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Geohydrological Investigation at Saroornagar, Rangareddy District, Andhra Pradesh, India

KEYWORDS | Geohydrology, Vertical electrical sounding, Potential Zones

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ABSTRACT *Saroornagar, Rangareddy District of Andhra Pradesh being chronically drought prone area, the development of ground water for assured and continuous water supply has assumed a significant preposition. This paper is an attempt to succinctly examine the possibility of ground water in the typical trap mandal of Saroornagar. The geo-electrical soundings conducted at eleven places in the Saroornagar area are interpreted by schlumberger method. These studies help to understand the sub-surface geology and in identifying ground water potential zones and in turn to locate the favourable sites for good yielding bore wells.*

INTRODUCTION

In ground water exploration knowledge of geology is the first and foremost consideration in addition to the general information on local stratiography and geomorphology, well inventory, drainage pattern and vegetation. Ground water potentialities of a region are controlled by the climate, topography, lithology and recharge. Ground water in hard rock areas is available only from the weathered and fractured zones of rocks. The hard rock areas are hither to known to yield limited quantities of ground water by virtue of its mode of origin and absences of inter granular porosity. Hence, the search for ground water in hard rock areas is confined to locate weathered, fractured and jointed patterns which are favorable zones of ground water.

The electrical resistivity methods, give fairly accurate results in ground water study. These methods assumed considerable importance in the field of ground water exploration because of its low cost and easy operation . the resistivity methods can be employed successfully to estimate the thickness of the formation and also the electrical nature of the formation which in turns provides useful information regarding the ground water potentialities (Griffith & king 1965, parasnis 1966 and balakrishna 1980) . The methods are more useful to identify between fresh and saline waters zones and therefore are widely employed throughtout the world.

Geophysical methods provide indirect picture of sub-surface formations by measuring the various physical parameters of the earth crust Electrical resistivity sounding methods are being used for a long time to understand the variation of resistivity in the sub-surface formations of the earth. By understanding the variation of resistivity with depth, sub-surface geology, the thickness of weathered and fractured zones and the sub-surface geohydrological conditions can be inferred. These parameters are density magnetic susceptibility, electrical conductivity and elasticity. Electrical resistivity survey by far is most suitable method for ground water investigation. The geo-electrical resistivity method when applied to collect resistivity values of surface to depth in a rock mass at a point is vertical electrical sounding (VES). The true resistivity values and thickness of layers are obtained by interpretation of the sounding curves. The schlumberger configuration was used in the VES conducted in a 12sq.Km the Saroornagar (Lat 17o19’ and long 78o30 ’) bore hole sites in granitic terrain. The terrain in general slopes gently towards South East. The relief varies between 539 to 660m with reference to mean sea level. The area being situated in semi-arid tracts of Deccan trap is marked high degree of temperature going up to a maximum of 45 c while in winter the lowest temperature recorded 10 C.

THE SCHLUMBERGER ELECRODE CONFIGURATION

In the schlumberger electrode configuration there are four electrodes placed along a straight line in which the distance between the two inner potential electrodes (b) is kept very close to each other and constant for some time compared to the distance between the current electrodes (L).The schematic set of the SCHLUMBERGER configuration is shown the figure 1.

SCHLUMBERGER ELECRODE ARRANGEMENT

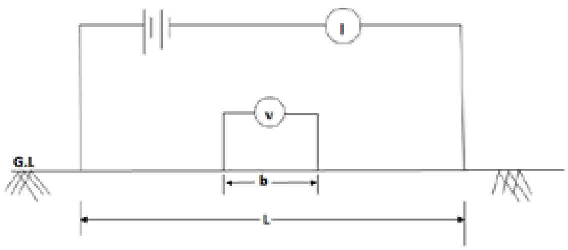

Fig .1

In practice, the distance between the potential electrodes is usually kept less than 1/5th of the distance between the current electrodes. The apparent resistivity value obtained is attributed to the midpoint of the configuration. The apparent resistivity for a measured resistance R=(v/I) is given by

$$\rho a = \frac{(L/2)^2 - (b/2)^2}{b} R$$

Where,
L= distance between current electrode
b = Distance between potential electrodes
R= V/I = potential difference between potential electrodes/ the current flowing.

From the electrical resistivity sounding method apparent restivity is obtained as a function of spacing. These measured values when plotted on a log – log graph give a sounding curve. Based on the shape of the curve, it can be classified mainly into four types – H,K,A and Q types for a three layered earth . The distribution of resistivity below the surface in each type is as follows:

H -Type $\rho1>\rho2>\rho3$
K- Type $\rho1>\rho2>\rho3$
A- Type $\rho1>\rho2>\rho3$
Q type $\rho1>\rho2>\rho3$

For a four layered earth situation, the curves can be classified as HQ-type, KA type etc. From the shape of the curve one can qualitatively interpret the sub surface resistivity distribution as shown above.

