

Index	Content	Page no.
1.0	Introduction-----	1
1.1	Scope of work-----	1
1.2	Geology of the area-----	2
1.3	Regional Geology-----	2
1.4	Geology of the block-----	4
2.0	Brief introduction of geophysical method-----	5
2.1	Induce polarisation-----	5
2.2	Self-potential method-----	5
2.3	Magnetic method-----	6
3.0	Geophysical quantum of work-----	8
4.0	Field activities-----	9
4.1	Duration of work-----	9
4.2	Back-office work-----	9
4.3	List of personnel-----	9
5.0	Exploration parameter-----	10
5.1	Field design and field data acquisition-----	13
5.2	Magnetic Method-----	13
5.3	IP Survey design-----	13
5.4	SP Survey design-----	14
6.0	Data reduction and processing-----	15
6.1	Magnetic Survey-----	15
6.2	Induced Polarization (IP) and Resistivity Profiles-----	15
6.3	Self-Potential (SP) Profiles-----	16
7.0	Results of Geophysical Survey-----	17
7.1	Magnetic-----	17
7.2	Reduced to Pole (RTP)-----	17
7.3	Residual Magnetic Anomaly-----	18
7.4	Analytic Signal Analysis Map-----	19
7.5	Radially Average Power Spectrum-----	19
7.6	Induced Polarization (IP) Profiles-----	20
7.7	IP Responses-----	20
7.8	Self-Potential (SP) Survey-----	21
8.0	Conclusion and Recommendations-----	22

List of Figures

Fig. 2.1	Source current and voltage decay with respect to time in IP time domain method
Fig. 2.2	The mechanism of self-potential anomalies
Fig. 2.3	Schematic diagram magnetic field vector
Fig. 5.1	Location map of the Jamtola-Khandapar of Block-I & II
Fig. 5.2	Block Boundary and traverse lines and survey stations of Jamtola-Khandapar Block-I
Figure 5.4	Block Boundary and traverse lines and survey stations of Jamtola-Khandapar Block-II
Fig. 5.5	Dipole – Dipole Configuration
Fig. 5.6	Data acquisition pattern in subsurface for roll along profiles.
Fig. 5.7:	Fixed Base SP Method Survey Configuration
Fig. 6.1.1.1:	Total Magnetic Intensity (TMI) map of Block-I
Fig. 6.1.1.2:	Magnetic Anomaly (MA) Map of Block-I
Fig. 6.1.1.3	Reduced to Pole (RTP) Map of (TMI) of Block-I
Fig. 6.1.1.4	Upward Continuation Map of Magnetic Anomaly at 100 m of Block-I
Fig. 6.1.1.5	Residual Anomaly Map of Magnetic Anomaly at 100 m of Block-I
Fig. 6.1.1.6:	Analytical Signal Analysis (ASA) Map of Block-I
Fig. 6.1.1.7	Radially Average Power Spectrum of Block-I
Fig. 6.1.1.8	Total SP anomaly Map of Block-I
Fig. 6.2.1.1:	2D Section of Resistivity and Chargeability (Line 1 to 04) of Block-I
Fig. 6.2.1.2	2D Section of Resistivity and Chargeability (Line 6 to 09) of Block-I
Fig. 6.2.1.3	2D Section of Resistivity and Chargeability (Line 10 to 13) of Block-I
Fig. 6.2.1.4	2D Section of Resistivity and Chargeability (Line 14 to 16) of Block-I
Fig. 2	Total Magnetic Intensity (TMI) Map of Block-I
Fig. 3	Magnetic Anomaly (MA) Map of Block-II
Fig. 4	Reduced to pole (RTP) map of (TMI) of block-II
Fig. 5	Upward Continuation Map of Magnetic Anomaly at 100 m of Block-II
Fig. 6	Residual Anomaly Map of Magnetic Anomaly at 100 m of Block-II
Fig. 7	Analytical Signal Analysis (ASA) Map of Block-II
Fig. 8	Radially Average Power Spectrum of block-II
Fig. 9	Total SP anomaly map of block-II
Fig. 10	SP Profile Map of block-II
Fig. 6.2.2.1	2D section of resistivity and chargeability (line 20 to 22) of block-II
Fig. 6.2.2.2	2D section of resistivity and chargeability (line 23 to 25) of block-III
Fig. 6.2.2.3	2D section of resistivity and chargeability (line 26 to 28) of block-III
Fig. 6.2.2.4	2D Section of Resistivity and Chargeability (Line 29 to 31) of Block-II
Fig. 6.2.2.5	2D Section of Resistivity and Chargeability (Line 32 to 34) of Block-II
Fig. 6.2.2.6	2D Section of Resistivity and Chargeability (Line 35 to 36) of Block-II

Table no.	Name	Page
Table 1.1	Regional stratigraphic sequence of litho units (After GSI)	3
Table 1.2	Stratigraphic sequence of the Jamtola-Khandapar G4 Block for Gold (After GSI)	4
Table 4.1	List of Personnel	9
Table 5.1	Coordinates of the corner points of the Jamtola-Khandapar block-I 1.434 Sq. Km	10
Table 5.2	Instruments Details	12
Table 6	Proposed inferred Borehole Locations for Block-I	22
Table 7	Proposed inferred Borehole Locations for Block-II	23

1.0 INTRODUCTION

Mineral Exploration & Consultancy Limited (MECL) formerly as Mineral Exploration Corporation Limited having its corporate office at Nagpur, Maharashtra is functioning under Ministry of Mines, Government of India with 100% holding for systematic exploration of minerals.

In view of the MMDR amendments act -2015, Minerals (Evidence of Mineral Contents) Rule 2015 and Mineral Auction Rule-2015, Ministry of Mines, MECL prepared proposal for G-4 level exploration of Jamtola-Khandapar Block and submitted in the 57th meeting of Technical-cum-Cost Committee (TCC) of NMET held on 26-27 September 2023 for approval. After detailed discussion TCC recommended it for approval of Executive Committee (EC) of NMET. The proposal was approved by EC in its 32nd meeting held on 06.12.2023 and approval received from NMET on 12.12.2023.

1.1 SCOPE OF WORK

Based on the evaluation of available geological data and reported known occurrence of the exploration scheme of Jamtola-Khandapar G4 block, Balaghat District of Madhya Pradesh is formulated with the following objectives:

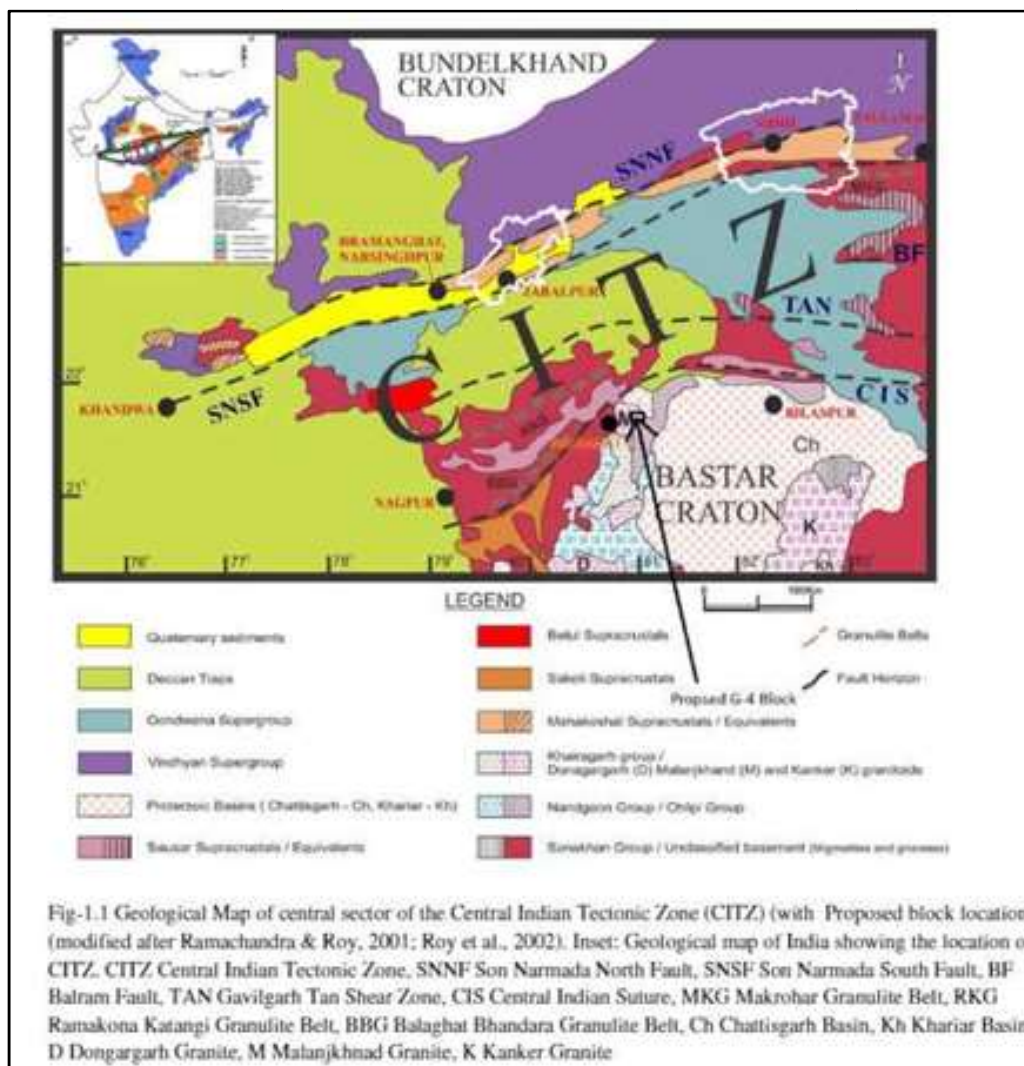
Phase-I

- To carry out Geological & structural mapping on 1:12,500 scale for demarcation of gold bearing host rock with the structural features to identify the surface manifestations and lateral and vertical disposition of the mineralized zones.
- To collect Surface samples including bedrock, Stream, Soil, Channel samples and Trench samples & to analyze for Gold and associated minerals to shape up for further course of Exploration program.
- Pitting / trenching will be done to expose the concealed host rock and mineralization.
- Geophysical Survey to delineate the suitable auriferous zones.
- To demarcate concealed potential mineralisation zones by carrying out surface geophysical survey i.e. IP cum Resistivity, Self-Potential (S.P) and Magnetic at 100 m traverse interval and 20 m station interval.
- To establish strike and depth continuity of mineralized body.
- To estimate resources as per UNFC norms Minerals (Evidence of Mineral Contents) Amendment Rules 2021.
- To upgrade the block to the higher level of exploration.

If phase-I exploration data will give positive results, 5 Nos. of scout boreholes may be drilled.

1.2 GEOLOGY OF THE AREA:

The Survey area belongs to granite gneiss of Amagaon Gneissic Complex, Gneisses and Migmatites of Tirodi Gneissic Complex, Intrusive Granites of Malanjkhanda Granite, Muscovite Schist, Schistose Grit of Sausar Group, Phyllites, Quartzite and Conglomerates of Chilpi Group and Basalts of Deccan Trap and Laterites.



1.3 Regional geology:

Regionally, the area falls near the southern boundary of the central India tectonic zone (CITZ) and Bastar craton. Central Indian Tectonic Zone (CITZ) in the Nagpur-Balaghat area, trending in the EW to ENE- WSW direction with about 20 to 40 km wide: and 300: 350km long. The belt is made up of four major geologic components, from south to north, the southern granulite belt, the supracrustal metasedimentary rocks of the Sausar Group, reworked in lenses of the Tirodi gneiss and the northern granulite belt.

Due to the effect of CITZ, the area in an around of CITZ, including the proposed block area has undergone intense shearing which is responsible factor for various mineralization in the

area including Gold, Copper, Manganese etc. The area lies in SW of the famous Malanjkhand Copper deposit. Part of Sausar group also falls in the area. The Chilpi Group was deposited between 2100 and 1800 Ma (Mohanty, 2015).

Stratigraphy, structure and metamorphism of the metasedimentary rocks of the eastern parts of Balaghat district have been studied by many workers since the last decade of the nineteenth century due to the economic significance of the manganese deposits in these areas. Similarly, the Malanjkhand copper mine and its environs have also been studied by many workers ever since the old workings at Malanjkhand came into light during late nineteenth century.

The area is exposed with granite gneiss of Amagaon Gneissic Complex, Gneisses and Migmatites of Tirodi Gneissic Complex, intrusive Granites of Malanjkhand Granite, Muscovite Schist Schistose Grit of Sausar Group. Phyllites, Quartzite and Conglomerates of Chilpi Group and Basalts of Deccan Trap and laterites, Gold Mineralisation is observed in the Quartz veins present within phyllites.

Major Lithology present in the area is Phyllites of Chilpi Group of Palaeo-Meso Proterozoic age which is present in the central, eastern and southern part of the area within which Malanjkhand Granite is observed as intrusive which the second dominant lithology in the region is Western part of the region is characterized by granite gneiss of Amagaon Gneissic Complex and gneisses and Migmatites of Tirodi Gneissic Complex.

Regional stratigraphic succession of the litho-units after GSI is illustrated in the Table 1.

Table 1.1: Regional Stratigraphic sequence of Litho units (After GSI)

Age	Group	Lithology
Recent to sub-recent	---	Laterite
Eocene to Up Cretaceous	Deccan Trap	Basalt
	-----Unconformity-----	
Palaeo-Meso Proterozoic	Chilpi Group	Pegmatites and Quartz veins, Phyllite with lenses of schistose grit and Crystalline limestone, quartzite. Ortho quartzite and conglomerate.
Palaeo Proterozoic	Sausar Group	Schistose grit, Muscovite Schist
	-----Unconformity-----	
Palaeo Proterozoic	Malanjkhand Granitoid	Granite
	-----Unconformity-----	
ARCHAEO	Amagaon Gneissic Complex	Granite gneiss with migmatite gneiss
	Tirodi Complex	Granitic gneisses with migmatite/granite

1.4 Geology of the Block:

General Geology:

The area mostly exposes litho-units belonging to Amagaon Gneissic Complex, Gneisses and Migmatites of Tirodi Gneissic Complex, Intrusive Granites of Malanjkhanda Granite, Phyllites, Quartzite of Chilpi Group, and Basalts of Deccan Trap and Laterites. Gold mineralization is observed in the sheared quartz veins present within phyllites near Khandapar area.

Important Lithologies Present in the Area:

- I. **Granite gneisses with migmatite/granite:** This lithology belongs to Archean aged Tirodi Gneissic Complex, which is the oldest rock present in the region. It is present as an elongated stretch in the west central part of the block having a NE-SW trend.
- II. **Granite gneiss with migmatite gneiss:** This lithology belongs to Amagaon Gneissic Complex and is present in the western part of the block. These are of Archean age having foliation of NE-SW and dipping towards NW.

Malanjkhanda Granitoid Intrusive: Granites of Malanjkhanda Granitoid group are present in the central part of the block as one of the dominant lithology in the block along with a few amphibolites dykes within it. This body forms a suite of rocks varying from diorite, quartz diorite, adamellite to granodiorite. The granodiorite is coarse-grained, pinkish grey to grey in colour and comprises quartz, feldspar and mafic. Hornblende is the chief mafic mineral along with chlorite being an alteration product. Shearing along the earlier mentioned trends are common also in the granodiorite. Free quartz is present predominantly within granodiorite. Inconsistent Copper mineralisation is present within these lithologies.

The tentative stratigraphic sequence of litho units exposed in the block area (After GSI) is given in table 1.2:

Table 1.2: Stratigraphic sequence of the Jamtola-Khandapar G4 Block for Gold (After GSI)

Age	Group	Lithology
Eocene to Up Cretaceous	Deccan Trap	Basalt
-----Unconformity-----		
Palaeo-Meso Proterozoic	Chilpi Group	Pegmatites and Quartz veins, Phyllite with lenses of schistose grit and Crystalline limestone, quartzite. Ortho quartzite and conglomerate.
-----Unconformity-----		
Palaeo Proterozoic	Malanjkhanda Granitoid	Granite
-----Unconformity-----		

2.0 BRIEF INTRODUCTION OF GEOPHYSICAL METHODS:

2.1 Induced Polarization:

Induce Polarization is the phenomena referred to build up of ionic charges in subsurface materials under the influence of electric field. There are two types survey method in IP

- I. Time Domain.
- II. Frequency Domain.

- I. **Time Domain:** The normalised area under the decay curve is the most often measured type of time domain IP. Using the parameters listed in the adjacent graphic, the following equation may be used to represent it.
Essentially, chargeability (M) is the red region beneath the decay curve that has been normalised by the source voltage.

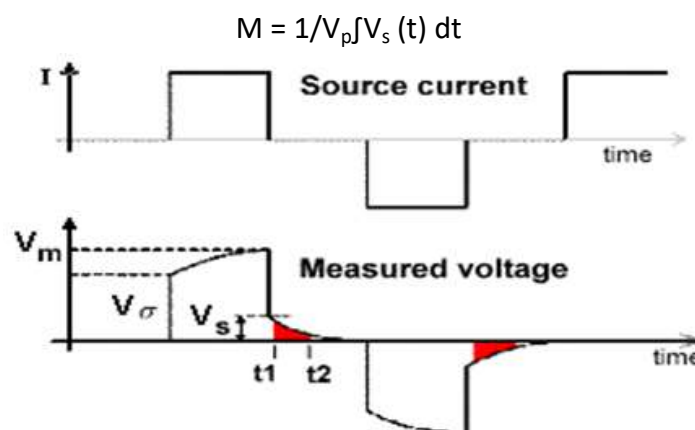


Fig. 2.1: Source current and voltage decay with respect to time in IP time domain method.

- II. **Frequency Domain:** In frequency domain method the amplitude of potential is measured for two frequencies and it can be expressed as frequency effect. In this method the resulting data include i) DC resistivity ρ_{dc} and ii) ρ_{ac} for non-zero low frequency. Frequency Effect can be expressed as following equation.

$$FE = (\rho_{ac} - \rho_{dc}) / \rho_{ac}$$

Similar to resistivity method depth of investigation can be increased by increasing spread of the array.

All the different type of array in IP method has their advantages and disadvantages, so it is very crucial to select optimum array method considering our objective.

2.2 Self-Potential Method:

The Self Potential method is based on the surface measurement of natural potential differences resulting from electrochemical reactions in the subsurface. Typical SP anomalies may have amplitude of several hundred millivolts(mV) with respect to barren ground. They invariably exhibit a central -Ve anomaly and are stable over long periods of time. Field studies indicate that for a SP.Anomaly to occur its causative body must lie

partially in a zone of oxidation. They are usually associated with deposits of metallic sulphides, magnetite or graphite.

A widely-accepted mechanism of self-potential requires the causative body to straddle the water table. Below the water table electrolytes in the pore fluids undergo oxidation and release electrons which are conducted upwards through the ore body. At the top of the body the released electrons cause reduction of the electrolytes. A circuit thus exists in

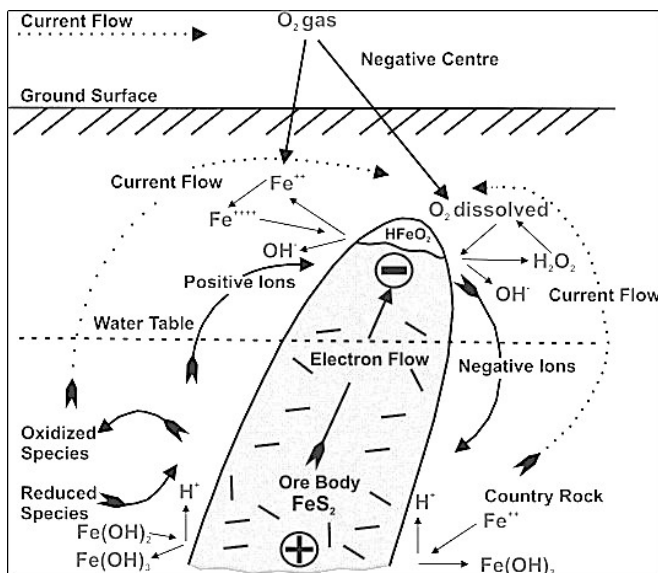


Fig.2.2: The mechanism of self-potential anomalies

which current is carried electrolytically in the pore fluids and electronically in the body so that the top of the body acts as a negative terminal. This explains the negative SP anomalies that are invariably observed and their stability as the ore body itself undergoes no chemical reactions and merely serves to transport electrons from depth. As a result of the subsurface currents, potential differences are produced at the surface.

