Granite Exploration Study using 2D ERI in Malaipatti Hills, 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 Malaipatti 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 resistivity 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 Malaipatti hills.

(Keywords: granite, apparent resistivity, 2D, electrical resistivity imaging, ERI, pseudosection, Thoothukudi)

INTRODUCTION

The study area having a exposure of gray granite near Malaipatti Hills and located in Latitude N 8º 55.831' and Longitude E 77º53.068' (Figure 1). Granite is a common widely occurring type of intrusive, felsic, igneous rock. Granite usually has a medium- to coarse-grained texture. Occasionally some individual crystals (phenocrysts) are larger than the groundmass, in which case the texture is known as porphyritic. A granitic rock with a porphyritic texture is sometimes known as a porphyry. Granites can be pink to gray in color, depending on their chemistry and mineralogy. By definition, granite is an igneous rock with at least 20% quartz by volume. Granites sometimes occur in circular depressions surrounded by a range of hills, formed by the metamorphic aureole or hornfels. Granite is usually found in the continental plates of the Earth's crust. Granite is nearly always massive (lacking internal structures), hard and tough, and therefore it has gained widespread use as a construction stone.

The Study Area Granite Setup and Geology

The study area is geological quartz, biotite, and feldspathic, garnet rich granitic terrain. The Strike of the study area N200 W and dipping 700 E, 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 Malaipatti 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.

INSTRUMENTATION

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,1993); (Dahlin and Loke,1998), (Loke, 2000), (Ravindran, 2011). The granite and karst topographies were studied by Olayinka (2008), Orowe et al. (2008), Oroware and Barker (1990), Al-Zoubi et al. (2007), and Zhou et al. (2000 and 2002). The following study of 2D Electrical Resistivity Imaging survey system were including CRM-500 resistivity meter, multicore cables, steel electrodes and Res2DINV Software (Figure 2).

