DIRECTORATE OF GEOLOGY AND MINING

Indrawati Bhawan, 2nd Floor, Block-4, Nava Raipur (C.G.) 492 002
Phone- 0771 – 2221840, 2511093 Fax- 0771 - 2221841,PBX 0771- 2221845 Email: dgm.cg@nic.in

No. 2353 /Geo – I/F.No-09 /NPEA United /2022 Atal Nagar Raipur, Dt. 22 MAR 2023

To,

Director
National Mineral Exploration Trust
Room No. 114, F – Wing, First Floor
Ministry of Mines, Shastri Bhawan,
New Delhi - 110001

Subject- Exploration Proposal for **Nawadih Graphite block (32.04 Sq. km.),** for G- 4 exploration of Graphite District Balrampur, Chhattisgarh submitted by **United Exploration India Pvt. Ltd**.

Reference:

1. Government of India, Ministry of Mines, NMET, New Delhi order dated 10th May 2022 regarding engagement of Notified Private Exploration Agencies.
2. Directorate of Geology and Mining, Chhattisgarh, letter no. 435/Geo – I/ F. No. 09/NPEA United /2022 Atal Nagar, Nava Raipur dated 19th January 2023.
3. Detailed Proposal Report (DPR) on G- 4 exploration of Nawadih Graphite Block, District Balrampur, M/s. United Exploration India Pvt. Ltd. dated 02nd February 2023.

With reference to the above subject, and in compliance with the Ministry of Mines NMET order dated 10th May 2022 for engagement of Notified Private Exploration Agency, under Mode – A, M/s United Exploration India Pvt. Ltd. had submitted Exploration Proposal for G-4 Exploration of Nawadih Graphite block (32.04 Sq. km.), District Balrampur, Chhattisgarh to DGM Chhattisgarh. After confirming the status of overlapping of area/ duplication of work in the proposed area from GSI, State Unit Chhattisgarh, DGM Chhattisgarh issued In principle approval for the cited proposed block by United Exploration India Pvt. Ltd on 19.01.2023 (Reference 2). Detailed project proposal (DPR) was received at DGM Chhattisgarh, after necessary scrutiny of the DPR in prescribed format of NMET for submission of proposal, few discrepancies were found in the project proposals(Details enclosed) which require corrections/updation.

The cited project proposal is hereby forwarded in original form for due discussion/ necessary action to NMET Technical cum Cost Committee.

The details of project being forwarded is as follows.

Sl. No.	Name of the Notified Private Exploration Agency (NPEA)	Details of proposal	Stage of Exploration
1.	M/s. United Exploration India Pvt. Ld.	Proposal for Nawadih Graphite block (32.04 Sq. Km.), Balrampur District, Chhattisgarh for G4 Stage Mineral Exploration.	G-4

For your kind perusal and necessary action please.

Enclosure:

1. Comment Note received from GSI, State Unit Chhattisgarh
2. Detailed Project Proposal by NPEA (United Exploration India Pvt. Ltd.)
3. Observation Note by DGM Chhattisgarh

Director
Geology & Mining
Chhattisgarh

No.2353(A)/Geo – I/F.No-09 /NPEA United /2022 Atal Nagar Raipur, Dt.

Copy to

1. United Exploration India Pvt. Ltd New Town, Kolkata, West Bengal for information and necessary further action.

Director
Geology & Mining
Chhattisgarh

Enclosure-1

Gmail DGM GEOLOGY <dgmgeology@gmail.com>

Proposal received from NPEA - United Exploration

3 messages

DGM GEOLOGY <dgmgeology@gmail.com> Fri, Dec 2, 2022 at 4:17 PM
To: State Unit Raipur Chhattisgarh <dir.sucg.rpr@gsi.gov.in>

Dear Sir,

DGM has received proposal on Graphite by United Exploration for exploration.

Requesting you to kindly check for any duplication of work in the proposed block.

Please refer the attach document.

--
OIC (Geology)/
Joint Director(Geology)
Directorate of Geology & Mining, C.G.
Indravati Bhavan, Block-4 , Second Floor, Atal Nagar,
Ph.- +91-771-2221840, 2221844, 2221849, FAX: +91-771-2221841

Exploration Proposal for Nawadih II Graphite Block, Chhattisgarh Under NMET.pdf
820K

State Unit Raipur Chhattisgarh <dir.sucg.rpr@gsi.gov.in> Mon, Dec 26, 2022 at 6:34 PM
To: DGM GEOLOGY <dgmgeology@gmail.com>
Cc: "DDG SU: Chhattisgarh Raipur" <ddg.sucg.rpr@gsi.gov.in>

Sir,

With reference to the G-4 stage proposal for graphite named Nawadih II in Balrampur district, CG by M/s. United India Exploration Pvt. Ltd under NMET, attached please find the reply document regarding overlap/duplicity.

भवदीय / Yours Sincerely

हरीश चंद्र शाहू / Harish Chandra Shahu

निदेशक, तकनीकी समन्वय / Director, Technical Coordination
कृते उपमहानिदेशक / *for* Deputy Director General

भारतीय भूवैज्ञानिक सर्वेक्षण / Geological Survey of India
राज्य इकाई छत्तीसगढ़ रायपुर / State Unit Chhattisgarh, Raipur
आईपी फोन / IP Phone: 27004

From: DGM GEOLOGY <dgmgeology@gmail.com>
Sent: 02 December 2022 16:17:45
To: State Unit Raipur Chhattisgarh
Subject: [External]Proposal received from NPEA - United Exploration

[Quoted text hidden]

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2 attachments

Exploration Proposal for Nawadih II Graphite Block, Chhattisgarh Under NMET.pdf
820K

GSI_Reply_Nawadih II_Graphite_UEIPL.pdf
232K

DGM GEOLOGY <dgmgeology@gmail.com> Wed, Dec 28, 2022 at 5:00 PM
To: "sukhenmajumder@gmail.com" <sukhenmajumder@gmail.com>

[Quoted text hidden]

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2 attachments

Exploration Proposal for Nawadih II Graphite Block, Chhattisgarh Under NMET.pdf
820K

GSI_Reply_Nawadih II_Graphite_UEIPL.pdf
232K

A) Details of Nawadih II Block, Balrampur District, Chhattisgarh for Graphite proposed by M/s. United Exploration India Pvt. Ltd under NMET funding.		
S. No.	**Block/Toposheet/District**	**Commodity**
1	Regional Graphite Exploration (G4) proposal for Nawadih II Block, Balrampur District, Chhattisgarh (T.S. 64M/10)	Graphite

Overlap/ Duplicity:

United Exploration India Pvt. Ltd. has given two blocks (Nawadih and Nawadih-II) for graphite exploration in Toposheet no. 64M/10 and observed overlap with each other.

GSI, State Unit: CG, Raipur has proposed a project for G4 stage exploration of Graphite during FS: 2023-24 in T.S. 64M/10. The project has been approved by GSI for FS 2023-24. An area of about 3 sq. km of Nawadih II block is overlapping with the GSI block for FS 2023-24 in its south-western part.

The Block vertices as given in the page no.4 of the proposal submitted by M/s. UEIPL is as given below.

3. Block Description

Block Corner Points / Cardinal Points	Latitude	Longitude
A	83° 40' 23.5954" E	23° 41' 49.4300" N
B	83° 43' 06.6438" E	23° 41' 49.4300" N
C	83° 43' 06.6438" E	23° 38' 23.8474" N
D	83° 40' 23.5954" E	23° 38' 23.8474" N

In the following figure 1, disposition of the of GSI proposed block for FS 2023-24 and earlier proposed Nawadih block by UEIPL with that of Nawadih II block are given.

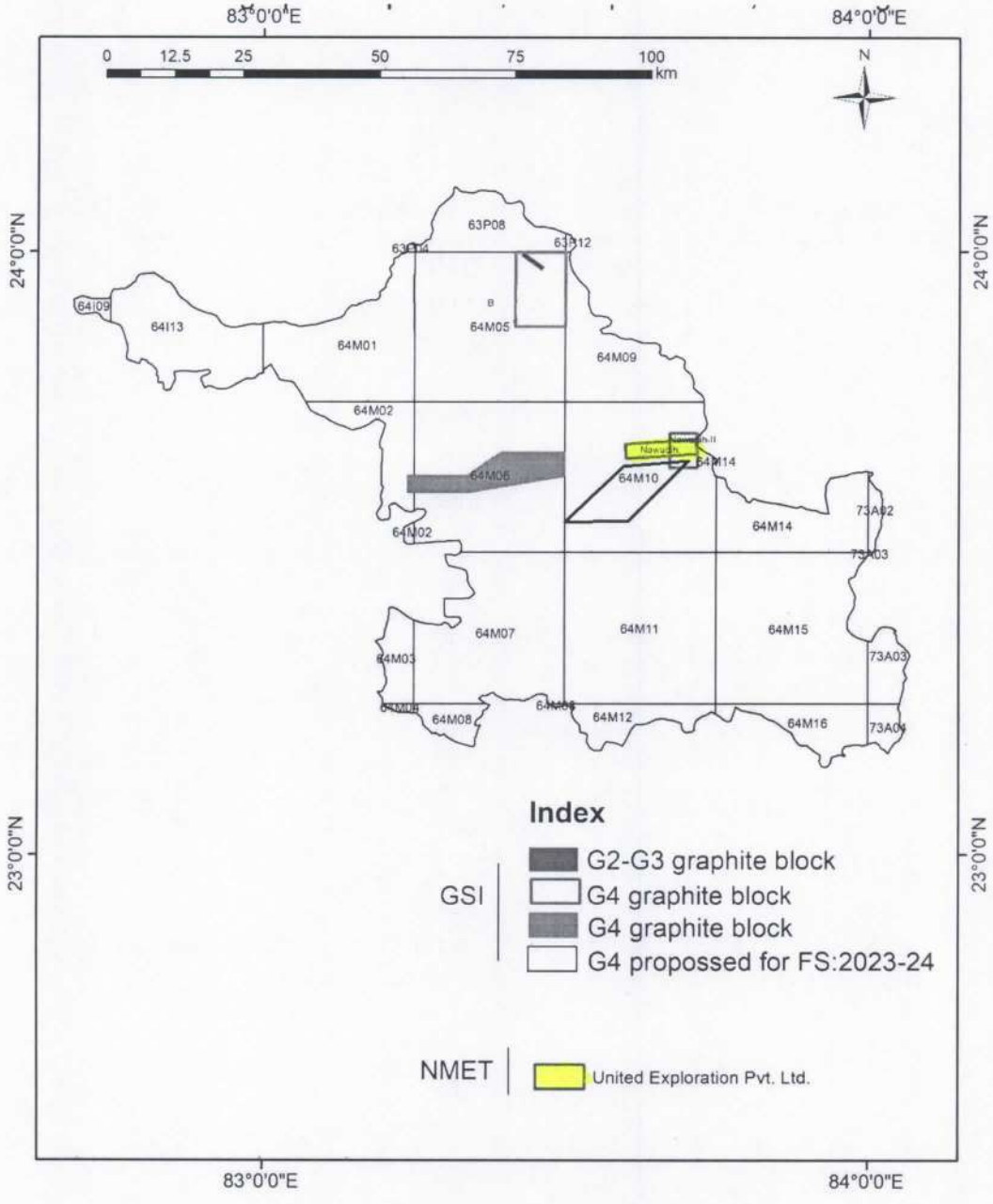

Fig.1: Disposition of GSI & UEIPL proposed blocks

Gmail DGM GEOLOGY <dgmgeology@gmail.com>

Proposal of Notified Private Exploration for NMET funding

4 messages

DGM GEOLOGY <dgmgeology@gmail.com> Tue, Oct 11, 2022 at 1:20 PM
To: State Unit Raipur Chhattisgarh <dir.sucg.rpr@gsi.gov.in>

Dear Sir,

United Exploration, being a notified private Exploration agency by the Ministry of Mines has submitted a proposal for graphite exploration, Balram District to DGM Chhattisgarh for NMET funding and approval.

In this line, it is requested you to check please the proposal for any duplication of work and technical discrepancies and revert the same with comments to DGM so that the project proposal can be put forward to NMET.

Please find the attachment proposal for your kind information and perusal please.

--
OIC (Geology)
Directorate of Geology & Mining
Indravati Bhavan, Block-4 , Second Floor, Atal Nagar,
Ph.- +91-771-2221840, 2221844, 2221849, FAX: +91-771-2221841

NMET Proposal-Chhattisgarh-Sept22 (2)_removed (1).pdf
1169K

State Unit Raipur Chhattisgarh <dir.sucg.rpr@gsi.gov.in> Mon, Nov 21, 2022 at 7:13 PM
To: DGM GEOLOGY <dgmgeology@gmail.com>
Cc: "DDG SU: Chhattisgarh Raipur" <ddg.sucg.rpr@gsi.gov.in>

Sir,

With respect to the cited proposal, it is to inform you that GSI, State Unit: Chhattisgarh has not carried out exploration for **graphite** in the proposed G4 Nawadih Block by United India Exploration Pvt. Ltd as per the data available with this office. The bounding cordinates of the proposed Nawadih Block in 64M/10 are -

	X	Y
A	83.59958	23.67918
B	83.71511	23.68673
C	83.71937	23.66277
D	83.6009	23.65522

The available data suggest that GSI has carried out specialized thematic mapping during FS 2010-12 "Specialized Thematic Mapping in Chhottanagpur granite gneiss and metasediments of Surguja district, Chhattisgarh" in the half of the area (in the southern part) of the proposed block, which include Nawadih, Lurghuta areas.

In proposal material, although it is mentioned Graphite as the commodity, in the objective it is mentioned as *"To establish mineralogical potentiality with respect to gold mineralization."*. Kindly confirm the same.

भवदीय / Yours Sincerely

हरीश चंद्र शाहू / Harish Chandra Shahu

निदेशक, तकनीकी समन्वय / Director, Technical Coordination
कृते उपमहानिदेशक / *for* Deputy Director General

भारतीय भूवैज्ञानिक सर्वेक्षण / Geological Survey of India
राज्य इकाई छत्तीसगढ़ रायपुर / State Unit Chhattisgarh, Raipur
आईपी फोन / IP Phone: 27004

From: DGM GEOLOGY <dgmgeology@gmail.com>
Sent: 11 October 2022 13:20:19
To: State Unit Raipur Chhattisgarh
Subject: [External]Proposal of Notified Private Exploration for NMET funding

[Quoted text hidden]

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24 attachments

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DGM GEOLOGY <dgmgeology@gmail.com> Tue, Dec 6, 2022 at 10:12 AM
To: Joydeep banerjee United Exploration <jbanerjee@unitedexploration.co.in>

Please refer to the trailing mail and update your proposal accordingly in the prescribed NMET format.

So as the said block can be move forward to NMET for due approval

Please refer GSI comments,/suggestion in the trailing mail.
[Quoted text hidden]

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DGM GEOLOGY <dgmgeology@gmail.com> Thu, Dec 15, 2022 at 2:06 PM
To: dkonar@unitedexploration.co.in

---------- Forwarded message ---------
From: **State Unit Raipur Chhattisgarh** <dir.sucg.rpr@gsi.gov.in>
Date: Mon, Nov 21, 2022 at 7:13 PM
Subject: Re: [External]Proposal of Notified Private Exploration for NMET funding
To: DGM GEOLOGY <dgmgeology@gmail.com>
Cc: DDG SU: Chhattisgarh Raipur <ddg.sucg.rpr@gsi.gov.in>

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OIC (Geology)/
Joint Director(Geology)
Directorate of Geology & Mining, C.G.
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Enclosure-3

Observations On Detailed Proposals Submitted By NPEAs – Chhattisgarh State

United Exploration India Pvt. Ltd.

Block ID : Nawadih Block (G4)

Commodity : Graphite

District : Balrampur

Sr. No.	Observations	Reference
1	Bifurcation of land (Forest/Government/Private) not provided.	Page no. 2 & 3 of the proposal
2	Synthesis of all available data is not given as per format	Point 2.7
3	Labor charges rates shall be as per rates prescribed by Central/State labor commissioner (Whichever is higher)	Point 2.7
4	Project cost is not made in line with SoC for NMET funded projects. Clauses are not mentioned against work items	Point 2.7
5	Self potential line km quantity is given as 90 line km exceeding maximum quantity of 20 line km. (against 8-20 Km) – it should be clarified.	Point 2.7
6	Land/Crop compensation shall be As per actuals as certified by local authorities subject to a maximum of 20,000 per bore hole	Point 2.7
7	Drilling rate is not as per NMET SoC	Point 2.7
8	Size wise (HQ/NQ) drilling meter not provided	Point 2.7
9	Borehole plugging by cement rates are not as per SoC	Point 2.7
10	Quantity for preparation of polished section and digital photomicrograph of thin polished selection is varying – clarification required.	Point 2.7
11	Plate 1: Geological map on 1:50,000 with location index - Not provided	List of Plates are not as per NMET format
12	Plate 2: Geological map/s on 1:50,000 : Proponent has provided map on 1:80000 against the requirement of 1:50K	
13	Plate 3: Ground geophysical map/s (NGPM) on 1:50,000. Not Provided	
14	Plate 4: Aeromagnetic map/s. : Not Provided	
15	Plate 5: Proposed block boundary over Geological map : Not provided	
16	Plate 6: Proposed block boundary over Land use/ Accessibility map. Not required at this stage.	
17	Plate 7: Proposed block boundary over topographic map on 1:50,000 : Proponent has provided map on 1:80000 against the requirement of 1:50K	

DIRECTORATE OF GEOLOGY AND MINING

Indrawati Bhawan, 2nd Floor, Block-4, Nava Raipur (C.G.) 492 002
Phone- 0771 - 2221840, 2511093 Fax- 0771 - 2221841, PBX 0771- 2221845 Email: dgm.cg@nic.in

No.435/Geo - I /F. No-09 /NPEA United/2022 Atal Nagar Nava Raipur, Dt 9 JAN 2023

To,

M/s United Exploration India Pvt. Ltd.
New Town, Kolkata, W.B.

Subject: In- principle approval of Exploration Project Proposal.

With reference to the above subject, Directorate of Geology and Mining, Chhattisgarh hereby **provides the In-principle approval** for the following projects submitted by you after required scrutiny as per provision laid down by Ministry of Mine for engagement of Notified Private Exploration Agency.

The Details of proposal are as under:

Sl. No.	Name of the Notified Private Exploration Agency (NPEA)	Details of proposal	Stage of Exploration
1.	M/s. United Exploration India Pvt. Ld.	Proposal for Nawadih Graphite block (32.04 Sq. Km.), Koriya District, Chhattisgarh for G3 Stage Mineral Exploration under NMET.	G-4

Hence, you are requested to send the detailed project proposal in required NMET format at the earliest, so that same can be forwarded to NMET Directorate for due approval/sanction of the project.

For your necessary action and perusal please.

Director
Geology & Mining
Chhattisgarh

Ref: NMET/CHT/GP/23/01

To
The Director & HoD
National Mineral Exploration Trust (NMET)
Ministry of Mines
F-114, Shastri Bhavan
New Delhi- 110001

It is certified that:

1. Project titled "Regional Graphite Exploration (G-4 Stage) proposal for "**Nawadih Block, Balrampur District, Chhattisgarh**" along with estimated cost of the project is submitted for consideration of NMET funding.
2. The project proposal is prepared following the guidelines prescribed in Minerals (Evidence of Mineral Contents) Rules, 2015 in case of mineral exploration project proposals.
3. The requisite approval has been obtained from the competent authority for the project proposal for NMET funding.
4. The proposal has been duly examined and concurred by associate finance in accordance with canons of financial propriety.
5. The same project proposal or project proposal with similar objectives has not been submitted to any other funding agency by this organization and the project proposal bears no duplication with existing work / ongoing project undertaken by this agency.

Yours faithfully,

For United Exploration India Pvt Ltd.

Date: 02/02/2023

Place: Kolkata, West Bengal

Enclosure 1: In Principal Approval from DMG Chhattisgarh

Enclosure 2: G4 exploration proposal for Nawadih Graphite Block

Enclosure-1

In-Principle Approval of Exploration Project Proposal from DGM Chhattisgarh

DIRECTORATE OF GEOLOGY AND MINING

Indrawati Bhawan, 2nd Floor, Block-4, Nava Raipur (C.G.) 492 002
Phone- 0771 - 2221840, 2511093 Fax- 0771 - 2221841, PBX 0771- 2221845 Email: dgm.cg@nic.in

No.435/Geo - I /F. No-09 /NPEA United/2022 Atal Nagar Nava Raipur, Dt 19 JAN 2023

To,

M/s United Exploration India Pvt. Ltd.
New Town, Kolkata, W.B.

Subject: In- principle approval of Exploration Project Proposal.

With reference to the above subject, Directorate of Geology and Mining, Chhattisgarh hereby **provides the In-principle approval** for the following projects submitted by you after required scrutiny as per provision laid down by Ministry of Mine for engagement of Notified Private Exploration Agency.

The Details of proposal are as under:

Sl. No.	Name of the Notified Private Exploration Agency (NPEA)	Details of proposal	Stage of Exploration
1.	M/s. United Exploration India Pvt. Ld.	Proposal for Nawadih Graphite block (32.04 Sq. Km.), Koriya District, Chhattisgarh for G3 Stage Mineral Exploration under NMET.	G-4

Hence, you are requested to send the detailed project proposal in required NMET format at the earliest, so that same can be forwarded to NMET Directorate for due approval/sanction of the project.

For your necessary action and perusal please.

Director
Geology & Mining
Chhattisgarh

Enclosure-2

G4 Exploration Project Proposal for Nawadih Graphite Block, Balarampur, Chhattisgarh

Proposal for Nawadih Graphite Block, Balrampur District, Chhattisgarh for Reconnaissance Survey (G4 Stage) under NMET

(Basemetals/ Ferrous/ Non-Ferrous/ Industrial/ Strategic & Critical/ Precious metals etc.)

Prepared by

United Exploration India Pvt. Ltd.

Unit 402, 4th floor, Axis Mall, Block-C

Newtown, Kolkata, West Bengal, 700156

Place: Kolkata, West Bengal

Date: 02/02/2023

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ANNEXURE LIST

Annexure No	Description
Annexure-1	Reference Literature
	A. Pradhan Rajesh Kumar; Interim Report on Geochemical Mapping in Toposheet No. 64m/6 In Parts of Balrampur and Surajpur District, Chhattisgarh, F.S. 2017–18.
	B. Radhakrishna T.S.; Geological Survey of India Progress report, geology of a part of Surajpur Tahsil, Surguja District, Madhya Pradesh, F.S. 1967–68.
	C. District Resource Map- Sarguja District, Chhattisgarh, GSI 2003.
Annexure-2	Gazette Notification of Accreditation
Annexure-3	Details of Project Members and Associates

1 GENERAL INFORMATION OF NAWADIH GRAPHITE BLOCK:

	Features	Details
	Block ID	**Nawadih Graphite Block**
	Exploration Agency	United Exploration India Pvt. Ltd. (UEIPL)
	Commodity	Graphite
	Mineral Belt	Chhotanagpur Granite Gneissic Complex
	Completion period with entire time schedule to complete the project	12 months
	Objectives	Exploration for Graphite is governed by the industrial demand of the mineral. The Graphite Market is Segmented by Type (Natural Graphite and Synthetic Graphite), Application (Electrodes, Refractories, Casting, and Foundries, Batteries, Lubricants, and Other Applications. The Graphite Market is expected to reach over 2,800 kilotons by the end of this year and is projected to register a CAGR of over 4.5% during the forecast period. That is why India is focusing on graphite mining to fulfill its demand in "Energy Storage Device". Project objective is aligned with India's 2030 Target and 2047 Vision. Based on the evaluation of geological data available, the present exploration program has been formulated to fulfill the following objectives. i. To carry out Remote Sensing study, Geological & Structural mapping on 1:12500 scale for identification of graphite bearing formation (host rock) with the structural features to identify the surface manifestation and lateral disposition of the mineralized zones. ii. To collect surface (Bedrock/stream sediment) samples & analyse for

	Features	Details
		Graphite and decide further course of Exploration program. iii. To know the subsurface extension of ore body five scout boreholes will be drilled based on analytical results of surface samples. iv. To estimate reconnaissance resources as per UNFC norms and Minerals (Evidence of Mineral Contents) Rule-2015 at G-4 level mineral exploration.
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof Components to be outsourced and name of the outsourced agency	UEIPL and its associates
	Name / number of the geoscientists	5 geoscientists will involve (2 geologist, 1 geophysicist, 1 resource geologist, 1 GIS specialists)
	Expected field days (Geology, Geological party days)	10 months
1	**Location**	
	Latitude	23° 39' 18.788" N - 23° 41' 12.212" N
	Longitude	83° 35' 58.498" E - 83° 43' 9.749" E
	Village	Nawadih, Lurghuta, Rajbandha, Sarangpur, Dhaneshpur & Vishramnagar
	Tehsil/Taluk	Balrampur
	Districts	Balrampur
	State	Chhattisgarh
2	**Area (hectares/square Kilometers)**	
	Block Area	32.04 Sq. Km.
	Forest Area	Partly falling in forest land.

	Features	Details
	Govt Land Area	Data Not Available
	Private Land Area	Data Not Available
3	**Accessibility (Arial Distance)**	
	Nearest Rail Head	Barwadih (50 km), Ambikapur (90 km)
	Road	NH-343 is passing through the proposed block boundary. Chhattisgarh-Odisha state boundary is within 2 km from the eastern boundary.
	Airport	Ranchi (180 km), Varanai (210 km), Raigarh (220 km)
4	**Hydrography**	
	Local/Surface Drainage Pattern	The drainage pattern is dendritic to sub-dendritic with moderate drainage density and is primarily controlled by Kanhar river & its tributaries.
	Rivers/Streams	Kanhar river is passing within 2 km from the eastern boundary of the proposed block
5	**Climate**	
	Mean Annual Rainfall	120 cm
	Temperature (December)(Minimum) Temperatures (June)(Maximum)	The climate of the study area is tropical. The summer begins from middle of March to early June and characterized by stretches of humid to very hot dry months with maximum temperature up to 45°C. The area receives heavy rainfall, from early June to September. The winter starts from November to mid-February and temperature fluctuates between 16° to 24°.
6	**Topography**	
	Toposheet Number	64 M/10
	Morphology of the area	The area consists of highly rugged topography with hills running along the southern side of the block having steep slopes and scraps. Topographic slopping down radially from south to north.
7	**Availability of baseline geoscience data**	

	Features	Details
	Geological Map (1.50k/25k)	1:50000
	Geochemical Map	Not Available (NGCM raw data from Bhukosh was downloaded containing stream sediment sample results for 22 element's)
	Geophysical Map (Aero-physical, Ground geophysical, regional as well as local scale GP maps)	Not Available
8	**Justification for taking up Reconnaissance Survey/ Regional exploration**	➢ Proposed block is potential for graphite mineralization. ➢ Geologically the area falls in the graphite schist belt where presence of graphite mineralization was reported by GSI. ➢ Graphite occurrences between Kennapara and Manikpur in Surguja district (now Balrampur district) were recorded by T.S. Radhakrishna in 1967-68. This reported area is situated 10km west of the proposed block. ➢ Site visit carried out by UEIPL team also established graphite deposition in the project block. Photographs of site visit given below (Figure-3). Precambrian age metamorphic rock such as Gneiss, Mica schist and Quartzite is mainly exposed. Intrusive Igneous rocks such as pegmatite vein, Quartz veins of east west trending are also recorded. Graphite bearing mica schists beds not recorded in the proposed block. However, floats of graphite schist noted on river beds. Graphite schist in-situ deposits noted in the western extension of the quartzo mica schist horizon falling in the proposed block. So, as per the above references, the proposed area needs further investigation for graphite exploration.

2 DETAILED DESCRIPTION OF THE PROPOSAL:

2.1 Block Summary:

2.1.1 PHYSIOGRAPHY:

Physiographically, the area is occupied by crystalline rocks marked by rugged and undulating topography with linear low-lying ridges. The Gondwana and Decan trap areas are manifested by highly rugged topography with hills and plateau with steep slopes and scraps.

In the proposed block, elevation is varied from 450m to 480m. General slope of the area is from South to North. E-W trending hill range noted in the southern part of the proposed block (Figure 1).

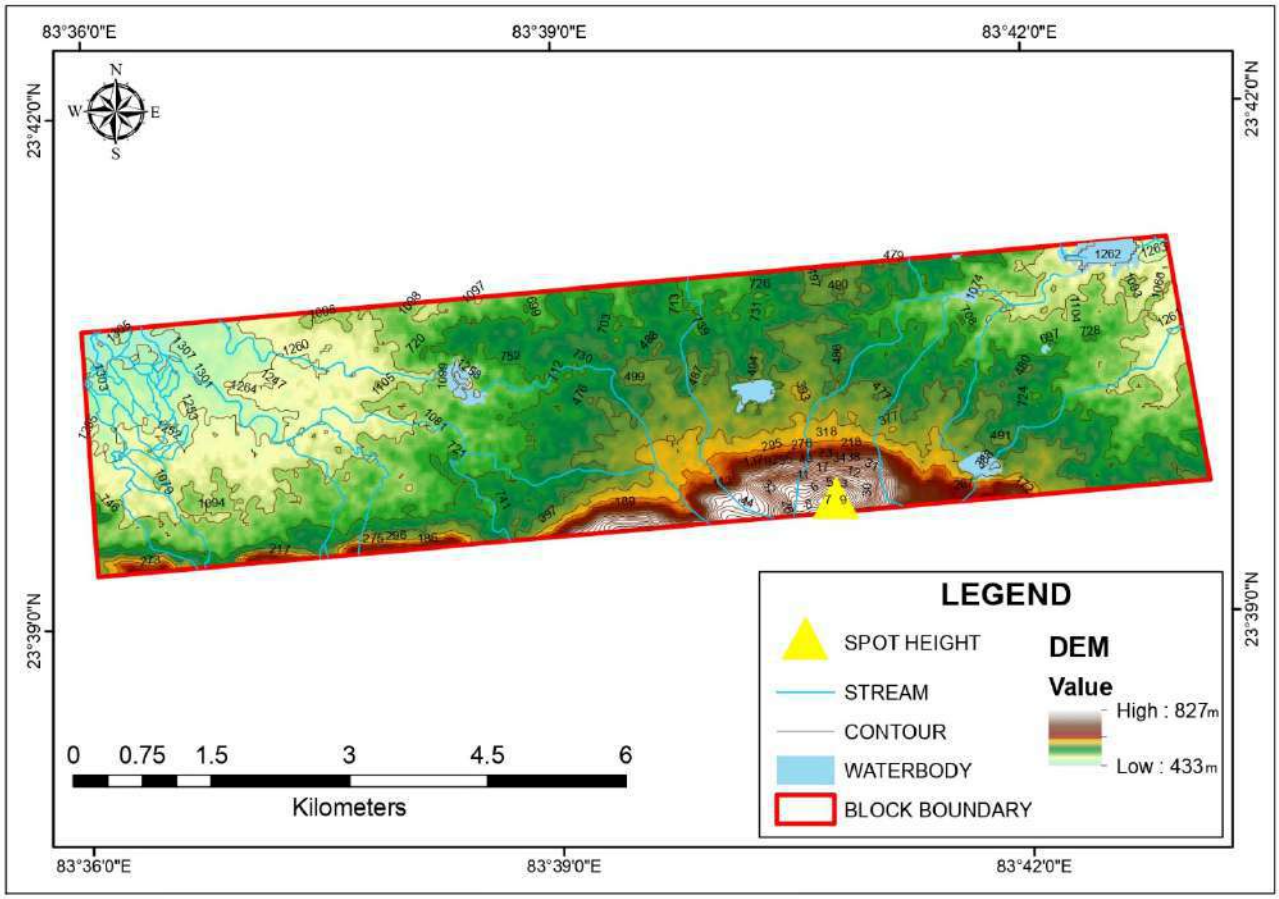


Figure 1: Physiographic map of proposed block

2.1.1.1 Drainage:

The drainage pattern is dendritic to sub-dendritic with moderate drainage density. Drainage system of the area is primarily controlled by Kanhar and Sendur River & its tributaries (Figure 2).

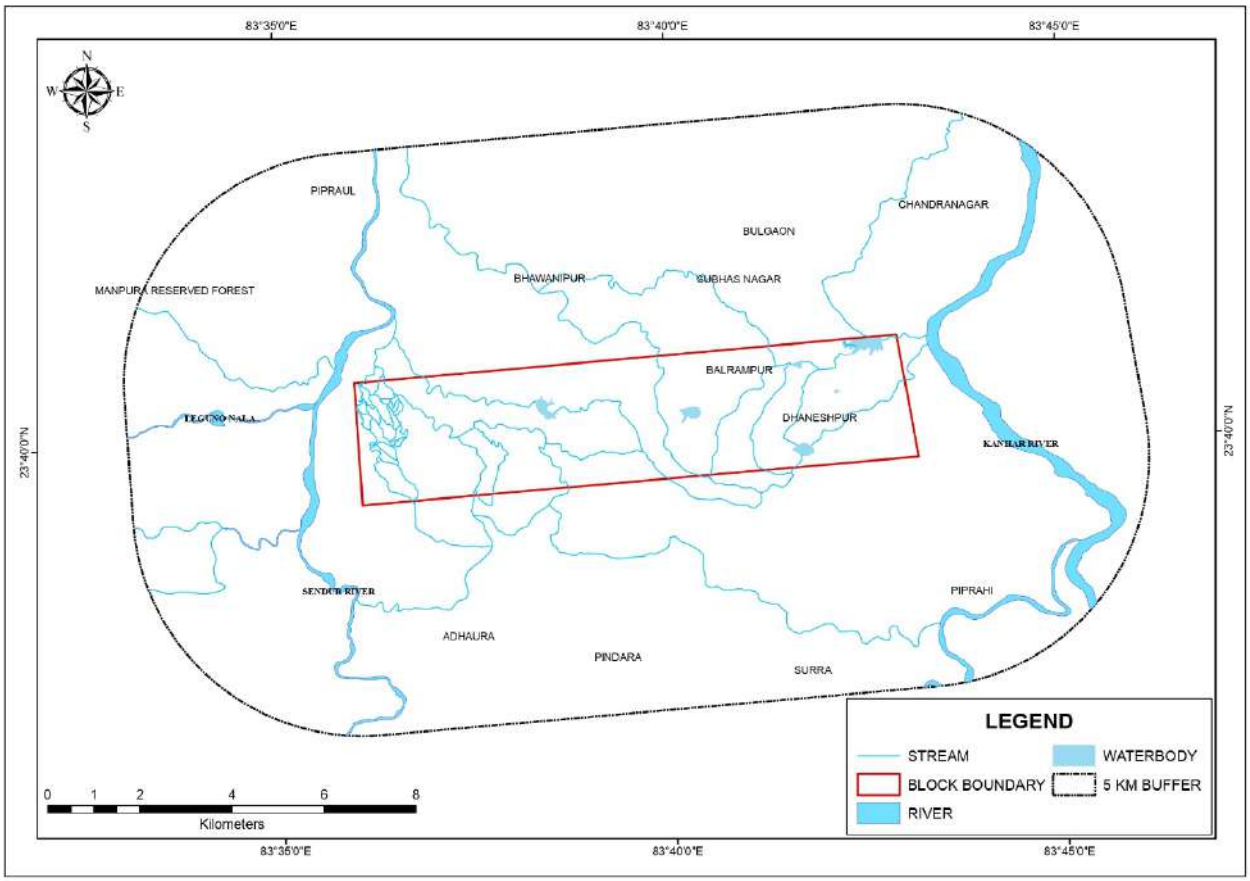


Figure 2: Map showing drainage pattern in and around proposed block

2.1.2 BACKGROUND GEOLOGY (REGIONAL GEOLOGY & GEOLOGY OF THE BLOCK):

2.1.2.1 Reginal Geology

The mapped area is occupied by Precambrian rocks and Gondwanas. The Precambrians comprise gneiss, quartzite, phyllite, mica schists, calc-gneiss and migmatites. Granite occurs as intrusive into the schists and gneisses. The Precambrian rocks form the basement for the Gondwana sediments. The area is traversed by pegmatites and quartz veins. The granite, gneiss and migmatites with the inclusion of older suite of mica schist and hornblende

schist, phyllite, amphibolite and quartzite have described together as Precambrian of Archaean to Proterozoic age.

Major Portion of the of the area is consist of Archean age rock and thereafter by rock of Chhotanagpur gneissic complex. Dominant lithology at the Northern part of the Balrampur district is consist of Archean age rocks whereas rocks of Chhota Nagpur Gneissic complex are mainly found at the southern part of the district. Central and Southern part of the district is mainly covered with Gondwana sediments.

Gondwana are represented by Talchair, Barakar, Raniganj, Panchet, and Mahadeva formation. The contact between Precambrian age rock and Gondwana sediments are appeared to be faulted and Many Nonconformities have been found at such places where Igneous and metamorphic rock are underlain by Gondwana sediments.

Table 1: Stratigraphy of Balrampur district, Chhattisgarh

AGE	LITHO STRATIGRPHY		LITHOLOGY
Cenozoic			Laterite with Bauxite
Upper Cretaceous to Eocene	Deccan Trap		Basalt capped by Laterite; Trap Basalt / Dykes
Cretaceous	Lameta formation		Cherty Limestone, Gritty Sandstone, Clay
Lower Middle Jurassic to Upper Triassic	Gondwana Supergroup	Mahadev formation / Supra Panchet formation / Pansora formation	Sandstone, Shale
Triassic		Panchet formation	Sandstone, Shale
Lower Triassic		Kamthi formation	Sandstone,
Upper Permian		Raniganj formation	Sandstone, Shale, Carbonaceous Shale with Coal Seam
Lower Permian		Barakar formation	Sandstone, Shale with Coal Seam
Lower Permian		Talchair formation	Sandstone, Shale, Tillite

AGE	LITHO STRATIGRPHY	LITHOLOGY
Archean - Proterozoic	Chhotanagpur Gneissic Complex	Granite Gneiss, Biotite Gneiss, Granite, Biotite granite
Archean		Calc-silicate rock, Marble, Amphibolite, Quartz-Staurolite-Kyanite Schist and Graphite Schist

(Source- District survey report of Balrampur, Chhattisgarh)

2.1.2.2 Local Geology

Litho units which are encountered during preliminary site visit of the project block are described below.

Graphite mica schist

Boulder size graphite floats have been found from the North western part of proposed block boundary along Sendur river bed and its tributaries (Figures -3a, 3b, 3c, 3d). Graphite mineralization is noted within weathered mica schist. It is a tributary of the Sendur River.

Quartz Mica Schist

This rock contains large amount of Mica with lesser amount of Quartz. Schistosity is well preserved within the rock due to well arrangements of flaky Mica (Figure. 3e).

Augen Gneiss

Augen gneiss noted along Sendur river consist of porphyroblasts/augens of predominantly K-feldspar and Plagioclase feldspar and together with Biotite and Quartz. Gneiss developed S-C fabric which showing both dextral and sinistral type of shearing. But dextral shearing is predominant at that area (Figure. 3f).

Banded Gneiss

The rock contains predominantly quartz, alkali feldspar, Biotite etc. This rock is found in many areas of the block. Gneissic banding is well preserved and the color of the rock is grayish white with fine to medium grained.

Quartzite

The rock contains predominantly quartz as the essential mineral with mica as accessory mineral. Color of the rock is white to buff color with fine to medium grained hard and compact rock. General trend of quartzite noted in the area is E-W direction.

Pegmatite

Numerous granite pegmatite veins are found within the study area mainly exposed along Sendur river. It crosscut to the older metamorphic rock and the direction of intrusion is parallel to foliation plane. Trend of the Pegmatite vein is also E-W direction.

Quartz Vein

It is found intruded frequently across the country rock and the trend of quartz veins is nearly E-W direction.

Migmatite

Migmatite have been found from North western part of proposed block boundary along Sendur river. This rock is formed under extreme high temperature and pressure condition during Prograde metamorphism hence the proposed block area is seems to be a very high grade metamorphic zone.

	
Figure 3a: Graphite bearing mica schist found from the North western part of proposed block boundary along Sendur river bed.	Figure 3b: Graphite bearing mica schist found from the North western part of proposed block boundary along Sendhur river bed.
	
Figure 3c: Graphite bearing weathered mica schist noted on Leguna river flowing along western part of the block.	Figure 3d: Graphite Schist recorded Bhawanpur area located 5km west of the proposed block.

Figure 3e: Quartz Mica Schist exposed along Sendur river.

Figure 3f: Augen Gneiss noted in the southern part of proposed block.

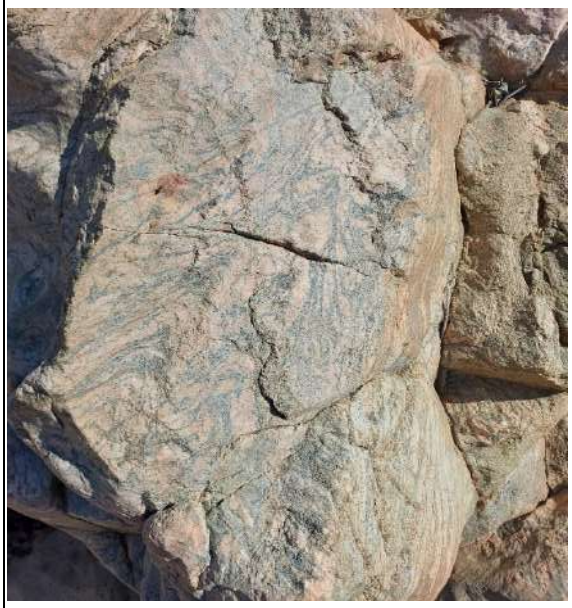


Figure 3g: Migmatite Rock exposed along Sendur river

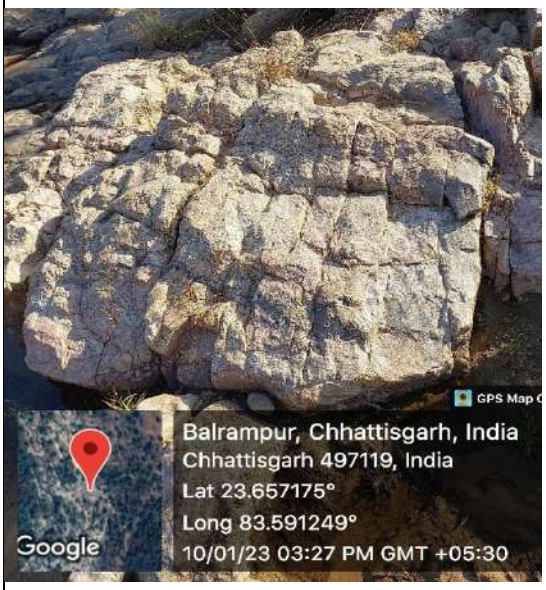


Figure 3h: 2sets of perpendicular joints noted.

Figure 3: Photographs of litho-units recorded during site visit

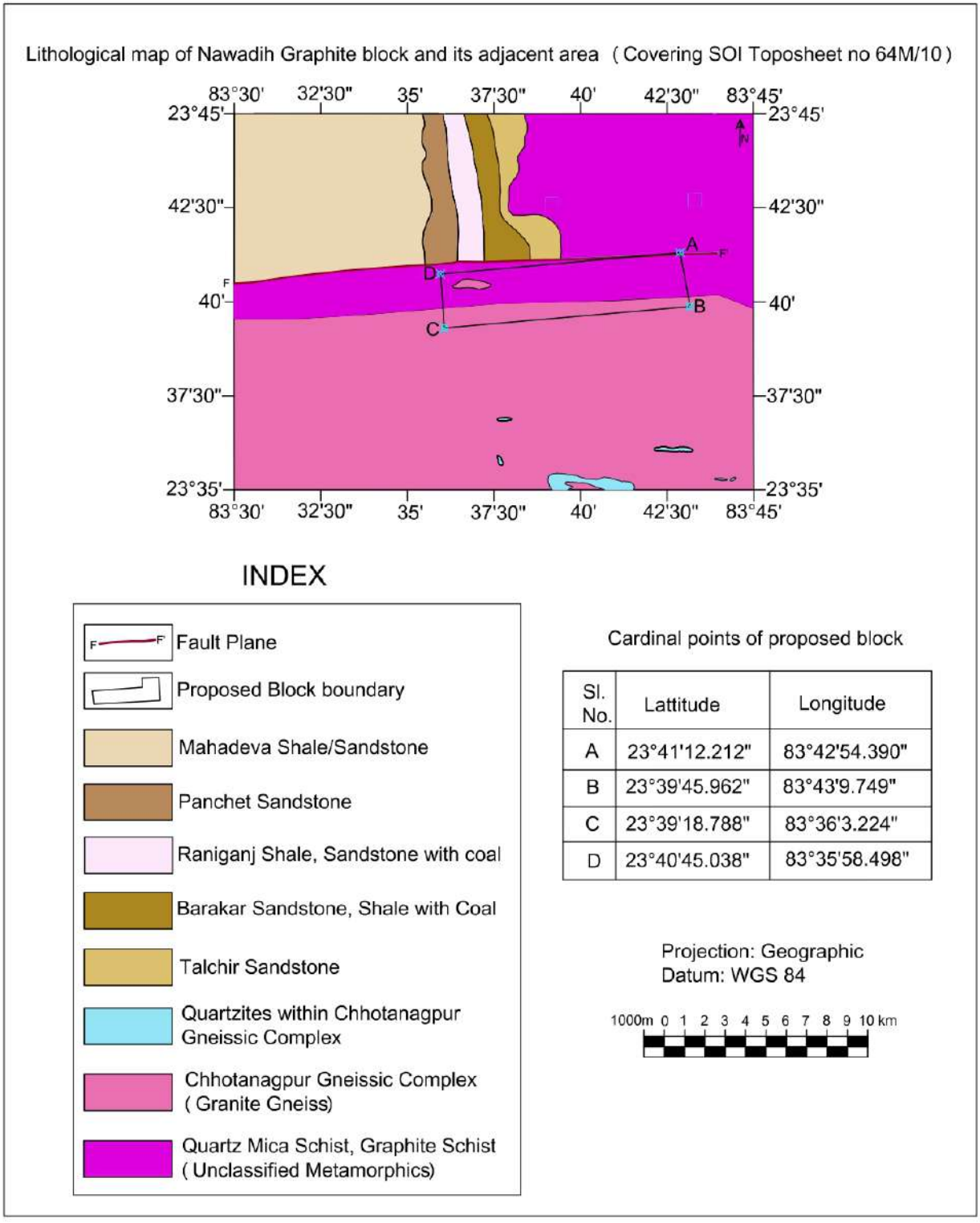
2.1.3 MINERAL POTENTIALITY BASED ON GEOLOGY, GEOPHYSICS, GROUND GEOCHEMISTRY):

The prospect area and the adjacent areas are occupied by rocks belonging to the Chhotanagpur gneissic complex, which have been intensely sheared along the Tatapani-Ramkola fault in the northern part and a patch of Gondwana rocks comprising Talchir, coal bearing Barakar, Ranigan and Panchet occur in the northwestern part of the area.

Occurrences of various important major minerals are found at Balrampur District are Coal, Pisolitic and massive Bauxite, Graphite and Polymetallic mineralization of Calc-silicate rocks with Galena-Chalcopyrite-Sphalerite Scheelite association and Pyrite-Arsenopyrite-Chalcopyrite association have been observed here.

Geologically the proposed block fall on Graphite schist belt (Figure 4). Graphite-mica schist is mostly found associated with the meta-sedimentaries. It is generally found in association with grey quartzite and or quartz-mica schist. At places it is also found associated with calc-silicates. Graphite mica schist consists of flaky graphite, mica and minor amounts of quartz. The thickness of graphite schist varies from a few cm to as much as 1.5m observed in nala sections.

Graphite bodies are occurred as lensoidal body, showing ENE-WSW trend and mostly present along the shear zone. Graphite bodies are found as discontinuous band and are associated with quartzite, quartz sericite schist and calc silicate in the area.



Sl. No.	Lattitude	Longitude
A	23°41'12.212"	83°42'54.390"
B	23°39'45.962"	83°43'9.749"
C	23°39'18.788"	83°36'3.224"
D	23°40'45.038"	83°35'58.498"

Figure 4: Geological map in and around proposed block

(Source: Bhukosh, Geological Survey of India)

2.1.4 SCOPE FOR THE EXPLORATION:

a. Topographical survey
b. Large scale mapping in 1:12,500 scale
c. Channel sampling
d. Geochemical sampling
e. Scout drilling
f. Petrographic study
g. Geophysical study
h. Remote sensing
i. Geological report preparation

2.1.5 OBSERVATION AND RECOMMENDATIONS OF PREVIOUS WORK:

In 1967-68 T.S. Radhakrishna of GSI have done the Mineral exploration on Graphite occurrences between Kennapara and Manikpur in Surguja district, Chhattisgarh. He reported that graphite schist occurs as lenses ranging from 3 to 80 m in length and 0.16 o 13 m in width. A total of 35 occurrences were reported. Inferred gross reserve of 10 to 22%graphite is estimated at 2350 metric tones. About 60 metric tons containing 5 to 8% graphite is available in the area.

With respect to the above findings, a G4 stage investigation for graphite was proposed in the current block for establishing graphite bearing zone's eastern extension.

2.2 Previous Work:

2.2.1 GSI EXPLORATION:

In 1967-68 T.S. Radhakrishna of GSI have done the Mineral exploration on Graphite occurrences between Kennapara and Manikpur in Surguja district, Chhattisgarh. He reported that graphite schist occurs as lenses ranging from 3 to 80 m in length and 0.16 o 13 m in width. A total of 35 occurrences were reported. Inferred gross reserve of 10 to 22%graphite is estimated at 2350 metric tonse. About 60 metric tons containing 5 to 8% graphite is available in the area.

K.C. Dass, Animesh Mukherjee and Vivek. V. Kumar (FS 2013-15) of GSI has carried out Specialized thematic mapping in Bilaspur-Raigarh-Surguja metamorphic belt in Birjnagar-Dhamini area, Surguja district, Chhattisgarh. they have mapped an area of 700 sq km on 1:25,000 scale in parts of

toposheet nos. 64M/5 and 64M/6. The mapped area and the adjacent areas are occupied by rocks belonging to the Chhotanagpur gneissic complex, which have been intensely sheared along the Tatapani-Ramkola fault in the northern part and a patch of Gondwana rocks comprising Talchirs, coal bearing Barakar, Ranigan and Panchets occur in the northwestern part of the area. Their study also revels occurrences of Graphite in this area.

With respect to the above findings, a G4 stage investigation for graphite was proposed in the current block for establishing graphite bearing zone's eastern extension.

2.3 Block Boundary:

The Co-ordinates of the corner points of the proposed block area are given below.

Block Corner Points / Cardinal Points	Latitude	Longitude
1	23° 40' 45.038" N	83° 35' 58.498" E
2	23° 41' 12.212" N	83° 42' 54.390" E
3	23° 39' 45.962" N	83° 43' 9.749" E
4	23° 39' 18.788" N	83° 36' 3.224" E

2.4 Planned Methodology

The exploration program is proposed in accordance to the objective set for reconnaissance survey (G-4) of the block. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rule-2015. Accordingly, the following scheme of exploration is formulated in order to achieve the objectives. The details of different activities to be carried out are presented in subsequent paragraphs.

i) **Remote sensing studies:** Identification of lineaments of tectonic, structural and mineral signature will be done using satellite imagery study. The remote sensing study which will be applied includes but not limited to the soil moisture study related to possible graphite and/or organic carbon rich reflectance of surface and identifying low thermal regions from TIR Band analysis of Landsat TM/ETM satellite data.

ii) **Geological Mapping:** Geological mapping will be done in the entire area on 1:12,500 scale. Rock types, their contact, structural features will

be mapped. Surface manifestations of the mineralisation available along with their surface disposition will be marked on map.

iii) **Survey:** The area surrounding drill points/mineralized zones (ore bodies)/potential area will be contoured with the help of DGPS survey.

iv) **Geochemical Survey:** Regional grab/ chip/ stream sediment/ soil sampling to be carried out at regular interval.

a. Grab Sampling: During the course of Geological mapping, bed rock samples shall be collected for identifying various litho units.

b. Soil Sampling: Soil samples will be carried out in entire area to delineate graphite mineralized zone.

v) **Ground Geophysical Survey:** Graphite is highly conductive mineral as compared to the host rock. Based on the geology of the area, SP, Magnetic and Gravity survey will be conducted.

vi) **Channel Sampling:** Based on the availability of the exposure, channel sampling will be carried out. Dimension of 50m X 0.1 m X 0.1m (L×W×D) may be used for collection of rock-chip samples.

vii) **Scout Drilling:** Based on Geological Mapping, Geochemical Sampling, the extension of the mineralized zones (ore bodies) will be marked. To find out the potentiality of mineralized zones in strike & dip direction, 5 no scout boreholes involving 500m of drilling will be carried out for upper (first) level of intersection of mineralized zones.

viii) **Chemical Analysis:** All samples need to analyzed for Cu, Pb, Zn, Cd, Bi, Au & Ag (Bed Rock Sample) and major and trace elements (Soil Samples) along with analysis for fixed carbon.

ix) **Petrographic study:** XRD studies have mostly been performed on grab samples to determine the grain size morphology and crystallinity. The graphitization can also be examined by the X-ray powder diffractometer. Occasionally, handheld XRF analyzers may provide significant and potentially material information about mineralization on a property.

x) **Data verification and Quality Check:** Standard reporting of resources are classified and estimated by using two types of data. Data acquired from previous exploration and data generated by exploring the block. Data verification and Gap analysis is the interpretive or indirect methods. Interpretive Data may include results from mapping, seismic, magnetic, gravity

and other geophysical and geological surveys. An Interpretive Data, may be used in conjunction with Explored Data to improve confidence levels.

QA/QC will be strictly followed during the collection, recording and storage of any of the data ultimately used in the geological report preparation. This programme should be concerned with, but not limited to, data verification, drill sample recovery, sample size, sample preparation, analytical methods, the use of duplicates/blanks/standards, effects of multiple periods of data acquisition and consistency of interpretation in three dimensions.

