Exploration of Quartz, Feldspar, and Mica Minerals Using Geophysical Resistivity, Self-Potential, and Natural Electrical Field Techniques

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Funding: No specific funding was received for this work.

Potential competing interests: No potential competing interests to declare.

Abstract

The aim of the present study is examined by various modeling and self-potential (SP) techniques which are useful for the exploitation of shallow and deep deposits. In the present study area, 12 areas conducted the self-potential techniques. From that analysis, a v-shaped formation was formed, as may be the geological formation of an ore anomaly. The study area's highest millivolt values (30 to 50 mV) indicate the presence of quartz, feldspar, and negative values are associated with the mica group of minerals. The Nellore schist belt is majorly dominated by the schistose group of rocks. The schistose group of rocks has a density very less like 5 to 10 MV. This study would be helpful for various arenas, including exploration geologists and mineralogists.

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Keywords: Self-potential graphs, natural electrical fields graphs.

1. Introduction

Exploration means to search for ore deposits below the subsurface of the ground. Geophysical methods, especially self-potential and vertical electrical sounding, play an important role in finding ore deposits. Among geophysical methods, self-potential and sounding techniques are widely employed (Golla et al., 2014).

Since it uses measurements of naturally occurring potential differences caused by electrochemical, electrokinetic, and thermoelectric fields in the earth's subsurface, the self-potential (SP) technique is passive. Fox (1830) introduced the SP technique for subsurface research at the beginning of the 1800s. The technique was first applied to understand the potential for mineralization, mostly related to sulphide ore bodies, which was described by oxidation potential and electrochemical mechanism (Sato and Mooney, 1960; Sundararajan, N et al.,1980). When ores or hidden metals come into contact with rocks, groundwater, or rock fluids, electrochemical reactions, including reductions and oxidations, take place that result in the generation of self-potentials. Self-potentials are always characterised by a core negative anomaly and long-term stability (Biswas et al., 2017).

"Redox potentials," which are based on static contacts and are typically more than 40 mV to 200 mV, are what determine the reductions and oxidations. Since its discovery, the SP method has been widely applied in a wide range of geophysical applications, including engineering and environmental applications, well logging, geothermal exploration, mineral exploration, hydrogeological investigations (Golla et al., 2022).The present analysis reveals the self-potential technique in the quartz, feldspar, and mica group of minerals along the Nellore schist belt area.

2. Study area

The study area was located near Gudur town, and it is in the Tirupathi District of Andhra Pradesh State, India. It belongs to the Andhra region. It is located about 12 KM south of Gudur town. It receives rainfall during the months of November and December and contains a semi-arid type of climate.

2.1. Geology of the study area

The geology of the study area was predominately occupied by pegmatite, schist, and quartzite. These are the last stages of crystallization. It is a womb of minerals like quartz, feldspar, mica, beryl, and tourmaline.

2.2. Physiography

The study area has an almost moderate slope to plain land.

3. Method of exploration

The present study area was widely used in two types of methodology: geophysical. One is self-potential, and the second is vertical electrical sounding (natural electromagnetic difference). The graphs below explain the anomaly (Fig. 1).