The interpretation of the surrounding curve involves estimation of the resistivity and its thickness of different layers. This

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can be done by using either the conventional approach such as curve matching technique, where in the surrounding curve is compared with a set of master curves and the best fit curve is selected. The subsurface resistivity distribution parameters (ρ, h) of the selected master curve give the subsurface resistivity distribution below the sounding curve. However, this approach requires innumerable set of master curves for 3 or more layers and the job time consuming. Other way of interpreting the 3, 4, 5... Layer sounding curves is by auxiliary point method. In the present study all the curves are interpreted manually using two layer auxiliary point approach.

AUXILIARY POINT METHOD:

The details of this method are briefly here considering three layer H-type sounding curve (Mooney and Orellanna (1966). The different steps involved in using the two layer auxiliary curves are as follows:

1. Firstly, the data should be plotted on a transparent paper with log-log scale (62.5cm) i.e.., keeping the same scale as in the case of master curves.
2. To start with the left hand portion of the field curve is selected and compared with the two layer master curve. But care should be taken such that the axes of the field curve and the master curve are parallel to each other. The best fit curve is selected and marks the first cross (+) which give ρ1, h1 and an estimate of ρ2 from ρ2/ρ1.
3. Now by keeping first cross over the coordinate origin in coordinate with the horizontal line of the master curve move the field curve to get the best match on the right hand portion of the field curve.
4. Mark the position of the coordinate origin (second cross) and the resistivity mark from the master curve sheet. The resistivity mark gives ρ3, the resistivity of the 3rd layer.
5. Place the field curve once again onto the master curve diagram and locate the first cross in the same position. From the second cross match the closest dashed line which will give h2/h1.
6. From h1 value, h2 can be computed.

GEOLOGICAL SETTING

The region is underlain by crystalline rocks of Archaean age consisting of granites and gneisses of Dharwarian period and basaltic flows of late cretaceous to early Eocene age with lateritic caps of recent to sub-recent period. The Dharwarian schist are also extensively covered by peninsular granitic complex of Archaean age. Dharwarian rocks occur as narrow patches and belts within peninsular granites. The Dharwar rocks consist of hornblende schists, chlorite schists and banded or massive gerruginous quartzites.

The structural elements that are identified in the area of investigation are joints, shearing fractures and fissures. Most of the joints are trending NE-SW with almost steep dips or nearly vertical. The sheeting is quite prominent in the granitic terrain of the region. The sheet planes are either parallel or subparallel to the surface morphology. The area experiences semi-arid climate and the effects of temperature on evapotranspiration are quite extensive.

INTERPRETATION

The resistivity sounding data are interpreted with the help of two layer master curves and auxiliary points' charts. The results of interpretations are shown in table 1 and geological sections are drawn on the basis of resistivity sounding data (x&y) (Fig.2). The main features arising out of this resistivity investigation can be summarized as follows:-

Sounding Point	curve type	ρ_1 ohm.m	ρ_2 ohm.m	ρ_3 ohm.m	h_1 m	h_2 m
SP1	H	528	52	529	0.6	9.0
SP2	A	38	198	High	4.0	20.0
SP3	A	13	63	-	2.8	14.5
SP4	A	80	198	-	1.4	15.1
SP5	H	24	62	-	1.5	22.0
SP6	H	164	32	High	0.5	19.0
SP7	H	100	18	-	1.1	17.2
SP8	H	100	60	High	0.8	21.9
SP9	H	19	95	190	1.5	25.0
SP10	H	46	25	-	0.3	18.2
SP11	H	165	33	High	0.5	20.0

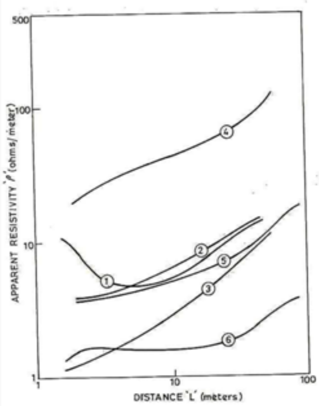

FIGURE . 2

These are three distinct layers having different resistivity's up to depth 100cm. The interpreted results show that to a large extent thickness of weathered zone and depth to the basement values are generally tallying with field observations and bore hole lithology. While highly weathered granite shows around 10 ohm metres for saturated conditions. Similarly the resistivity values for fractured zone show around 100 ohm metres for saturated conditions and for unsaturated fractured units greater than 120 ohm metres. In the case of Deccan basalts the values of resistivities are generally less than granites particularly if they are weathered comprising clay minerals.

CONCLUSIONS

The study reveals that the ground water table is found approximately at 10m depth. It is noted that the thickness of the weathered zone varies from 5-15m, while fractured zone extends even up to 90m. Another important finding is that the fracturing is found to be more with depth which contains sufficient resources of ground water in the southern central parts where there is a scarcity of water and it could be exploited at specific points from depth ranging from 20 to 40m. This will go a long way in avoiding the wrong locations of wells and adverse effects of their economy. This study further clearly demonstrates that not all the fractures are water bearing and some of the fractures like shear are purely water barren fractures.

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