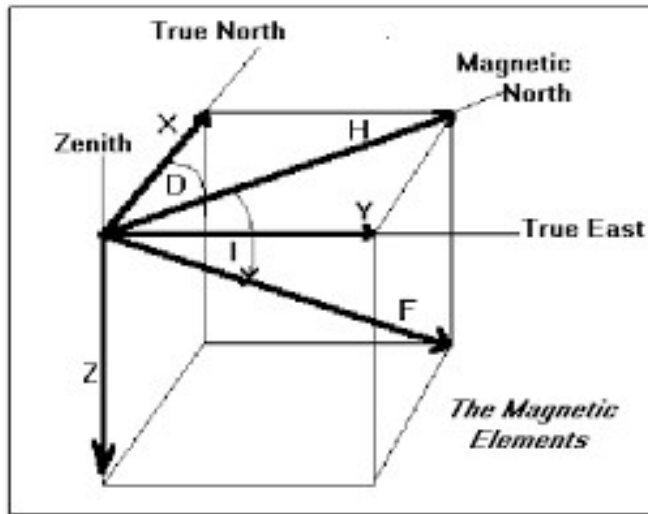
2.3 Magnetic Method:

Generally, the aim of a magnetic survey is to investigate subsurface geology on the basis of the anomalies in the earth's magnetic field resulting from the magnetic properties of the underlying rocks. In general, the magnetic content (susceptibility) of rocks is variable depending on the rock type. Commonly causes of magnetic anomalies include dykes, faults and lava flows. In case of geothermal environment, due to high temperatures, the susceptibility decreases. It is not usually possible to identify with certainty the causative bodies of any anomaly from magnetic information alone.

Magnetism is, just like gravity, a potential field. So, it is also possible to transform one potential field to others. Anomalies in the earth's magnetic field are caused by induced or remnant magnetism. Induced magnetic anomalies are the result of secondary magnetization induced in a ferruginous body by the earth's magnetic field. The shape dimensions, and amplitude of an induced magnetic anomaly is a function of the orientation, geometry, size, depth, and magnetic susceptibility of the body as well as the intensity and inclination of the earth's magnetic field in the survey area.

The magnetic method involves the measurement of the earth's magnetic field intensity. At any point on the Earth's surface a freely suspended magnetic needle will assume a position in space in the direction of the ambient geomagnetic field.

This will generally be at an angle to both the vertical and geographic north. A schematic diagram is given below in order to describe the magnetic field vector. The total field vector B has a vertical component Z and a horizontal component H in the direction of magnetic north. The dip of B is the inclination I of the field and the horizontal angle



between geographic and magnetic north is the declination D . In the present study total magnetic field has been measured. Measurements are of the horizontal or vertical component or horizontal gradient of the magnetic field.

Fig.2.3: Schematic diagram magnetic field vector

3.0 GEOPHYSICAL QUANTUM OF WORK:

The scope of work consists of acquisition, processing and interpretation of ground geophysical data across a prospective mineralized area spanning 3.55 square kilometers. The Profile lines were designed and aligned in such a way that it lays across the regional geological strike direction of the targeted potential zones and to be covered with 25 lines km (2.5 Unit) of IP, SP and magnetic Survey Profile as approved by NMET.

Survey Details:

The 25-line kilometers were divided into two blocks: Block-I (Fig.5.2) having area 1.43 square kilometers near Khandapar village which is possible associated with gold mineralization and the Block-II (Fig.5.3) having area 2.090 square kilometers near Karwahi village which is possible associated with graphite mineralization covering of 13.0 and 12.2 line-kilometers respectively.

The lines were kept at 100 meters spacing with 20 meter as station spacing for recording data. The survey consists of Induced Polarization (IP) cum Resistivity, Ground Magnetic, and Self-Potential (SP) methods to detect subsurface anomalies indicative of mineralization. The objective of the Geophysical survey was to delineate Gold and Graphite mineralization and its host rock with other associated mineralized zone in respective blocks.

4.0 FIELD ACTIVITIES:

A base camp was established near the Jamtola-Khandapar block to facilitate the geophysical survey in both the blocks. The survey team consisted of three to four members (Table 4.) equipped with specialized instruments including the ENVI Pro Magnetometer for magnetic measurements, the IRIS Syscal R2 Resistivity Meter for SP data recording, the Syskal Kid 72 Channels for IP-cum-Resistivity measurements and Trimble Juno Handheld GPS unit for precise location tracking/markings. Detailed specifications of this equipment are provided in Table 5. The location Map/Block boundary map, along with its coordinates, is presented in Figure 5.1. and Table 5.1 respectively. To ensure accuracy and minimize disturbances the magnetic base was established outside of the Jamtola-Khandapar block boundary area, as specified in Table.

4.1 DURATION OF WORK:

The Geophysical survey was completed within 60 days i.e. from 24-10-2024 to 24-12-2024

4.2 BACK-OFFICE WORK:

- QA/QC of acquired data on day-to-day basis.
- Preliminary processing of data to check for errors/jumps and any repetition if needed.
- Monitoring of covered Line Km and area.

4.3 LIST OF PERSONNEL

The following personnel were involved in the project as given below:

Table 4.1: List of Personnel

Sl. No.	Name & Designation	Responsibility
1.	G.S. Dhami HOD (GS)	Heading the Project, Planning Monitoring, Liasoning, Data processing, interpretation and report writing.
2.	ABBS Rama Krishna Manager (Geophysicist)	Survey design
3.	Rajat Kumar Geophysicist	Data acquisition, Data QA/QC, Data processing, interpretation& report writing
4.	Vikas Kumar (Contingent Geophysicist)	Data acquisition.
5.	Rupesh D Jambhale Sr. Tech.(S&D)	Surveying
6.	Puneeth P Khandale Sr.Tech. (S&D)	Surveying

5.0 EXPLORATION PARAMETER

Project Area And Location:

The block is located in Baihar and Paraswada tehsil of Balaghat district in Madhya Pradesh. Major villages in the proposed block are Khandapar, Patpari, Jamtola, Kinarda, Kiniyan, Barwahi, Katangi etc.

The proposed block is situated about 40 km in NE direction of Balaghat which is the district headquarter. The proposed block is well connected to Balaghat via MP SH-26 which connects Khategaon and Amarkantak and passes through the NW corner of the proposed block. NH-543 is the spur road of National Highway 43 that passes through Balaghat.

Balaghat Junction (station code: BTC) is situated on the Jabalpur–Nainpur–Gondia section of South East Central Railway in Madhya Pradesh. The nearest airport from the proposed block is situated in Gondia in Maharashtra (~65km in SW direction). Another airport is there in Jabalpur, MP (~145 km in SW direction).

The proposed block has the area of 96.62 sq km and it falls in Survey of India Toposheet No. 64C/09.

Table 5.1: Coordinates of the corner points of the Jamtola-Khandapar Block (3.524 Sq.km)

Co-ordinates of the corner points of the Jamtola-Khandapar Block-I 1.434 Sq.km. Khandapar				
Block Corner Points	WGS 84 (DD MM SS)		UTM ZONE 44-N	
	Longitude	Latitude	Easting	Northing
A	80° 30' 17.07" E	21° 57' 37.43" N	448864.3	2428526
B	80° 30' 49.14" E	21° 57' 37.52" N	449784.3	2428526
C	80° 30' 29.79" E	21° 56' 48.68" N	449224.3	2427026
D	80° 30' 01.20" E	21° 56' 48.59" N	448404.3	2427026
E	80° 30' 01.14" E	21° 57' 04.85" N	448404.3	2427526
F	80° 30' 01.83" E	21° 57' 08.11" N	448424.3	2427626

Co-ordinates of the corner points of the Jamtola-Khandapar Block-II 2.090 Sq.km. Karwahi				
Block Corner Points	WGS 84 (DD MM SS)		UTM ZONE 44-N	
	Longitude	Latitude	Easting	Northing
G	80° 33' 40.27" E	21° 58' 9.52" N	454695.1	2429495
H	80° 34' 10.25" E	21° 58' 9.60" N	455555.1	2429495
I	80° 34' 16.99" E	21° 59' 27.67" N	455755.1	2431895
J	80° 33' 46.30" E	21° 59' 27.59" N	454875.1	2431895

Magnetic Base coordinates				
Magnetic Base	Longitude	Latitude	Easting	Northing
	80° 32' 65.9" E	21° 59' 24.10" N	452960	2431498

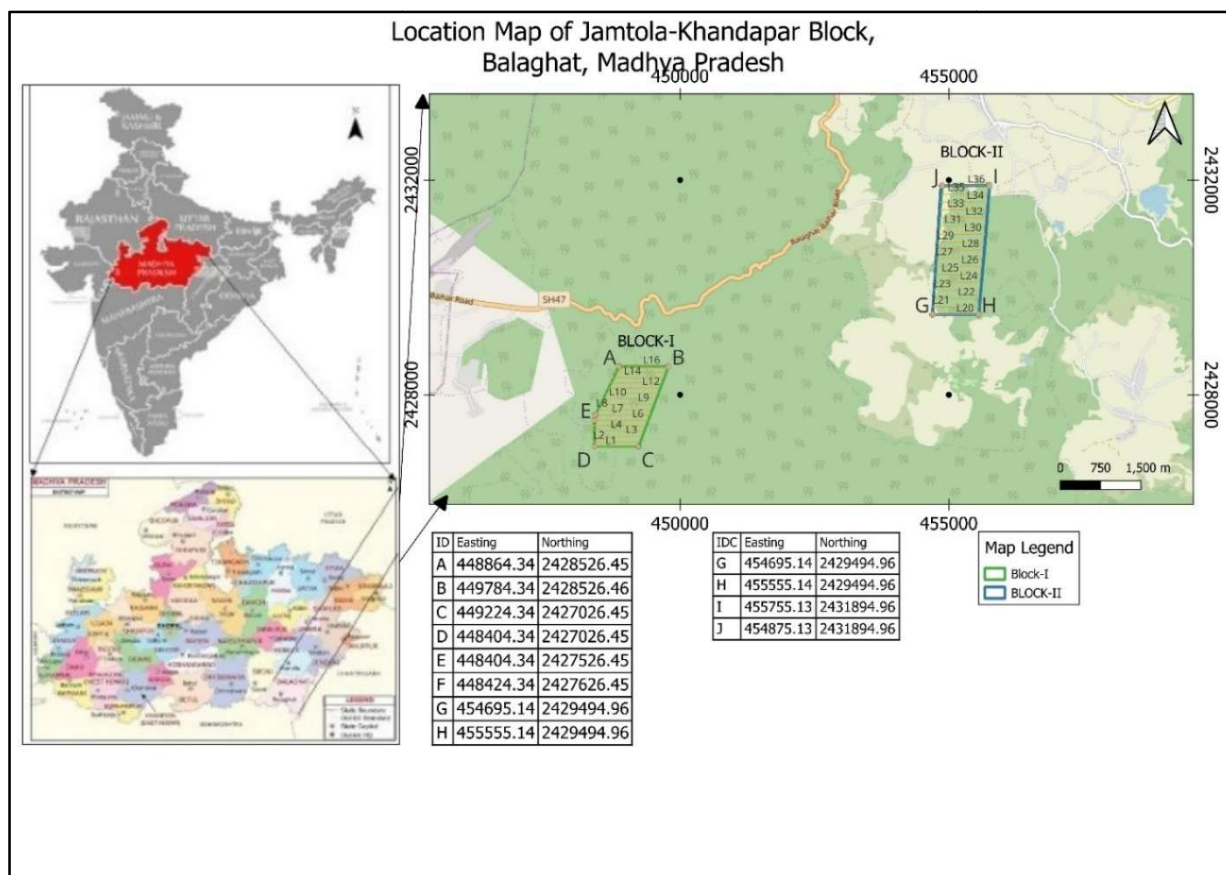


Fig.5.2: Location map of the Jamtola-Khandapar of Block-I & II

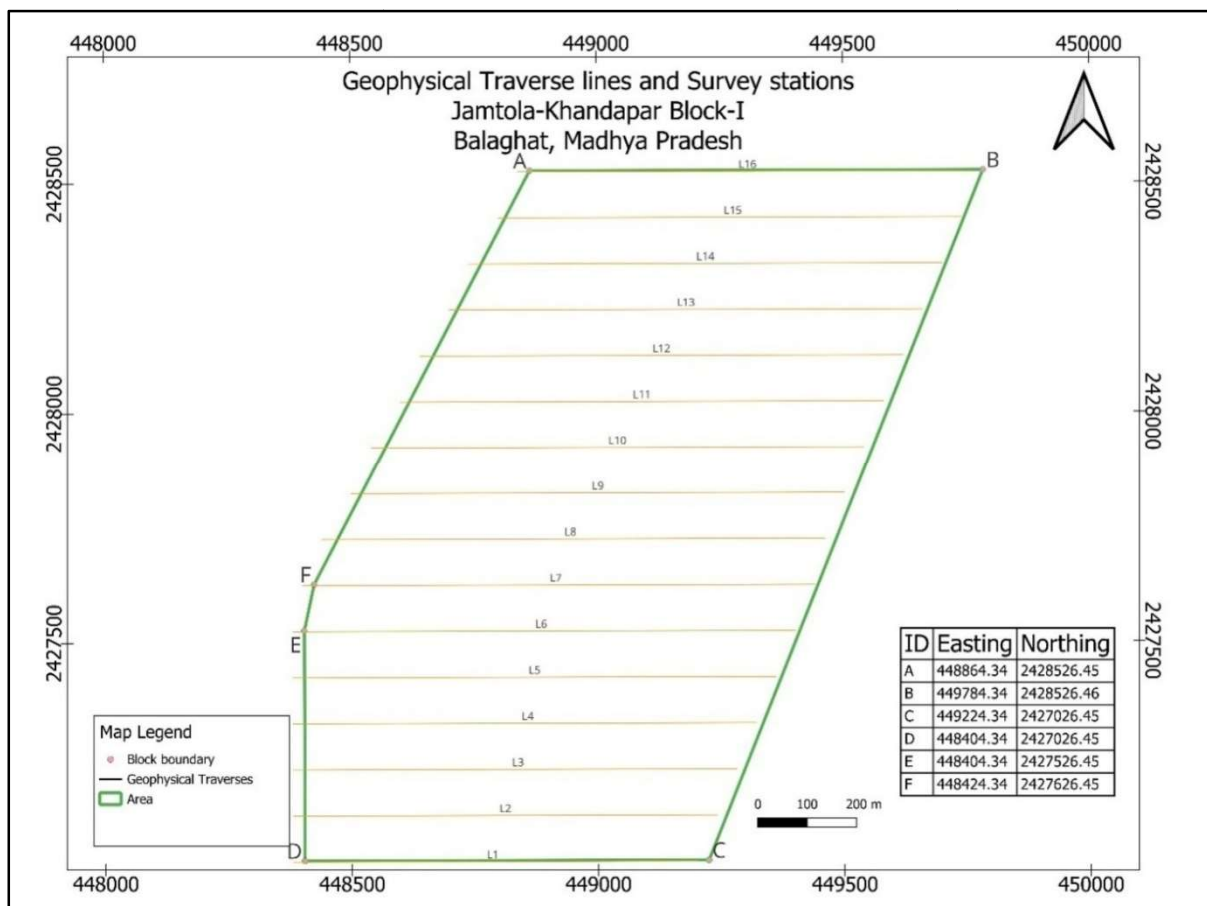


Fig.5.2: Block Boundary and traverse lines and survey stations of Jamtola-Khandapar Block-I

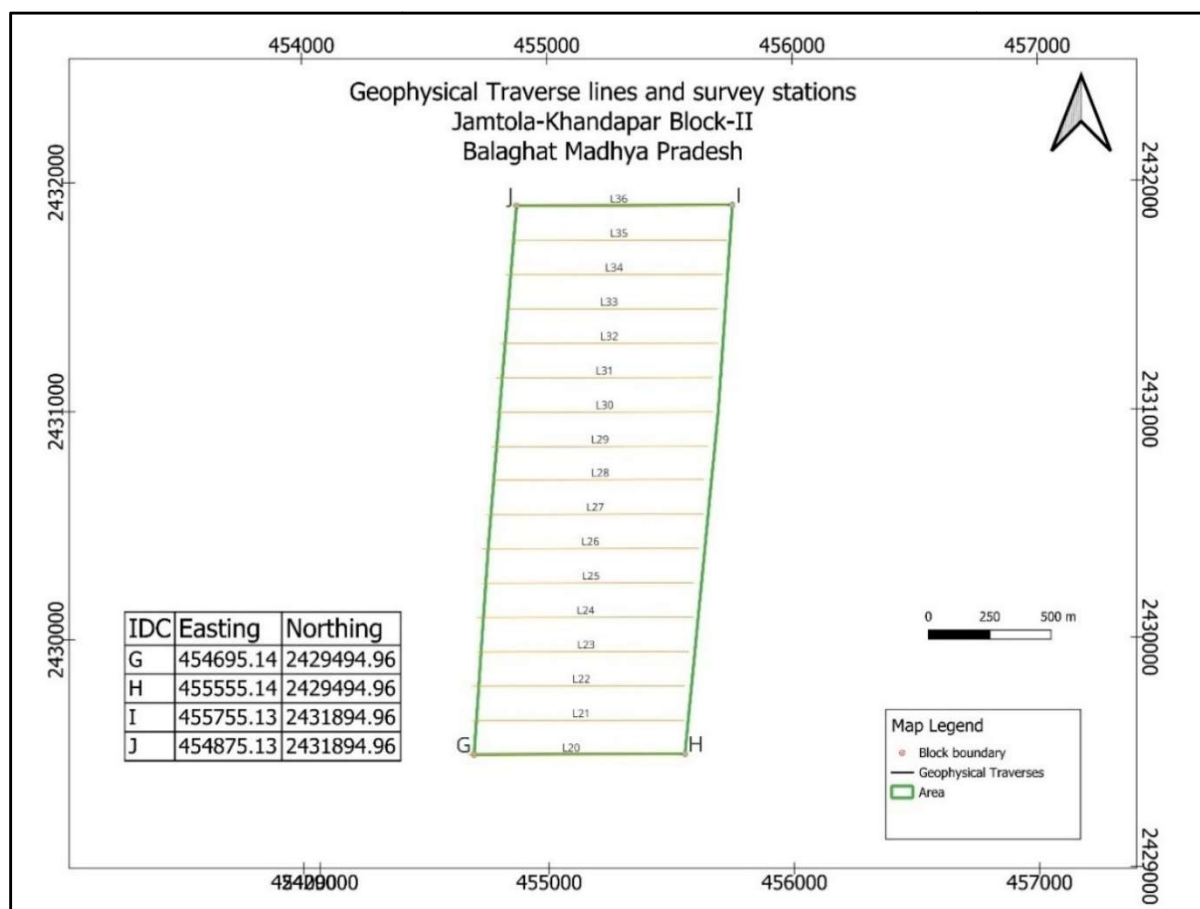


Figure 5.4: Block Boundary and traverse lines and survey stations of Jamtola-Khandapar Block-II.

Table 5.2: Instruments Details

INDUCED POLARIZATION DATA ACQUISITION UNIT	
Type	Multi -Electrode
Make	IRIS(SYSKAL-PRO)
Maximum No of Channel	72
Minimum Channel Interval	10
Sensitivity	1 μ V/0.2
MAGNETOMETER	
Type	Proton Precision Magnetometer (PPM)
Make	Scintrex (ENVI Pro MAG)
Sensitivity	0.1 nT
Accuracy	+1nT
Range	23000 to 100000 nT
RESISTIVITY METER (SP Measuring Unit)	
Type	SYSKAL R2 Resistivity meter with IP & SP measurements
Make	IRIS Instrument

Input impedance	100 MOhm
Voltage resolution	1 μ V/0.2%
Voltage accuracy	0.2%
Automatic compensation of SP	-5V to +5V
SURVEYING	
Type	DGPS
Model	Trimble

5.1 Survey Design and Field Data Acquisition:

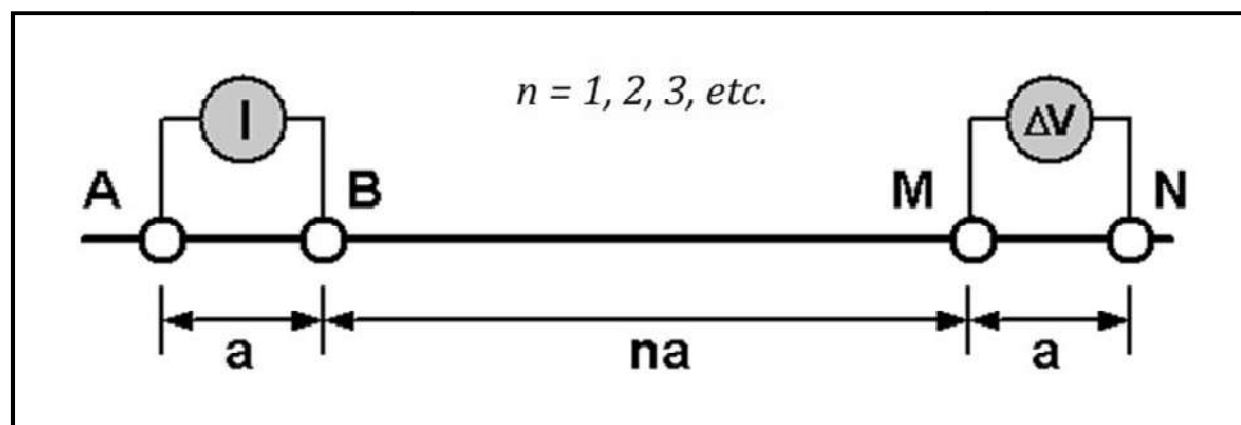
The survey stations were fixed in the grid pattern with line interval of 100m and station spacing as 20m using DGPS and demarcated locations by putting pegs with marked line and station number.

