A CASE STUDY OF SHALLOW EXPLORATION OF GRANITE MINING STUDY USING 2D ERI IN VALLANADU HILLS, SRIVAIKUNDAM, THOOTHUKUDI,INDIA

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ABSTRACT

The present study is an attempt to understand the application of 2D Electrical Resistivity Imaging (ERI) in granite exposure at Near Vallanadu Hills, Srivaikundam, Thoothukudi District, Tamilnadu. The 2D ERI to map the hard and compact granite bodies from the overburden material in the study area. The delineation of higher resistivity contrast with the low resistivity values of the weathered overburden was done to locate a suitable site for mining of granite at Study area. The surveys were carried out using CRM resistivity meter, multicore cable, multi electrodes with wenner array used. The collected resistivity data were interpreted using by Res2DINV original software. The apparent reistivity value of the pseudosection is used for the interpretation of the granite survey. The range of apparent resistivity range from 5-60 Ohm.m is indicate weathered zone and the high quality of granite is occurring from 170-600 ohm.m in the Near Vallanadu hills.

Key words: Granite, Resistivity, 2D, ERI,Thoothukudi.

INTRODUCTION

The study area having a exposure of gray granite near Vallanadu Hills (Fig. 1). Granite is a common widely occurring type of intrusive, felsic, igneous rock. The man annual temperature of the district is 28.30C. Mean annual precipitation in 675.71 mm. Major rainfall is received during the northeast monsoon period, the maximum rainfall is received during November. Quartzites are exposed in the areas of Vallanadu, Ottapidaram, Kovilpatti and Pudukottai as hillocks. The general trend of the hills are NWW – SSE direction. The maximum elevation of the hills at Ottapidaram and Vallanadu are 28m and 314m respectively. The major soil types of Thoothukudi district are given below, they are, Black cotton soil ,Shallow red soil, Deep red soil , Pink granite, Quartzite, charnockite, calc-granulite, peninsular gneiss.

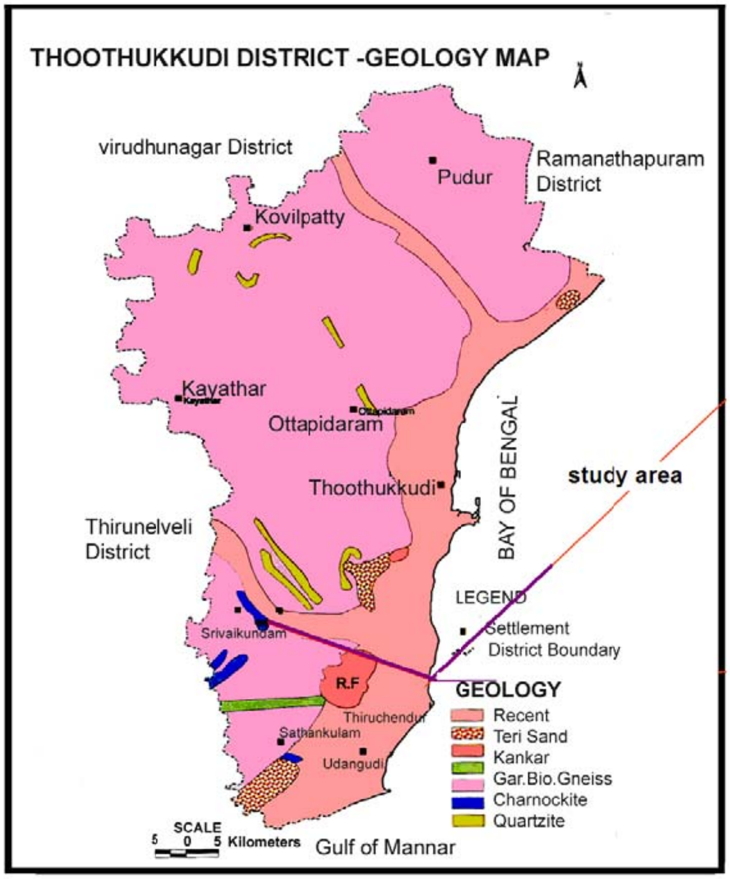

Figure.1 The Geological Map of the study area.

