

A Geophysical Approach on The Depth Estimation of Manganiferous Phyllite, Joldhal Formation, Chitradurga Group, North Kanara District, Karnataka

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The gravity and magnetic (TF) survey has been conducted in survey of India toposheet nos. 48I/3, 4, 9, 10 and 11 under the program National Geophysical Mapping (NGPM) during Field Season 2018-19. In the survey of India toposheet no. 48I/11, the response of manganiferous phyllite is observed in Bouguer and Magnetic anomaly. The Bouguer and magnetic (TF) anomaly of survey of India toposheet 48I/11 is shown in Figure-1(b)&(c) respectively. The Bouguer anomaly map shows a low zone over PGC and high zone over schist. There is gradient of around 10 mGal between these lithounits. The magnetic (TF) anomaly shows an E-W trend near Nagargadi. Collaborating these results with geology of survey of India toposheet 48I/11 a zone from Gnaeshgudi to Nagargadi is demarcated. Shri S C Tripathi, DDG, RMH-I, GSI, SR, Hyderabad has visited that zone(Figure-1(d)&(e)) and to validate this, he has recommended one traverse of three kilometers with station spacing of 100 meters. The profile was chosen along the available tracks and one such location was at limb of regional fold reported in this area.

Brief geology of area- This toposheet is bounded by latitude 15°15'00" and 15°30'00" N and longitude 74°30'00" and 74°45'00"E and cover parts of Supa and Haliyal taluk of North Kanara district, Karnataka. The area has exposure of Pennisular Gneiss Complex-I and argillite, schist and meta-sediments of Chitradurga Group of Dharwar Supergroup of Archean age. Both meta-sediments and meta-volcanics units constituents of Chitradurga Group, resting unconformably over granitic gneiss of PGC-I(Figure-1(a)). The PGC-I is bordering with manganiferous phyllite, banded magnetite quartzite and quartzite in the east. This area has undergone a major fold with fold axis along NW-SE with plunge along SE. These band has developed fractures and faults after the formation. The regional trend of foliations is NNW-SSE to NW-SE with moderate dips towards east. The manganese was earlier mined along the manganifeous phyllite band.

