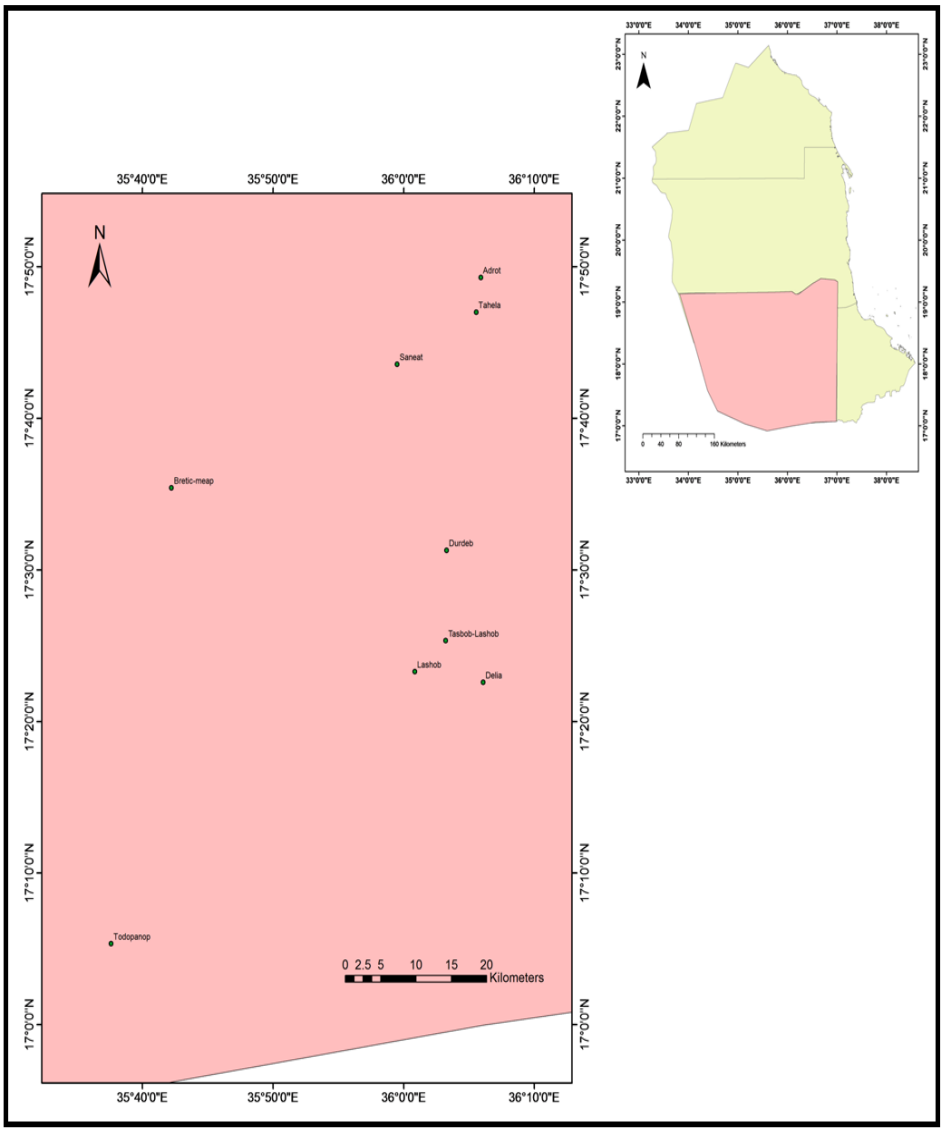

Fig. (1.1): Location of the study area in the Red Sea State.

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Topography and drainage system:

The study area is located at the western slope of the Red Sea Hills, where the landscape changes from the steep hills to the gently sloping, open landscape towards the River Nile (Babiker, and Gudmundsson 2004), Figure (1.2).