The study area granite setup and geology:

The study area is geological quartzite, biotite, and feldspathic, garnet rich granitic terrain. The Strike of the study area N20ºW and dipping 70ºE, mostly of the places grain of quartz lineation in the NS orientation. The trend line of the orientation of the rock is associated with Near Vallanadu Granite hills. The igneous intrusions are represented by veins and bands of grey granites, pink granites and pegmatites and also pipes and bands of basic intrusives now represented by basic granulites. The charnockite and banded gneissic rocks reported in this area were formed by the process of migmatization (Narayanasamy and Lakshmi, 1967; Verma et. al., 1980; Hansen et. al., 1987; Chiba and Kumada, 1994; Janardhan, 1999b; Mostafa et. al., 2003). Katsube and Hume, 1987; Nishimaki et. al., 1999 and Suzuki, 2002 studied the relationship of resistivity and charnockite rock. The increase and decrease of resistivity relationship of permeability in the granites rock was studied by Matsui et. al., 1997. Beauvais A, Ritz M, Parisot JC, Bantsimba C (2003). , Beauvais A etal, (2004),Beauvais A, et al (2007) Beauvais A, et al (1999). Braun JJ, et al (2009). Ritz M, et al (1999). Roqué C, et al (2012).

Figure.2 shows the 2D ERI field survey were carried in the Granitic terrain.

METHODOLOGY

The distribution pattern of the apparent resistivity values obtained from the 2D electrical resistivity imaging study can be used to delineate of weathering profiles, which in turn will be used to map different grades of weathered rock mass. Based on the above statements it can be specifically concluded that electrical resistivity model can be used in getting more reliable information about the subsurface weathered profile from unweathered granite bed rocks. The 2D electrical resistivity imaging techniques are carried out to investigate the subsurface structure of the thick lateritic weathered mantle overlie at the granite bedrocks in Srivaikundam. Aquameter CRM 500, 48 steel electrodes, 12 Volts battery, multi core cables to a length of 240m and operated switching unit have been used for the data collection. Wenner electrode configuration has been used for 2D electrical resistivity imaging studies. The preparation of the pseudosection and data interpretation was carried out using RES2DINV Ver.3.56 software. The apparent resisitivity measured was used to construct the pseudo section of the subsurface. The apparent resistivity distribution pattern of the psedosection constructing from the 2D electrical resistivity imaging survey of the subsurface delineated the weathered layer from the hard rock granite.The weathered layer generally exhibits a low resistivity than the hard and compact rocks (Loke, 2004). By this resistivity contrast, the delineation of weathered profile can be easily made. The weathered rocks are developed on many kinds of parent rocks by different weathering process. The 2D electrical resistivity imaging surveys were conducted at the location (Fig. 1), where the geology of the area is known from the outcrops and the mine sections help to compare with the resistivity distribution with the weathered profiles and the hard rock terrain. Four 2D electrical resistivity imaging surveys to the length of 80 m with the electrode spacing of 3, 6, 9, 12 and 15m were carried out in and around the granite mine. To the study 2D ERI technique the fault zone, crystalline Granite and weathered soil were studied. The 2D ERI technique is a fast and cost effective technique, which covers both perpendicular and straight changes in the subsurface resistivity Barker R.D., '1989' and Barker, R.D., 1990. This 2D technique is also applied for characterization of shallow subsurface studies by Griffiths D.H. and (Barker R.D.,1993); (Dahlin,T. and Loke, M.H.,1998), (Loke, 2000), (Antony Ravindran,2011, Antony ravindran et al 2012),. The Granite and karst topographys was studied by Olayinka, 2008, (Orowe.M. O et al 2008), (Oroware. A. I. and Barker, 1Abdallah S. Al-Zoubi, 2007 et al), Zhou et al 2000 and 2002. (Figure.2)

DISCUSSION AND CONCLUSION

The profile 1 (Figure.3.1) trends E-W direction to a length of 150 m. The inversion displays the ranges by resistivity values from 3.5 Ohm.m to 16 Ohm.m indicating that weather Soil or overburden material up to a depth of 3.10m. The intermediate second layer exhibits resistivity values that ranges from 34ohm.m to 159ohm.m represents the sheet like granitic rock. The high resistively zone of pseudo section with range of resistivity 159-731ohm.m from a depth 5.41-10.71m indicate folded granitic rock mass.