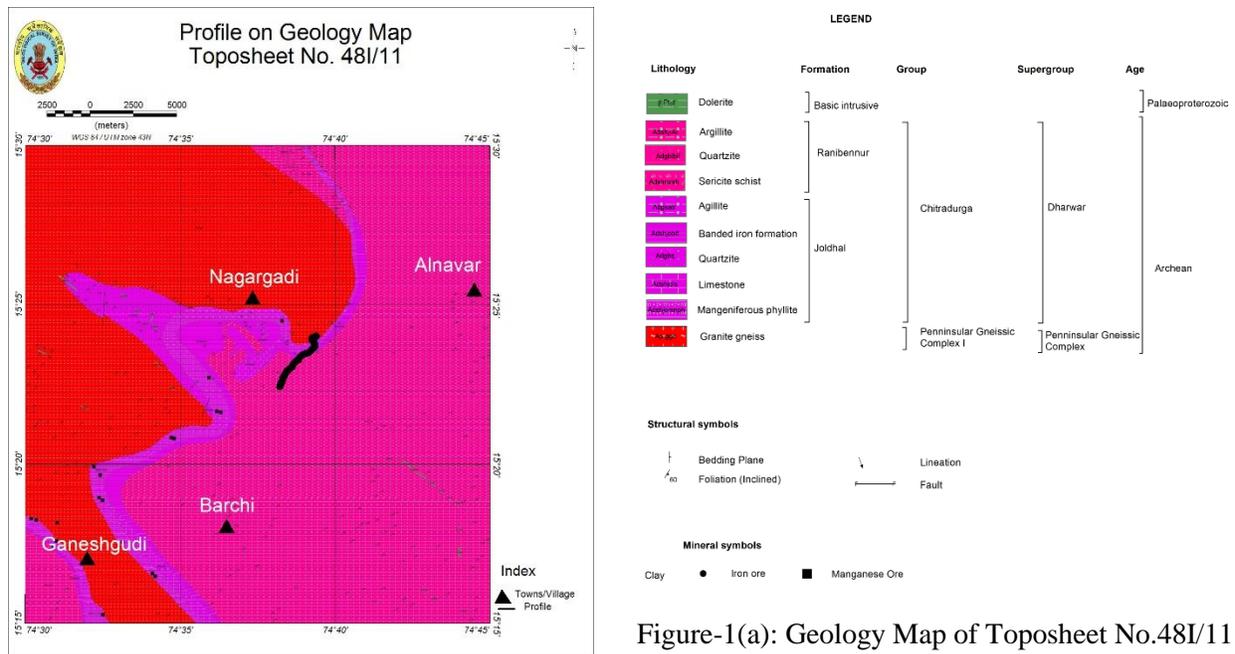


Figure-1(a): Geology Map of Toposheet No.48I/11

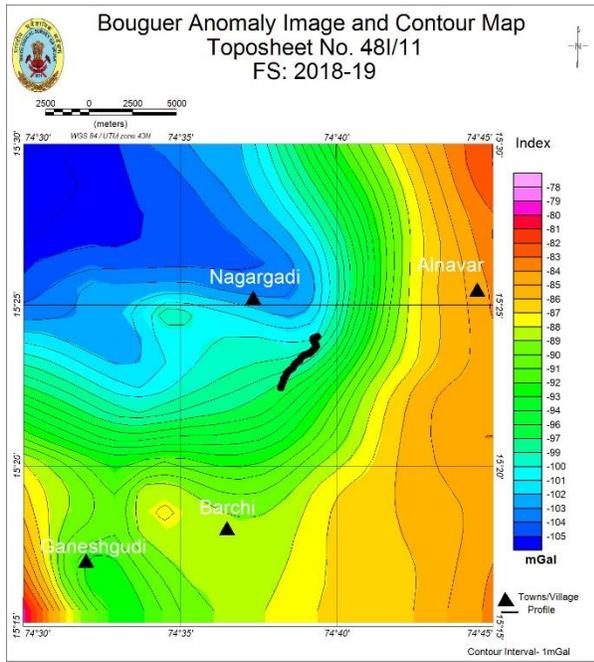


Figure-1(b): Bouguer Anomaly Map of Toposheets Nos. 48I/11

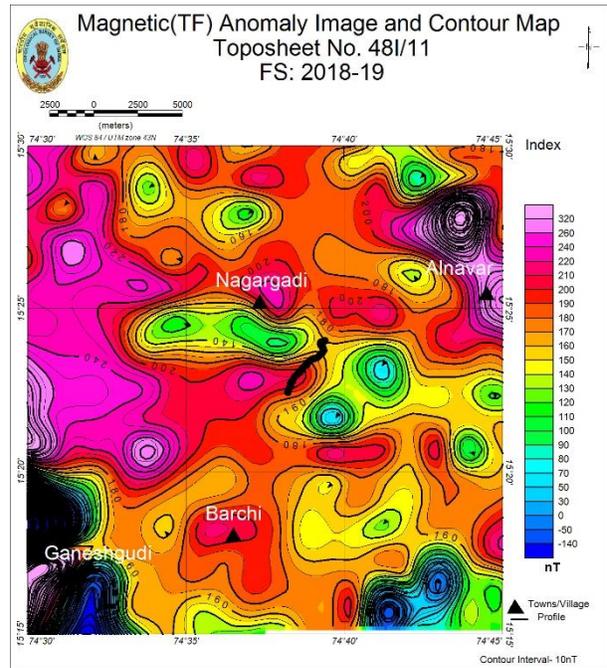


Figure-1(c): Magnetic (TF) Anomaly Map of Toposheets Nos. 48I/11



Figure-1(d): Manganese ore near abandoned mine



Figure-1(e): Abandoned Mining area

In this additional survey along the profile detailed gravity and magnetic observations were done with one station per 100meter. The gravity and magnetic survey were conducted along the traverse lines near Nagargadi about three Kilometer, across the manganiferous phyllite. The samples were also collected to measure physical properties. After applying necessary corrections, Bouguer and Magnetic (TF) anomalies were calculated. For quantifying the results and to estimate the depth persistence of manganiferous phyllite, wenner method and 2D model using GM-SYS modelling is used. In addition, this, various filters were applied to enhance the response from target source and to get its dimension. In case of wenner method, smoothening of Bouguer anomaly data was done through spline and then the wenner solutions were calculated on vertical derivative of Bouguer anomaly. In case of gm-sys modelling, profile was projected along the E-W direction and dimension of litho-units is estimated from geology map as well as from filtered map. The gravity profile used here after applying free air correction only. The calculated physical properties were utilized into gm-sys 2d model to fit to observed response.