2.5 Nature Quantum and target

Components	G4	Quantum of Work
Aerial Reconnaissance	Remote sensing, airborne geophysical survey etc.	32 sq.km
Geological Mapping and Topo survey	i) 1.25k/ 12.5K	Geological mapping 32 sq.km (320 km traversing)
	ii) Assessment of lithology, structure, surface mineralization and analysis of old history of mining if any	
	iii) Survey	DGPS survey will be carried out to fixing drilling points, geophysical control points and so on.
Geochemical Survey	i) Regional grab/ chip/ stream sediment/ soil sampling	BRS:100 SS: 200
	ii) Recording of broad geomorphology, drainage etc.	60 days
Geophysical Survey	Aero-geophysical/ Regional ground geophysical survey	Ground Magnetic and Gravity Survey: over 270 station point SP: 90-line km (Line spacing 400m)
Channel	Channel sampling along exposure.	Trenching: 50 nos. (25 cum)

Scout Drilling/ systematic drilling only systematic drilling	Few boreholes if required along the positive profiles delineated by surface sampling/ pitting/ trenching	500m
Core sample	Sample from mineralize zones as well as hanging wall/ footwall side to be collected.	250 nos. drill core samples and 250n trench samples.
Petrographic and mineralogical studies	Principal rock types, mineral assemblage, identification of minerals of interest	Surface sample analysis (Grab/Chip): 50 XRD: 25 XRF: 25
Synthesis of all available data **Not required in the quantum of the work**	i. Integration of regional geophysical, geological and geochemical data, if not done earlier ii. Synthesis of all available data and report writing	3 Hard copies

2.6 Project schedule

Item of work in weekly time frame	Month-1	Month-2	Month-3	Month-4	Month-5	Month-6	Month-7	Month-8	Month-9	Month-10	Month-11	Month-12
Aerial reconnaissance												
Ground Geophysical Survey												
Gravity Survey												
Magnetic Survey												
SP Survey												
Geological Survey												
Large Scale mapping in 1:12,500 Scale												
Surveying												
Geochemical Survey												
Soil Sediment sampling												
Grab Sampling												
Trenching												
Trenching												
Chemical Analysis												
Soil samples analysis												
Surface sample analysis												
Drill core samples												
Scout Drilling (if required)												
Drilling												
Core Logging/sampling												
Petrographic and Mineral graphic studies												
Pterographic study												
XRD/ XRF study												
Geological report												

Interim Review Report

2.7 Project cost

Sl. No.	Item of Work	Unit	Qty.	Cost per unit/ per day/ manday (In Rs.)	Amount (In Rs.)
	Preparation of Exploration Proposal	Lumsum	1	380000.00	380000
1	**Satellite imagery/Aerial photo interpretation studies**				
	Charges for procurement of imageries (As per actual cost incurred)				
	Cost of interpretation in terms of Geologist mandays	Days	30	9000.00	270000
2	**Geophysical Survey**				
	Magnetic Surveys	per station	270	1800.00	486000
	Gravity Method-Regional/Detailed (0.5 to 200 sq.km depending on the objective)	per station	270	3800.00	1026000
	Self-Potential (8-20 line km)	Line Km	90	29600.00	2664000
	Processing + Interpretation Cost (Charges for Expert Geophysicist)	Mandays	30	9000.00	270000
3	**Geological Mapping (Scale 1:12,500)**				
	Charges of Geologist (2 Geo- 4month)	Mandays	240	11000.00	2640000
	Labour Charges (2 Helper for each geo)	Mandays	480	443.00	212640
	Topographical Survey (1 Reg. Surv + 4 Labours) (Duration 30 days)				
	a) Charges of Surveyor (Reg. Surveyor)	Mandays	30	8300.00	249000
	b) Labour Charges (4 Nos.)	Mandays	120	443.00	53160
4	**Geochemical Survey**				
	a) Charges of Geologist	Mandays	60	11000.00	660000
	b) Labour Charges	Mandays	120	443.00	53160
	(Reg. Geo = Rs11,000/day as per NMET SoC),				
	(Unskilled Labour cost @ Rs 443/day as per Min. of Labour rate)				
5	**Trenching**				
	Trenching	cu.m	25	3330.00	83250
6	**Sample Preparation**				
	sampler charges for Sample processing work	Mandays	30	5100.00	153000
7	**Chemical Analysis**				
	a) Bed Rock samples (including 10% check samples)	Nos	110	8157.00	897270
	b) Soil Samples (including 10% check samples)	Nos	220	8157.00	1794540
	c) Drill core samples (including 10% check samples)	Nos	275	8157.00	2243175
	d) Trench samples (including 10% check samples)	Nos	275	8157.00	2243175
	e) Proximate analysis for Graphite	Nos	50	3000.00	150000
8	**CORE DRILLING (500m/ 5 BH)**				
	a) Drilling camp setting cost	Lumsum	1	250000.00	250000
	b) Monthly Accommodation charges for drilling camp	Months	3	50000.00	150000

Sl. No.	Item of Work	Unit	Qty.	Cost per unit/ per day/ manday (In Rs.)	Amount (In Rs.)
	c) Transportation of Drill Rig & Truck associated for drill	per km	2000	36.00	72000
	d) Land/Crop Compensation	per BH	5	20000.00	100000
	e) BH fixation and demarcation of Coordinates and RL of BH by DGPS	per BH	5	19200.00	96000
	f) Road Prepartion (Dozzing Charges,Drill site)	Km	5	32200.00	161000
	g) Drilling (NQ Size Core) (5 BH)(Medium Hard Rock of 300m, 20% added for HQ)	Mtr	500	11500.00	5750000
	h) Drill Core Logging, Core Sampling				
	1) Charges of Geologist	Mandays	90	11000.00	990000
	2) Labour Charges	Mandays	180	443.00	79740
	i) Bore Hole Plugging by Cement	per m	500	500.00	250000
	j) Construction of Concrete Pillar (12" X 12" X 30")	per BH	5	2000.00	10000
	k) Drill Core Preservation	per m	500	1590.00	795000
	l) Drill camp winding cost	Lumsum	1	250000.00	250000
9	**Physical Analysis**				
	i) Petrographic Studies (BH core + Surface Samples)				
	a) Preparation & Study of thin section	Nos	50	2,353.00	117650
	b) Study of thin section for petrography	Nos	50	4,232.00	211600
	c) Preparation of polished section	Nos	30	1,549.00	46470
	d) Study of polished section for mineragraphy	Nos	30	4,232.00	126960
	e) Digital photomicrograph of thin polished	Nos	50	280.00	14000
	ii) XRD	Nos	25	4000	100000
	iii) XRF	Nos	25	4200	105000
	Total Exploration Cost				**₹ 26,203,790.00**
	Exploration Report- 0.5% of (Exploration Cost)				**₹ 13,101,895.00**
	GRAND TOTAL				**₹ 39,305,685.00**

2.8 Reference

Pradhan Rajesh Kumar; Interim Report on Geochemical Mapping in Toposheet No. 64m/6 In Parts of Balrampur and Surajpur District, Chhattisgarh, F.S. 2017–18.

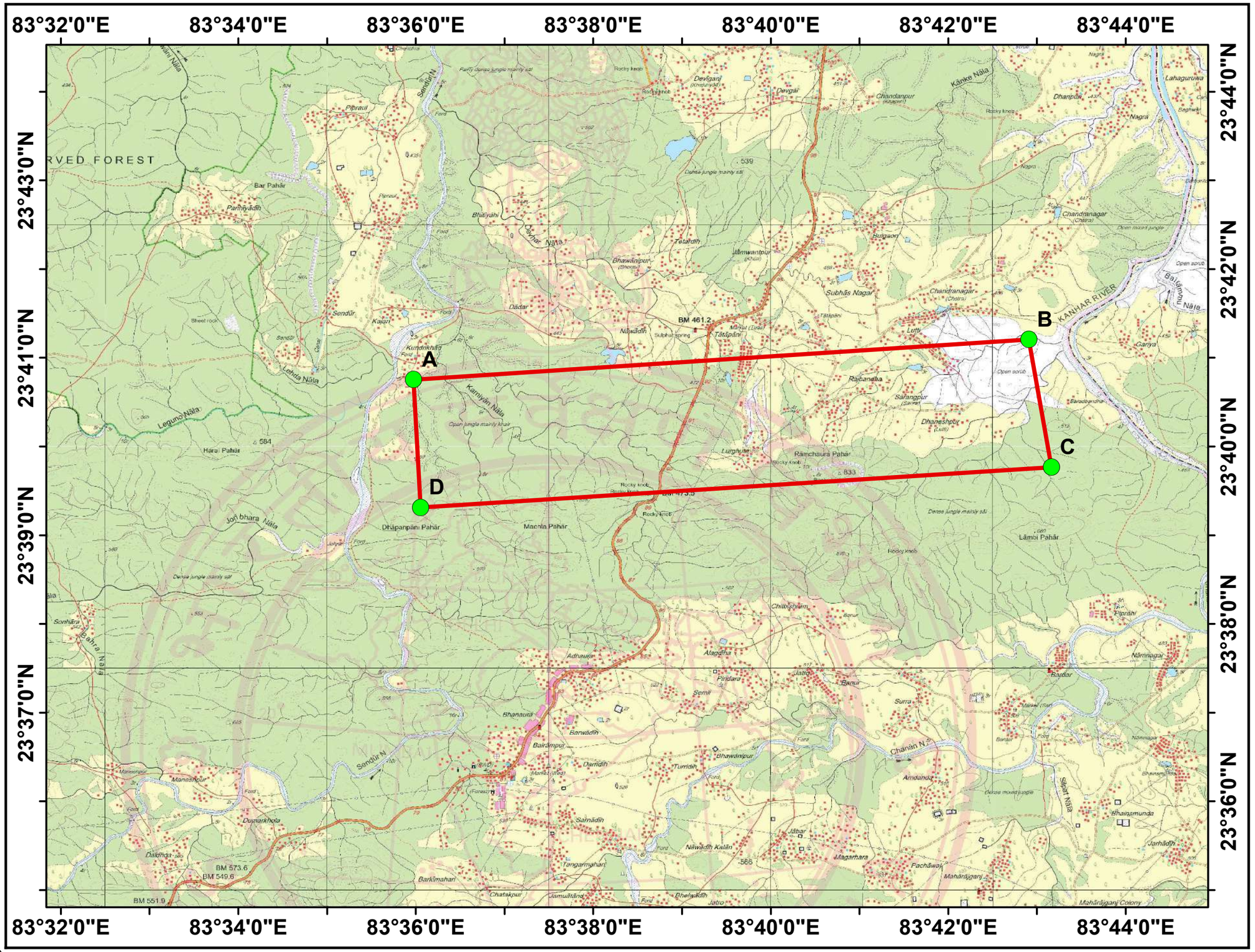
Radhakrishna T.S.; Geological Survey of India Progress report, geology of a part of Surajpur Tahsil, Surguja District, Madhya Pradesh, F.S. 1967–68.

District Resource Map- Sarguja District, Chhattisgarh, GSI 2003.

Plate-1

Location Map of proposed Nawadih Graphite Block on Toposheet

Loaction of Nawadih Proposed Graphite Block on Toposheet No. 64 M/10. District- Balrampur, State- Chhattishgarh.



Points ID	Longitude	Latitude
A	83° 35' 58.498" E	23° 40' 45.038" N
B	83° 42' 54.390" E	23° 41' 12.212" N
C	83° 43' 9.749" E	23° 39' 45.962" N
D	83° 36' 3.224" E	23° 39' 18.788" N

Legend

- Proposed Block Boundary
- Corner Points

Annexure-1

Reference Paper

मुक्त फाईल प्रतिवेदन
OPEN FILE REPORT

भारत सरकार
GOVERNMENT OF INDIA

भारतीय भूवैज्ञानिक सर्वेक्षण
GEOLOGICAL SURVEY OF INDIA

छत्तीसगढ़ राज्य के बलरामपुर एवं सूरजपुर जिला में स्थलाकृतिक मानचित्र संख्या **64M/6** में भूरासायनिक मानचित्रण पर अंतरिम प्रतिवेदन।
(स्थलाकृतिक संख्या: 64M/6)

कार्यसत्र 2017-18
मद संख्या: 022/ जी.सी.एम. / म.क्षे. / छ.ग. / 2017 / 17
एफ.एस.पी. आई.डी.: एम.1ए.जी.सी.एस.- जी.सी.एम./ एन.सी./ म.क्षे./ एस. यू .- छ.ग./ 2017/ 13143

INTERIM REPORT ON GEOCHEMICAL MAPPING IN TOPOSHEET NO. 64M/6 IN PARTS OF BALRAMPUR AND SURAJPUR DISTRICT, CHHATTISGARH.

(Toposheet No. 64M/6)

Field Season: 2017-18
Item No.: 022/ GCM / CR / CG/ 2017 / 17
FSP ID: M1AGS-GCM/NC/CR/SU-CG/2017/13143

द्वारा

राजेश कुमार प्रधान, भूवैज्ञानिक
संदीप बरुवा, भूवैज्ञानिक

परियोजना : भूरसायनिक मानचित्रण
राज्य इकाई : छत्तीसगढ़, रायपुर

By

Rajesh Kumar Pradhan, Geologist
Sandeep Baruah, Geologist

Project: Geochemical Mapping
State Unit: Chhattisgarh, Raipur

छत्तीसगढ. राज्य के बलरामपुर एवं सूरजपुर जिला में स्थलाकृतिक मानचित्र संख्या 64M/6 में भूरासायनिक मानचित्रण पर प्रारूप प्रतिवेदन ।

(कार्यसत्र 2017-18)

मद संख्या: 022/ जी.सी.एम/ म.क्षे./ छ.ग./2017/17

(स्थलाकृतिक मानचित्र संख्या 64M/6)

द्वारा

राजेश कुमार प्रधान, भूवैज्ञानिक

संदीप बरुवा, भूवैज्ञानिक

भारतीय भूवैज्ञानिक सर्वेक्षण,

रायपुर

सारांश

भारतीय भूवैज्ञानिक सर्वेक्षण की एक देशव्यापी भूरासायनिक मानचित्रण आंकड़े की तैयारी कार्यसत्र 2001-2002 में शुरू कि गयी जिसका लक्ष्य पृथ्वी के प्राकृतिक संसाधनों को ठीक से प्रबंधन करने के लिए किसी भी आधुनिक भूवैज्ञानिक संगठन के लिए एक वैज्ञानिक विकास का सबसे जरूरी हिस्सा है। इस लक्ष्य को प्राप्त करने के लिए, राष्ट्रीय स्तर पर भूरासायनिक मानचित्रण और डेटाबेस भूमि की सतह पर विभिन्न तत्वों के वितरण की रूपरेखा बनाया जाना चाहिए। इस प्रकार का डेटाबेस खनिज अन्वेषण, भूमि उपयोग,कृषि,वानिकी,पर्यावरण के प्रबंधन, मानव स्वास्थ्य और अन्य सामाजिक चिंताओं के कई पहलुओं आदि क्षेत्र में अन्य प्रयोजनों के लिए उपयोग किया जा सकता है।

स्थलाकृतिक मानचित्र संख्या 64M/6 में भूरासायनिक मानचित्रण हेतु कार्यसत्र 2017-18 में कुल सात सौ अट्ठाईस (728) वर्ग किलोमीटर क्षेत्र का भूरासायनिक मानचित्रण किया गया छत्तीसगढ. राज्य में बहुउद्देश्यीय पर्यावरण के भूरासायनिक आधारभूत आंकड़े प्राप्त करने के उद्देश्य के साथ कार्य कर रहे है। जिसमें तत्वों के वितरण की रूपरेखा बनाने के लिये विभिन्न प्रकार के नमूने को अध्ययन क्षेत्र से एकत्र किया जाता है जैसे सरिता मृदा अवसाद, मृदा सी-क्षितिज, रिगोलिथ, जल, शैल अध्ययन इत्यादि ।राष्ट्रीय भूरासायनिक मानचित्रण का लक्ष्य बहु-मौलिक विश्लेषण का उपयोग करके देश के भूरासायनिक आधारभूत डेटा तैयार करना और उन तत्वों के वितरण की भूरासायनिक रूपरेखा चित्रित करने के लिये प्रत्येक तत्व के लिए उसके मौलिक वितरण का मानचित्र तैयार करना है अध्ययन क्षेत्र में स्थलाकृतिक मानचित्र संख्या 64M/6 का

ज्यादातर भाग में छोटानागपुर नाइसिक कॉम्प्लेक्स (सी.जी.सी.), गोंडवाना महासमूह के अवसाद शामिल हैं।

कार्य शुरू होने के पूर्व कई तरह की तैयारीयां कि गई जिसमें विभिन्न मीडिया से नमूनों के एकत्र करना और इसके विश्लेषण और रासायनिक विश्लेषण आंकड़ों को अध्ययन करना । कार्य शुरू होने के पूर्व तैयारी स्थलाकृतिक मानचित्र संख्या 64M/6 के साहित्य और भूवैज्ञानिक मानचित्र का अध्ययन किया गया। नमूना एकत्र के लिए हमने ड्रेनेज मानचित्र, भूमि उपयोग/भूमि का नक्शा और ढलान नक्शा ArcGIS सॉफ्टवेयर के द्वरा तैयार किया था। स्थलाकृतिक मानचित्र संख्या 64M/6 से कुल सात सौ अट्ठाईस (728) यूनिट सेल नमूने, नौ(9) मृदा (C-horizon) नमूने, नौ (9) रेगोलिथ नमूने, नौ (9) भारी खनिज के नमूने, एवं नौ (9) जल के नमूने एकत्रित किये गये जो 1 किमी x 1 किमी ग्रिड में थे । कुल एक सो बायासी (182) कम्पोजिट नमूने जो 2 किमी x 2 किमी ग्रिड सेल से लिया गया और इस सभी नमूने को रासायनिक प्रभाग, सीआर, नागपुर भूरासायनिक प्रयोगशाला में परीक्षण एवं विश्लेषण के लिया भेजा गया है ।

विश्लेषणात्मक आकडे. की आकलन हेतु माइक्रोसॉफ्ट एक्सेल में सांख्यिकीय विश्लेषण का विशेष रूप से उपयोग किया। यह भूरासायनिक मानचित्रण तत्व की पूरी रेंज को दिखाने के लिए किया गया है । पैकेज-A के समग्र नमूने के लिए विश्लेषणात्मक परिणाम आज तक प्राप्त हुए हैं । भूरासायनिक मानचित्रण तैयार करने और आकलन करने के लिए सभी परिणाम का प्रतीक्षा कर रहे हैं । प्रत्येक तत्व के लिए भौगोलिक समरूप मानचित्र के साथ वर्णनात्मक आंकड़े और हिस्टोग्राम तैयार किए जाएंगे जैसे ही सभी 182 कम्पोजिट नमूनों के आंकड़े प्राप्त हो जाएंगे।

तत्व Cr, Ni, Nb, Pd, Sr, Th, Zn, Be, Ar, As, Sn in Pakrari, Chalgali, Manikpur, Chemi और उत्तर पश्चिमी भाग के कुछ विसंगतियों को दर्शाने वाले क्षेत्र का समोच्च मानचित्र। Zn के उच्च मूल्य 333.00 ppm और Pb 204 ppm तक के क्षेत्र में चेमी और पकरारी गांव के पास के दक्षिणी भाग में दिखाई देते हैं। नी upto114ppm का अनोमली जोन और 387ppm तक का चम्पी के दक्षिण पूर्व में और पकरारी गाँव के दक्षिण पश्चिम में उल्लेख किया गया है। चल्गली गाँव के उत्तर पूर्व में और इलाके के पश्चिमी भाग के पास 22ppm तक के उच्च मूल्य को दर्शाने वाले आर्सेनिक (As) उन क्षेत्रों में एक संदूषण का सुझाव देते हैं जिससे स्वास्थ्य को खतरा हो सकता है।

REE तत्व जैसे ला, Ce, Pr, Nd, Eu, Sm, Gd, Te, Dy, Er, Yb एक समान विषम क्षेत्र दिखा रहे हैं जो चल्गली, मानिकपुर गाँव और क्षेत्र के उत्तर पश्चिमी भाग के पास है।

मिट्टी के नमूनों के विश्लेषणात्मक आंकड़ों का अध्ययन किया गया और मिट्टी में विभिन्न तत्वों की एकाग्रता के मानक मूल्यों के साथ तुलना की गई। क्रोमियम सी-

क्षितिज (120ppm) के भीतर B2 क्वाड्रंट में थोड़ा संदूषण दिखाता है और अन्य सभी क्वाड्रंट के लिए सीआर विशिष्ट संयुक्त-संदूषण श्रेणी में आता है। नी संदूषण A2 (41ppm) के सी-क्षितिज में मनाया जाता है।

शैल के सूक्ष्म अध्ययन हेतु शैल के नमूने को संबंधित प्रभाग में जमा करा दिया गया है। शैल के नमूने को प्राप्त होने के बाद ही उसका विस्तार से अध्ययन किया जा सकेगा जो कि शैल प्रभाग, कलकत्ता से उसका परिणाम आना है | भारी खनिज के नमूने को धारगांव स्थित भंडार एवं प्रयोगशाला में भेज दिया गया है जिसका ग्रेविटी शोधन का कार्य होगा | आर्थिक महत्व के खनिज के पहचान हेतु एक्सआरडी अध्ययन भारी खनिज के नमूने से किया जाता है | भारी खनिज और एक्सआरडी अध्ययन ग्रेविटी शोधन के बाद किया जा सकेगा जो कि धारगांव स्थित भंडार एवं प्रयोगशाला, नागपुर से आना है |

INTERIM REPORT ON GEOCHEMICAL MAPPING IN TOPOSHEET NO.64M/6 IN PARTS OF BALRAMPUR AND SURAJPUR DISTRICT, CHHATTISGARH.

FS: 2017-18
Item Code No: 022/GCM/CR/CG/2017/18
(Toposheet no. 64M/6)

by
Rajesh Kumar Pradhan, Geologists and Sandeep Baruah, Geologist

Abstract

In pursuance of the approved FSP item no. 022/GCM/CR/CG/2017/18 and FSP ID-M1AGS-GCM/NC/CR/SU-CG/2017/13143 of Geological Survey of India during FS 2017-18, an item was taken up under the National Geochemical Mapping (NGCM) project lunched by Geological Survey of India during FS 2001-02, which aims at preparing elemental distribution map and generating a geochemical baseline data, covering the entire landmass of the country. The geochemical elemental baseline data will have great societal significance and can be used for management and development of natural resources as well as for application in environmental, land use, agricultural, forestry, human health and other social concerns.

Geochemical mapping, covering an area of 728 sq km was carried out in toposheet no. 64M/6 during FS 2017-2018. The main objective of the present mapping program is to create a geochemical database of 64M/6 of Chhattisgarh State using multi- elemental analysis that can be utilized in the search for hidden mineral resources and other environmental concerns. Geologically the area falling within toposheet no. 64M/6 is characterized by rocks of Chhotanagpur Gnessic Complex and Gondwana Supergroup.

The work involved, pre-field preparation, field work for collection of samples from different media, its processing and post-field interpretation of analytical data. During pre-field work toposheet, previous literature and geological map of the area was consulted. Drainage map with tentative sample location points, land use/ land cover map and slope map was prepared in ArcGIS. Field work was carried out in toposheet no. 64M/6 with the collection of 728 stream sediment/ slope wash samples from 1km X 1km grid (unit cells), 9 soil (‘C’ horizon) samples, 9 regolith samples, 9 heavy mineral samples (HMS), 9 petrographic samples (PS) and 9 water samples (one sample from each quadrant). Details of all samples collected were noted in the datasheet as per SOP. The Stream sediment/ slope wash samples (representing unit cells) were thoroughly homogenized by coning and

quartering and 202 composite samples (representing 2km X 2km grid) were prepared. All composite, soil ('C' horizon), regolith and water samples were sent to Chemical Division CR, GSI, Nagpur for chemical analysis.

Post-field interpretation of analytical data includes statistical analysis in Microsoft Excel and preparation of element distribution maps with the help of Surfer software to identify anomalous zones of different element. Analytical results of 47 elements (Package A and H)for 182 composite samples have been received till date. Descriptive statistics and histogram along with geochemical contour map for each element has been prepared.

The contour map of the area showing some anomalies of element Cr, Ni, Nb, Pd, Sr, Th, Zn, Be, Ar, As, Sn in Pakrari, Chalgali, Manikpur,Chemi and north western part of the area. Higher values of Zn upto 333.00 ppm and Pb upto 204 ppm showing in the southern part of the area near Chemi and Pakrari village. Anomaly zone of Ni upto114ppm and Cr upto 387ppm noted in south east of Chemi and south west of Pakrari village. Arsenic (As) showing a higher value upto 22ppm near north east of Chalgali village and western part of the area suggest a contamination in those area which may cause health hazard.

The REE elements such as La, Ce, Pr, Nd, Eu, Sm, Gd, Te, Dy, Er, Yb are showing a similar anomalous zones near Chalgali, Manikpur village and north western part of the area.

Analytical data of soil samples were studied and compared with standard values of concentration of different elements in soil. Chromium shows slight contamination in B2 quadrant within C- Horizon(120 ppm) and for all the other quadrants Cr comes under typical un-contamination category. Ni contamination is observed in C-horizon of A2 (41 ppm).

Petrographic samples were submitted for preparation of thin sections. Petrographic studies will be carried out in details after receiving the thin sections of rock samples from Petrographic Lab, CHQ, Kolkata. Heavy mineral samples (HMS) were sent to Dhargaon camp, CR, Nagpur for further processing (gravity separation). XRD studies are carried out for identifying mineral grains of economic importance obtained from heavy samples. HMS and XRD studies will be done after receiving the processed HMS samples from Dhargaon camp, CR, Nagpur.

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Abstract (in English)

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INTERIM REPORT ON GEOCHEMICAL MAPPING IN TOPOSHEET NO. 64M/6 IN BALRAMPUR AND SURAJPUR DISTRICT, CHHATTISGARH.

FS: 2017-18

Item Code No: 022/GCM/CR/CG/2017/17

by

Rajesh Kumar Pradhan (Geologist) & Sandeep Baruah (Geologist)

CHAPTER-1
INTRODUCTION

1.1 General Introduction

Geochemical mapping has been introduced as an important tool to understand the effects of varied surface concentration of elements in relation to soil fertility, agriculture, human and animal health and for establishing valid environmental baseline and chemistry of the country. Geological Survey of India initiated the National Geochemical Mapping programme from FS 2000-2001 with an objective to cover the entire surface area of the country by geochemical mapping. The main objective of the geochemical mapping programme is to generate a geochemical database of the country by using multi-elemental analysis (68 elements) and to utilize these data in various fields like mineral exploration, agriculture, forestry, environment and human and animal health.

The main objective of the present geochemical mapping programme is to develop a geochemical database of 64M degree sheet of Chhattisgarh state using multi elemental analyses and thereby geochemically characterize the abiotic environment in these parts. The present study area falls in Survey of India Toposheet No: 64M/6. The study is taken as part of Field Season Programme of GSI, Central Region under Item no. 022/GCM/CR/CG/2017-18/17during the field season 2017-18. The location map of the study area is given in plate no.1.

1.2 Communication

The area is bounded by latitudes 23°30’N to 23°45’N and longitudes 83°15’E to 83°30’E and forms a part of Balrampur district of Chhattisgarh. The field camp was

established at Pratappur in Surajpur district, Chhattisgarh which is about 381 km away from Raipur city by road via NH 130. The area can be approached from Ambikapur railway station which is 65 km away from Pratappur town towards north. The main locality in the area Chalgali village situated in the central part of the area. Other important localities are Ranhat, Lurgi, Dabra, Rampur, Khobi, Murka, Sardapur, Badkagaon, Odari, Manpura, Manikpur, Bhagwanpur

1.3 Physiography

Most of the part of the area is mainly covered by pediment-pediplain complex of denudational origin. The south-eastern and eastern part is covered with low dissected hills and valleys of structural origin and north-eastern part is characterized by rugged and undulating topography with hills and plateaus having steep slope. The area exhibits geomorphic features like moderately dissected upper plateau of structural origin in the in the central, eastern and south eastern part of the area. low dissected hills and valleys of structural origin in the northern part, low dissected lower plateau in the north-western part, moderately dissected lower plateau in the western and south-western part. The highest point 1029m is represented by Mandru Pahar, above msl lies in south-central part while lowest point 440m above msl occurs along Moran River course to the south of Dhorahi, in the west. Geomorphological map of the area is given in plate no.2.

1.4 Climate and Rainfall

The area enjoys a sub-tropical humid climate characterized by hot summer and cold winter. The normal average rainfall of the area is 1304 mm. The annual temperature varies from 46ºC in summer to 5ºC in winter. The relative humidity varies from 87% during rainy season to 35% in winter. (Source:Google)

1.5 Drainage and Water supply

The Moran River and its tributaries constitute the main drainage of the area. It flows from south-west to north-east in its initial stage and in the central part near Khobi village it bends towards north. Further near Manpura village it takes a sharp bends towards south-west direction. The important tributaries of Moran River are Dudhaniya nala, Goga nala, Barauli nala, Kerrajharia nala and Sukhnaiya nala.A small river Banki Nadi is flowing north-east to south west in the southern part of the area. The drainage pattern is mainly sub-dendritic to dendritic and some places the drainage pattern is sub-parallel to parallel. The Moran River

with its meander loops control the drainage of the area Goga nala, Barauli nala flowing east to west and meet the Moran river at the central part of the area.. The main source of water in the area includes both surface and ground water. Rainfall is the main input for both surface and ground water. Surface water includes streams, rivers and ponds whereas groundwater includes dug wells and tube wells. At present, ground water meets the entire requirement of water for domestic purposes. Moran River, Dudhaniya nala, Goga nala, Barauli nala, Kerrajharia nala and Sukhnaiya nala are also sources of water supply. Since the southern part of the area is mostly of granitic rocks the surface water and tube wells are being utilized mainly for drinking purposes. Water table is good in weathered and semi confined condition in deep fracture zones. Beside manmade ponds, canals, bunds and tanks also supply water to the area. Plate 3 shows the drainage map of the area.

1.6 Soil erosion

The area is characterized by low to moderate weathering due to climatic conditions(subtropical humid climate), which leads to the rich development of soil. The soil varieties present in the study area are red and yellow soils, alluvial soils and lateritic soils. Soil derived from granitic rocks is generally sandy loam and is generally acidic. These soils are mostly light coloured and coarse because of the presence of light coloured coarse minerals. The soil derived from shale is clayey and heavy whereas soil overlying sandstone is sandy loam and light red and the yellow soils are derived from parent rocks of sedimentary origin of the Gondwana Supergroup. They are formed in-situ from the erosion of rocks present in the area. The red colour is due to wide diffusion of irons while hydration of ferric oxide results in yellow colour in the soils. This soil is of lighter texture, porous and friable in nature. Laterite soils is the deciding result of weathering found in area of heavy precipitation which drains of of lime and silica leaching behind oxides of iron and aluminum. Alluvial soils are present along the stream and areas near rivers.

1.7 Fauna and Flora

Most part of the area is covered by Reserved Forests(R.F) which includes Manpura R.F, Ranhat R.F, Mandru R.F and few dense jungle/fairly dense jungle. Rest of the area is mainly under cultivation and built up area. The major crop grown here is paddy. The flora in the area comprises of mostly tropical moist and dry deciduous type with mainly sal (*Shorea robusta*), bamboo (*Dendrocalamous strictus*) and species like saja (*Terminaliato mentosa*),

bija (*Pterocarpus marsupium*), mahaua (*Madhuka latifolia*), mango (*Manganiferra indica*), lendia (*Largerstroemia parviflora*), aldu (*Adina cardiflora*), dhaora (*Anogeissus latifolia*), sarai(*Terminalia tomentose*), tendu (*Diospyros melanoxylon*), teak (*Tectona grandis*), harra, behers (*Terminalia beherica*), amla (*Phyllanthus emblica*), palash and semal (*Bombax sp*.) etc.

The forest of the area provides shelter for a variety of wild animals, migratory and indigenous birds. These include tigers, panther, bison, wild boar (*Sus cristatus*), jackal, foxes, bear (*Meluvsus ursinus*), and elephants. Variety of antelopes including spotted deer (*Cervus axis*) is present. Smaller animals like monkeys or langurs (*Semipithecus entellus*), wild cats, hare, snakes and insects (scorpions) are present.

1.8 Land Use and Land Cover

The area falling within T.S: 64M/6 can be classified into agricultural land, forest area, scrub land, water body and settlement area based on the land use/ land cover of the area. The forest lands are mainly in north, NE, SSW, SSE and eastern part of the area and cultivated lands are sparsely distributed in the map excluding the NE part and NE corner of the area. Major part of the land is utilized for agricultural purpose, cultivating mainly paddy crop, pulses and seasonal vegetables. Plate 4 shows the land use/ land cover map of the area.

1.9 Slope

The slope of the area falling within T.S: 64M/6 may be divided into nine classes based on the degree of slope from 0^0-3^0, 3^0-6^0, 6^0-9^0, 9^0-12^0 , 12^0-16^0,16^0-21^0,21^0-26^0,26^0-32^0 and 32^0-53^0. Most of the area (>70%) comes under the slope range of 0^0-12^0. The maximum slope (in degrees) ranging between 32^0 - 53^0 is indicated by red and minimum slope ranging between 0°- 3° is indicated by green in the slope map given in plate 5.

1.10 Present Work

The present work is an attempt to fulfil the objectives set for National Geochemical Mapping. Geochemical mapping primarily involves collection of stream sediment samples, regolith, soil 'C'- horizon and water samples. Geochemical mapping was carried out in toposheet 64M/6 during field season 2017-18. In Toposheet no. 64M/6, a total of 728sq km area was covered with collection of 728 nos. stream sediment/ slope wash samples (182 nos. composite samples) and 9 nos. of each soil C-horizon, regolith samples, stream water

samples. 9 nos. of samples for heavy mineral study and 09 nos. of rock samples for petrographic studies were also collected. Humus and flood plain samples were not collected as they are not developed in the area. The density of stream sediment samples was kept at 1 sample (unit cell sample) per sq. km area. For soil, one pair of sample (viz. top soil 'R' and soil from 'C' - horizon) was collected from each quadrant i.e. 5′ x 5′ grid. The size fraction of the stream sediment and soil samples was kept at -120 mesh(ASTM) for analytical purpose. Table 1.1 shows the nature of work and achievement along with the target assigned for sample collection from different media.

All samples were submitted to the geochemical laboratory, CR, Nagpur for chemical analysis. The chemical analysis results of 46 elements (Package A and H) for 182 composites have been received so far. The analytical results has been processed in Excel for calculating statistical parameters and in Surfer 9 for generating elemental anomaly maps to understand the elemental distribution pattern in the area which is the main objective of this project.

Table 1.1: Nature and Quantum of work for FS-2017-18

Nature of work	Target (T.S no.64M/6)	Achievement (T.S no.64M/6)
1. GCM (1:50,000) (Sq. kms.)	728 Sq. kms.	728 Sq. kms.
2. GCM SMPL		
(i) Stream sediments / Slope wash	728 nos.	728 nos.
(ii) Composite samples	182 nos.	182 nos.
(iii) Soil (C- horizon)	9 nos.	9 nos.
(iv) Regolith	9 nos.	9 nos.
(v) Water	9 nos.	9 nos.
(vi) Humus	-	-
(vii)Duplicate samples	9 nos.	9 nos.
3.SMPL		
HMS	9 nos.	9 nos.
PS	9 nos.	9 nos.
XRD	9 nos.	9 nos.

Table 1.2: Details of field days of Field officers and Supervisory officer

Name of officer	No. of field days	Remarks
Rajesh Kumar Pradhan, Geologist	121	Full time field assignment.
Sandeep Baruah, Geologist	123	Full time field assignment.
Gautam Roy, Director(G)	11	Supervisory Officer

Table 1.3: Details of RCA expenditure

	Account Head	Total Expenditure (in Rupees)
1.	Other charges	85741/-
2.	Wages	156748/-
3.	POL	85020/-

1.11 Acknowledgements

The authors are grateful to Shri N. Kutumba Rao, former Additional Director General and HOD and Shri. S Natesan, present Additional Director General & HOD, Central Region for providing the opportunity to carry out NGCM work. The authors acknowledge Shri Rajeshwer Paul, Dy. D.G, RMH-1, CR, Nagpur for providing the opportunity to work and learn the nuances of geochemical mapping. The guidance and co-operation rendered by Dr. Shabbir Hussain, Deputy Director General, State Unit: Chhattisgarh is highly acknowledged for his technical guidance and constant support and guidance to accomplish the field work successfully. The authors owe thanks to Shri Gautam Roy, Director (G) (Supervisory Officer) for his valuable technical suggestions and logistic support during the course of the field work. The authors are also thankful to all the officers and staffs of Regional Geochemical Laboratory, Chemical Division, Nagpur for their efforts in testing and preparing chemical analytical data. The authors appreciate the co-operation and support provided by fellow colleagues of SU: CG, Raipur office. The untiring efforts and hard work of the field labours and driver in field during sampling and sample processing are also greatly acknowledged.

CHAPTER – 2

PREVIOUS LITERATURE

In FS 1965-66 of Geological survey of India, T.S. Radhakrishna mapped the Geology of a part of Surajpur tahsil, Surajpur district, Chhattisgarh. The mapped area consists of the Archaean and Lower Gondwana rocks. Biotite gneiss, albite-oligoclase gneiss and biotite microcline gneiss comprise the metamorphics which contain relics of Sausar metasediments (Schistose quartzites, muscovite-biotite-schist, muscovite - biotite - chlorite schist, calc-gneiss with intrusives of amphibolite) Granite, pegmatites, aplites and quartz veins also occur in the area. The trends of foliation in gneisses range from - E.N.E. – W.S.W to east-west with steep (60 to 80°) or vertical dips. The trends of the relics of metasediments are sub-parallel to those of gneisses. The metasediments afford evidences that they were intensely folded and metamorphosed before migmatization. There are a few conspicuous strike shears and minor faults in the Archaeans. Biotite gneiss is formed in part by migmatisation of metasediments which were largely pelitic with minor arenaceous and caloereous ones and in part by consolidation of potash rich magma. Albite - oligoclase gneiss and biotite-microcline gneiss appear to have resulted from soda and potash metasomatism. The granites are intrusive and their emplacement has been along the crest of folds in metasediments, some of the pegmatites are intrusive, and their emplacement is also along crests of minor folds in the schists. The general trend of the Archaean is in accordance with Satpura strike along which there has been migmatisation of Sausars and emplacement of granite. The Lower Gondwanas along the boundaries of Romkola and Bisrampur Coalfields comprise the Talchirs, Karharbaris (?) and Barakars. The Archaean - Gondwana contact is at places faulted. The sediments dip into the basins. The basal beds (Karharbaris?) dip 10 to 25° in Ramkola coalfield whereas the Barakars dip less than 10 degrees. A few faults are recorded in the Lower Gondwanas. There are indications of occurrence of beryl, muscovite and garnet in the pegmatites localised in the schists in Rampur, Bheria, Paharkarwa and Khunsi areas. There are also indications of occurrence of coal and fire-clay in Ramkola coalfield. Biotite gneiss in Paharkarwa area and Jhor, the granite at Chanrell and dolerite near Pakni are good source of building material and road metal. Preliminary reconnaissance of certain reported occurrences of minerals in Surajpur and Ambikapur tahsils indicates the presence of Ochres near Lalea, Kamaleswarpur, Kasira, Barma and Serbhaja. There are also indications of occurrence of bauxite on plateau adjoining Shikariadand and

Sapnadand. The quartz-magnetite rock occurrences near Batauli are small in their extent but are significant in that they contain manganese as indicated by preliminary chemical analysis.

Photogeological studies in parts of Surguja district, Chhattisgarh. (Progress Report of G.S.I for F.S. 1985-86 & 1986-87) done by U.S. Dubey. The area mapped by him identified Archaean gneiss, granite, schist and slate sediments of Gondwana Super Group, Deccan Trap flows; Laterite and Quaternary alluvium. Archaean rocks show distinct photo-characters from Gondwana sediments. Similarly the lower Gondwanas can also be distinguished from the Upper Gondwanas. However the Lower Gondwanas display very similar photo-characters rendering distinction difficult. The stratigraphic – unconformity between the Archaeans and the Gondwanas is represented by the prominent boundary faults which in turn have been off-set by number of cross faults. Other minor faults and/or micro- lineaments affecting the Archaeans as well as the Gondwanas appear mostly sympathetic to the major boundary faults. Trap flows in the ESE part of the area appear to have undergone complete 1ateritisation.

T.S. Radhakrishna and V.V. Mulay, mapped the geology in parts of Ramamujganj and Ambikapur tahsils, Surguja district, Chhattisgarh. They were mapped to locate minerals for base metals. An area of 510 sq,km was covered on a scale of 63,360 on photostat enlargements of topoSheet Nos. 64 M/N.W. and 64 M/ S.W. The area consists of meta-sediments (Sausars?) of green schist and amphibolite facies and gneisses of Lower Pre-Cambrian age. The metasediments are a part of a geosyncline, folded over a dominant E.-W. axes in conformity with the Satpura strike. Three phases of folding, each culminated by metamorphism and metasomatism, are recognisable with the formation of reconstituted gneisses and emplacement of granite mostly along anticlinal axes of the cross-folds. Lead ore, graphite, sillimanite, radioactive minerals, potash felspars, talc and abundant building material occur in the area. At Kudartola (23° 14' : 83° 25'; 64 M/8 S.W.) lead ore occurs as thin fissure veins in the metacarbonate, rocks in the synclinal part of a cross fold. Large scale mapping of the mineralised area, geochemical sampling, pitting and trenching are recommended to delineate the extent of the occurrences of ore. Radioactive minerals may be brought to the notice of the Raw Materials Division of the A.E.C(Atomic Energy Commission). Graphite occurrences between Kennapara (23° 37' ; 83° 15' 64 M/6 N.W) and Manikpur (23° 40' : 83° 29' 64 M/6 NW) are to be mapped on large scale followed by pitting, trenching and sampling for assessment. Preliminary

investigation of sillimanite and talc occurrences in the area by pitting on a small scale and sampling is also recommended.

In 1967-68 T.S.Radhakrishna of GSI have done the Mineral exploration on Graphite occurrences between Kennapara and Manikpur in Surguja district, Chhattisgarh. He reported that graphite schist occurs as lenses ranging from 3 to 80 m in length and 0.16 o 13 m in width. A total of 35 occurrences were reported. Inferred gross reserve of 10 to 22%graphite is estimated at 2350 metric tonse. About 60 metric tons containing 5 to 8% graphite is available in the area.

K.C. Dass, Animesh Mukherjee and Vivek. V. Kumar (FS 2013-15) of GSI in their Specialised thematic mapping in Bilaspur-Raigarh-Surguja metamorphic belt in Birjnagar-Dhamini area, Surguja district, Chhattisgarh, they mapped an area of 700 sq km on 1:25,000 scale in parts of toposheet nos. 64M/5 and 64M/6. The mapped area and the adjacent areas are occupied by rocks belonging to the Chhotanagpur gneissic complex, which have been intensely sheared along the Tatapani-Ramkola fault in the northern part and a patch of Gondwana rocks comprising Talchirs, coal bearing Barakars, Raniganjs and Panchets occur in the northwestern part of the area. The area has presence of minor incidences of sulphide mineralization, graphite bearing schist, manganese rich ferruginous quartzite, tourmaline and mica bearing pegmatite.

CHAPTER-3

GENERAL GEOLOGY

3.1 REGIONAL GEOLOGICAL SET UP

The mapped area is occupied by Precambrian rocks and Gondwanas. The Precambrians comprise gneiss, quartzite, phyllite, mica schists, calc-gneiss and migmatites. Granite occurs as intrusive into the schists and gneisses. The Precambrian rocks form the basement for the Gondwana sediments. The area is traversed by pegmatites and quartz veins. The granite, gneiss and migmatites with the inclusion of older suite of mica schist and hornblende schist, phyllite, amphibolite and quartzite have described together as Precambrian of Archaean to Proterozoic age.

The Gondwanas are represented by the Talchir, Barakar, Raniganj, Panchet and Mahadeva Formations. The contact between the Precambrians and the Gondwanas appears to be faulted. Gondwana sequence commences with the Talchir Formation and includes coarse grained sandstone, siltstone and Khakhi-green splintery shale. The Barakar Formation overlies the Talchir conformably. The Barakar includes arenaceous, coarse grained sandstone with few thick coal seams, fine grained sandstone, shale and thin coal seams. Raniganj Formation overlies the Barakars. The Raniganj comprises rippled and laminated sandstone, grey splintery shale, thin clay stone and shaly coal seams. Panchet Formation conformably overlies the Raniganj beds. Lithologically, the Formation is made up of alternating sequence of fine grained, micaceous, cross bedded sandstone, reddish and greenish siltstone and shale. Mahadeva Formation occurs along the higher contours of the hills. The rocks included in this formation are pebbly multistoried, profusely cross bedded sandstone with thin interbands of red siltstone. The rocks are exposed in the Sinduria Pahar, Khokra Jharia Pahar and Berin Pahar. The Panchet Formation occurs around Manpur while the Raniganj Formation is exposed around Alka, Manpura and Dhorhi. Barakars are reported around Nawapara and Barkagaon. The Talchirs are exposed around Amartipur and Pandauli. Thick coal seams are exposed in the Sukhnaiya nala, west of Nawapara and west of Barkagaon.

Litho-stratigraphy of the area given below in table no. 3.1.

Table: 3.1 Regional Litho-stratigraphy of the area(after Manoj Kumar and B.K.Mishra,1991-92)

Permian Up. Carboniferous	Lower Gondwanas	Ferruginous sandstone
---------- Unconformity----------		
P r e c a m b r i a n s	Granitoids	Veins of pegmatite, syenite, aplite and quartz. Pink alkali granite, leucogranite.
	----------Intrusive contact----------	
	Grey granite gneiss migmatite complex	Grey granite gneiss and migmatites with minor enclaves of quartz-mica schist, quartzite, marble, calc-silicate, graphite schist, basic granulite, amphibolite and B.M.Q. and tonalitic gneiss.
	----------Gradational contact----------	
	Metasedimentaries	Marble and calc-silicate, graphite schist, banded garnetiferous quartzite, mica schist, quartz-biotite plagioclase-garnet schist, quartz-biotite-garnet andalusite schist, Quartz-biotite-garnet-staurolite-kyanite-fibrolite-cordierite (?) schist. Quartz muscovite-feldspar-sillimanite schist, Pebbly quartzite, massive quartzite and micaceous quartzite with meta-conglomerate.

3.2 GEOLOGY OF THE AREA

The area under Toposheet No. 64M/06 is occupied by Precambrian rocks and Gondwanas. Precambrians comprise gneiss, quartzite, phyllite, mica schists, calc-gneiss and migmatites. Granite occurs as intrusive into the schists and gneisses. The Precambrian rocks form the basement for the Gondwana sediments. Gondwanas are represented by the Talchir, Barakar, Raniganj, Panchet and Mahadeva Formations. Talchir Formation unconformably overlying the Precambrian rocks includes coarse grained sandstone, siltstone and Khakhi-green splintery shale. Barakar Formation overlies the Talchir conformably includes arenaceous, coarse grained sandstone with few thick coal seams, fine grained sandstone, shale and thin coal seams. Raniganj Formation overlies the Barakars and comprises of rippled and laminated sandstone, grey splintery shale, and thin clay stone and shaly coal seams. Panchet Formation conformably overlies the Raniganj beds and consists of alternating sequence of fine grained, micaceous, cross bedded sandstone, reddish and greenish siltstone and shale. Mahadeva Formation occurs along the higher contours of the hills. The rocks included in this formation are pebbly multistoried, profusely cross bedded sandstone with thin interbands of red siltstone.

DESCRIPTION OF THE LITHO UNITS:

3.2.1. Quartzite/Schistose quartzite

It is a fine to medium grained, greyish white to buff coloured, weak to moderately foliated lithounit. Quartzite is mostly hard with mainly quartz as the essential minerals and mica in varying amounts. At places quartzite also has ferruginous bandings. The general trend of the quartzites in the area is E-W which changes to ENE-WSW at places.

3.2.2. Quartz-mica schist

The rock mainly comprises mica and minor quartz. The rock shows well developed schistosity due to parallel orientation of the muscovite flakes and aggregates of quartz. The schistosity is generally crenulated.

3.2.3. Graphite-mica schist

Graphite-mica schist is mostly found associated with the metasedimentaries. It is generally found in association with grey quartzite and or quartz-mica schist. At places it is also found associated with calc-silicates. Graphite mica schist consists of flaky graphite, mica and minor amounts of quartz. The thickness of graphite schist varies from a few cm to as much as 1.5m observed in nala sections. The strike continuity is mostly not known except at some places along Goga nala where it can be seen for a strike length of 60m. (Photographs:Plate no.8d)

3.2.4. Calc-silicate

The rock is white to greenish grey, medium to coarse grained and massive in nature. Calc silicates consist of mostly calcite, diopside, tremolite and quartz. Ribs and furrows are mostly seen in the rock. Calc-silicates observed near Parsapani village in unit cell no.104C. (Photographs:Plate no.8c)

3.2.5. Augen gneiss

Augen gneiss contains porphyroblasts/augens of predominantly K-feldspar and plagioclase feldspar and along with biotite and quartz. The gneisses develop S-C fabric indicating both sinistral and dextral shear sense, but the dextral sense is dominating. In south of Manikpur, the augens of plagioclase feldspar are preserved in the S fabrics with little elongation parallel to S plane and can be seen further elongated parallel to C plane developing a gneissic banding similar to banded gneisses.

3.2.6. Banded gneiss

The biotite granite gneiss is the most dominant lithology of the study area. It is a greyish white to pinkish grey, medium grained rock with well-developed gneissic banding. The rock is essentially composed of quartz, plagioclase feldspar, alkali feldspar and biotite. Gneissic banding is well preserved at most of the places whereas at places banding is not well defined.

3.2.7. Pegmatites

Numerous pegmatite veins and boudins of pegmatite are noticed within the study area. Pegmatites are found as boudins within banded/augen gneisses. These are generally rich in

muscovite, tourmaline and garnets and are normally parallel to the foliation planes of banded/augen gneisses.

3.2.8. Quartz veins

Quartz veins are frequent and are found intruding the country rocks generally in an E-W direction although quartz veins in different orientations are noticed.

3.3 STRUCTURE

3.3.1. Bedding

Bedding is observed in the sandstones of Gondwana Super Group. Ferruginous sandstone is exposed in the northern part of the area with a strike varying from N-S to NW-SE.

3.3.2. Schistosity

Schistosity is defined by parallel arrangement of mica flakes. There are two generations of schistosity developed in quartz mica schist. The first one, S1 is the dominant schistosity plane with an attitude of N80°E. The second schistosity planes are the S2 planes which are parallel to the crenulation cleavages developed along the axis of the kink bands.

3.3.3 Gneissosity

Gneissosity is marked by alternate arrangement of light minerals like quartz, potash feldspar, plagioclase feldspar and dark minerals mostly of biotite, amphiboles. Gneissosity in banded gneiss is mostly ENE-WSW and dipping steeply due south and north**.**

3.3.4 Joints and fractures

Joints and fractures are developed in most of the lithounits. Three sets of joints are commonly developed trending NNE-SSW, NE-SW and NW-SE.

3.3.5 Folds

The mapped area shows different types of folds, from macroscopic to regional scale, which is signature of several stages of deformation. These are mostly shown by quartzite, quartz mica schist, calc-silicates and banded gneisses. The earliest phase F1 has resulted in the development of penetrative planar fabric or the schistosity. This is characterized by tight to isoclinal folds which are developed on S0 in metasedimentary rocks. F2 folds are generally open symmetrical type with axial plane vertical or steeply dipping. The

axial planes in general are steeply dipping and the axes show a moderate to low plunge towards ESE or WNW.

3.4 MINERALISATION

3.4.1 Graphite schist: Very good quality of graphite schist associated with quartzite and quartz mica schist has been reported in SE of Bhawankhar village. The exposure is located in unit cell no. 082A. The same has been informed to mineral exploration team with item no.087 working in the same area.(Photographs:Plate no.8d)

3.4.2 Coal seam: Coal bed is found in abundance in the Lower Gondwana Group where SECL has taken mining lease near Bhagwanpur village. However, some other prominent coal beds has been located near Pandauli village. The whole area is very much rich in coal deposits. (Photographs:Plate no.8b)

3.4.3 Sulphide mineralization: 5. Small specks of sulphide mineralization reported near Pakrari village in Southern part and near Mukha village in South Eastern part of the study area. (Photographs: not taken due to very small in size)

CHAPTER: 4

THEMATIC MAPS

During the geochemical mapping programme in Balrampur dist in toposheet no 64M/06, various thematic maps were prepared for pre-field study and for carrying out field work. During pre-field study different maps have been prepared and studied to understand the geology, physiography, Landuse/Landcover, slope and drainage pattern of the area. Post field analysis of chemical data involved preparation elemental distribution maps/ anomaly maps and classified post maps in surfer. The different thematic maps are described as follows:

- Geological map
- Geomorphological Map
- Drainage Map
- Land use and Land cover map
- Slope map

4.1 Geological map

Geological map of the study area on 1:50000 scale was obtained from Geodata Division, State Unit Chhattisgarh. It was digitized by the Geodata Division in ArcGIS using WGS 84 datum and UTM Projection which is given in Plate No.06. Geologically the study area comprises of granite and granite gneiss of CGC, fine grained sandstone of Talchir Formation and sandstone of Barakar, Panchet and Parsora formations. Dolerite dyke of Amarkantak Group occurs as intrusive. The details geology of the study area is given in Chapter 3.

4.2 Geomorphology map

Geomorhological map gives the detailed physiography, morphology and landforms of the area (plate no.2). The map was obtained from bhuvan.nrsc.gov.in. Description of geomorphology of the study area is given in chapter 1.

4.3 Drainage Map

Drainage Map is the most important thematic map prepared for carrying out NGCM field work. It gives a detailed overview of the drainage pattern of the area. Description of drainage of the area is given in chapter-1. The drainage map was prepared on 1:50000 scale using toposheet as the base map in ArcGIS by digitization of streams and rivers. The datum of the map is WGS84 and projection is Geographic Coordinate System (GCS). The drainage

map is given in plate no.03. During pre-field preparation tentative sample locations were marked on the drainage map for best sampling locations. After field work and collection of samples as per NQT, location of sample collected was marked on the drainage map as shown in plate no.03.

4.4 Land use and Land cover map

Land use and Land cover is another essential map for carrying out field work and also for post-field analysis and interpretation of analytical data. It was prepared in ArcGIS using toposheet and IRS P6 LISS III satellite data (obtained from Bhuvan) as base maps. The toposheet was georeferenced and land cover features were extracted and digitized to prepare the map. IRS P6 LISS III satellite data obtained from Bhuvan was used to update the land use/ land cover map. It was prepared on 1:50000 scale, WGS84 datum and GCS projection. Description of land use and land cover of the area is given in chapter.1 and the map is given in plate no.4.

4.5 Slope map

Slope map on 1: 50000 scale was prepared by using Cartosat 1 data obtained from Bhuvan. For preparing slope map the Cartosat-1 data of 64M was downloaded and clipped (as per the extent of toposheet 64M/06). It was than projected to UTM projection. Then the slope map of the area was generated using this data in ArcGIS. Description of the slope of the area is given in chapter.1. The slope map shows the relief and elevation difference of the area. The slope map of the study area is given in plate No.5.

CHAPTER-5

SAMPLING AND SAMPLING PROCEDURE

Geochemical mapping essentially require a systematic approach as per 2014 updated NGCM SOP for its effective execution. The sampling method is rigorous and needs a lot of care in terms of the site of sample collection and prevention of contamination. The work of geochemical mapping can be sub-divided into: (1) Pre-field preparation, (2) Field work and (3) Post-field analysis and interpretation.

5.1 Pre-field preparation:

Before proceeding to field for sample collection certain pre-field preparations were carried out for understanding the geology of the area and selection of site of sample collection which includes:

5.1.1 Consultation of toposheet, geological map and past literature:

Toposheet (from Survey of India) on 1:50,000 scale and previous literature was studied to get an overview of the physiography, drainage pattern and overall geological setup of the study area. Geological map of the area on 1:50,000 scale, obtained from Geo-data Division, SU:CG, Raipur, was studied in detail so that a better understanding on the geology of the area can be achieved. This was useful during sample collection where exposures of rocks were not present or where the site of sample collection had been converted to agricultural land or built- up area. The geological map is used as a base map for interpretation of analytical data.

5.1.2 Gridding of toposheet & numbering of unit and composite cells:

The NGCM program is conducted toposheet wise on 1:50,000 scale. Stream sediment/ slope wash or colluvium is the main sampling media and it is collected from every one sq km area of a toposheet. Therefore, for this purpose, before commencement of the sampling work a 1km x 1km grid was drawn on the toposheet to be sampled. Every 1km x1km grid is a unit cell which was numbered starting from the SW corner of the toposheet. Four unit cells (numbered as A, B, C and D) together constitute a single composite cell of 2km x2km area. The grid in SW corner of the toposheet is marked as the 1st composite cell (001). As per convention, the numbering of composite cells proceeds from left to right in a book shelf pattern covering the entire toposheet. Thus 182 composite cells were marked

along with their respective unit cells for toposheet no. 64M/6. Soil and water are other sampling media which were collected from every 5' x 5' grid cells (quadrant wise).