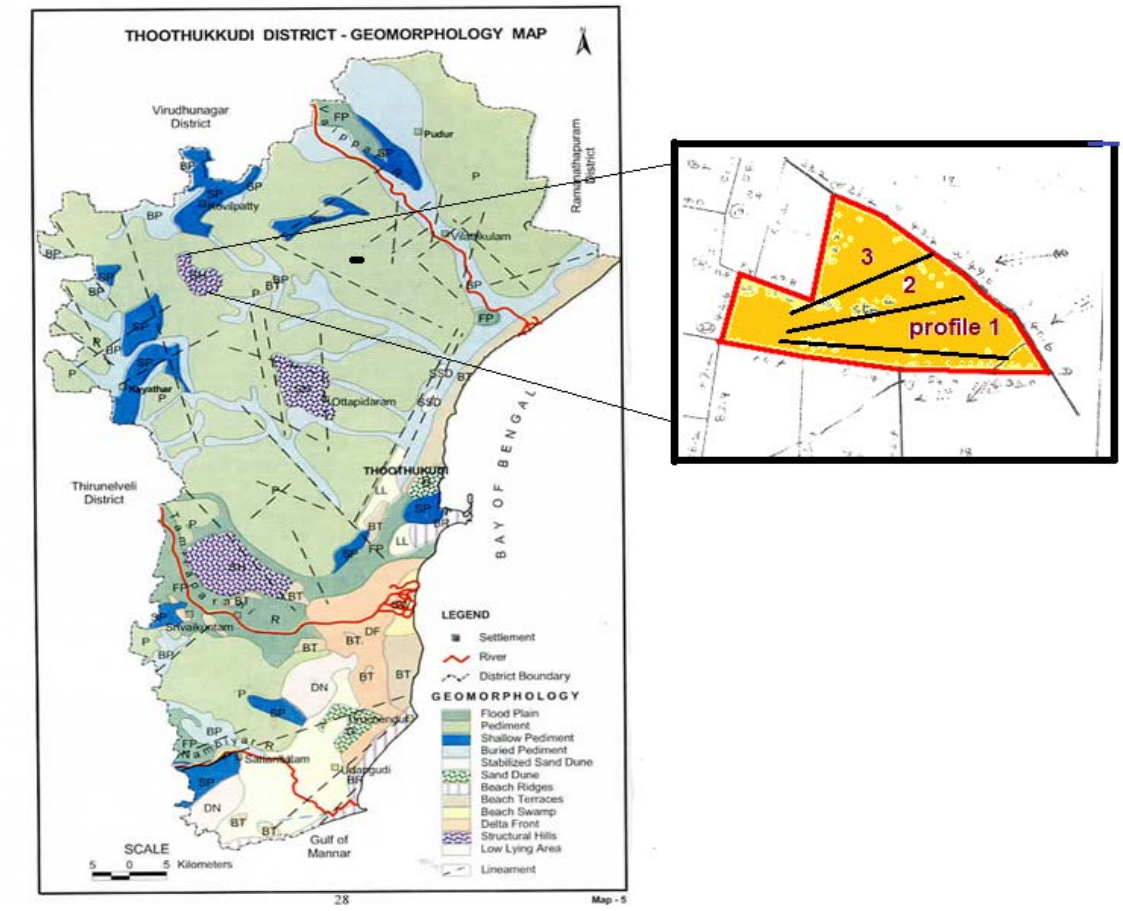

Figure 1: The Geological Map of the Study Area.

Figure 2: The 2D ERI Field Survey carried out in the Granitic Terrain.

DISCUSSION AND CONCLUSION

The very high resistivity values and low resistivity in ohm meters were mapped in the Malaipatti granitic terrain. However, a similar anomaly associated with high resistivity values can be observed with the granite terrain for mining purpose. The granite identification was carried out using 2D electrical resistivity imaging techniques with help from the Wenner configuration by using the CRM 500 resistivity meter, multi-core cables, stainless steel electrodes and RES2DINV software are used.

The profile 1 (Figure 3) trends E-W direction to a length of 96m. 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.

The profile 2 (Figure 4) trends E-W direction to a length of 96m. 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 1.10m. The intermediate second layer exhibits resistivity values that ranges from 34 Ohm.m to 159 Ohm.m represents the sheet like granitic rock. The high resistively zone of pseudosection with range of resistivity 202-659 Ohm.m from a depth 5.41-10.71m indicate folded granitic rock mass.

The profile 3 (Figure 5) trends E-W direction to a length of 96m. 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.

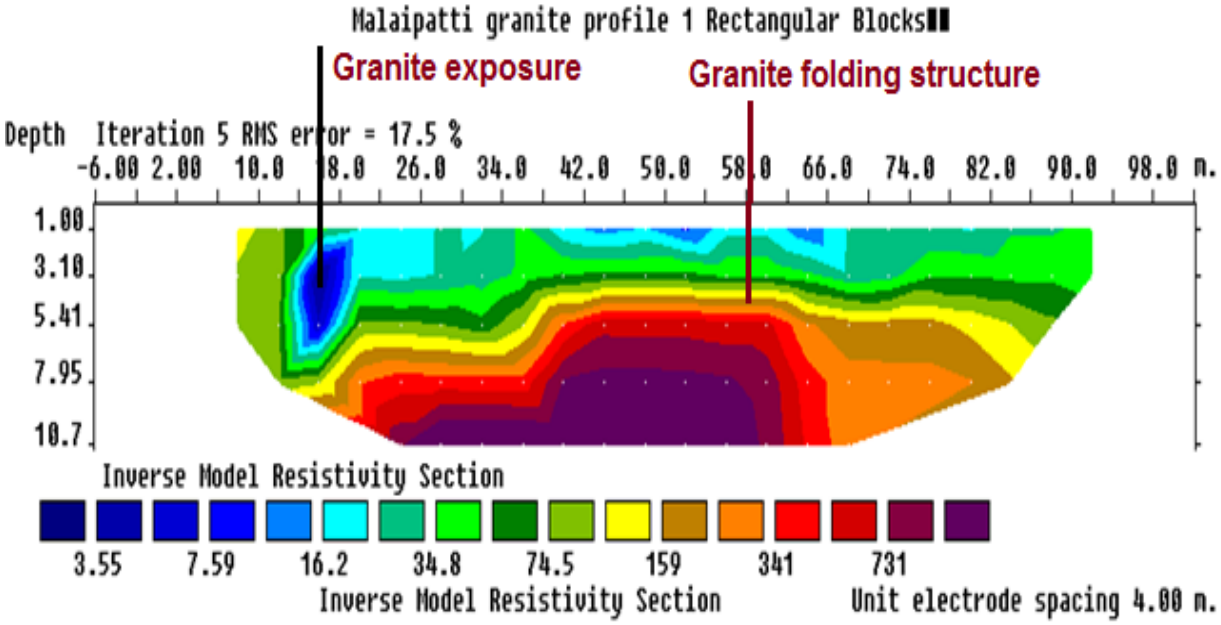

Figure 3: 2D Electrical Resistivity Imaging Pseudosection along Profile 1 shows the Hard Granite Rock and Overburden Rocks at Near Malaipatti, Thoothukudi District, Tamilnadu.