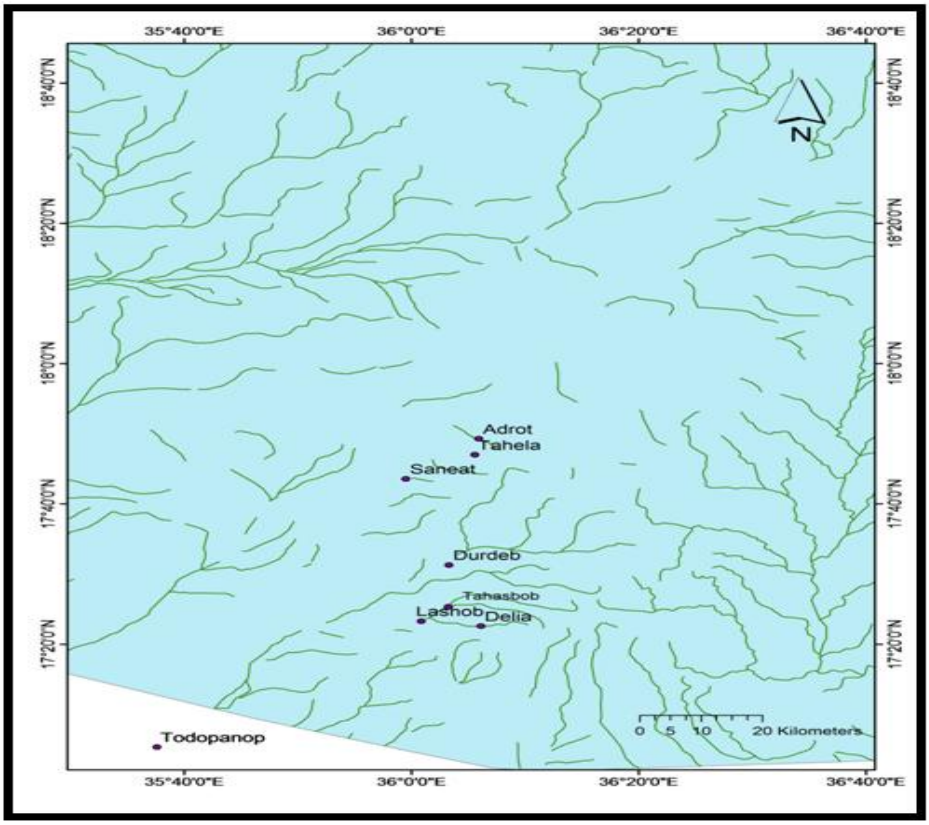

Fig. (1.2): Drainage System in Durdeb Area.

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Climate and Water Situation

The climate of the study area is semi-arid to arid. The area is receiving precipitation at the summer times. Summer rain is brought by southwesterly monsoon winds which originate from the Gulf of Guinea. Rain falls either as the winds rise over the mountains or as a result of thermal convection, (El-tom, 1991). The amount of rainfall received in the area is very small (100 mm $year^{-1}$). The surface runoff in the study area is rapid due to the steep gradient.

The water resources are mainly hand-dug wells or recently drilled hand-pump wells located in seasonal Wadis. These Wadis are flow only after rainy seasons, so the quality and quantity of water in the wells varies in space and time. The groundwater in the study area is available only at water courses and it is highly depended on the rainfall and runoff.

The population uses water for domestic, watering animals and Cultivation. In some places people may have to walk several kilometers to collect water, especially during the dry seasons.

Geology of the study area

The main geological units in the study area are composed of the Basement complex rocks and Quaternary to Recent Sediments, (El Nadi, 1984). The area as a whole is covered by The Basement rocks which are encompassed igneous, Meta-volcanic and meta-sedimentary rocks, (Kabesh and Lotfi, 1962). The Basement rocks considered as non-water-bearing strata, except at fracture zones. The

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Quaternary and Recent sediments are structurally controlled and they consist of silt, clay and sand intercalated with a few amount of gravels. Generally, they represent the main water-bearing strata in the study area.

Methodology

Methods which are used to achieve the objectives of this study include Literature review, Field work and Office work. The field work comprises geological reconnaissance, hydrogeolgical and geophysical survey. The geological reconnaissance was done to determine the various geological units of the study area. The hydrogeolgical work includes well-inventory (determination of well locations using GPS, measuring water levels and yield of existing borehole). The Geoelectrical survey was done using VES technique to determine depth to basement, water table, water quality and saturated thickness of the aquifer.

Data Collection

A total of 24 Vertical Electrical Soundings (24VESs) with Schlumberger configuration were performed in nine selective Khors where groundwater is available. The equipment sets for data collection consist of a portable ABEM Terrameter SAS 1000, four set of cables and steel electrodes for current connections and potential measurements, (Fig. 1.3-B). Some sounding are conducted closed to existing boreholes for calibration. Depth to water table and Coordinates of VESs and wells were recorded in the field using water level indicator and GPS instrument respectively, (Fig. 1.3-A).

