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A Case Study on Chigicherla Watershed Using Geophysical Methods for Groundwater Investigation, Anantapur District, Andhra Pradesh, India

B. Ramanarasimha Rao	Research Scholar, Dept. of Geology S.V. University, Tirupati, A.P.
*** Dr. V. Gope Naik**	Assistant Professor, Dept. of Geology S.V. University, Tirupati, A.P. * Corresponding Author
K. Naresh kumar	Research Scholar, Dept. of Geology S.V. University, Tirupati, A.P.
R. Guru Bhaskar	Research Scholar, Dept. of Geology S.V. University, Tirupati, A.P.

ABSTRACT

This Paper gives a brief idea about the standard Wenner configuration method for surface geophysics applicable to ground-water investigations. It covers Vertical electrical sounding wave's method, the general physical principles underlying the method and its capabilities and limitations are de-scribed. Possibilities for non-uniqueness of interpretation of geophysical results are noted. Examples of actual use of the methods are given to illustrate logic environments. The objective of the ground water investigation is to provide the hydro geologist with a sufficient understanding of the capabilities, limitations, and relative cost of geo physical methods to make sound decisions. The paper also provides enough information for a hydro geologist to work with a geophysicist in designing geophysical surveys that differentiate in significant hydro-geologic times.

KEYWORDS

INTRODUCTION:

The Paper is a brief review of the standard Wenner configuration method of surface geophysical exploration and their application in ground-water investigations. It explains ground water investigation, the capabilities of exploration geophysics and, in a general way, the method of obtaining, processing, and interpreting geophysical data. A minimum of mathematics is employed, and the scope is limited to an elementary discussion of theory, a description of the methods, and examples of their applications. It is in no sense intended as a textbook on applied geophysics. Rather its aim is to provide the hydro geologist with a rudimentary under-standing of how surface geophysical measurements may be of help to him. Many of the standard methods of geophysical exploration are described, but those used most extensively in ground-water investigations are stressed. The rapidly developing techniques of geophysical exploration involving measurements in the micro-wave, infrared, and ultraviolet portions of the electromagnetic spectrum are not included. The application of these "remote sensors" to ground-water investigations is in an early stage of development and testing; thus, their eventual importance cannot be appraised at this time. Borehole geophysical techniques will not be discussed here except as they relate to surface or airborne surveys. In the discussions that follow each of the major geophysical methods will be briefly described with emphasis on the applications and limitations in ground-water investigations. A few examples of successful application of each method will be described.

STUDY AREA:

Chigicherla watershed area Anantapur District, Andhra Pradesh state longitude 77° 35 ′ 00″ to 77° 46 ′ 00″ latitude14 °30′ 00″ to 14 °35′ 00″ watershed area around 211 sq km. Five Mandls are covered namely Anantapur, Rapatadu, Kanaganipalle, Battalapalle and Dharmavaram. The Study area is mostly plain land and western part is covered with residual hills, Denudational hills and some pediments are there. Anantapur district area experiences semi-arid climate, the summer is very hot and the Mercury rises to + 42^0 Celsius. Winter is pleasant; night temperature is about 13^0 Celsius to 15^0 Celsius. Average rain fall per annum 550 mm in the year of 2013.

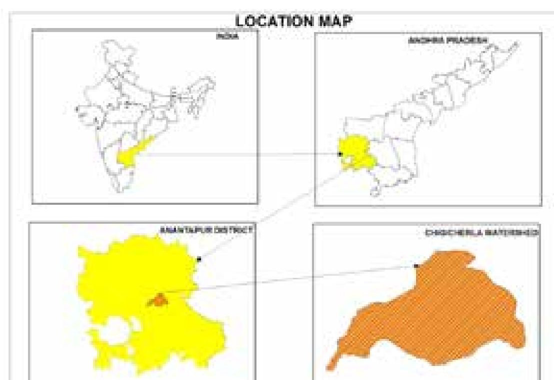

Fig: 1 Location Map of Chigicherla Watershed, Anantapur District, Andhra Pradesh

THE POROSITY:

The porosity is the ratio between the volumes of the pores and that of the rock. When dealing with saturated layers (under the water level, that is to say under the vadose zone where the pores are filled with air and with water), the water content is equal to the porosity.

Porosity = (volume of pores) / (volume of the rock)

Being a ratio, the porosity is expressed in %. The total porosity also includes the water located in clay, even if clay is impermeable. For the exploitation of water, it is important to determine the porosity of free water (water which can move), and hydro geologists speak of the **effective porosity** which is the ratio of the volume of the pores which are interconnected to the volume of the rock. As an order of magnitude, the effective porosity can be for instance 80% of the free water porosity. The porosity of a fissured rock can be a few percents, that

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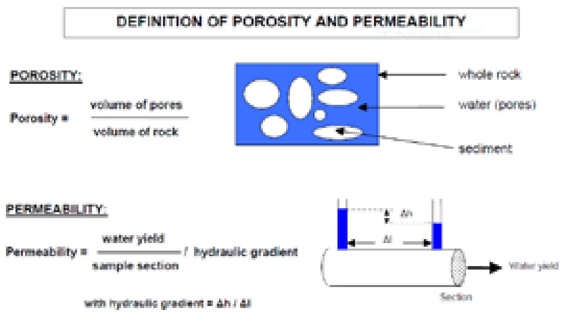
of a gravel or a sand of the order of 30 percents.

