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# Delineation of Groundwater Prospective Zones by Schlumberger electrode array in Bangriposi block of Odisha

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## Abstract

*Geo resistivity of sounding of Bangriposi block was conducted to delineating the groundwater feasibility and selection of site for installation of bore wells.The reason for choosing this area is due to the poor and backward inhabitants residing in the locality. 2D resistivity imaging technique was utilized. The 2-D resistivity imaging technique utilized the Schlumberger electrode array configuration because this array is moderately sensitive to both horizontal and vertical structures. Eighteen (18) Vertical electrical resistivity soundings were acquired with Geo Resistivity Meter in Schlumberger configuration. The electrode spacing AB/2 was varied from 1.5 to maximum spread length of 100 m. The interpretation of resistivity curve is done by JESIX software. Four distinct subsurface geologic layers were identified, aided by borehole lithological logs. These include; the topsoil, Over burden, Weathered and Fractured layer.The top soil layer of variable nature has resistivity value between 16to464 ohm.mt, whose thickness is ranging from 1 to 2.5 m.Over burden zone containing sandy soil and lateritic soil with resistivity value ranging from 78 to 250 ohm.mt whose thickness is 3.1 to ∞ .After investigation we find that all points are suitable for Bore well. Most of the feasible sites are fractured granite. Rock type of study area are Granite, Quartzite and Granite gness. Taking in view of VES interpretation and Strata of Exploration drilling, the Bangriposi block is consider for feasibility of Bore Wells.*

**Keywords:** VES, Schlumberger configuration, apparent resistivity, Aquifer.

## Introduction

Geo physics is the best technique for the study of earth. Geophysical study of the earth involves taking measurement at or near the earth's surface that are influence by the internal distribution of physical properties. Geophysical methods would be extremely useful to assess and monitor geotechnical properties and then cheaper to perform than drilling many sampling wells. VES is also very useful in determining risk assessment of aquifers. In this technique the two dimensional (2D) resistivity data generated using multi electrodes which resulted in high density pseudo-sections with dense sampling of apparent resistivity measurements at shallow depth ranging from surface to a depth of 200 m.

The total two parent of the world's fresh water is distributed spatially and temporarily in an irregular manner while the groundwater eight to ninety-parent of the world's reasonably constant supply, which is not likely to dry up under natural conditions in crust to the surface sources. Groundwater development therefore constitutes a practicable choice, where potential groundwater is good. In the Indian context, the situation becomes more precarious due to negligible primary porosity and low permeability of host rocks restricting groundwater storage as well as movement. Further, low rainfall, high evaporation and run-off limit recharge to the groundwater systems[1]. The feasibility of using the geo-electric method to determine resistivity, depth and thickness of the model earth layers, estimation of the number of smooth and equivalence layers corresponding to the number of model earth layers (stratigraphic correlation)[2]. Geophysical investigations of the subsurface strata can be made either from the land surface or in adrilled hole in the formation. The surface methods include electrical resistivity, seismic refraction and reflection, soil temperature, magnetometer, gravity, remote sensing etc.[3]. Among these methods, the electrical resistivity method is widely used for groundwater potential identification has been applied most widely in groundwater exploration studies4and5.

Bangriposi in Mayurbhanj district of Odisha lies in hard rock terrain. Groundwater is available only in weathered and fractured zones. In this area assured surface water supplies are nominal and most of the farmers depend on groundwater for drinking and irrigation purposes. Average annual rainfall is around 1022 mm which is mostly lostas surface runoff and evaporation. The age of formation of rock in this area is Archain and rock type is Meta sediment.

**Study area:** The present study area is situated in the Baangriposi block of Mayurbhanj district. The area lying between the parallels Latitude 22º16' N North and Longitudes 86º16'E - 86º40' E East. The study area comprises of fivevillages namely Darkantia, Bhadrasul, Sarasposi, Dhabanisul, Ronasul coming under Mayurbhanj district of Odisha State. The study area falls into consolidated formations derived from granite gneisses. Ground water is restricted to Fractured Granite Gneiss and Weathered Granite Gneiss.

Cultivation is the major activity in this area, monsoon water is not sufficient to fulfil the requirement for both domestic and economical purposes. As the ground storage water is only the ultimate source for all requirements. In this context of more dependent on groundwater, as well as open wells are deepened and creation of deep bore wells are constructed for irrigational purposes.