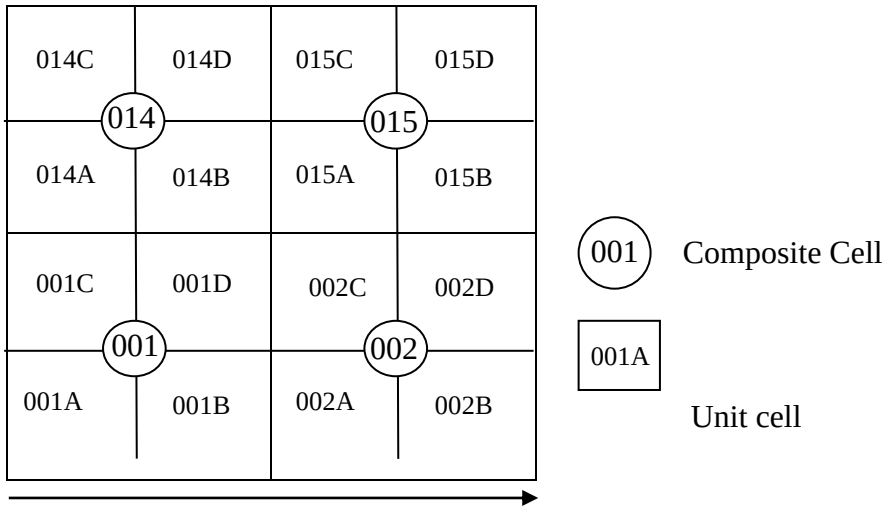

Fig.5.1 Gridding and numbering of unit and composite cells from left to right starting from SW corner

5.1.3 Preparation of maps:

Drainage, land use/ land cover and slope map was prepared on 1:50000 scale in GIS platform. Drainage map is the most essential and fundamental requirement of geochemical mapping since it forms the base map for planning and execution of the sampling work. To prepare the drainage map, the rivers and streams in toposheet no. 64M/6 were digitised. Then tentative stream sediment sample location for each unit cell was marked on the drainage map preferably on 1st and 2nd order streams having largest catchment area and occurring within the unit cell. In case streams are absent within a unit cell, slope wash sample location points were marked considering it as zero order stream.

Land use/ land cover map was prepared on 1:50,000 scale in ArcGIS. First level classification of land use units was done using toposheet as the base map. Slope map was generated using Cartosat1 data obtained from Bhuvan.

The drainage, slope and land use/ land cover map of toposheet no. 64M/6 is given in plate nos. 3, 4 and 5 respectively.

5.1.4 Equipment Required:

The essential equipment required for geochemical sampling and processing are as follows:

- Hard copy gridded toposheet showing tentative sample locations.
- Tough pad for locating the sampling point exactly with respect to its co-ordinates and to enter field data.
- Pocket Global Positioning System (GPS) for locating the sampling point exactly with respect to its co-ordinates.
- Digital camera for taking photographs of sampling points.
- Wooden or plastic hand scoops, wooden picks and scrappers, transparent polythene bags, stickers for numbering, permanent marker pen of various colours for sample collection.
- Transparent plastic sheets for spreading and covering wet samples for drying.
- -120 mesh nylon sieves, plastic tubs, brush for cleaning the sieves, wooden pestle and motor for de-lumping, cloth duster, weighing machine and food grade sturdy colourless plastic bottles of 500 gm and 250 gm capacity are for sample processing and storing.
- 1000 ml and 125 ml poly lab colourless plastic bottles, colourless plastic bucket and mug for collection of water samples.

5.2 Field work:

Field work includes collection of samples from various sampling media as per NGCM norms followed by processing, storing and submission of samples to Geochemical Lab CR, Nagpur for chemical analysis.

5.2.1 Sampling Media:

The choice of sampling media was made in accordance with the guidelines provided by GSI, Mission-I, CHQ, Kolkata through the Standard Operating Procedure (SOP) for NGCM. The media described below are considered to be the most representative of the surface environment, and they are the most commonly used media in the geological investigations. The sampling media are:

- Stream sediment (S): reflects the average geogenic composition of a catchment basin.
- Regolith (R): upper horizon/top soil (0-25cm) without the top organic layer (<2mm). It reflects variations in geogenic compositions of the uppermost layers of the earth's crust.

- Soil (C): a 25 cm layer within a depth range of 50 cm to 200 cm: Comparison of a soil and regolith would give information about environmental changes affecting anthropogenic contamination of the top layer (R).
- Humus (H): optional, to determine the atmospheric (anthropogenic) input of elements to the ecosystem. Humus was not present in toposheet 64M/6.
- Stream water (W): reflects interplay between the geosphere and hydrosphere and at the same time it is the main source of drinking water.
- Heavy Mineral Sampling (HMS): collected for study of abundance of heavy minerals in the area.
- Petrographic Samples (PS): it is important where rocks show indication of mineralization and also for identification of various lithounits present in the area which helps in better interpretation of chemical analysis data.

5.2.2 Sampling Methodology:

- Stream sediment/ Slope wash sampling: After identifying the sampling location within a unit cell, the fine to medium grained bed load material (silty-clayey-sandy) was collected from 1st and 2nd order streams at 3 to 5 places along the stream bed of 50 to 200 m length. In case drainage is absent in a cell, slope wash materials and materials generated by small scale gully erosion was collected considering it to be '0' order stream from four to five locations within the cell to make representative sample of the cell. 5 to 7 kg stream sediment/ slope wash samples were collected and taken to camp in thick transparent plastic bags with proper labeling for processing. Total 728 unit cell samples (1km x 1km) were collected from toposheet no. 64M/6.
- Soil sampling: Soil samples were collected from suitable sites within 5' x 5' grid. The two categories of soil sample collected from each grid are; topsoil i.e. regolith sample (R) from 0-25 cm (excluding materials from the organic layer where ever present) and a sub soil sample (C- horizon) from a 25 cm layer within a depth range of 50 to 200 cm. A suitable soil profile where residual soil is present was selected for soil sample collection. Total 9 soil C- horizon and 9 regolith samples were collected from toposheet no. 64M/6. Details of soil samples are given in table 5.1.
- Stream water sampling: Samples were collected from flowing stream within 5' × 5' grid (quadrant wise) to represent the elemental distribution of that particular drainage basin. Samples were collected and numbered in presence of chemist and as per

NGCM guidelines. The sample location points were marked on the map. Electrical conductivity, pH, TDS and temperature were determined in the field by the chemist. Sample bottles (1litre capacity) were labeled as per NGCM norms, rinsed 4-5 times with stream water and samples were collected by submerging the bottle completely under water so that no air bubble is left in the bottle. Bottle was closed tightly below water level. Total 9 water samples were collected from toposheet no. 64M/6. Details of water samples are given in table 5.2.

- Heavy Mineral Sampling (HMS): Samples were collected preferably from 1st, 2nd or 3rd order streams in 5' × 5' interval in order to understand the heavy minerals of the area which are missed out while collecting the fine stream sediment samples. About 30- 50 kg of sample were collected from each quadrant from suitable trap sites like, below roots of trees on the stream bank, upstream side of big boulders, central deep portion of the stream if no other site is found or at breaks in gradient along the stream channel. Total 9 heavy mineral samples were collected from toposheet no. 64M/6. Details of HMS samples are given in table 5.3.
- Petrographic Samples (PS): It is especially collected where rocks show indication of mineralization and in absence of such indications rock samples of various lithounits present in the area for thin section study. 9 nos. petrographic samples were collected. Details of petrographic samples are given in table 5.4.
- Details of all samples collected were entered in the datasheet. Plate-03 shows location of all samples collected for toposheet no. 64M/6.

Table 5.1: Details of Soil Samples of Toposheet 64M/6

Soil Sample No	Latitude	Longitude	Measurement of depth of collection of sample
64M06/A1/R/17-18	23° 40' 25" N	83° 18' 39" E	9 cm
64M06/A1/C/17-18	23° 40' 25" N	83° 18' 39" E	60 cm
64M06/A2/R/17-18	23° 37' 03" N	83° 15' 41" E	12 cm
64M06/A2/C/17-18	23° 37' 03" N	83° 15' 41" E	70 cm
64M06/A3/R/17-18	23° 31' 29.4" N	83° 18' 44.9" E	10 cm
64M06/A3/C/17-18	23° 31' 29.4" N	83° 18' 44.9" E	50 cm
64M06/B1/R/17-18	23° 43' 28" N	83° 21' 39" E	15 cm

64M06/B1/C/17-18	23° 43' 28" N	83° 21' 39" E	120 cm
64M06/B2/R/17-18	23° 35' 45" N	83° 21' 33" E	18 cm
64M06/B2/C/17-18	23° 35' 45" N	83° 21' 33" E	105cm
64M06/B3/R/17-18	23° 32' 07.1" N	83° 20' 02.8" E	10 cm
64M06/B3/C/17-18	23° 32' 07.1" N	83° 20' 02.8" E	90 cm
64M06/C1/R/17-18	23° 41' 15" N	83° 25' 26.8" E	15 cm
64M06/C1/C/17-18	23° 41' 15" N	83° 25' 26.8" E	120 cm
64M06/C2/R/17-18	23° 38' 13.9" N	83° 27' 40.9" E	8 cm
64M06/C2/C/17-18	23° 38' 13.9" N	83° 27' 40.9" E	40 cm
64M06/C3/R/17-18	23° 31' 29" N	83° 27' 47.3" E	8 cm
64M06/C3/C/17-18	23° 31' 29" N	83° 27' 47.3" E	60 cm

Table 5.2: Details of Water Samples of Toposheet 64M/6

Sl. No	Water Sample No.	Latitude	Longitude	Locality
01	64M06/A1/W/17-18	23° 40' 56.827" N	83° 18' 1.982" E	Odari
02	64M06/B1/W/17-18	23° 43' 3.415" N	83° 21' 55.754" E	Manpura
03	64M06/C1/W/17-18	23° 42' 0.860" N	83° 24' 11.778" E	Bachrajkunwr
04	64M06/A2/W/17-18	23° 37' 41.252" N	83° 25' 9.886" E	Basera
05	64M06/B2/W/17-18	23° 39' 44.292" N	83° 22' 37.726" E	Pandauli
06	64M06/C2/W/17-18	23° 38' 16.784" N	83° 18' 29.742" E	Sardapur
07	64M06/A3/W/17-18	23° 31' 29.395" N	83° 18' 33.401" E	Chaugai
08	64M06/B3/W/17-18	23° 32' 6.366" N	83° 20' 6.309" E	Ranhat
09	64M06/C3/W/17-18	23° 32' 50.237" N	83° 28' 44.069" E	Ghagra

Table 5.3: Details of HMS of Toposheet 64M/6

Sl. No	HMS Sample No.	Latitude	Longitude	Locality
01	64M06/HMS-1/2017-18	23° 40' 55.754" N	83° 18' 2.807" E	Balrampur dist.
02	64M06/HMS-2/2017-18	23° 42' 52.387" N	83° 22' 6.481" E	Balrampur dist.
03	64M06/HMS-3/2017-18	23° 42' 33.663" N	83° 25' 8.483" E	Balrampur dist.
04	64M06/HMS-4/2017-18	23° 38' 16.601" N	83° 18'28.620"E	Balrampur dist.
05	64M06/HMS-5/2017-18	23° 39' 44.192" N	83° 22' 39.413" E	Balrampur dist.
06	64M06/HMS-6/2017-18	23° 37' 42.752" N	83° 25' 1.955" E	Balrampur dist.
07	64M06/HMS-7/2017-18	23° 31' 15.488" N	83° 19' 6.018" E	Balrampur dist.
08	64M06/HMS-8/2017-18	23° 31' 25.471" N	83° 20' 15.995" E	Balrampur dist.
09	64M06/HMS-9/2017-18	23° 34' 7.327" N	83° 28' 47.560" E	Balrampur dist.

Table 5.4: Details of Petrographic Samples of Toposheet 64M/6

Sl. No	PS Sample No.	Latitude	Longitude	Locality
01	64M06/PS-1/2017-18	23° 33' 32.080" N	83° 23' 48.310" E	Mandru RF
02	64M06/PS-2/2017-18	23° 44' 13.786" N	83° 21' 10.662" E	Bajarmarpara
03	64M06/PS-3/2017-18	23° 42' 2.357" N	83° 25' 32.882" E	Bachrajkunwar
04	64M06/PS-4/2017-18	23° 36' 49.361" N	83° 18' 40.946" E	Bhawankhar
05	64M06/PS-5/2017-18	23° 36' 14.668" N	83° 25' 36.186" E	Dhanwar
06	64M06/PS-6/2017-18	23° 37' 18.057" N	83° 25' 44.752" E	Basera
07	64M06/PS-7/2017-18	23° 30' 43.162" N	83° 17' 0.937" E	Chemi/Semra
08	64M06/PS-8/2017-18	23° 34' 4.893" N	83° 23' 51.680" E	Kapot
09	64M06/PS-9/2017-18	23° 30' 18.320"N	83° 26' 33.578" E	Mukha

5.2.3 Sample Processing:

Sample processing is carried out at field camp by the field labour supervised by the field officer as per NGCM guidelines. The method adopted for processing and storing of different samples is as follows:

- Stream sediment / Slope wash samples: The unit cell samples were sun died on transparent plastic sheets and sieved through -120 mesh nylon cloths after de-lumping with wooden pestle and motor, if required. After homogenization, coning and quartering 500gms of sample for each unit cell was collected. Each 500gm unit cell sample was divided into two parts. One part (250gm) was stored as original sample for that particular unit cell. The remaining 250gm was mixed and homogenized with 3 other unit cell samples of same composite cell to prepare 1kg composite sample. After homogenization, coning and quartering of the 1kg composite sample it was split into two parts of 500gms each and stored in labelled plastic food grade bottles. One part was sent to Geochemical lab C.R., Nagpur for analysis and the other kept as storage.

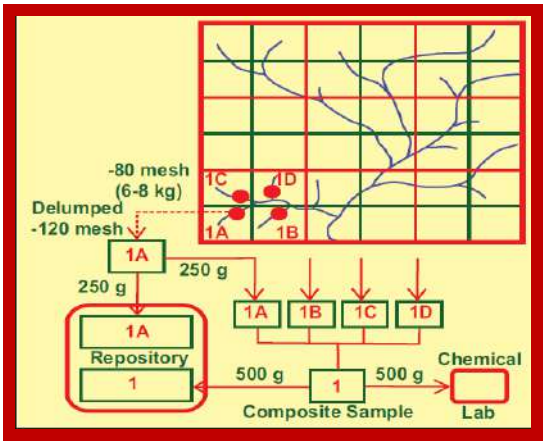

Fig.5.2 Preparation of Composite Samples

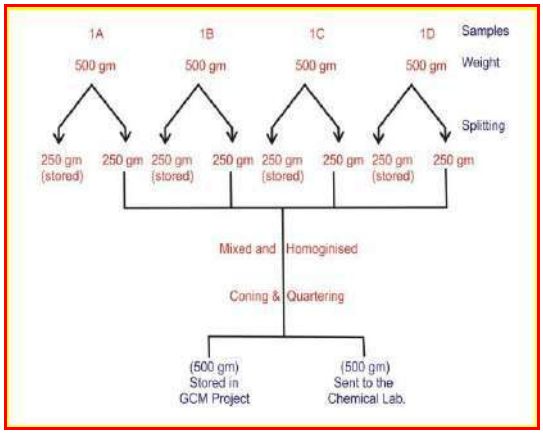

Fig.5.3 Quantity of samples prepared

- Soil samples (Regolith 'R' & 'C' horizon): Regolith and soil 'C' horizon samples for each grid were sun died on transparent plastic sheets and sieved through -120 mesh nylon cloths and 1kg of each sample were collected after processing and split into two parts. One set of processed regolith and 'C' horizon weighing 500gms was sent for chemical analysis and the other part weighing 500gms was stored.
- Heavy Mineral Sampling (HMS): The samples collected were panned and dried. The coarser rock fragments were separated by hand picking. After panning 5-6 kg of the sample was sent to Dhargaon camp, CR, Nagpur for further processing (Gravity separation).

5.2.4 Sample Packing:

All the sample bottles were properly labelled, numbered, packed and dispatched to the respective laboratories with duly filled 'sample submission' proforma for chemical analysis. The numbering scheme followed was as per SOP i.e., Toposheet no. / Unit Cell no. or

Composite Cell no. or Grid no. / Sample Code ('S' for Stream Sediment Sample/ Slopewash Sample; 'R' for Regolith Sample & 'C' for Soil C- Horizon Sample; W for Water Sample/ Year of collection.

5.3 Post-field analysis and interpretation:

The analytical data received from the chemical lab has to be studied thoroughly for statistical analysis, preparation of elemental distribution anomaly maps and interpretation. The chemical analysis results of 46 elements (Package-A and package-H) for 182 composites have been received so far. The analytical data have been processed in Excel for calculating statistical parameters and in Surfer 9 for generating elemental anomaly maps to understand the elemental distribution pattern in the area

Petrographic samples were submitted for preparation of thin sections on 21.03.2018. Petrographic studies will be carried out in details after receiving the thin sections of rock samples from Petrographic Lab, CHQ, Kolkata. Heavy mineral samples (HMS) were sent to Dhargaon camp, CR, Nagpur for further processing (gravity separation) on 13.04. 2018. XRD studies are carried out for identifying mineral grains of economic importance obtained from heavy samples. HMS and XRD studies will be done after receiving the processed HMS samples from Dhargaon camp, CR, Nagpur.

CHAPTER-6

CHEMICAL ANALYSES

Geochemical programme demand special requirement for chemical analysis:

a. The methods adopted should be such that it encompasses wide range of determinants in all sample media at background level
b. The precision and accuracy of the methods and analysis must be of high quality
c. All record of analysis must be fully documented and traceable
d. 5% of the total samples analyzed should be repeated to check the consistency of sampling as well as analysis.

Samples collected from stream sediment and soils of the present investigation were submitted for analysis in the Central Region Chemical Laboratory of Geological Survey of India. The list of elements/oxides analyzed by different methods under different packages are given in Table 6.1. As per the guidelines it is proposed to analyse various samples collected for 68 elements with lowest possible detection limit (up to Clarke; Table 6.2 or even below in certain cases). The chemical analysis results of 26 elements (Package-A) for 48 composites have been received so far. The details of the analytical data received are given in Annexure-1.

Table 6.1: The list of elements/oxides analyzed by different methods

Sample packages	**Analytical Techniques**	**Elements to be determined with lowest limit of detection in parenthesis.**
A	XRF	SiO2, Al_2O_3, Fe_2O_3, TiO_2, CaO, MgO, MnO, Na_2O, K_2O, P_2O_5. Ba, Co, Cr, Cu, Ga, Nb, Ni, Pb, Rb, Sc, Sr, Th, V, Y , Zn, Zr.
B.	GF-AAS	Au.
C.	F-AAS	Li, Cs
D.	HG-AAS	As, Sb, Bi, Se
E.	ISE	F
F.	GF-AAS	Cd, Ag
G.	CV-AAS	Hg.
H.	ICP-MS	La, Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Sn, In, Hf , Ta, Mo, W, Ge, Be, U.
I.	FA-GFAAS	Pt, Pd
J	ICP-MS	Cs, Sn, Mo, In and Tl
Package: W(A) + W(B) + W(C) Major, Minor and trace elements in water samples, Bicarbonates, Salinity, pH etc.		

Table 6.2: List of elements analysed with lower detection limits (ppm) in parenthesis

Ag (0.02) Silver	Cl (15) Chlorine	Ge (0.05) Germanium	Mo (0.5) Molybdenum	Sc (3.5) Scandium	Tm (0.012) Thulium
Al_2O_3 (1000)	Co (1) Cobalt	Hf (0.5) Hafnium	Na_2O (1000)	Se (0.05) Selenium	U (3) Uranium
As (1) Arsenic	Cr (15) Chromium	Hg (0.005) Mercury	Nb (5) Niobium	SiO2 (1000)	V (20) Vanadium
Au (0.003) Gold	Cs (10) Caesium	Ho (0.010) Holmium	Nd (0.056) Neodymium	Sm (0.050) Samarium	W (0.5) Tungsten
B (5) Boron	Cu (1) Copper	I (0.5) Iodine	Ni (2) Nickel	Sn (1) Tin	Y (5) Yttrium
Ba (50) Barium	Dy (0.010) Dysprosium	In (0.03) Indium	P_2O_5 (100)	Sr (5) Strontium	Yb (0.0034) Ytterbium
Be (0.3) Beryllium	Er (0.015) Erbium	K_2O (1000)	Pb (2) Lead	Ta (0.2) Tantalum	Zn (10) Zinc
Bi (0.1) Bismuth	Eu (0.006) Europium	La (1) Lanthanum	Pd (0.0002) Palladium	Tb (0.028) Terbium	Zr (5) Zirconium
Br (0.6) Bromine	F (100) Fluorine	Li (5) Lithium	Pr (0.075) Praseodymium	Te (0.005) Tellurium	
CaO (1000)	Fe_2O_3 (1000) Iron	Lu (0.0023) Lutetium	Pt (0.0003) Platinum	Th (4) Thorium	
Cd (0.1) Cadmium	Ga (5) Gallium	MgO (1000)	Rb (3) Rubidium	Ti (100) Titanium	
Ce (8) Cerium	Gd (0.025) Gadolinium	MnO (30) Manganese	Sb (0.2) Antimony	Tl (0.05) Thallium	

CHAPTER- 7
STATISTICAL ANALYSIS AND GEOCHEMICAL MAPS

The data obtained from chemical analysis have been processed in two forms

(a) Basic statistics

(b) Spatial element distribution map

7.1 Basic Statistics

Basic statistics of each element is provided along with the anomaly map. Statistical methods were applied to have a comprehensive idea about concentrations, deviation and distribution of the elemental data set. The basic statistical parameters calculated include mean, standard error, median, mode, standard deviation, sample variance, kurtosis, skewness, range, minimum, maximum and count. The mean is the most common measure of central tendency. It is computed by summing all the scores in the distribution and dividing that sum by the total number of scores. Median is the score that divides the distribution into halves. It is the middle score. The mode of a distribution is the most frequent or common score in the distribution. The variance is a measure based on the deviations of individual scores from the mean. It is the average of the sum of the squared deviations. The standard deviation is the positive square root of the variance. Skewness is the degree of asymmetry in a distribution. Kurtosis refers to the peakedness of the distribution. Mean plus two times the standard deviation is taken as the threshold value for the elements. Histograms for each element were also prepared through which the distribution pattern of the data can be visualized and outliers can be checked.

7.2 Correlation

Correlation matrix of the elements analyzed for 182 composite samples have been calculated and prepared after receiving all the chemical analytical data from chemical lab, CR, Nagpur. Two oxides/elements having strong positive correlation show a value greater than 0.7 on the correlation matrix table, whereas two elements have moderate or weak correlation if its value lies between 0.5 to 0.7 or fall below 0.5 respectively. Similarly, two elements share similar degrees of negative correlation if the value is preceded by a ‘minus’ or ‘negative’ sign (Table 7.1).

Table 7.1: Shows correlation co- efficient and relationship

	Correlation Co- efficient	Relationship
1.	1.0 to 0.7	Strong positive correlation
2.	0.7 to 0.5	Moderate positive correlation
3.	0.5 to 0	Weak positive correlation
4.	0 to -0.5	Weak negative correlation
5.	-0.5 to -0.7	Moderate negative correlation
6.	-0.7 to -0.9	Strong negative correlation

7.3 Spatial elemental distribution maps

Elemental distribution maps are prepared using Surfer software for toposheet 64M/06. The contours representing above threshold values are shown in red, mean to threshold values in green and below mean values are shown in blue. Threshold values are compared to the Upper Continental Crust (UCC) average of R.L. Rudnick and Gao, 2003. Distribution pattern of each element represented by the contours is then superimposed on the geological map of the area so that the anomaly zones can be easily interpreted in terms of the lithology. During the preparation of geochemical anomaly map or geochemical contour map, substantial space was maintained between two contours so that the source lithology of the anomalous zone is visible on geological map of the area beneath. This helped in easy interpretation of the distribution pattern of the elements analyzed. In case of elemental values below the detection limit, new values have been assigned which is lesser than the detection limit to show the decreasing trend of the contours. Classed post maps for elements are also prepared which divides the elemental distributions into classes of specified range and represents the range of values for a particular location with the help of different symbols.

7.4 Interpretation of elemental distribution maps of T.S. No 64M/06

The geochemical distribution maps showing anomalies for elements were studied with respect to spatial distribution of various lithologies, the mineralogical characteristics of the lithologies and contamination by various agents. The results from univariate and bivariate statistical analysis of the data sets were also corroborated with the anomaly pattern and an attempt has been made for interpretation on the element distribution in the area, the sum up of which is as follows:

Package A:

Silica (SiO2)

SiO2 content in the area varies from 46.36 to 71.33 wt. % with a mean value of 68.97 wt%. The population is negatively skewed (-0.18) and has a kurtosis of -0.94. Threshold value of the population is 70.43 which is just above upper continental crustal (UCC) value (66.60 wt%). No distinctive anomalous zones for SiO2 are present in the area (Plate-13) since threshold value calculated is greater than maximum value in the distribution. SiO2 shows strong negative correlation with Al_2O_3, Fe_2O_3, P_2O_5, CaO, MgO, MnO, Ga, Sc and weak positive correlation with Ba, Cr, Zr.

Alumina (Al2O3)

Al_2O_3 content in the area varies from 9.03 to 20.17 wt. % with a mean value of 15.38 wt%. The population has a skewness of -0.27 and a kurtosis of -0.27. Threshold value of the population is 19.75 which is just above upper continental crustal (UCC) value (15.40 wt%). No distinctive anomalous zones for Al_2O_3 are present in the area (Plate-14). Al_2O_3 shows strong positive correlation with MgO, MnO, Ga and strong negative correlation with SiO2.

Ferric oxide (Fe_2O_3)

Fe_2O_3 values in the area range from 2.35 to 9.31 wt.% with a mean value of 5.47 wt%. The population is positively skewed (o.50) and has a kurtosis of 0.38. Threshold value of the population is 8.10 which is above upper continental crustal (UCC) value (5.04 wt%). Anomalous value of Fe2O3 is recorded in the eastern part of the area (Plate-15). The anomaly pattern of Co, Cu and Sc is similar to that of Fe_2O_3. It shows strong positive correlation with TiO_2, MgO, MnO, CaO, Co, Ga, Cu, Sc, V, and weak negative correlation with K_2O, Ba, Pb, Rb, Th, Zr, Ce, Hf and strong negative correlation with SiO2.

Titanium oxide (TiO_2)

TiO_2 values in the area range from 0.35 to 3.08 wt.% with a mean value of 1.03 wt%. The population is positively skewed (2.22) and has a kurtosis of 8.71. Threshold value of the population is 1.70 which is above upper continental crustal (UCC) value (0.64 wt%). Almost all the values are above the upper continental crustal (UCC) value. Anomalous value of TiO_2 is recorded in the east central and northern part of the area. (Plate-16). The anomaly pattern

of V is similar to that of TiO_2. The area is mainly occupied by intrusives. It shows strong positive correlation with Fe_2O_3, Co, Sc and V.

Calcium oxide (CaO)

CaO values in the area range from 0.21 to 2.32 wt.% with a mean value of 0.74 wt%. The population is positively skewed (1.44) and has a kurtosis of 2.19. Threshold value of the population is 1.58 which is below upper continental crustal (UCC) value (3.59 wt%). All the values are below upper continental crustal (UCC) value. Some anomalous zones for CaO were detected in SW part of the area.(Plate-17) since threshold value of the distribution is less than UCC. It shows Strong positive correlation with Fe_2O_3, MgO, MnO, P_2O_5, Sc and strong negative correlation with SiO2.

Magnesium oxide (MgO)

MgO values in the area range from 0.36 to 3.40 wt.% with a mean value of 1.12 wt%. The population is positively skewed (1.18) and has a kurtosis of 1.46. Threshold value of the population is 2.24 which is below upper continental crustal (UCC) value (2.48 wt%). Some anomalous zones for MgO were detected in southern part of the area (Plate-18). It shows strong positive correlation with Al_2O_3, Fe_2O_3, CaO, MnO, and P2O5, weak negative correlation with Ba, Cr, Pb and Zr and strong negative correlation with SiO2.

Manganese oxide (MnO)

MnO values in the area varies from 0.04 to 0.25 wt.% with a mean value of 0.09 wt%. The population is positively skewed (1.25) and has a kurtosis of 3.87. Threshold value of the population is 0.15 which is just above upper continental crustal (UCC) value (0.10 wt%). Majority of the population is below threshold value. Higher values of MnO are seen in South-Westren part of the area. (Plate-19). It shows strong positive correlation with Al_2O_3, Fe_2O_3, CaO, MgO, Co, Ga, Sc, V, and weak negative correlation with K_2O, Ba, Cr, Pb, Zr, Hf and strong negative correlation with SiO2.

Sodium oxide (Na_2O)

Na_2O values in the area varies from 0.19 to 1.67 wt.% with a mean value of 0.55 wt%. The population is positively skewed (1.11) and has a kurtosis of 1.30. Threshold value of the population is 1.10 which is below upper continental crustal (UCC) value (3.27 wt%). All the values are below upper continental crustal (UCC) value thus no anomalous zones for Na_2O

were detected in the area (Plate-20). It shows strong positive correlation with Y, Be, Ho, Er, Tm, Yb, Lu and moderate negative correlation with SiO2, Ba.

Potassium oxide (K_2O)

K_2O values in the area range from 0.61 to 5.32 wt.% with a mean value of 2.49 wt%. The population is negatively skewed (-0.33) and has a kurtosis of -0.03. Threshold value of the population is 4.14 which is just above upper continental crustal (UCC) value (2.80 wt%). Majority of the population is below threshold value. A significant anomalous zone is detected in southern part of the area (Plate-21). It shows strong positive correlation with CaO, MgO, Rb, Pb and moderate negative correlation with Cr, Ni.

Phosphorus pentoxide (P_2O_5)

P_2O_5 values in the area range from 0.05 to 0.27 wt.% with a mean value of 0.11 wt%. The population is positively skewed (1.10) and has a kurtosis of 1.92. Threshold value of the population is 0.18 which is above upper continental crustal (UCC) value (0.15 wt%). Some si anomalous zones are present in the area since threshold value is more than UCC (Plate-22). It shows strong positive correlation with Rb, Pb, moderate negative correlation with Cr, Ni and strong negative correlation with SiO2.

Barium (Ba)

The values for Ba range from 205 to 835 ppm with a mean value of 573.57 ppm. The skewness is 0.47 and kurtosis is 0.05. Threshold value of the population is 707.82 ppm which is above upper continental crustal (UCC) value (628 ppm). Majority of the population is below threshold value. No significant anomalous value of Ba is present in the area (Plate-23). The area is mainly occupied by granite and granite gneiss. It shows moderate positive correlation with Sr and moderate negative correlation with Na_2O.

Cobalt (Co)

Co values vary from 2 to 24 ppm with a mean value of 13.68 ppm. The distribution is positively skewed (0.22) and has a kurtosis of -0.21. Threshold value of the population is 22.20 ppm which is above upper continental crustal (UCC) value (17.30 ppm). Majority of the population is below threshold value. Higher values of Co are present in the north eastern part of the area near Manikpur villages. (Plate-24). The anomaly pattern of Co is similar to Fe_2O_3, Cu, Ni, Sc and V. It shows strong positive correlation with Fe_2O_3, TiO_2, MnO, Cr, Cu,

Ni, Sc, V, moderate positive correlation with Ga and moderate negative correlation with SiO_2.

Chromium (Cr)

Cr values ranges from 10 to 387 ppm with a mean value of 71.21 ppm. The distribution is positively skewed (3.30) and has a kurtosis of 25.27. Threshold value of the population is 147.20 ppm which is above upper continental crustal (UCC) value (92.00 ppm). It shows weak positive correlation with Cu, Sc, V, Eu, moderate positive correlation with Ni and moderate negative correlation with Rb, K_2O. A anomalous zone of Cr are present mainly SW part of the area near Chemi village where the major lithounit is Granite-Gneiss of CGC(Plate-25).

Copper (Cu)

The Cu values range from 9.0 to 46.00 ppm a mean value of 22.99 ppm. The distribution is positively skewed (0.73) and has a kurtosis of 0.18. Threshold value of the population is 38.08 ppm which is above upper continental crustal (UCC) value (28.00 ppm). It shows strong positive correlation with Fe_2O_3, Co, Ni, Sc, V, moderate negative correlation with SiO_2. Higher values of Cu with anomaly are present in the south western part of the area near Ranhat villages. The area is occupied by mainly Granite-Gneiss of CGC (Plate-26).

Gallium (Ga)

Ga values vary from 13 to 26 ppm with a mean value of 18.63 ppm. The skewness is 0.16 and kurtosis is -0.18. Threshold value of the population is 23.90 ppm which is just above upper continental crustal (UCC) value (17.50 ppm). Most of the values are below threshold value. Higher values of Ga are present in SE corner and central part of the area (Plate-27). Feldspar and mica are the dominant host minerals for Ga in igneous and metamorphic rocks. It shows strong positive correlation with Al_2O_3, Fe_2O_3, MnO, Sc and strong negative correlation with SiO_2.

Niobium (Nb)

Nb values ranges from 10 to 72 ppm with a mean value of 22.80 ppm. The distribution is positively skewed (1.90) and has a kurtosis of 1.90. Threshold value of the population is 39.81 ppm which is above upper continental crustal (UCC) value (12.00 ppm). It shows moderate positive correlation with Al_2O_3, TiO_2, Ga, Eu, Ta and weak negative

correlation with SiO2, Cr. Nb is widely present at trace levels in rock-forming minerals such as biotite, rutile, sphene, cassiterite and zircon; of special geochemical significance is the ionic substitution of Nb for Zr in zircon, since this mineral is widely distributed in igneous rocks. High Nb concentrations are found in late stage magmatic differentiates, and felsic igneous rocks generally have the highest contents. Shale and granite tend to have the highest Nb concentrations, and limestone and sandstone the lowest. Higher values of Nb with anomaly are present mainly within granite and granite gneiss near Manikpur villages (Plate-28).

Nickel (Ni)

Ni values vary from 10 to 114 ppm with a mean value of 29.93 ppm. The distribution is positively skewed (4.37) and has a kurtosis of 37.83 Threshold value of the population is 48.38 ppm which is just above continental crustal (UCC) value (47.00 ppm). A significant anomalous values of Ni is found near SE of Chemi village in the area (Plate-29). It shows strong positive correlation with Co, Cu, V, and moderate positive correlation with Fe_2O_3, TiO_2, Sc, Cr and moderate negative correlation with K_2O.

Lead (Pb)

Pb values vary from 5.00 to 204.00 ppm with a mean value of 32.14 ppm. The distribution is positively skewed (6.07) and has a kurtosis of 46.59. Threshold value of the population is 70.70 ppm which is much above upper continental crustal (UCC) value (17.00 ppm). It shows strong positive correlation K_2O, Rb and moderate positive correlation with Th, Be, U. It is widely dispersed at trace levels in a range of other minerals, including K–feldspar, plagioclase, mica, zircon and magnetite. The Pb2+ ion (119 pm) is intermediate in size between K+ (138 pm) and Ca2+ (100 pm) and so it replaces these ions in K-feldspar, mica and to a lesser extent, plagioclase and apatite. Higher values of Pb with significant anomalous zones are present within granite and granite gneiss of Chhotanagpur Gneissic Complex near Chemi and Pakrari villages (Plate-30).

Rubidium (Rb)

Rb values vary from 19 to 329 ppm with a mean value of 156.39 ppm. The distribution is positively skewed (0.04) and has a kurtosis of -0.60. Threshold value of the population is 292.08 ppm which is above upper continental crustal (UCC) value (82.00 ppm). Majority of the values are above upper continental crustal (UCC) value. It shows strong

positive correlation with K_2O, Pb, Th, Y, Be, Tb, Dy, Ho, Er, Tm, Yb, Lu, U and moderate negative correlation with Cr. The Rb+ ion (ionic radius 152 pm) substitutes for K+ (138 pm) in mica such as muscovite and to a lesser extent, in K-feldspar such as microcline and orthoclase. However, because Rb+ has a larger ionic radius and, therefore, behaves incompatibly, it becomes concentrated in late stage differentiates in magmatic systems. Higher values of Rb are noted in western part of the area (Plate-31).

Scandium (Sc)

Sc values vary from 6 to 26 ppm with a mean value of 15.07 ppm. The distribution is positively skewed (0.57) and has a kurtosis of 0.46. Threshold value of the population is 21.54 ppm which is above upper continental crustal (UCC) value (14.00 ppm). It shows strong positive correlation with Fe_2O_3, TiO_2, CaO, MnO_2, Co, Cu, Ga, V and strong negative correlation with SiO2. Higher values of Sc with anomaly are present in the south western part of the area near Pakrari village and south eastern part of Chalgali village. The area is occupied by granite and granite gneiss of Chhotanagpur Gneissic Complex (Plate-32).

Strontium(Sr)

Sr values ranges from 33 to 133 ppm with a mean value of 68 ppm. The distribution is positively skewed (1.61) and has a kurtosis of 3.20. Threshold value of the population is 93.54 ppm which is much below upper continental crustal (UCC) value (320.00 ppm). All values as well as threshold value of the population is below upper continental crustal (UCC) value. Thus there are no significant anomalous zones for Sr but some higher values are noted in eastern part of the area near Manikpur village and it stretches towards south. (Plate-33). It shows moderate positive correlation with Ba and Eu.

Thorium (Th)

Th values ranges from 14 to 138 ppm with a mean value of 41.25 ppm. The distribution is positively skewed (1.81) and has a kurtosis of 5.02. Threshold value of the population is 81.60 ppm which is much above upper continental crustal (UCC) value (10.50 ppm). Most of the values in the study area are above UCC value. Th shows a strong positive correlation with Y, La, Ce, Pr, Nd, Sm, Tb, Gd, Dy, Ho, Er, Tm, Yb, Lu, U and Rb. Thorium is generally higher in granitic than mafic igneous rocks and is also present in monazites which are minor constituents of granites. Higher anomalous values of Th are present near

Chalgali, Manikpur villages and an significant anomalous zone noted in the north west part of the area. (Plate-34)

Vanadium (V)

V values vary from 46 to 224 ppm with a mean value of 103.58 ppm. The distribution is positively skewed (0.44) and has a kurtosis of 1.28. Threshold value of the population is 154.04 ppm which is above upper continental crustal (UCC) value (97.00 ppm). V exhibits strong positive correlation with Fe_2O_3, TiO_2, MnO, Co, Cu, Ni, Sc and moderate negative correlation with SiO2. The trivalent ion V^{3+} has an ionic radius (64 pm) almost identical to that of Fe^{3+} (65 pm). Because of this, V is frequently found as a substitute for Fe in magnetite and in the ferromagnesian silicate minerals formed during primary magmatic processes (Curtis 1964). The anomaly zone for V is mostly noted in eastern and east central part of the area(Plate-35). The anomaly pattern of Fe2O3, Co, Cu, Ni, Sc and V are similar to each other.

Yttrium (Y)

Y values vary from 36 to 181 ppm with a mean value of 68.41 ppm. The distribution is positively skewed (1.85) and has a kurtosis of 4.71. Threshold value of the population is 115.77 ppm which is much above upper continental crustal (UCC) value (21.00 ppm). All values are above upper continental crustal (UCC) abundance. Y shows strong positive correlation with Na_2O, Be, Sm, Tb, Gd, Dy, Ho, Er, Tm, Yb, Lu, U, Th, Rb and moderate negative correlation with SiO2. Higher values of Y with anomaly are present in near Chalgali and west of Manikpur villages where the major lithounit is granite and granite gneiss of CGC (Plate-36)

Zinc (Zn)

Zn values vary from 35 to 333 ppm with a mean value of 66.90 ppm. The distribution is positively skewed (2.40) and has a kurtosis of 8.87. Threshold value of the population is 158.07 ppm which is much above upper continental crustal (UCC) value (10.00 ppm). All values are above upper continental crustal (UCC) abundance. Zn shows strong positive correlation with Na_2O, Be, Sm, Tb, Gd, Dy, Ho, Er, Tm, Yb, Lu, U, Th, Rb and moderate negative correlation with SiO2. Higher values of Zn with anomaly are present in near Pakrari and Chemi villages where the major lithounit is granite and granite gneiss of CGC (Plate-37).

Zirconium (Zr)

Zr values vary from 260 to 2981 ppm with a mean value of 764.37 ppm. The distribution is positively skewed (1.92) and has a kurtosis of 5.83. Threshold value of the population is 1566.19 ppm which is much above upper continental crustal (UCC) value (193.00 ppm). All values are well above upper continental crustal (UCC) abundance. It shows strong positive correlation with Hf. Zirconium is a lithophile metallic element and forms several minerals including zircon $ZrSiO_4$. The ionic radii of Zr^{4+} and Hf^{4+} (72 and 71 pm respectively) are almost identical, resulting in very similar chemical behaviour of the two elements. Felsic igneous rocks are generally enriched in Zr relative to mafic lithologies. Mielke (1979) reports a crustal average of 162 mg kg^{-1} Zr; ultramafic 45 mg kg^{-1}; basaltic 140 mg kg^{-1}; granitic 140–175 mg kg^{-1} and syenite 500 mg kg^{-1}. Higher values of Zr with anomaly are present in north western part of the area (Plate-38).

Package H

Beryllium (Be)

The values for Be range from 0.50 to 13.06 ppm with a mean value of 2.58 ppm. The distribution is positively skewed (3.66) and has a kurtosis of 20.79. Threshold value of the population is 5.63 ppm which is above upper continental crustal (UCC) value (2.10 ppm). It shows strong positive correlation with Na_2O, Tb, Dy, Ho, Er, Tm, Yb, Lu, U, Rb, Y and moderate negative correlation with SiO2. Higher values of Be with anomaly are present in granite and granite gneiss of CGC near north of Chalgali village (Plate-39). Generally Be is abundant in micaceous minerals like muscovite and also found in rocks of later differentiates like granite and pegmatitic rocks.

Germanium (Ge)

Ge values vary from 0.18 to 3.49 ppm with mean value of 1.55 ppm. The distribution is positively skewed (1.00) and has a kurtosis of 7.60. Threshold value of the population is 2.21 ppm which is above upper continental crustal (UCC) value (1.40 ppm). Most values are above upper continental crustal (UCC) abundance. Ge effectively camouflage and replace Si since the two have same charge. Higher values shown by Ge are found in granite and granite gneiss near north east of Chalgali villages (Plate-40). It shows moderate positive correlation with Tb, Dy, Ho, U, Be and weak negative correlation with SiO2, TiO_2, Ba, Cr, Sr, Zr, Hf.

Arsenic (As)

As values vary from 1.00 to 22.00 ppm with mean value of 4.33 ppm. The distribution is positively skewed (1.96) and has a kurtosis of 6.04. Threshold value of the population is 10.78 ppm which is above upper continental crustal (UCC) value (2.10 ppm). Most of values are above upper continental crustal (UCC) value of the total population. *As* shows moderate positive correlation with N_2O, Rb, Y, Be, Tb, Dy, Ho, Er, Tm, Yb, Lu andU. Higher values of As with anomaly are present in granite and granite gneiss of CGC near Chalgali villages and western part of the area. (Plate-41).

Tin (Sn)

Sn values vary from 0.50 to 21.50 ppm with mean value of 2.42 ppm. The distribution is positively skewed (3.12) and has a kurtosis of 12.94. Threshold value of the population is 8.26 ppm which is above upper continental crustal (UCC) value (2.10 ppm). Some values are below detectable limit but comprise less than 50% of the total population. Sn shows moderate positive correlation with N_2O, Rb, Y, Be, Tb, Dy, Ho, Er, Tm, Yb, Lu andU. Higher values of Sn with anomaly are present in granite and granite gneiss of CGC near Chalgali villages (Plate-42).

Lanthanum (La)

The La values range from 10.71 to 384.89 ppm with mean value of 111.18 ppm. The distribution is positively skewed (1.88) and has a kurtosis of 6.18. Threshold value of the population is 215.63 ppm which is much above upper continental crustal (UCC) value (31 ppm). Majority of the values are above upper continental crustal (UCC) abundance. It shows strong positive correlation with Sm, Tb, Gd, Dy, U and Th. Higher values of La with anomaly are present near Chalgali, Manikpur villages and north western part of the area. (Plate-43). Higher values of La in granite might be due to replacement of Ca^{2+} by La in accessory minerals like sphene and apatite.

Cerium (Ce)

The Ce values range from 21.91 to 778.41 ppm with mean value of 206.55 ppm. The distribution is positively skewed (2.02) and has a kurtosis of 6.10. Threshold value of the population is 423.86 ppm which is much above upper continental crustal (UCC) value (63 ppm). Majority of the values are above upper continental crustal (UCC) abundance. It shows strong positive correlation with Th, La, Pr, Nd, Sm, Tb, Gd, and U. High values of Ce with

anomaly are present near Chalgali, Manikpur villages and north western part of the area (Plate-44).

Praseodymium (Pr)

Pr values vary from 2.50 to 91.12 ppm with mean value of 28.00 ppm. The distribution is positively skewed (1.50) and has a kurtosis of 2.53. Threshold value of the population is 58.72 ppm which is above upper continental crustal (UCC) value (7.10 ppm). Most values in the study area are above UCC abundance. It shows strong positive correlation with La, Ce, Nd, Sm, Tb, Gd, Dy, Ho, Th and U. High values of Pr with anomaly are present Chalgali, Manikpur villages and north western part of the area. Pr exhibits similar distribution pattern like La (Plate-45).

Neodymium (Nd)

Nd values vary from 9.91 to 407.80 ppm with mean value of 104.30 ppm. The distribution is positively skewed (1.85) and has a kurtosis of 5.00. Threshold value of the population is 220.71ppm which is much above upper continental crustal (UCC) value (27.00 ppm). It shows strong positive correlation with La, Ce, Pr, Th, Sm, Tb, Gd, Dy, Ho and U. High values of Nd with anomaly are present Chalgali, Manikpur villages and north western part of the area. Nd exhibits similar distribution pattern like La and Pr (Plate-46).

Europium (Eu)

Eu values vary from 0.23 to 3.97 ppm with a mean value of 1.94 ppm. The distribution is positively skewed (0.83) and has a kurtosis of 2.10. Threshold value of the population is 2.98 ppm which is above upper continental crustal (UCC) value (1.00 ppm). Maximum values in the study area are above UCC abundance. It shows moderate positive correlation with Al_2O_3, Fe_2O_3, TiO_2, Sm, Gd, Ga, Nb, Sc, Sr, V, La, Ce, Pr and Nd. Higher values of Eu with anomaly are observed near Chalgali villages and north western part of the area. The lithology of the area is mainly granite and granite gneiss of CGC (Plate-47).

Samarium(Sm)

Sm values vary from 1.91 to 66.42 ppm with a mean value of 19.10 ppm. The distribution is positively skewed (1.82) and has a kurtosis of 4.68. Threshold value of the population is 39.04 ppm which is above upper continental crustal (UCC) value (4.70 ppm). Maximum values in the study area are above UCC abundance. It shows strong positive

correlation with Th, Y, La, Ce, Pr, Nd, Tb, Gd, Dy, Ho, Er, Tm, Yb, Lu and U. Higher values of Sm with anomaly are observed near Chalgali, Manikpur villages north western part of the area (Plate-48). The distribution pattern of Sm is similar to La, Pr, Nd and Gd.

Terbium (Tb)

Tb values vary from 0.24 to 9.53 ppm with a mean value of 2.70 ppm. The distribution has a skewness of 2.01 and kurtosis of 5.78. Threshold value of the population is 5.35 ppm which is above upper continental crustal (UCC) value (0.70 ppm). Maximum values in the study area are above UCC abundance. It shows strong positive correlation with Rb, Th, Y, Be, La, Ce, Pr, Nd, Sm, Gd, Dy, Ho, Er, Tm, Yb, Lu and U. Higher values of Tb are observed near Chalgali, west of Manikpur villages and north western part of the area. (Plate-49).

Gadolinium (Gd)

Gd values vary from 1.74 to 60.23 ppm with a mean value of 16.91 ppm. The distribution has a skewness of 1.89 and kurtosis of 5.22. Threshold value of the population is 33.79 ppm which is above upper continental crustal (UCC) value (4.00 ppm). Maximum values in the study area are above UCC abundance. It shows strong positive correlation with Th, Y, La, Ce, Pr, Nd, Sm, Tb, Dy, Ho, Er, Tm, Yb, Lu and U. Higher values of Gd are observed near Chalgali village and north western part of the area (Plate-50). The distribution pattern of Gd is similar to Tb and Sm.

Dysprosium (Dy)

Dy values vary from 1.27 to 47.91 ppm with a mean value of 14.92 ppm. The distribution has a skewness of 1.96 and kurtosis of 5.14. Threshold value of the population is 29.38 ppm which is above upper continental crustal (UCC) value (3.90 ppm). Maximum values in the study area are above UCC abundance. It shows strong positive correlation with Rb, Th, Y, Be, La, Pr, Nd, Sm, Tb, Gd, Ho, Er, Tm, Yb, Lu and U. Higher values of Dy with anomaly occur near Chalgali, west of Manikpur villages of the area where the lithology is granite and granite gneiss of CGC (Plate-51) The anomaly pattern of Dy is similar to Ho and Er.

Holmium (Ho)

Ho values vary from 0.24 to 9.08 ppm with a mean value of 2.83 ppm. The distribution has a skewness of 1.72 and kurtosis of 4.06. Threshold value of the population is 5.48 ppm which is above upper continental crustal (UCC) value (0.83 ppm). Maximum values in the study area are above UCC abundance. It shows strong positive correlation with Na_2O, Rb, Th, Y, Be, Pr, Nd, Sm, Tb, Gd, Dy, Er, Tm, Yb, Lu, U and moderate negative correlation with SiO2. Higher values of Ho with anomaly occur near Chalgali, west of Manikpur villages of the area where the lithology is granite and granite gneiss of CGC (Plate-52). Distribution pattern of Ho matches the anomaly trend of Dy and is similar to Er also.

Erbium (Er)

Er values vary from 0.64 to 25.41 ppm witha mean value of 8.15 ppm. The distribution has a skewness of 1.62 and kurtosis of 3.53. Threshold value of the population is 15.63 ppm which is much above upper continental crustal (UCC) value (2.30 ppm). Most of values in the study area are above UCC abundance. It shows strong positive correlation with Na_2O, Rb, Th, Y, Be, Sm, Tb, Gd, Dy, Ho, Tm, Yb, Lu and U. Higher values of Er with anomaly occur near Chalgali, west of Manikpur villages of the area where the lithology is granite and granite gneiss of CGC (Plate-53). Distribution pattern of Er matches the anomaly trend of Dy and Ho.

Thulium (Tm)

Tm values vary from 0.09 to 3.83 ppm with a mean value of 1.31 ppm. The distribution has a skewness of 1.35 and kurtosis of 2.39. Threshold value of the population is 2.47 ppm which is much above upper continental crustal (UCC) value (0.30 ppm). Maximum values in the study area are above UCC abundance. It shows strong positive correlation with Na_2O, Rb, Th, Y, Be, Sm, Tb, Gd, Dy, Ho, Er, Yb, Lu and U. Higher values of Tm with anomaly occur near Chalgali, west of Manikpur villages of the area where the lithology is granite and granite gneiss of CGC (Plate-54). Distribution pattern of Tm matches the anomaly trend of Yb and Lu.

Ytterbium (Yb)

Yb values vary from 0.69 to 22.90 ppm with a mean value of 8.33 ppm. The distribution has a skewness of 1.27 and kurtosis of 2.12. Threshold value of the population is 15.51 ppm which is much above upper continental crustal (UCC) value (2.0 ppm). Most of

values in the study area are above UCC abundance. It shows strong positive correlation with Na_2O, Rb, Th, Y, Be, Sm, Tb, Gd, Dy, Ho, Er, Tm, Lu and U. Higher values of Yb with anomaly occur near Chalgali, west of Manikpur villages of the area where the lithology is granite and granite gneiss of CGC (Plate-55). Distribution pattern of Yb matches the anomaly trend of Tm and Lu.

Lutetium (Lu)

Lu values vary from 0.09 to 3.45 ppm with a mean value of 1.28 ppm. The distribution has a skewness of 1.22 and kurtosis of 2.06. Threshold value of the population is 2.36 ppm which is much above upper continental crustal (UCC) value (0.31 ppm). Most of values in the study area are above UCC abundance. It shows strong positive correlation with Na_2O, Rb, Th, Y, Be, Sm, Tb, Gd, Dy, Ho, Er, Tm, Yb and U. Higher values of Lu with anomaly occur near Chalgali, west of Manikpur villages of the area where the lithology is granite and granite gneiss of CGC (Plate-56). Distribution pattern of Lu matches the anomaly trend of Tm and Yb.

Hafnium (Hf)

Hf values vary from 2.01 to 100.01 ppm with a mean value of 25.04 ppm. The distribution is positively skewed (1.88) and kurtosis of 4.24. Threshold value of the population is 56.65 ppm which is much above upper continental crustal (UCC) value (5.30 ppm). Most of values in the study area are above UCC abundance. It shows strong positive correlation with Zr. Higher values of Hf with anomaly occur near north western part of the area(Plate-57). The distribution of Hf is very similar to the distribution pattern of Zr since the ionic radius of Hf (71 pm) is almost identical to that of Zr (72 pm).

Tantalum (Ta)

Ta values vary from 0.17 to 15.90 ppm with a mean value of 2.32 ppm. The distribution is positively skewed (5.67) and kurtosis is 49.98. Threshold value of the population is 5.10 ppm which is above upper continental crustal (UCC) value (0.90 ppm). Most of the values in the study area are above UCC abundance. It shows moderate positive correlation with Al_2O_3, Nb and Be. Higher values of Ta with anomaly occur towards north of Chalgali villages where the lithology is granite and granite gneiss of CGC (Plate-58).