THE PERMEABILITY:
The permeability (which, as defined in the usual hydro geological language, is actually the hydraulic conductivity) is the ability of a material to let water current flow through it when a hydraulic pressure is applied, can be defined on a sample of rock by the Darcy law:

Permeability = (Yield / Section) / Pressure gradient

The yield being expressed in m^3/s, the sample section in m^2, and the pressure gradient (difference of water pressure / sample length) in m/m, the unit of permeability is m/s. If the porosity is almost zero the permeability is necessarily also very weak. But the porosity can be high, such as in the case of a clay layer, and the permeability very weak. The porosity and the permeability are not two parameters independent from each other: the permeability already includes the information of the porosity for determining the volume of water which can be extracted from the ground. **The permeability is linked not only to the volume of the available water, but also to the size of the pores:** for a given value of the porosity, large size pores lead to a higher permeability than small size pores, as the water flows more easily in the first case than in the second one. The permeability of a clay layer can be as low as 10^{10} m/s, of a weakly permeable layer 10^{6} m/s, of a highly permeable layer 10^{2} m/s



VERTICAL ELECTRICAL SOUNDING (VES)

METHODOLOGY:
Vertical Electrical Sound waves (VES) were conducted at number of places to know the lithology, depth to bed rock, depth to water table and the water quality in the Anantapur Mandal. The soundings that were done earlier by the author are made use of in the present study. Sounding surveys were carried out employing an expanding electrode system of Wenner configuration. The resistivity measurements were made using a D. C. Resistivity Meter manufactured by M/s Integrated Geo Instruments Services, Hyderabad. As the area under report has granitic basement a maximum electrode separation of 80 meters was kept.

The interpretation of the resistivity sounding data was done following the curve-matching method of Orellana and Mooney (1966). The procedure of interpretation is not documented as it is well known.

The granitic country reflects great changes in the aquifer conditions very rapidly from place to place. This helps in identifying the thickness of the weathered zone more precisely. Under such circumstances, in hard rock areas, the resistivity survey is found to be very powerful for obtaining a detailed sub-surface picture up to reasonable depths of interest.

Results of the study:
In granitic terrain, the weathered rock along with the fractured and jointed rock hosts the ground water. In fact the underlying fractured rock acts as an aquifer. The terrain under discussion is a plain country with well developed profile of weathered zone and is fractured due to the tectonism that it has suffered. Due to the said reasons, the infiltration capacity is more. Further there is good recharge from the Denudational hills of the area under study. The fracturing and good recharge qualifies this terrain suitable for the ground water exploration. However, the amount of rainfall is an important parameter in establishing areas of potential zones for exploration

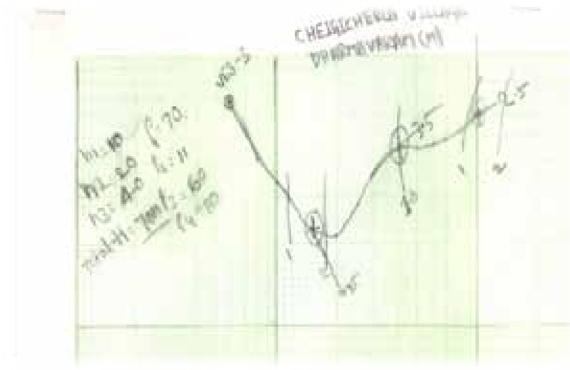


Fig: 2 Graph Of geophysical investigation, Chigicherla village, Anantapur District, A.P

Table.1 Results of the Vertical Electrical Soundings

AB/2	MN/2	K	Pa (V/I*K)
6	2	25.1	70
8	2	47.1	43
10	2	75.4	36
15	2	173.6	33
20	2	311.1	32
25	2	487.9	38
30	2	704.0	36
30	10	125.7	42
40	10	235.7	46
50	10	377.1	45
60	10	550.0	47
70	10	754.3	48
80	10	990.0	45
90	10	1257.1	39
100	10	1555.7	61

The resistivity sounding curves (a VS a) of the 57F/10 can be classified into two styles viz., the H-type (a three layered medium with a low resistivity layer sandwiched between the two high resistivity layers where, 1 > 2 > 3. The second, A-type (three layers with progressively increasing resistivities where, 1 < 2 < 3. The subsurface picture has been clearly brought by the study. The results of the Vertical Electrical Soundings are documented in the table .1. These results indicate a three layered structure with the layers possessing different resistivities and thickness. The top layer is a very thin and fairly high resistive layer corresponding to the soil cover. This is underlain by another layer whose resistivity and thickness vary from place to place. The resistivity of this layer grades from 6.5 to 162 ohm/ meter and the thickness changes from 1.4m to 28.5m. This layer corresponds to the weathered and fractured zone ("grus"). It is this layer that helps in tapping the ground water. The less fractured and UN weathered hard granitic basement extending to a great depth underlies the second layer. This layer of hard granitic basement reflects as a high resistive layer (thousands of ohm-meter) in the results of the investigation. This information is presented in the form of a chigicherla log (Fig. 3) for better understanding.