Nagargadi profile:

Figure-3 shows gravity and magnetic profile with vertical and horizontal derivative of Bouguer anomaly and analytical signal and horizontal derivative of magnetic (TF) anomaly. The litho-units with their extension are shown along x-axis in the Figure-2. The gravity profile shows an increasing regional trend with a residual high near 600m. The magnetic (TF) has same value either side except a bipolar with low at 600m and high over the meta-sediments. The distinct manganiferous phyllite/BIF unit has sharp contact with granite gneiss and a smooth variation with schistose formation as per their physical property contrast. The probable depths of manganifeous phyllite/BIF and argillites suit of rocksover the gneissic basement are estimated to be about 100mby assuming the densities of these formation from the received samples. Figure-3 shows gm-sys 2d modelling of gravity and magnetic profile. The top window is magnetic response observed and calculated with error, similarly middle is for gravity. The bottom window shows depth variation of different litho-units. This model predicts the PGC basement below the Argillites and meta-sediments. The manganiferous phyllite and BIF is formed on a relief basin of PGC. The Argillite have depth of 100 meter. The BIF has extension below the Argillites and is formed over the manganiferous phyllite. This nature is fitting to observed gravity response and the edges are fixed according to magnetic(TF) anomaly.

Filters (Analytical Signal, Horizontal Derivative and Vertical Derivative) of Gravity-Magnetic Profiles from Nagargadi