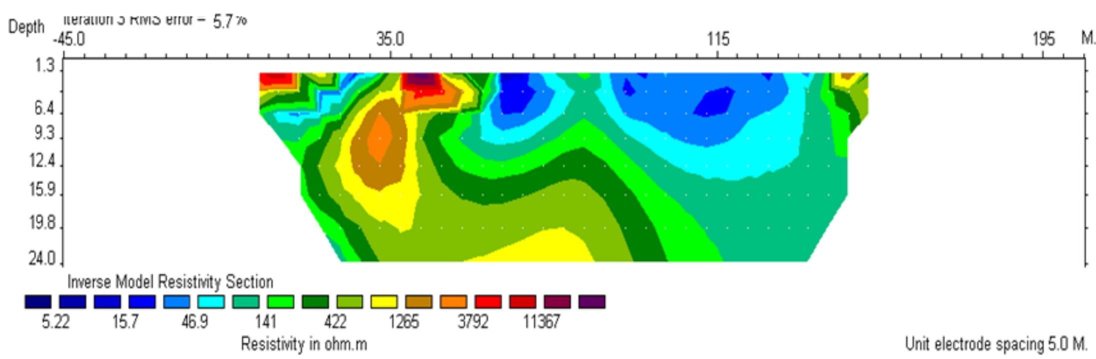

Figure.3.1 2D electrical resistivity imaging pseudosection along profile 1 shows the hard granite rock and overburden rocks at Near Vallanadu, Thoothukudi District, Tamilnadu.

The profile 2 (Figure.3.2) trends E-W direction to a length of 150m. The inversion displays the ranges by resistivity values from 3.5 Ohm.m to 16 Ohm.m indicating at weathered Soil or overburden material up to a depth of 1.10m. The intermediate second layer exhibits resistivity values that ranges from 34ohm.m to 159ohm.m represents the sheet like granitic rock. The high resistively zone of pseudo section with range of resistivity 202-659 ohm.m from a depth 5.41-10.71m indicate folded granitic rock mass.

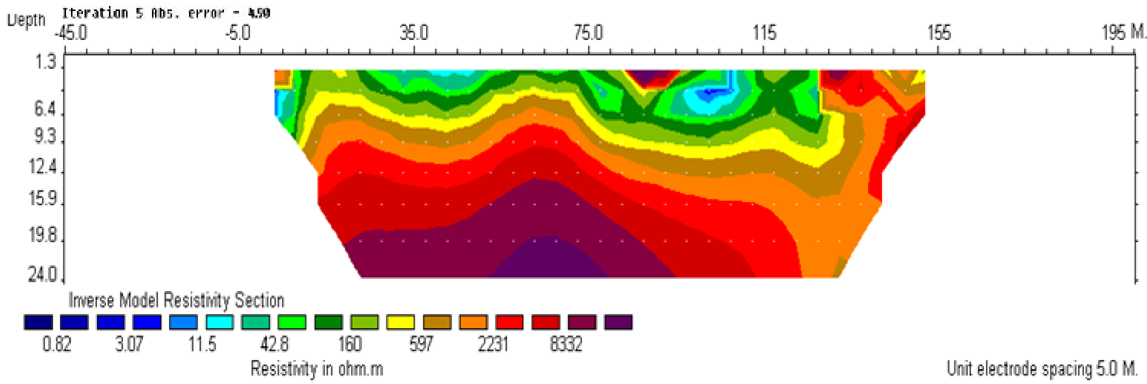

Figure.3.2 2D electrical resistivity imaging pseudosection along profile 2 shows the hard granite rock and overburden rocks at Near Vallanadu, Thoothukudi District, Tamilnadu.