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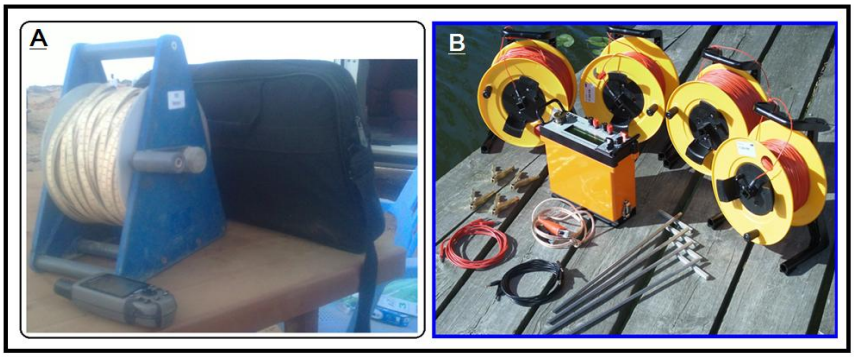

Fig. (1.12): Instrument and Equipments was used in the Investigations;

A are Water level Indicator, GPS and Laptop, and B is SAS 1000 and its Accessories.

Field Data Interpretation and Results

The field data are interpreted quantitatively using IPI2win. and RESIX computer programme for the semi-automatic and automatic interpretation. This interpretation leads to layered geoelectrical models which in turn transformed into layered geological models using the available geological and boreholes information. The match between computed resistivity model and field curves was obtained by continuous iteration with a root-mean-square (RMS) of less than 5% in most cases. The low (RMS) error values indicates good fits between field and computed resistivity model curves, however it may not indicate best geological model, (Reinhard Kirsch, 2008) and (Telford, 1976). Examples for the final results of interpretation are shown in figure (1.4) and summarized in table (1.1).

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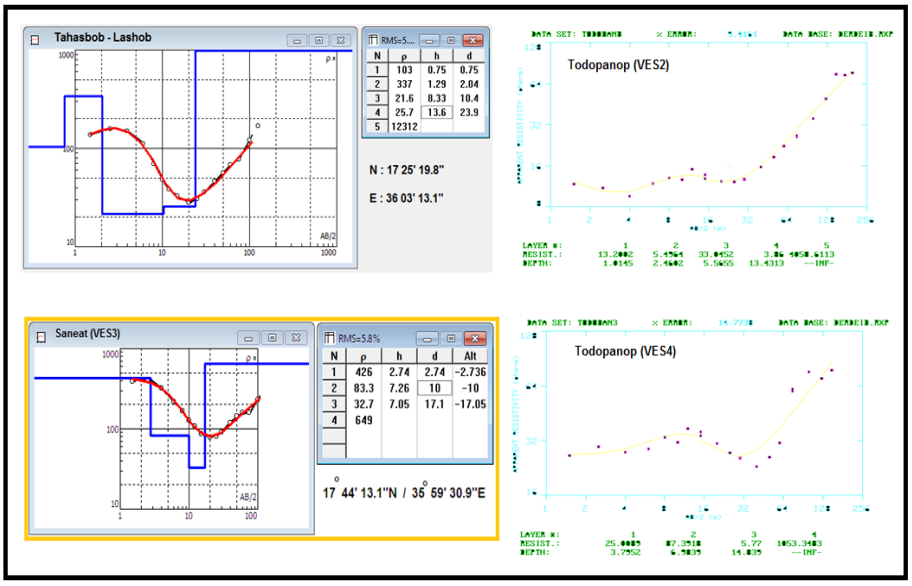

Fig. (1.4): Example of Quantitative interpretation of selected VES data.

Table (1.1): Summary of field data interpretation.