## Methodology

Eighteen (18) Schlumberger vertical electrical resistivity soundings were acquired at selected location. The Schumberger array used, with maximum current electrode separation of 1.5m to100m. Electrodes are normally arranged along a straight line, with the potential electrode placed in AB/2<= 5MN/2 between the current electrodes. This configuration is mostly used as it would provide subsurface information considering the depth of penetration.

After noting ΔV and ΔI the apparent resistivity is calculated by the fundamental equation for resistivity survey is derived from Ohm's low the voltage applied across the conductor is directly proposal to the current flowing through it.

That is V α I
V=RI (R=Constant and Resistivity)
R= V/I

Where, V - voltage across the conductor
I - current flowing through the conductor
R - Resistance

According to Ohm's law and from the primary data, the mathematical process is as follows:-
Resistivity of the soil (R) =K.V / I
K=constant (ohm's constant)
V= voltage across the conductor
I = current in ampere.

The results are put in log-log graph and the resultant curve is interpreted through master curve of Schumberger method and the interpretation results are calculated.

## Result and Discussion

Resistivity soundings in this area clearly identified the nature of the lithological depths and proved useful at identifying water-bearing zones[6]. After interpreted resistivity data and value, of the study area is found to be changes due to the sub surface strata variation. There resistivity value and layer thickness of the study area is given in the table. It is observed that most of the locations have four layer curves, whereas 3 layer curves are noticed in location 2.The top soil layer of variable nature has resistivity value between 16 to 464 ohm.m whose thickness is ranging from 1 to 2.5 m. The weathered layer in identified with resistivity value ranging from 78 to 250ohm.m whose thickness is 3.1 to ∞. After investigation we find that all the points are suitable for bore well. Most of the feasible sites are fractured granite gneiss, Weathered Granite Gneiss and hard Granite.

**Table-1**
**Interpretation of Lithology as per their respective resistivity values**

| Ves No | Apparent resistivity in ohm-mt. | Thickness in mt. | Probable Litho logy | Remarks |
|---|---|---|---|---|
| 1 | 113.5 | 1.0 | Top soil | Aquifer Zone |
| | 21.0 | 5.3 | Clay | |
| | 19.0 | 7.6 | Clay | |
| | 186.9 | inf | Fractured granite gneiss | |
| 2 | 133.1 | 2.4 | Top soil | Aquifer Zone |
| | 18.3 | 13.7 | Clay | |
| | 165.5 | inf | Fractured Granite Gneiss | |
| 3 | 464.2 | 1.3 | Top soil | Aquifer Zone |
| | 82.9 | 6.4 | Clay | |
| | 33.2 | 13.7 | Clay | |
| | 190.6 | infinite | Fractured granite gneiss | |
| 4 | 104.5 | 2.1 | Top soil | Less Discharge Aquifer Zone |
| | 19.4 | 3.2 | Clay | |
| | 22.4 | 4.1 | Sandy Clay | |
| | 392.2 | Infinite | Hard granite gneiss | |
| 5 | 417.0 | 1.50 | Top soil | Aquifer Zone Aquifer Zone |
| | 104.3 | 7.0 | Sandy Clay | |
| | 223.1 | 26.1 | Fractured granite gneiss | |