The profile 3 (Figure.3.3) trends E-W direction to a length of 150 m. The inversion displays the ranges by resistivity values from 3.1 Ohm.m to 16 Ohm.m indicating that overburden material up to a depth of 1.10m. The intermediate second layer exhibits resistivity values that ranges from 34ohm.m to 159ohm.m represents the sheet like granitic rock. The high resistively zone of pseudo section with range of resistivity 202-659 ohm.m from a depth 5.41-10.71m indicate folded granitic rock mass.

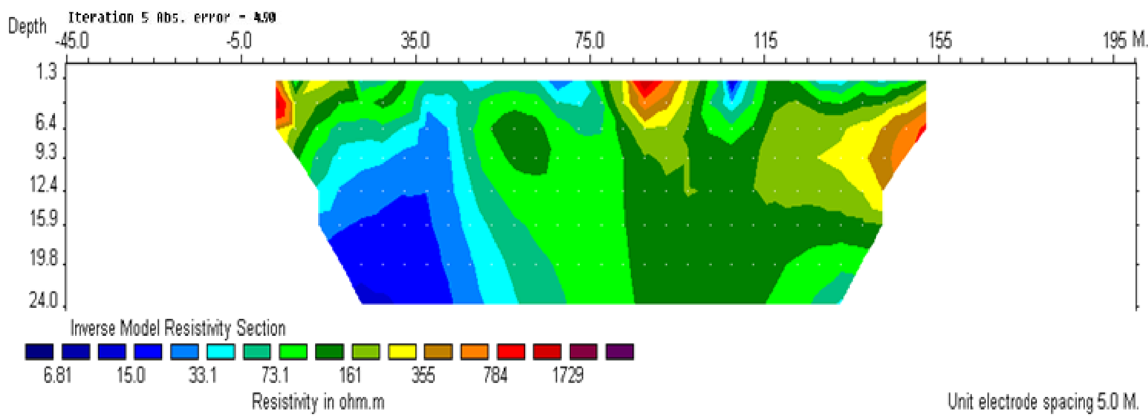

Figure. 3.3 2D electrical resistivity imaging pseudosection along profile 3 shows the hard granite rock and overburden rocks at Near Vallandu, Thoothukudi District, Tamilnadu.

Conclusion

The 2D Electrical Resistivity Imaging case study was explain the geological and subsurface condition of the granite, weathered zones and partially weathered zone identified in near Vallanadu. The highly weathered zone is demarcated with the range of resistivity from 31.4 to 84 Ohm.m. The intermediate zone with water table is identified with the range of resistivity value from 84 to 136 Ohm.m at a depth of 5.6 m. The granite rock zone is demarcated with the range of resistivity values from 366 to 978 Ohm.m. The pseudosection shows the undulation of the granites structure at various levels. The 2D Electrical Resistivity Imaging case study was explain the geological and subsurface condition of the granite, weathered zones and partially weathered zone identified in the mining place of Srivaikundam. The high quality granites are exported in this place to other countries. The extension of mining field was carried out by 2D Electrical Resistivity Imaging technique. The apparent resistivity contrast have easily to distinguish the hard and soft rock in the study area. The following technique can be estimate quality and quantity of granite block in the study area. The 2D ERI technique data was compared to the open cast mining data to give the suitable result for the further mining in the study area.

ACKNOWLEDGEMENT

The authors express their sincere thanks to Mr. A.P.C.V. Chockalingam, Secretary and Professor. Veerabhagu, Principal, V. O. C. College, Tuticorin, professor, Head Department of Geology, V. O. Chidambaram College.Thoothukudi.

REFERENCES

1. Abdallah S. Al-Zoubi, Abd El-Rahman A. Abueladas, Rami I. Al-Rzouq, Christian Camerlynck, Emad Akkawi, 3M. Ezarsky, Abu-Hamatteh, Z.S.H., 5Wasim Ali, and Samih Al Rawashdeh (2007). Use of 2D Multi Electrodes Resistivity Imagining for Sinkholes Hazard Assessment along the Eastern Part of the Dead Sea, Jordan. Amer.Jour.Env. Sci.3 (4),p. 230-234.