5.2 Magnetic Method:

The survey was designed in a grid pattern with a line interval of 100 meters and a station spacing of 20 meters, with positions marked using Hand held DGPS. Survey locations were meticulously demarcated by placing pegs, each indicating the corresponding line and station number. The layout map of the traverse lines and observation stations is shown in Fig. 4. The Magnetic data was recorded at every station with starting and ending at the base station on routine basis. The survey was meticulously designed to detect subtle changes in the magnetic field, which could indicate the presence of geological features such as shear zones, faults, and mineralized bodies.

5.3 IP Survey Design:

An induced polarization (IP) survey is conducted using various electrode arrangements, typically involving four electrodes: two current electrodes (C1 and C2) and two potential electrodes (P1 and P2). The choice of electrode configuration depends on the specific objectives of the survey. Different arrangements can provide different responses based on geological conditions. For instance, to map lateral changes in geological structures, the Dipole-Dipole and Werner arrays are often more effective. In this case, the Dipole-Dipole array, as illustrated in Figure 4.2.1, has been employed for the Block survey, with the



preplanned survey block shown in Figure 4.1.1.

Fig. 5.5: Dipole – Dipole Configuration.

In the current field survey, a total of 36 channels were used for subsurface imaging, with an electrode spacing of 20 meters and a maximum array length of 720 meters. The multi-electrode channel system automatically selects various combinations of current (C1 and C2) and potential (P1 and P2) electrodes from the 36 available electrodes, enhancing the efficiency of subsurface imaging within an optimal timeframe. Throughout the survey block, a cumulative total of 31-line kilometers of profile data were recorded. A graphical representation of the multi-electrode system is provided for better illustration.

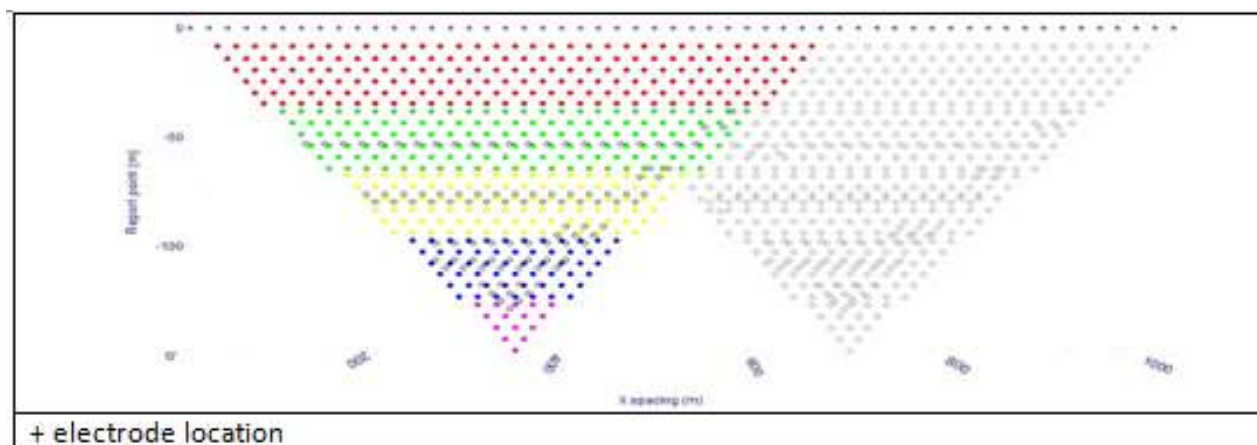


Fig. 5.6: Data acquisition pattern in subsurface for roll along profiles.

5.4 SP Survey Design:

The SP survey was carried out using non-polarizing electrodes and a high-impedance voltmeter, along with an SYSCAL R2 system. The recording was done in a grid pattern, with a station spacing of 20 meters and line spacing of 100 meters. A total of 30 LKM was covered.

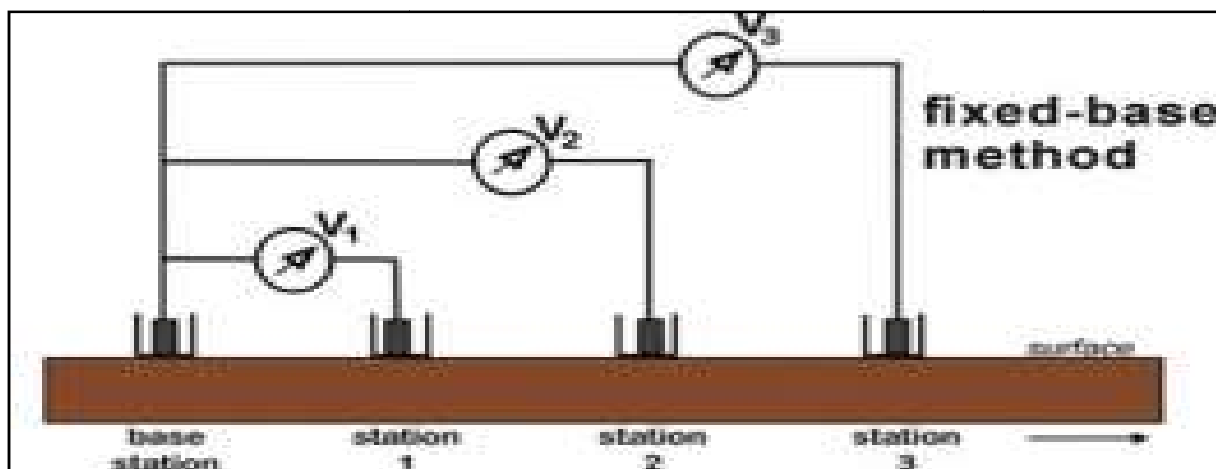


Fig. 5.7: Fixed Base SP Method Survey Configuration

6.0 Data Reduction and Processing.

6.1 Magnetic Survey:

Recorded magnetic data was corrected for diurnal variation of the geomagnetic field with respect to the base station where data was recorded at the start and end of every day field work. IGRF correction of model 2020 was applied on the data set to overcome the large-scale structure of the Earth's main magnetic field and its secular variation. The data was processed using Geosoft Oasis Montaj software and the below listed magnetic anomaly maps have been generated.

6.1.1 Maps for Block-I

- Total Magnetic Intensity (TMI) Map. (Fig.6.1.1.1)
- Magnetic Anomaly (MA) Map of Block-I. (Fig.6.1.1.2)
- Reduced to Pole (RTP) Map of (TMI) of Block-I. (Fig.6.1.1.3)
- Upward Continuation Map of Magnetic Anomaly at 100 m of Block-I. (Fig.6.1.1.4)
- Residual Anomaly Map of Magnetic Anomaly at 100 m of Block-I. (Fig.6.1.1.5)
- Analytical Signal Analysis (ASA) Map of Block-I. (Fig.6.1.1.6)
- Radially Average Power Spectrum of Block-I. (Fig.6.1.1.7)

After applying diurnal corrections, the recorded magnetic data showed variation of 951.6 nT with the highest total magnetic intensity value of 45563.6nT and minimum of 45315.2nT was observed in TMI map (Fig. 6.1.1.1). While the magnetic anomaly with respect to IGRF shows a minimum of -420.1nT and maximum of -180.1nT in Magnetic Anomaly Map (Fig. 6.1.1.2)).

6.1.2 Maps for Block-II

- Total Magnetic Intensity (TMI) Map. (Fig.6.1.2.1)
- Magnetic Anomaly (MA) Map of Block-II. (Fig.6.1.2.2)
- Reduced to Pole (RTP) Map of (TMI) of Block-II. (Fig.6.1.2.3)
- Upward Continuation Map of Magnetic Anomaly at 100 m of Block-II. (Fig.6.1.2.4)
- Residual Anomaly Map of Magnetic Anomaly at 100 m of Block-II. (Fig.6.1.2.5)
- Analytical Signal Analysis (ASA) Map of Block-II. (Fig.6.1.2.6)
- Radially Average Power Spectrum of Block-II. (Fig.6.1.2.7)

After applying diurnal corrections, the recorded magnetic data showed variation of 507.3nT with the highest total magnetic intensity value of 45686.5nT and minimum of 45179.2nT was observed in TMI map (Fig. 5.4.1.1). While the magnetic anomaly with respect to IGRF shows a minimum of -593.67nT and maximum of -83.93 nT in Magnetic Anomaly Map (Fig. 5.4.1.2).

6.2 Induced Polarization (IP) And Resistivity Profiles:

The resistivity data were checked station-wise to remove any near surface effect prevailing in the data. The pseudo-depth data were inverted using the RES2DINV software to bring out the subsurface resistivity and chargeability distribution. The inverted sections for recorded IP and

Resistivity data are processed in following order to obtain subsurface 2D models: -

1. Geo-referencing.
2. Edit/Mute (Noises).

3. Generate 2D models of subsurface with the help of IP and Resistivity data (Fig. 6.2.1.1 to Fig.6.2.1.4) of Block-I
4. Generate 2 D models of subsurface with the help of IP and Resistivity data (Fig. 6.2.2.1 to Fig. 6.2.2.6) of Block-II

6.3 Self-Potential (SP) Profiles:

The SP data was processed using Geosoft Oasis Montaj software.

6.3.1 Block-I

Total SP anomaly Map (Fig.6.3.1.1) and the SP Profile (Fig. 6.3.1.2) along each traverse have been generated from the SP data. Total variation in SP value was observed with the highest value of 294 mV and mV -146.3 mV as lowest.

1. Total SP anomaly Map of Block-I. (Fig.6.3.1.1)
2. SP Profile Map of Block-I. (Fig. 6.3.1.2)

6.3.2 Block-II

Total SP anomaly Map (Fig.6.3.2.1) and the SP Profile (Fig.6.3.2.2) along each traverse have been generated from the SP data. Total variation in SP value was observed with the highest value of 627 mV and mV -328.1 mV as lowest.

1. Total SP anomaly Map of Block-I. (Fig.6.3.2.1)
2. SP Profile Map of Block-I. (Fig.6.3.2.2)

7.0 RESULTS OF GEOPHYSICAL SURVEY

7.1 Magnetic:

7.1.1 Block-I

A total variation of 248.4 nT was observed in the Total Magnetic Intensity (TMI), with the maximum value recorded at 45,563.6 nT and the minimum at 45,315.2 nT, as shown in Figure 6.1.1.1. Similarly, the Magnetic Anomaly (MA) exhibits a total variation of 240 nT, with the highest value recorded at -180.1 nT and the lowest at -420.1 nT, as illustrated in Figure 6.1.1.2.

Both the TMI and MA maps show characteristic magnetic responses across various lithological units. Geologically, the magnetic anomaly map suggests that the structural control in the area is predominantly oriented in the north-south (N-S) direction. In the northern part of the area, magnetic high anomalous zones dominate, which may be controlled by the underlying geological structure. Additionally, some anomalies in the region show alignment in the east-west (E-W) direction, further suggesting structural influences.

7.1.2 Block-II

A total variation of 507.3 nT in the Total Magnetic Intensity (TMI) was observed, with the highest value recorded at 45,686.5 nT and the lowest at 45,179.2 nT. Similarly, the Magnetic Anomaly (MA) showed a total variation of 509.74 nT, with a maximum value of -83.93 nT and a minimum of -593.67 nT, as illustrated in Figures 6.1.2.1 and 6.1.2.2, respectively.

Both the TMI and MA data indicate characteristic magnetic responses corresponding to different lithological units, with a prominent north-south (N-S) orientation. The magnetic anomaly map suggests that the geological structure of the area is primarily controlled along the N-S direction, with a consistent trend observed throughout the region.

7.2 Reduced To Pole (RTP):

Because of the dipolar nature of geomagnetic field, the magnetic sources observed anywhere except magnetic poles are asymmetric, this feature makes the interpretation of magnetic data difficult. The reduced to pole (RTP) technique is implemented over the Magnetic anomaly grid in order to convert magnetic anomaly to symmetrical shape so that the angle of inclination is 90 degree and declination is zero and hence, the effect of dipoles were eliminated.

Block-I

The Reduction to the Pole (RTP) transformation of the magnetic anomaly map for Block-I was generated to enhance structural trends and highlight anomalous features. Although the RTP processing improved the clarity of magnetic anomalies and partially aligned them in the N-S direction, thus reducing the asymmetric effects of magnetic sources, no continuous structural trend is distinctly visible in the RTP map. This suggests that the magnetic sources may be discontinuous or structurally complex in nature, as shown in Fig. 6.1.1.3

Block-II

The Reduction to the Pole (RTP) transformation of the magnetic anomaly map for Block-II was performed to enhance structural trends and highlight anomalous features. The RTP-processed map clearly delineates an anomalous zone oriented in the north-south (N-S) direction. This transformation effectively realigned the magnetic anomalies toward their true causative sources, thereby mitigating the asymmetry typically caused by the inclination and declination of the Earth's magnetic field. As a result, the RTP map provides a clearer representation of subsurface structures and shows a better alignment of the anomalies with the known mineralization zone, as illustrated in Fig. 6.1.2.3. A consistent trend is observed, which is further supported by the correlation with other geophysical data, reinforcing the validity of the anomaly and its geological significance.

7.3 Residual Magnetic Anomaly:**Block-I**

The Residual Magnetic Anomaly Map (Fig. 6.1.1.5) was generated by subtracting the 100 m Upward Continuation Map (Fig. 6.1.1.4) from the Magnetic Anomaly Map (Fig. 6.1.1.2) using the "Grid Math" function in Geosoft Oasis Montaj software. This residual map effectively highlights local geological features and structures by minimizing the influence of broader regional trends.

In the residual anomaly map, most anomalous zones appear more distinct and sharper, as the effects of regional geological trends have been reduced. Notably, the anomaly zone in the northern part, which was previously dominated by regional geology, now shows enhanced detail. The magnetization of the targeted mineralized body—previously suppressed by regional anomalies—becomes more evident in the residual map (Fig. 6.1.1.5).

Block-II.

The Residual Magnetic Anomaly Map (Fig. 6.1.2.5) was generated by subtracting the 100 m Upward Continuation Map (Fig. 6.1.2.4) from the Magnetic Anomaly Map (Fig. 6.1.2.2) using the "Grid Math" function in Geosoft Oasis Montaj software. This residual map effectively highlights local geological features and structures by minimizing the influence of regional magnetic trends.

In the residual anomaly map, the magnetic anomaly previously observed in the northwestern part of the study area has disappeared. This suggests that the anomaly in that region was primarily associated with regional geological influences. In contrast, the anomaly observed in the southeastern part of the block, trending in a N-S direction, remains prominent. This anomaly is likely associated with shear facies in the study area and is more distinctly represented as a residual feature.

Overall, the residual magnetic anomaly map enhances the visibility of smaller, localized anomalies that were previously obscured by strong regional disturbances in the original magnetic anomaly map.

7.4 Analytic Signal Analysis Map:

Block-I

The Analytical Signal analysis, also known as the Total Gradient method, is a reliable technique for delineating the edges and lithological boundaries of magnetic source bodies. A key strength of this method is its relative independence from the magnetic field orientation and remanent magnetization.

The Analytical Signal Amplitude Map (Fig. 6.1.1.6) of the study area reveals high-intensity signal amplitudes along geological contacts and shallow magnetic bodies, indicating potential lithological boundaries. However, no continuous trend was observed across the block, suggesting that the magnetic sources are more localized and discontinuous in nature.

While both the Analytical Signal and Reduced-to-Pole (RTP) maps highlight similar anomaly and target zones—generally trending in a north-south (N–S) direction—the Analytical Signal map offers better clarity in defining the discrete boundaries of anomalous bodies.

Block-II.

The Analytical Signal analysis, also referred to as the Total Gradient method, is an effective tool for identifying the edges and lithological boundaries of magnetic source bodies. Its primary advantage lies in the fact that the shape of the analytical signal is nearly independent of the magnetic field orientation and remanent magnetization.

The Analytical Signal Amplitude Map (Fig. 6.1.2.6) of the study area displays high-intensity signal amplitudes along geological contacts and over shallow anomalous sources, helping to infer subsurface lithological boundaries. Contour lines, marked in white, clearly delineate the boundaries of the causative magnetic bodies.

Both the Analytical Signal map and the Reduced-to-Pole (RTP) map indicate consistent anomaly and target zones, predominantly trending in a north-south (N–S) direction. Unlike Block-I, a **continuous trend** is observed in Block-II, which closely follows the underlying geological structure. Additionally, the Analytical Signal map provides enhanced resolution of the boundaries of these anomalous features, aiding in more accurate geological interpretation.

7.5 Radially Average Power Spectrum:

The Radially Averaged Power Spectrum (RAPS) plots for Block-I and Block-II, as shown in Fig. 6.1.1.7 and Fig. 6.1.2.7 respectively, indicate that the majority of the magnetic anomaly features and their causative bodies lie within a depth range of approximately **100 to 500 meters**. This depth estimation provides valuable insight into the subsurface geological structures and supports the interpretation of near-surface and intermediate-depth magnetic sources across both blocks.

7.6 Induced Polarization (IP) Profiles:

The Resistivity cum IP (Induced Polarization) response in the survey area is characterized by low resistivity and high chargeability values, which are typically associated with Sulphide and Oxides minerals and alteration and shear zones. The combination of low resistivity and high chargeability suggests the presence of mineralized zones, likely containing sulfides or other conductive minerals, within these altered geological formations.

7.7 IP Response:

Block-I

The Induced Polarization (IP) survey data reveal significantly low resistivity values and high chargeability values exceeding 40 mV/V along the survey lines. This combination is indicative of the presence of conductive formation zones, which may correspond to gold, copper, and associated mineralization.

A continuous trend is observed from Line 1 to Line 12, after which the trend becomes discontinuous. The dark red zones, corresponding to high chargeability values, and the dark blue zones, reflecting low resistivity, highlight anomalous areas that extend up to 135 meters in depth, as shown in the IP anomaly profiles.

In areas with closely spaced data points, the geophysical anomalies are better defined. Notably, the central part of the block shows overlapping low resistivity and high chargeability values, suggesting continuous mineralization extending to the full investigated depth of 135 meters.

These anomalous zones, characterized by high chargeability and low resistivity responses, are illustrated in Figures 6.2.1.1 to 6.2.1.4

Block-II.

The Resistivity values along the IP lines are significantly low, while the chargeability values are elevated, exceeding 40 mV/V. This combination of low resistivity and high chargeability suggests the presence of conductive formation zones, which may correspond to graphite mineralization within the surveyed area.

Although no consistent trend is observed across all lines, areas showing localized zones of low resistivity and high chargeability may indicate potential mineralization. These zones generally align in a north-south (N-S) direction across the survey area.

The dark red IP anomaly zones, associated with high chargeability values, and the dark blue low resistivity zones point to anomalous areas extending up to 135 meters in depth, as shown in the IP anomaly profiles. Areas with closely spaced data points show better-defined geophysical anomalies, enhancing the identification of mineralized zones.

Notably, the resistivity and chargeability anomalies in the central part of the block suggest continuous mineralization extending to a depth of 135 meters (the full depth of the survey investigation).

These anomalous zones, reflecting high chargeability and low resistivity responses, are shown in Figures 6.2.2.1 to 6.2.2.6.

7.8 SELF-POTENTIAL (SP) SURVEY:

Block-I

The total SP anomalies along each traverse have been generated from the SP data. The total variation of the SP anomaly observed was 158 mV, with the highest value recorded at 294 mV and the lowest at -146 mV. The SP data reveal significant structural disturbances in the area, as shown in Figures 6.3.1.1 and 6.3.1.2.

The SP data correlate well with the IP, resistivity, and magnetic data, suggesting that the electro-kinetic potential observed in the shear zones is likely due to sulphide mineralization. The low SP values align closely with areas identified by the IP and other data sets, reinforcing the interpretation of the shear zone's role in the mineralization process.

Block-II.

The total SP anomalies along each traverse have been derived from the SP data. A total variation of 299 mV was observed, with the highest value reaching 627 mV and the lowest at -328.1 mV. The SP data highlight structural disturbances in the area, providing conclusive results, as shown in Figures 6.3.2.1 and 6.3.2.2.

The SP data exhibit a strong correlation with the IP, resistivity, and magnetic data, suggesting that the electro-kinetic potential observed in the area is likely due to sulphide mineralization. Block-II, associated with graphite mineralization, the data clearly demonstrate low SP values. These values align with the overall north-south (N-S) trend, indicating the presence of a significant mineralization zone.

8.0 CONCLUSION AND RECOMMENDATIONS

8.1 Block-I

Based on the Magnetic IP cum resistivity data interpretation the following anomalous zone indicated by white dotted line has been marked on the reduced to pole (RTP) anomaly map.

Based on the integrated analysis of the Magnetic, IP-Resistivity, and SP data, several anomalous zones have been identified and clearly marked on the resistivity surface anomaly map. The zones exhibiting higher anomalous signatures are particularly noteworthy, as they are likely associated with gold mineralization.

All four proposed Borehole over line 6, 9, 11 and 13 are following the characteristics of low to moderate resistivity and high chargeability which is well collaborating with low magnetic zone as mineralization could be within the Quartzite.

A continuous trend is also observed which is marked as white dotted line for the continuous mineralization.

For the phase-1: Four borehole locations are proposed for further confirmation or exploration.

Below table is showing the inferred location of the borehole.