Uranium (U)

U values vary from 0.51 to 27.14 ppm witha mean value of 9.03 ppm. The distribution is positively skewed (1.35) and kurtosis of 2.51. Threshold value of the population is 17.75 ppm which is above upper continental crustal (UCC) value (2.70 ppm). It shows strong positive correlation with Rb, Th, Y, Be, La, Ce, Pr, Nd, Sm, Tb, Gd, Dy, Ho, Er, Tm, Yb and Lu. Higher values of U with anomaly occur near Chalgali villages where the lithology is granite and granite gneiss of CGC (Plate-59)

Table no.-7.2 Mutual relationships of elements showing affinity and antipathy among element

	Oxide/ Element	Positive correlation	Negative correlation
1	SiO2	-	Al_2O_3, Fe_2O_3, MnO, P_2O_5, Sc, Pb, Sr, Y, Zn, La, Pr,Nd, Eu,Sm ,Gd, Tb, Dy, Ho, Er,Tm, Yb, Lu,Ta, U.
2.	Al_2O_3	Fe_2O_3, Th, Eu,	SiO2
3	Fe_2O_3	-	SiO2, K2O
4	MnO	Sr, Zn, Sc, Pb, Y, La, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Yb, Ta, U	SiO2, TiO2, MgO, V, Cr, Zr,
5	TiO_2	Mgo, V, Zr	SiO2, Sc, Pb, Sr, Y, Zn, Eu,
6	CaO	-	-
8	MgO	V, Zr, Cu, Tio2	Sc, Co, Sr, Zn,
7	Na_2O	-	-
8	K_2O	Ba, Co,	P_2O_5, Rb, Y, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu
9	P_2O_5	-	SiO2, K_2O
10	Ba	Co, K_2O	-
11	Ga	-	-
12	Sc	Sr, Ni, Y, Zn, MnO	V, Cr, Zr, MgO, TiO2
13	V	Zr, Cu, TiO2	Sr, MnO,
14	Th	Al_2O_3	-

15	Pb	Sr, Y, Zn, La, Pr, Nd, Eu, Sm Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, U, MnO	SiO2, TiO2
16	Ni	Sc,	SiO2
17	Nb	-	-
18	Co	Na_2O ,K2O, Ba	Cu, Cr, Zr MgO
19	Cu	-	-
20	Cr	-	Sr, Y, Zn, Sc, MnO
21	Rb	-	Co, K2O
22	Sr	Y, Zn, Eu, Tb, Dy, Ta, Pb	SiO2 , Zr, TiO2, MgO, V, Cr
23	Y	Zn, La, Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, U, Hf, Ta, Ce, MnO, Sc	SiO2, Cr, K2O, TiO2
24	Zr	Hf, TiO2	Zn, MnO, Sc, Co, Sr
25	Zn	Pr, Nd, Sm,Gd, Tb, U, Sc, Pb, Sr, La, Ce,Eu, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta	SiO2, TiO2, MgO, V, Cr
26	Be	-	-
27	Ge	Sc, Y, Cr, Ge, La, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Tm, Yb, Lu, Hf, Ta, U	-
28	As	-	-
29	Sn	-	-
30	La	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, Eu, Ta, MnO, Pb, Zn, Ge, Ta,	SiO2
31	Ce	Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, La, Y, Zn, Eu, Er, Tm, Yb, Lu, ta	-
32	Pr	Ce, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, La, Ge, Pb, MnO, Eu, Ta	SiO2, K20,
33	Nd	Ce, Pr, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, La, MnO, Pb, Eu, Ta	SiO2, K2O,
34	Eu	Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, La, Sm, Hf, Ta, U, Nd, Pr, Ce, La, Ge, Zn, Sr, Pb, MnO, Al_2O_3	SiO2, TiO2

35	Sm	Ce, Pr, Nd, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, La Eu, Ge, Pb, MnO, Ta	SiO2, K2O,
36	Gd	Ce, Pr, Nd, Eu, Sm, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, La Ta, Ge, Pb, MnO	SiO2, K2O
37	Tb	Ce, Pr, Nd, Eu, Sm, Gd, Dy, Ho, Er, Tm, Yb, Lu, Hf, U, La Ge, Sr, Pb, MnO, Ta	SiO2, K2O,
38	Dy	T Ce, Pr, Nd, Eu, Sm, Gd, Tb, Ho, Er, Tm, Yb, Lu, Hf, U, La, MnO, Pb, Sr, Zn, Ge,	SiO2, K2O,
39	Ho	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Er, Tm, Yb, Lu, Hf, U, La Ta, MnO, Pb, Zn, Ge	SiO2, K2O,
40	Er	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Tm, Yb, Lu, Hf, U, La Ta, MnO, Pb, Zn, Ge, Ce,	SiO2, K2O,
41	Tm	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Yb, Lu, Hf, U, La Ta, Pb, Zn, Ge, Ce,	SiO2, K2O,
42	Yb	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Lu, Hf, U, La Ta, MnO, Pb, Zn, Ge, Ce,	SiO2, K2O,
43	Lu	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Hf, U, La Ta, Pb, Zn, Ge, Ce	SiO2, K2O
44	Hf	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, U, La Ta	-
45	Ta	Ta, Eu, MnO, Pb, Sr, Y, Zn, La, Ce, Pr, Nd, Eu, Sm, gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf.	SiO2
46	U	Ce, Pr, Nd, Eu, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, La, Ta, MnO, Pb, Ge, Eu,	SiO2

7.5 Interpretation of the water chemistry of T.S. No 64M/06

The analytical result of nine water samples is awaited.

7.6 Application of Geochemical Data

The data generated through geochemical mapping has significant utility in geological as well as non-geological fields. It serves as a base data on which detailed work can be formulated. Geochemical baseline elemental data can be used for developing and managing natural resources. The elemental distribution maps prepared from the analytical results of stream sediment samples give us the first hand information regarding the regional distribution

of any element in a large area. Departments such as agriculture, health, geology, etc and agencies dealing with environmental and ground water studies may use these data as basic information before taking up detailed work. The various possible fields for utilization of geochemical data have been discussed in this chapter like mineral exploration and agricultural activities.

7.6.1 Mineral Investigation

The sediment derived from each lithounit will have characteristics akin to that particular lithology. Therefore, the chemistry of sediments in streams of limited basin area should reflect the lithology in its catchment area. If more than one lithology is present in the catchment, then the chemistry reflects a combined effect of these lithologies. In areas of extensive lateritisation, the chemistry may reflect an already reworked system and may mask the geochemical signatures of the original bedrock.

7.6.2 Environment

The study on the geochemistry of the top layer of the Earth has got wide implications in monitoring and preserving the biosphere from degradation. Steadily increasing public concern over man-made changes to the environment makes it essential to determine the present global elemental distribution pattern to allow early recognition of changes and also to explore the possibilities of mitigation. The abundance of certain elements on the Earth's surface has a direct influence on human and animal health and agriculture. Unlike other environmental issues like air and water pollution, deforestation etc., the role of elemental distribution in the environment has not evoked much response until recently. Elements are variably present in soil and water due to weathering of rocks. It also enters the environment as waste products of industries and mines. These elements reach the body of humans and animals through direct intake or ingestion through plants and water. If the intake exceeds the tolerance level prescribed for each element, it may lead to serious health problems. The spatial dimension of geochemical maps along with soil profile chemistry would facilitate identification of hot spots that may need immediate attention by the environmental scientists and planners.

The water chemistry provides a general picture on the pollution levels in the area. Stream water samples provide information on elemental anomalies within its drainage basin. Water quality studies carried out by various renowned agencies have fixed levels for the presence of each element to qualify the purity of water. Table 7.2 lists BIS(Bureau of Indian

Standard) prescribed limits for safe consumption of water. Values above the permissible value fall in the level of pollution or toxicity. There are five key groups of water contaminants:

- Particulates like sediment, rust, clay which affect taste, odour and colour of water
- Organics include pesticides and herbicides
- Inorganics include elements such as Cd, As, Cu, Fe, Lead, Se etc. and salts of Na, K, Mg, Ca etc.
- Microbiologicals include protozoans cysts, cryptosporidium etc., bacteria like *E.coli*, *salmonella, vibrio* etc. and viruses like those of polio, rotavirus, hepatitis A etc.
- Radiologicals include dissolved and particulate U and Ra, beta particle and photon etc.

Table 7.3: BIS prescribed limits for drinking water (trace element content in ppm)

Parameters	BIS Prescribed Limits (*WHO)		T.S. 64M/06 ppm/ppb#	Para-meters	BIS Prescribed Limits (*WHO)		T.S. 64M/06 ppm/ ppb#
	Desirable	Permissible			Desirable	Permissible	
pH	6.5	8.5	7.15 – 8.74	F	1.0	1.5	Result awaited
EC	400	2000	82 – 293	Fe	0.30	1.0	
Al	0.03	0.2	-	Hg	0.001	-	
As	0.05	-	<1#	K*	10	12	
B	1.0	5.0	<0.50	Mg	30	100	
Ba	2.0	-	10.40 – 63.71#	Mn	0.1	0.3	
Be	-	0.0002	<0.1#	Na*	20	175	
Ca	75	200	5 – 35	Ni	-	-	
Cd	0.01	-	<0.01#	Pb	0.05	-	
Cl	0.20	-	6 – 16	Sb	0.006	-	
Cr	0.05	-	<4#	Se	0.01	0.3	
Cu	0.05	1.50	<0.5#	Zn	5.0	15	

The chemistry of soil also provides information about the pollution aspects. Based on the trace element content, the soils can range from uncontaminated to contaminated soil. This concentration may be geogenic or anthropogenic. The natural anomalous zones may lead to identification of hidden mineralization while man-made anomalies are pollution centers that have adverse effects on human well-being.

Table 7.4: Levels of contamination (in ppm) of various elements in soil (Bowen, 1979)

Element	Typical uncontamination	Slight contamination	Contamination	Heavy Contamination	Unusually Heavy contamination	Present study area (TS 64M/06)
As	0-30	30-50	50-100	100-500	>500	NR
Cd	0-1	1-3	3-10	10-50	>50	NR
Cr	0-100	100-200	200-500	500-2500	>2500	10 - 120 ppm
Cu	0-100	100-200	200-500	500-2500	>2500	2.5- 37 ppm
Hg	0-1	1-3	3-10	10-50	>50	NR
Mn	0-500	500-1000	1000-2000	2000-10000	>10000	0.02-0.1 wt%
Ni	0-20	20-50	50-200	200-1000	>1000	5 - 41
Pb	0-500	500-1000	1000-2000	2000-10000	>10000	5 - 39 ppm
Sb	0-30	30-50	50-100	100-500	>500	NR
Se	0-1	1-3	3-10	10-50	>50	NR
U	0-100	100-200	200-500	500-2500	>2500	2.05 – 19.72 ppm
Zn	0-250	250-500	500-1000	1000-5000	>5000	3.43 – 26.52 ppm

7.6.3 Agriculture:

The plains of the study area are utilized for cultivation, the main crop being paddy. A few of the elements (available in the present data set) that are important for the growth of plants/ crops have been assessed in relation to the areas under cultivation. For the proper growth of plants, adequate supply of certain elements is required (Table 7.4). On the other hand, an excessive supply of the same will cause toxicity. Toxic elements from waste water may contaminate agricultural soils, water supplies and environment and hence human food chain. Due to modern agricultural techniques, new crop varieties and highly effective methods have enabled farmers to increase the yield to great level, putting an ever increasing burden on the soil in terms of its ability to supply nutrients, which are supplied by the use of fertilizers. Table 7.3, 7.6 and 7.7 provide the details of normal elemental content in soil and its critical values. It also provides the elemental content in plants and its critical value that can affect the productivity of the crops. Apart from carbon, hydrogen and oxygen, plants require nitrogen, phosphorous, potassium, sulphur, calcium, magnesium and iron as macronutrients. Except iron other elements are required in large amounts. Boron, copper, iron, manganese, molybdenum and zinc are essential trace elements required in small

amounts by plants. These essential trace elements are frequently referred to as micronutrients. They are required for proper growth of the plant and soil is the main source of these micronutrients. If an organism's supply of a micronutrient is inadequate, its growth is adversely affected while it becomes toxic if present in excess. Elements like As, Br, Cl, Na, Rb, Sr, Si, V, Co and I which may not be essential for higher plants are very essential for certain algae and fungi while some bacteria need Li and Se. Some of them are macronutrients for these organisms (Alloway, 1990). Elements like Hg, Cu, Ni, Pb, Co, Cd, Ag, Be, Sn are toxic and thereby harmful if present in excess amount.

Table 7.5: Role of elements in agriculture and environment

Elements	Functions
Iron	Iron plays an important role in formation of chlorophyll a vital component to ensure plant health.
Manganese	Manganese is essential for the proper growth of the plants. It is said to play a significant role in disease resistance.
Beryllium	Beryllium is widely used in agriculture as a fungicide.
Zinc	Zinc deficiency in agriculture soil leads to crop failure
Molybdenum	Plant grown in nutrient solutions without molybdenum develops characteristic phenotypes including nottling lesions on the leaves and altered leaf morphology where the lamellae becomes involuted, a phenomenon commonly referred as "whiptail". The only trace element that can eliminate these phenotypes is molybdenum.
Copper	In copper deficiency, the rate of photosynthesis in plants is reduced.
Sodium	Sodium has an influence on plant growth and yield of the plant.
Potassium	Potassium is a plant nutrient and it increases yield of the product.
Selenium	Selenium is important in the metabolism of cyan bacteria and some plants being involved in the ant oxidative process. Although it is harmful to plant on higher concentration, it can exert beneficial effect at low concentration. It can increase the tolerance of plants to UV induced oxidative stress delay senescence and promote the growth of ageing seedlings. 'Se' is able to regulate the water status of plants under conditions of draught.
Cobalt	Cobalt is an essential nutrient of plants
Iodine	It is an essential micronutrient of plants
Phosphate	It is an essential plant nutrient
Calcium	High calcium in the soil is likely to increase the pH of the soil.
Silica	High silica in the soil is likely to reduce the pH of the soil.
Heavy metals	Higher concentration of heavy metals (such as, mercury, cadmium, lead, chromium, zinc, arsenic, nickel, tin, thallium, manganese) can be dangerous to the health or the environment.

Table 7.6: Role of trace elements in biological function & their toxicity (Bowen, 1979)

Element	Biological Function	Phototoxicity (ug/g) Conc in leaf tissue	Mammalian Toxicity	Soil Range mg/Kg
Al	Activates succinic Dehydrogenase	Moderate (50-200)	Low	10,000 to 300,000
As	None in animals phospholipid in algae and fungi	Moderate to high (5-20)	High	3.6 to 8.8
Cd	Not known	Moderate to high (5-30)	High	0.06 to 1.1
Cr	Sugar metabolism on mammals	Moderate to high (5-30)	High	20 to 85
Cu	Essential to all organisms-redox enzymes-oxygen transport pigments	Moderate to high (20-100)	Moderate	14 to 29
Fe	Essential to all organisms-cofactor in many enzymes, proteins	Low (>1000)	Low	50 to 1000
Hg	Non known	High (1-3)	High	0.04 to 0.28
Mn	Essential to all organisms-splits water in photosynthesis	Low to moderate (300 – 500)	Moderate	260 to 840
Mo	Essential to almost all organisms - cofactor in Nitrogen fixation	Moderate (10 – 50)	Moderate	0.35 to 5.8
Ni	Essential to plants	Moderate to high (10 – 100)	Moderate	13 to 30
Pb	Non known	Moderate (10-100)	High	17 to 26
Se	Essential to mammals and plants	Moderate to high (5-30)	High	0.19 to 1.05
Zn	Essential to all organisms	Low to moderate (100-400)	Low moderate	34 to 84

Table 7.7: Micro-nutrient level in ppm (Epstein, 1978)

Elements	Deficiency	Normal	Toxicity	Soil range	Value in study area (64M/06)
Iron (Fe)	Less than 20	20 – 1000	2000 and above	50 – 1000	2.86 - 9.74 wt%
Manganese (Mn)	Less than 90	90 – 200	200 and above	260 – 840	<0.03 - 0.14 wt%
Cobalt (Co)	Less than 25	25 – 60	60 and above	0.5 – 65	6 – 30 ppm
Nickel (Ni)	Less than	100 – N.A.	N.A.	2 – 750	11 – 59 ppm

	100				
Copper (Cu)	Less than 10	10 – 25	25 and above	14 – 29	7 – 40 ppm
Zinc (Zn)	Less than 10	10 – 120	120 and above	34 – 84	<70 – 129 ppm
Boron (B)	Less than 10	10 – 80	80 and above	2 – 130	-
Molybdenum (Mo)	Less than 0.1	0.1 – 90	90 and above	0.35 – 5.8	-

Table 7.8: Average abundance of some important elements in crust, soil and their toxic presence in ppm ('THE MEDICAL GEOLOGY' editor, OlleSelinus et. al. 2005, Elsevier publication)

Element	Crustal Abundance	Soil Abundance	Agricultural soil		Toxic	
			Average	Range	Agriculture	Industrial
Cu	70	30	13-24	1-205	63	100
Zn	80	90	64	17-125	200	360
Pb	16	35	32	3-189	70	600
As	5	6	5.8	<1-95	12	12
Sb	0.2	1	-	-	20	40
Cd	0.2	0.35	0.06-1.1	0.01-2.5	1.4	27
Cr	100	70	54	14-1300	64	87
Co	20	8	10	0.1-70	40	300
Ni	80	50	20	0.2-450	50	50
Mo	1.5	1.2	1.8	0.013-17	5	40
Hg	0.05	0.06	0.03	0.05-0.3	6.6	50
Se	0.05	0.4	0.33	0.005-3.5	1	3.9
V	100	90	58	18-115	130	130
F	650	200	329	10-1360	200	2000
I	0.14	5	2.8	0.1-30		

7.6.4 Human health

Environmental factors affected geographical distributions of human diseases 2,400 years ago and in 300 B.C, Aristotle noted lead poisoning in miners. Rocks and minerals have also been used for thousands of years to treat various diseases. Trace elements enter human body

through food chain. Thus, every day people eat, drink and breathe minerals and trace elements, without knowing what transfers from the environment into their bodies. This interaction with natural materials is harmless, perhaps even beneficial, supplying mankind with essential nutrients. However, for some, the interaction with minerals and trace elements can be devastating or even fatal. The essential trace elements for human beings are calcium, chlorine, magnesium, potassium, sodium, sulphur, chromium, cobalt, copper, fluorine, iron, manganese, molybdenum, zinc and selenium. The elements cadmium, arsenic, mercury, lead and radon are toxic to human health. The deficiency and excess of elements in the body leads to illness. The essential elements for human health and their functions are given in Table 6.10 and elements that are proved to have adverse effects if consumed in excess and its effects are listed in Table 6.11.

Table 7.9: Role of elements for human health

Elements	Functions
Ca, P, Mg, F	Structural functions in bones and membranes.
Na, K, Cl	Maintenance of water and electrolyte balance in cells.
Zn, Cu, Se, Mn, Mo	Essential constituents of enzymes or serve as carriers for ligands essential in metabolism. 'Se' also plays an important protective role in the immune system and in the prevention and suppression of a number of diseases such as carcinomas, cardiovascular disease, cystic fibrosis and low fertility.
Iodine	Essential component of the thyroid hormone thyroxine.
Chromium	Role in glucose tolerance factor.
Iron	The main role of the 'Fe' in the body is in the red blood cell. Here it combines with oxygen to form haemoglobin when we inhale oxygen in our lungs, oxygen is attracted to the iron in the haemoglobin and combines with it to form oxyhemoglobin. This is transported around the body of the blood cells and oxygen is released wherever needed for the nourishment of the cells.
Nickel	The health benefits of nickel include optimal growth, healthy skin and bone structure. It may also be involved in iron metabolism. It is required for metabolism of glucose, liquids, hormones and cell membrane.
Zinc	Zinc is an essential trace element for human, animals and plants. It plays a crucial role in more than 300 enzymes in the body. It is vital for growth and cell division, fertility, immune system, taste, smell and apatite, skin, hair and nails. Zn deficiency leads to diarrhea and pneumonia in children.
Vanadium	At higher intakes vanadium gets accumulated in tissues such as liver, kidney and bones. Knowledge of basic metabolic processes regulating vanadium remains incomplete.
Tin	Tin is an essential nutrient which offers protection throughout the body. It can prevent cancer, digestive problems, skin problems and sleep problems. In

	addition, it can boost energy levels.
Antimony	Higher values of antimony can leave adverse effect on human health as studies on rats have indicated lung, heart, liver and kidney damage due to its high intake.
Cobalt	The main function of cobalt is to prevent anemia. It works with vitamin B12 in the production of red blood cells and to ensure health of the nervous system.
Arsenic	High levels of arsenic can cause skin damage, circulatory system problem and increased cancer risk especially the skin, bladder and lungs.
Cadmium	Cadmium is transported to the liver through the blood. There it is bounded to proteins to form complexes that are transported to the kidneys. Cadmium accumulation in kidney causes damages to its filter mechanism. This causes the excretion of essential proteins and sugar from the body and further kidney damage.
Lead	Most of the dysfunctions of lead are due to lead's ability to mimic and inhabit actions of calcium. Once in blood stream lead is distributed to three main compartments: blood, soft tissues (kidney, bone marrow, liver and brain) and mineralize tissues (bones and teeth). Once lead enters the body it interference with normal cell function and physiological processes.

Table 7.10: Elements and their implications in human health (Epstein, 1978)

Element	Deficiency	Excess
Al	-	Neurological disorder
As	-	Skin damage and circulatory system problem, risk of cancer
B	-	Affects central nervous system, its salts may cause nausea, cramps, convulsions, coma, etc.
Ba	-	Increases blood pressure
Be	-	Berylliosis. Carcinogenic.
Ca	Deficiency causes rickets. (Essential for nervous and muscular systems, cardiac functions and coagulation of blood).	Excess causes concretions in kidney or bladder and irritation in urinary tract.
Cd	-	Acute toxicity may cause renal disorder and arterial hypertension. Cadmium salts causes cramps, nausea, vomiting and diarrhoea.
Co	Anaemia, White liver disease	Heart failure. Polycythaemia
Cr	Disturbances in glucose metabolism (Cr-III)	(Cr-VI) Nephritis, Carcinogenic
Cu	Anaemia, Sway back	Chronic copper poisioning Wilson-Bedlington disease
F	Reduces dental caries.	Very high concentration may cause dental flurosis and crippling skeletal fluorosis

Fe	Anaemia	Haemochromatosis
Hg	-	Causes neurological and renal disturbances. Excess causes gonadotoxic and mutagenic effects and disturbs the cholesterol metabolism
K	An essential nutritional element	Laxative if taken in excess.
Mg	Dysfunction of gonads,Convulsions, Malformations of skeleton, Urolithiasis	Ataxia (loss of full control of bodily movements)
Mn	Essential as a co-factor in enzyme systems and metabolism	Excessive intake causes change in appetite and reduction in metabolism of iron to form haemoglobin.
Na	-	Harmful to persons suffering from cardiac, renal and circulatory diseases.
Ni	-	Allergic dermatitis. Can be carcinogenic; can react with DNA resulting in DNA change.
Pb	-	Toxic in both acute and chronic exposures. Burning in mouth, sever inflammation of the gastrointestinal tract with vomiting and diarrhea. Chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, anaemia, etc.
Sb	-	Increases blood cholesterol, decreases blood glucose
Se	Liver necrosis, Muscular dystrophy, Heart disease, Arthritis	Akali disease, Blind staggers
Zn	Dwarfed growth, Retarded development of gonads, Akrodermatitisenteropathica	Metallic fever Diarrhoea

The contour map of the area showing some anomalies of element Cr, Ni, Nb, Pd, Sr, Th, Zn, Be, Ar, As, Sn in Pakrari, Chalgali, Manikpur,Chemi and north western part of the area. Higher values of Zn upto 333.00 ppm and Pb upto 204 ppm showing in the southern part of the area near Chemi and Pakrari village. Anomaly zone of Ni upto114ppm and Cr upto 387ppm noted in south east of Chemi and south west of Pakrari village. Arsenic (As) showing a higher value upto 22ppm near north east of Chalgali village and western part of the area suggest a contamination in those area which may cause health hazard.

The REE elements such as La, Ce, Pr, Nd, Eu, Sm, Gd, Te, Dy, Er, Yb are showing a similar anomalous zones near Chalgali, Manikpur village and north western part of the area.

Analytical data of soil samples were studied and compared with standard values of concentration of different elements in soil. Chromium shows slight contamination in B2

quadrant within C- Horizon(120 ppm) and for all the other quadrants Cr comes under typical un-contamination category. Ni contamination is observed in C-horizon of A2 (41 ppm). Rest quadrants which comes under typical uncontamination field. All the other elements like Cu, Mn, Pb, U and Zn fall within typical uncontamination field. Comparative study of the elemental variation line diagram of soil samples of different quadrants shows relatively higher values of zirconium in all quadrants with both the horizon. Rb shows higher value in C- horizon of C1 quadrant. Values of La,Ce,Nd shows higher values in all the quadrants.

Micro- nutrient level in soil from agricultural point of view for elements like Co (except in C- horizon of A2) and Ni is less and falls within deficiency field. Micro- nutrient elements like Cu shows toxicity level in soil samples of both horizons of A1(C-horizon),A2(C-horizon),B2(C and R horizons),C1(C-horizon),C2 (C- horizon) .

Table 7.11. Elements showing high value vis-a-vis toxic limit

Elements	Toxic limit (in ppm)	Range of value of elements (in ppm)	Areas of value higher than toxic limit
Cr	64	10-387 ppm	The toxic limit for chromium in agriculture is 64 ppm. The Cr shows higher values exceeding the toxic limit of agriculture. Highest concentration of Cr is reported in SW of Pakrari and SE of Chemi village.
Pb	70	05-204 ppm	The values are exceeds the toxic limit in the South of Pakrari and SE of Chemi village.
Zn	200	35-333 ppm	The values of Zinc exceed the toxic limit in SW of Pakrari and SE of Chemi village.
Ni	50	10-114 ppm	The values of Nickel exceed the toxic limit in SW of Pakrari and SE of Chemi village.
V	130	46-224 ppm	Values of V exceed the toxic limits SE of Chalgali village and eastern part of the study area.
Cu	63	8-31ppm	The values are within the toxic limit.

In the studied area Cr, Ni, and V exceed the toxic limit in SW of Pakrari and SE of Chemi village the toxic limit for agriculture. The adverse effects of these excess values of elements in soil and stream sediment/slope wash are described below:

The values of Zinc exceed the toxic limit in SW of Pakrari and SE of Chemi village. Zn is an airborne pollutant, so in general it majorly accumulates in open and earth crops; however, root crop plants also assimilate great proportion from Zn contaminated soils. High content in seed could act as a starter fertilizer. Plants emerging from seed with low Zn have poor seedling vigor. Nickel is known to be responsible for cancer (oral and intestinal), depression, heart attacks, haemorrhages, kidney dysfunction, low blood pressure, malaise, muscle tremors and paralysis, nausea, skin problems and vomiting.Excess of V in soil causes chlorosis and dwarfing of plants.

The values of Pb are exceeds the toxic limit in the South of Pakrari and SE of Chemi village. Which may toxic in both acute and chronic exposures. Burning in mouth, sever inflammation of the gastrointestinal tract with vomiting and diarrhea. Chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, anaemia, etc.

CHAPTER-8
CONCLUSION AND RECOMENDATION

Geochemical mapping programme for FS 2017-18 was carried out in Survey of India Toposheet No: 64M/06. The main objective of was to develop a geochemical database of 64M degree sheet of Chhattisgarh state using multi elemental analyses and thereby geochemically characterize the abiotic environment in these parts. The work involved collection of samples from different sampling media like stream sediments, soil (C horizon and regolith samples), flowing water, lithology for petrographic studies and sand samples from streams for heavy mineral studies. The density of stream sediment samples was kept 1 sample per sq. km area. For analytical convenience, composite samples were prepared by mixing 250 gm each, sample of 4 adjacent unit cells (of 1 km x 1 km). For soil samples, one sample per 5' x 5' grid was collected between 0-25 cm depth below the top organic layer representing top soil (R) and at 50-200 cm depth representing the 'C' horizon. The size fraction of the stream sediment and soil samples was kept at -120 mesh. Composite and soil samples were sent to the Chemical Division, GSI, Central Region, Nagpur for analysis. Water samples, sand samples for heavy mineral studies, and rock samples for petrographic studies were also collected for every 5' x 5' grid and submitted for analysis. An area of 728 sq km was covered during the course of mapping of toposheet no. 64M/06. A total number of 728 unit cell samples (1 km x 1 km) were collected and from them 182 composite samples representing 2 km x 2 km grid were prepared and submitted for analysis. In addition 09 regolith samples, 09 soil C- horizon samples, 09 water samples, 09 samples for petrographic studies and 09 samples for heavy mineral studies were collected.

The details of sample collected were simultaneously entered in a datasheet. This datasheet has 17 columns of information giving details of geology, soil condition, land form and land use *etc.* It also contains the location of the unit cell sample in DMS located by GPS. The entire chemical data as well as the 17 columns data sheet was fed in MS-Excel sheet. Analytical results of package-A and H of 182 composite samples have been received for toposheet no 64M/06 so far. The analytical result processing and interpretation have been carried out after receiving the results from chemical division CR, Nagpur.

The contour map of the area showing some anomalies of element Cr, Ni, Nb, Pd, Sr, Th, Zn, Be, Ar, As, Sn in Pakrari, Chalgali, Manikpur,Chemi and north western part of the area. Higher values of Zn upto 333.00 ppm and Pb upto 204 ppm showing in the southern

part of the area near Chemi and Pakrari village. Anomaly zone of Ni upto114ppm and Cr upto 387ppm noted in south east of Chemi and south west of Pakrari village. Arsenic (As) showing a higher value upto 22ppm near north east of Chalgali village and western part of the area suggest a contamination in those area which may cause health hazard.

The REE elements such as La, Ce, Pr, Nd, Eu, Sm, Gd, Te, Dy, Er, Yb are showing a similar anomalous zones near Chalgali, Manikpur village and north western part of the area.

Analytical data of soil samples were studied and compared with standard values of concentration of different elements in soil. Chromium shows slight contamination in B2 quadrant within C- Horizon(120 ppm) and for all the other quadrants Cr comes under typical un-contamination category. Ni contamination is observed in C-horizon of A2 (41 ppm). Rest quadrants which comes under typical uncontaminated field. All the other elements like Cu, Mn, Pb, U and Zn fall within typical uncontaminated field. Comparative study of the elemental variation line diagram of soil samples of different quadrants shows relatively higher values of zirconium in all quadrants with both the horizon. Rb shows higher value in C- horizon of C1 quadrant. Values of La, Ce, Nd shows higher values in all the quadrants.

Micro- nutrient level in soil from agricultural point of view for elements like Co (except in C- horizon of A2) and Ni is less and falls within deficiency field. Micro- nutrient elements like Cu shows toxicity level in soil samples of both horizons of A1(C-horizon),A2(C-horizon),B2(C and R horizons),C1(C-horizon),C2 (C- horizon) .

The analytical results of the stream sediment/slope wash samples and soil samples reveal that Cr, Ni and V are above the toxic limit near Pakrari and Chemi village in the Chhotanagpur Gneissic Complex(CGC) This can harm the agriculture/crop due to reduction of photosynthesis in the plant. As the final produce of agriculture is consumed by human/animals, indirectly the excess of these elements can result in to heart attack, cancer, kidney problems, hypertension, low blood pressure, paralysis, skin problems etc.

The values of Zinc exceed the toxic limit in SW of Pakrari and SE of Chemi village. Zn is an airborne pollutant, so in general it majorly accumulates in open and earth crops; however, root crop plants also assimilate great proportion from Zn contaminated soils. High content in seed could act as a starter fertilizer. Plants emerging from seed with low Zn have poor seedling vigor. Nickel is known to be responsible for cancer (oral and intestinal), depression, heart attacks, haemorrhages, kidney dysfunction, low blood pressure, malaise,

muscle tremors and paralysis, nausea, skin problems and vomiting. Excess of V in soil causes chlorosis and dwarfing of plants.

The values of Pb are exceeds the toxic limit in the South of Pakrari and SE of Chemi village. Which may toxic in both acute and chronic exposures. Burning in mouth, sever inflammation of the gastrointestinal tract with vomiting and diarrhea. Chronic toxicity produces nausea, severe abdominal pain, paralysis, mental confusion, visual disturbances, anaemia, etc.

Recommendation:

The REE elements such as La, Ce, Pr, Nd, Eu, Sm, Gd, Te, Dy, Er, Yb are showing a similar anomalous zones near Chalgali, Manikpur village and north western part of the area in the Chhotanagpur Gneissic Complex(CGC) whether the anomalies noticed are important in economic point of view is to be taken up for further study.

LOCALITY INDEX OF T.S. No. 64 M/6

LOCALITY	LATITUDE	LONGITUDE
Alka	23°42'41.736"N	83°21'4.775"E
Amartipur	23°41'24.368"N	83°23'29.507"E
Amartipur	23°41'15.647"N	83°23'35.751"E
Bachrajkunwar Temple	23°42'37.025"N	83°25'6.98"E
Bada	23°34'50.817"N	83°26'8.013"E
Barauli	23°39'8.27"N	83°26'45.635"E
Barkagaon	23°38'49.168"N	83°19'32.475"E
Belia	23°38'59.224"N	83°21'22.866"E
Belkudri	23°38'48.123"N	83°27'58.412"E
Berini Pahar	23°41'28.282"N	83°27'13.972"E
Bhagwanpur	23°37'53.06"N	83°15'43.976"E
Bhairopur	23°32'1.637"N	83°15'18.92"E
Bhawankhar	23°37'19.867"N	83°18'36.368"E
Bhedari	23°30'5.996"N	83°21'9.7"E
Burhatand	23°40'40.098"N	83°16'35.158"E
Chalgali	23°36'31.408"N	83°22'22.28"E
Champapur	23°34'57.087"N	83°28'5.976"E
Chandaura	23°33'55.994"N	83°22'34.504"E
Charangora	23°32'43.76"N	83°18'11.265"E
Chattani	23°34'29.402"N	83°15'54.041"E
Chemi	23°31'32.426"N	83°16'32.562"E
Chitma	23°31'52.963"N	83°22'28.354"E
Dabra	23°31'31.188"N	83°26'49.567"E
Daldaliya	23°31'58.342"N	83°29'35.32"E
Dhanwar	23°36'12.683"N	83°27'14.194"E
Dharhia	23°41'49.269"N	83°20'1.6"E
Dhorhi	23°40'46.094"N	83°15'25.344"E
Domarkhola	23°32'34.5"N	83°26'10.172"E
Dongru	23°38'30.031"N	83°21'49.387"E
Fatehpur	23°32'14.549"N	83°22'16.404"E
Gamnha	23°35'37.93"N	83°25'26.896"E
Garhauli	23°41'30.638"N	83°21'41.394"E
Ghaghra	23°32'50.081"N	83°28'10.516"E
Haraiya Pahar	23°30'21.843"N	83°28'24.213"E
Hasuwatand	23°40'15.042"N	83°17'23.128"E
Injani	23°39'24.074"N	83°16'1.322"E
Jabarpara	23°39'56.197"N	83°18'42.792"E
Jhalariya	23°32'58.99"N	83°29'44.572"E
Jhurli	23°41'3.012"N	83°19'49.179"E
Juba Pahar	23°44'24.529"N	83°28'33.208"E
Kachia	23°42'5.545"N	83°20'25.585"E
Kadaikhala R.F.	23°30'34.049"N	83°24'5.518"E
Kadaura	23°31'56.603"N	83°23'41.808"E
Kajra Pahar	23°39'36.495"N	83°25'54.736"E
Kandia	23°40'1.722"N	83°23'52.121"E
Kannapara	23°37'25.649"N	83°15'5.643"E
Kapot	23°34'47.819"N	83°24'8.088"E
Karamdiha	23°32'34.662"N	83°24'36.193"E
Karri	23°31'53.52"N	83°17'13.701"E
Kerta	23°40'6.451"N	83°27'13.389"E
Kharsota	23°31'18.379"N	83°29'1.047"E

LOCALITY	LATITUDE	LONGITUDE
Khobi	23°37'3.069"N	83°24'9.39"E
Kotadih	23°30'38.507"N	83°25'5.489"E
Kotarki	23°40'21.047"N	83°27'47.105"E
Kuchli	23°31'23.992"N	83°27'31.712"E
Kutsari	23°30'10.753"N	83°25'1.378"E
Lipri	23°32'40.547"N	83°20'45.068"E
Lolki	23°33'36.935"N	83°15'10.996"E
Lurgi	23°32'17.034"N	83°20'48.281"E
Makro	23°32'15.363"N	83°19'8.443"E
Manikpur	23°40'37.905"N	83°29'32.365"E
Manpura	23°43'8.933"N	83°23'6.413"E
Mukha	23°30'38.507"N	83°26'13.59"E
Nawapara	23°39'14.223"N	83°18'39.152"E
Odari	23°40'40.741"N	83°18'18.593"E
Pandauli	23°39'40.958"N	83°22'21.252"E
Parsapani	23°38'32.087"N	83°29'35.654"E
Pathri	23°34'43.382"N	83°27'13.081"E
Rampur	23°35'29.364"N	83°22'24.225"E
Ranhat	23°32'35.151"N	83°18'46.985"E
Ranhat Pahar	23°33'51.283"N	83°19'21.125"E
Saraswatipur	23°33'52.568"N	83°21'33.899"E
Sarbahrapara	23°41'5.154"N	83°17'39.832"E
Sardapur	23°37'50.062"N	83°17'54.822"E
Sautar	23°30'10.984"N	83°15'54.529"E
Semar Kadra	23°31'45.296"N	83°25'29.055"E
Semra	23°30'9.099"N	83°16'41.814"E
Silonta	23°30'15.01"N	83°17'45.481"E
Sinduria Pahar	23°42'40.88"N	83°19'36.758"E
Sursa	23°37'16.44"N	83°17'2.783"E
Sursa Pahar	23°35'51.636"N	83°16'56.145"E
Tolkipara	23°36'46.031"N	83°17'50.753"E

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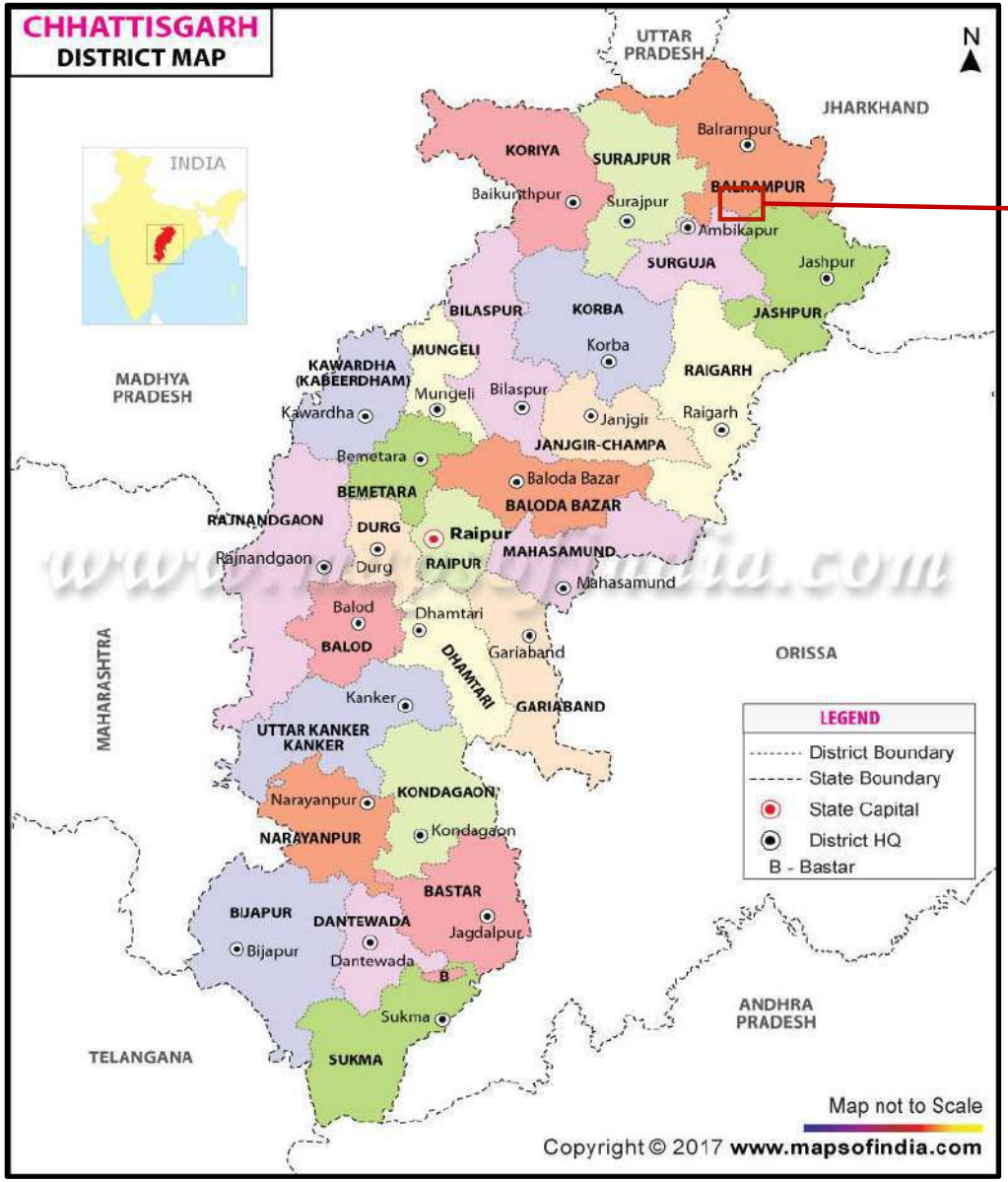
- Radhakrishna T.S.; Geological Survey of India Progress report, geology of a part of Surajpur Tahsil, Surguja District, Madhya Pradesh, F.S. 1965–66.
- Saxena R.K., Prasad J. M.; Report on the geothermal investigation of the Tattapani - Jhor hot spring belt in Surguja district, Madhya Pradesh in T.S. no.64 M/6 and M/10, F.S. 1982 -83.
- Standard Operational Procedure for National Geochemical Mapping in India.

Plate 1: Location Map for FS 2017-18



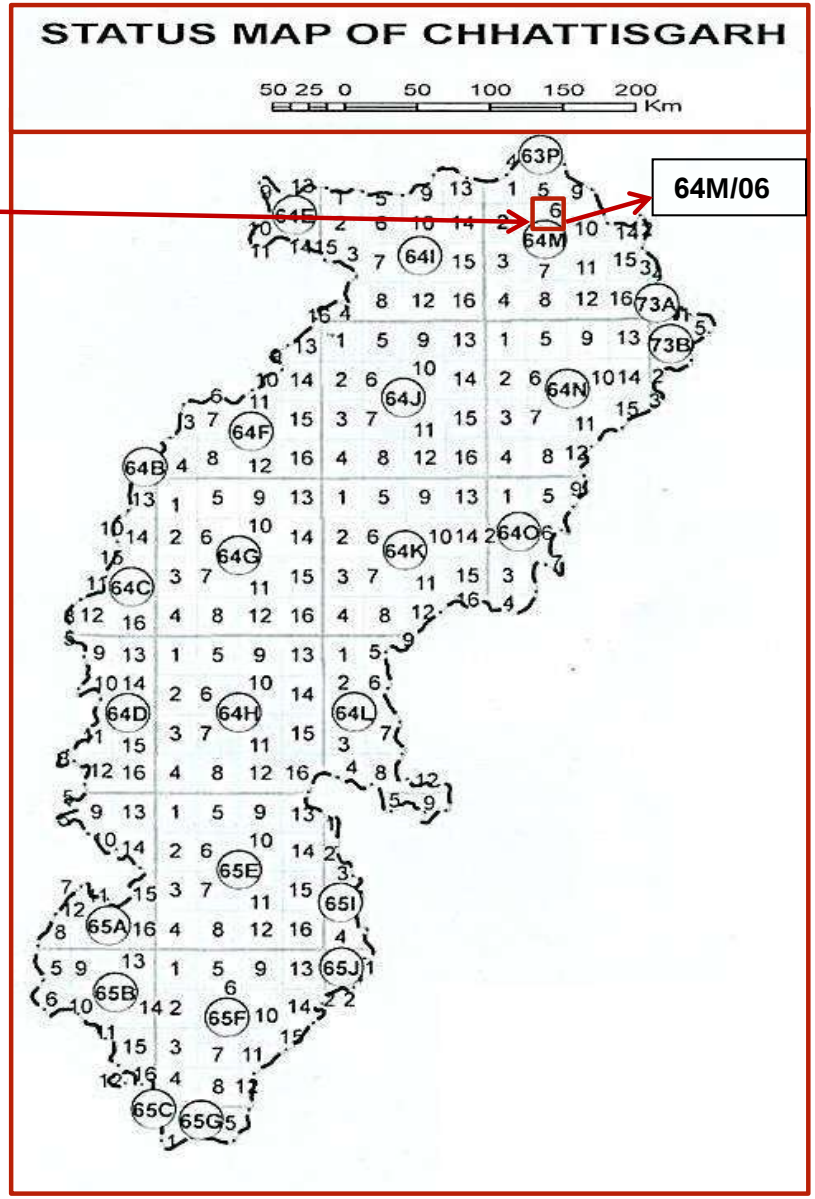
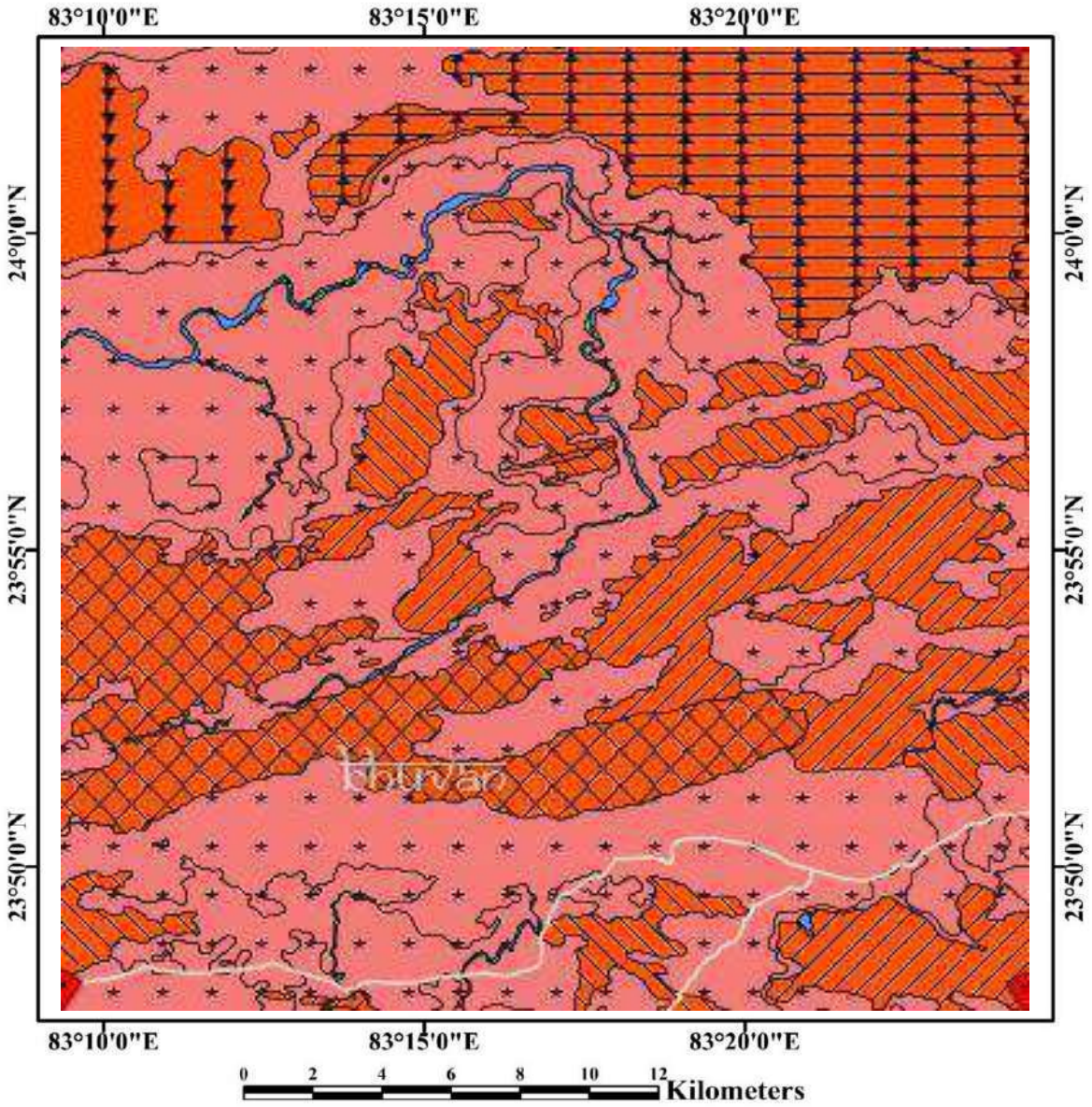


Plate 2: Geomorphological map of T.S. No. 64M/6



Geomorphology
Structural Origin-Highly Dissected Hills and Valleys
Structural Origin-Moderately Dissected Hills and Valleys
Structural Origin-Low Dissected Hills and Valleys
Structural Origin-Highly Dissected Upper Plateau
Structural Origin-Moderately Dissected Upper Plateau
Structural Origin-Moderately Dissected Lower Plateau
Structural Origin-Low Dissected Upper Plateau
Structural Origin-Low Dissected Lower Plateau
Denudational Origin-Highly Dissected Hills and Valleys
Denudational Origin-Moderately Dissected Hills and Valleys
Denudational Origin-Low Dissected Hills and Valleys
Denudational Origin-Highly Dissected Upper Plateau
Denudational Origin-Moderately Dissected Upper Plateau
Denudational Origin-Pediment-PediPlain Complex
Fluvial Origin-Active Flood Plain
Anthropogenic Origin-Anthropogenic Terrain
Waterbodies

Plate 3: Drainage map of T.S. No. 64M/6 with actual unit cell and different sample media locations

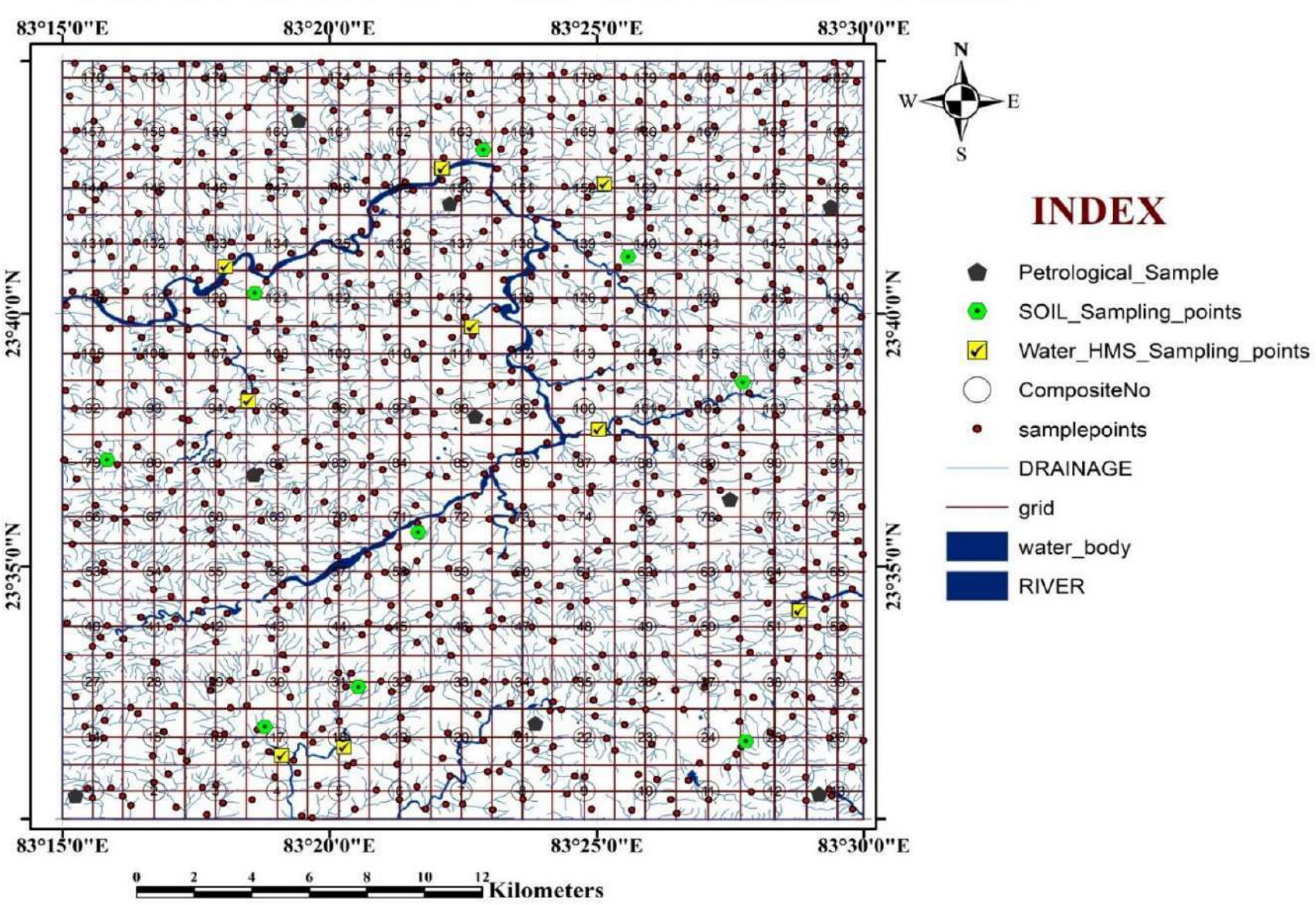


Plate 4: Land use and Land Cover map of T.S. No. 64M/6

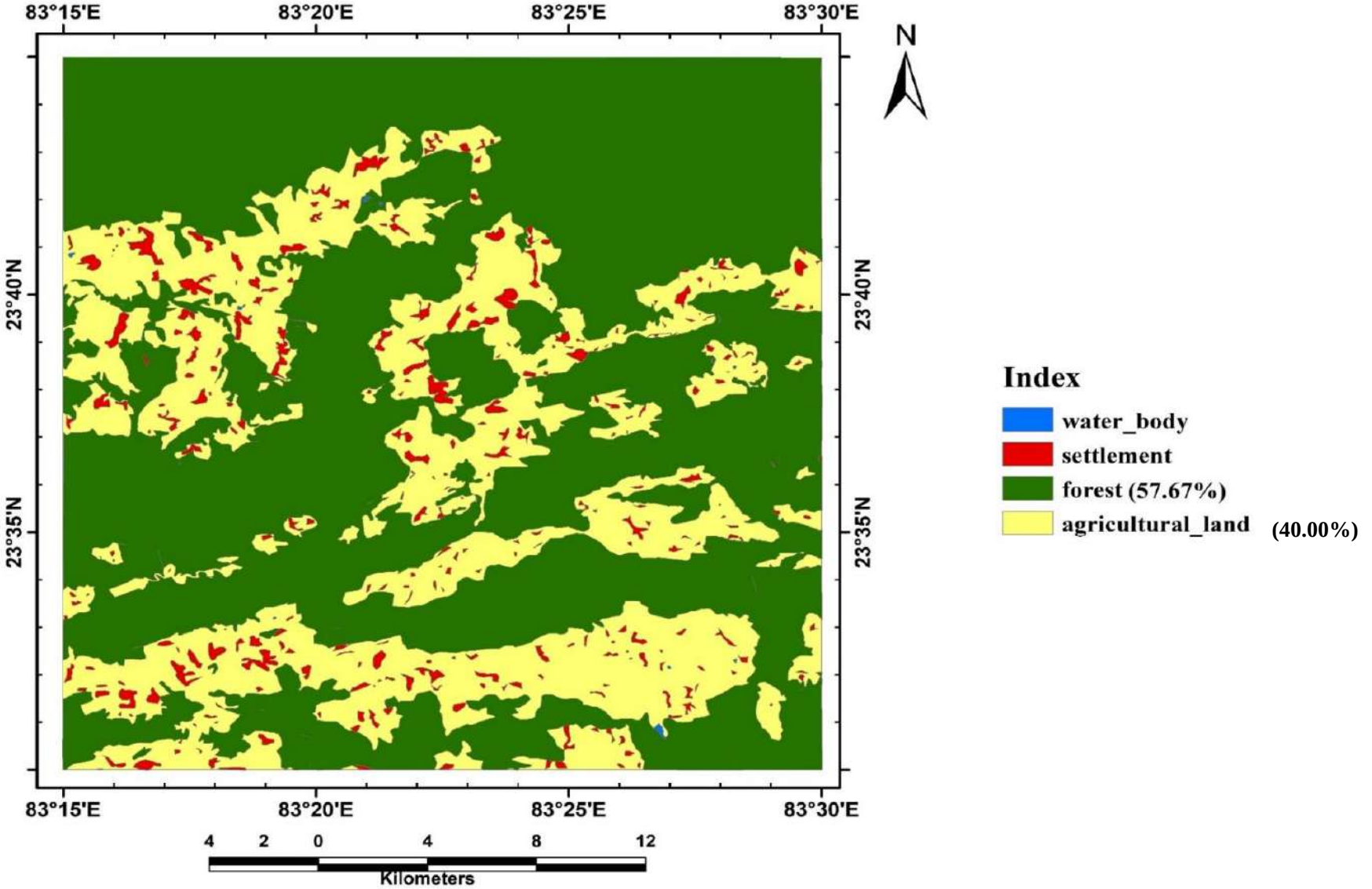
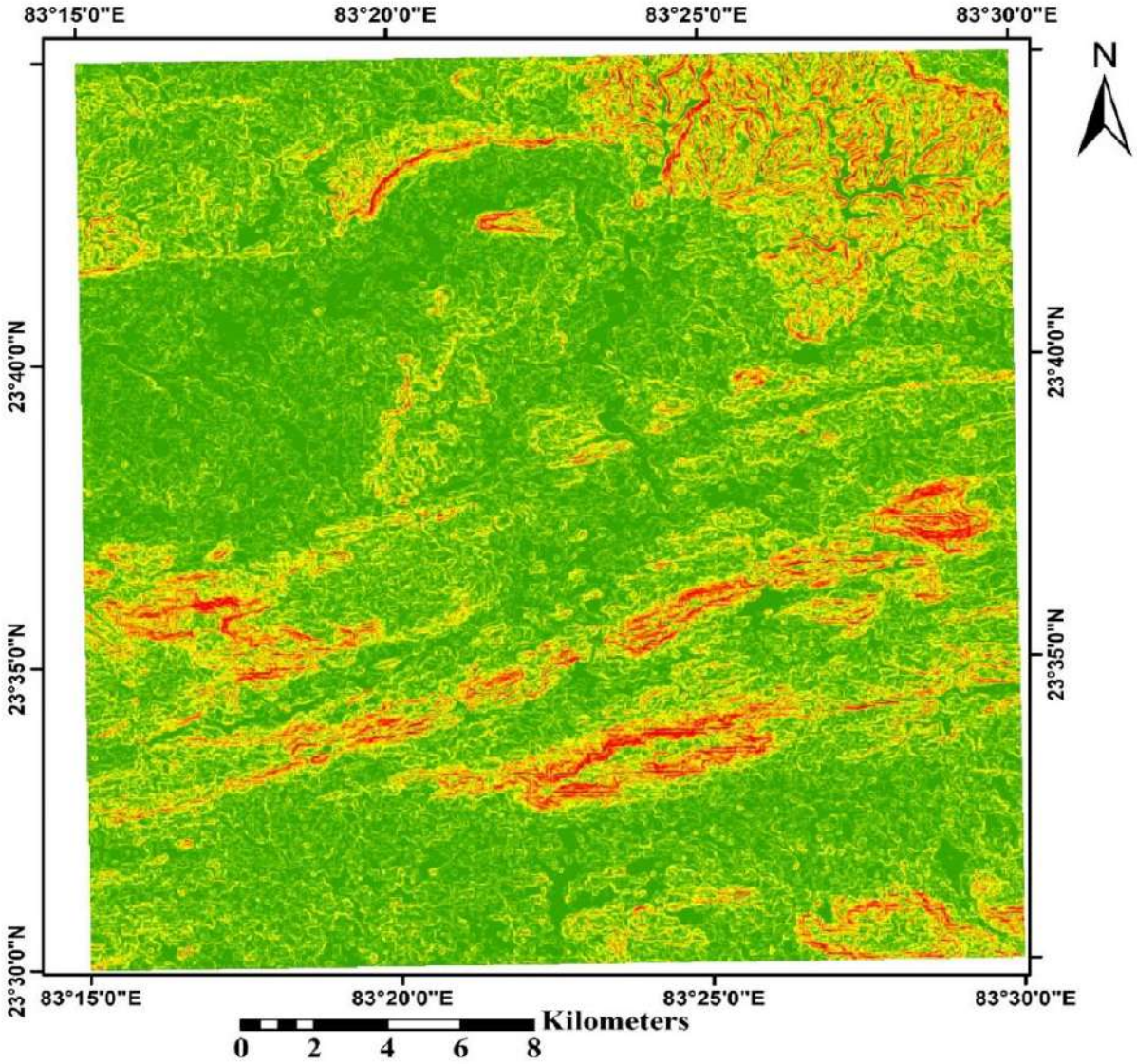