| | | | | |
|---|---|---|---|---|
| | 78.1 | infinite | Highly Weathered Granite Gneiss | |
| 6 | 446.1 | 1.1 | Top soil | Aquifer Zone |
| | 45.1 | 11.0 | Clay | |
| | 33.2 | 11.3 | Sandy Clay | |
| | 209.3 | infinite | Fractured granite gneiss | |
| 7 | 464.2 | 1.3 | Top soil | Aquifer Zone |
| | 82.9 | 6.4 | Clay | |
| | 33.2 | 13.7 | Clay | |
| | 190.6 | infinite | Fractured granite gneiss | |
| 8 | 464.2 | 1.3 | Top soil | Aquifer Zone |
| | 82.9 | 6.4 | Clay | |
| | 33.2 | 13.7 | Clay | |
| | 190.6 | infinite | Fractured granite gneiss | |
| 9 | 98.6 | 1.3 | Top soil | Aquifer Zone |
| | 16.7 | 1.5 | Lateritic soil | |
| | 33.9 | 3.1 | Sandy Clay | |
| | 236.0 | infinite | Fractured granite gneiss | |
| 10 | 145.2 | 1.4 | Top soil | Aquifer Zone |
| | 77.4 | 6.6 | Lateritic Soil | |
| | 33.9 | 16.0 | Clay | |
| | 147.4 | infinite | Fractured Granite Gneiss | |
| 11 | 417.0 | 1.50 | Top soil | |
| | 104.3 | 7.0 | Sandy Clay | Aquifer Zone |
| | 223.1 | 26.1 | Fractured granite gneiss | Aquifer Zone |
| | 78.1 | infinite | Highly Weathered Granite Gneiss | |
| 12 | 113.5 | 1.0 | Top soil | Aquifer Zone |
| | 21.0 | 5.3 | Sandy Clay | |
| | 19.0 | 7.6 | Clay | |
| | 186.9 | infinite | Fractured granite gneiss | |
| 13 | 133.1 | 2.4 | Top soil | Aquifer Zone |
| | 18.3 | 13.7 | Clay | |
| | 165.5 | infinite | Fractured Granite Gneiss | |
| 14 | 16.5 | 1.6 | Top soil | Aquifer Zone |
| | 36.8 | 3.8 | Clay | |
| | 50.3 | 6.4 | Sandy Clay | |
| | 245.5 | infinite | Fractured Granite Gneiss | |
| 15 | 270.6 | 1.2 | Top soil | Aquifer Zone |
| | 45.4 | 5.5 | Lateritic Soil | |
| | 23.3 | 9.7 | Clay | |
| | 250.8 | infinite | Fractured Granite Gneiss | |
| 16 | 95.8 | 1.9 | Top soil | Aquifer Zone |
| | 26.5 | 5.6 | Sandy Soil | |
| | 11.0 | 10.7 | Clay | |
| | 206.2 | infinite | Fractured Granite Gneiss | |
| 17 | 145.8 | 1.1 | Top soil | Aquifer Zone |
| | 24.0 | 3.8 | Sandy clay | |
| | 26.7 | 7.5 | Clay | |
| | 185.2 | infinite | Fractured Granite Gneiss | |
| 18 | 130.2 | 2.3 | Top soil | Aquifer Zone |
| | 25.6 | 3.2 | Clay | |
| | 36.8 | 4.2 | Sandy Clay | |
| | 160.4 | infinite | Fractured granite gneiss | |

## Conclusion

There are four geo electric layers were delineated within the study area. These include; the topsoil, clay, weathered granite, fractured granite gneiss. Interpretation of the VES tests indicates the presence of an alluvial aquifer that mainly consists of fractured granite gneiss/Weathered Granite Gneiss, with intermediate resistivity range between 78 to 250Ω m, The groundwater prospects are less in hard rock areas, especially in granitic terrains. The interpretation of resistivity curve is done by JESIX software. Four distinct subsurface geologic layers were identified, aided by borehole litho logical logs. These include; the topsoil, over burden, weathered and fractured layer. The top soil layer of variable nature has resistivity value between 16 to 464 ohm.mt, whose thickness is ranging from 1 to 2.5m. Over burden zone containing sandy soil and lateritic soil with resistivity value ranging from 78 to 250 ohm.mt whose thickness is 3.1 to ∞. After investigation we find that all points are suitable for Bore well. Most of the feasible sites are Fractured granite. Rock type of study area are Granite, Quartzite and Granite gness. Taking in view of VES interpretation and strata of exploration drilling, the Bangriposi block is consider for feasibility of Bore Wells.

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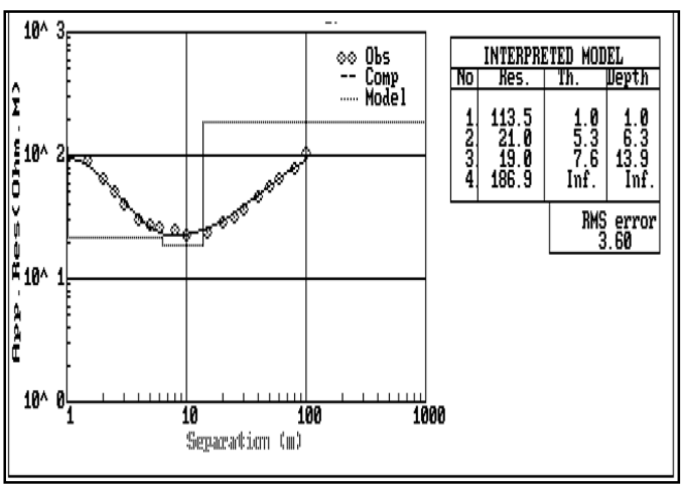