Iso-Resistivity: This iso-resistivity (Fig.1) has helped in understanding the general pattern of the resistivity of the study area that in turn helped in identifying the potential zones.

Depth to bed rock / Depth to water level:
Based on the data culled out from the monitoring wells of CGWB and from the piezometers established by State Ground Water Board, the depths to water levels have been studied in respect of the topographical map, 57F/10 of the Anantapur District, Dharmavaram mandal. This study has been done in the Pre-monsoon period. According to the information, the depth grades from 6 meters to 18 meters below ground level. This has been verified with the data published by the Central Ground Water Board. There is a general agreement in comparison.

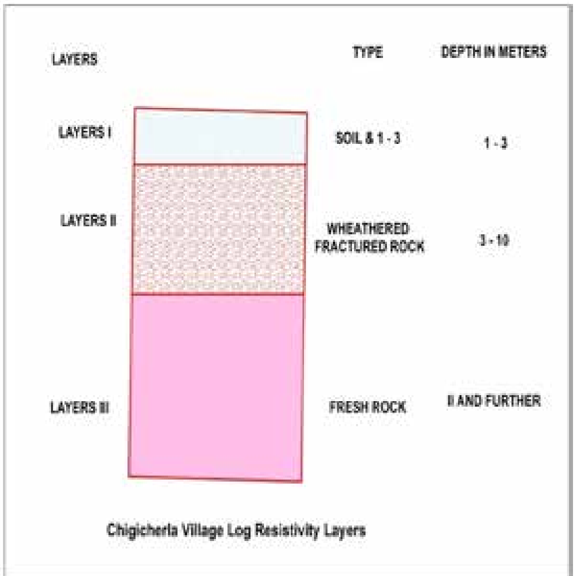


Fig:2 Chigicherla Village Log Resistivity layers

Conclusions and Recommendations:
Groundwater is a limited source so careful use of groundwater needs to be done with a suitable planning.

Geophysical investigation was carried out in Chigicherla watershed, Chigicherla village, Dharmavaram Mandal, Anantapur District, Andhra Pradesh. The resistivity sounding curves (VES) of the 57F/10 have given the H-type curve (a three layered medium with a low resistivity layer sandwiched between the two high resistivity layers) which suggests a ground water bearing/potential zone. The upper section is composed of peninsular gneissic complex, which can be called as PGC. Of the total depth of investigation, it was found that in the depth range 1-3 m, soil and fractured rock is covered, in 3-10m depth range fracture rock is covered and for 10m and above fresh rock is covering. The second section which has the ground water bearing formation, the resistivity range is "40m". The derived curve has shown that this zone is falling in the depth range "70m". This interpretation is showing that the wenner geophysical method is very useful for the ground water investigators and users. Farmers are more advantageous to use the ground water with less expenditure. This method can also be used in agriculture, industries, domestic and many research fields.

Reference:

1. **APSRAC (A.P. State Remote Sensing Applications Centre) 1997.** Integrated Study to Combat Drought, Anantapur District, Andhra Pradesh, Project Report, 102p.
2. **Eswar reddy.G., (2011).** Integrated hydro geological studies of ground water using spatial technology, in parts of anantapur district, A.P, India. Unpublished Ph.D. Thesis, S.V.University,Tirupati.
3. **Raghava Rao, K.V., (1974b).** Groundwater Resources in Rayalaseema, Seminar on Natural in Rayalaseema, Kurnool
4. **Subramanyam, V., (1953).** Report on the investigations of Groundwater supply in some parts of the Chandragiri, Palamaner, and Ttirupati Taluk, Chittoor District, Unpublished Report. Geol. Survey. India, Calcutta.
5. **Sudheer, A.S., (1986).** Hydrogeology of the upper Araniar river basin, Chittoor District, Andhra Pradesh, India, Unpublished Ph.D., Thesis, S.V.University, Tirupati, P.151-207.
6. **Srinivasulu. J., (2004**). Geomorphic Evolution and its Reflection on the Ground Water Evolution of Chandragiri Valley in Chittoor District, A.P. India. By Using Remote Sensing Data and GIS.Unpublished Ph.D. Thesis, S.V.University.
7. **Todd, D.K., (1959).** Groundwater Hydrology: Jhon Wiley & Sons, New York.
8. **Walton, W.C., (1970).** Groundwater resource Evaluation: McGraw – Hill Book Company, New York, 664 P.
9. **Wilcox, L.V., (1948).** The quality of Ground water for irrigation use: U.S. Dept. Agric. Tech. Bull. 962, Washington, O.C., P. 40.
10. **Whiteside, D.V., (1971).** Yields and specific capacities of bed rock wells in Kentucky: Geological of survey. Information Circ. 21, 18 P.

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