Plate 5: Slope map of T.S. No. 64M/06



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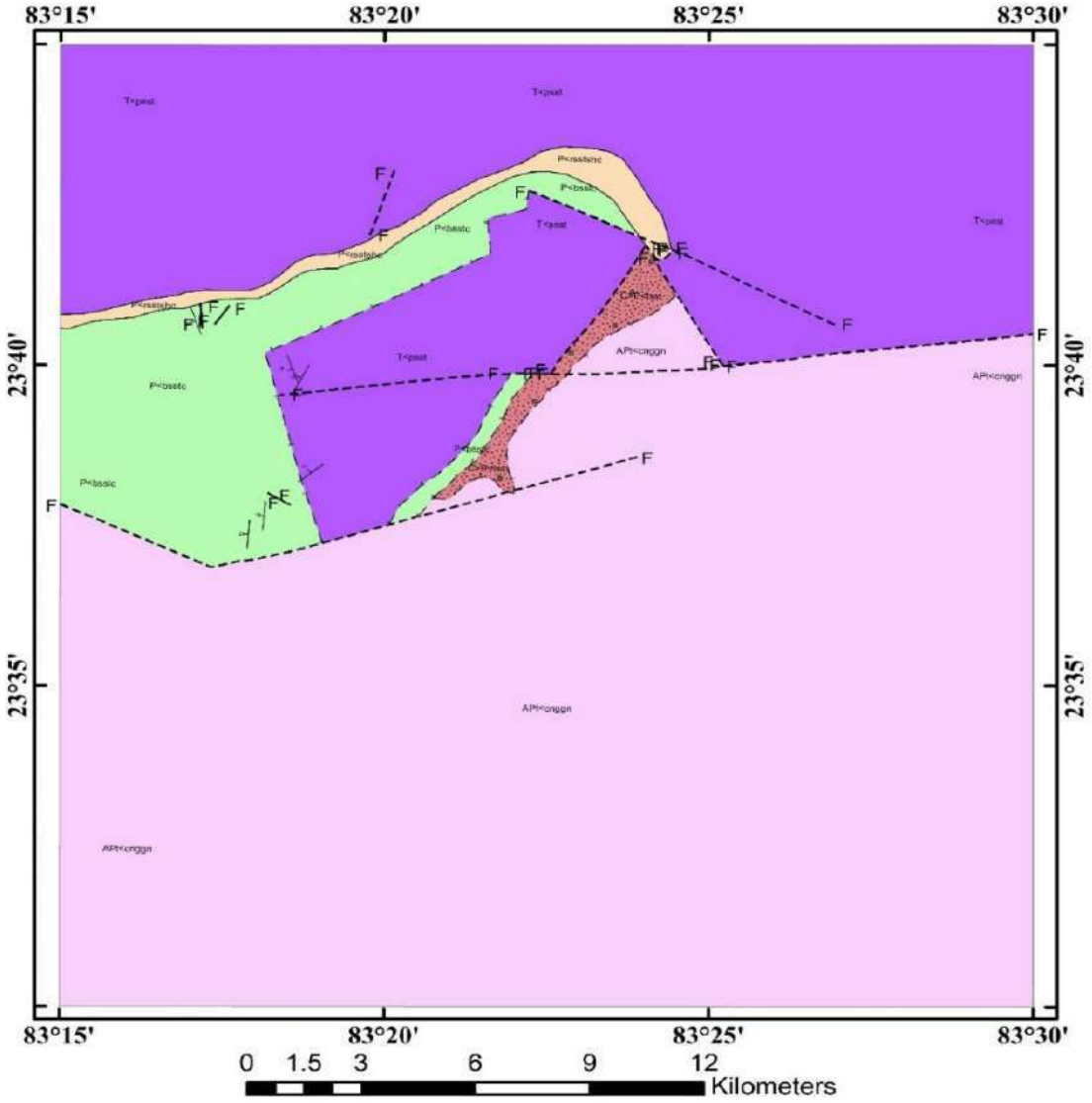
- 0° - 3.0°
- 3.0° - 6.0°
- 6.0° - 9.0°
- 9.0° - 12.0°
- 12.0° - 16.0°
- 16.0° - 21.0°
- 21.0° - 26.0°
- 26.0° - 32.0°
- 32.0° - 53.0°

High : 1028 meters

Low : 444 meters

Plate 6: Geological map of T.S. No. 64M/06



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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- F-----F Inferred Fault
- F——F Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

Source: Geodata Division

Plate 7: Field Photographs

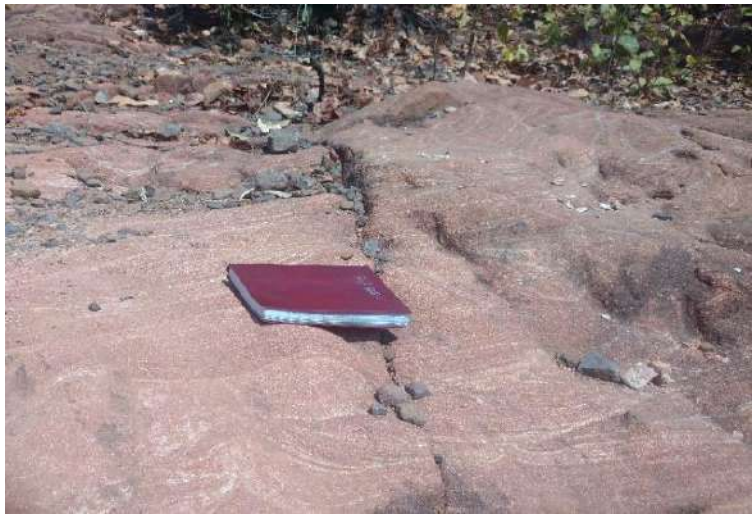
a. Stream sediment sample collection from Unit Cell 044D

b. Slope Wash sample collection from Unit Cell 025C

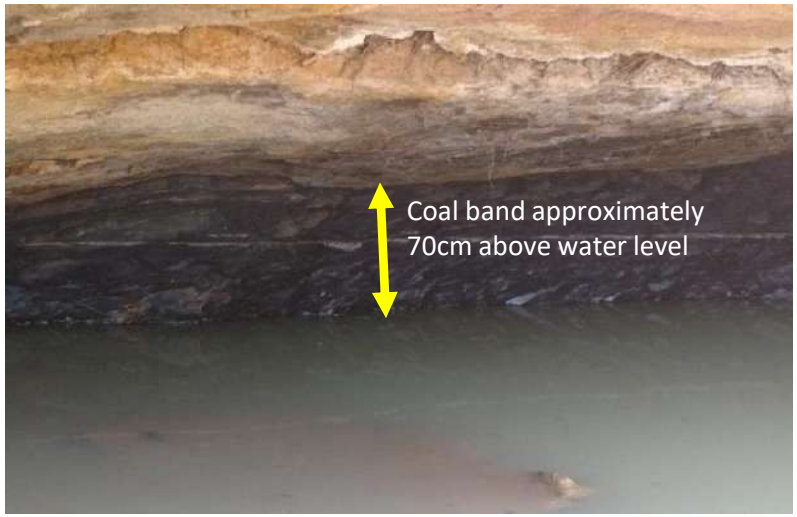
c. Water sample collection in A2 quadrant

d. HMS collection in C3 quadrant

Plate 8:Field Photographs



a. Seismites in Sandstone north of Manikpur



b. Coal band reported near Pandauli village

c. Calc-Silicate near Parsapani village in unit cell no. 104C

d. Inspection of Graphite schist near Bhawankhar village by Supervisory officer

Plate 9: Field Photographs

a. Pegmatite vein in granite gneiss NW of Daldaliya village

b. Granite gneiss near Dudhaniya nala

c. Cross bedding in sandstone in unit cell no. 146C

d. Non-Conformity between CGC and Lower Gondwana Group

Plate 10: Field Photographs

a. Pegmatite vein in unit cell no. 0004B

b. Augen structure in Granite Gneiss in unit cell no. 089D

c. Calc-silicate in in unit cell no. 043A

d. Banded gneiss in unit cell no. 075B

Plate 11: Field Photographs

a. Gneissosity in unit cell no. 025D

b. Fold in unit cell no. 045C

c. Cross bedding in sandstone in unit cell no. 140D

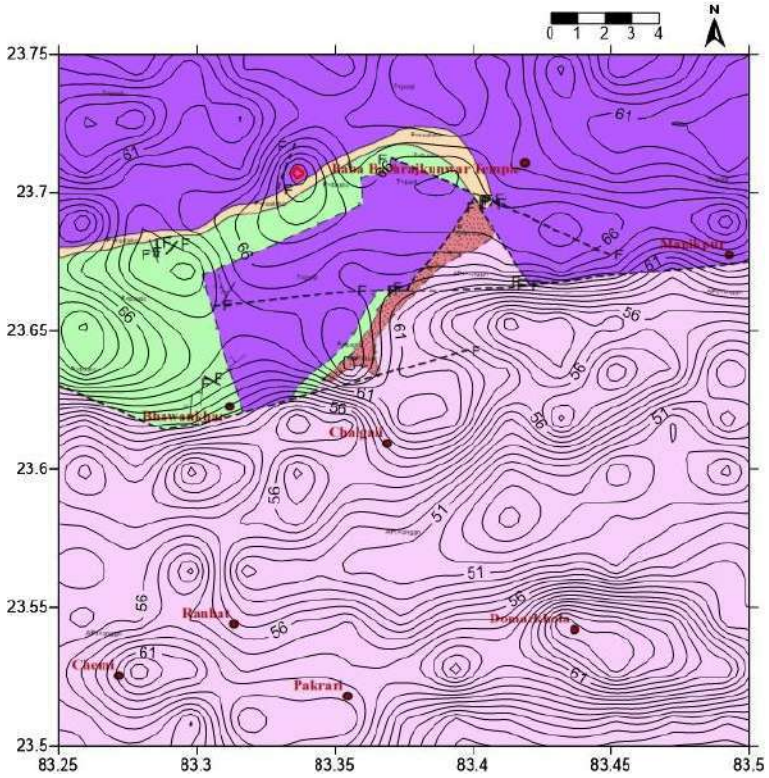
d. Joint and Fracture in granite

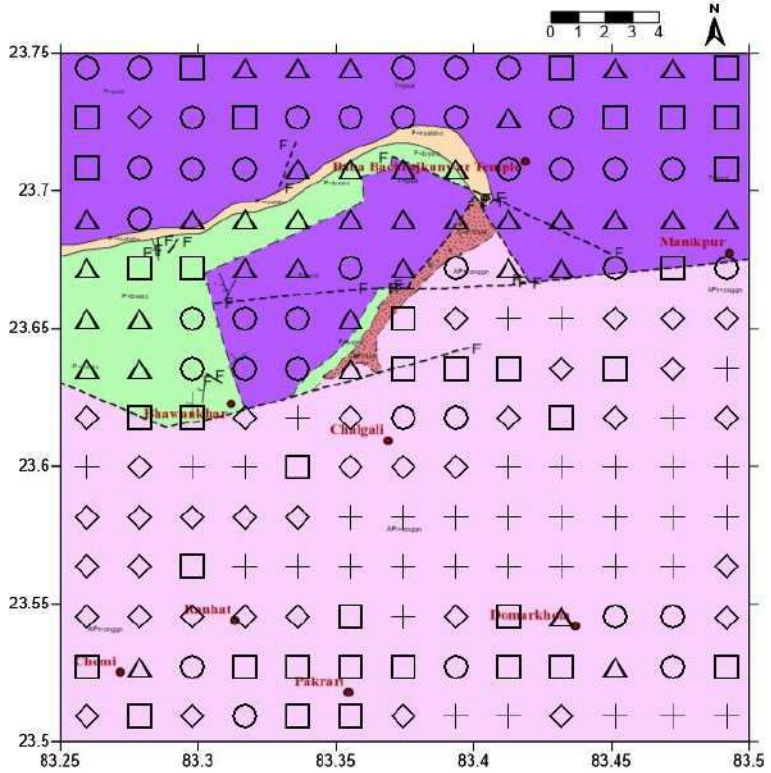
Plate 12: Field Photographs

a. Graphite schist in unit cell no. 082D

b. CGC Gondwana non-conformity near Pandauli village

Plate 13: Geochemical distribution and classed post map of SiO_2 in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of SiO_2

Mean	58.97	Range	24.97
Standard Error	0.42	Minimum	46.36
Median	59.69	Maximum	71.33
Mode	55.34	Sum	10732.04
Standard Deviation	5.73	Count	182
Sample Variance	32.86	Threshold Value	70.43
Kurtosis	-0.94	UCC Average	66.62
Skewness	-0.18		

Histogram of SiO_2

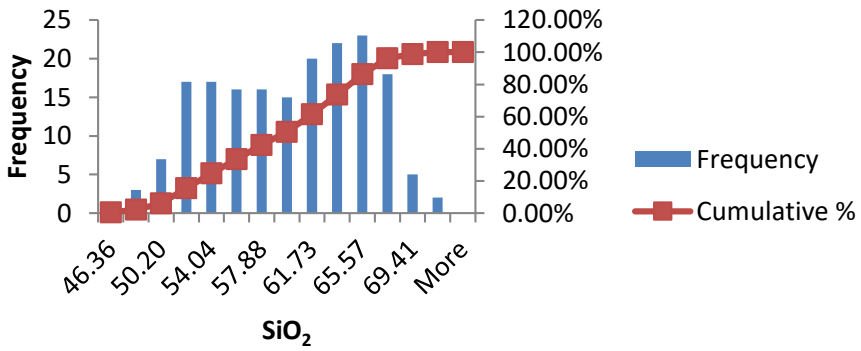
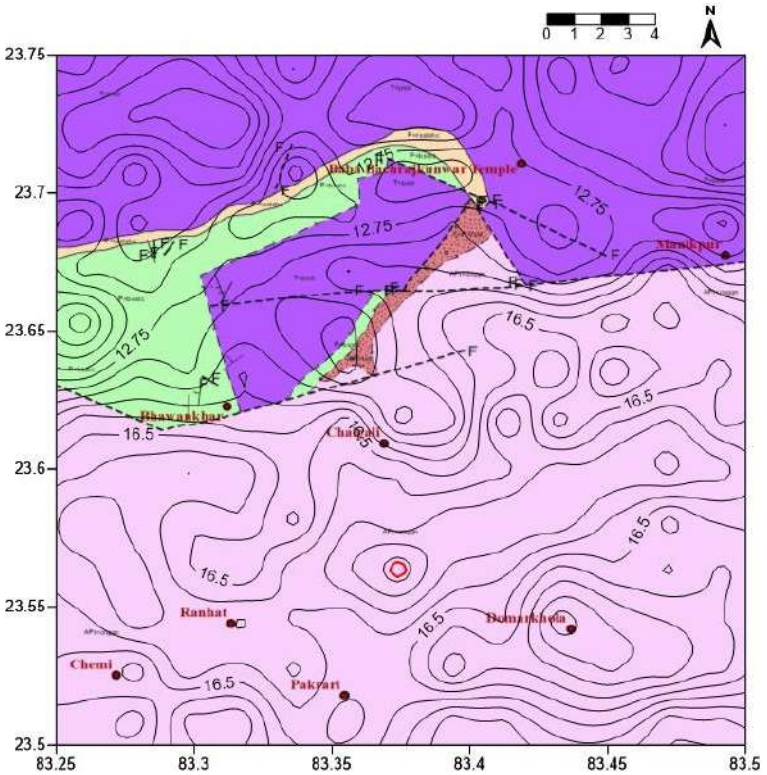
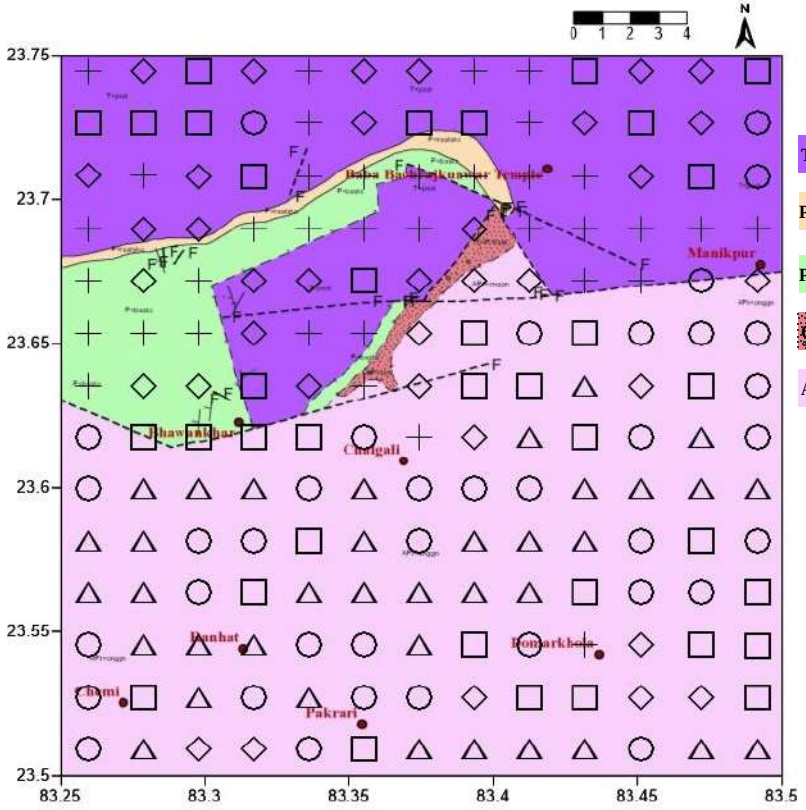


Plate 14: Geochemical distribution and classed post map of Al_2O_3 in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

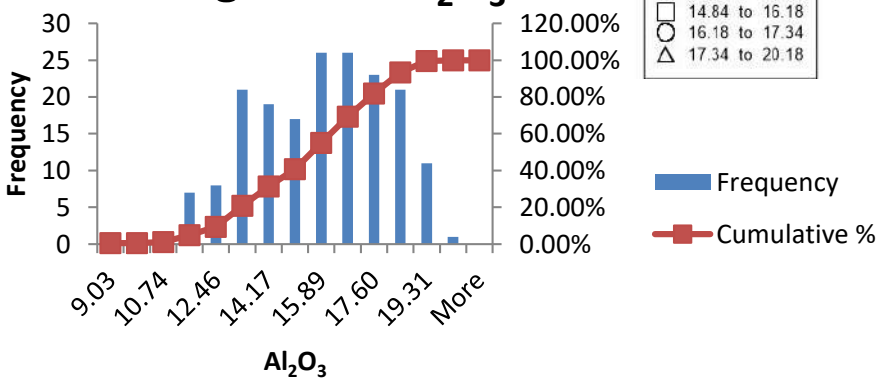
INDEX

Above threshold value

Below threshold value

Values in Wt.%
- 9.03 to 13.31
- 13.31 to 14.84
- 14.84 to 16.18
- 16.18 to 17.34
- 17.34 to 20.18

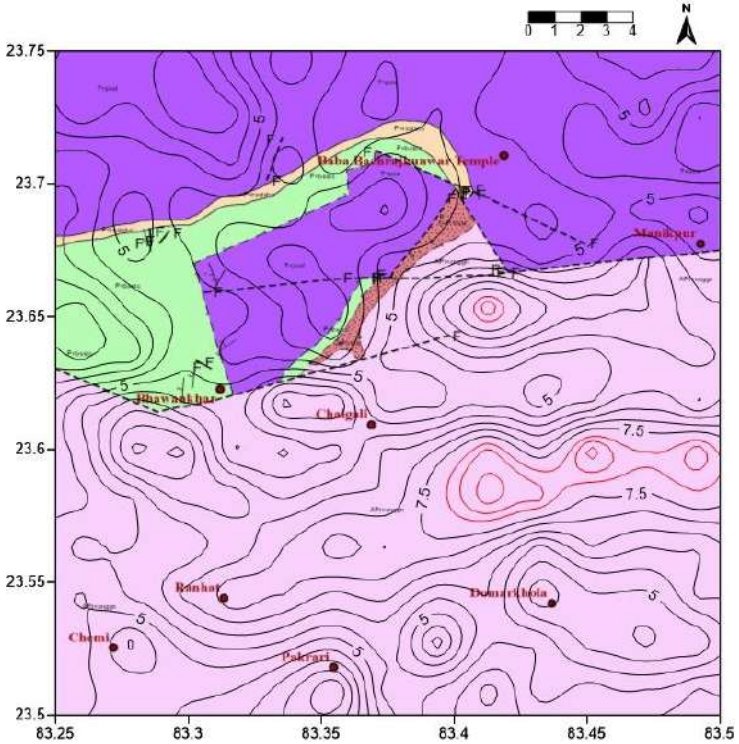
Histogram of Al_2O_3

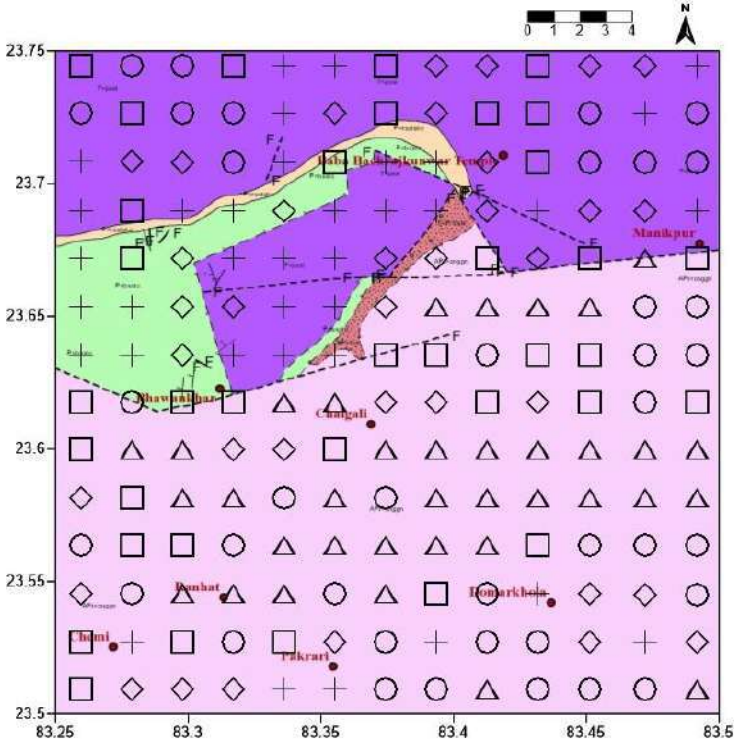


Statistical parameters of Al_2O_3

Mean	15.38	Range	11.14
Standard Error	0.16	Minimum	9.03
Median	15.61	Maximum	20.17
Mode	15.77	Sum	2799.30
Standard Deviation	2.19	Count	182
Sample Variance	4.78	Threshold Value	19.75
Kurtosis	-0.56	UCC Average	15.40
Skewness	-0.27		

Plate 15: Geochemical distribution and classed post map of Fe_2O_3 in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

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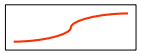
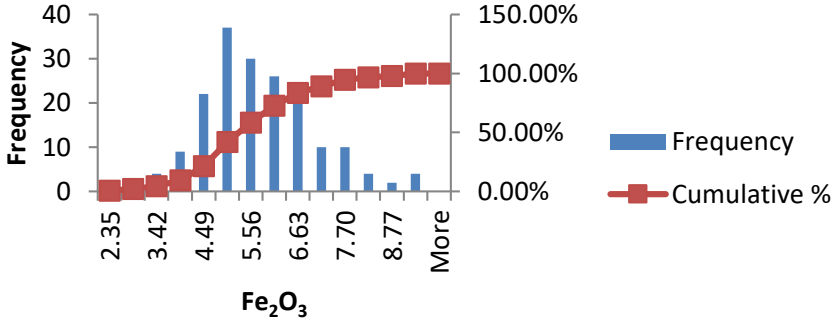


Above threshold value

Below threshold value

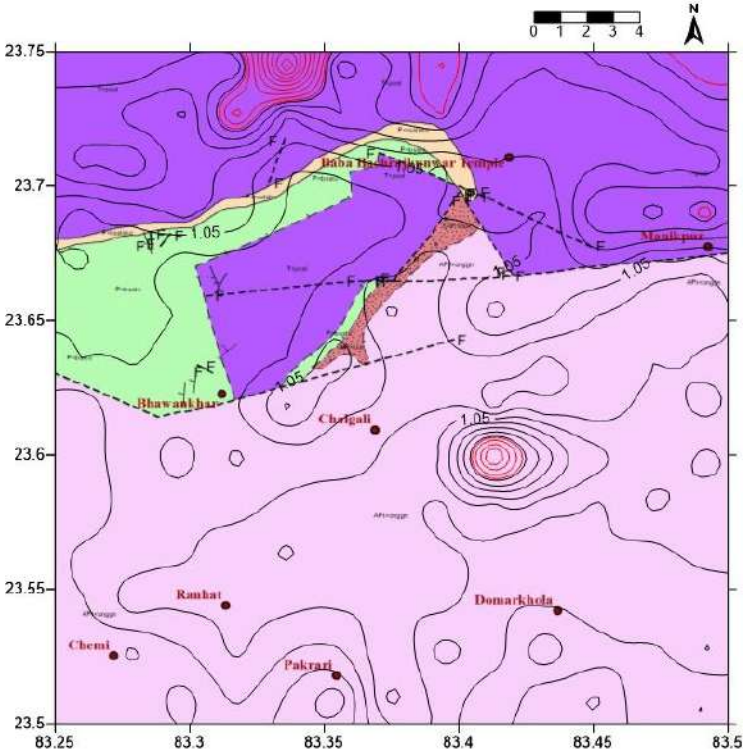
Histogram of Fe_2O_3

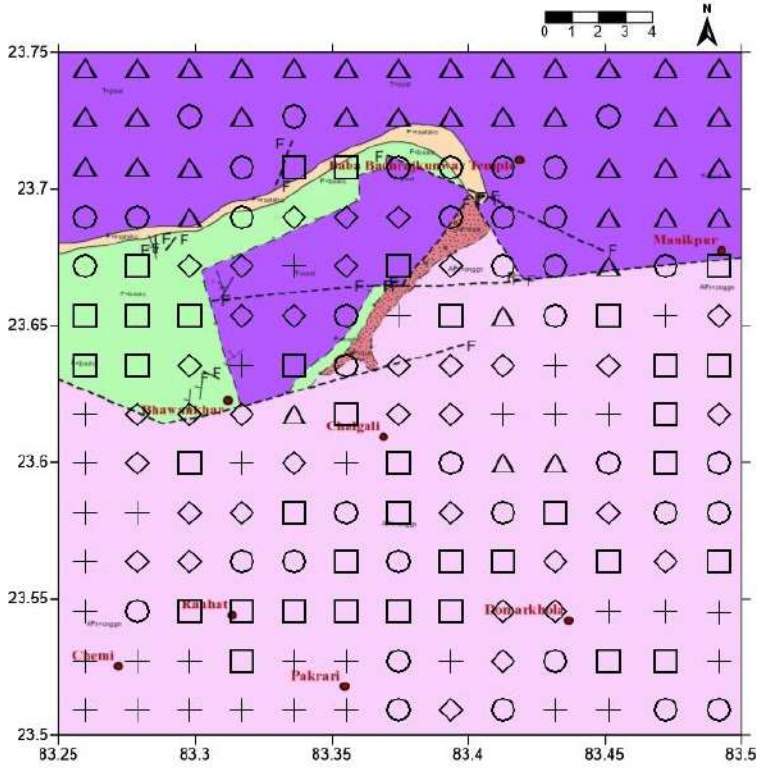


Statistical parameters of Fe_2O_3

Mean	5.47	Range	6.96
Standard Error	0.10	Minimum	2.35
Median	5.32	Maximum	9.31
Mode	4.96	Sum	995.58
Standard Deviation	1.31	Count	182
Sample Variance	1.73	Threshold Value	8.10
Kurtosis	0.38	UCC Average	5.04
Skewness	0.50		

Plate 16: Geochemical distribution and classed post map of TiO_2 in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of TiO_2

Mean	1.03
Standard Error	0.02
Median	0.94
Mode	0.88
Standard Deviation	0.33
Sample Variance	0.11
Kurtosis	8.71
Skewness	2.22

Range	2.73
Minimum	0.35
Maximum	3.08
Sum	188.25
Count	182
Threshold Value	1.70
UCC Average	0.64

Histogram of TiO_2

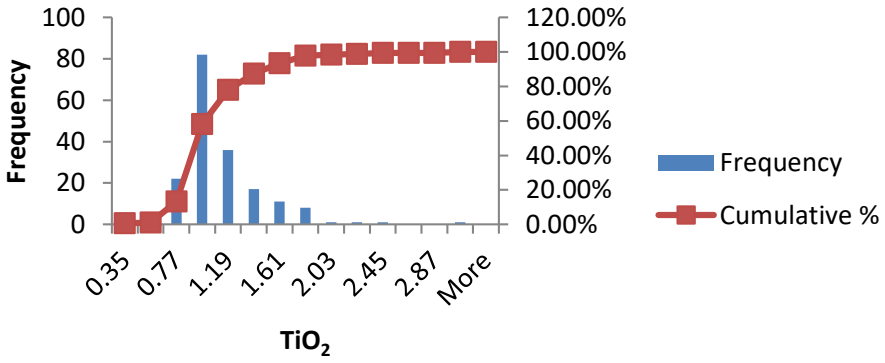
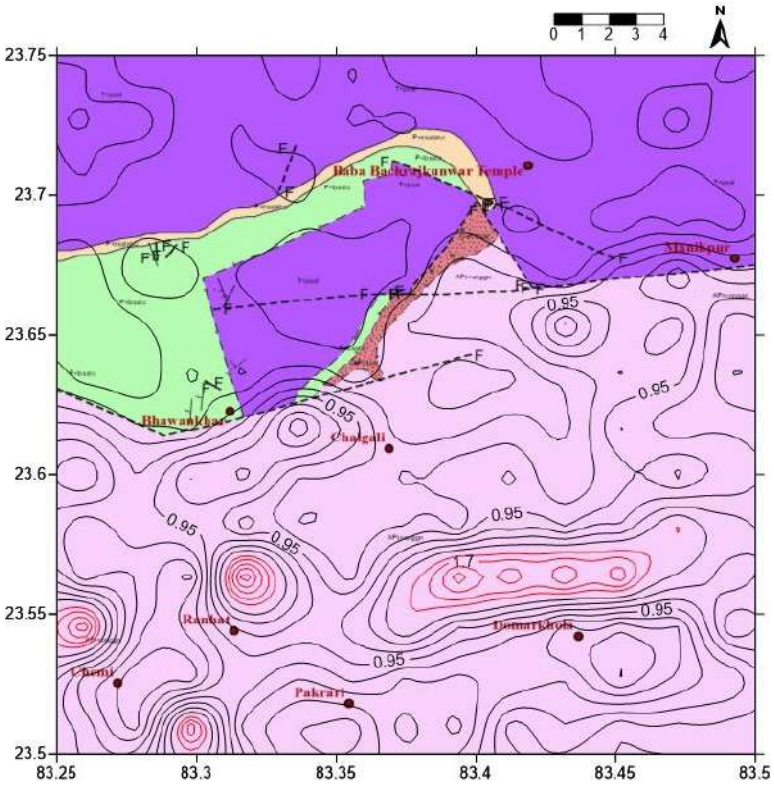
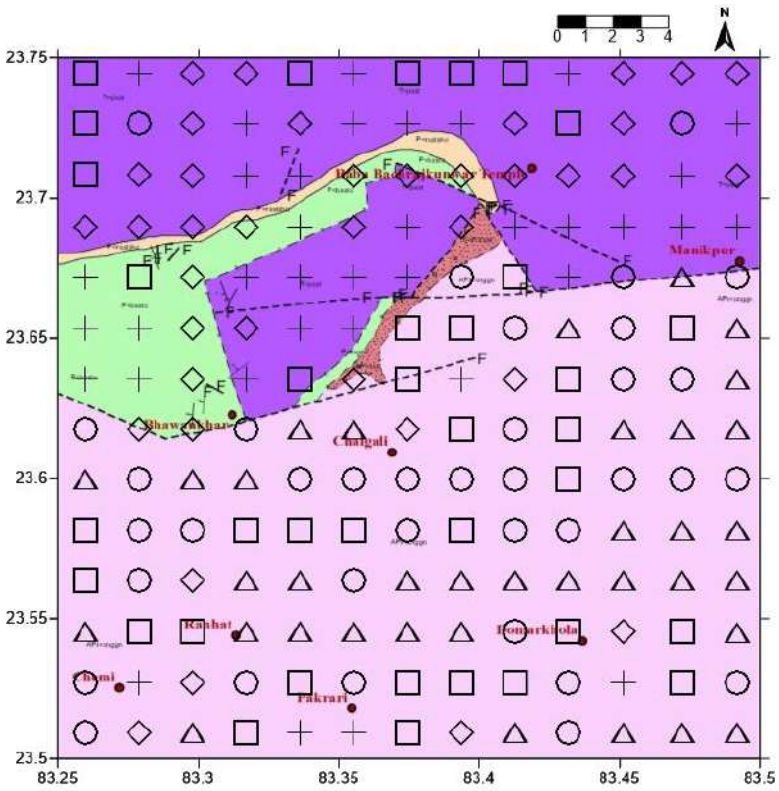


Plate 17: Geochemical distribution and classed post map of CaO in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in Wt.%
- 0.21 to 0.4
- 0.4 to 0.56
- 0.56 to 0.74
- 0.74 to 1.04
- 1.04 to 2.321

Statistical parameters of CaO

Mean	0.74
Standard Error	0.03
Median	0.64
Mode	0.35
Standard Deviation	0.42
Sample Variance	0.18
Kurtosis	2.19
Skewness	1.44

Range	2.11
Minimum	0.21
Maximum	2.32
Sum	134.03
Count	182
Threshold Value	1.58
UCC Average	3.59

Histogram of CaO

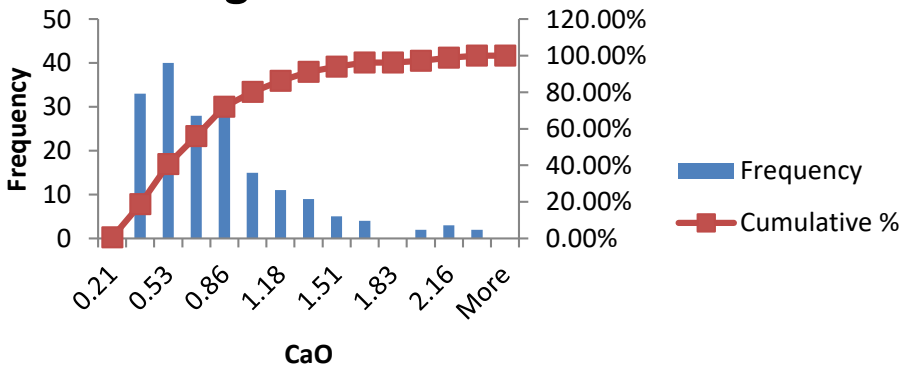
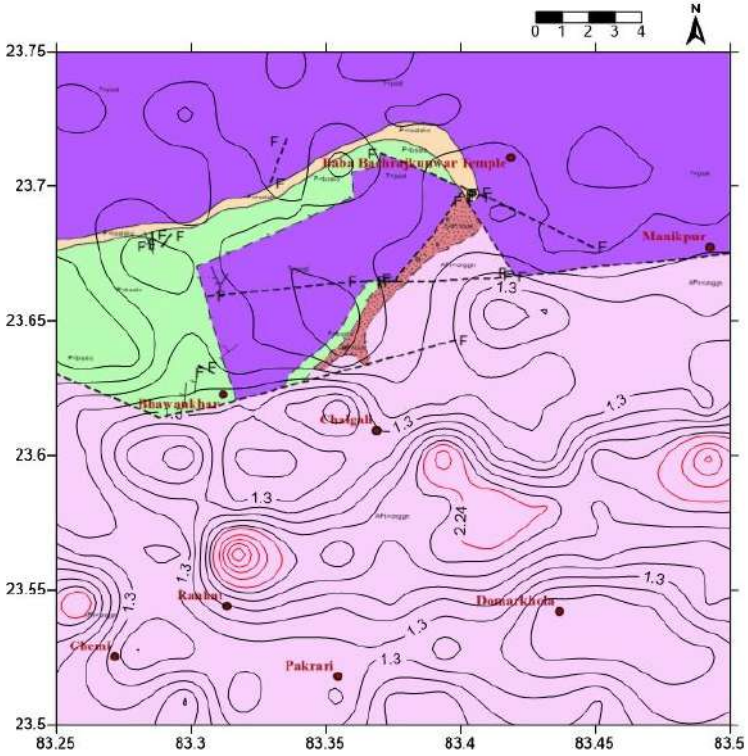
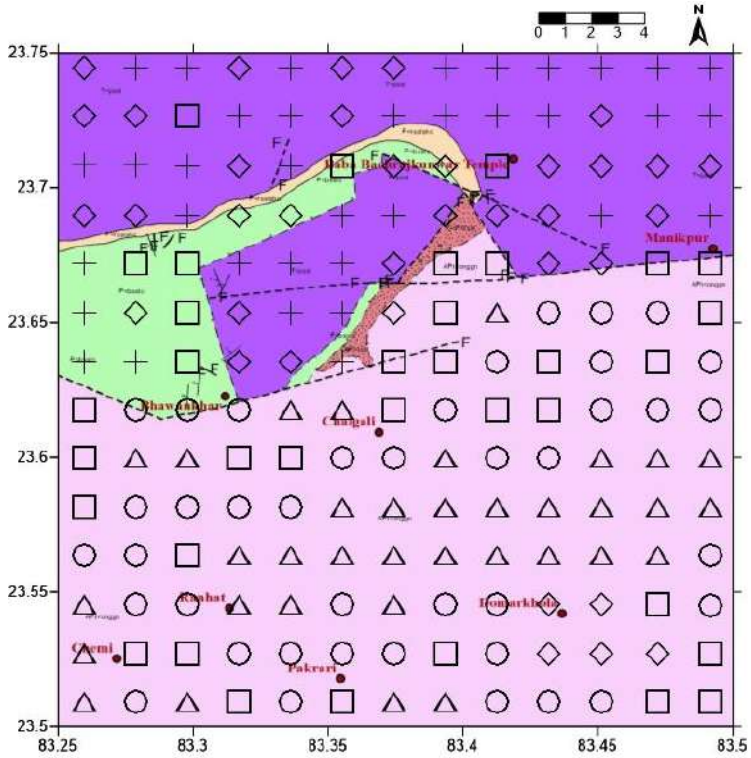


Plate 18: Geochemical distribution and classed post map of MgO in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

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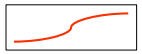
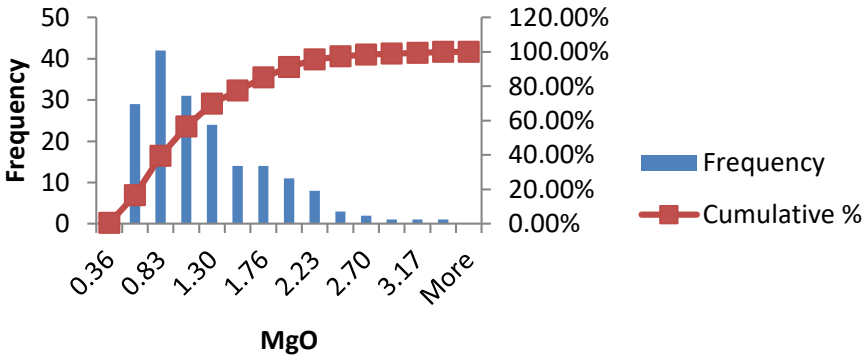


Above threshold value

Below threshold value

Histogram of MgO

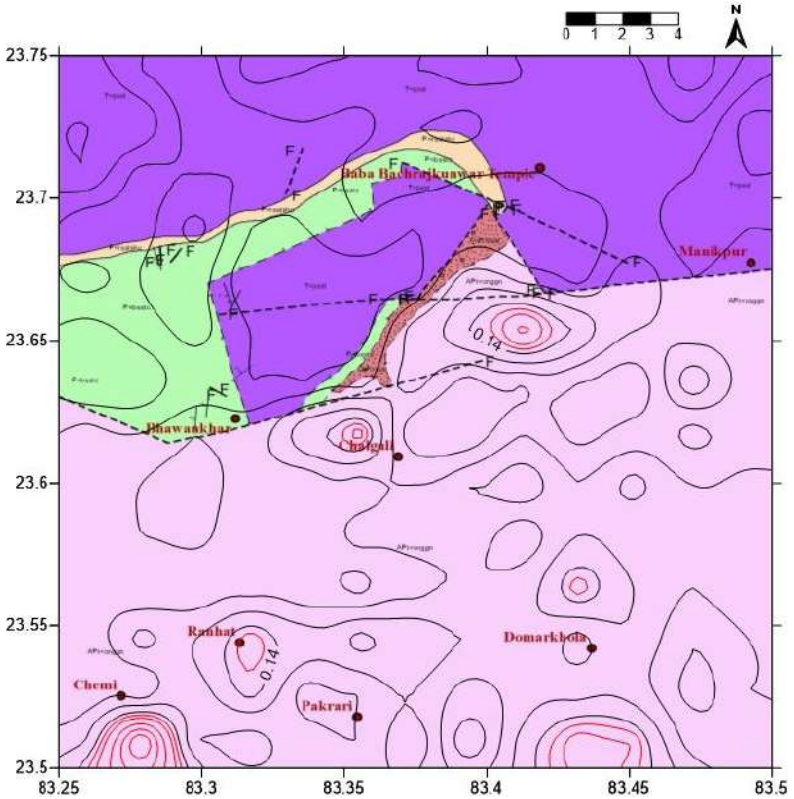


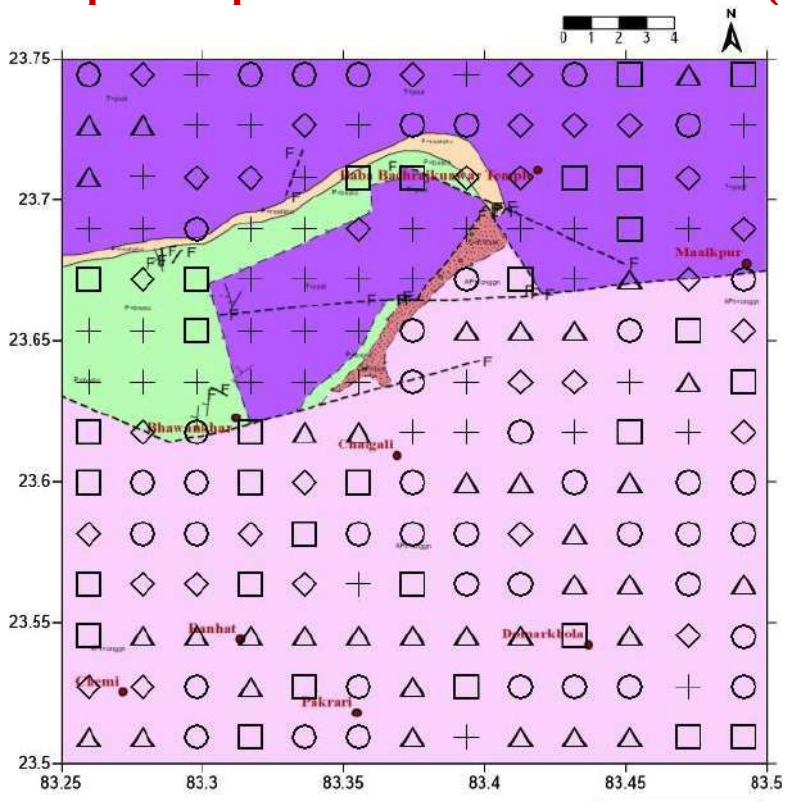
Statistical parameters of MgO

Mean	1.12
Standard Error	0.04
Median	1.00
Mode	1.53
Standard Deviation	0.56
Sample Variance	0.31
Kurtosis	1.46
Skewness	1.18

Range	3.04
Minimum	0.36
Maximum	3.40
Sum	203.98
Count	182
Threshold Value	2.24
UCC Average	2.48

Plate 19: Geochemical distribution and classed post map of MnO in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

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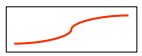
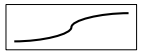


Above threshold value



Below threshold value

Values in Wt.%
- 0.04 to 0.08
- 0.08 to 0.09
- 0.09 to 0.1
- 0.1 to 0.12
- 0.12 to 0.2501

Statistical parameters of MnO

Mean	0.09
Standard Error	0.00
Median	0.09
Mode	0.08
Standard Deviation	0.03
Sample Variance	0.00
Kurtosis	3.87
Skewness	1.25

Range	0.21
Minimum	0.04
Maximum	0.25
Sum	17.17
Count	182
Threshold Value	0.15
UCC Average	0.10

Histogram of MnO

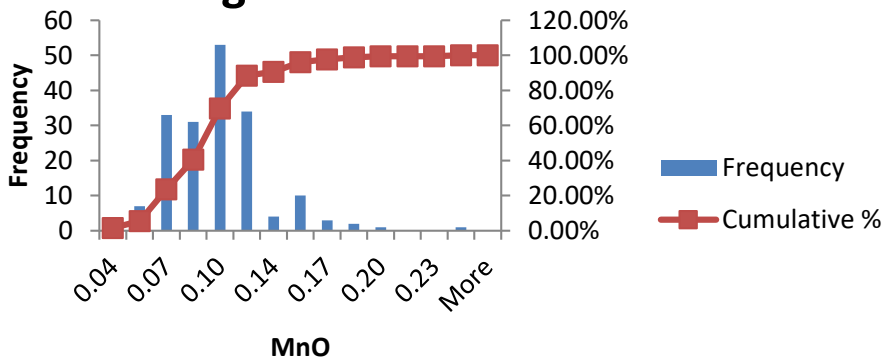
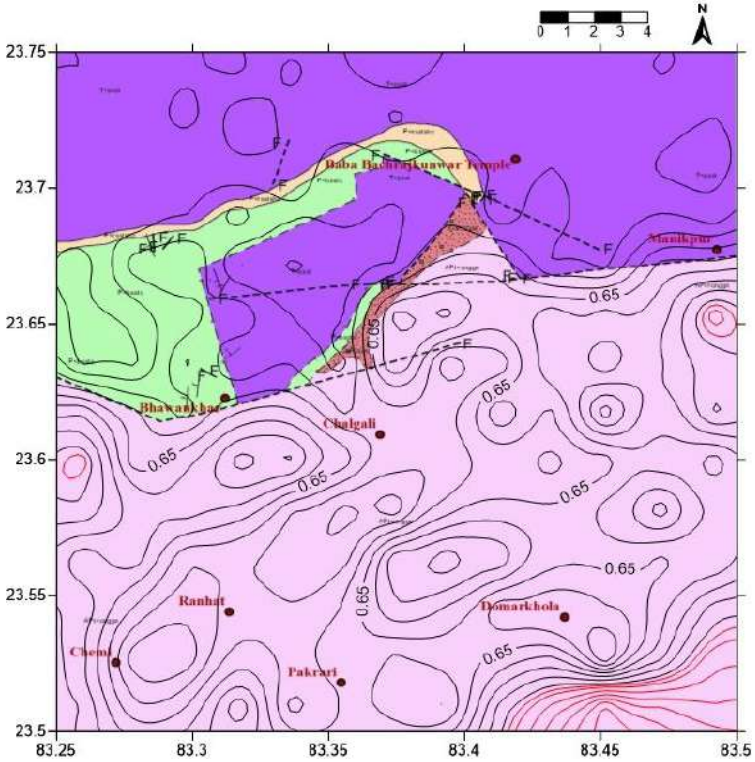
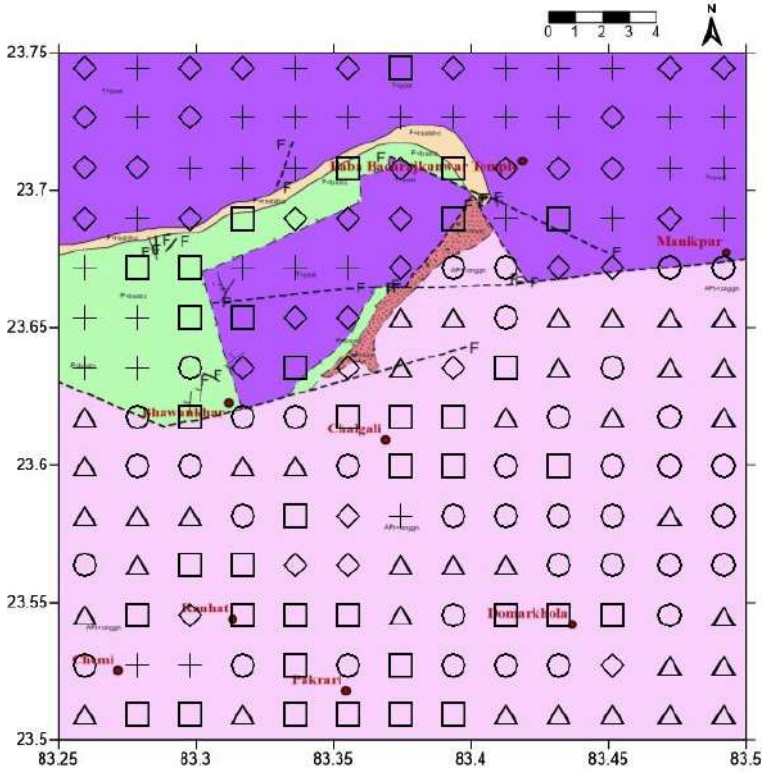


Plate 20: Geochemical distribution and classed post map of Na_2O in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Na_2O

Mean	0.55
Standard Error	0.02
Median	0.50
Mode	0.28
Standard Deviation	0.27
Sample Variance	0.08
Kurtosis	1.30
Skewness	1.11

Range	1.48
Minimum	0.19
Maximum	1.67
Sum	100.90
Count	182
Threshold Value	1.10
UCC Average	3.27