Table 6: Proposed inferred Borehole Locations for Block-I

PBH	Line	IP station	DEPATH	EASTING	NORTHING
PBH-1	6	440	80	448821	2427524
PBH-2	9	460	75	449001	2427924
PBH-3	11	440	80	449041	2428024
PBH-4	13	420	90	449161	2428324

Block-II.

Three boreholes are proposed along **Line 24**, **Line 25**, and **Line 29**, all of which fall within a **low magnetic zone**. These zones exhibit **low to moderate resistivity** and **high chargeability**, suggesting a potential association with **graphite** and **quartzite** mineralization. In contrast, the proposed boreholes along **Line 29** and **Line 32** are located within a **high magnetic zone**. These locations are characterized by **moderate to high resistivity** and **high chargeability** values in the **IP sections**, indicating a possible association between **graphite** and **phyllite**.

Whereas Proposed Boreholes over line 20 falling on transition zone of magnetic high to low with high resistivity and high chargeability may represent the alteration halo region in which metamorphism has takenplace and could be the contact zone of quartz and phyllite.

Conclusion:

The proposed borehole locations offer potential targets for further exploration and confirmation of graphite mineralization.

Based on the Magnetic IP cum resistivity data interpretation the following anomalous **zone with a higher anomalous signature, potentially corresponding to graphite mineralization, has been identified** indicated by white dotted line has been marked on the reduced to pole (RTP) anomaly map.

Based on the integrated analysis of the Magnetic, IP-Resistivity, and SP data, several anomalous zones have been identified and clearly marked on the resistivity surface anomaly map. The zones exhibiting higher anomalous signatures are particularly noteworthy, as they are likely associated with graphite mineralization.

Zone having higher anomalous signature is marked which may be corresponding to the graphite mineralization zone. Through the correlation of the magnetic data, IP-Resistivity profiles, and SP responses five potential borehole locations have been inferred to further confirm and explore these anomalies.

Below table is showing the inferred location of the borehole.

Table 7: Proposed inferred Borehole Locations for Block-II

BHID	Line	Easting	Northing	IP-Station	Depth
1	24	454931.8	2430093	220	50
2	25	455011.8	2430243	280	60
3	29	455357.8	2430874	580	70
4	32	455326.8	2431293	515	40
5	20	455281.8	2429493	610	48
6	30	455151.8	2430993	360	65

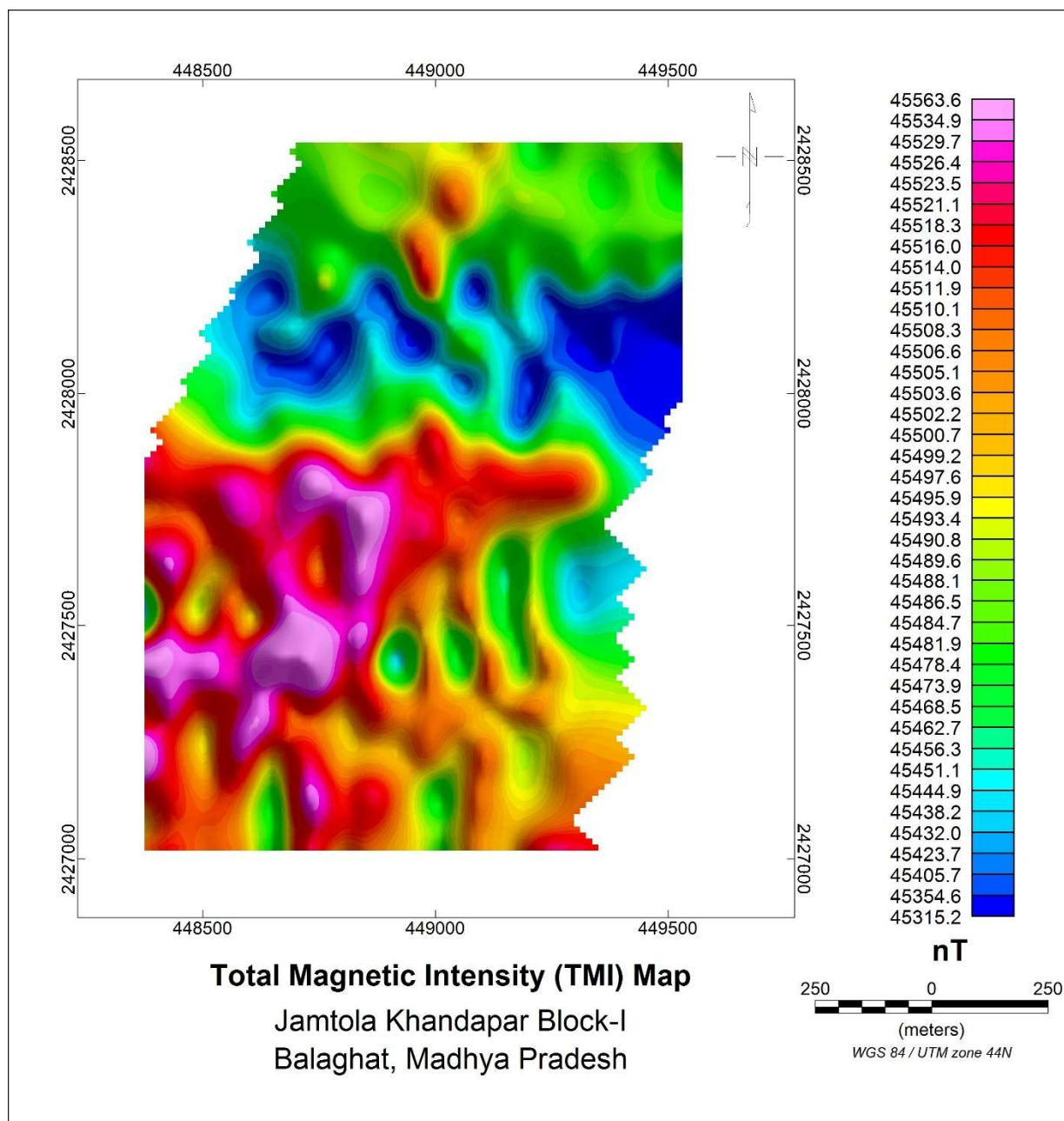
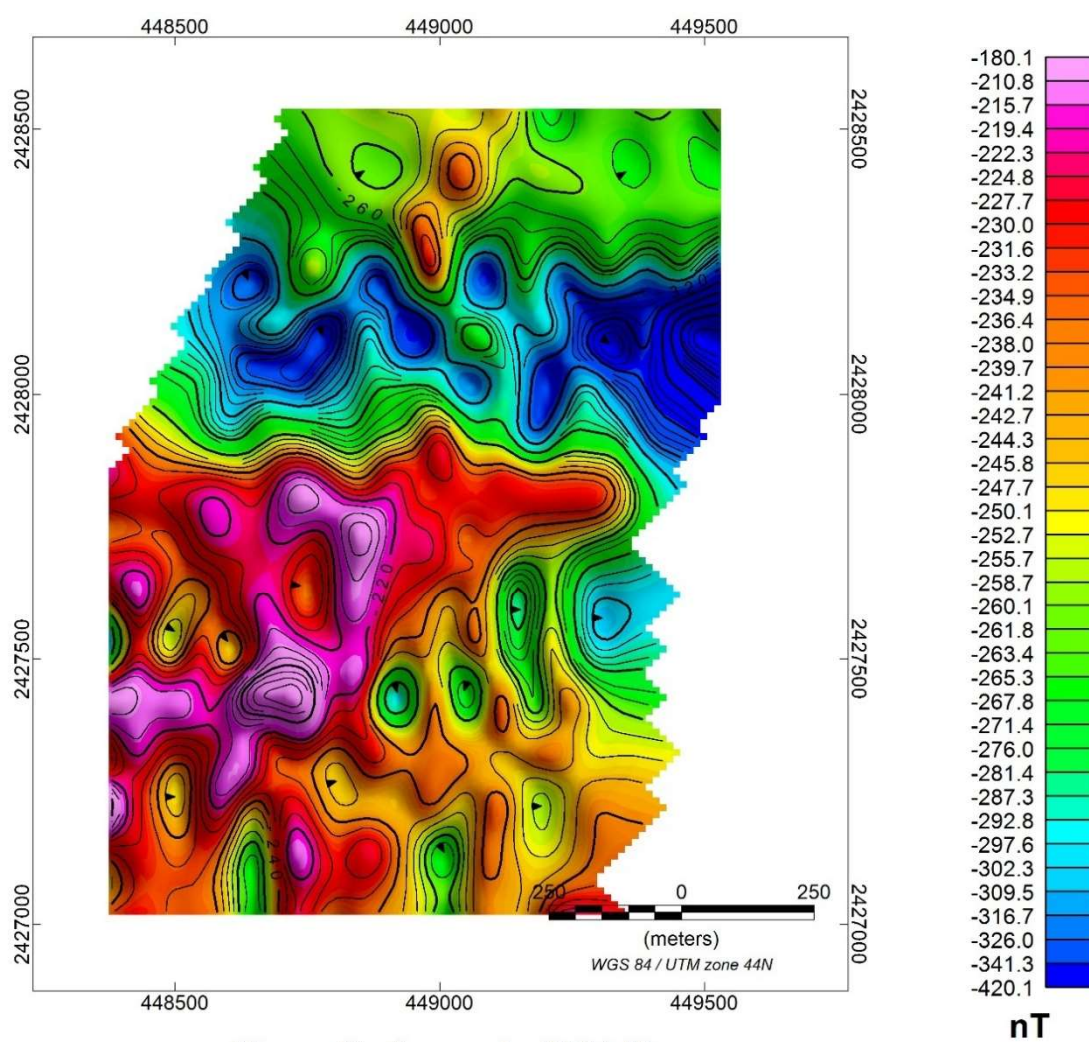