**Figure1**
**Geo resistivity curve of location 1**

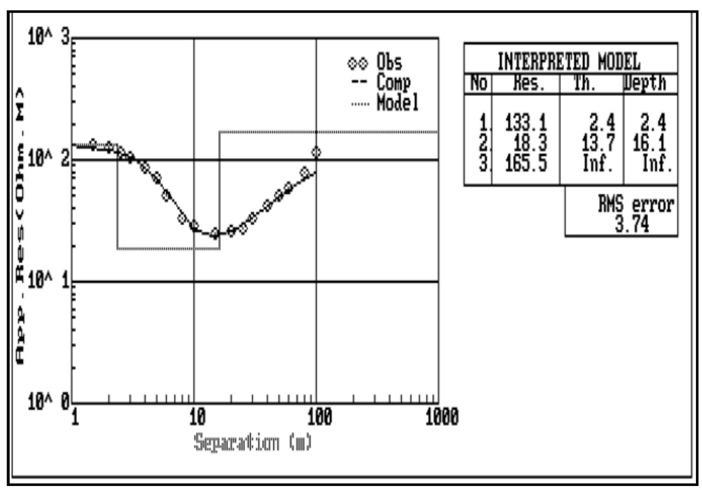


**Figure-2**
**Geo resistivity curve of location 2**

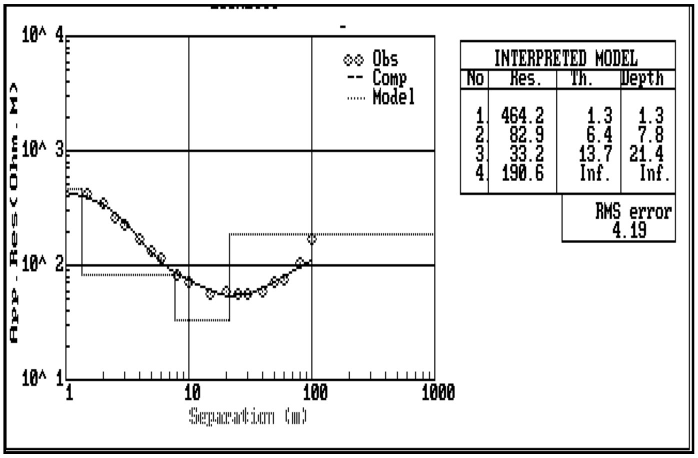


**Figure-3**
**Geo resistivity curve of location 3**

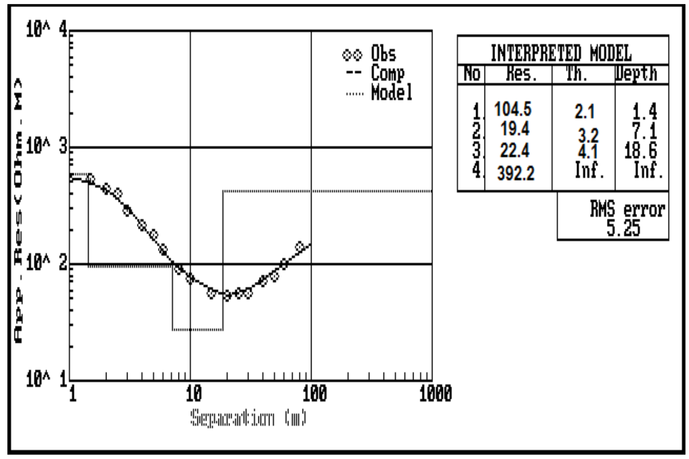


**Figure-4**
**Geo resistivity curve of location 4**

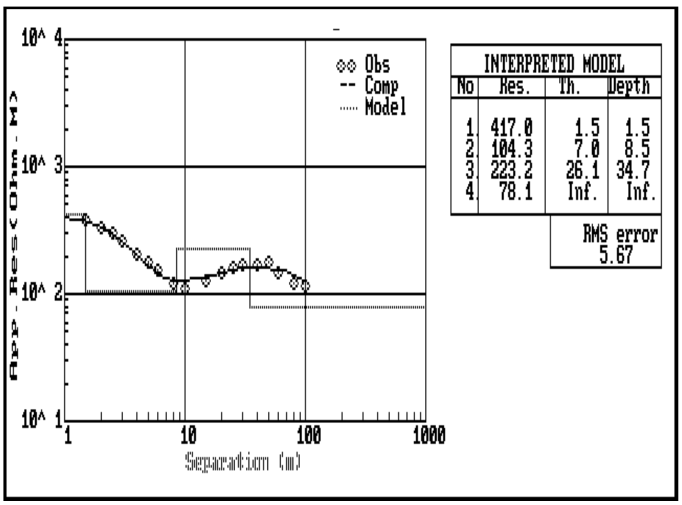