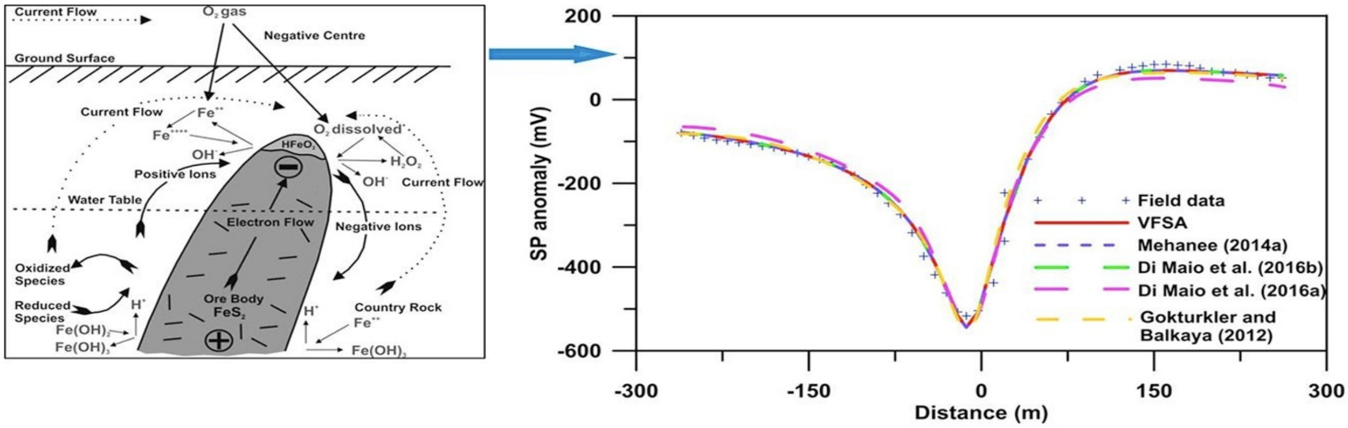


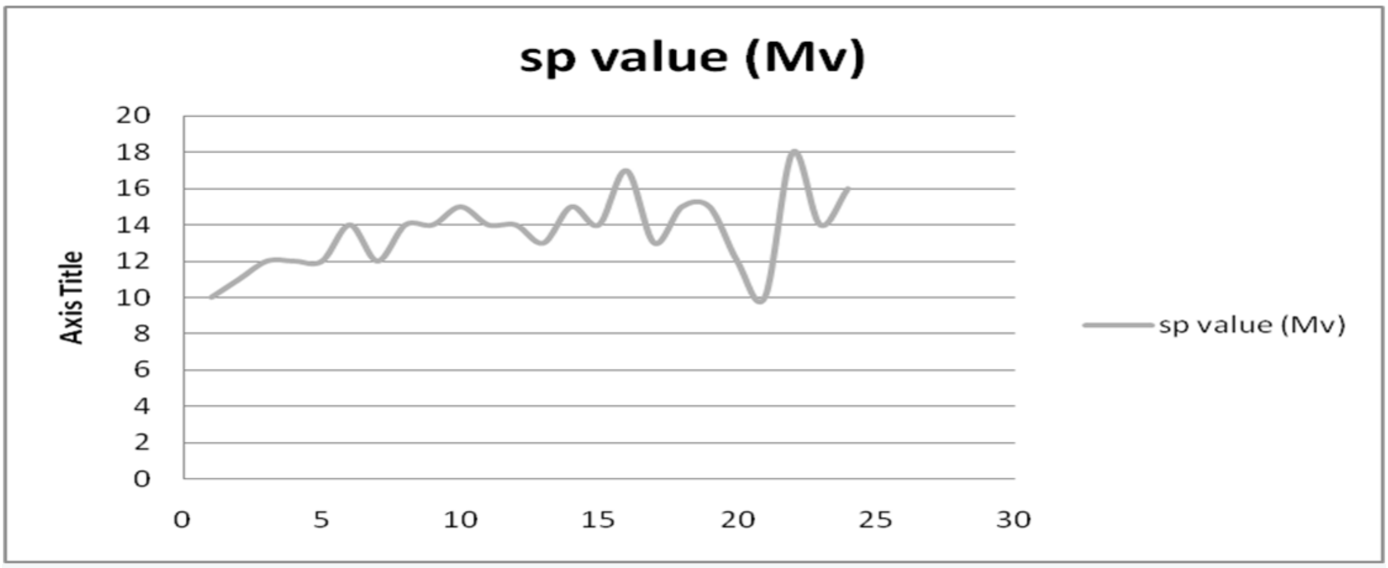
Figure 1. It shows the graphical representation of the anomaly (Biswas, A. (2017))

4. Results and discussion

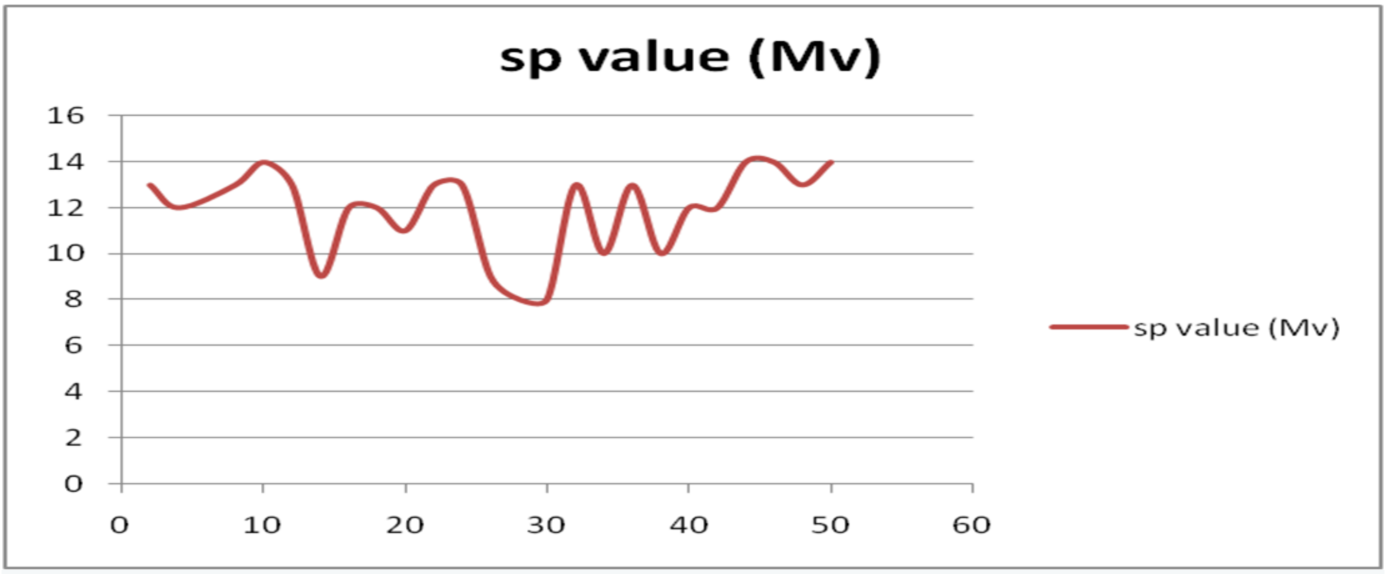
In the overall study area, 12 SP surveys have been conducted, and 20 to 40 VES (natural electromagnetic difference) data were captured and processed in different software to produce the graphs. In these graphs, the bell-type curves express the anomalies like quartz, which starts with 0.1 values, whereas the remaining feldspar shows 0.04 to 1 values, and mica indicates negative values, e.g., -1, -3. The study area majorly contains schist rocks, which is explained by the low self-potential values obtained. Quartz, feldspars, and mica were not formed continuously; they formed like pocket types. In this result analysis, two techniques are portrayed. 1) Self-potential method 2) Natural electrical sounding method

Self-potential explains the trend of the ore deposits in the study area, whereas natural electrical sounding explains the vertical depth of the study area.