Fig. 6.1.1.1: Total Magnetic Intensity (TMI) Map of Block-I



Magnetic Anomaly (MA) Map

Jamtola Khandapar Block-I
Balaghat, Madhya Pradesh

Fig. 6.1.1.2: Magnetic Anomaly (MA) Map of Block-I

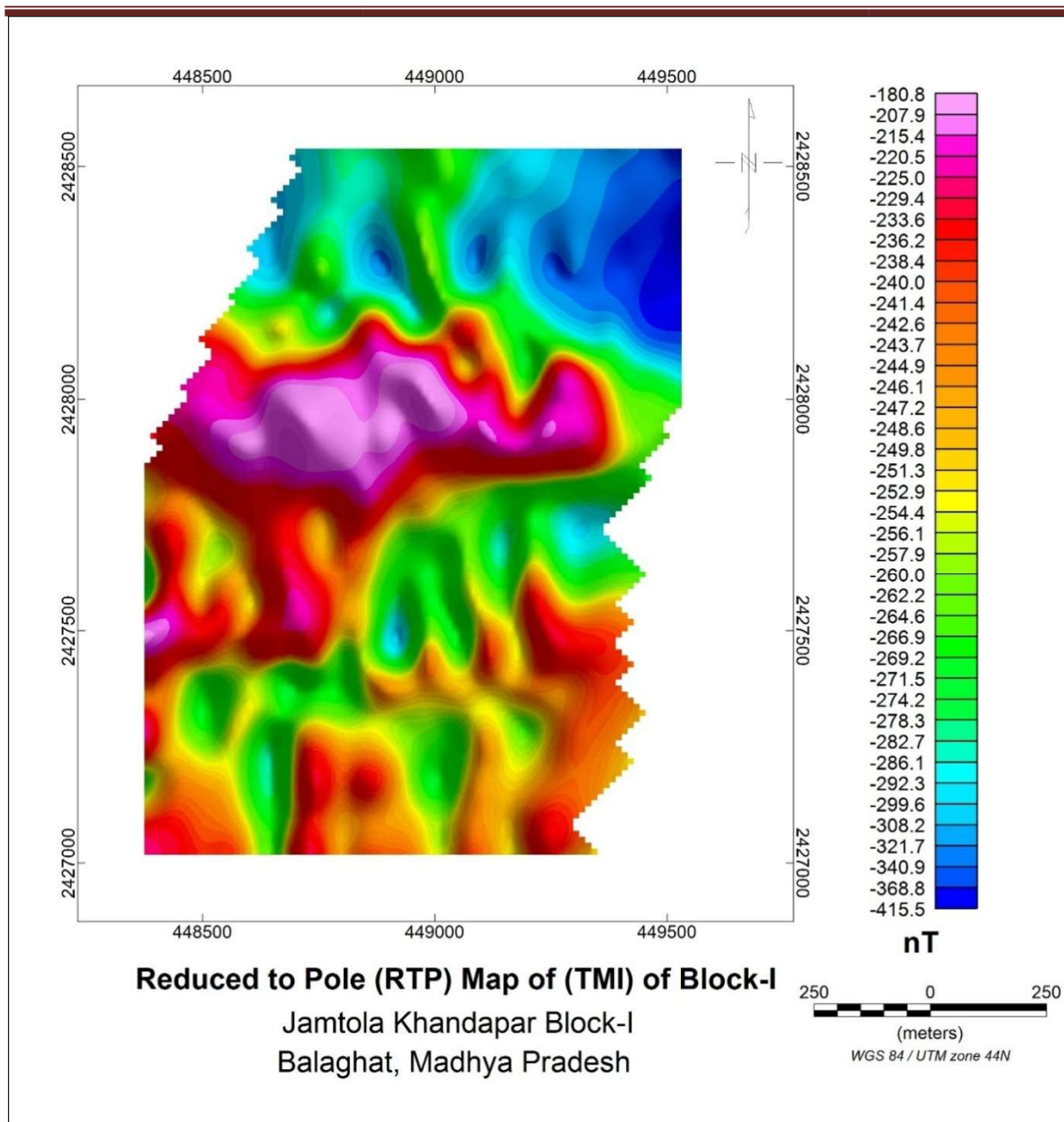


Fig. 6.1.1.3: Reduced to Pole (RTP) Map of (TMI) of Block-I

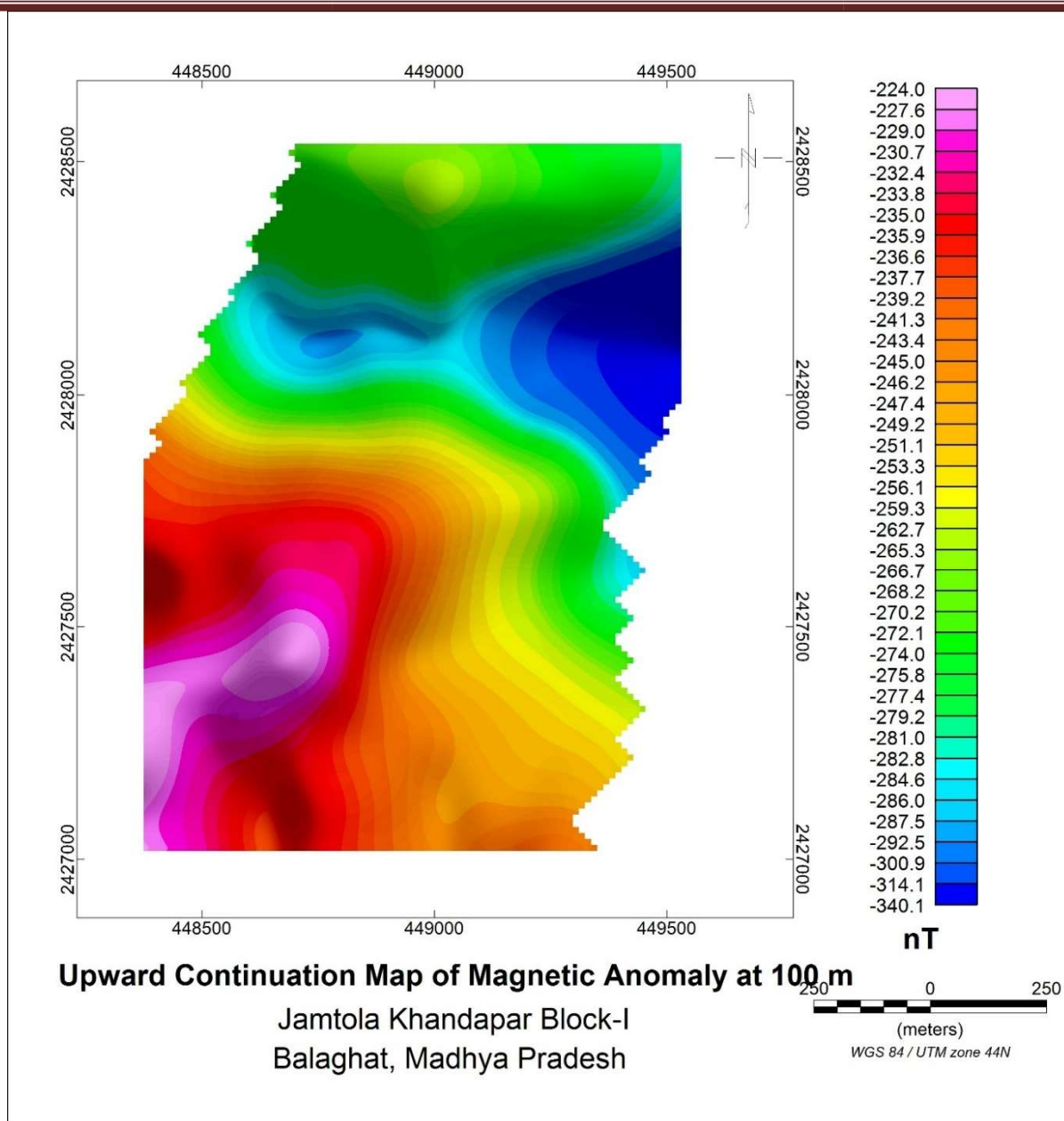


Fig. 6.1.1.4: Upward Continuation Map of Magnetic Anomaly at 100 m of Block-I

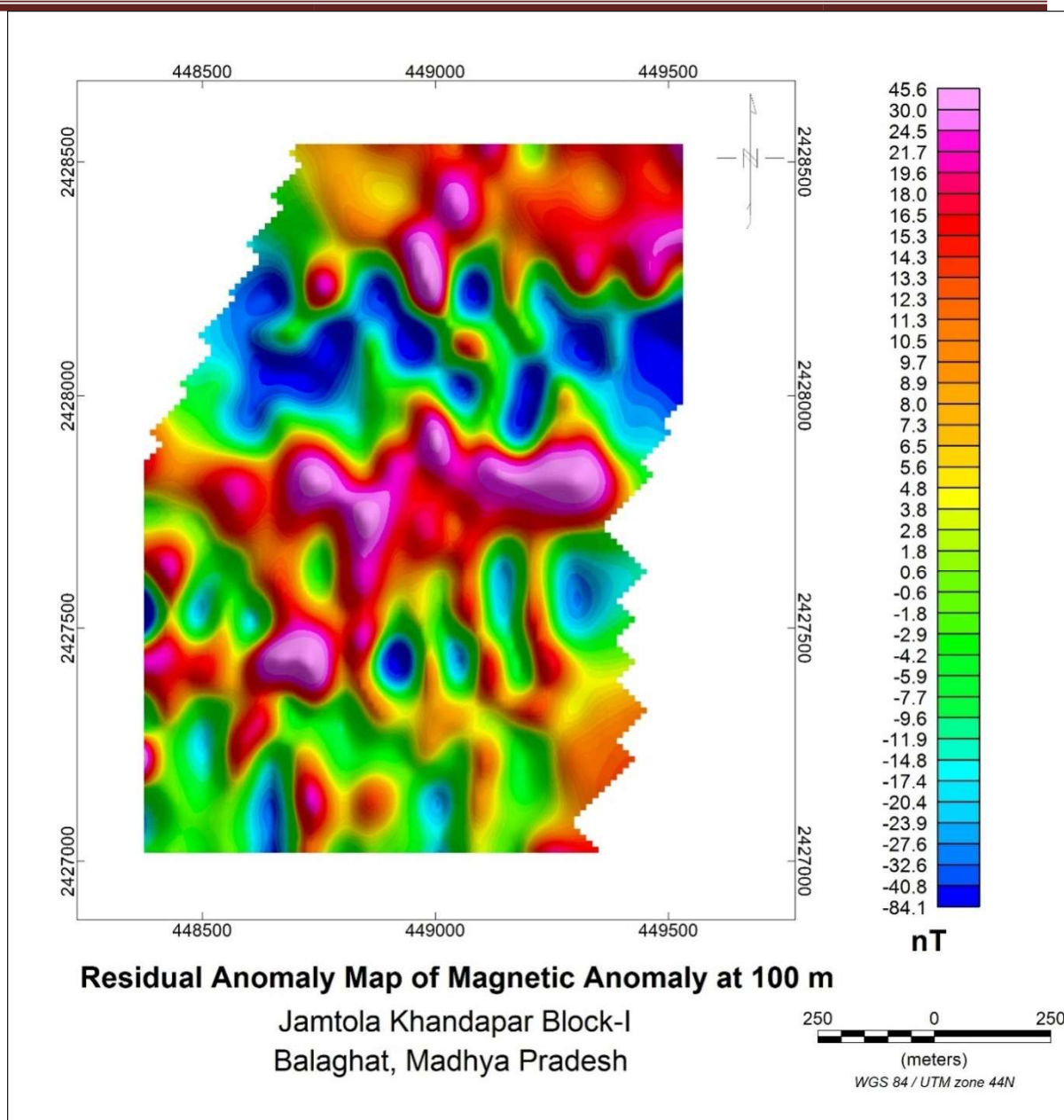


Fig. 6.1.1.5: Residual Anomaly Map of Magnetic Anomaly at 100 m of Block-I

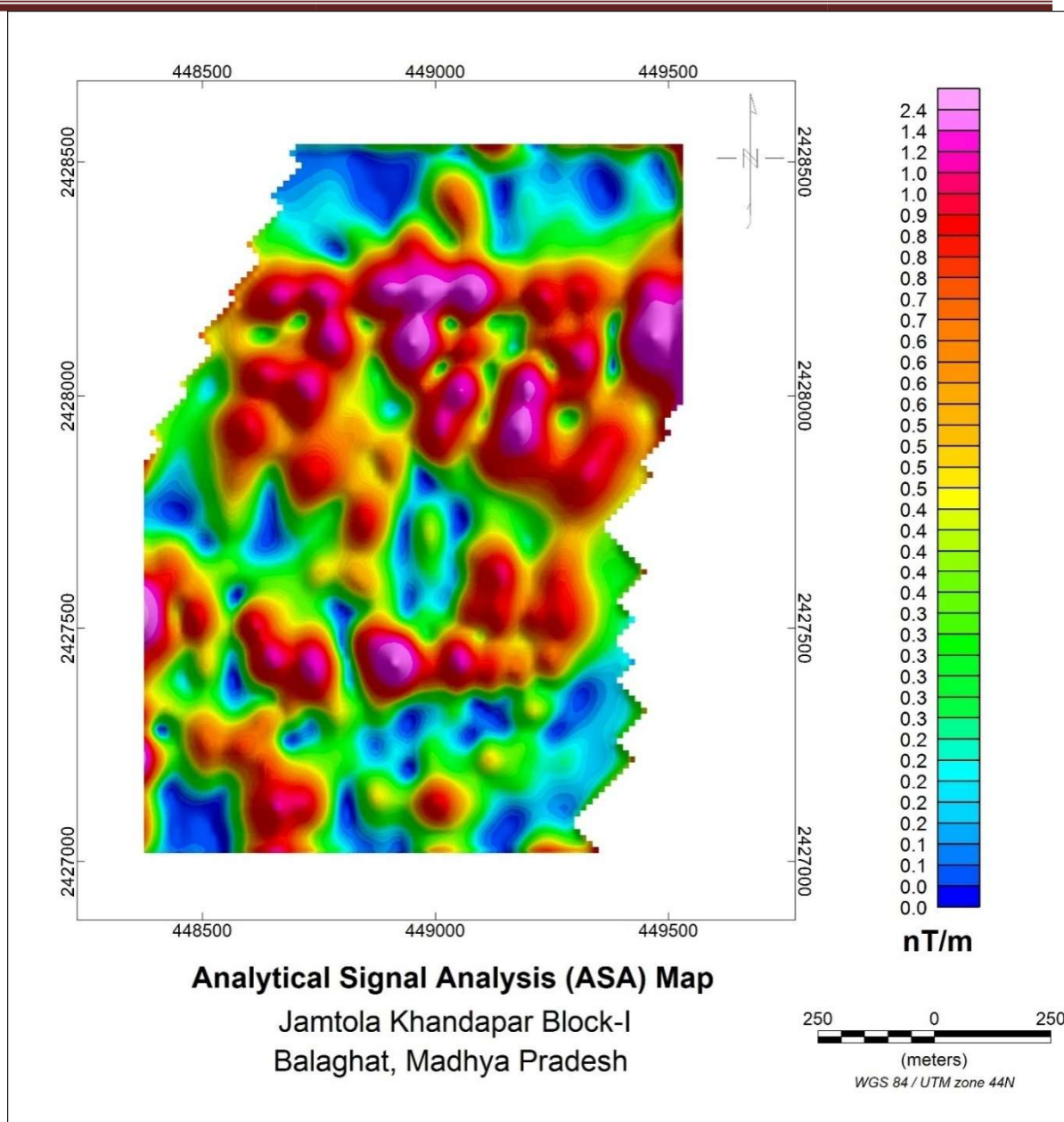


Fig. 6.1.1.6: Analytical Signal Analysis (ASA) Map of Block-I

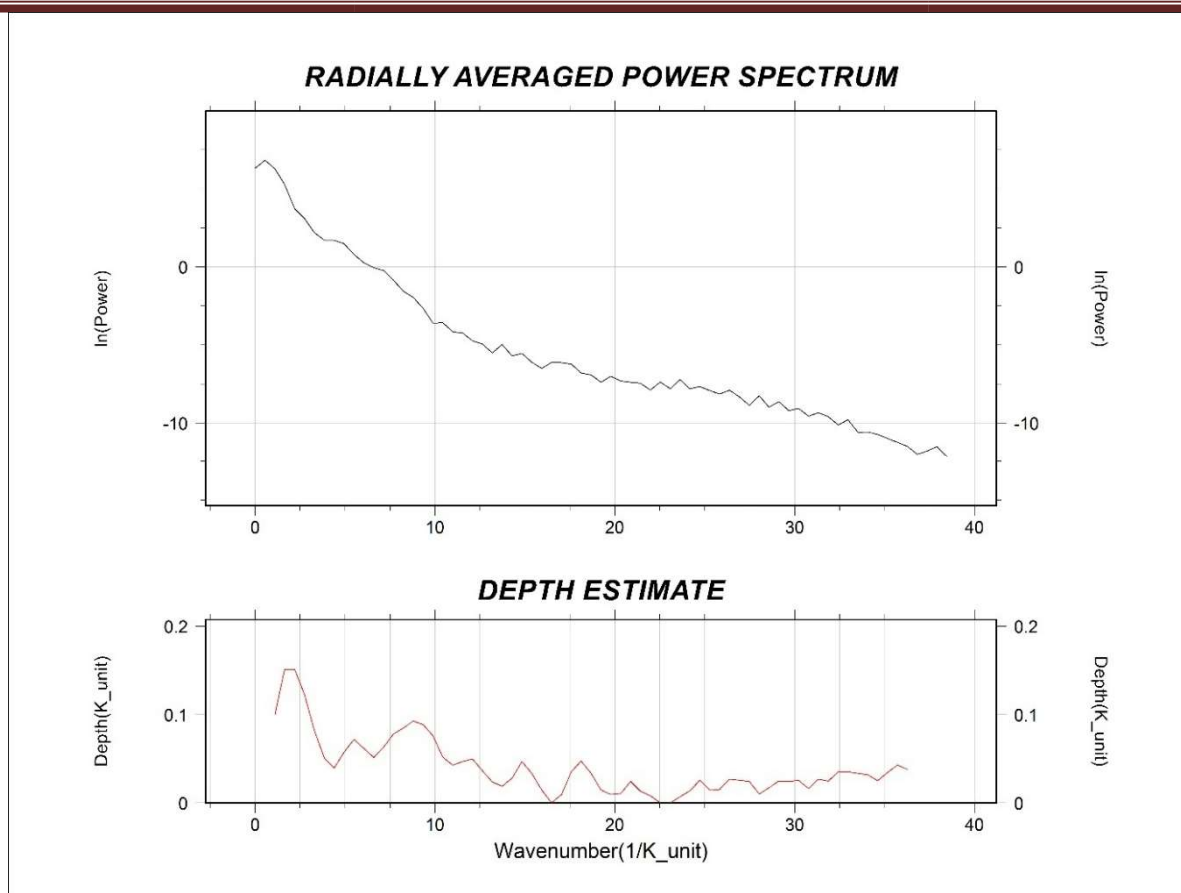


Fig. 6.1.1.7: Radially Average Power Spectrum of Block-I

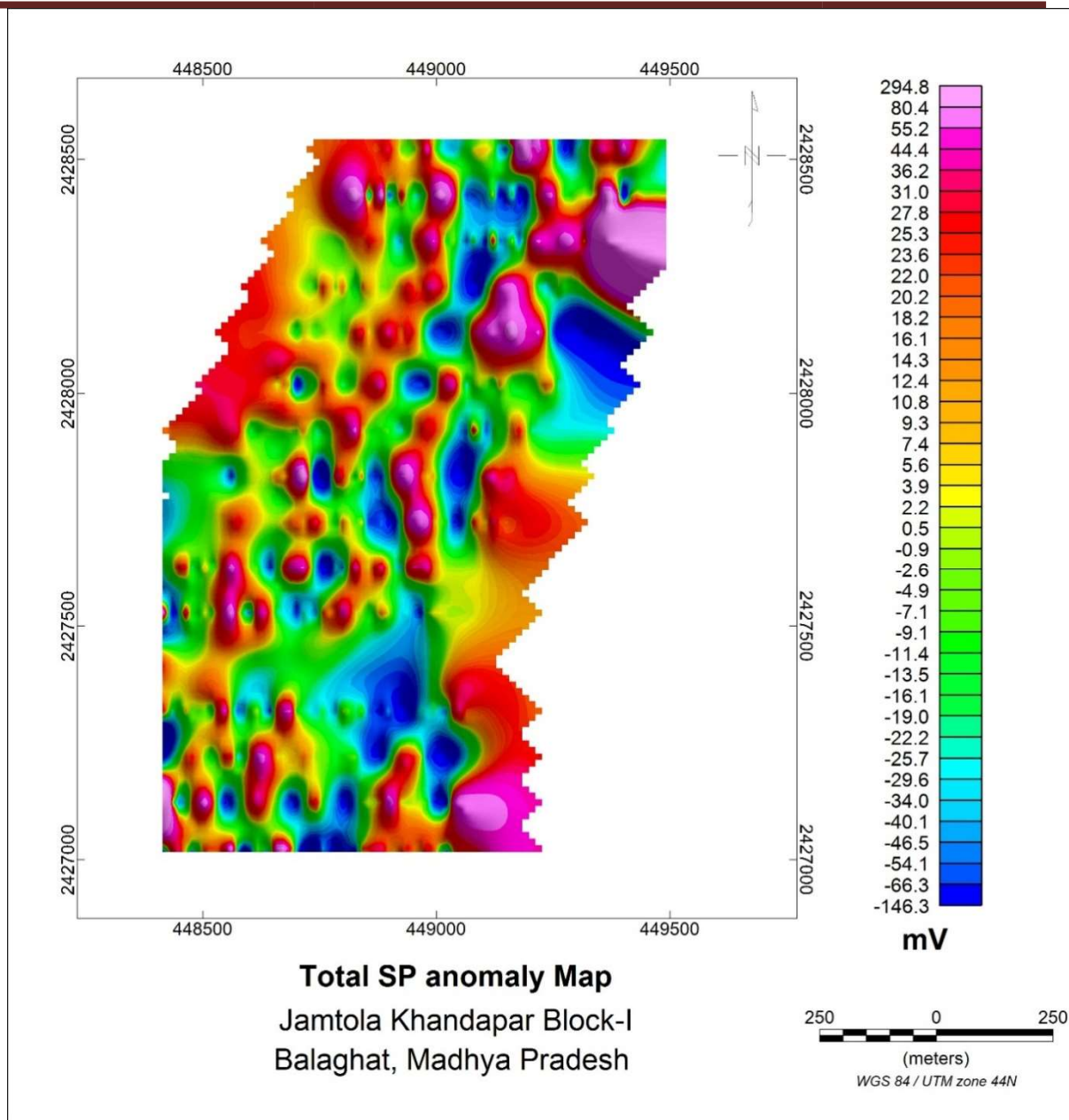
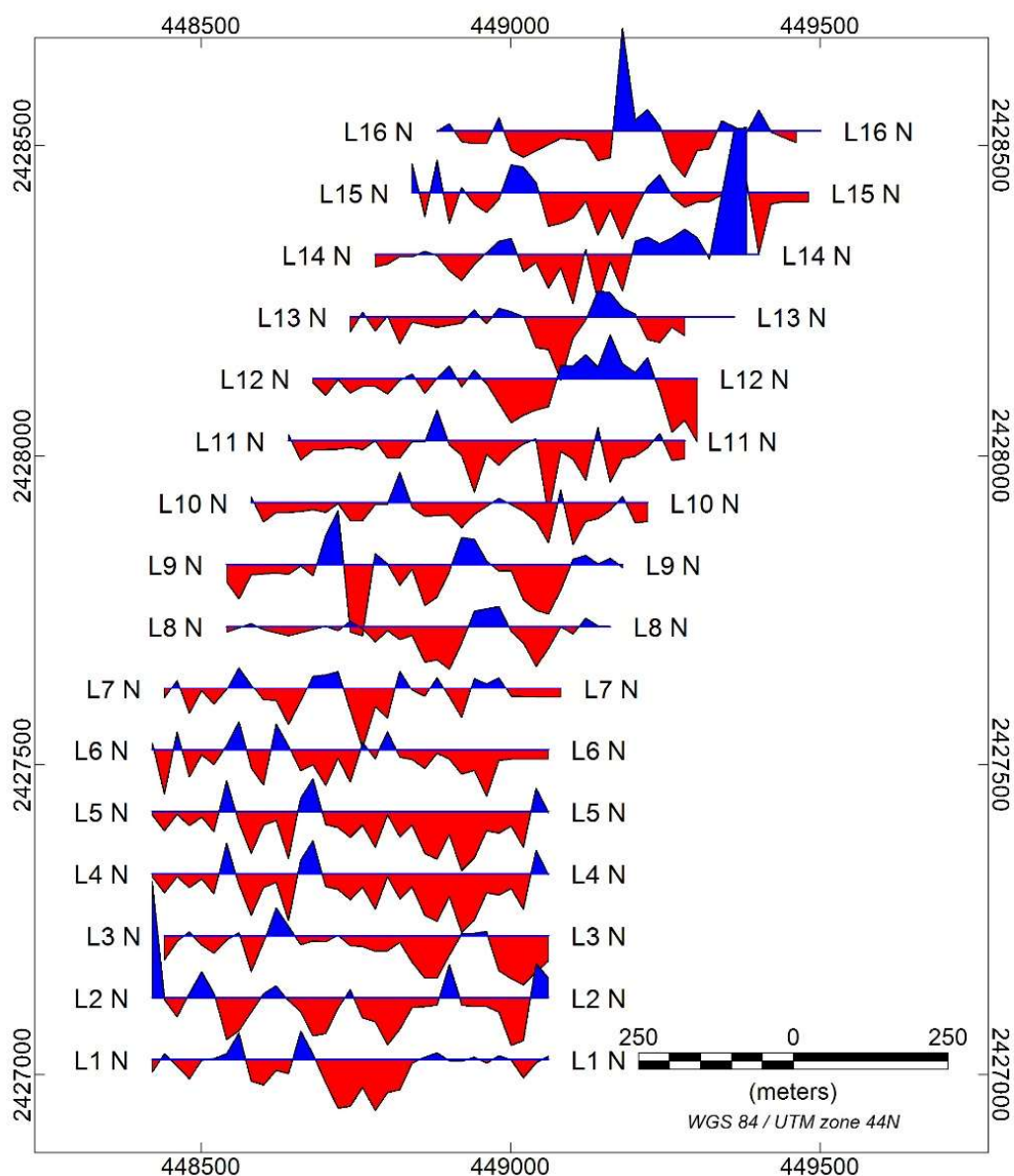


Fig. 6.1.1.8: Total SP anomaly Map of Block-I



SP Profile Map
 Jamtola Khandapar Block-I
 Balaghat, Madhya Pradesh

Fig. 6.2.1.1: SP Profile Map of Block-I

BLOCK-I2D Section of Resistivity and Chargeability



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ANNEXURE XIII/ 36

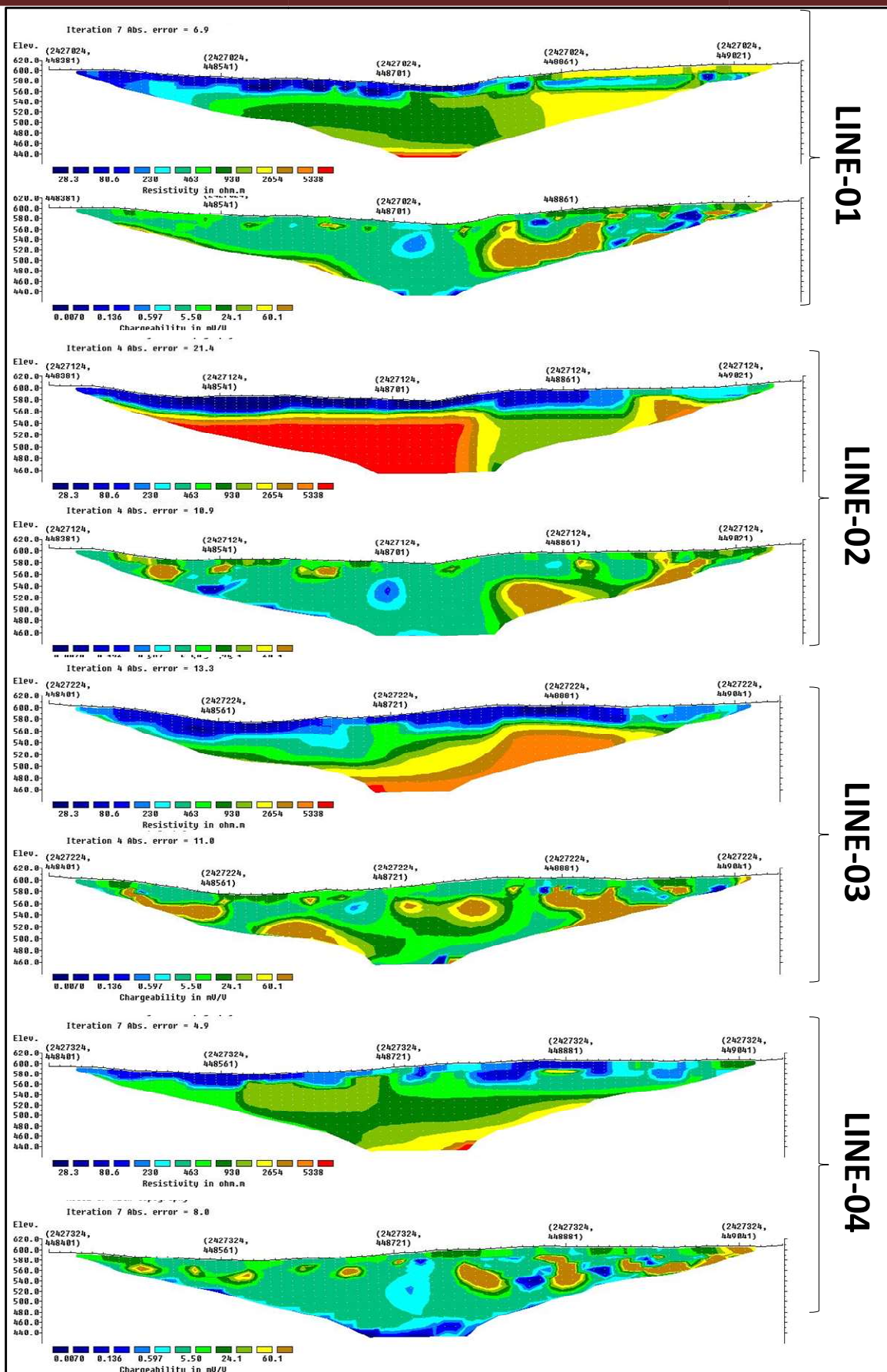


Fig.6.2.1.1: 2D Section of Resistivity and Chargeability (Line 1 to 04) of Block-I



Fig.6.2.1.2: 2D Section of Resistivity and Chargeability (Line 6 to 09)of Block-I