Area	ES No	Coordinates (N / E)	Aquifer esistivity (ohm-m)	epth to wate table (m)	Saturated hickness (m)
Adrot	1	17°49´17.04˝N / 36°05´54.48˝E	83	20	6
	2	17°49´41.58˝N / 36°05´40.74˝E	-	-	-
odopanop	1	17°15´20.04˝N / 35°37´36.24˝E	12.3	5	6.5
	2	17° 15.228´N / 35° 37.499´E	9	5	8
	3	17° 15.59´N / 35° 37.704´E	6.6	5	9
	4	17° 15.402´N / 35° 37.964´E	5.8	5	10
Lashob	1	17°23´03.2˝N / 36°00´07.8˝E	-	-	-

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	2	17°23´17.1˝N / 36°00´51.00˝E	-	-	-
	3	17°23'12.8"N / 36°00'02.8"E	-	-	-
	4	17°23'05.8"N / 35°59'47.2"E	-	-	-
	5	17°23'28.2"N / 36°01'14.2"E	-	-	-
Durdeb	1	17°32´05.7˝N / 36°03´35.50˝E	-	-	-
	2	17°31´17.2˝N / 36°03´17.40˝E	42.9	18	22
ratic-meap	1	17°35´49.3˝N / 35°42´12.45˝E	-	-	-
Tahasbob-Lashob	1	17°25´19.8˝N / 36°03´13.1˝E	25.7	14	10
Tahela	1	17°40´59.94˝N / 36°05´33.72˝E	47.2	15	10
Saneat	1	17°43´33.66˝N / 35°59´29.82˝E	-	-	-
	2	17°43´39.42˝N / 35°59´36.54˝E	80.6	5	20
	3	17°44'31.1"N / 35°59'30.9"E	32.7	10	7
	4	17°44'07.7"N / 35°59'27.9"E	-	-	-
Delia	1	17°22´34.9˝N / 36°06´05.4˝E	62	20	10
	2	17°22´35.2˝N / 36°05´56.1˝E	61	20	10
	3	17°22'34.9"N / 36°06'16.6"E	23.7	20	5.6
	4	17°22'35.0"N / 36°06'0.6"E	96.5	20	10

Table (1.2): Coordinates of proposed sites for drilling production wells.

Area	Coordinate of Drilling Site
drot area	(17°49´17.04˝N /36°05´54.48˝E)
odopanop area	(17° 15.402´N / 35° 37.964´E)
urdieb	(17°31´17.2˝N / 36°03´17.40˝E)
aneat	(17°43´39.42˝N /35°59´36.54˝E)
elia	(17°22´34.9˝N / 36°06´05.4˝E)
ahasbob-Lashob	(17°25´19.8˝N / 36°03´13.1˝E)
ahela	(17°40´59.94˝N / 36°05´33.72˝E)

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Recommendations

The present study is providing good knowledge of the hydrogeology system in nine different areas, and suggests the following recommendation:

Production well drilling at the seven areas of proposed high groundwater potentiality and saturated thickness greater than 10m, Tables (1.1, and 1.2).

Acknowledgments

We would like to express our gratitude and indebted to the Sudanese Red Crescent Society (SRCS), which provided us necessary data.

References:

[1] Babiker, M. and Gudmundsson, A., 2004. The effect of dykes and faults on groundwater flow in an arid land, Red Sea Hill, Sudan, J. Hydrol. 297: 256-273.

[2] Babiker, M and Gudmundsson, A., 2004. Geometry, structure and emplacement of mafic dykes in the Red Sea Hills, Sudan. Journal of African Earth Science, volume 38, pp 279-292.

[3] El-Tom, M. A., 1991. The climate of the Red Sea Region: an outline. RESAP techn. Paper, 1. The Reasp, Univer. Of Khartoum.

[4] El Nadi, A. H., 1984. The geology of the late Precambrian metavolcanic, Red Sea Hills, northeast Sudan. Ph.D. Thesis University of Nottingham.

[5] Kabesh, M. L and Lotfi, M., 1962 . On the Basement Complex of the Red Sea Hills of Sudan. Bull. Inst. Egypt, 12, 1- 19.

[6] Mandel, S., & Shiftan, Z.L., 1981. Groundwater Resources investigation and development, Academic press, New York, London,

[7] Musa , S .B. 1991 : Surface Water Runoff In The Red Sea . Red Sea Area Program (RESAP).

[8] Reinhard Kirsch, 2008. Groundwater Geophysics - Atool for Hydrogeology.

[9] Telford, W. M., Geldert, L.P., Sheriff, R.A.& Keys, D.A., 1976. Applied geophysics 1st edition. Cambridge University press.