**Figure-5**
**Geo resistivity curve of location 5**

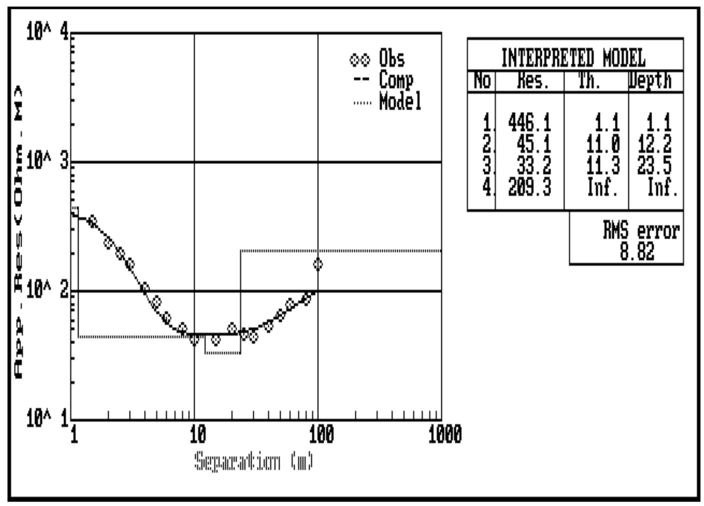


**Figure-6**
**Geo resistivity curve of location 6**

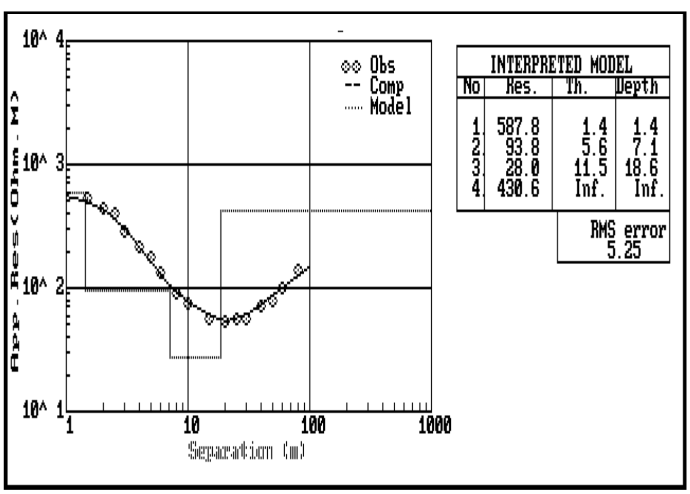


**Figure-7**
**Geo resistivity curve of location 7**

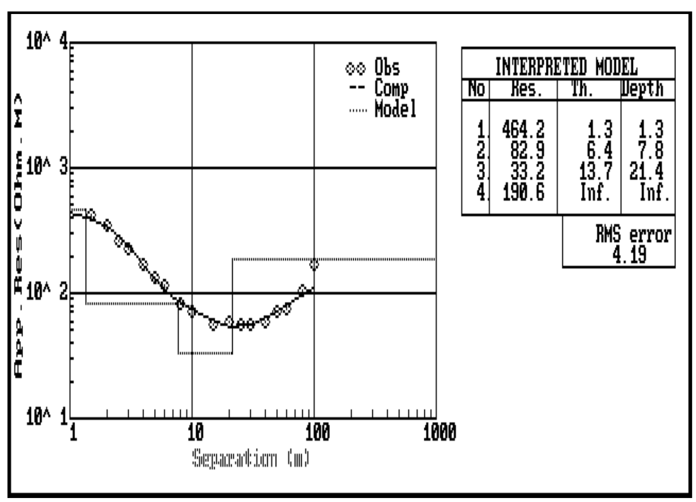


**Figure-8**
**Geo resistivity curve of location 8**

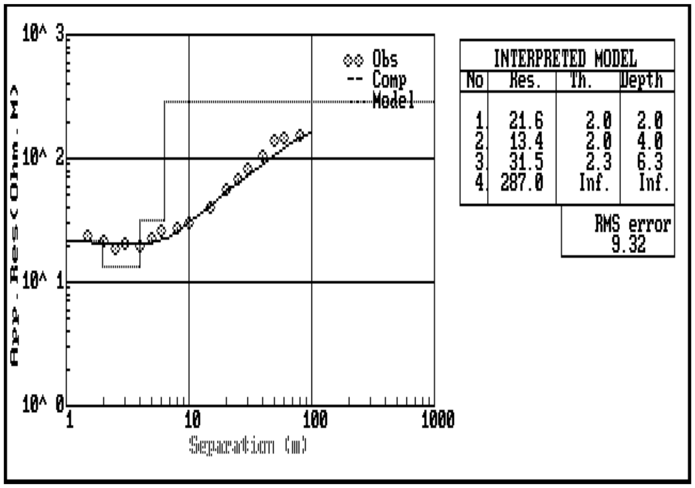