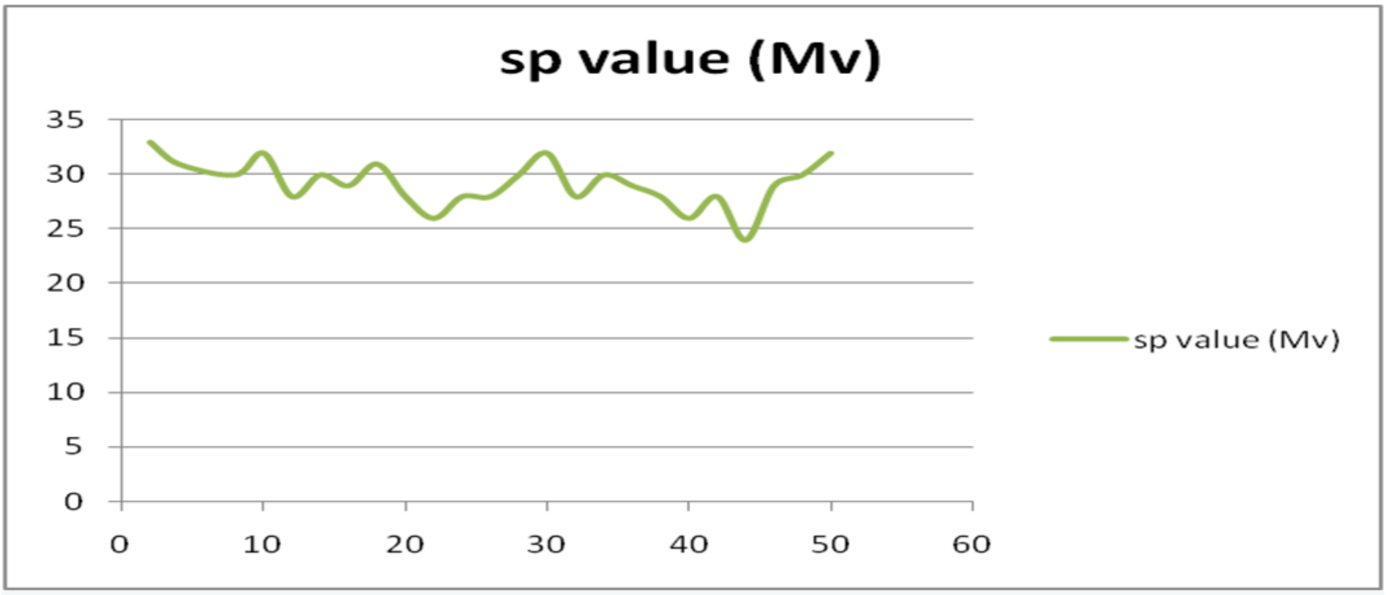
1. Self-potential method graph plots



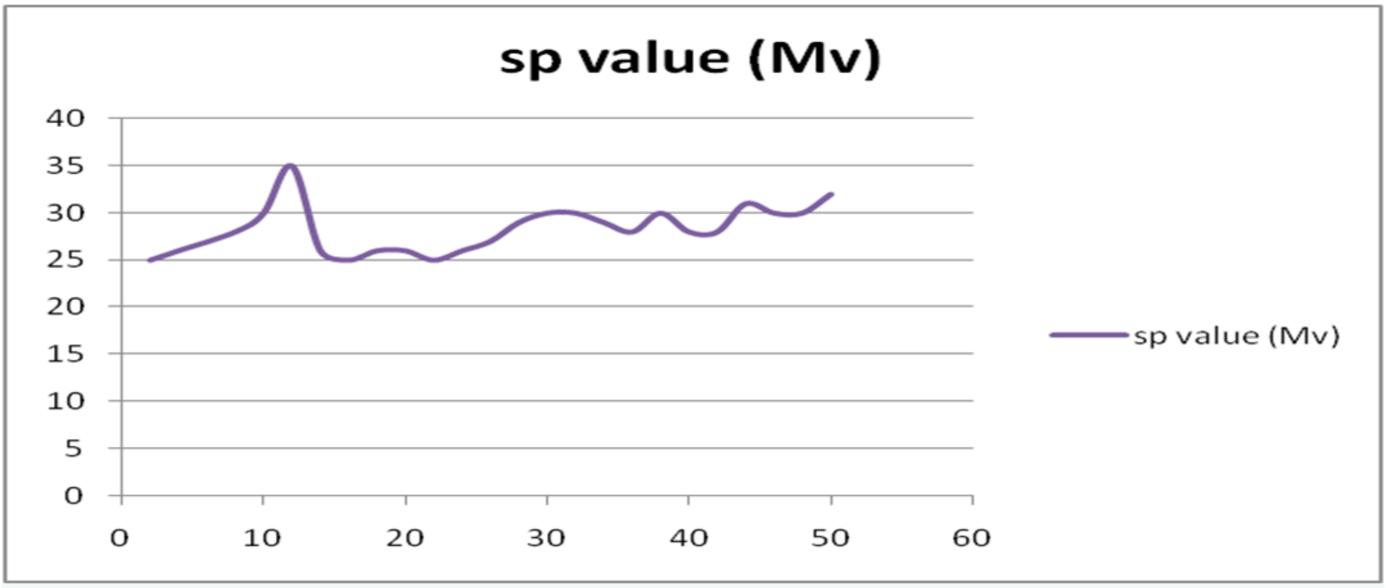
Point 1 (LAT: 14.146220-LONG-79.819658) (N-S)



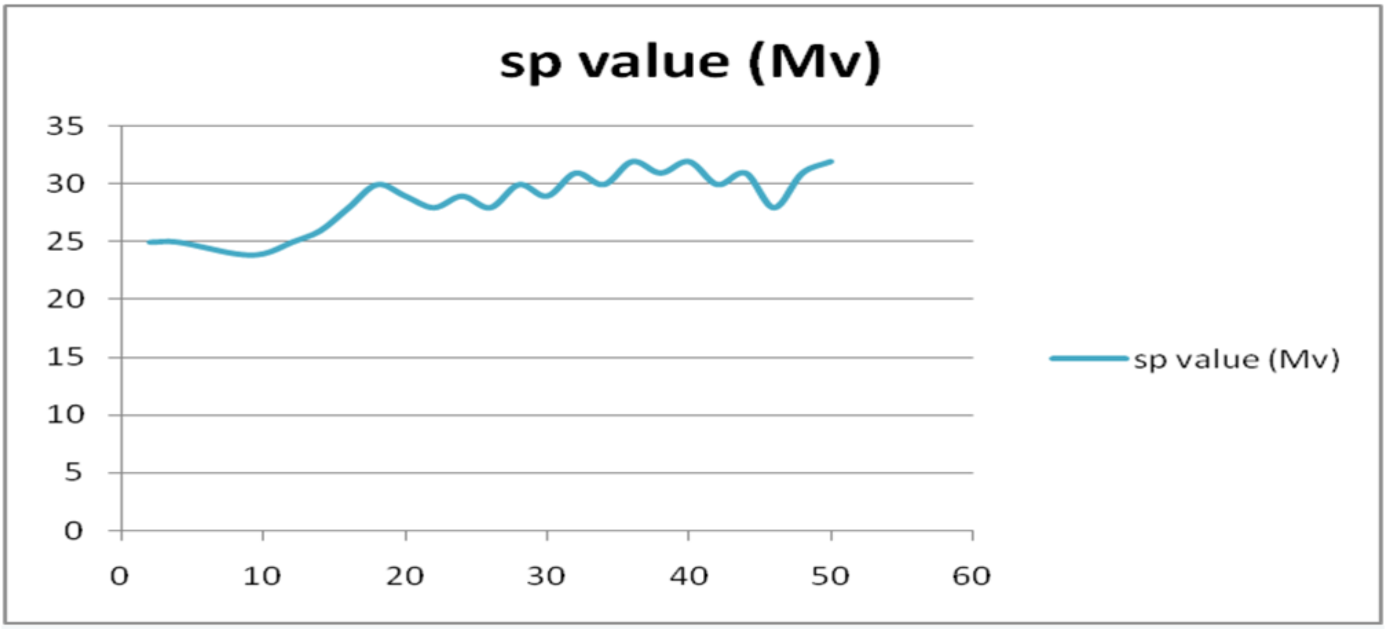
Point 2 (LAT: 14.132420-LONG-79.819658) (N-S)