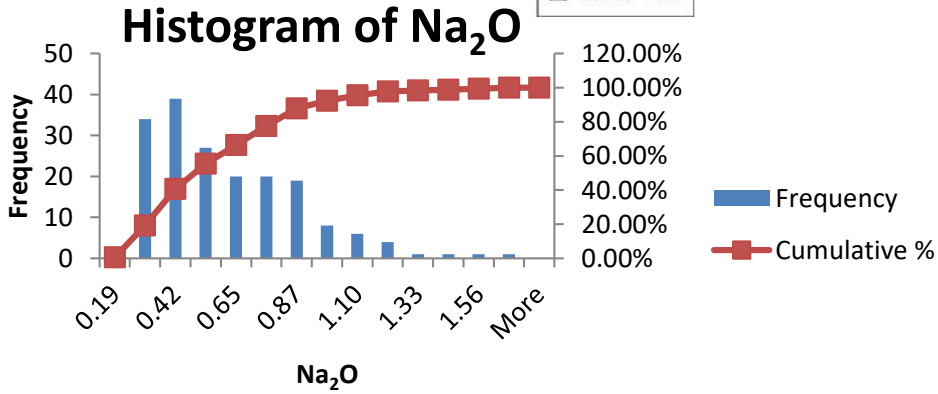
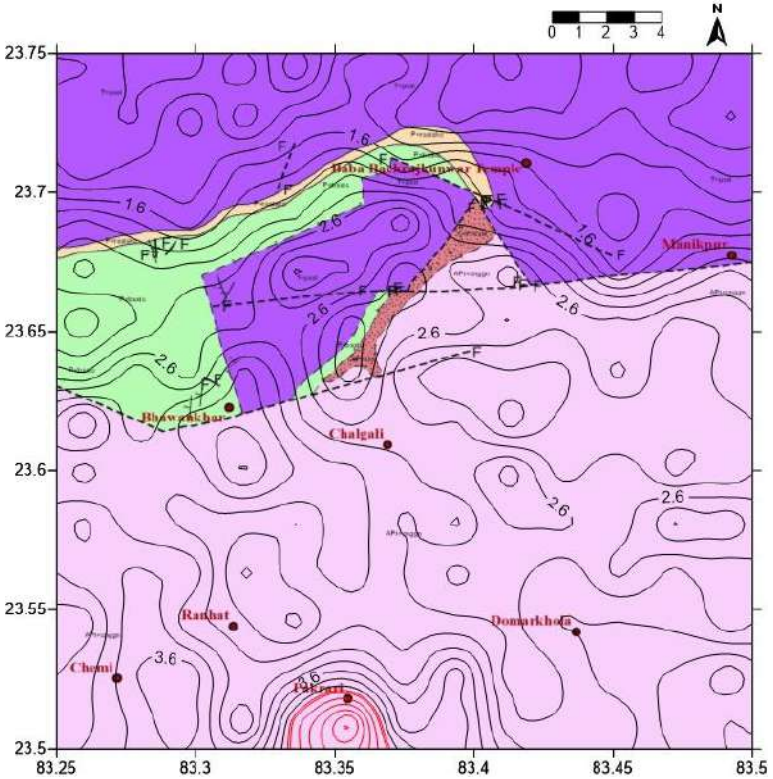
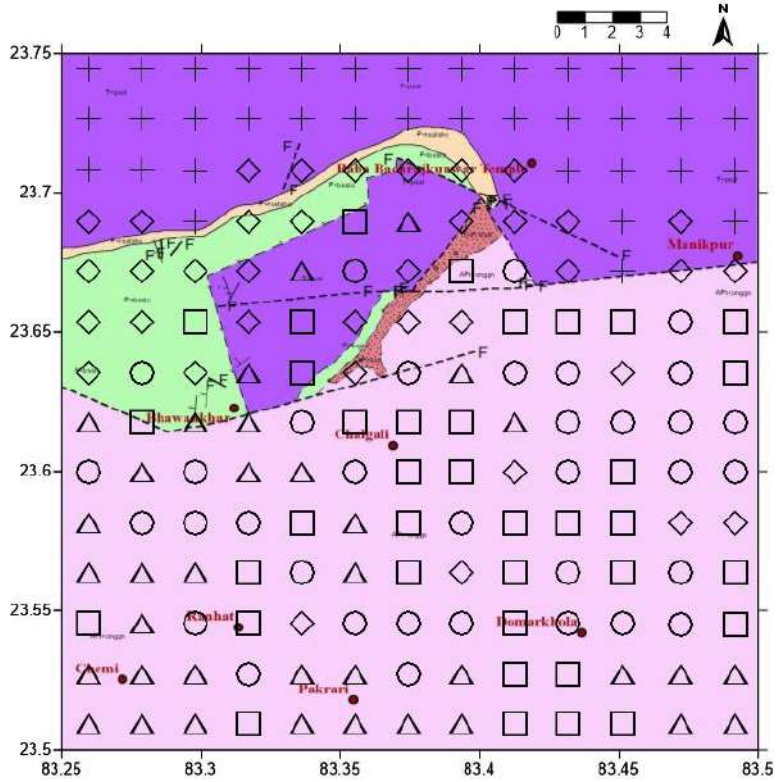


Plate 21: Geochemical distribution and classed post map of K_2O in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in Wt.%
- 0.61 to 1.68
- 1.68 to 2.54
- 2.54 to 2.85
- 2.85 to 3.11
- 3.11 to 5.321

Statistical parameters of K_2O

Mean	2.49
Standard Error	0.06
Median	2.73
Mode	2.98
Standard Deviation	0.83
Sample Variance	0.68
Kurtosis	-0.03
Skewness	-0.33

Range	4.71
Minimum	0.61
Maximum	5.32
Sum	452.34
Count	182
Threshold Value	4.14
UCC Average	2.80

Histogram of K_2O

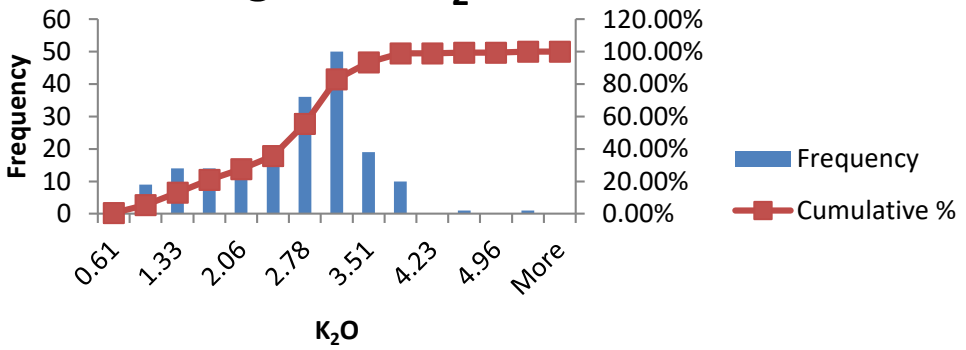
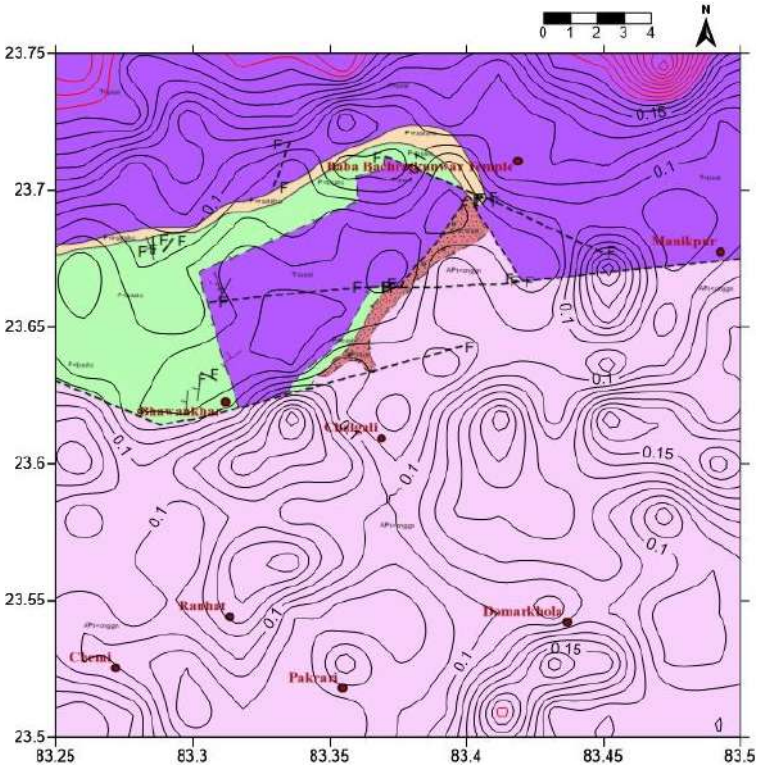
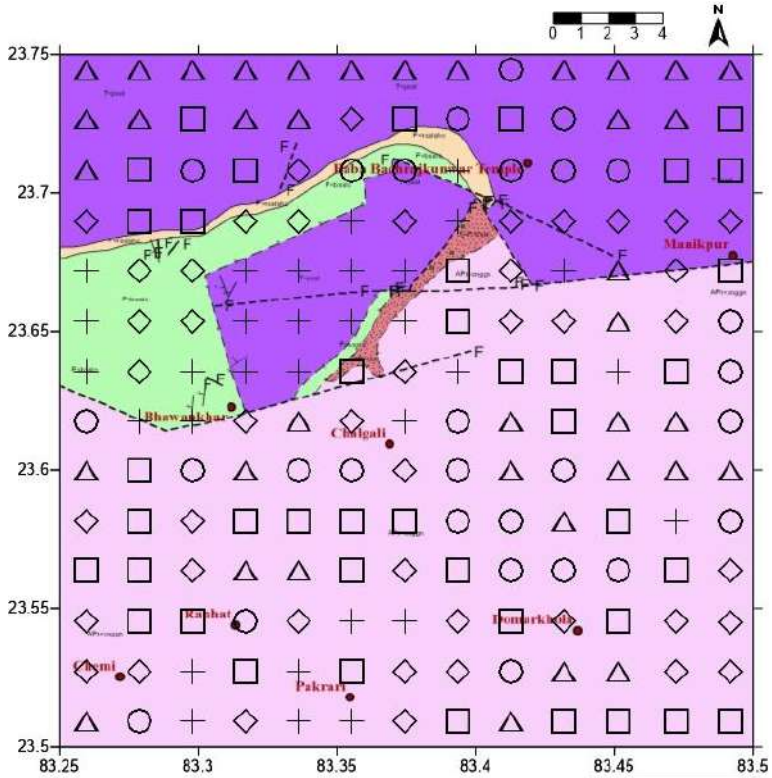


Plate 22: Geochemical distribution and classed post map of P_2O_5 in T.S. No.64M/06 (values in Wt.%)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

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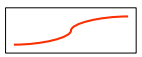


Above threshold value

Below threshold value

Statistical parameters of P_2O_5

Mean	0.11
Standard Error	0.00
Median	0.10
Mode	0.09
Standard Deviation	0.04
Sample Variance	0.00
Kurtosis	1.92
Skewness	1.10

Range	0.22
Minimum	0.05
Maximum	0.27
Sum	19.72
Count	182
Threshold Value	0.18
UCC Average	0.15

Histogram of P_2O_5

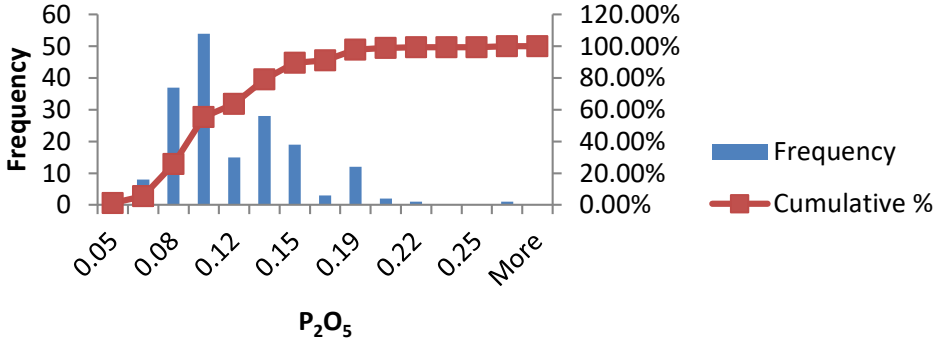
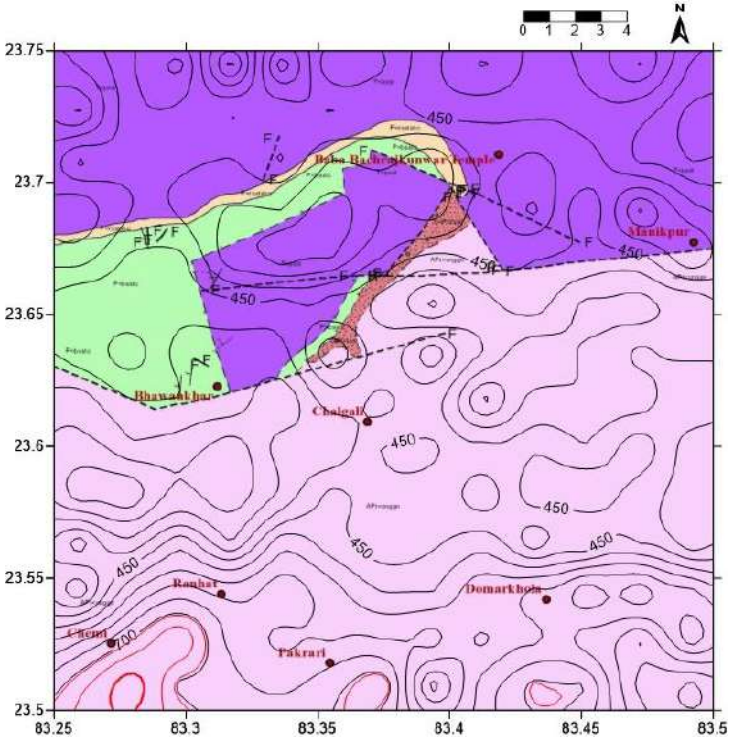
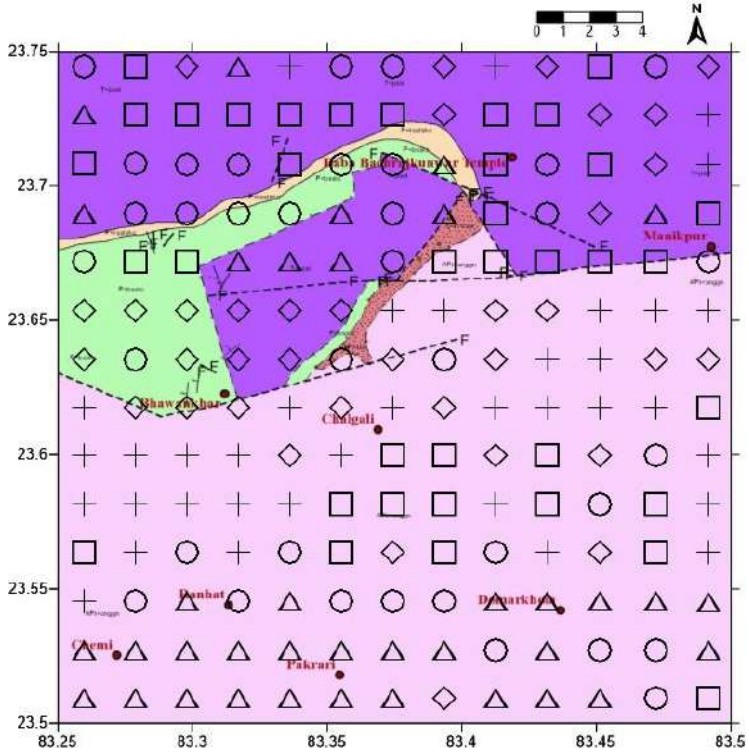


Plate 23: Geochemical distribution and classed post map of Barium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Barium

Mean	473.57
Standard Error	8.68
Median	450.00
Mode	599.00
Standard Deviation	117.13
Sample Variance	13718.42
Kurtosis	0.05
Skewness	0.47

Range	630.00
Minimum	205.00
Maximum	835.00
Sum	86189.00
Count	182
Threshold Value	707.82
UCC Average	628.00

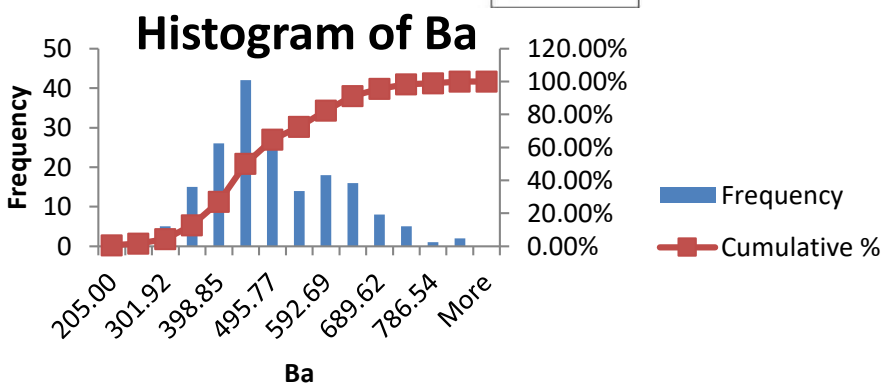
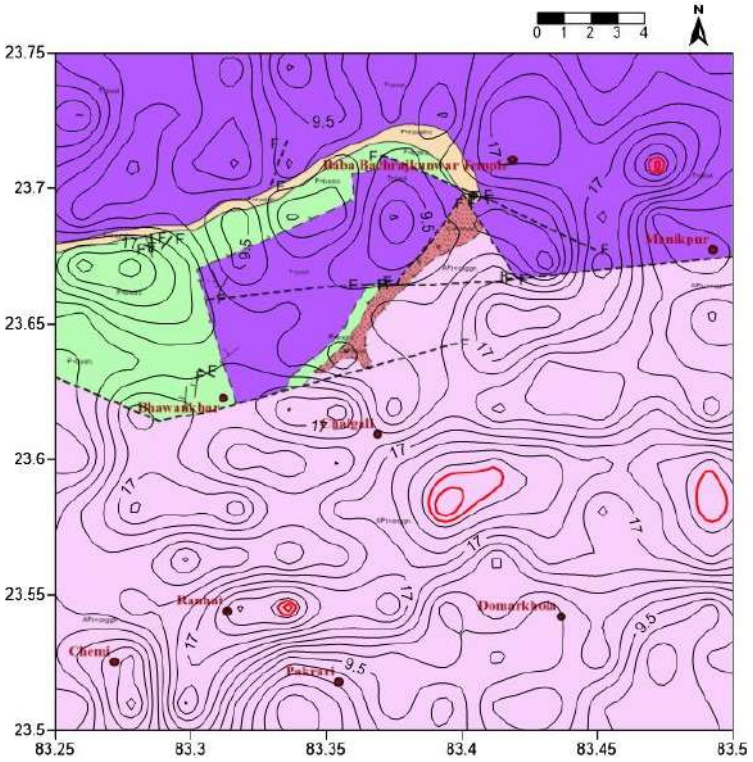
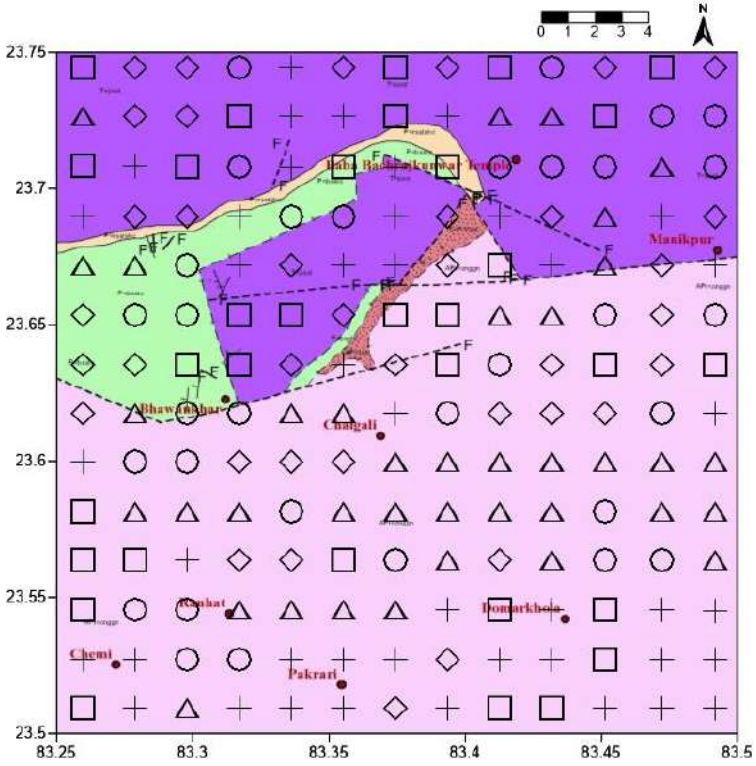


Plate 24: Geochemical distribution and classed post map of Cobalt in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Cobalt

Mean	13.68
Standard Error	0.32
Median	13.00
Mode	12.00
Standard Deviation	4.26
Sample Variance	18.17
Kurtosis	-0.21
Skewness	0.22

Range	22.00
Minimum	2.00
Maximum	24.00
Sum	2489.00
Count	182
Threshold Value	22.20
UCC Average	17.30

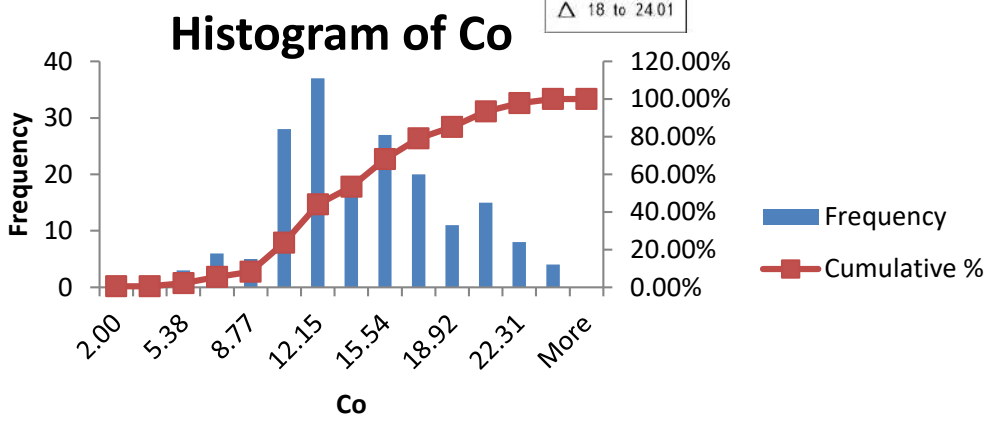
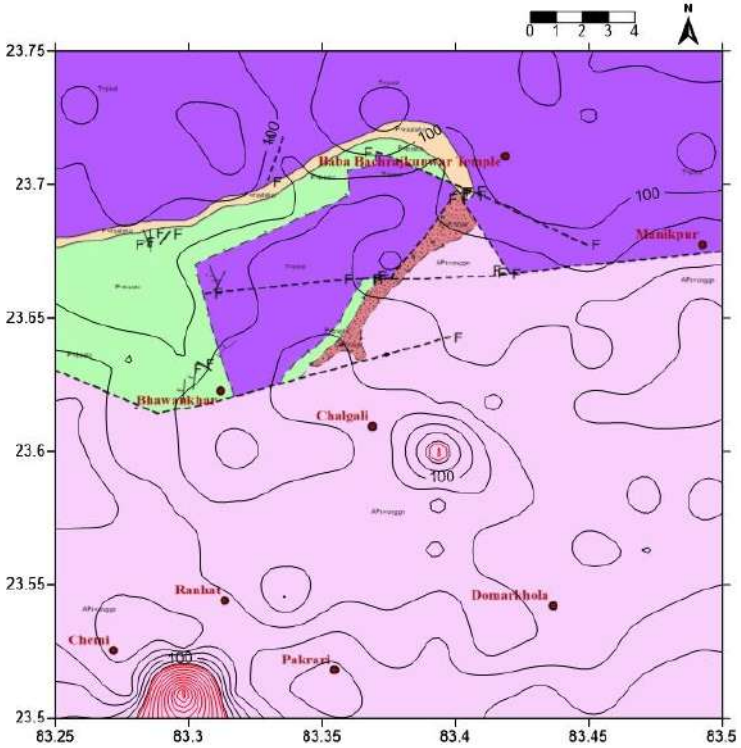
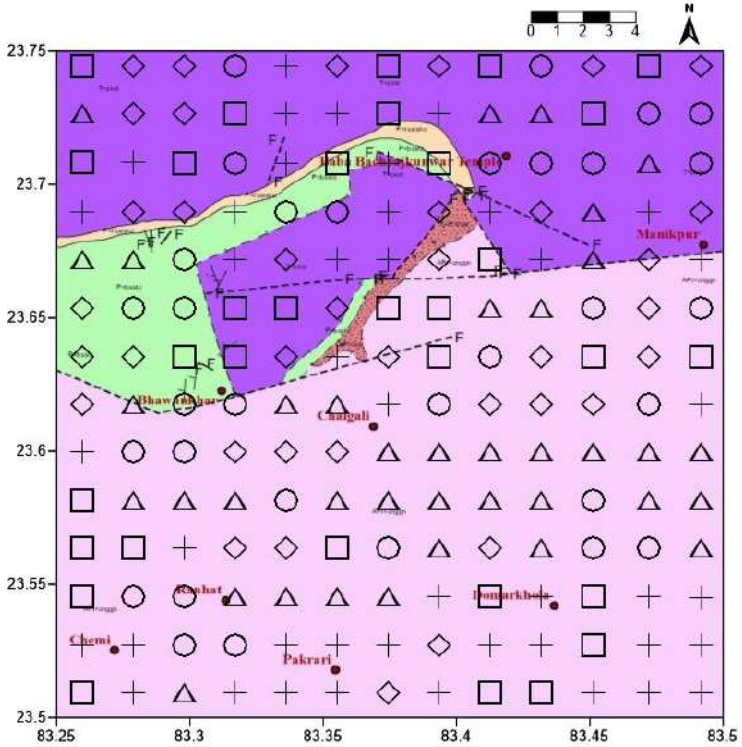


Plate 25: Geochemical distribution and classed post map of Chromium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 2 to 11
- 11 to 13
- 13 to 15
- 15 to 18
- 18 to 24.01

Statistical parameters of Chromium

Mean	71.21
Standard Error	2.82
Median	66.00
Mode	44.00
Standard Deviation	37.99
Sample Variance	1443.43
Kurtosis	25.27
Skewness	3.30

Range	377.00
Minimum	10.00
Maximum	387.00
Sum	12961.00
Count	182
Threshold Value	147.20
UCC Average	92.00

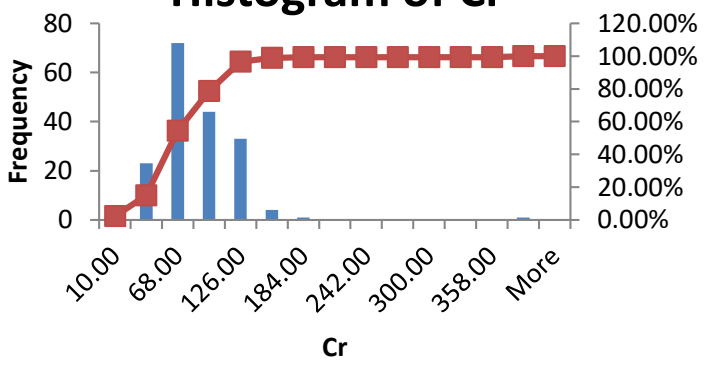
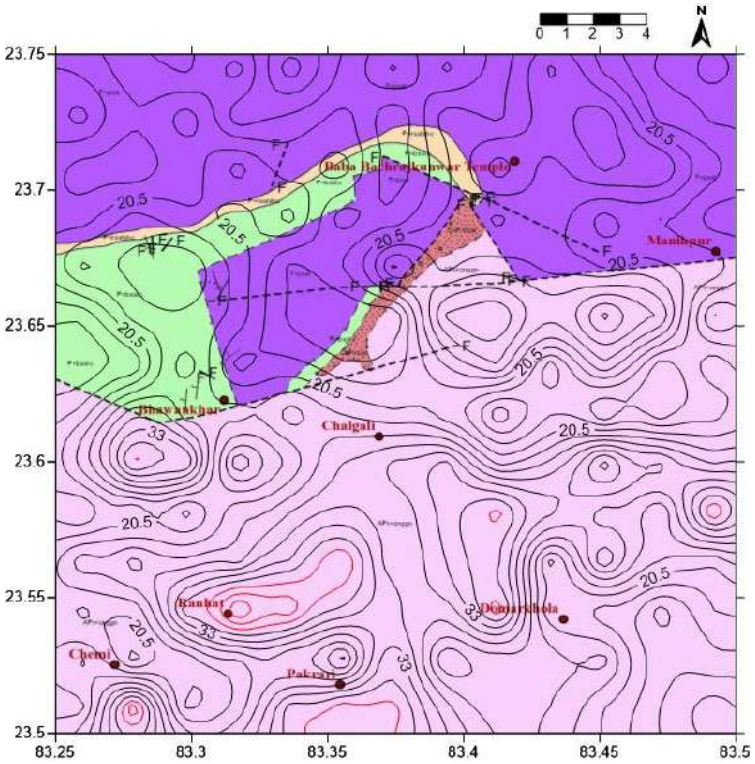
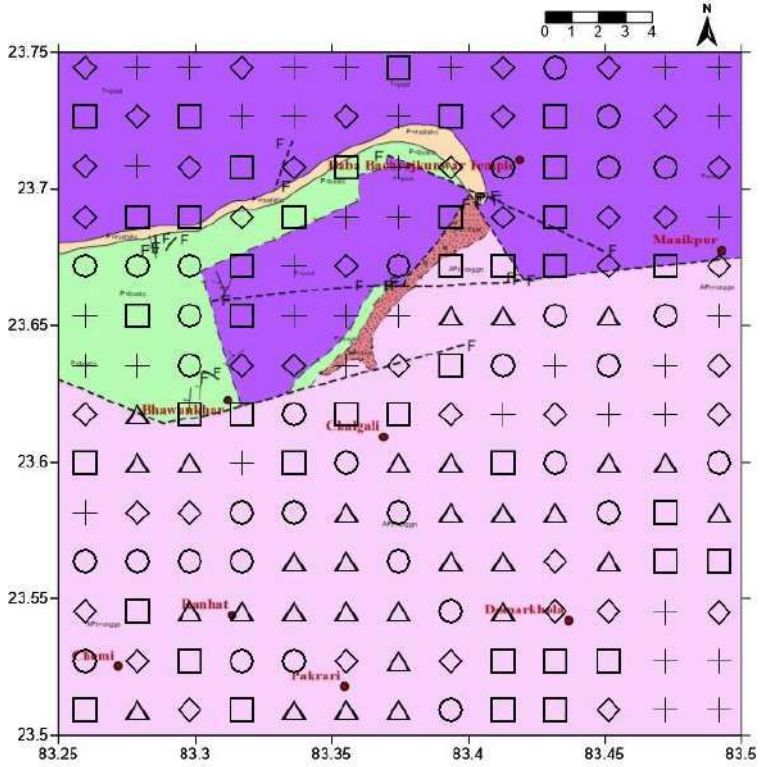


Plate 26: Geochemical distribution and classed post map of Copper in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

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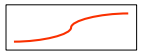


Above threshold value

Below threshold value

Values in ppm
- 9 to 17
- 17 to 21
- 21 to 25
- 25 to 30
- 30 to 46.01

Statistical parameters of Copper

Mean	22.99
Standard Error	0.56
Median	22.00
Mode	24.00
Standard Deviation	7.54
Sample Variance	56.88
Kurtosis	0.18
Skewness	0.73

Range	37.00
Minimum	9.00
Maximum	46.00
Sum	4185.00
Count	182
Threshold Value	38.08
UCC Average	28.00

Histogram of Cu

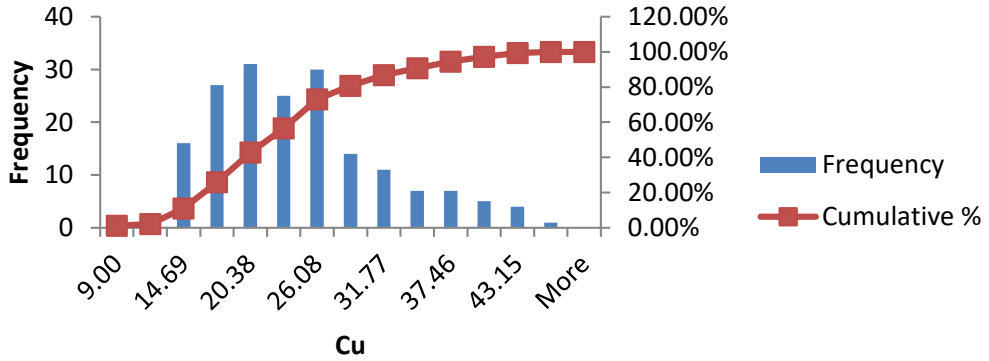
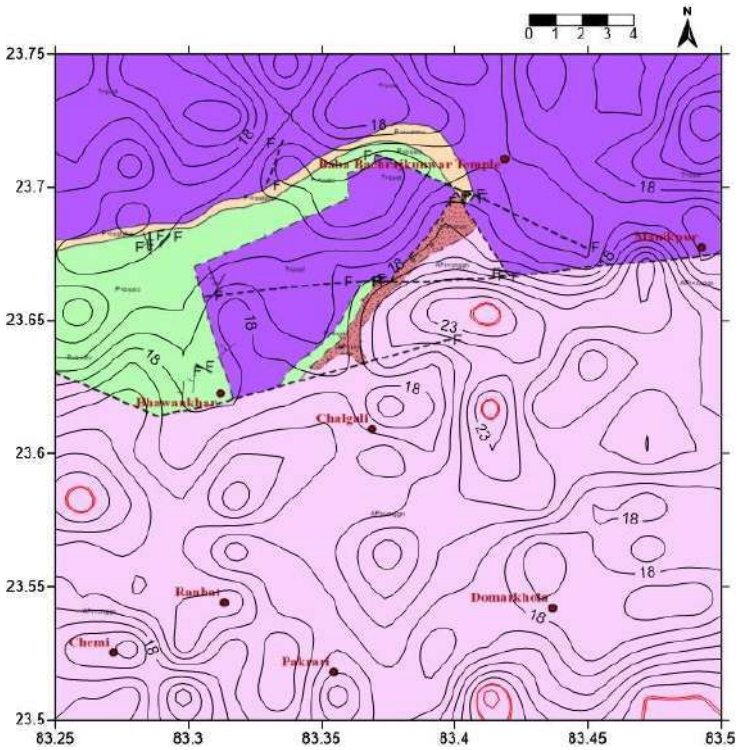
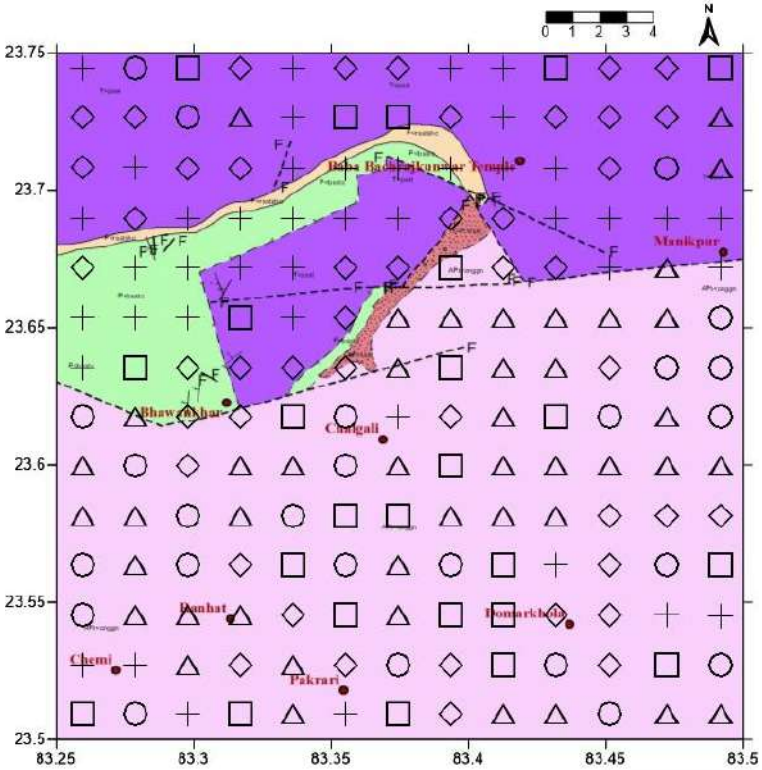


Plate 27: Geochemical distribution and classed post map of Gallium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

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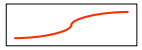


Above threshold value

Below threshold value

Statistical parameters of Gallium

Mean	18.63
Standard Error	0.20
Median	19.00
Mode	19.00
Standard Deviation	2.64
Sample Variance	6.96
Kurtosis	-0.18
Skewness	0.16

Range	13.00
Minimum	13.00
Maximum	26.00
Sum	3390.00
Count	182
Threshold Value	23.90
UCC Average	17.50

Histogram of Ga

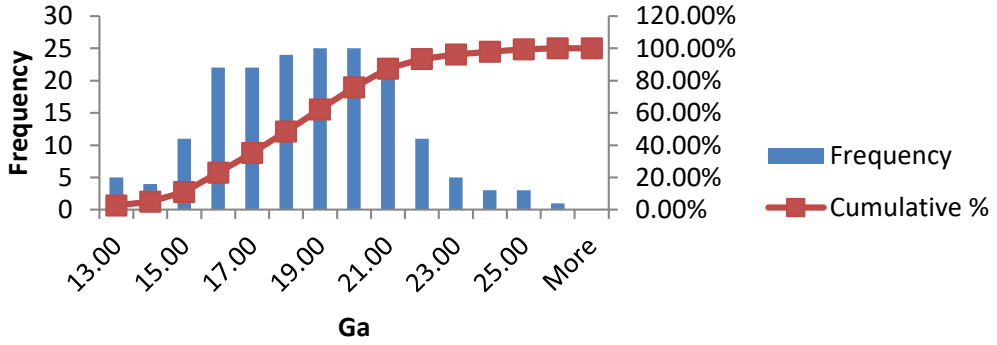
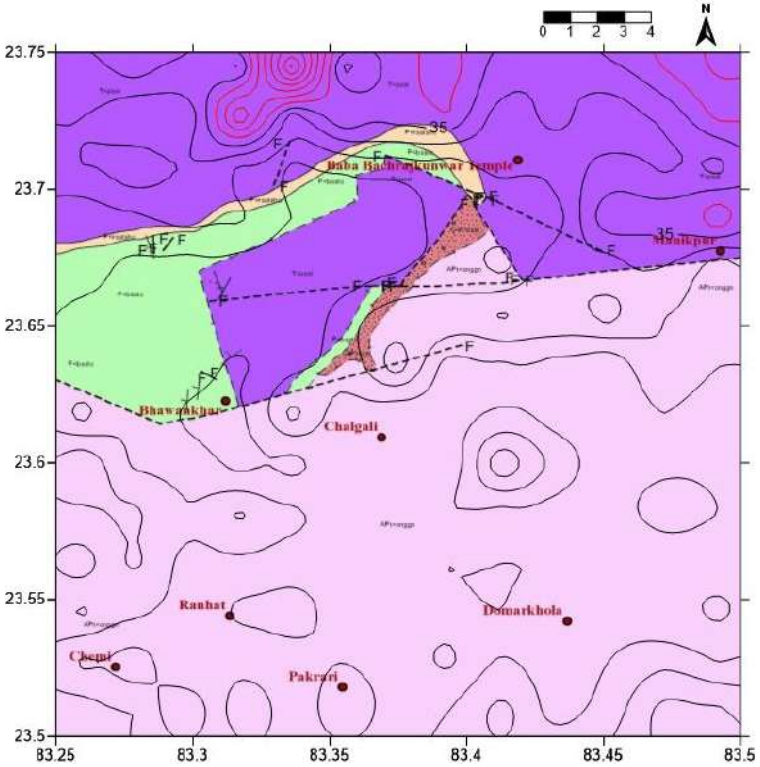
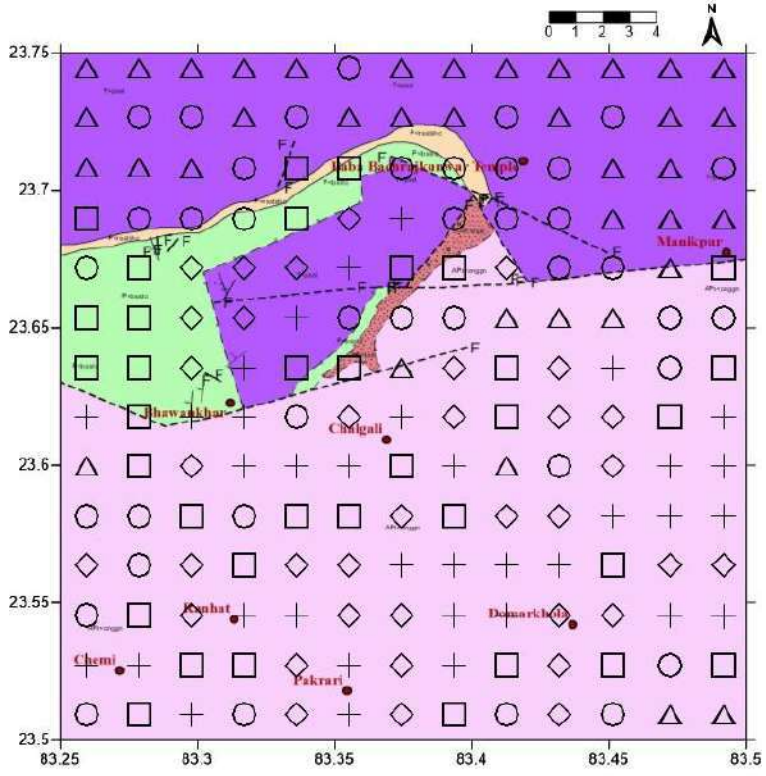


Plate 28: Geochemical distribution and classed post map of Niobium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Niobium

Mean	22.80
Standard Error	0.63
Median	20.00
Mode	18.00
Standard Deviation	8.51
Sample Variance	72.34
Kurtosis	6.32
Skewness	1.90

Range	62.00
Minimum	10.00
Maximum	72.00
Sum	4149.00
Count	182
Threshold Value	39.81
UCC Average	12.00

Histogram of Nb

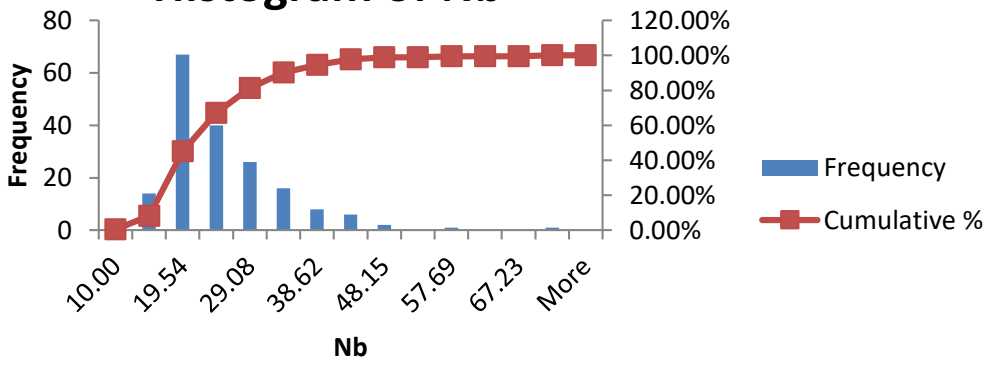
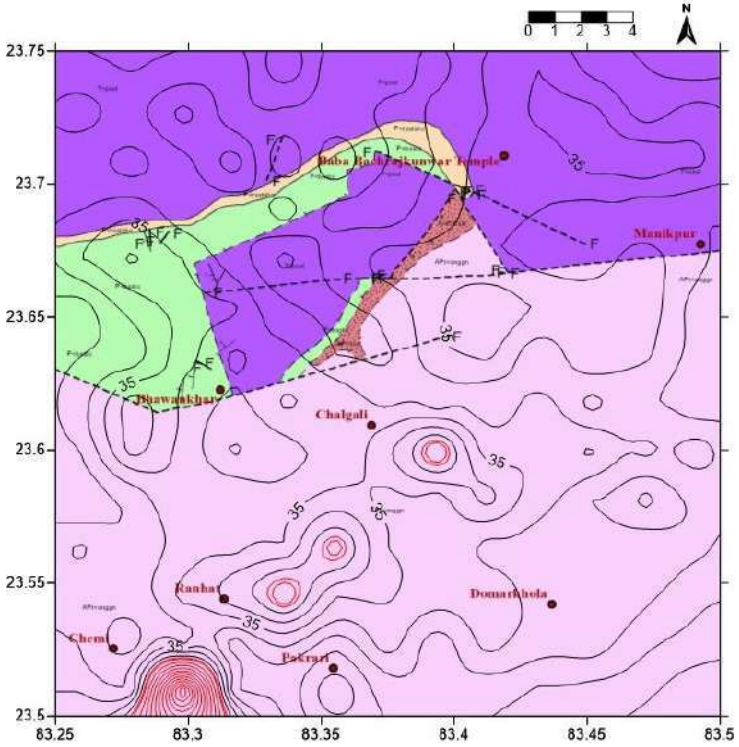
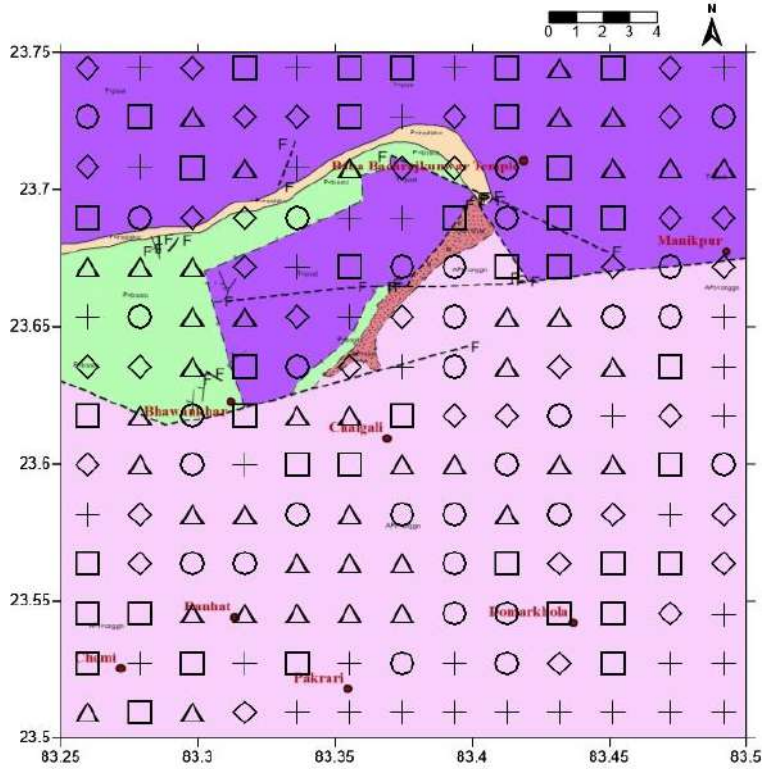


Plate 29: Geochemical distribution and classed post map of Nickel in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Nickel

Mean	29.93
Standard Error	0.68
Median	29.00
Mode	26.00
Standard Deviation	9.23
Sample Variance	85.13
Kurtosis	37.83
Skewness	4.37

Range	104.00
Minimum	10.00
Maximum	114.00
Sum	5447.00
Count	182
Threshold Value	48.38
UCC Average	47.00

Histogram of Ni

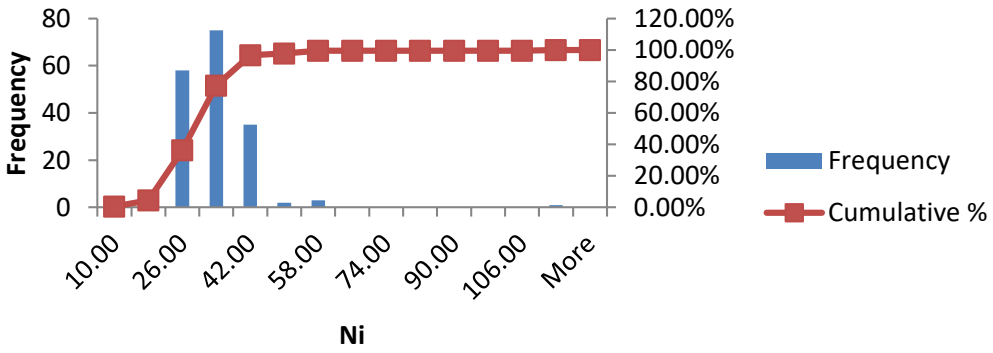
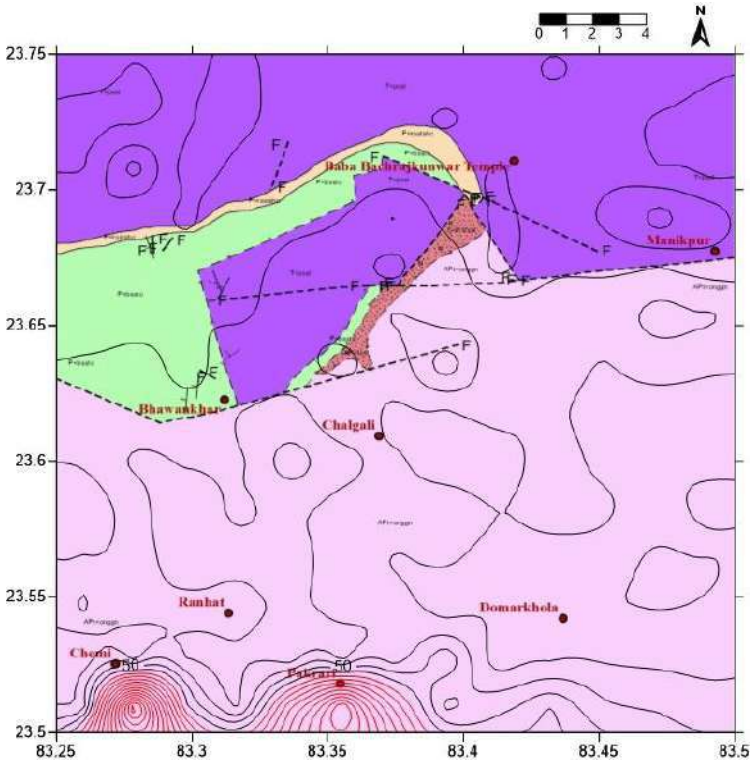
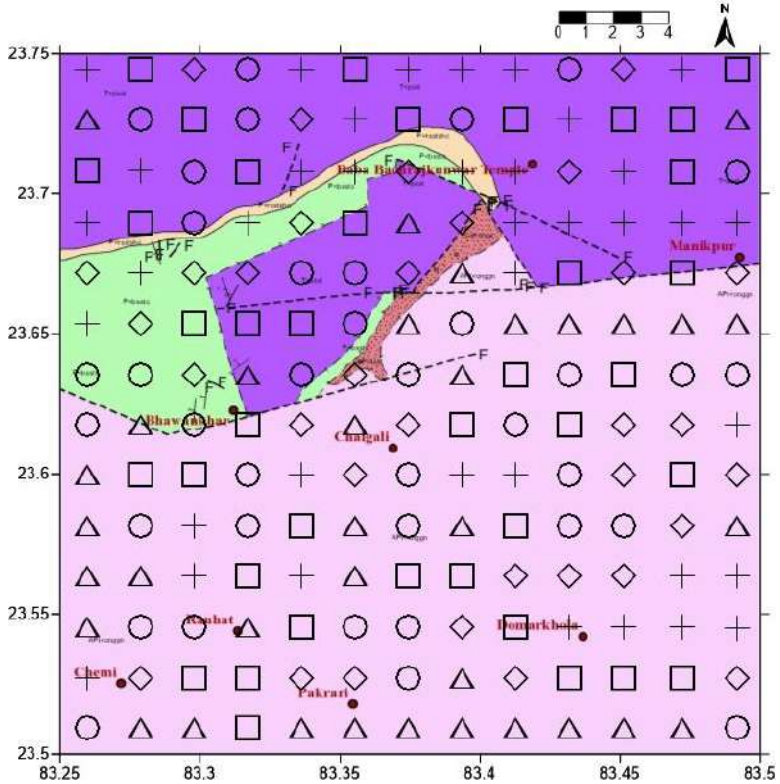


Plate 30: Geochemical distribution and classed post map of Lead in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Lead

Mean	32.14
Standard Error	1.43
Median	29.00
Mode	27.00
Standard Deviation	19.28
Sample Variance	371.73
Kurtosis	46.59
Skewness	6.07

Range	199.00
Minimum	5.00
Maximum	204.00
Sum	5850.00
Count	182
Threshold Value	70.70
UCC Average	17.00

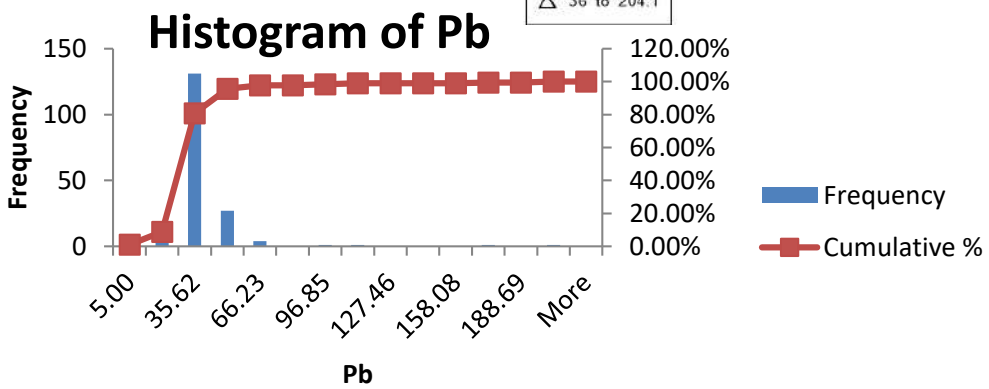
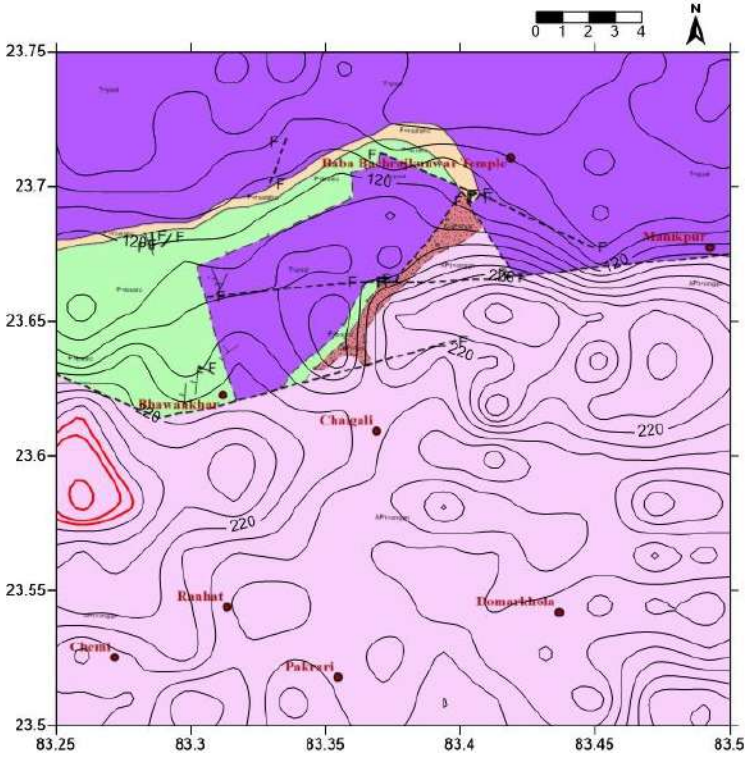
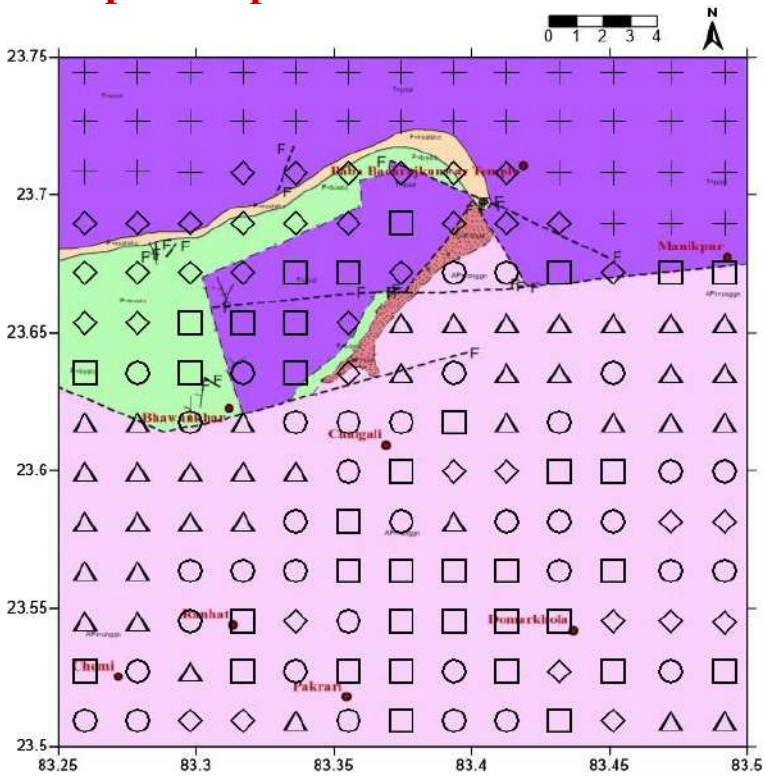