2. Antony Ravindran.A.(2010) Characterization of geology of subsurface shallow conglomerate using 2D Electrical Resistivity Imaging at Baragadi. Panna District, Madyapradesh, India. JASEM, vol. 14.(3), p.33-36.

3. Antony Ravindran . A and Ramanujam.N. (2012) investigation study using seismic refraction and 2D electrical resistivity imaging (ERI) technique in Ooty, Nilgiri District, Tamilnadu. Int.Jour.Phy.Sci,. 7(49), pp. 6263-6269.

4. Barker R.D., (1989), Depth of investigation of collinear symmetrical four electrode arrays,Geophysics, vol.54, p.1031-1037.
5. Barker, R.D.,(1990), Improving the quality of resistivity sounding data in landfill studies.In S.H.Ward (ed). "Geotechnical and environmental geophysics. V. 2 Environmental and groundwater applications" p. 245-251.

6. Beauvais A, Ritz M, Parisot JC, Bantsimba C (2003). Testing etching hypothesis for the shaping of granite dome
7. structures beneath lateritic weathering landsurfaces using ERT method. Earth Surface Processes and Landforms 28:1071–1080.
8. Beauvais A, Ritz M, Parisot JC, Bantsimba C, Dukhan M (2004). Combined ERT and GPR methods for investigating two-stepped lateritic weathering systems. Geoderma 119:121–132.
9. Beauvais A, Ritz M, Parisot JC, Bantsimba C, Savi C (2007). Ultramafic rock weathering and slope erosion processes in a South West Pacific tropical environment. Geomorphology 83:1–13.

10. Beauvais A, Ritz M, Parisot JC, Dukhan M, Bantsimba C (1999). Analysis of poorly stratified lateritic terrains overlying a granitic bedrock in West Africa, using 2-D electrical resistivity tomography. Earth and Planetary Science Letters 173:413–424.

11. Braun JJ, Descloitres M, Riotte J, Fleury S, Barbiéro L, Boeglin JL, Aurélie Violette A, Lacarce E, Ruiz L, Sekhar Kumar MSM, Subramanian S, Dupré B (2009). Regolith mass balance inferred from combined mineralogical, geochemical and geophysical studies: Mule Hole gneissic watershed, South India. Geochimica et Cosmochimica Acta 73:935–961

12. Dahlin,T. and Loke, M.H.,(1998), Resolution of 2D Wenner resistivity imaging a assessed by numerical modelling, Jour. App.Geophy, 38,p.237-249.

13. Griffiths D.H. and Barker R.D.,(1993), Two-dimensional resistivity imaging and Modeling in areas of complex geology. Jour. App.Sci, 29, p.211 – 226.

14. Loke M.H. and Barker R.D.,(1996), Rapid least-squares inversion of apparent resistivity pseudosections using a quasi-Newton method. Geophy.Prospec, 44. p.131-152.

15. Loke, M. H, (2002), Electrical imaging surveys for environmental and engineering studies – A practical guide to 2D and 3D surveys, 2000;info@terraplus.com.

16. Orowe M. O. k., V. S. Singh, V. Anand Rao and Ratnakar Dhakate,(2008), Geoelectrical characterization of zones of disintegration in a crystalline basement environment. Curr.scien, Vol.95, No. 8, p.1067-1071.

17. Olayinka, A. I. and Barker, R. D,(1990), Borehole sitting in crystalline basement areas of Nigeria, with micro-processor controlled resistivity- traversing system. Groundwater, 28, p.178 183.

18. Zhou, W., Beck, B. F. & J. B. Stephenson, (2000), Reliability of dipole-dipole electrical resistivity tomography for defining depth to bedrock in covered karst terrains. Env.Geo, 39, p.760 – 766.

19. Zhou, W., Beck, B. F., Adams, A.C, (2002), Effective electrode array in mapping karst hazards in electrical resistivity tomography. Env. Geo, 42, p.922 – 928.