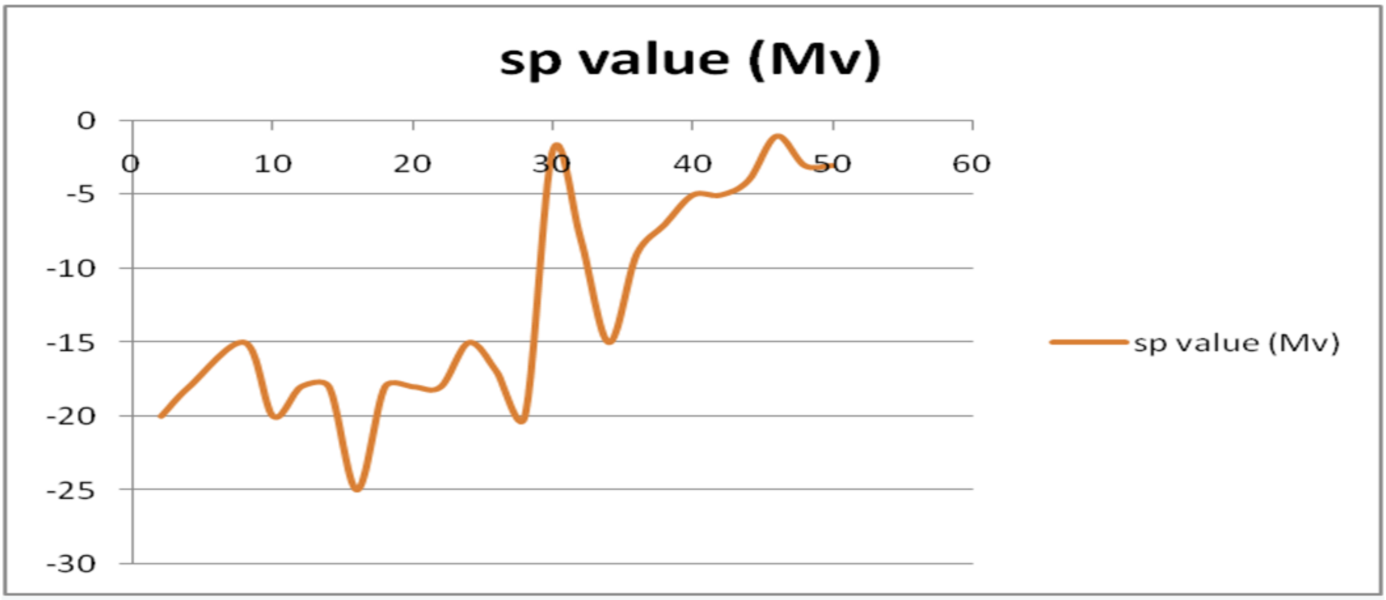
Point 3 (LAT:14:132420:long:79:819820) (N-S)



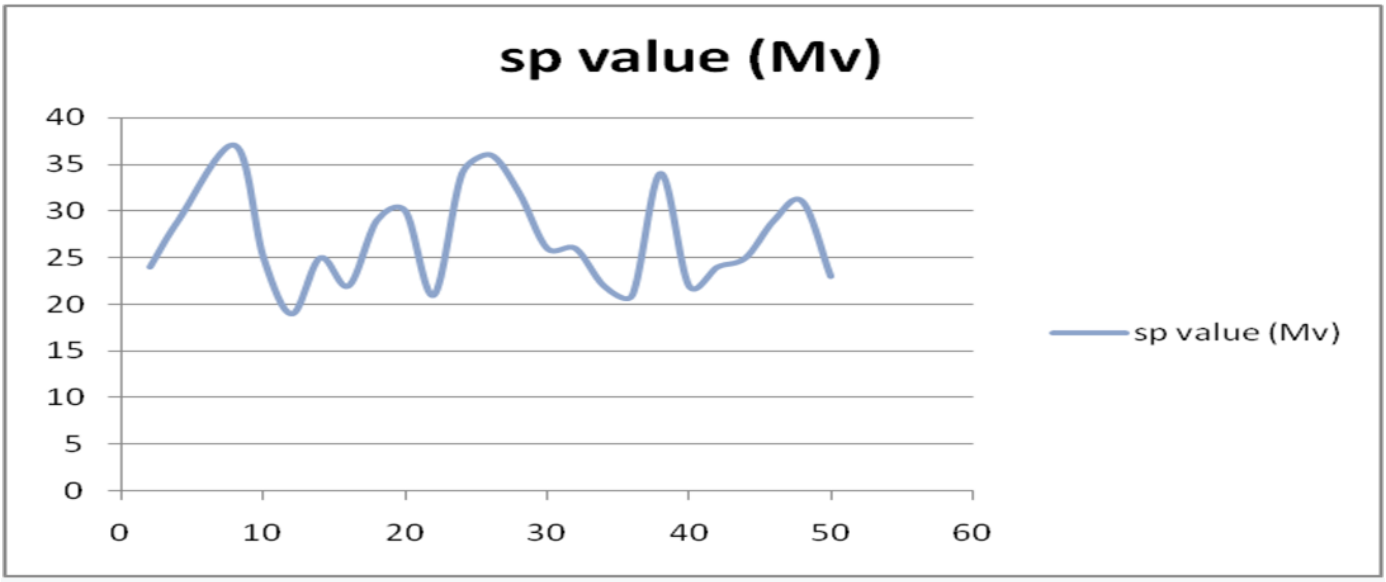
Point 4 (lat: 14.131520, lon:79:819678) (N-S)