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ANNEXURE XIII/ 38

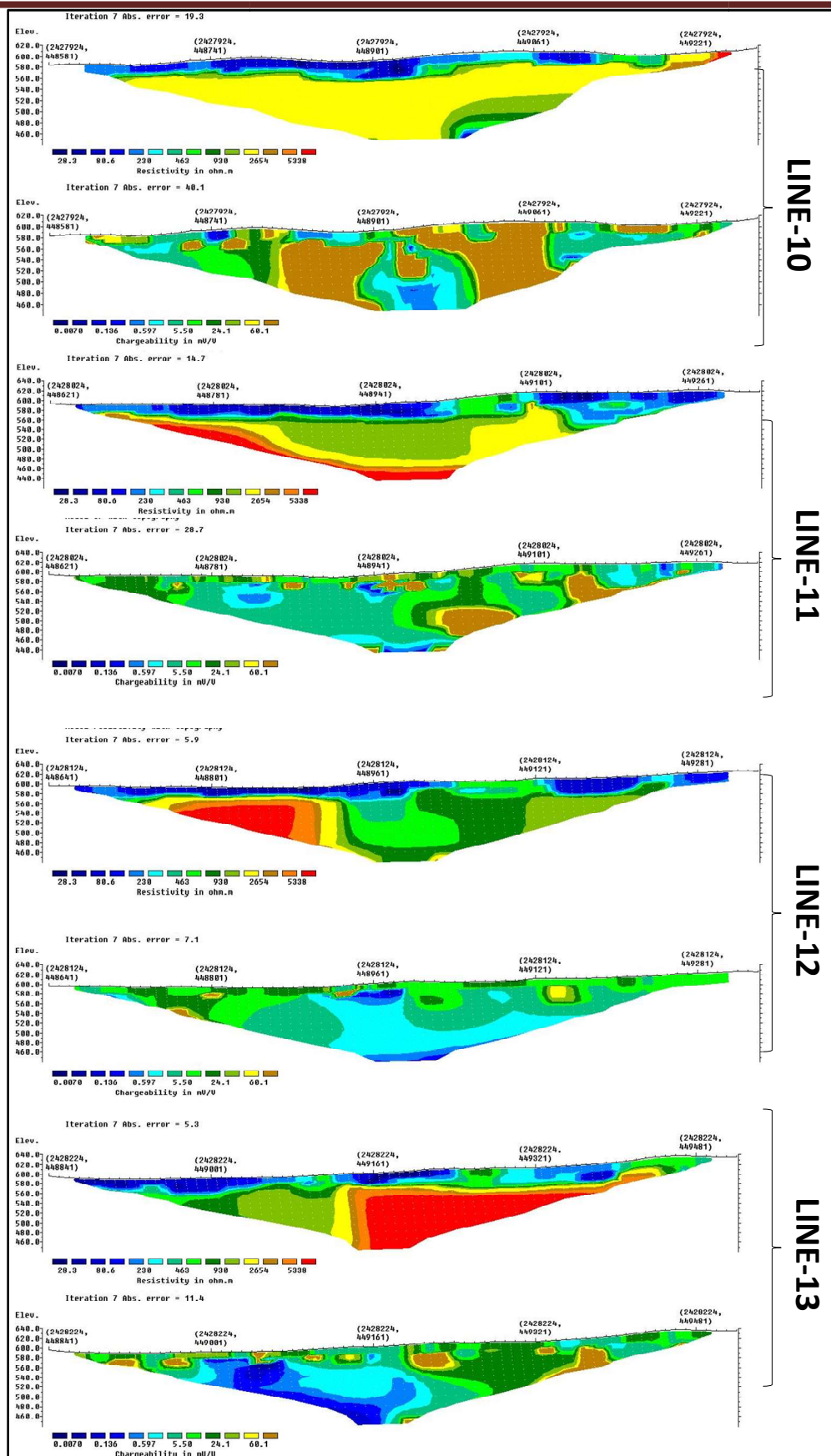


Fig.6.2.1.3: 2D Section of Resistivity and Chargeability (Line 10 to 13)of Block-I

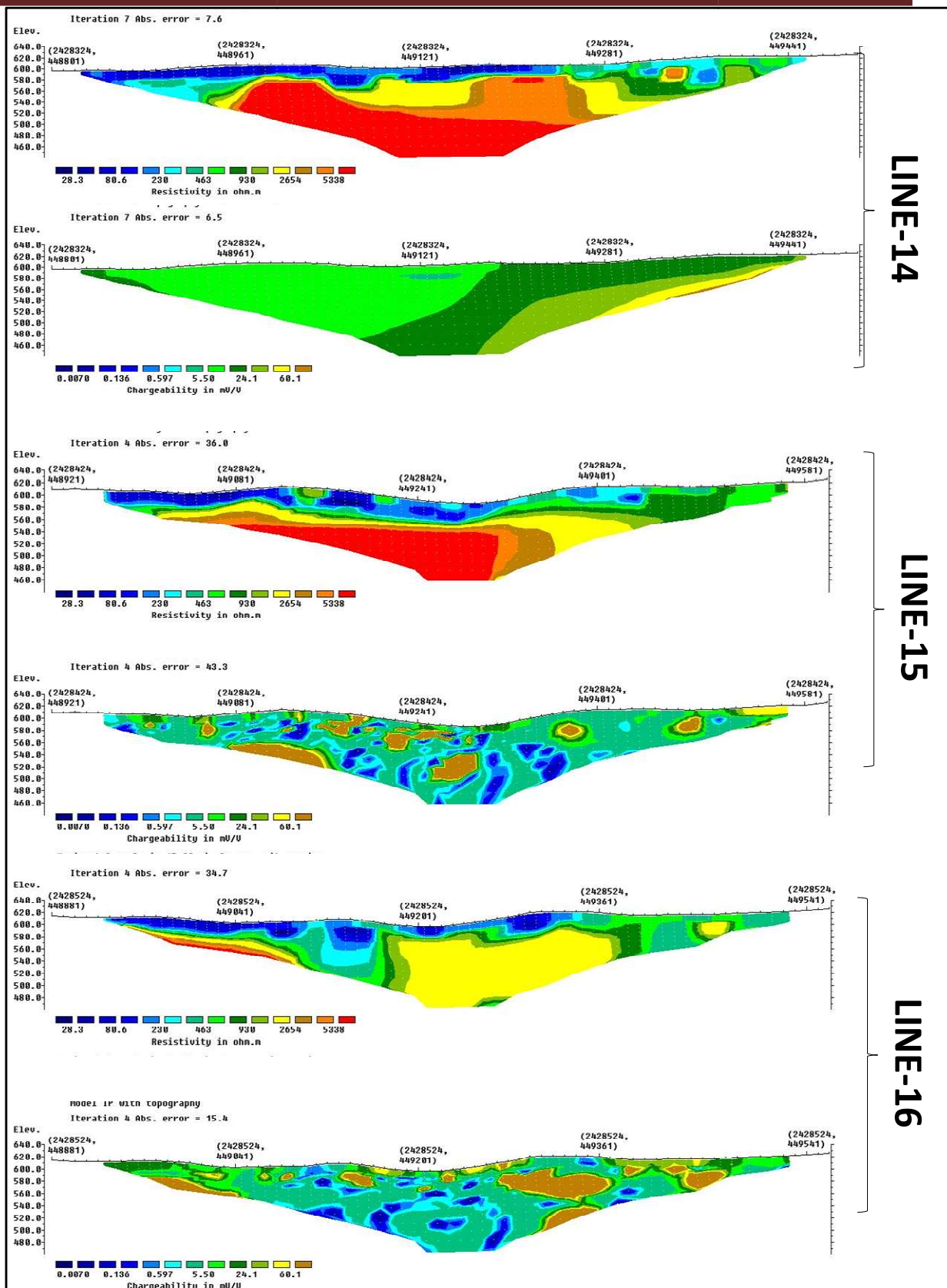


Fig.6.2.1.4: 2D Section of Resistivity and Chargeability (Line 14 to 16) of Block-I