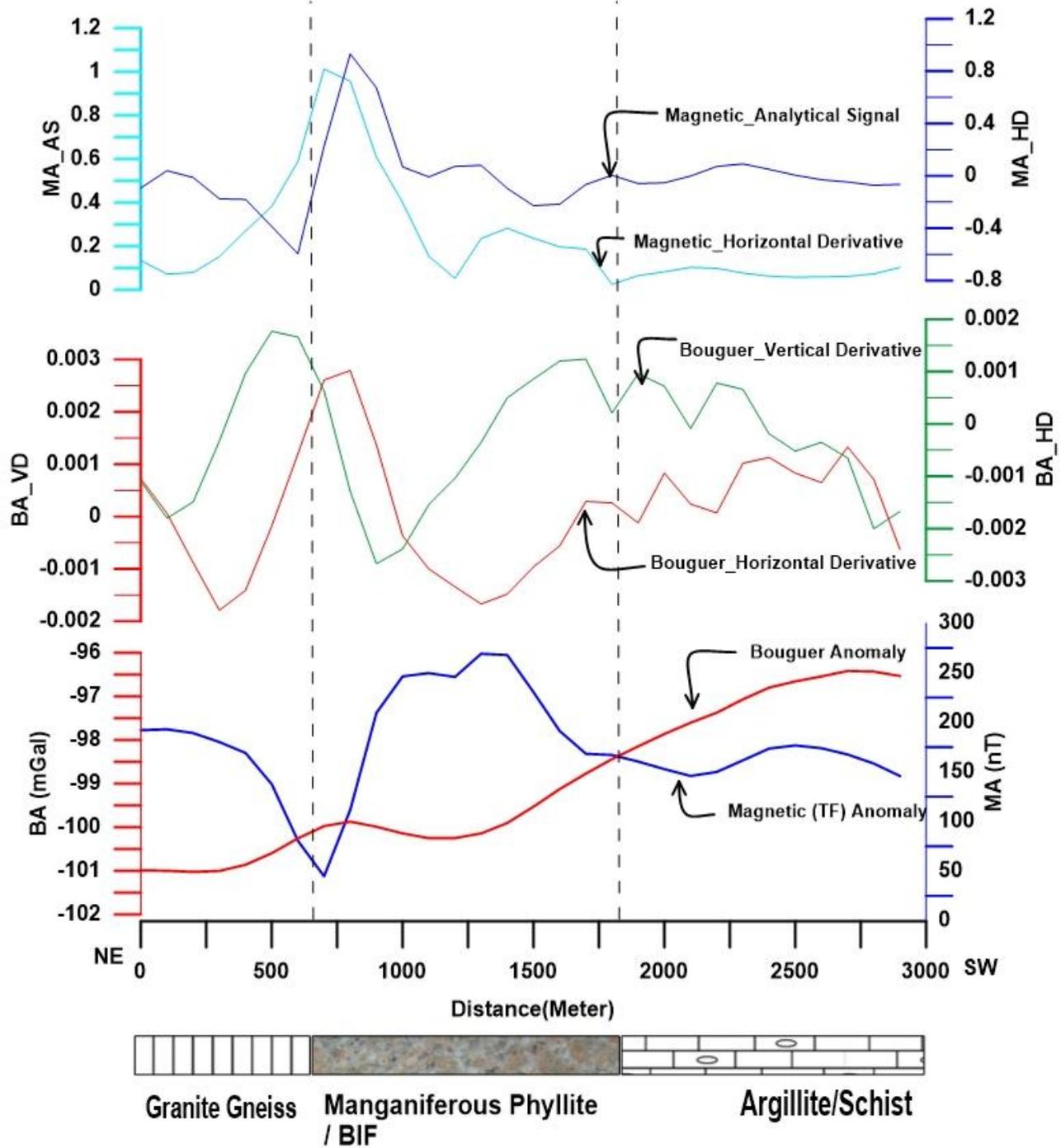


Figure-2: Gravity and Magnetic profile and processed data near Nagargadi area

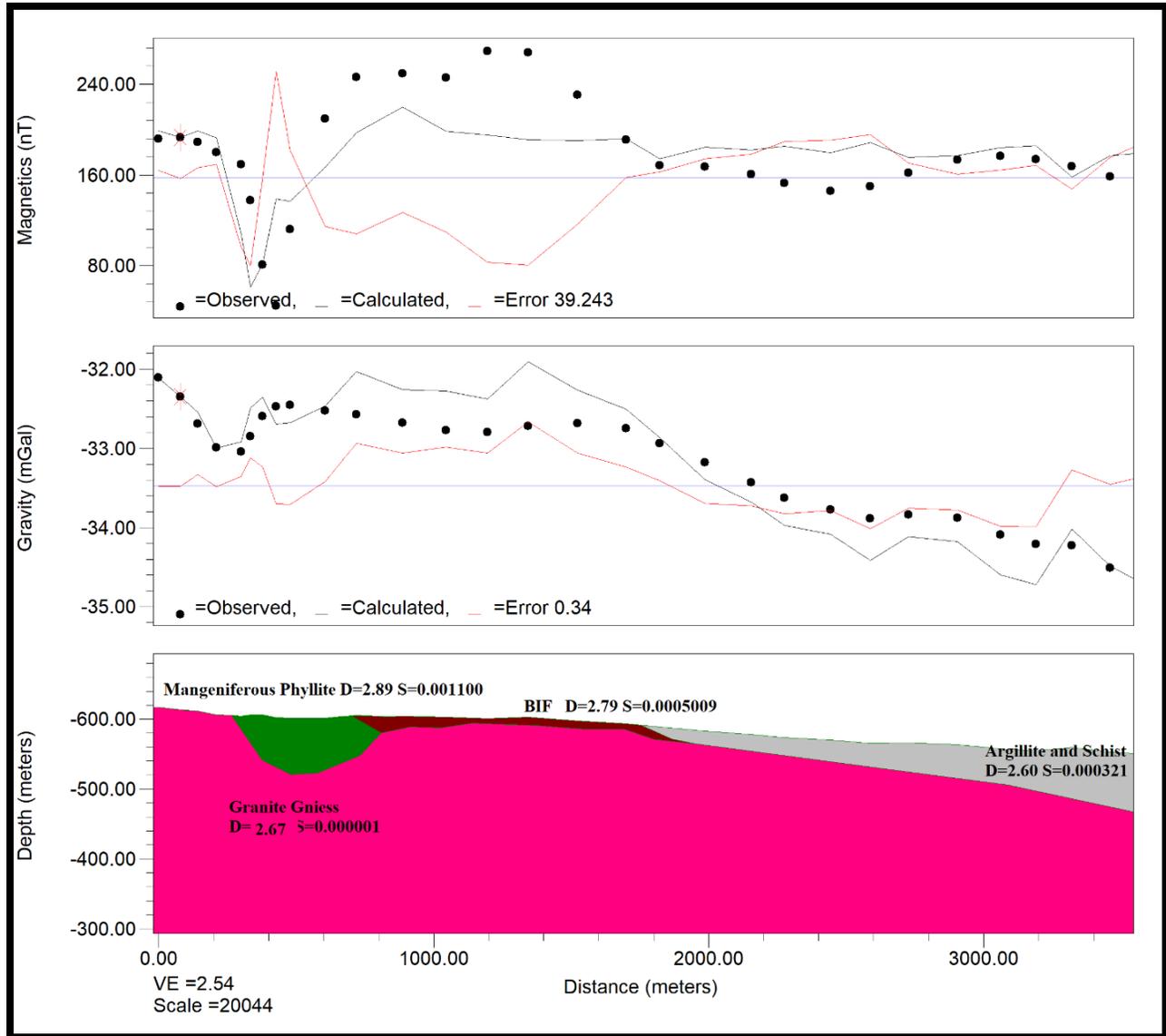


Figure-3: Gm-SYS 2D modelling of gravity and magnetic profile near Nagargadi.

Conclusion

In our additional work, we have done a semi-detailed survey of an area of interest. The area was chosen from studying gravity and magnetic response of our NGPM data with correlation of geology of area. We have done a traverse line, scientifically chosen to estimated maximum variation in depth and surface extension. The estimated depth at limb is approximately 200 meter. The additional data collected over a profile chosen from NGPM data has helped in quantifying the depth persistence of mineralized manganiferous phyllite.