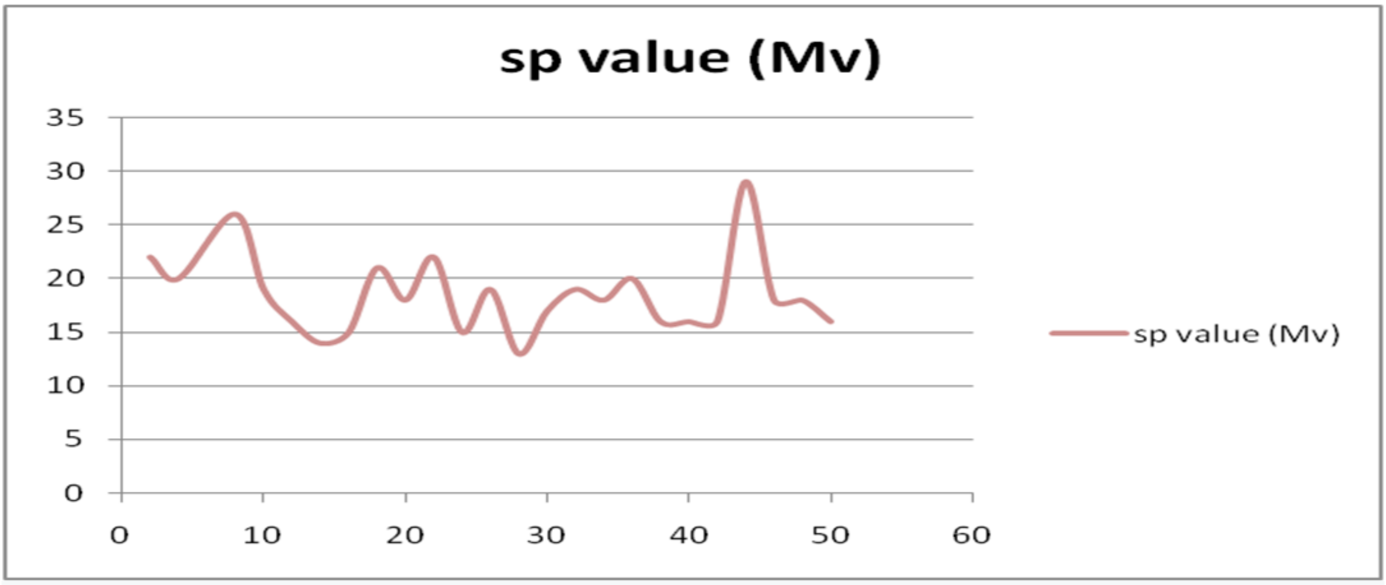
Point 5 (lat: 14.13203920, lon:79:810863) (E-W)



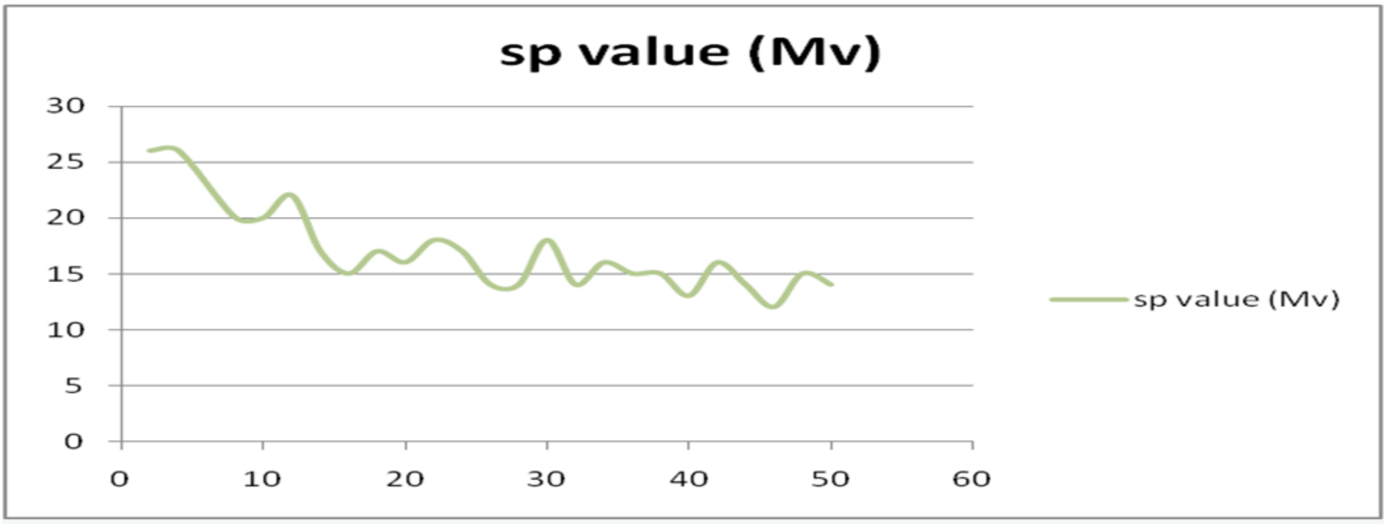
Point 6 (lat: 14.13203923, lon:79:810866)) (E-W)