Plate 31: Geochemical distribution and classed post map of Rubidium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Rubidium

Mean	156.39
Standard Error	5.03
Median	161.50
Mode	186.00
Standard Deviation	67.84
Sample Variance	4602.91
Kurtosis	-0.60
Skewness	0.04

Range	310.00
Minimum	19.00
Maximum	329.00
Sum	28463.00
Count	182
Threshold Value	292.08
UCC Average	84.00

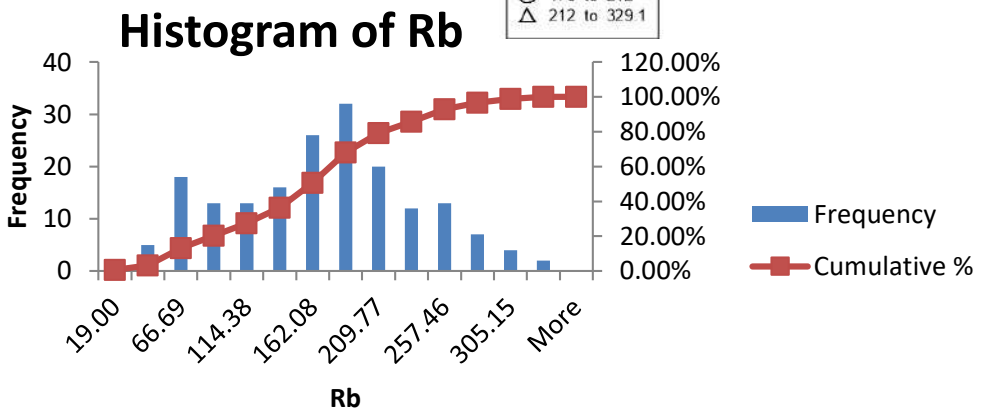
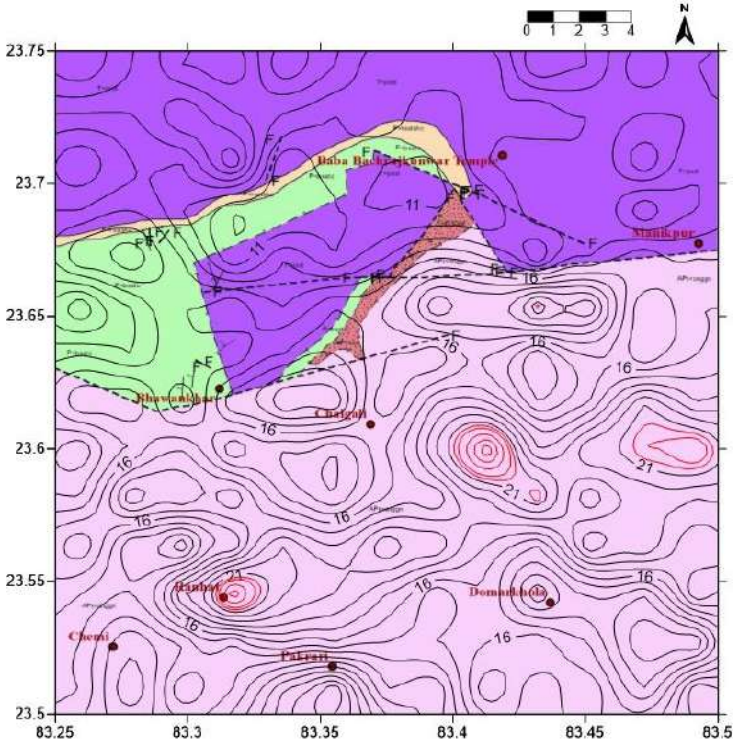
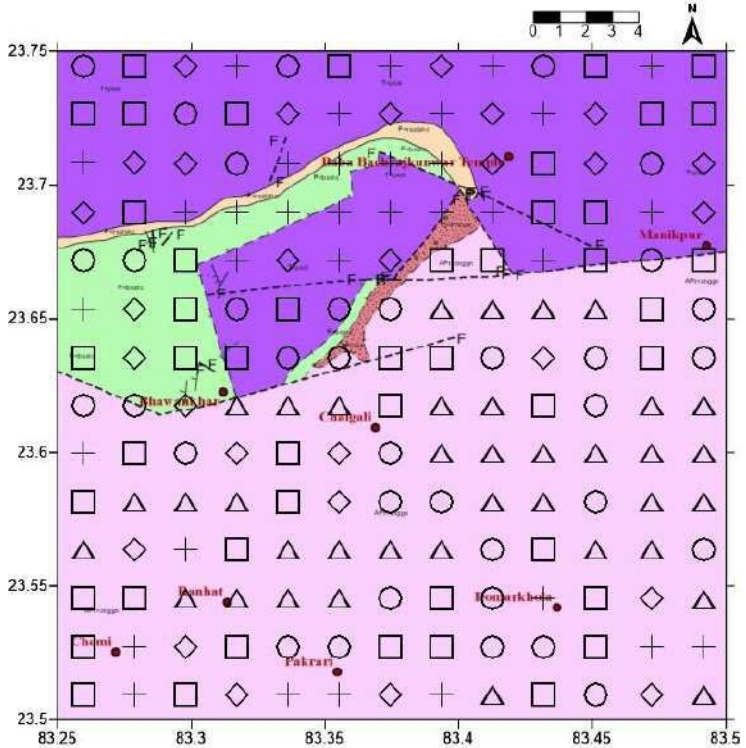


Plate 32: Geochemical distribution and classed post map of Scandium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Scandium

Mean	15.07
Standard Error	0.24
Median	14.00
Mode	14.00
Standard Deviation	3.24
Sample Variance	10.48
Kurtosis	0.46
Skewness	0.57

Range	20.00
Minimum	6.00
Maximum	26.00
Sum	2742.00
Count	182
Threshold Value	21.54
UCC Average	14.00

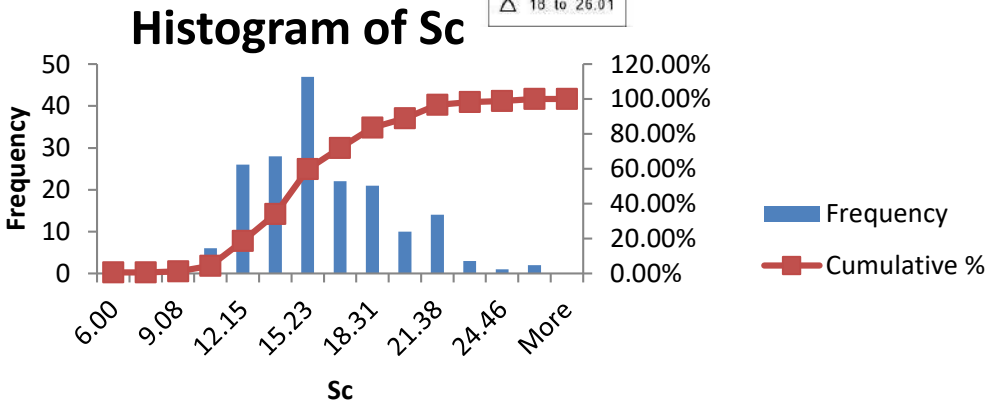
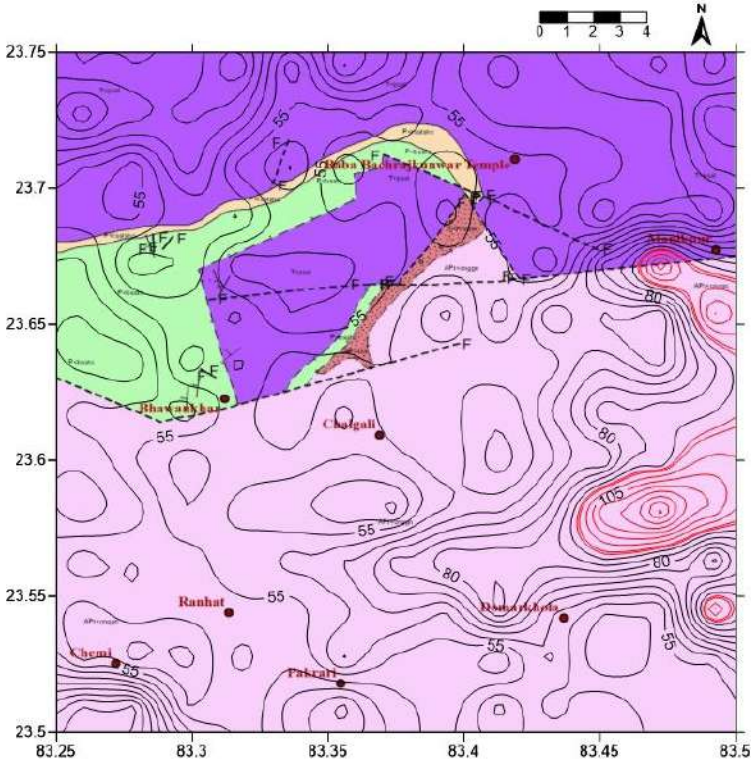
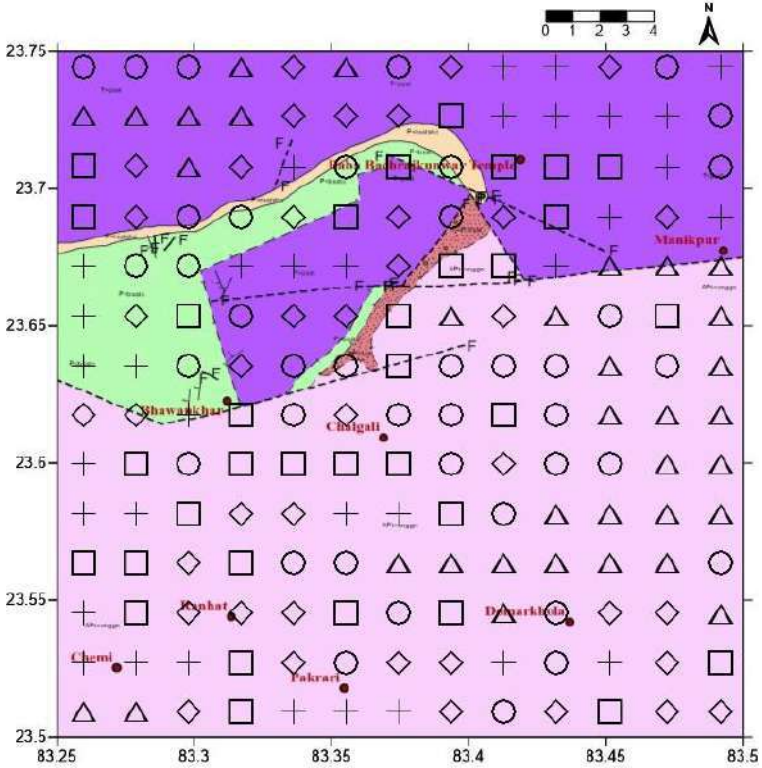


Plate 33: Geochemical distribution and classed post map of Strontium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 33 to 50
- 50 to 55
- 55 to 61
- 61 to 71
- 71 to 133.1

Statistical parameters of Strontium

Mean	61.45
Standard Error	1.19
Median	58.00
Mode	52.00
Standard Deviation	16.04
Sample Variance	257.36
Kurtosis	3.20
Skewness	1.61

Range	100.00
Minimum	33.00
Maximum	133.00
Sum	11184.00
Count	182
Threshold Value	93.54
UCC Average	320.00

Histogram of Sr

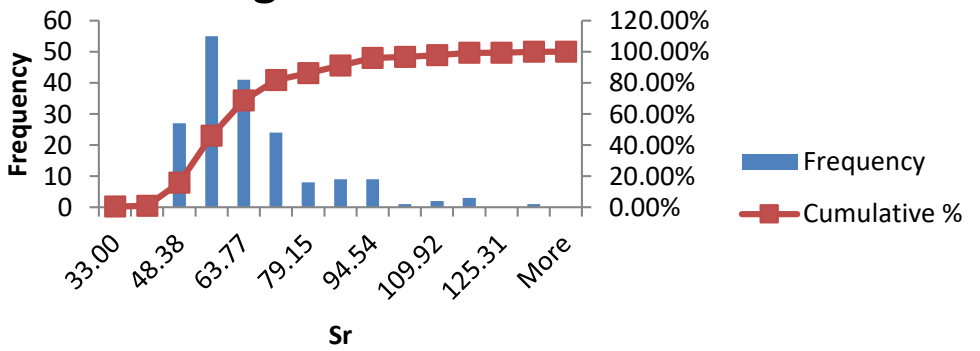
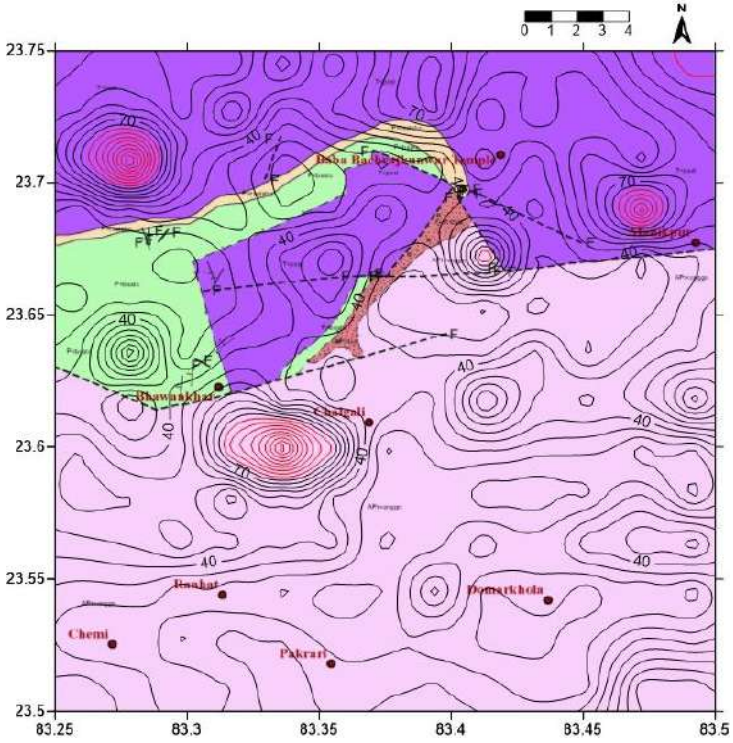
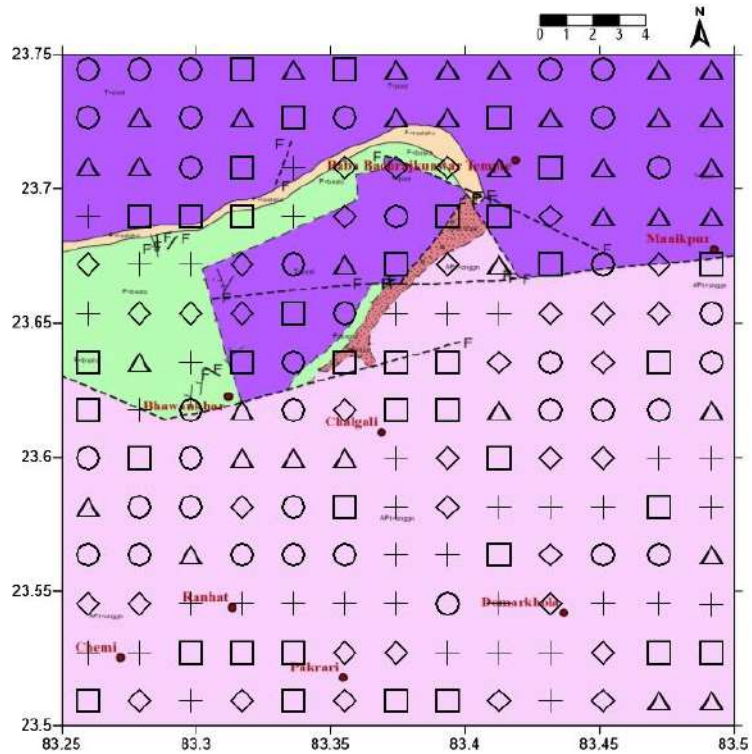


Plate 34: Geochemical distribution and classed post map of Thorium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Thorium

Mean	41.25
Standard Error	1.50
Median	36.50
Mode	22.00
Standard Deviation	20.17
Sample Variance	407.02
Kurtosis	5.02
Skewness	1.81

Range	124.00
Minimum	14.00
Maximum	138.00
Sum	7508.00
Count	182
Threshold Value	81.60
UCC Average	10.50

Histogram of Th

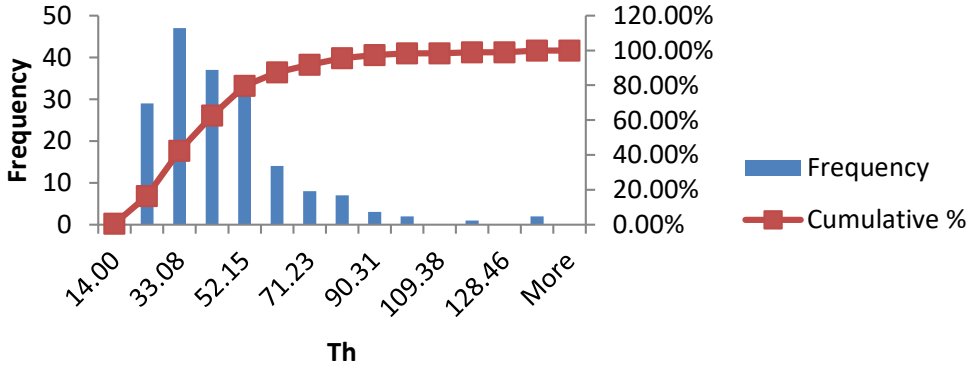
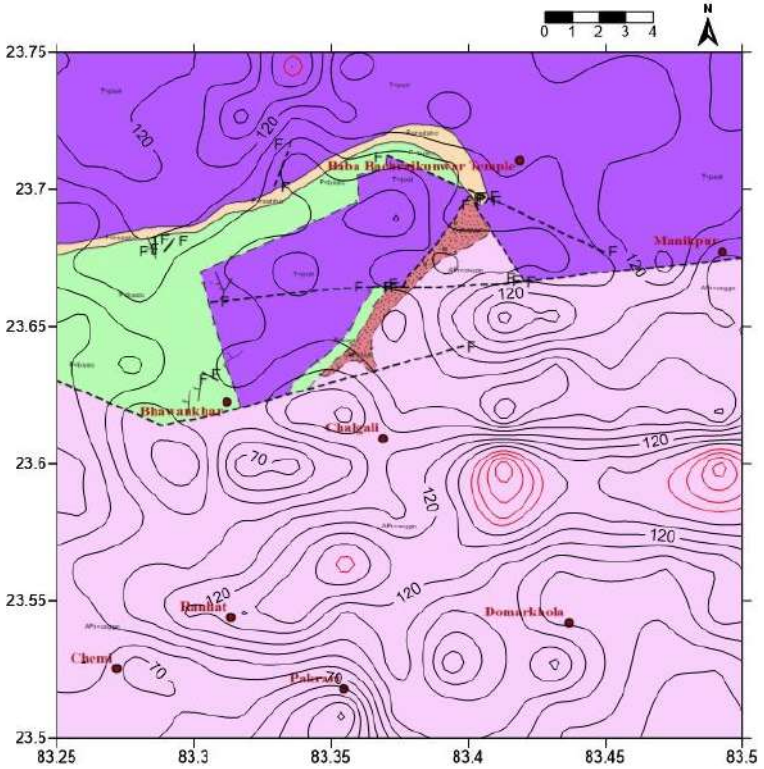
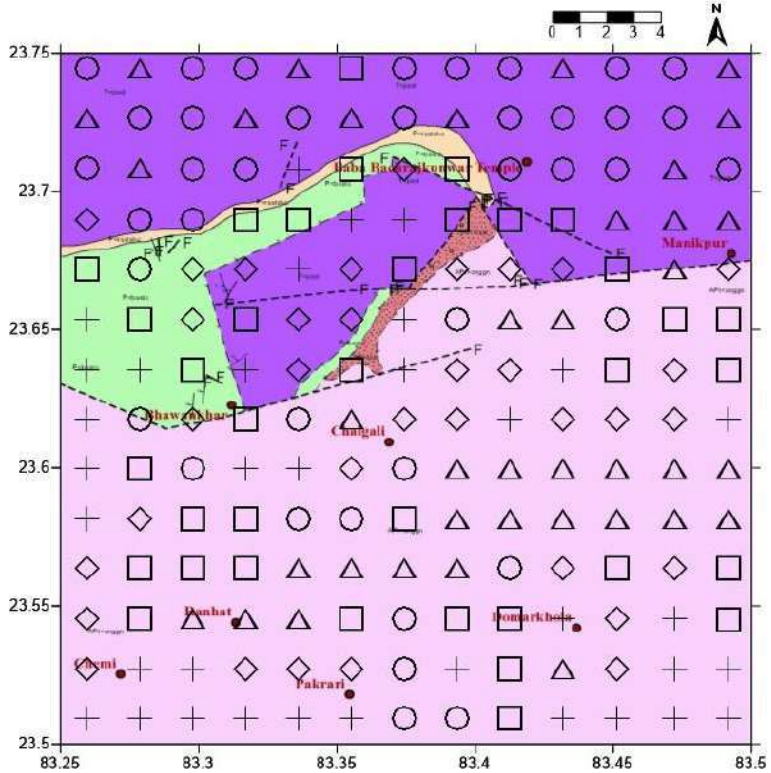


Plate 35: Geochemical distribution and classed post map of Vanadium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

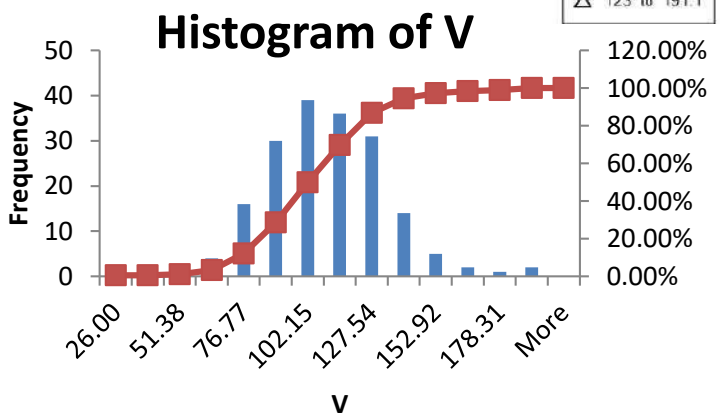
- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 26 to 84
- 84 to 97
- 97 to 108
- 108 to 123
- 123 to 191.1

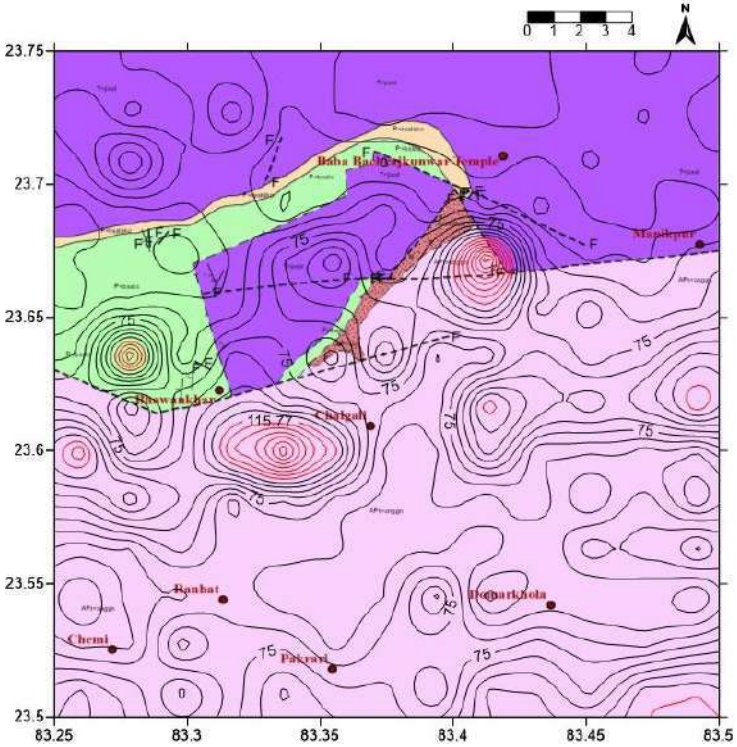


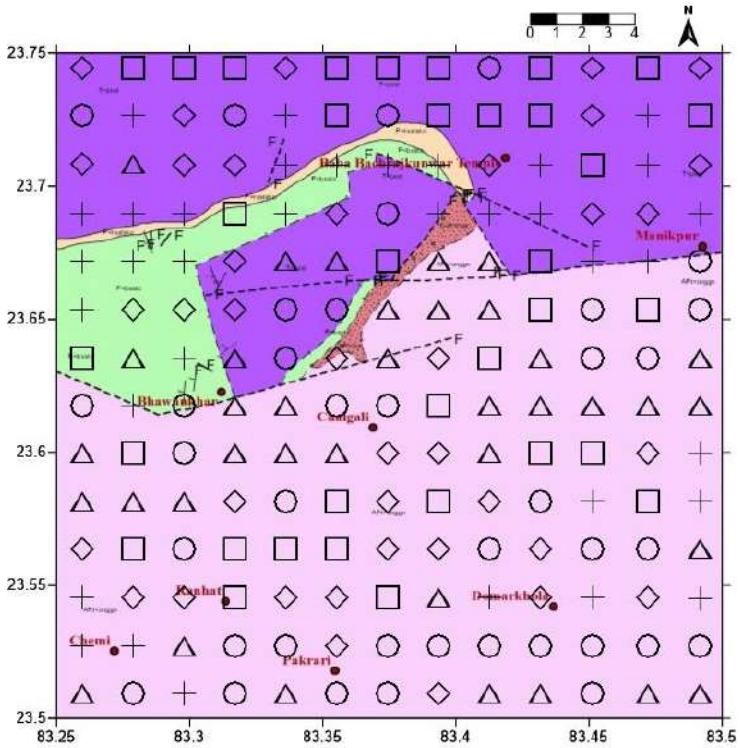
Statistical parameters of Vanadium

Mean	103.58
Standard Error	1.79
Median	102.50
Mode	97.00
Standard Deviation	24.19
Sample Variance	585.00
Kurtosis	1.28
Skewness	0.44

Range	178.00
Minimum	46.00
Maximum	224.00
Sum	18626.00
Count	182
Threshold Value	154.04
UCC Average	97.00

Plate 36: Geochemical distribution and classed post map of Yttrium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Yttrium

Mean	68.41
Standard Error	1.76
Median	61.00
Mode	61.00
Standard Deviation	23.68
Sample Variance	560.81
Kurtosis	4.71
Skewness	1.85

Range	145.00
Minimum	36.00
Maximum	181.00
Sum	12451.00
Count	182
Threshold Value	115.77
UCC Average	21.00

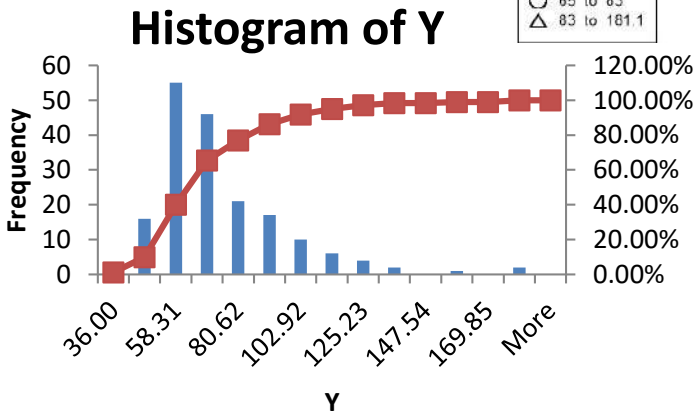
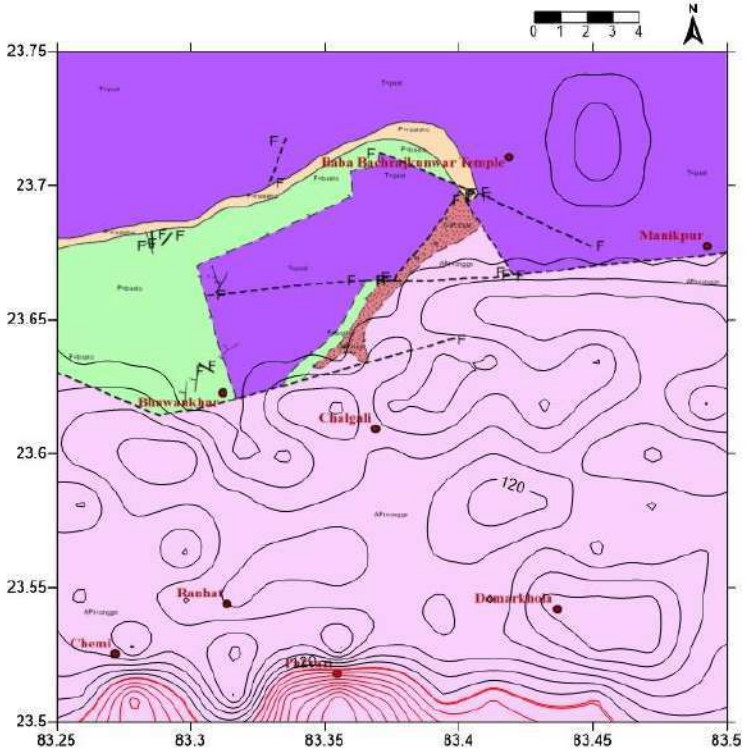
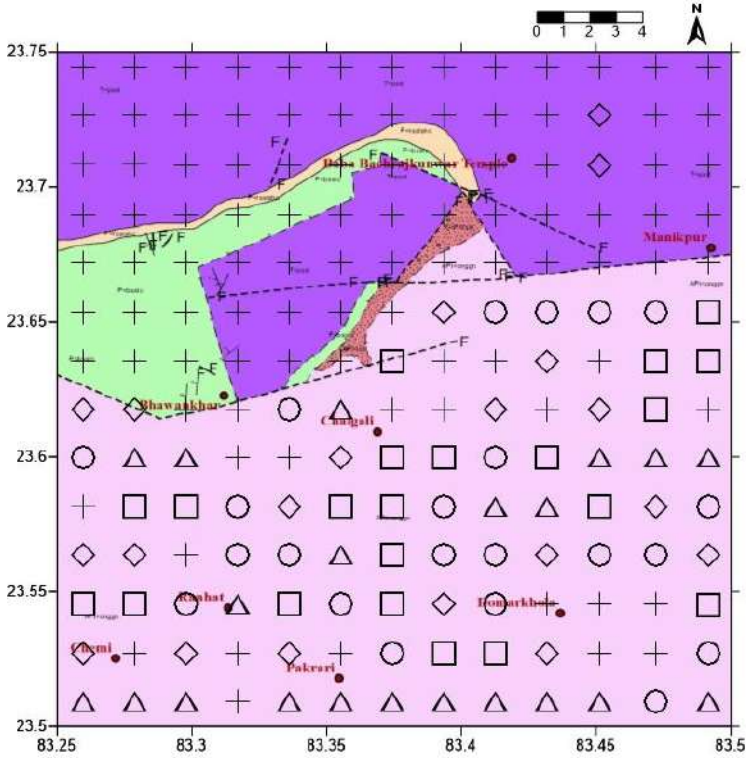


Plate 37: Geochemical distribution and classed post map of Zinc in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 35 to 71
- 71 to 80
- 80 to 92
- 92 to 107
- 107 to 333.1

Statistical parameters of Zinc

Mean	66.90
Standard Error	3.38
Median	35.00
Mode	35.00
Standard Deviation	45.59
Sample Variance	2078.17
Kurtosis	8.87
Skewness	2.40

Range	298.00
Minimum	35.00
Maximum	333.00
Sum	12176.00
Count	182
Threshold Value	158.07
UCC Average	67.00

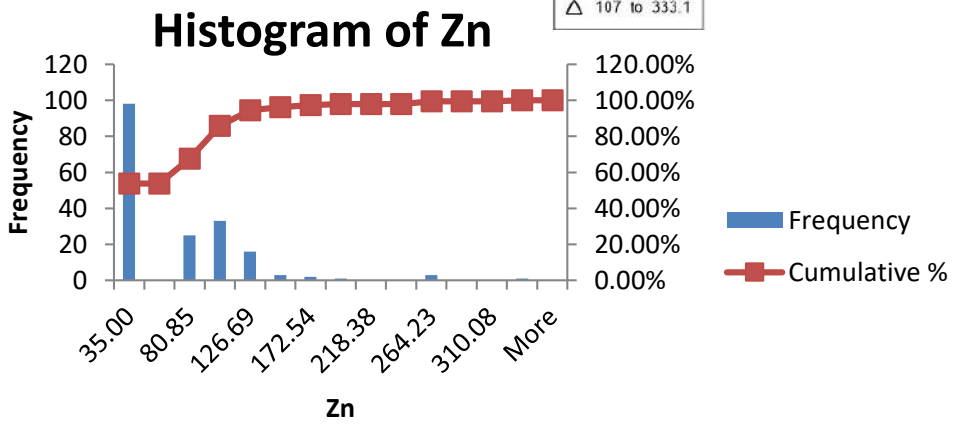
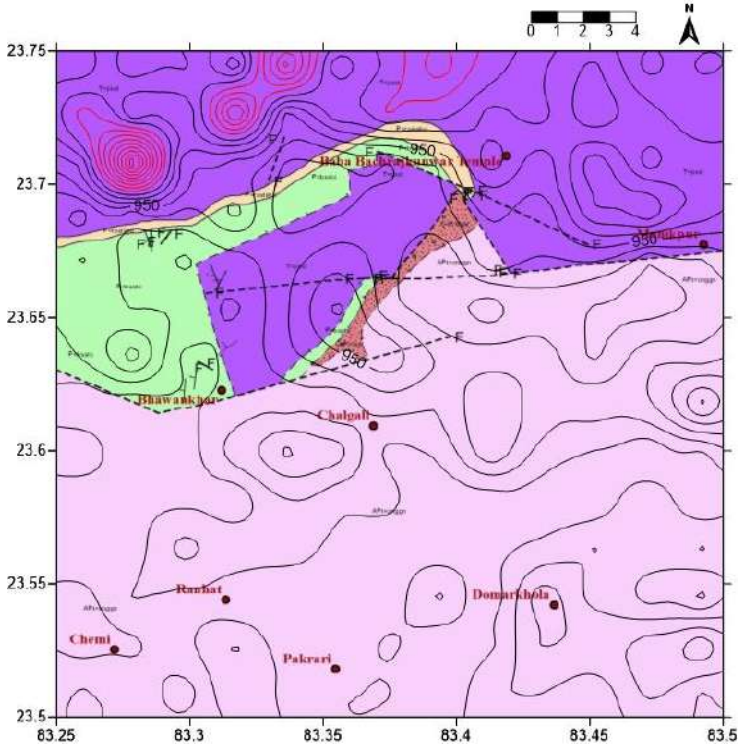
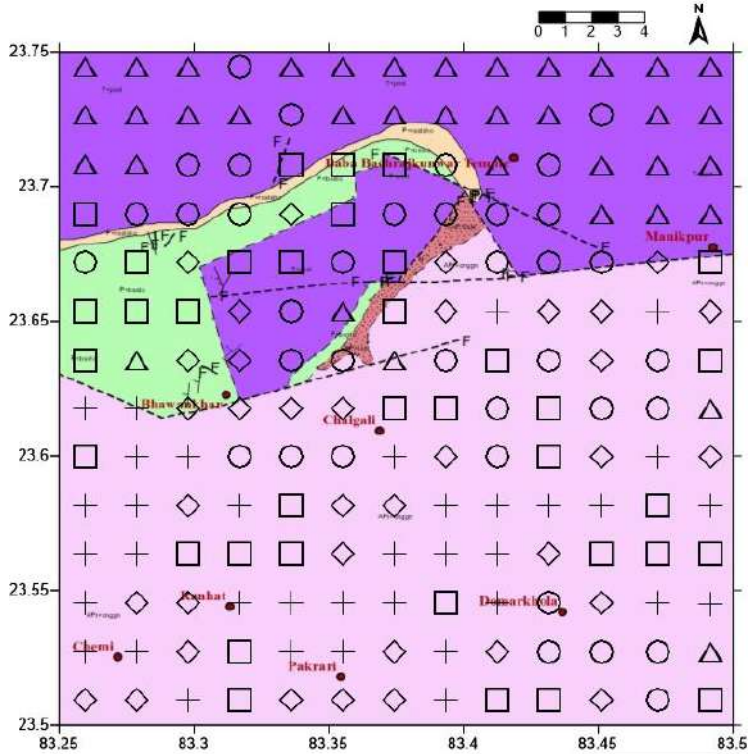


Plate 38: Geochemical distribution and classed post map of Zirconium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Zirconium

Mean	764.37
Standard Error	29.72
Median	649.00
Mode	475.00
Standard Deviation	400.91
Sample Variance	160728.53
Kurtosis	5.83
Skewness	1.92

Range	2721.00
Minimum	260.00
Maximum	2981.00
Sum	139115.00
Count	182
Threshold Value	1566.19
UCC Average	193.00

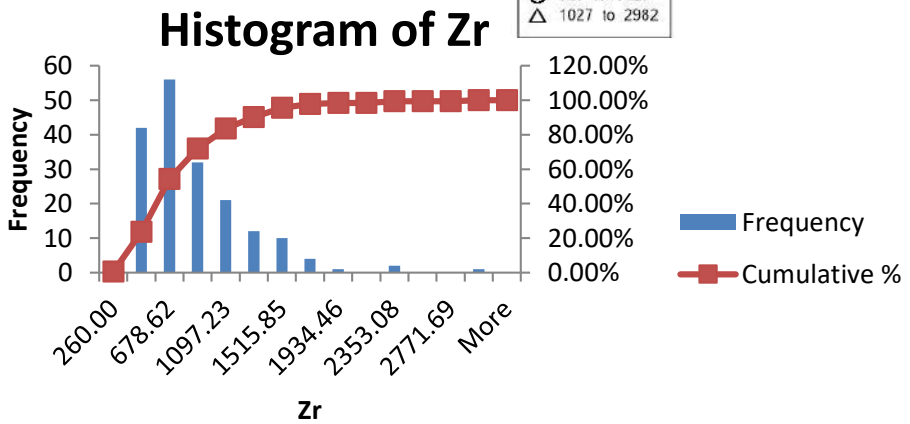
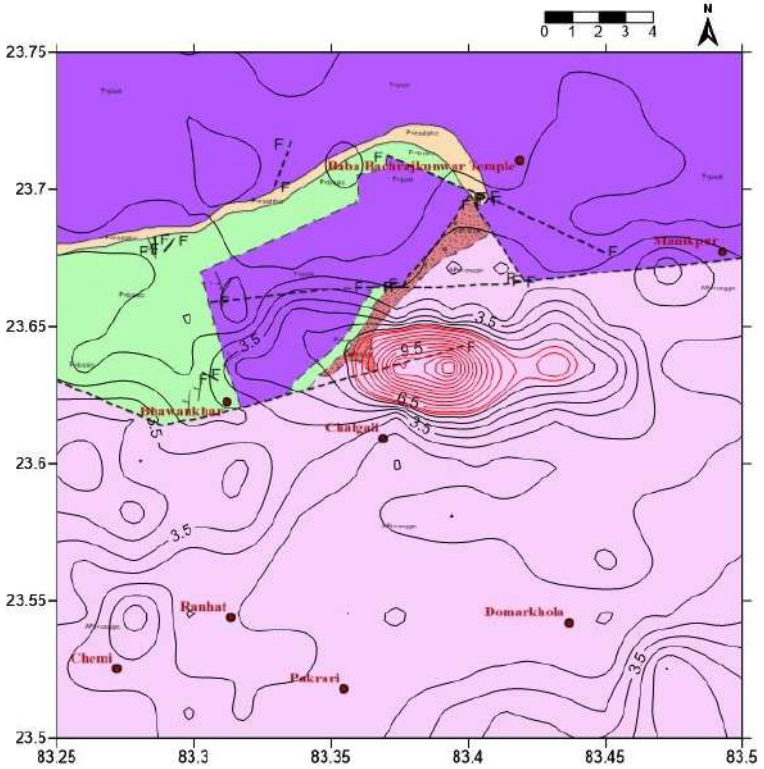
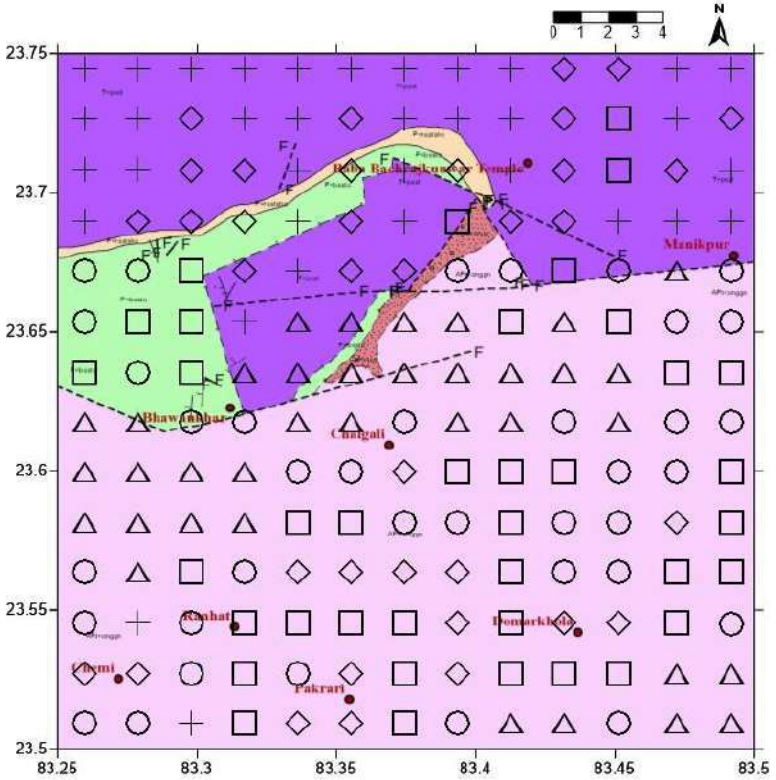


Plate 39: Geochemical distribution and classed post map of Beryllium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Beryllium

Mean	2.58
Standard Error	0.11
Median	2.21
Mode	2.29
Standard Deviation	1.53
Sample Variance	2.34
Kurtosis	20.79
Skewness	3.66

Range	13.06
Minimum	0.50
Maximum	13.56
Sum	469.17
Count	182
Threshold Value	5.637454
UCC Average	2.1

Histogram of Be

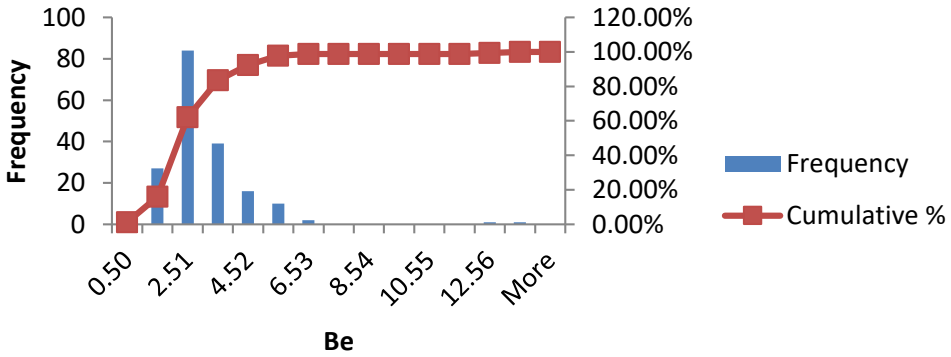
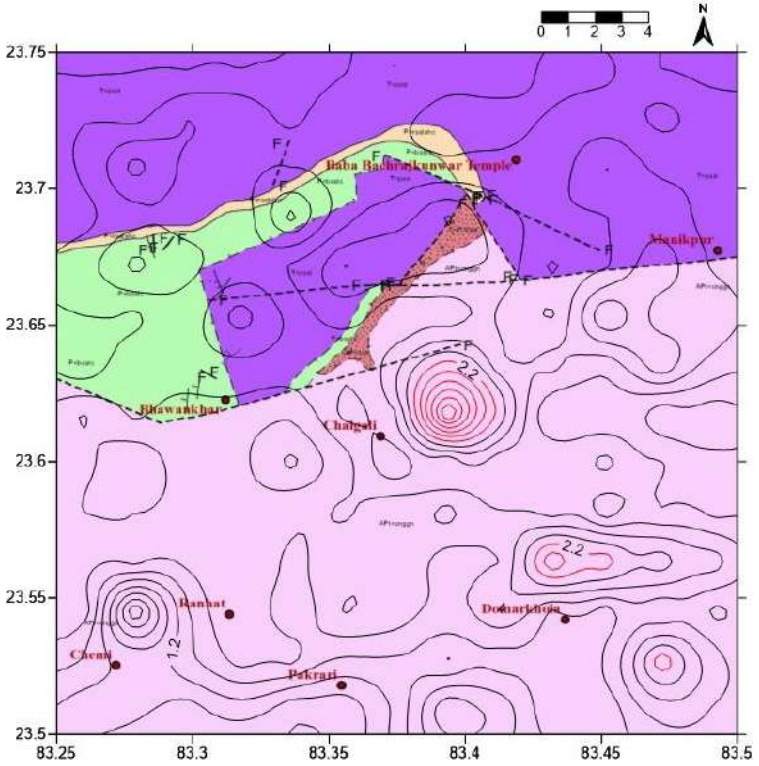
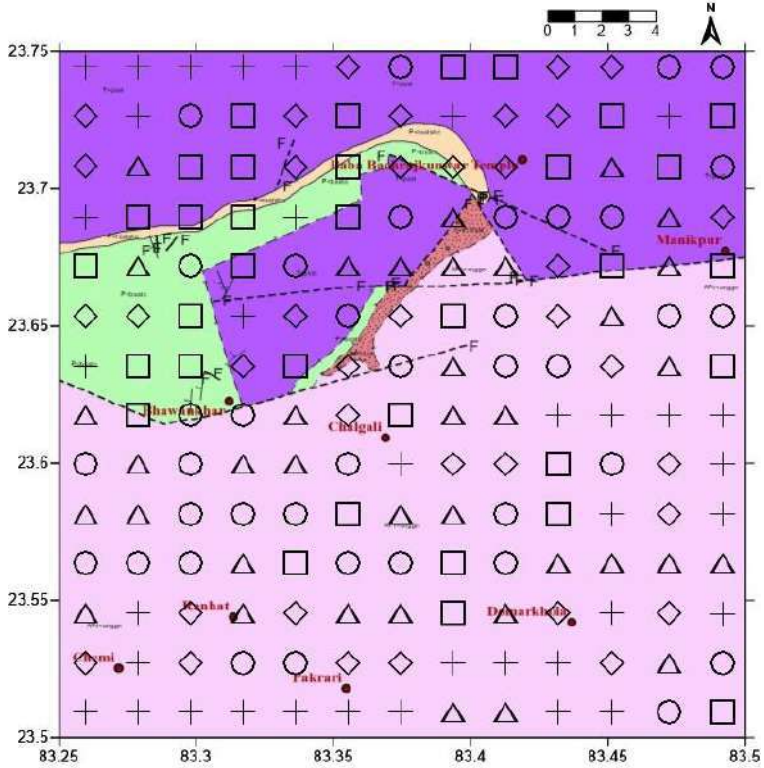


Plate 40: Geochemical distribution and classed post map of Germanium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Germanium

Mean	1.55
Standard Error	0.02
Median	1.55
Mode	1.56
Standard Deviation	0.33
Sample Variance	0.11
Kurtosis	7.60
Skewness	1.00

Range	3.31
Minimum	0.18
Maximum	3.49
Sum	281.92
Count	182
Threshold Value	2.211286
UCC Average	1.4

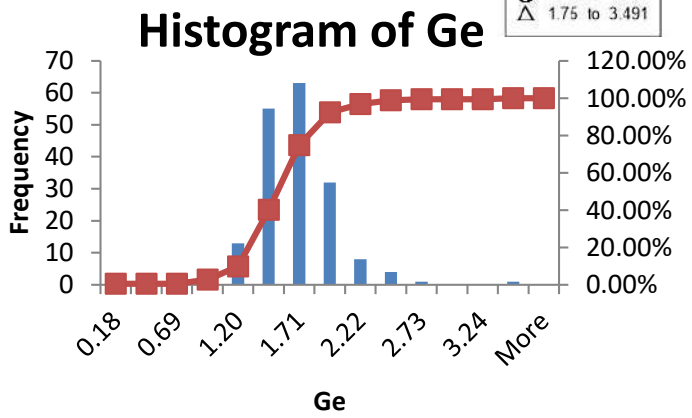
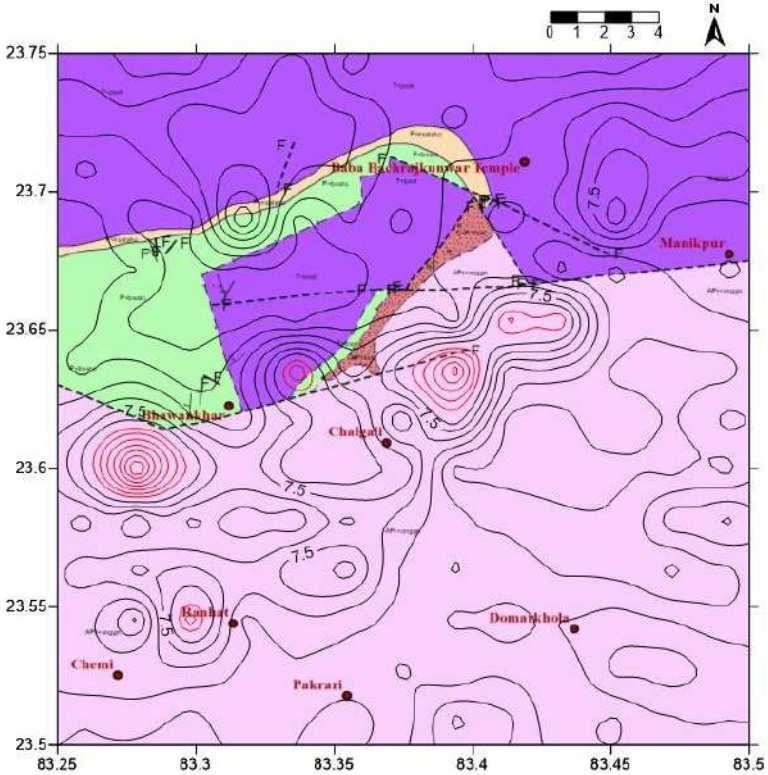
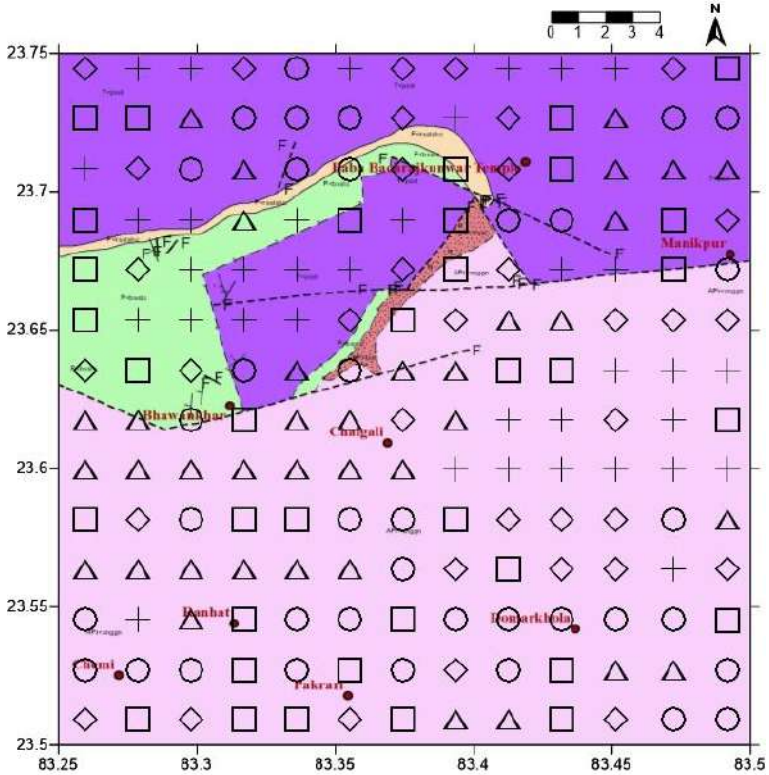


Plate 41: Geochemical distribution and classed post map of Arsenic in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 1 to 1.76
- 1.76 to 3.2
- 3.2 to 4.2
- 4.2 to 5.83
- 5.83 to 22.01

Statistical parameters of Arsenic

Mean	4.33
Standard Error	0.24
Median	3.63
Mode	1.00
Standard Deviation	3.23
Sample Variance	10.41
Kurtosis	6.04
Skewness	1.96

Range	21.00
Minimum	1.00
Maximum	22.00
Sum	788.32
Count	182
Threshold Value	10.78507
UCC Average	4.8