**Figure-9**
**Geo resistivity curve of location 9**

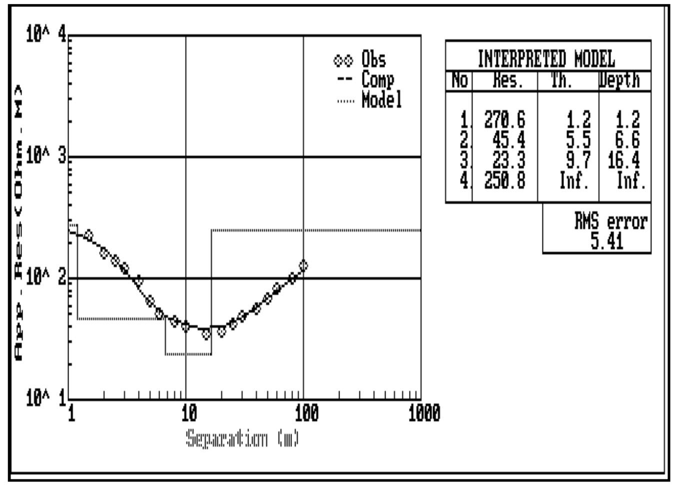


**Figure-10**
**Geo resistivity curve of location 10**

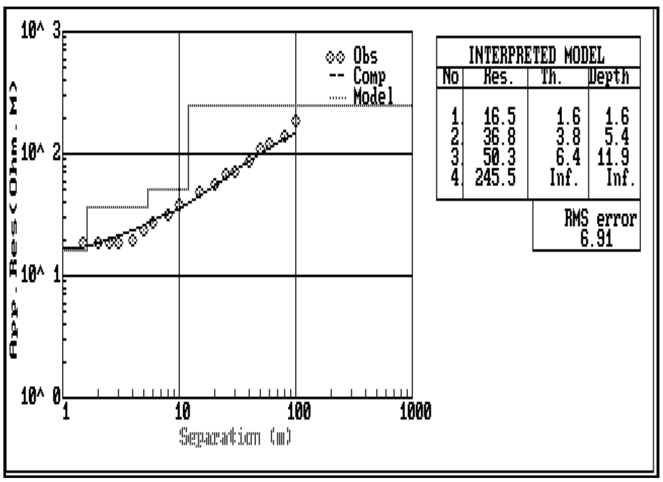


**Figure-11**
**Geo resistivity curve of location 11**

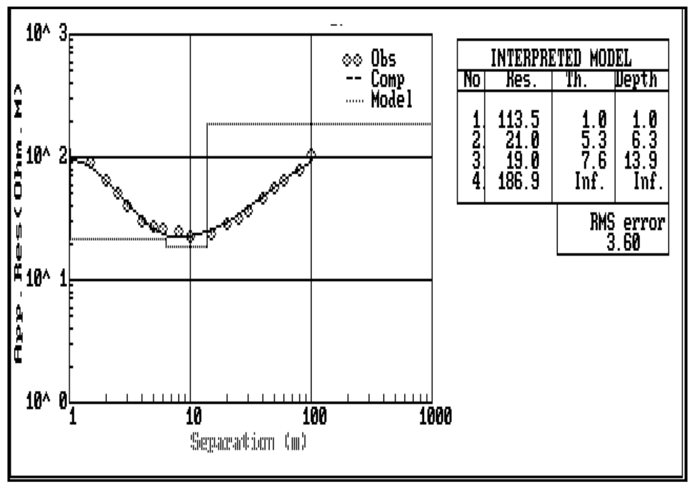


**Figure-12**
**Geo resistivity curve of location 12**

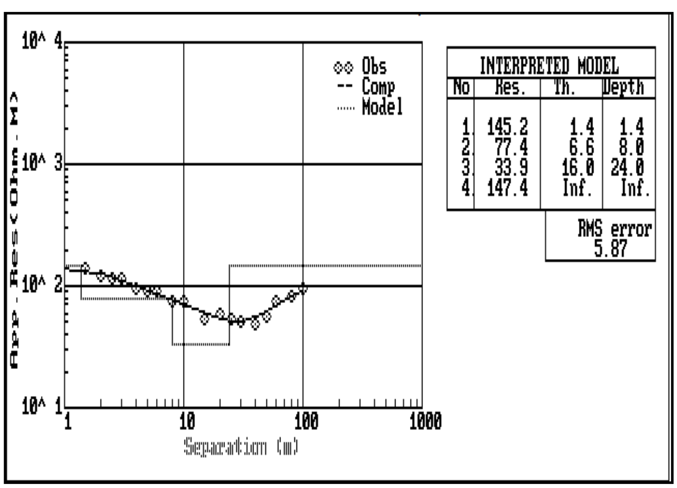