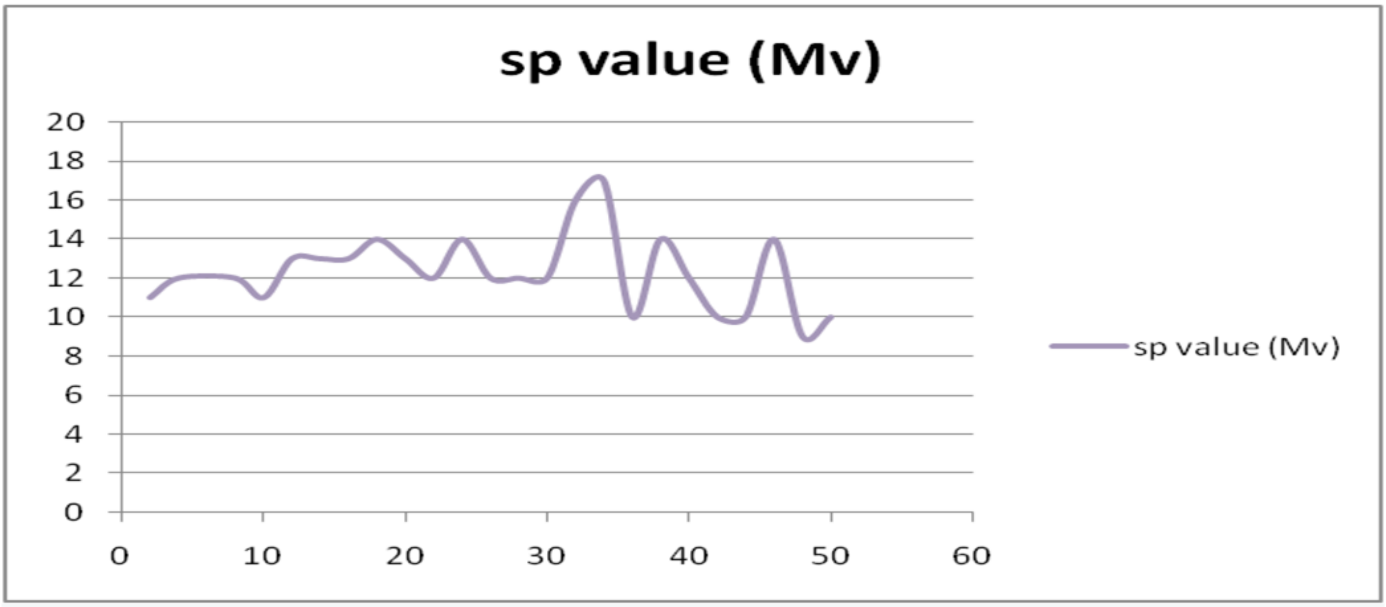
Point 7 (lat: 14.132927, lon:79:821568)) (E-W)



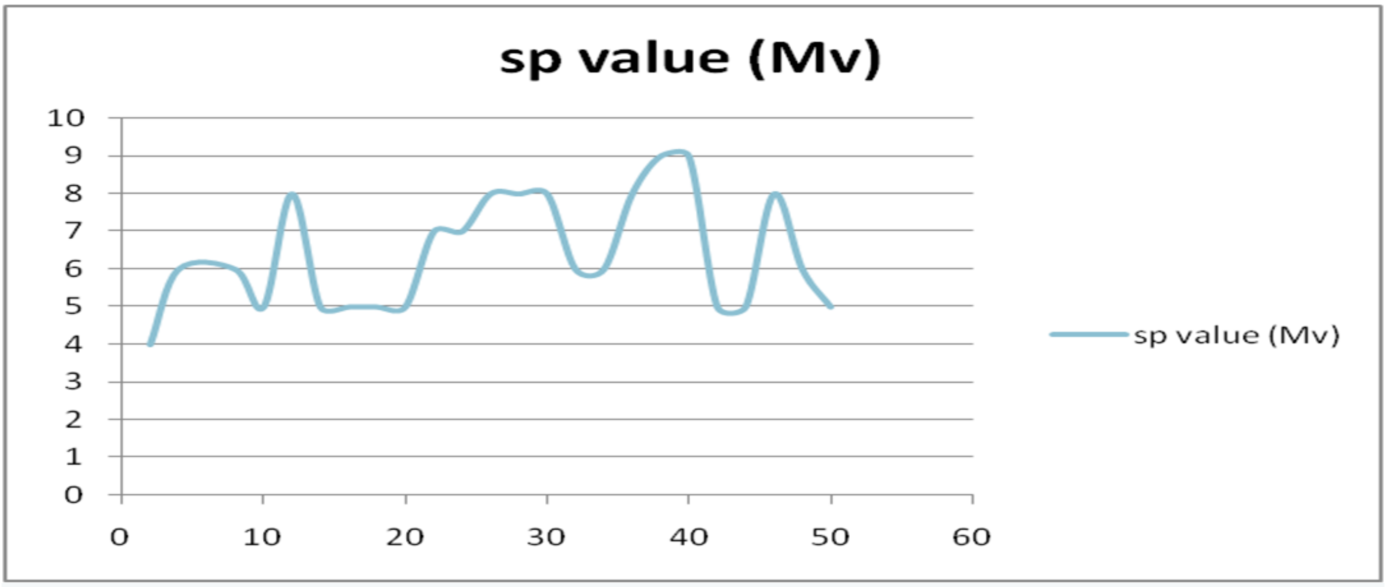
Point-8 (lat: 14.132720, lon:79:821458)) (E-W)