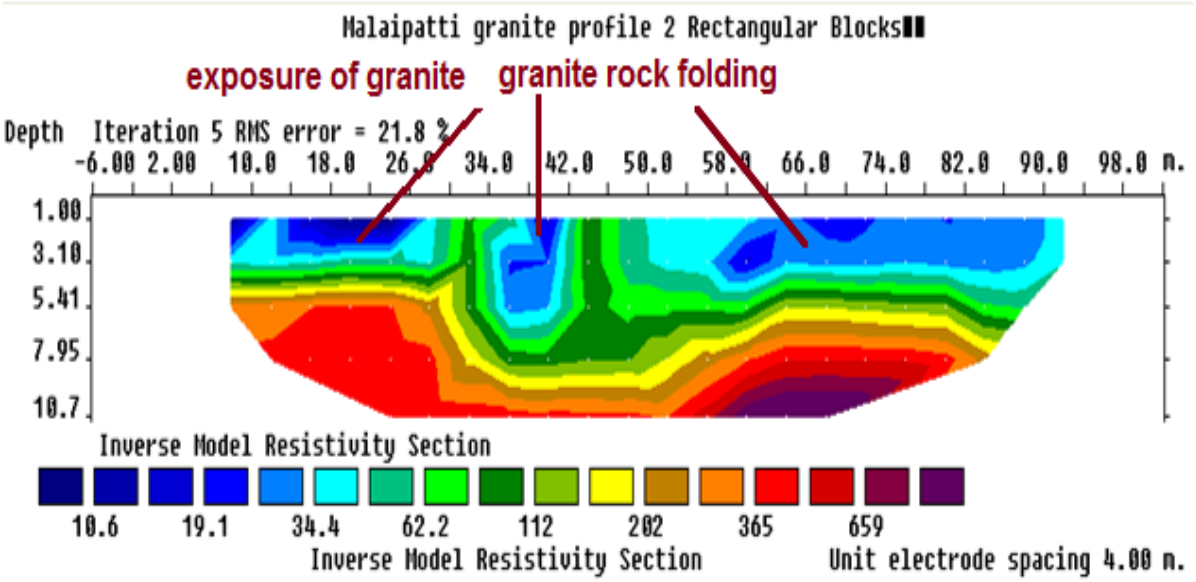

Figure 4: 2D Electrical Resistivity Imaging Pseudosection along Profile 2 shows the Hard Granite Rock and Overburden Rocks at Near Malaipatti, Thoothukudi District, Tamilnadu.