**Figure-12**
**Geo resistivity curve of location 13**

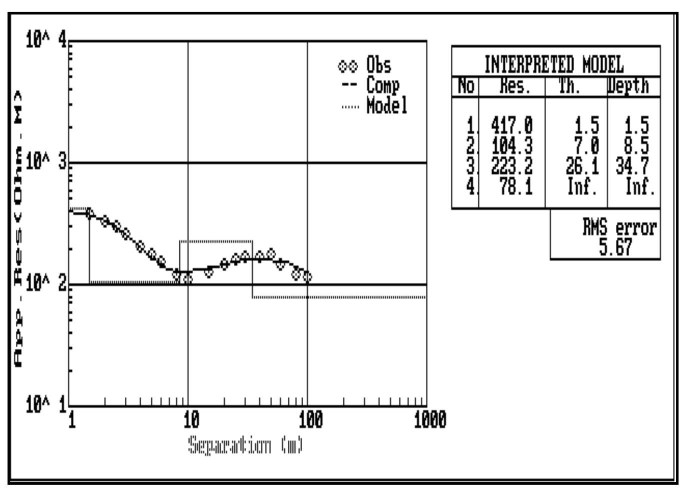


**Figure-13**
**Geo resistivity curve of location 14**

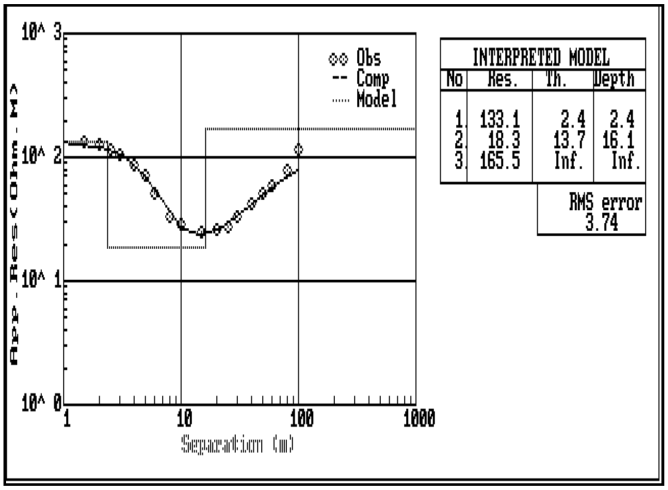


**Figure-14**
**Geo resistivity curve of location 15**

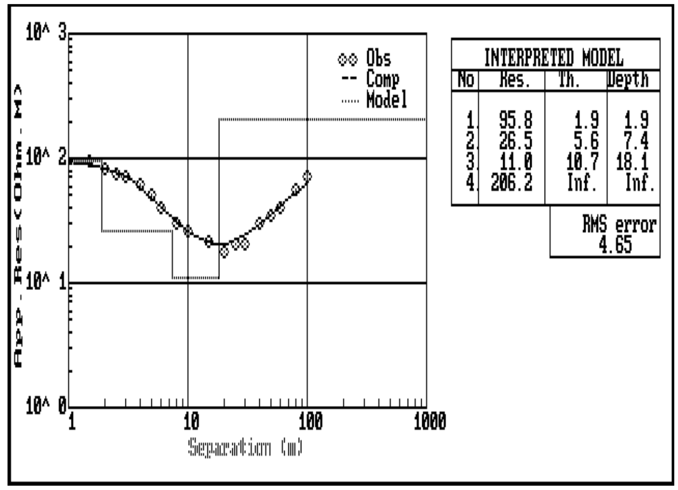


**Figure-15**
**Geo resistivity curve of location 16**

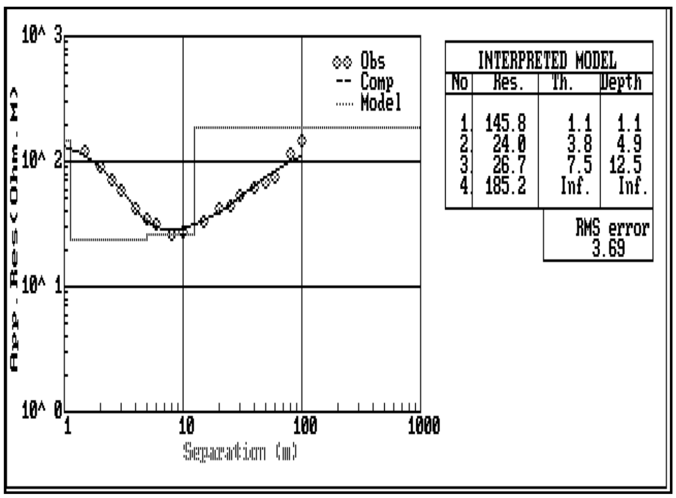