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ANNEXURE XIII/ 40

Block-II

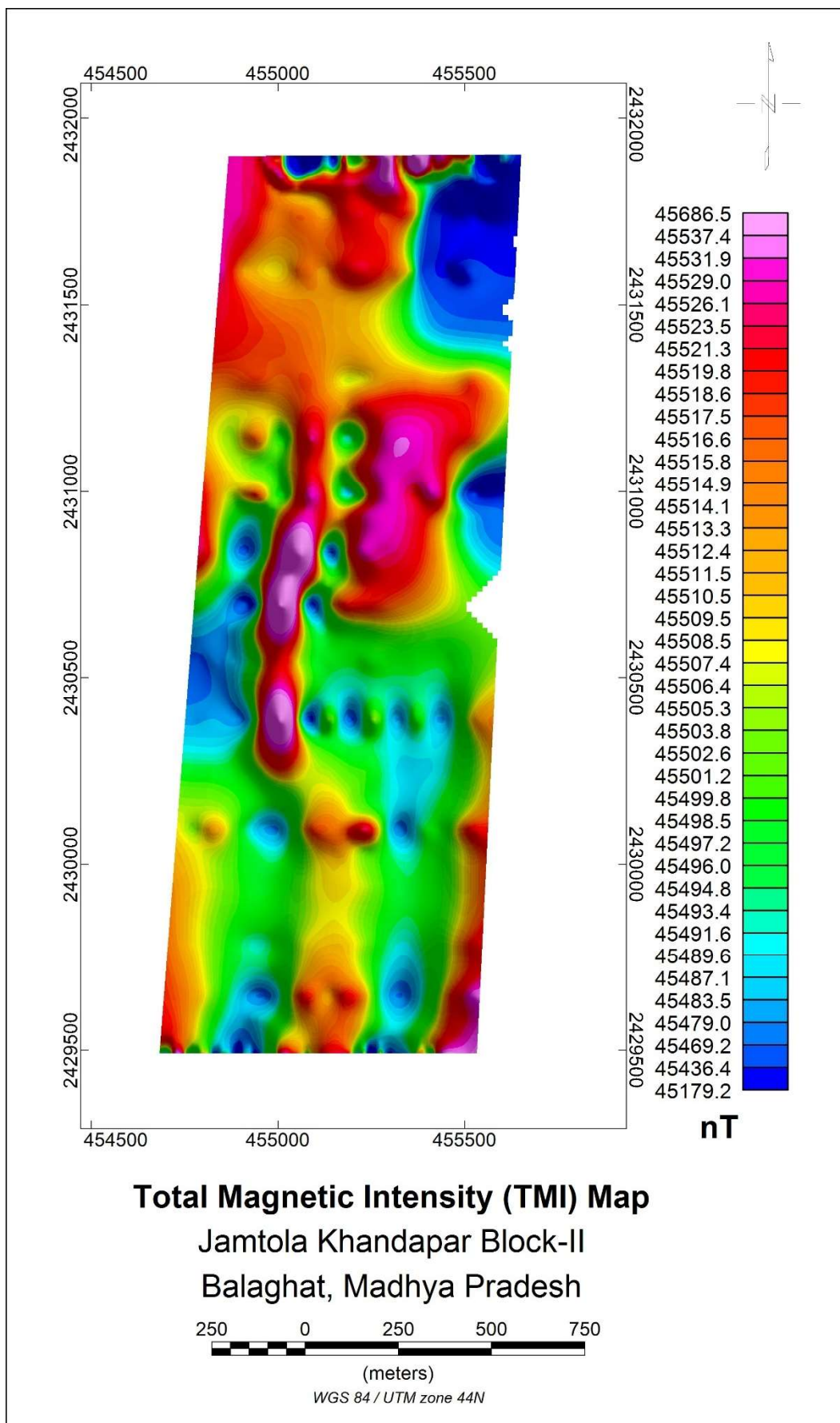


Fig. 2: Total Magnetic Intensity (TMI) Map of Block-I

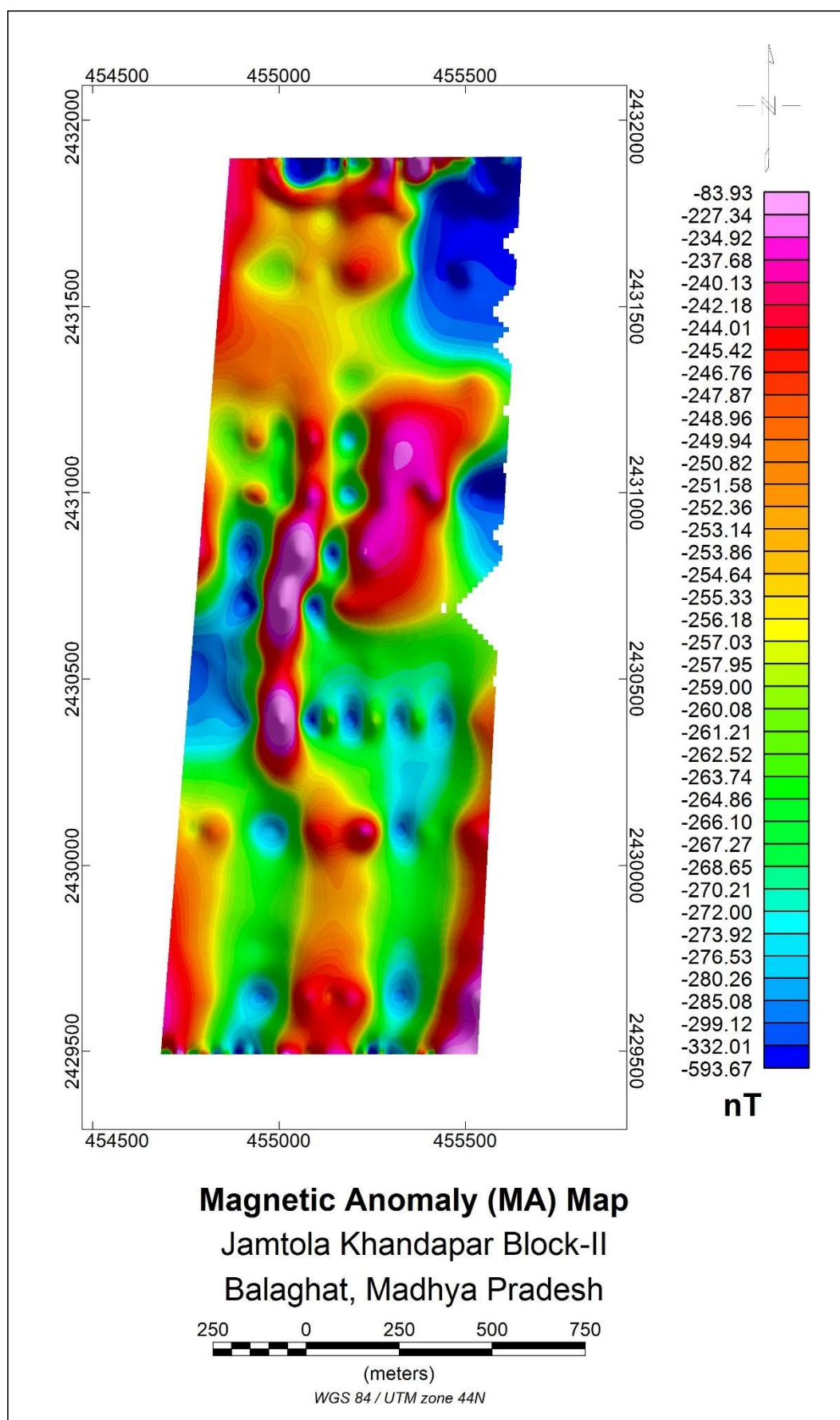


Fig. 3: Magnetic Anomaly (MA) Map of Block-II

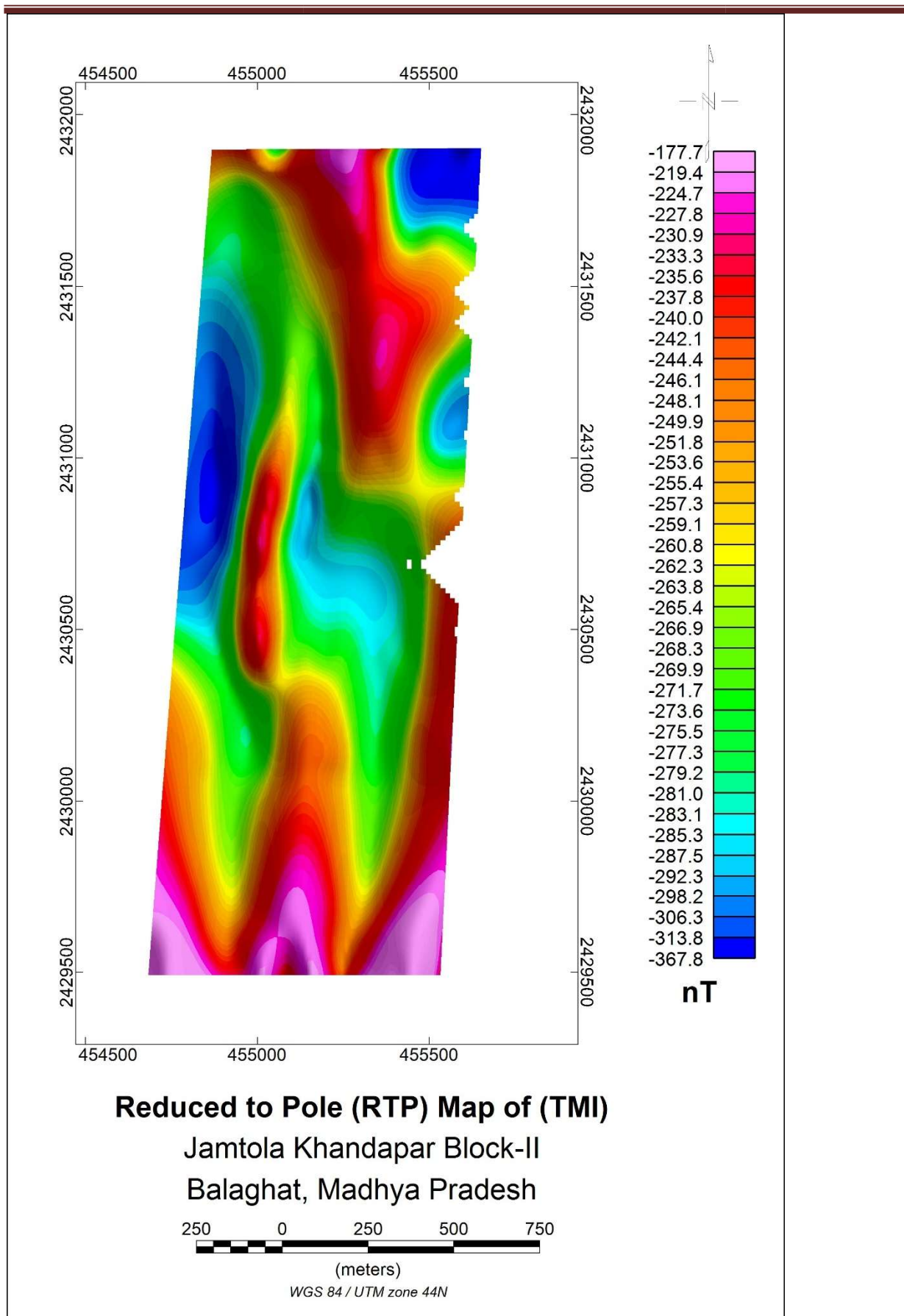


Fig.4: Reduced to Pole (RTP) Map of (TMI) of Block-II

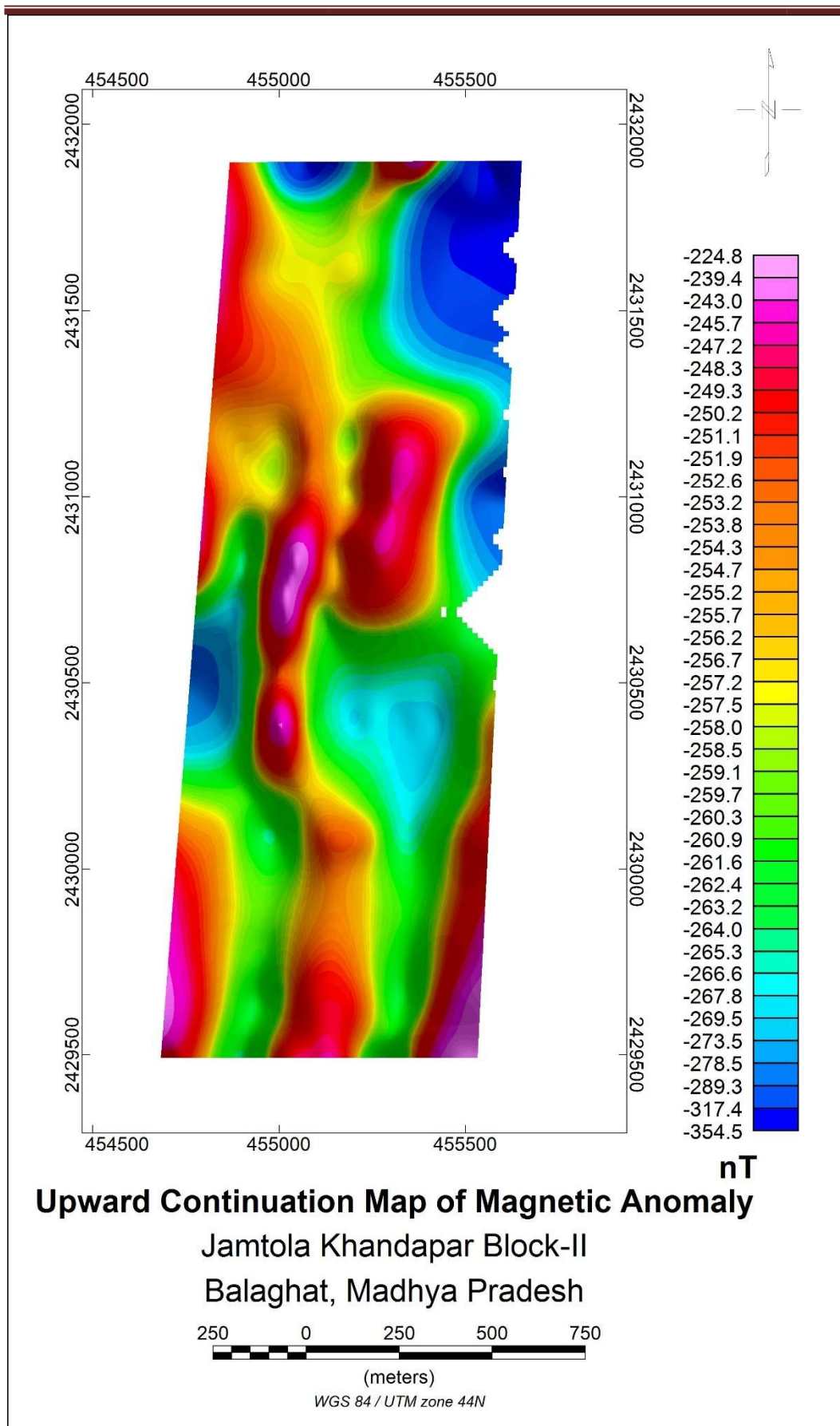


Fig. 5: Upward Continuation Map of Magnetic Anomaly at 100 m of Block-II

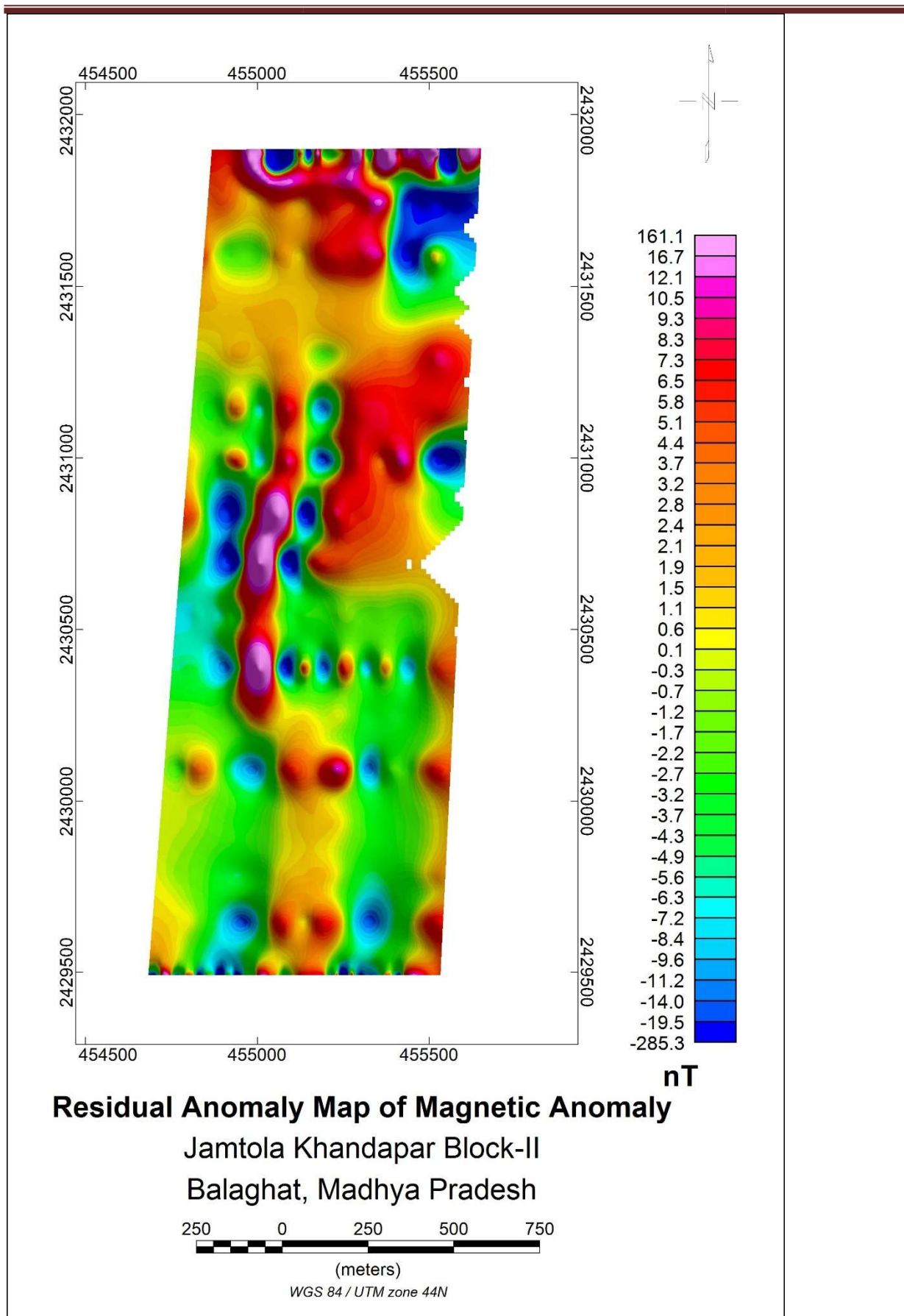


Fig. 6: Residual Anomaly Map of Magnetic Anomaly at 100 m of Block-II

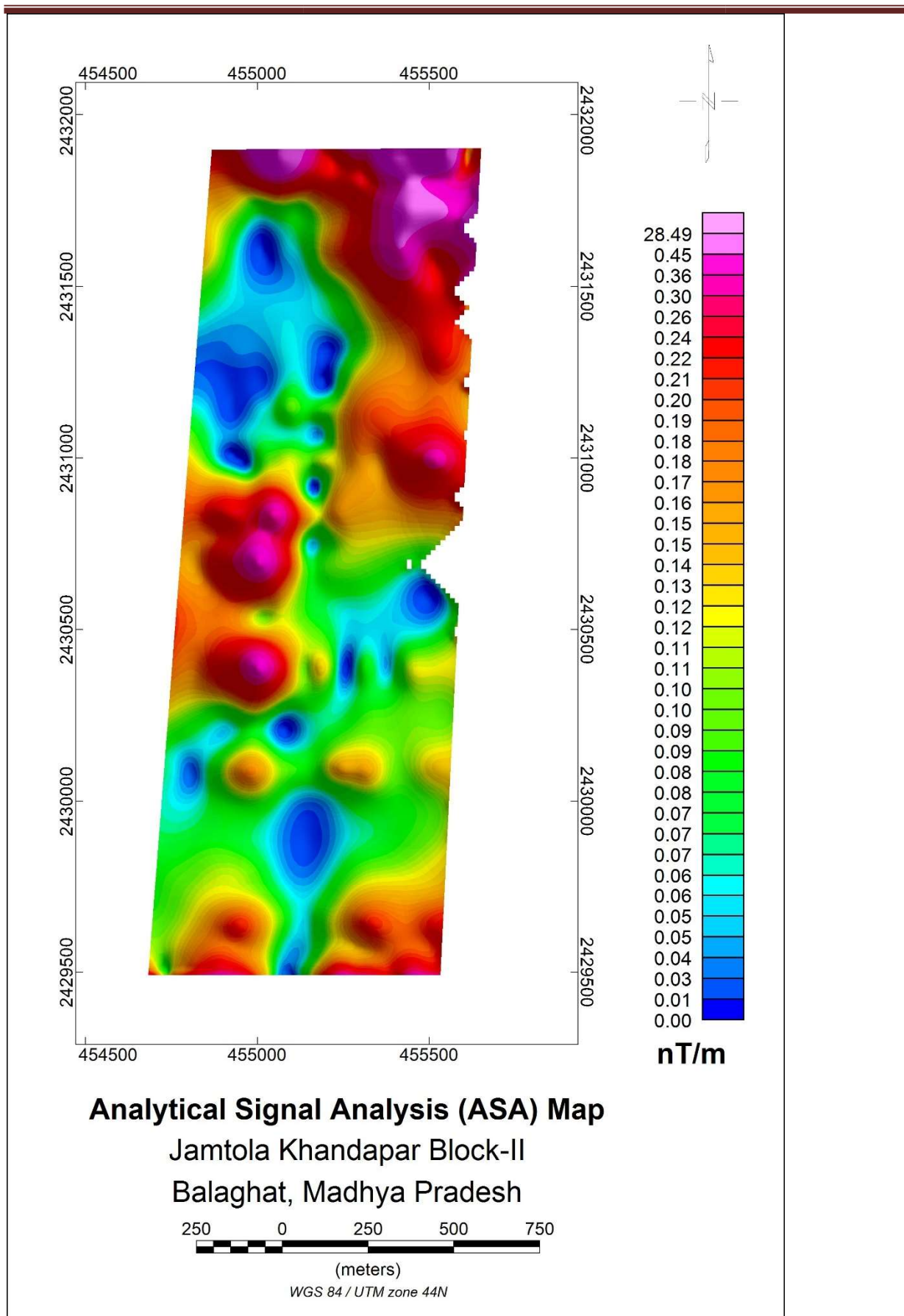


Fig. 7: Analytical Signal Analysis (ASA) Map of Block-II

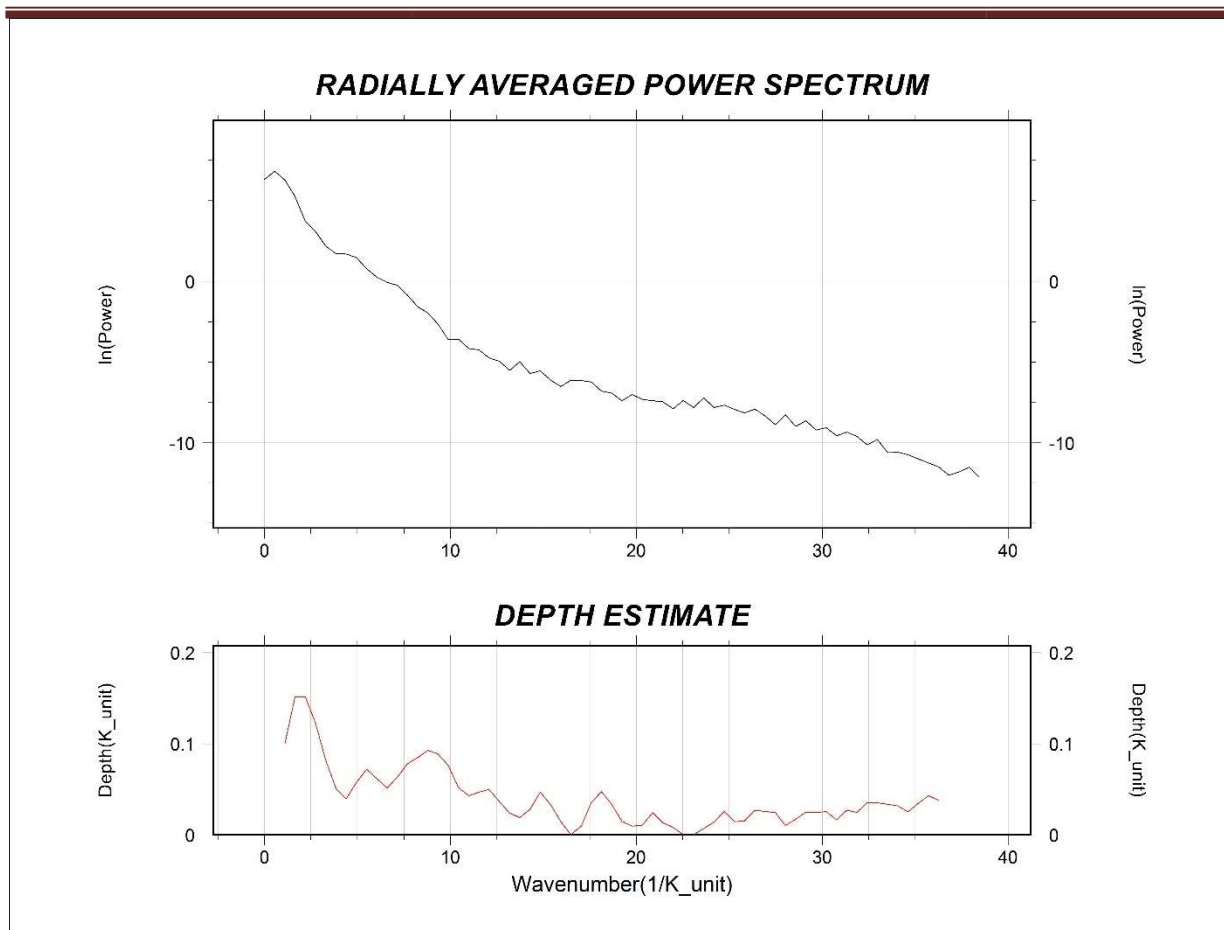


Fig. 8: Radially Average Power Spectrum of Block-II

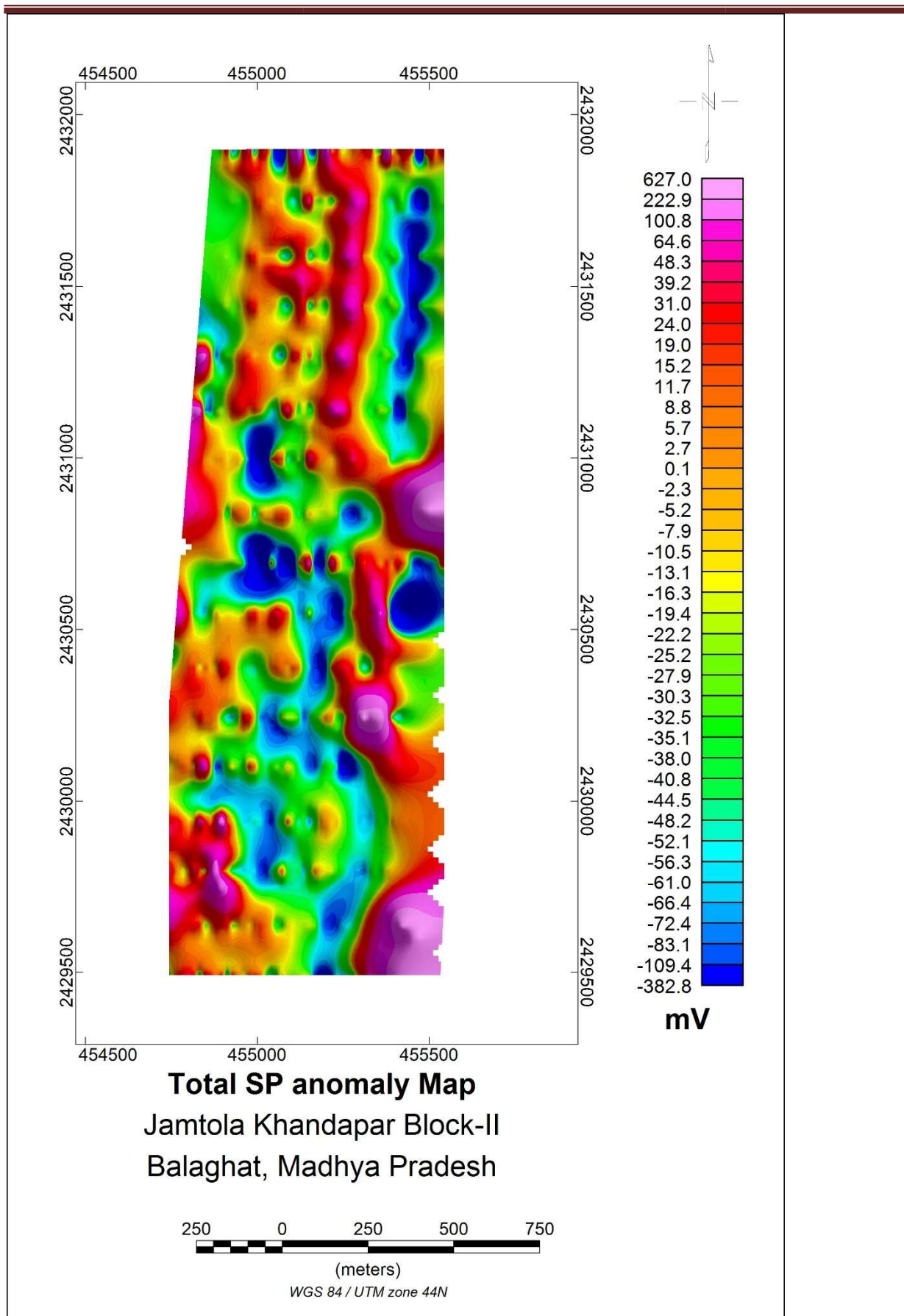
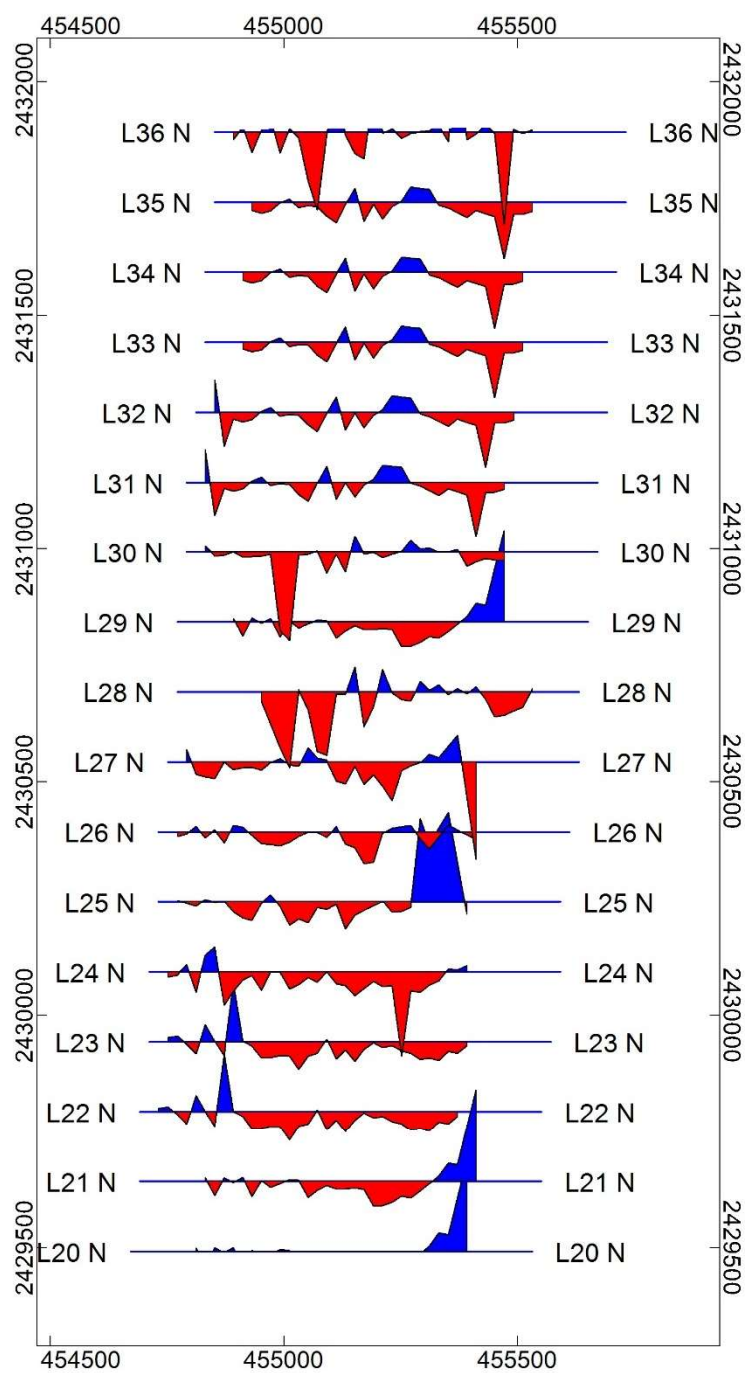
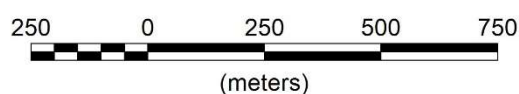


Fig.9: Total SP anomaly Map of Block-II



SP Profile Map

Jamtola Khandapar Block-II
Balaghat, Madhya Pradesh



WGS 84 / UTM zone 44N

Fig.10: SP Profile Map of Block-II



Block-II

2D Section of Resistivity and Chargeability

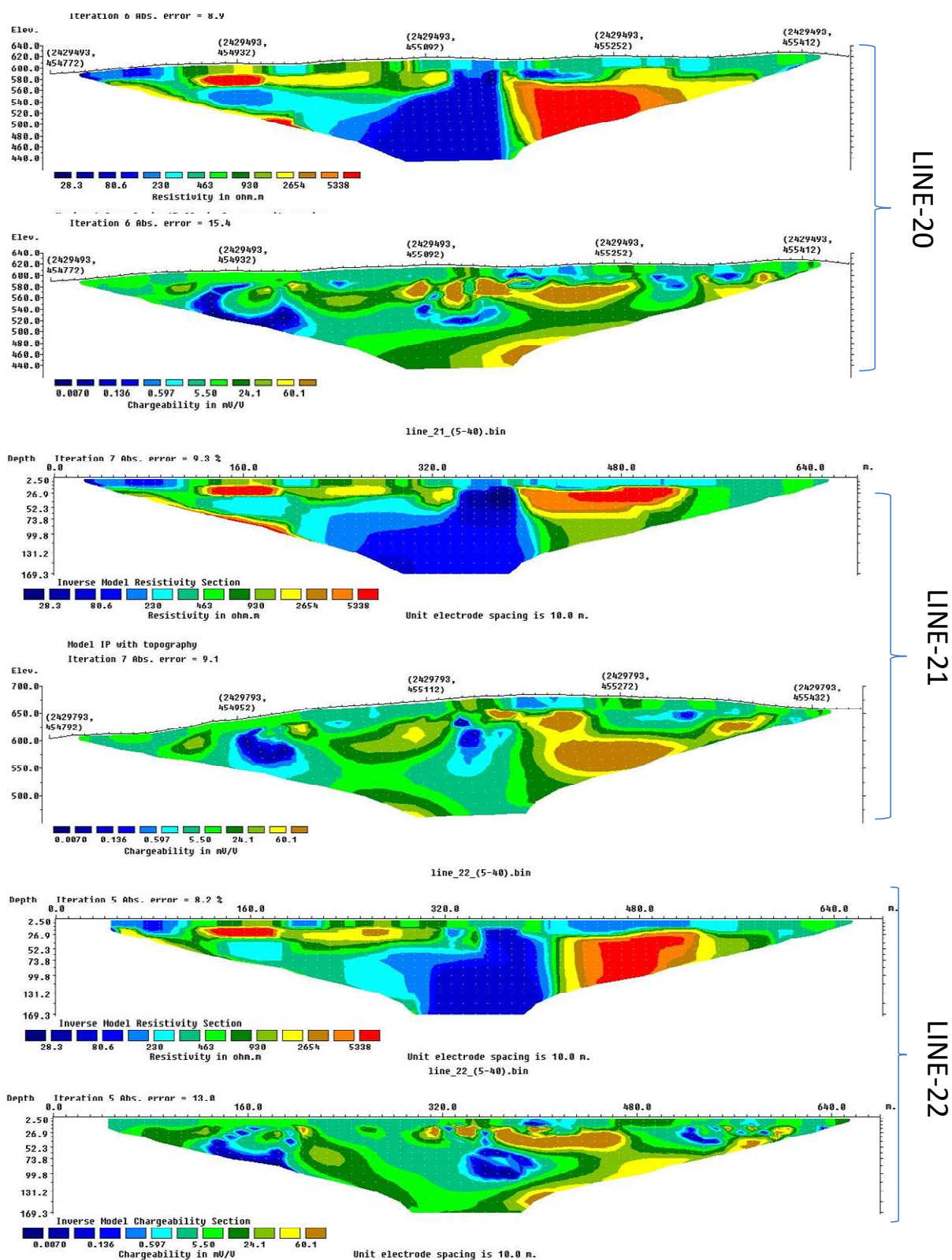


Fig. 6.2.2.1: 2D Section of Resistivity and Chargeability (Line 20 to 22) of Block-II