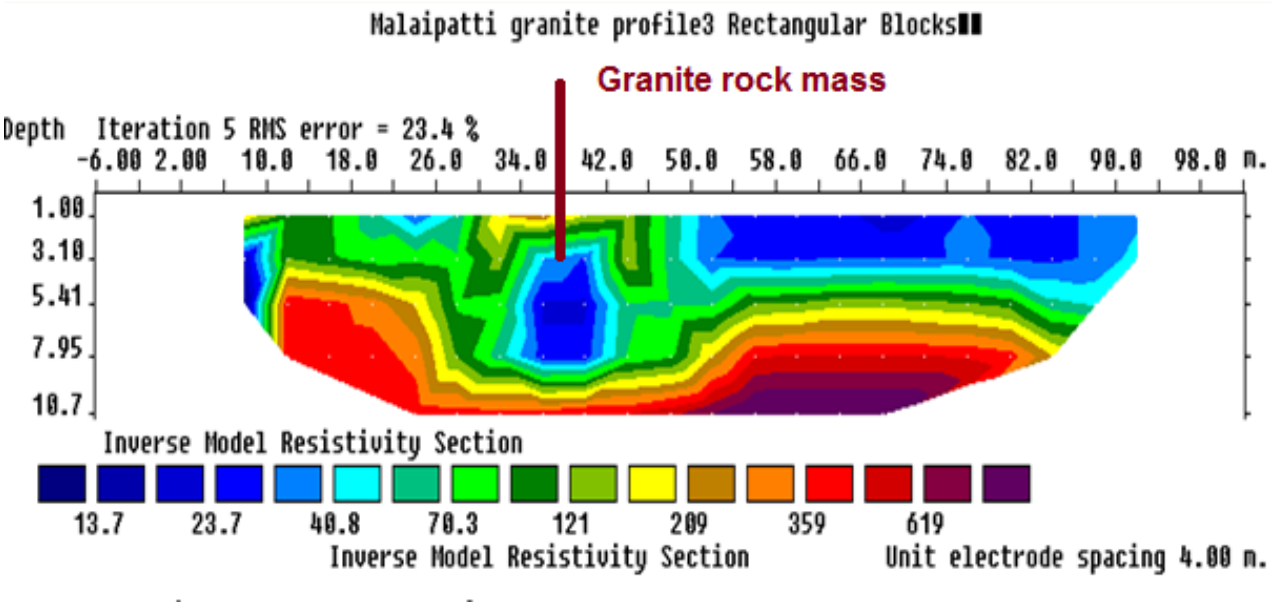

Figure 5: 2D Electrical Resistivity Imaging Pseudosection along Profile 3 shows the Hard Granite Rock and Overburden Rocks at Near Malaipatti, Thoothukudi District, Tamilnadu.

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 Malaipatti. The high quality granites are occurred in the study area. 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. On the basis upon the subsurface geometrical features and distribution patterns of granitic rock was estimated through 2D Electrical Resistivity Imaging. The granite rock and overburden was estimated through the pseudosection color difference and apparent resistivity variation.

ACKNOWLEDGEMENT

The author expresses his sincere thanks to Mr. A.P.C.V. Chockalingam, Secretary and Prof. Maragathasundaram, Principal, V.O.C. College, Tuticorin, Professor, Head Department of Geology, V.O. Chidambaram College. I also would like to extend heart-felt thanks to Dr. N. Ramanujam, Professor and Head, Coastal Disaster Management, Pondicherry University, Andaman.

REFERENCES

1. Al-Zoubi, A.S., A. El-Rahman A. Abueladas, R.I. Al-Rzouq, C. Camerlynck, E. Akkawi, M. Ezarsky, Z.S.H. Abu-Hamatteh, W. Ali, and S. Al Rawashdeh. 2007. "Use of 2D Multi Electrodes Resistivity Imagining for Sinkholes Hazard Assessment along the Eastern Part of the Dead Sea, Jordan". *American Journal of Environmental Sciences*. 3(4):230-234.

2. Ravindran, A. 2010 "Characterization of Geology of Subsurface Shallow Conglomerate using 2D Electrical Resistivity Imaging at Baragadi, Panna District, Madyapradesh, India". J*ournal of Applied Science and Environmental Management*. (JASEM). 14(3):33-36.

3. Barker, R.D. 1989. "Depth of Investigation of Collinear Symmetrical Four Electrode Arrays". *Geophysics*. 54:1031-1037.

4. 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*. 245-251.

5. Dahlin, T. and M.H. Loke.1998. "Resolution of 2D Wenner Resistivity Imaging Assessed by Numerical Modelling". *Journal of Applied Geophysics*. 38:237-249.

6. Griffiths, D.H. and R.D. Barker.1993. "Two-Dimensional Resistivity Imaging and Modeling in Areas of Complex Geology". *Journal of Applied Geophysics*. 29:211 – 226.

7. Loke, M.H. and R.D. Barker.1996. "Rapid Least-Squares Inversion of Apparent Resistivity Pseudosections using a Quasi-Newton Method". *Geophysical Prospecting*. 44:131-152.

8. Loke, M.H. 2002. "Electrical Imaging Surveys for Environmental and Engineering Studies: A Practical Guide to 2D and 3D Surveys, 2000". info@terraplus.com.

9. Orowe M.O.K., V.S. Singh, V. Anand Rao, and R. Dhakate. 2008. "Geoelectrical Characterization of Zones of Disintegration in a Crystalline Basement Environment". Current Science. 95(8):1067-1071.

10. Olayinka, A.I. and R.D. Barker. 1990. "Borehole Sitting in Crystalline Basement Areas of Nigeria, with Micro-Processor Controlled Resistivity-Traversing System". *Groundwater*. 28:178–183.

11. Zhou, W., B.F. Beck, and J.B. Stephenson. 2000. "Reliability of Dipole-Dipole Electrical Resistivity Tomography for Defining Depth to Bedrock in Covered Karst Terrains". *Environmental Geology*. 39:760 – 766.

12. Zhou, W., B.F. Beck, and A.C. Adams. 2002. "Effective Electrode Array in Mapping Karst Hazards in Electrical Resistivity Tomography". *Environmental Geology*. 42:922 – 928.

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SUGGESTED CITATION

Ravindran, A. 2012. “Granite Exploration Study using 2D ERI in Malaipatti Hills, Thoothukudi, India”. *Pacific Journal of Science and Technology*. 13(2):475-480.


Pacific Journal of Science and Technology