**Figure-16**
**Geo resistivity curve of location 17**

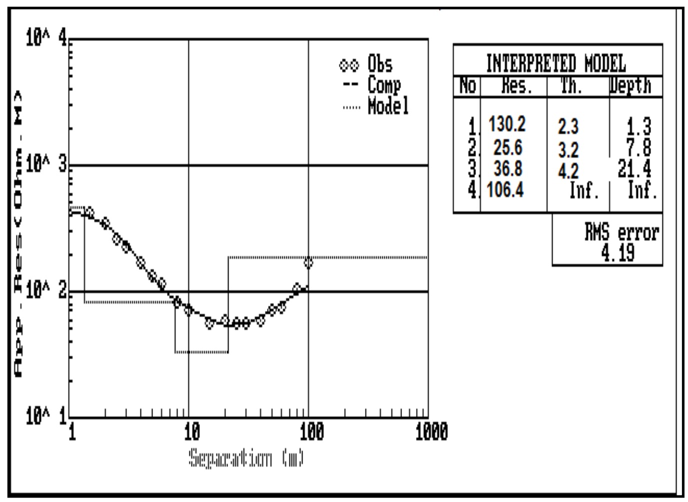


**Figure-18**
**Geo resistivity curve of location 18**

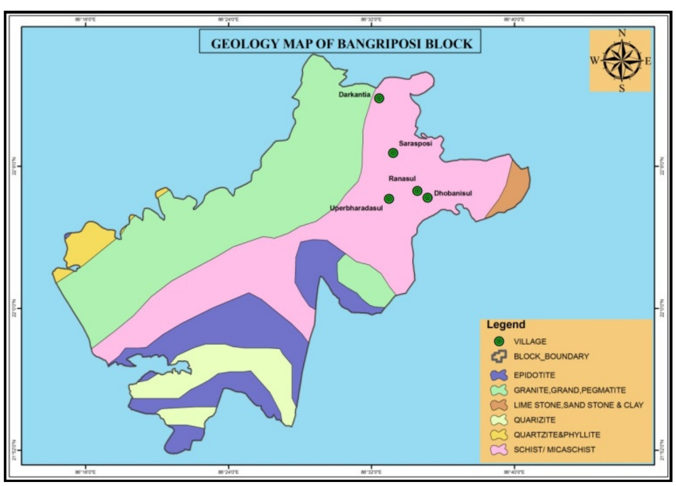


**Figure-19**
**Location map of Study area**

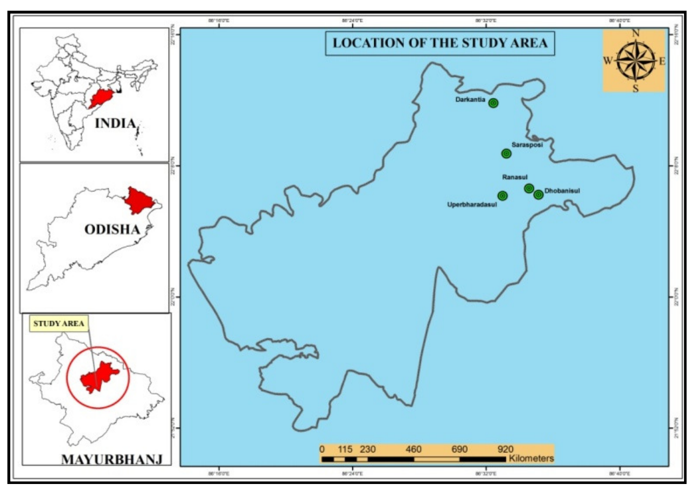


**Figure-20**
**Geology map of Study area**