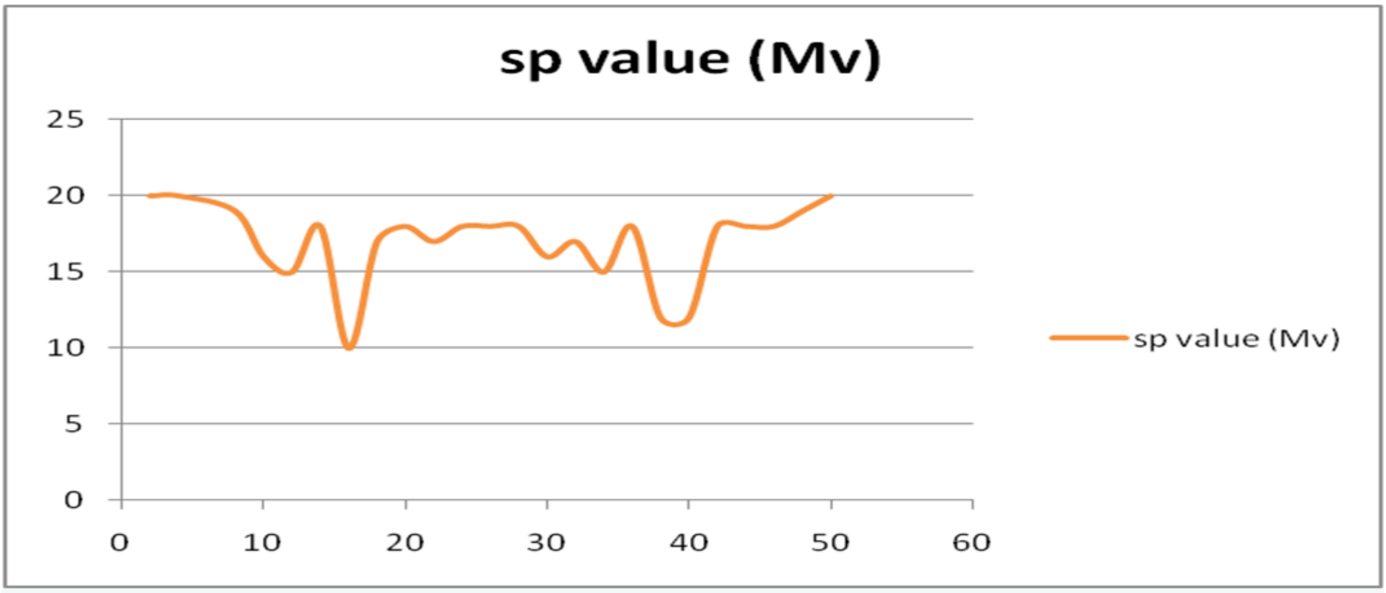
Point 9 (lat: 14.131622, lon:79:826698)) (E-W)



Point 10 (lat: 14.131522, lon:79:826098)) (E-W)

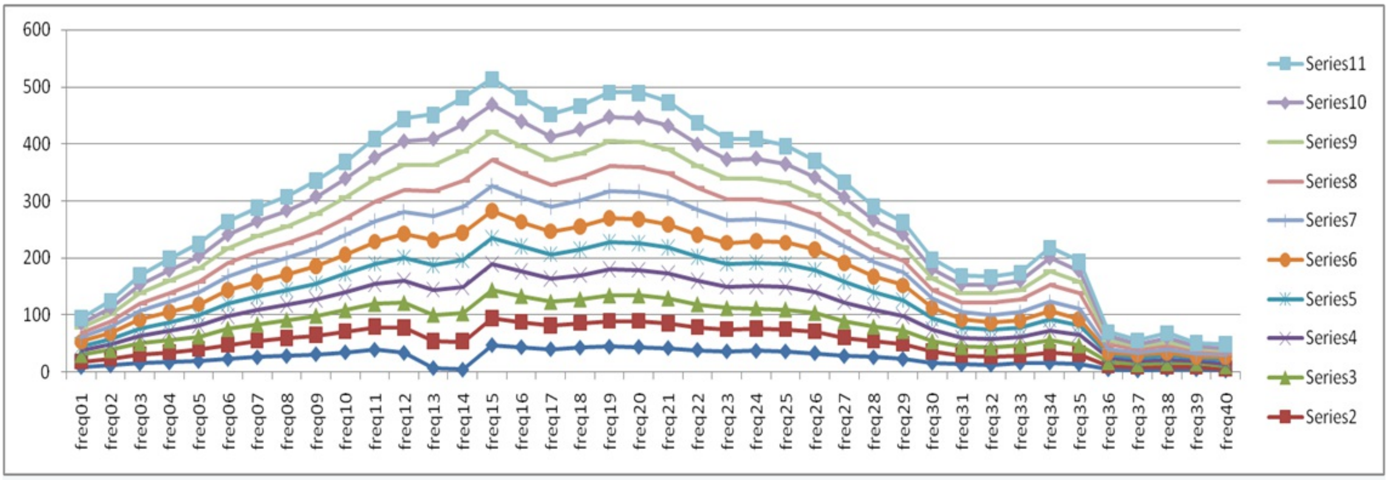


Point 11 (lat: 14.132062, lon:79:821987)) (E-W)



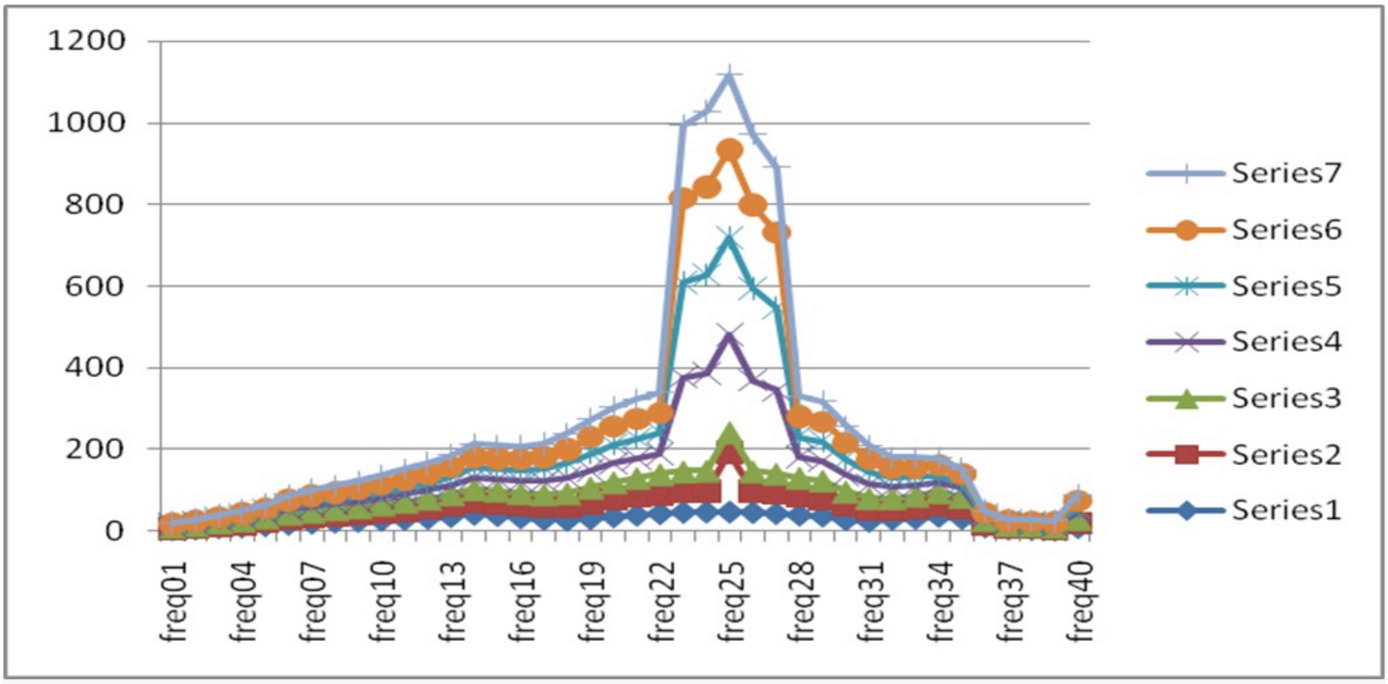
Point 12 (lat: 14.132062, lon:79:821987) (E-W)