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ANNEXURE XIII/ 50

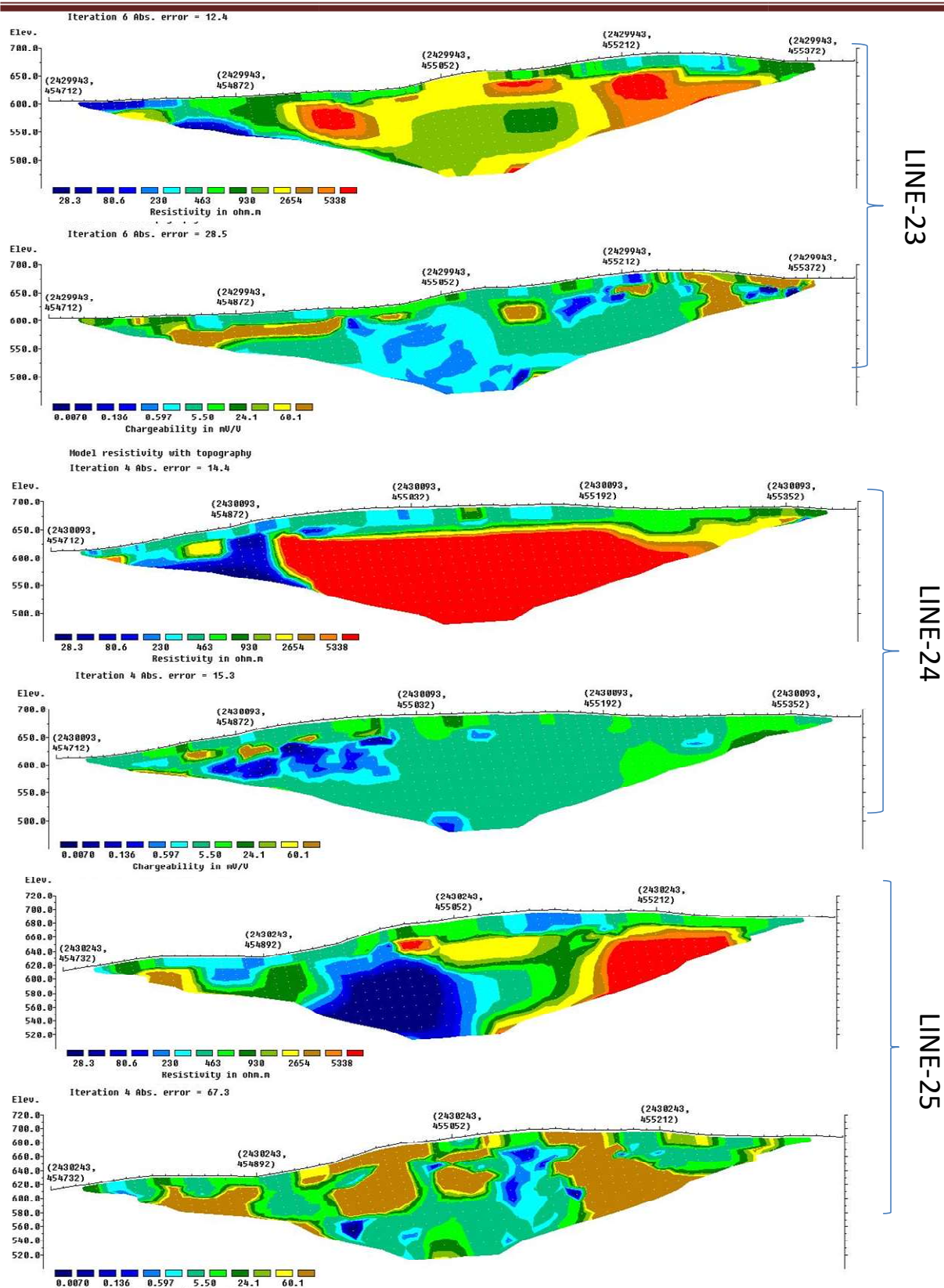


Fig. 6.2.2.2: 2D Section of Resistivity and Chargeability (Line 23 to 25) of Block-II

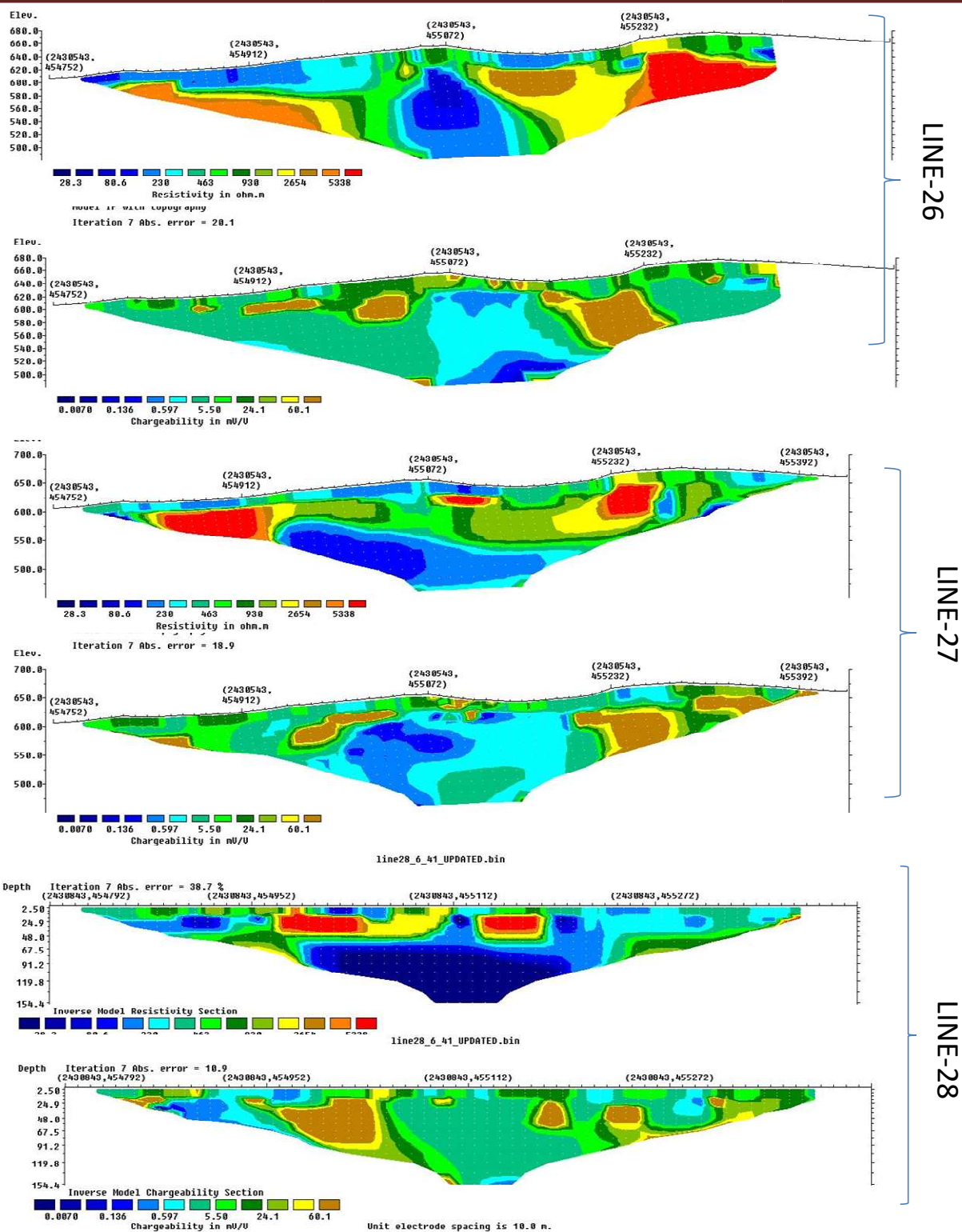


Fig. 6.2.2.3: 2D Section of Resistivity and Chargeability (Line 26 to 28) of Block-II

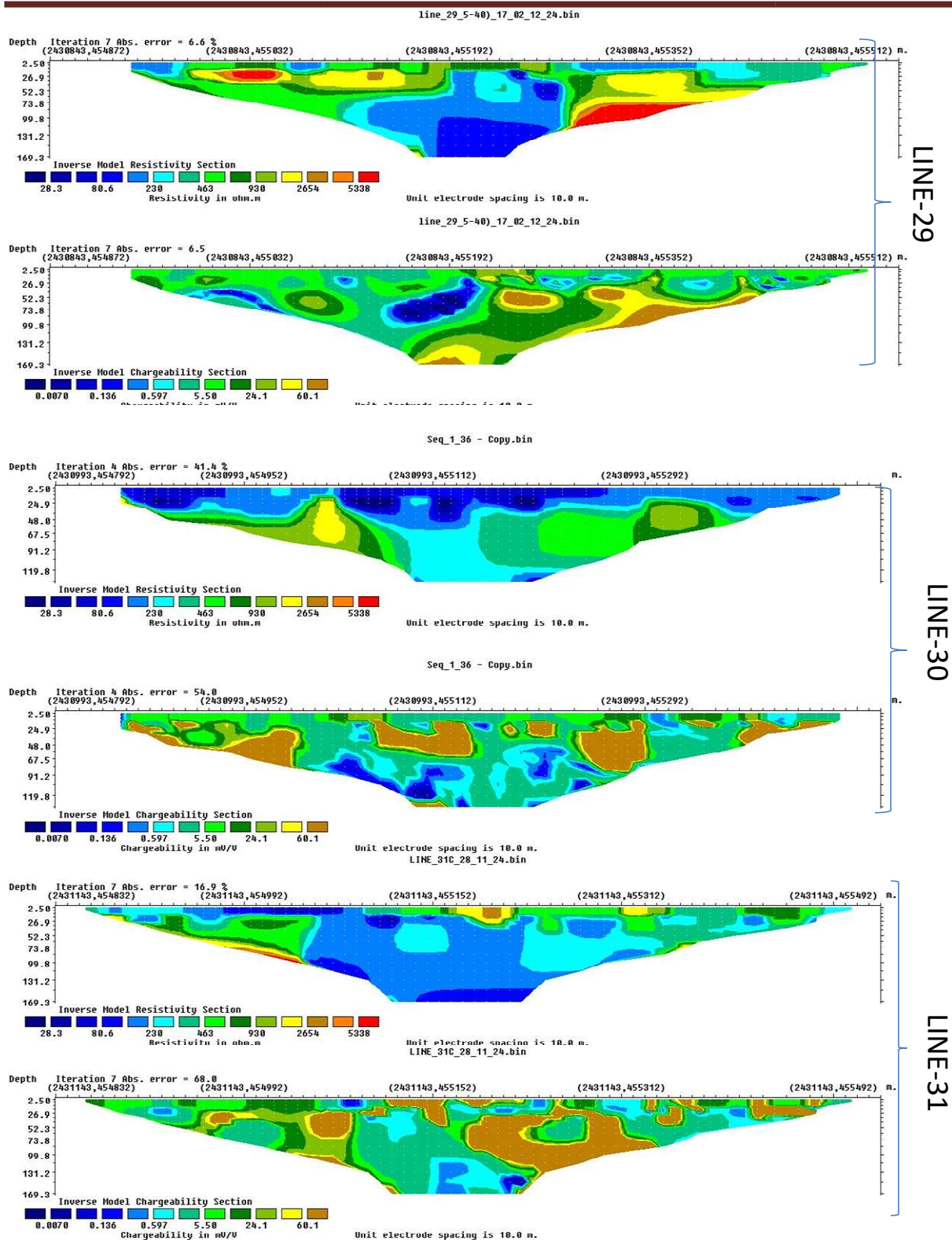


Fig. 6.2.2.4: 2D Section of Resistivity and Chargeability (Line 29 to 31) of Block-II

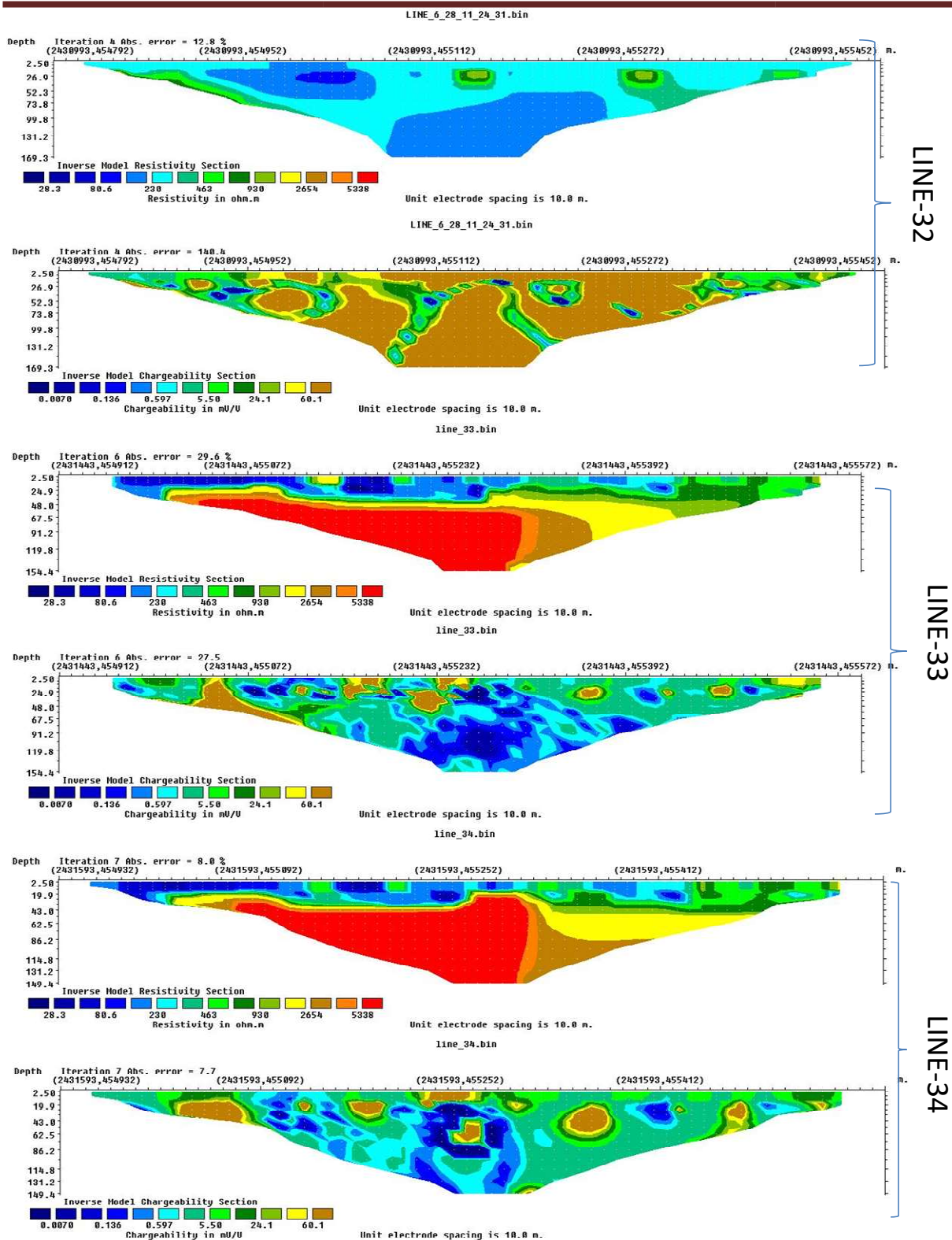


Fig. 6.2.2.5: 2D Section of Resistivity and Chargeability (Line 32 to 34) of Block-II



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ANNEXURE XIII/ 54

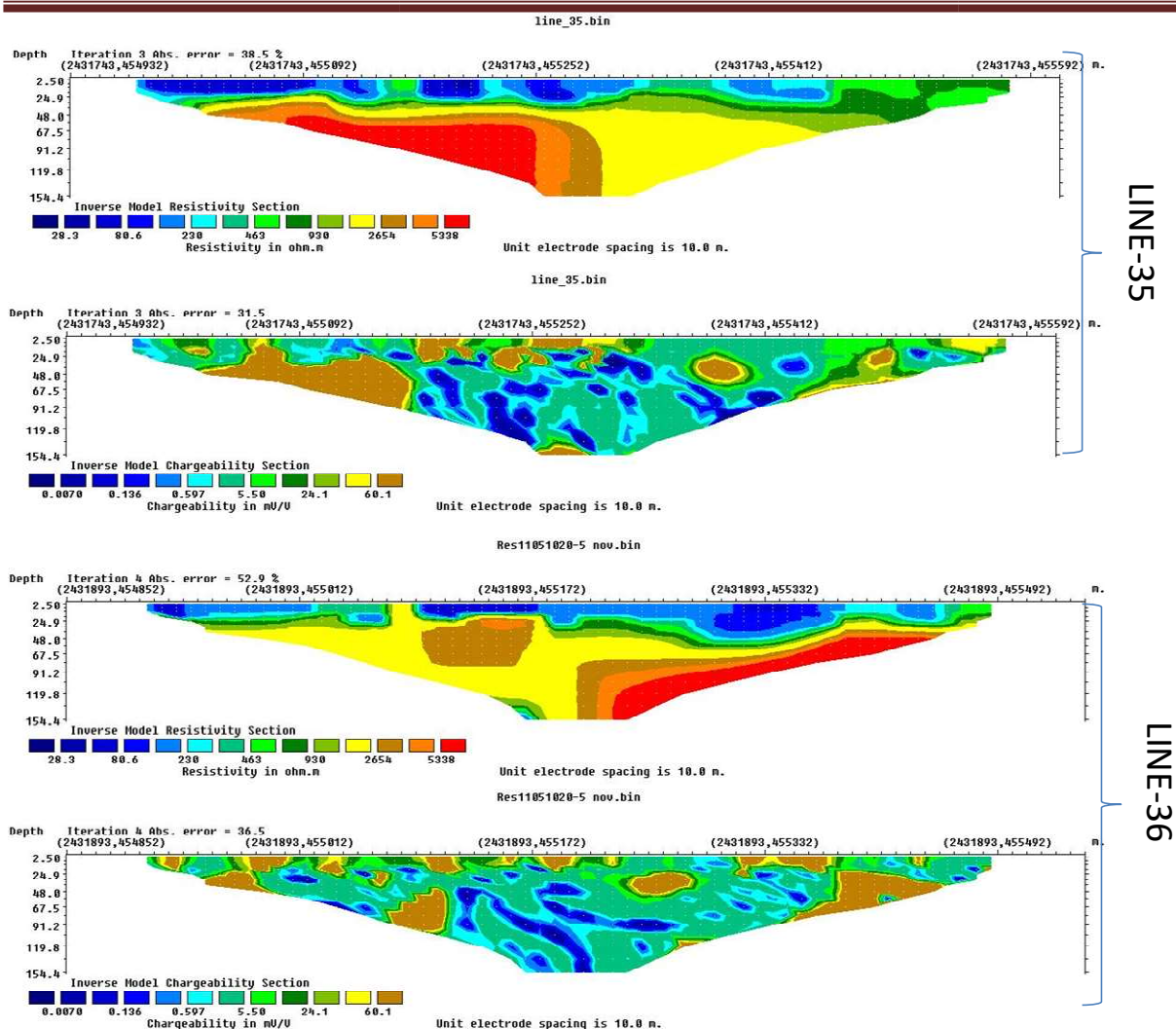


Fig. 6.2.2.6: 2D Section of Resistivity and Chargeability (Line 35 to 36) of Block-II