2. Natural Vertical electoral sounding data graphs



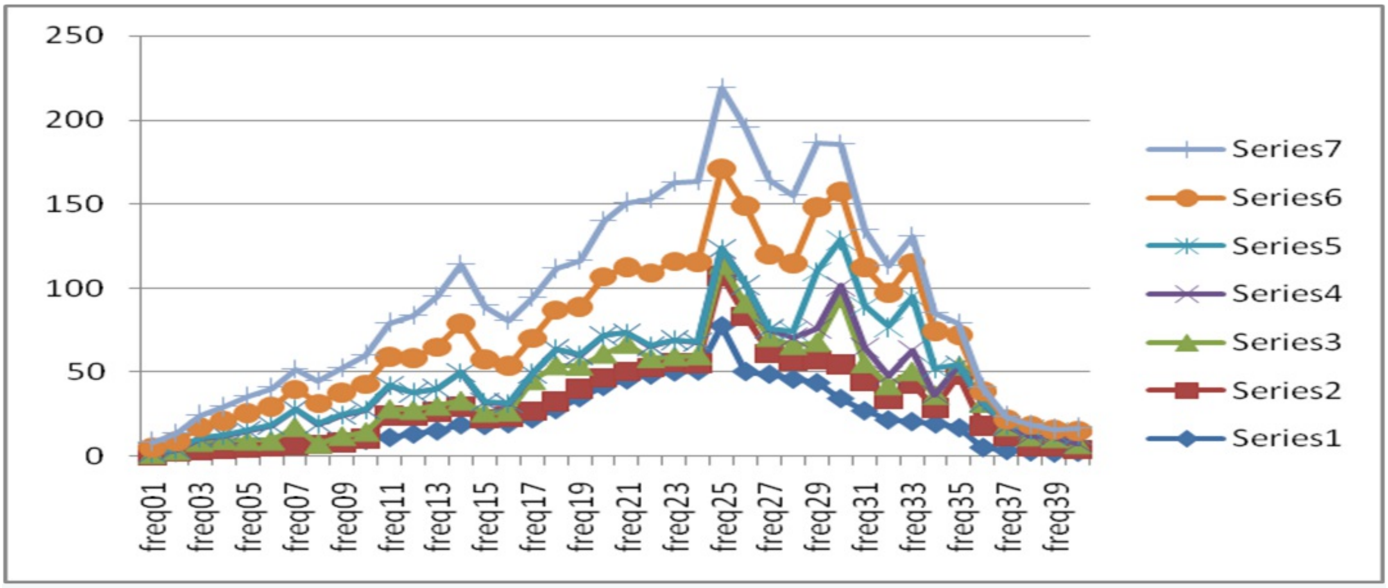
Point 1 (LAT: 14.146220-LONG-79.819658)(N-S)

The study area vertical data explains the above latitude and longitude area may contain the quartz group of minerals with a depth of approximately 100 to 150 feet, length 50m, and width may be 15 to 20 feet only.



Point 2 (LAT: 14.132420-LONG-79.819658) (N-S)

The study area vertical data explains the above latitude and longitude area may contain the almost schist group rocks only.



Point 3 (lat: 14.13203923, lon:79:810866)) (E-W)

The study area vertical data explains the above latitude and longitude area may contain the mica group of minerals with a depth of approximately 100 to 150 feet only.

5. Conclusions

Final conclusion of the research: In the study area, from 12 self-potential data points, which at points 1, 7, and 6, quartz and mica group minerals may have occurred. The remaining areas fell in the schistose group of rocks. The quartz veins lay in the **NORTH –SOUTH** direction, whereas the mica may be presented in the**East –West**. The study area's highest millivolt value (30 to 50 mV) indicates the presence of quartz, feldspar, and negative values associated with the mica group of minerals. The Nellore schist belt is majorly dominated by the schistose group of rocks. The schistose group of rocks has a density very less like 5 to 10 mV. This study would be helpful for various arenas, including exploration geologists and mineralogists.

References

- Biswas, A. (2017). A review on modeling, inversion and interpretation of self-potential in mineral exploration and tracing paleo-shear zones. Ore Geology Reviews, 91, 21-; https://doi.org/10.1016/j.oregeorev.2017.10.024
- FOX R W. On the electromagnetic properties of metalliferous veins in the mines of Cornwall [J]. Philosophical Transactions of the Royal Society of London, 1830, 120: 399–414
- WANG J J, TAO C H, WANG H J, DENG X M, XIONG W, LI Z. Study of self-potential observation ways in the seafloor polymetallic sulfide deposits [J]. Haiyang Xuebao, 2018,
- A. Biswas et al., 2014, Delineation of subsurface structure using self-potential, gravity, and resistivity surveys from South Purulia Shear Zone, India: implication to uranium mineralization
- Sato, M. and Mooney, H.M. (1960) The Electrochemical Mechanism of SulphideSelfPotential.Geophysics,25,226249. https://doi.org/10.1190/1.1438689
- Sundararajan, N., Srinivasa Rao, P., & Sunitha, V. (1998). An analytical method to interpret self-potential anomalies caused by 2-D inclined sheets. Geophysics, 63(5), 1551-1555.