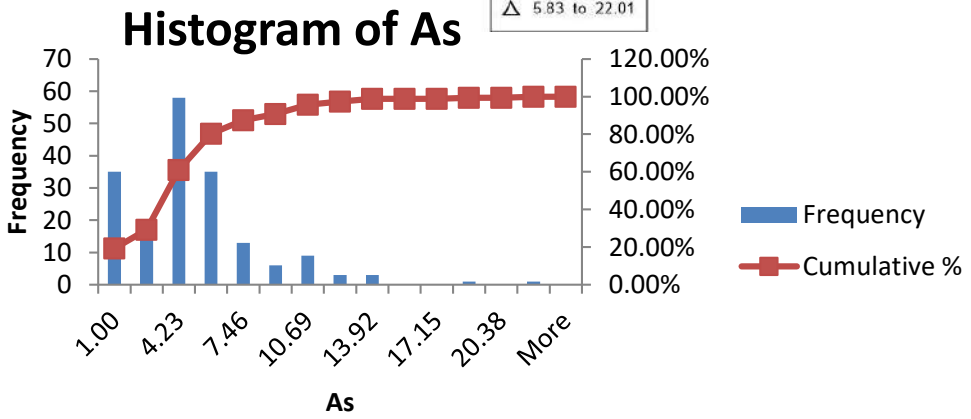
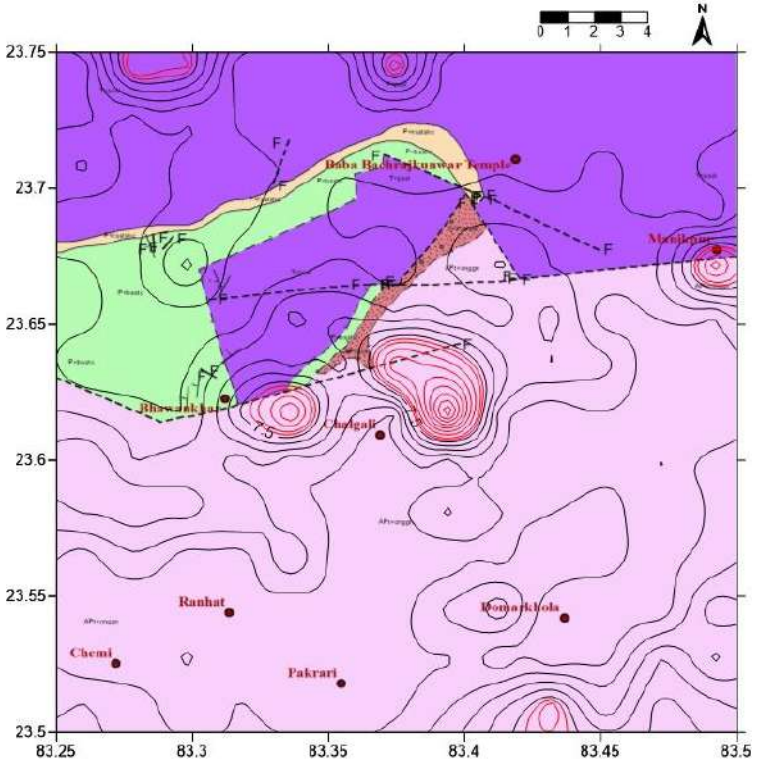
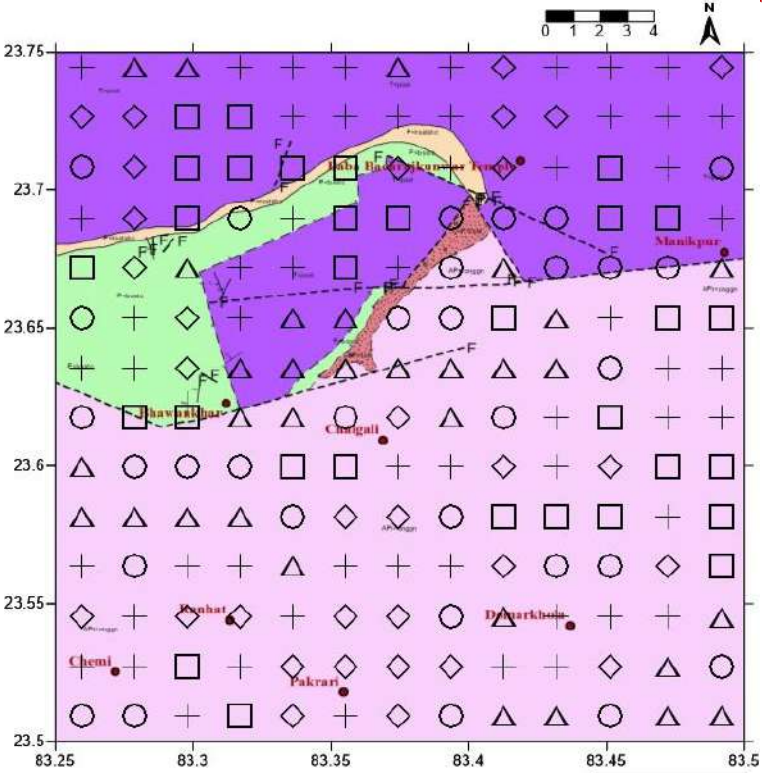


Plate 42: Geochemical distribution and classed post map of Tin in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Tin

Mean	2.42
Standard Error	0.22
Median	1.43
Mode	0.50
Standard Deviation	2.92
Sample Variance	8.53
Kurtosis	12.94
Skewness	3.12

Range	21.00
Minimum	0.50
Maximum	21.50
Sum	440.30
Count	182
Threshold Value	8.261745
UCC Average	2.1

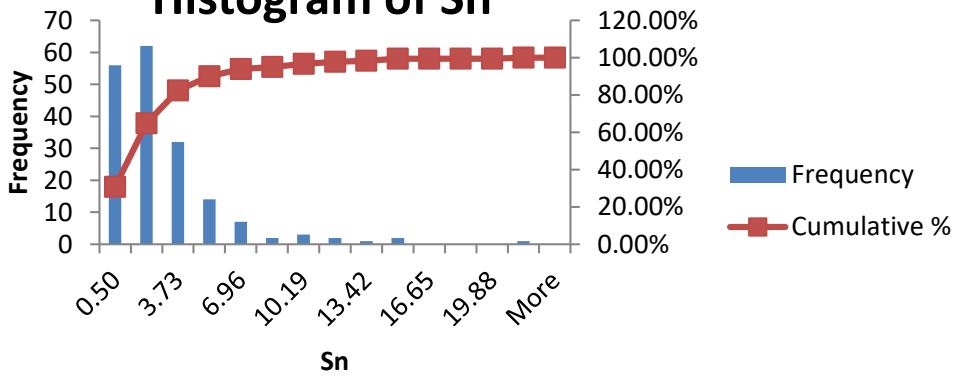
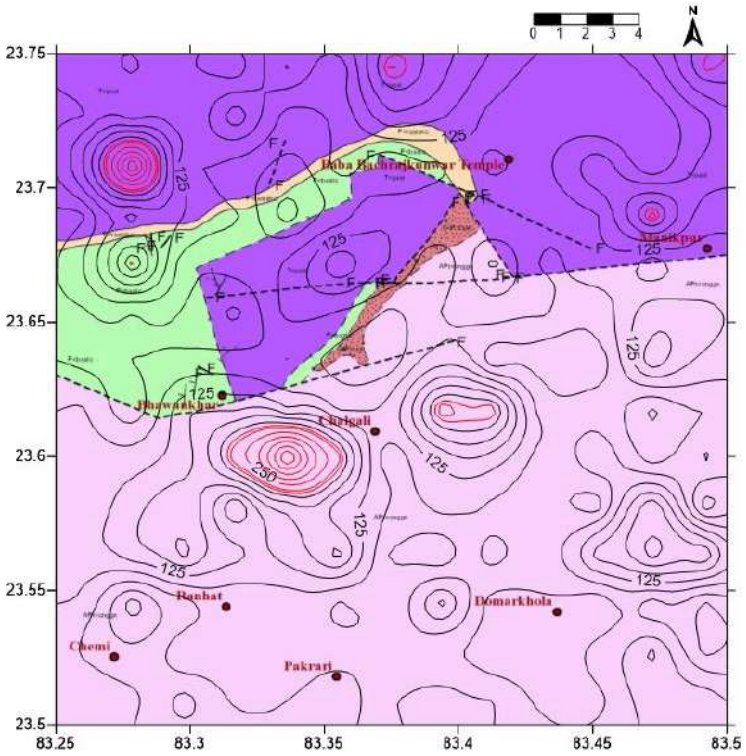
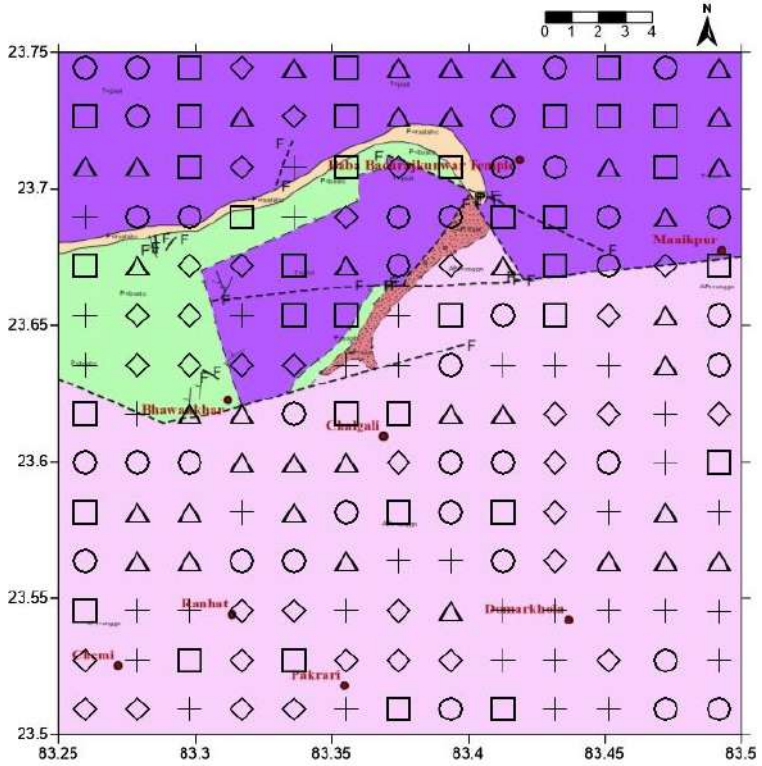


Plate 43: Geochemical distribution and classed post map of Lanthanum in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Lanthanum

Mean	111.18
Standard Error	3.87
Median	101.95
Mode	119.77
Standard Deviation	52.23
Sample Variance	2727.84
Kurtosis	6.18
Skewness	1.88

Range	374.18
Minimum	10.71
Maximum	384.89
Sum	20234.07
Count	182
Threshold Value	215.6338
UCC Average	31

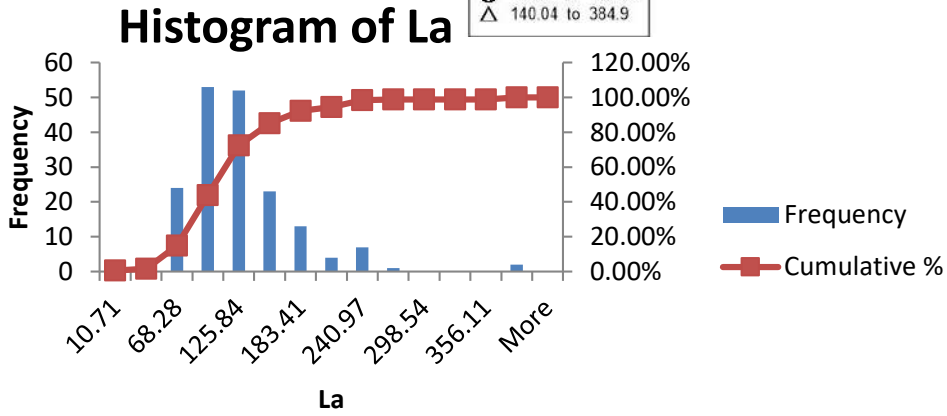
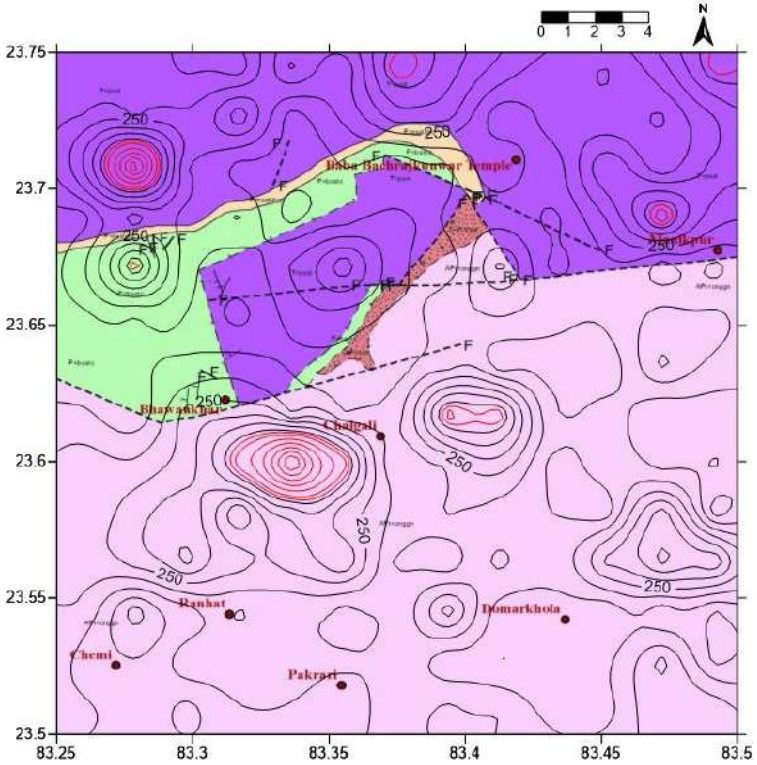
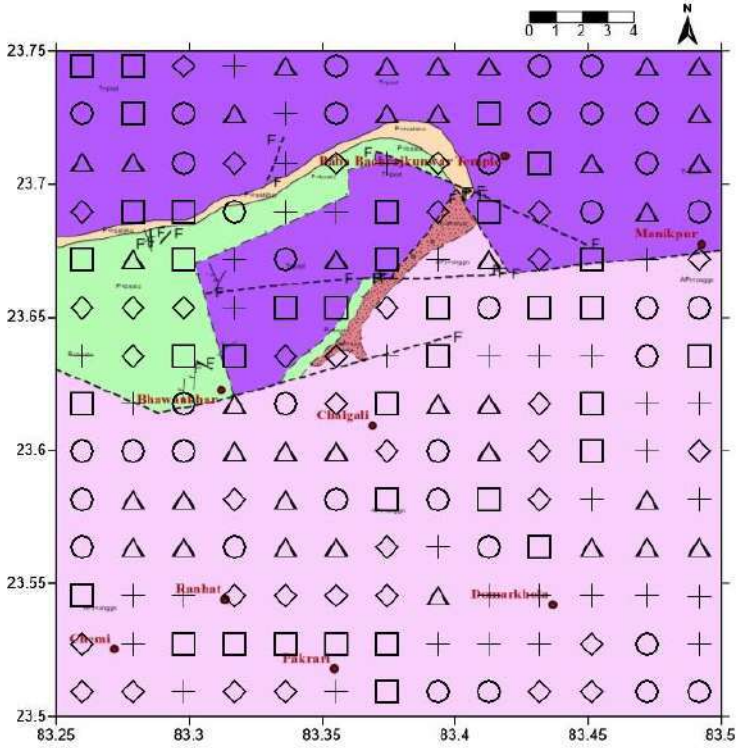


Plate 44: Geochemical distribution and classed post map of Cerium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Cerium

Mean	206.55
Standard Error	8.05
Median	178.13
Mode	-
Standard Deviation	108.66
Sample Variance	11806.68
Kurtosis	6.10
Skewness	2.02

Range	756.50
Minimum	21.91
Maximum	778.41
Sum	37592.10
Count	182
Threshold Value	423.8671
UCC Average	63

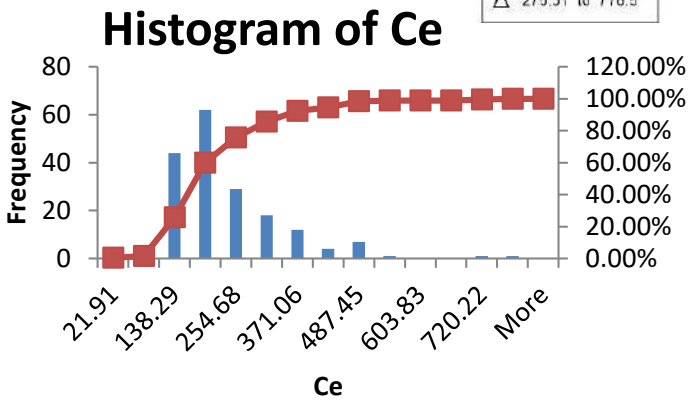
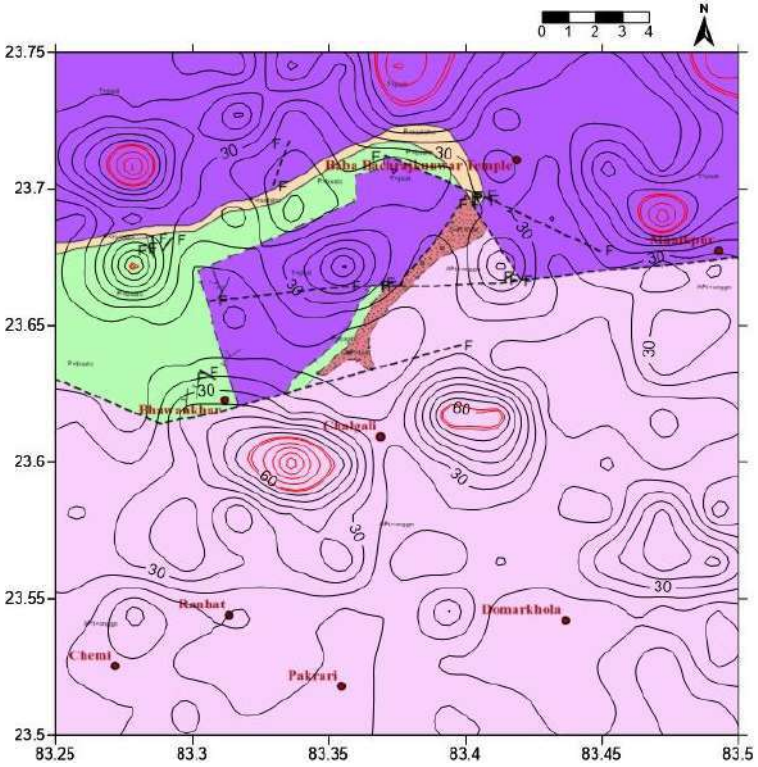
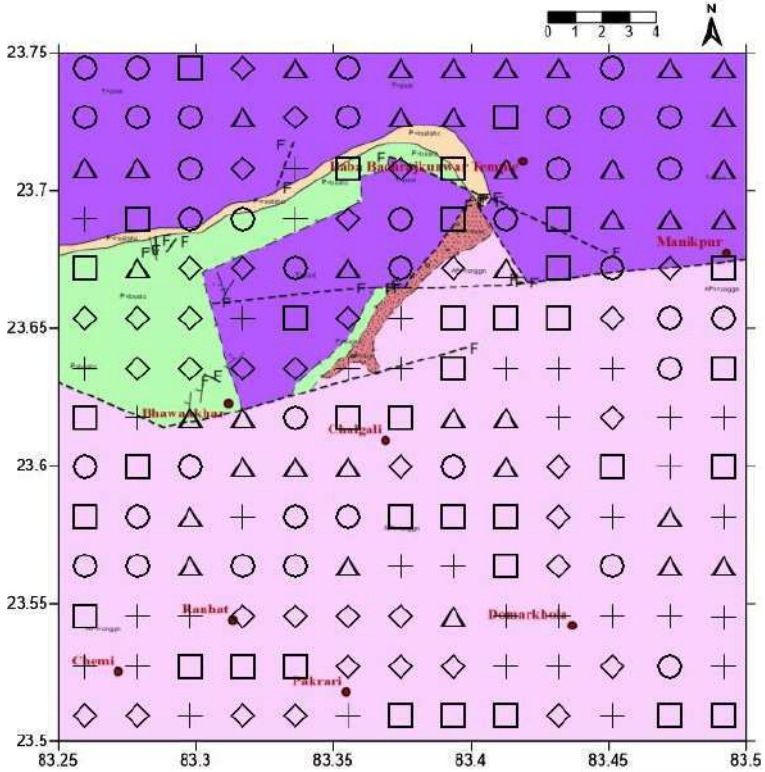


Plate 45: Geochemical distribution and classed post map of Praseodymium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Praseodymium

Mean	28.00
Standard Error	1.14
Median	23.52
Mode	23.53
Standard Deviation	15.36
Sample Variance	236.04
Kurtosis	2.53
Skewness	1.50

Range	88.62
Minimum	2.50
Maximum	91.12
Sum	5095.73
Count	182
Threshold Value	58.72539
UCC Average	7.1

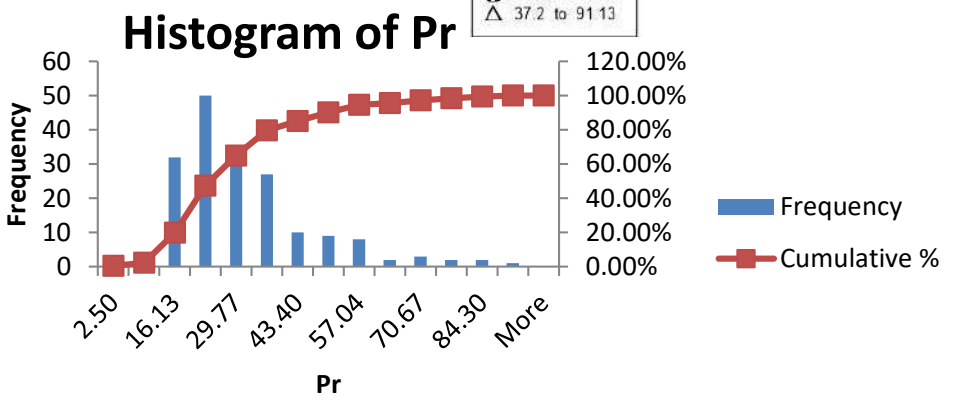
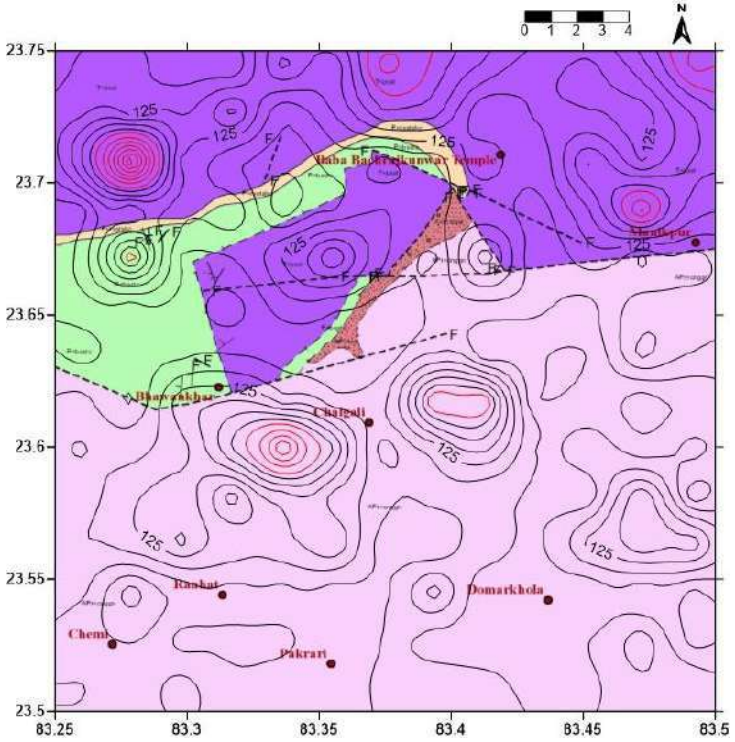
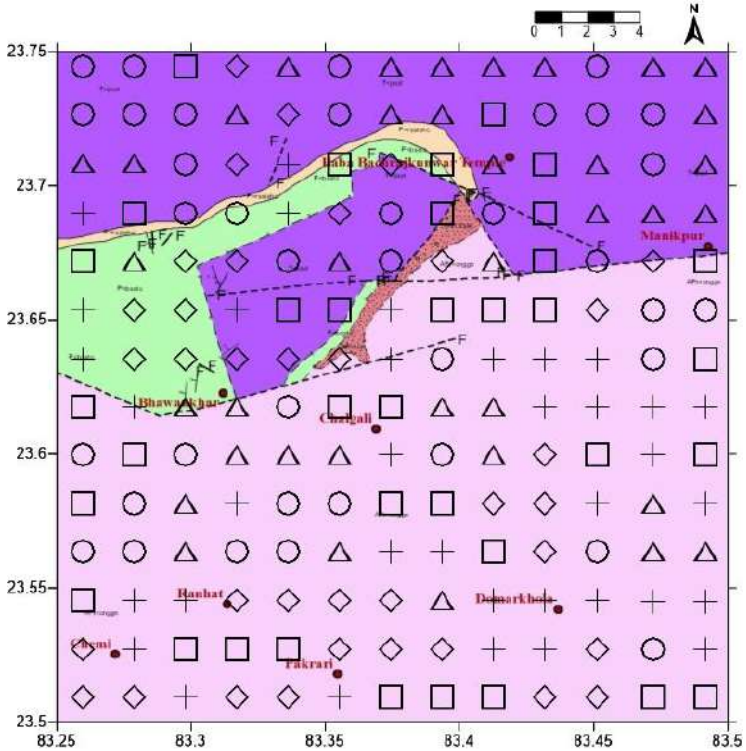


Plate 46: Geochemical distribution and classed post map of Neodymium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 9.91 to 61.35
- 61.35 to 79.5
- 79.5 to 99.64
- 99.64 to 136.59
- 136.59 to 407.9

Statistical parameters of Neodymium

Mean	104.30
Standard Error	4.31
Median	86.82
Mode	60.27
Standard Deviation	58.20
Sample Variance	3387.82
Kurtosis	5.00
Skewness	1.85

Range	397.89
Minimum	9.91
Maximum	407.80
Sum	18982.95
Count	182
Threshold Value	220.7118
UCC Average	27

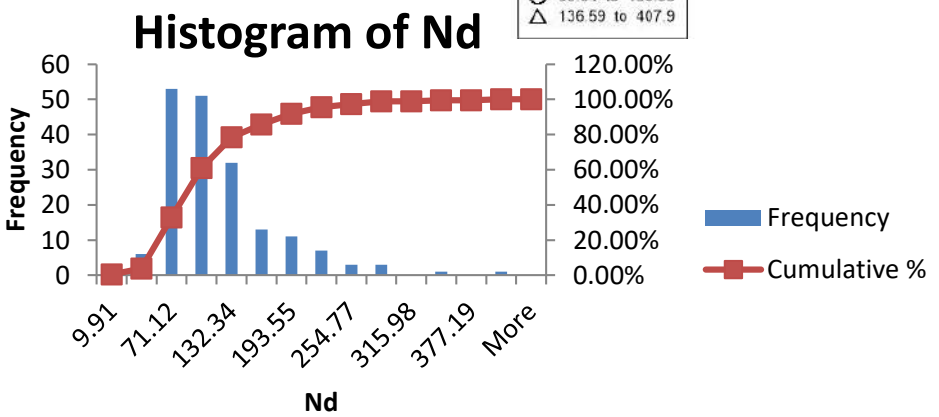
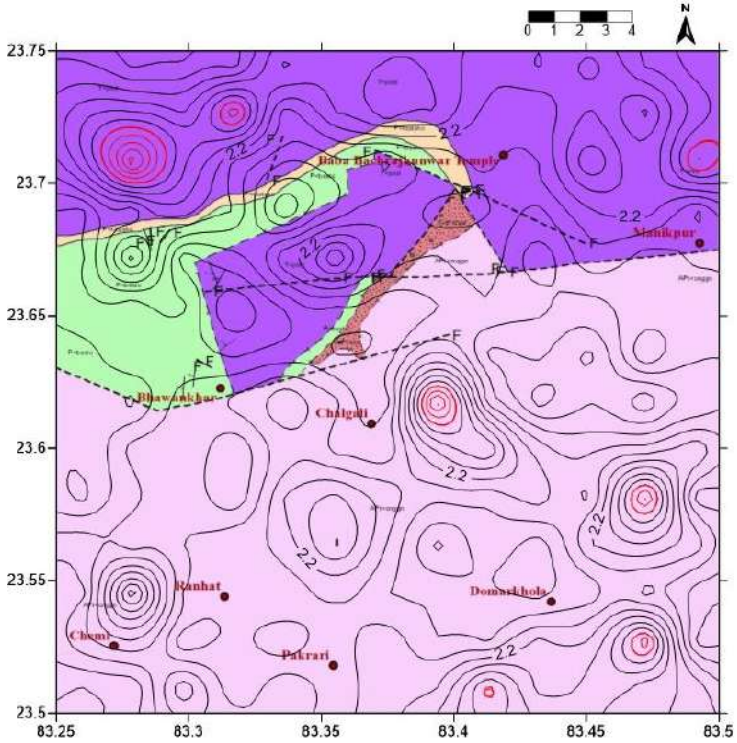
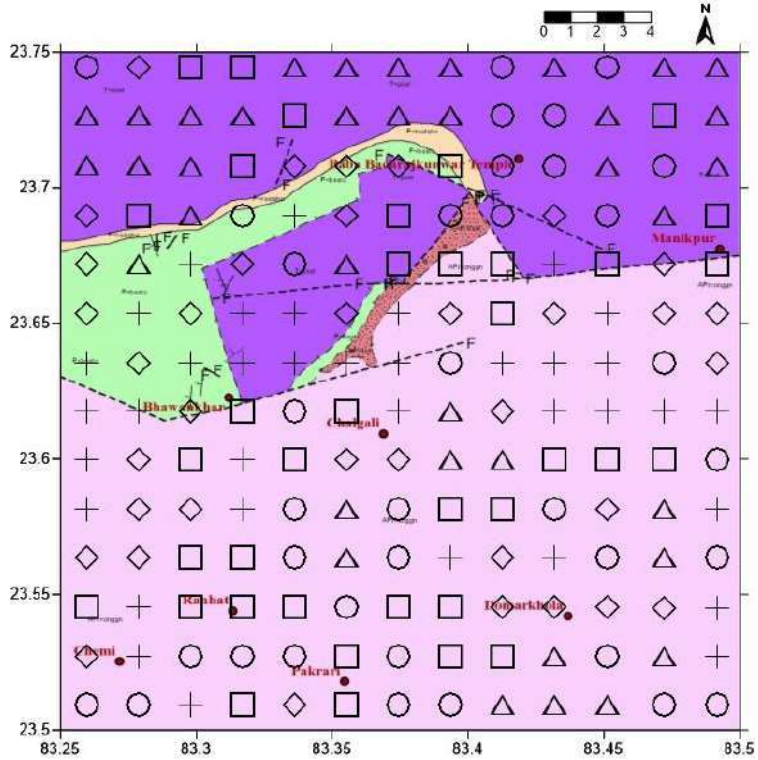


Plate 47: Geochemical distribution and classed post map of Europium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 0.23 to 1.52
- 1.52 to 1.77
- 1.77 to 1.97
- 1.97 to 2.26
- 2.26 to 3.971

Statistical parameters of Europium

Mean	1.94
Standard Error	0.04
Median	1.86
Mode	1.93
Standard Deviation	0.53
Sample Variance	0.28
Kurtosis	2.10
Skewness	0.83

Range	3.74
Minimum	0.23
Maximum	3.97
Sum	352.46
Count	182
Threshold Value	2.987502
UCC Average	1

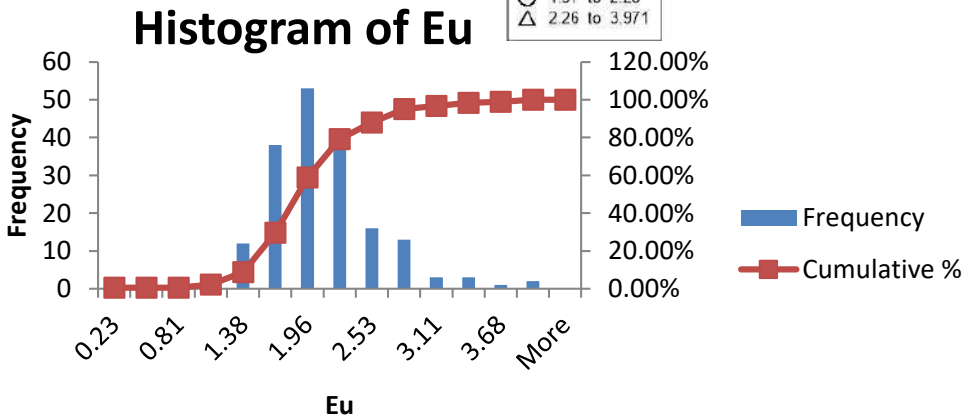
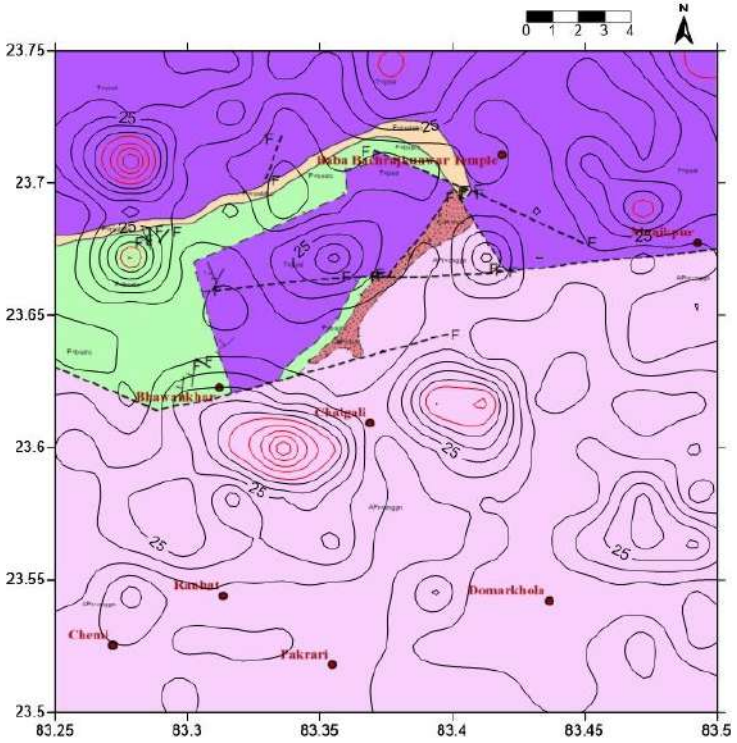
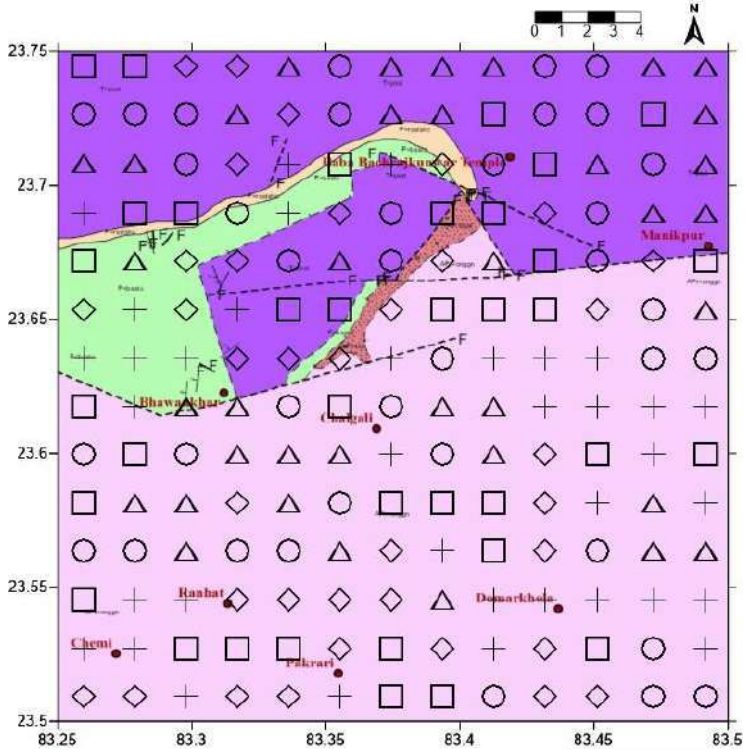


Plate 48: Geochemical distribution and classed post map of Samarium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Samarium

Mean	19.10
Standard Error	0.74
Median	16.48
Mode	16.30
Standard Deviation	9.97
Sample Variance	99.42
Kurtosis	4.68
Skewness	1.82

Range	64.51
Minimum	1.91
Maximum	66.42
Sum	3476.74
Count	182
Threshold Value	39.04512
UCC Average	4.7

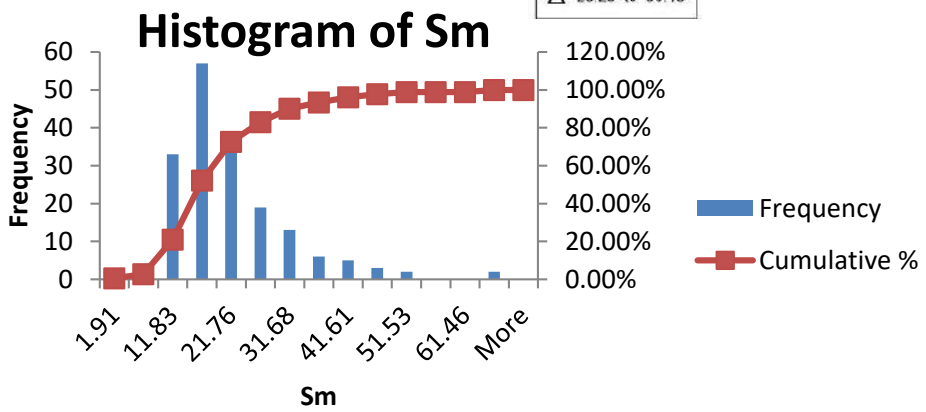
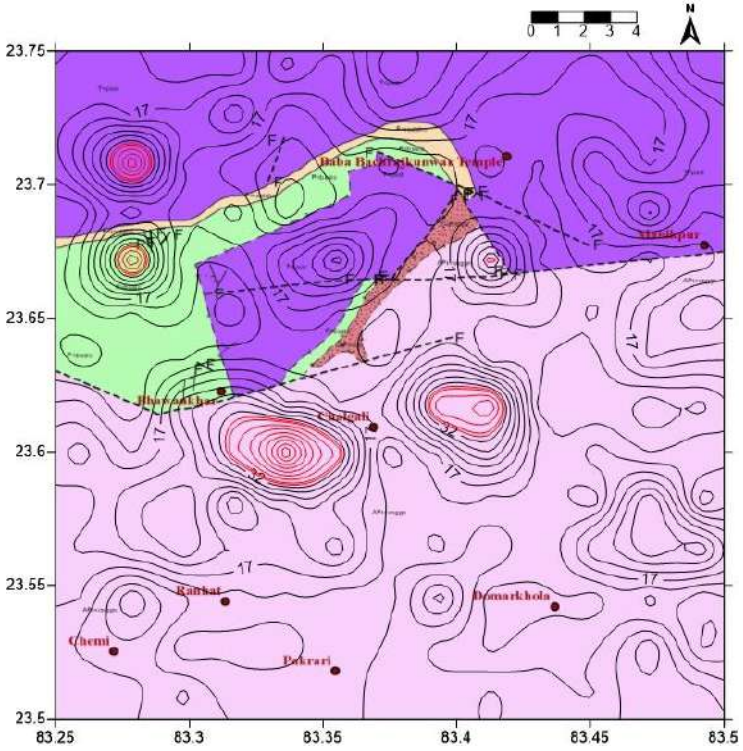
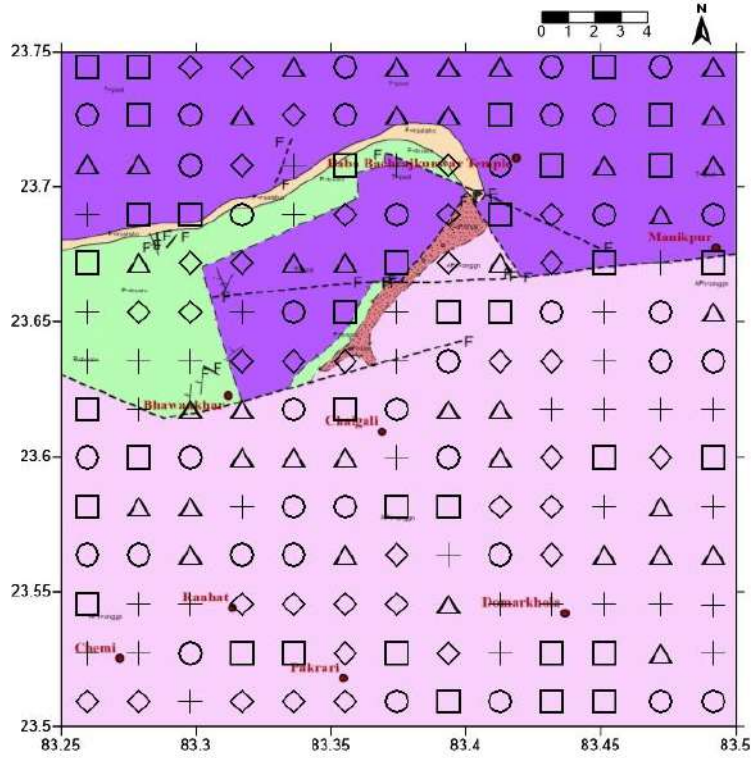


Plate 49: Geochemical distribution and classed post map of Gadolinium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 1.74 to 10.9
- 10.9 to 13.54
- 13.54 to 16.27
- 16.27 to 21.81
- 21.81 to 60.24

Statistical parameters of Gadolinium

Mean	16.91
Standard Error	0.63
Median	14.61
Mode	15.42
Standard Deviation	8.44
Sample Variance	71.29
Kurtosis	5.22
Skewness	1.89

Range	58.49
Minimum	1.74
Maximum	60.23
Sum	3076.73
Count	182
Threshold Value	33.79128
UCC Average	4

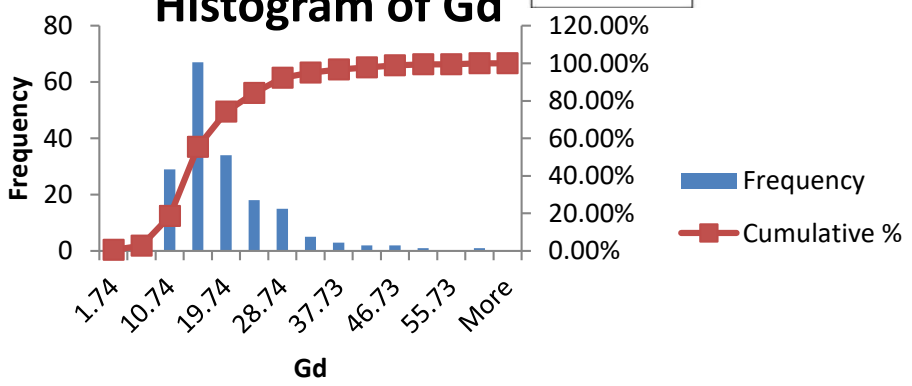
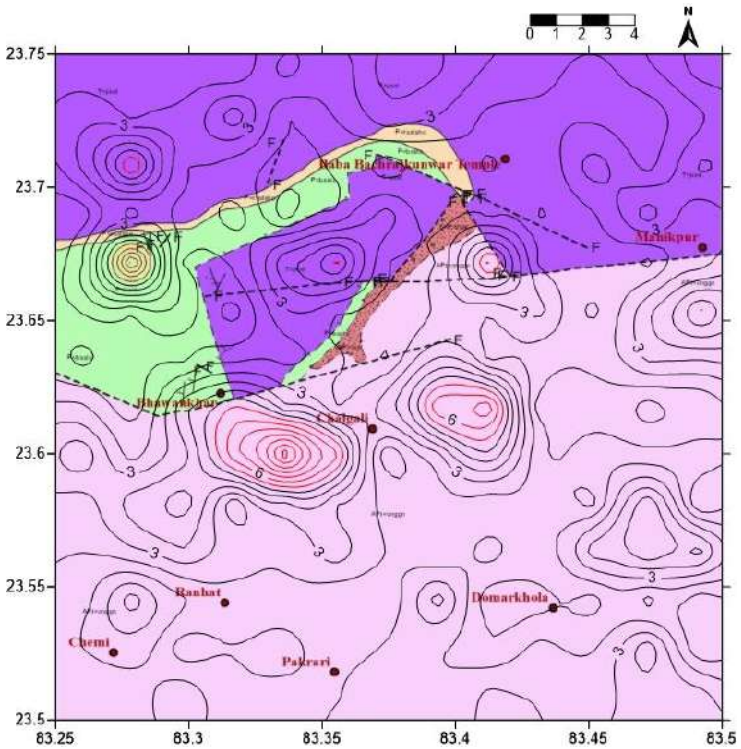
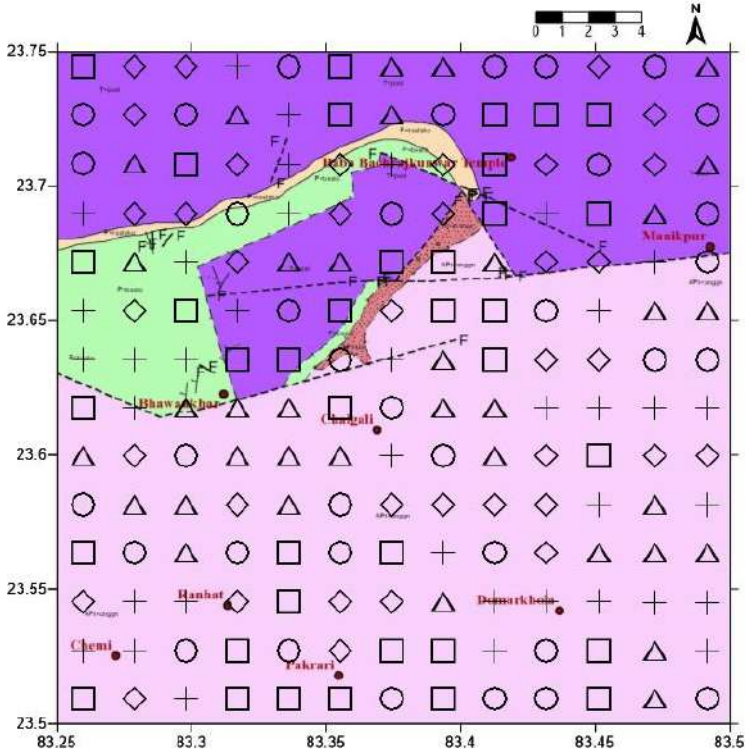


Plate 50: Geochemical distribution and classed post map of Terbium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 0.24 to 1.85
- 1.85 to 2.21
- 2.21 to 2.58
- 2.58 to 3.44
- 3.44 to 9.531

Statistical parameters of Terbium

Mean	2.70
Standard Error	0.10
Median	2.36
Mode	2.19
Standard Deviation	1.33
Sample Variance	1.76
Kurtosis	5.78
Skewness	2.01

Range	9.29
Minimum	0.24
Maximum	9.53
Sum	492.03
Count	182
Threshold Value	5.354996
UCC Average	0.7

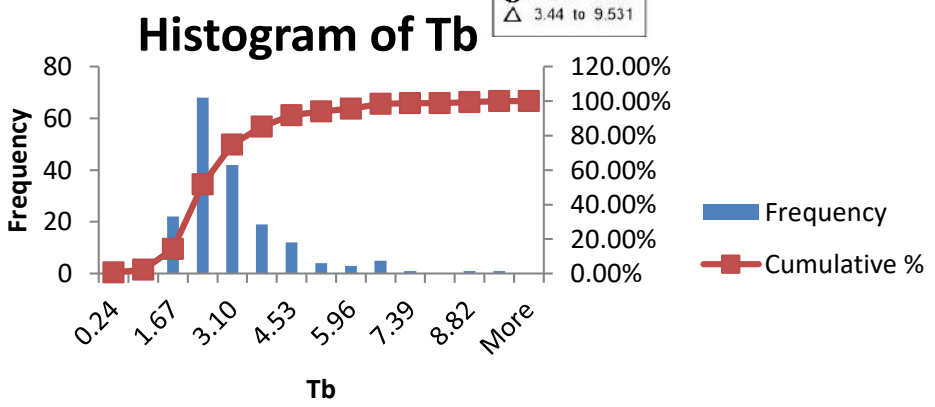
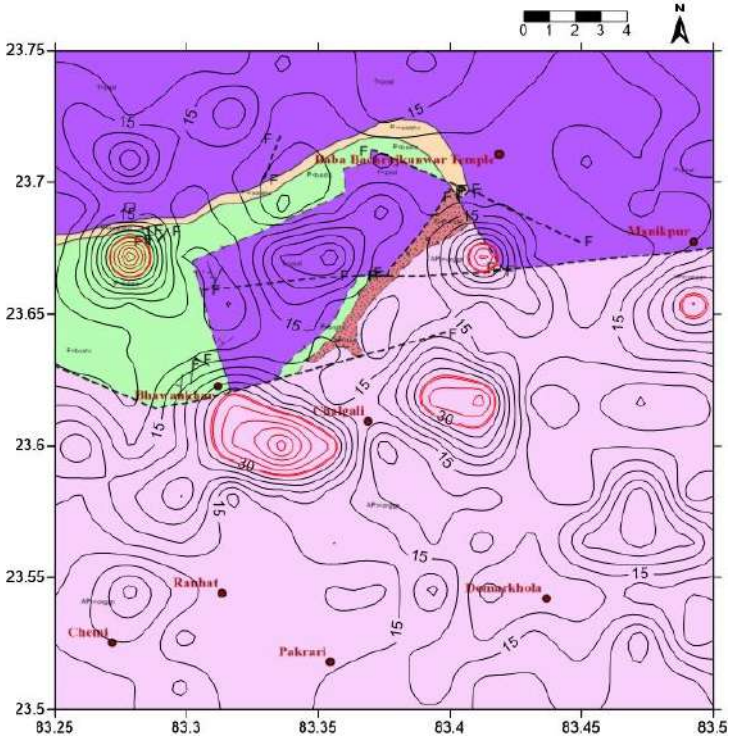
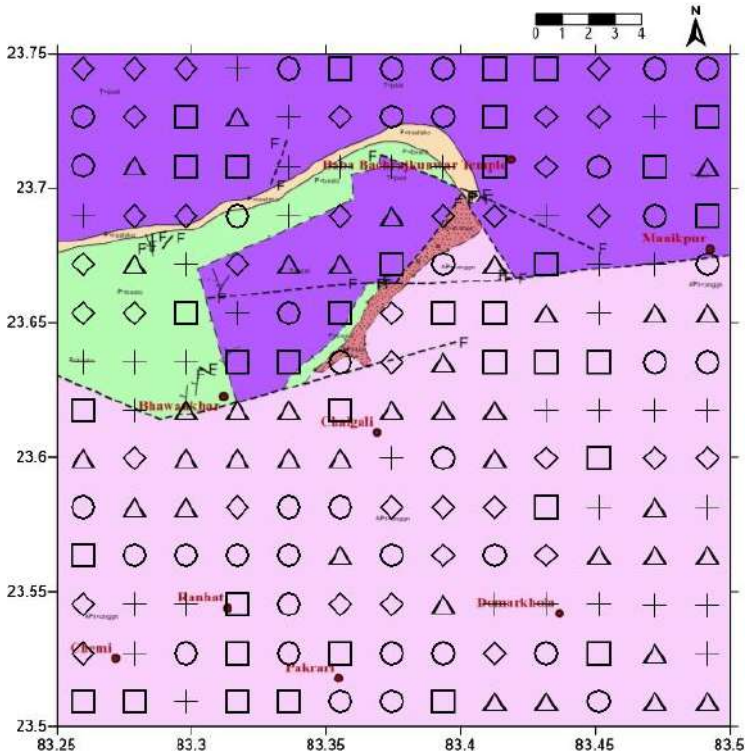


Plate 51: Geochemical distribution and classed post map of Dysprosium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Dysprosium

Mean	14.92
Standard Error	0.54
Median	13.20
Mode	14.00
Standard Deviation	7.24
Sample Variance	52.37
Kurtosis	5.14
Skewness	1.96

Range	46.64
Minimum	1.27
Maximum	47.91
Sum	2714.56
Count	182
Threshold Value	29.38853
UCC Average	3.9

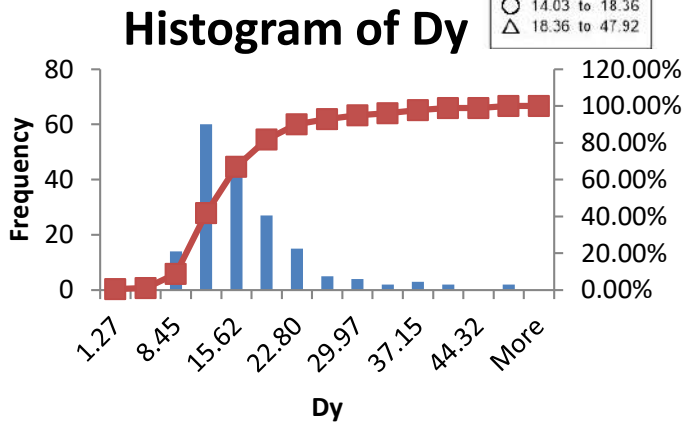
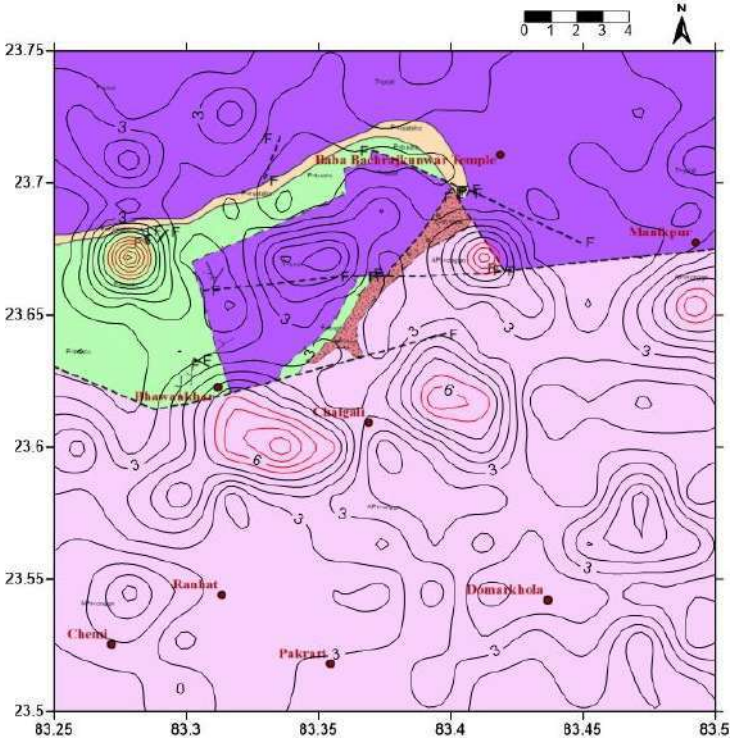
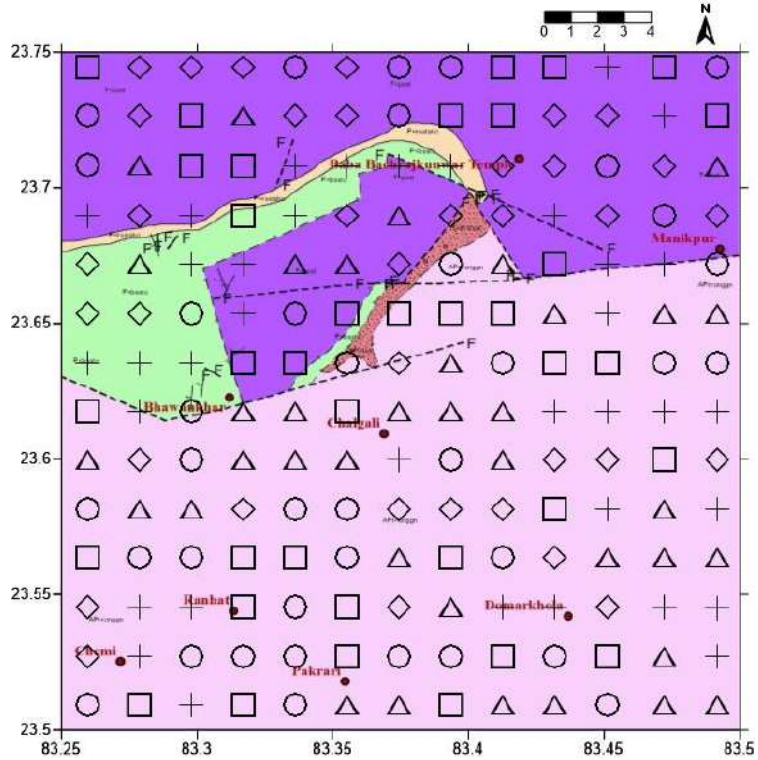


Plate 52: Geochemical distribution and classed post map of Holmium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Holmium

Mean	2.83
Standard Error	0.10
Median	2.55
Mode	2.62
Standard Deviation	1.33
Sample Variance	1.76
Kurtosis	4.06
Skewness	1.72

Range	8.84
Minimum	0.24
Maximum	9.08
Sum	515.39
Count	182
Threshold Value	5.484854
UCC Average	0.83

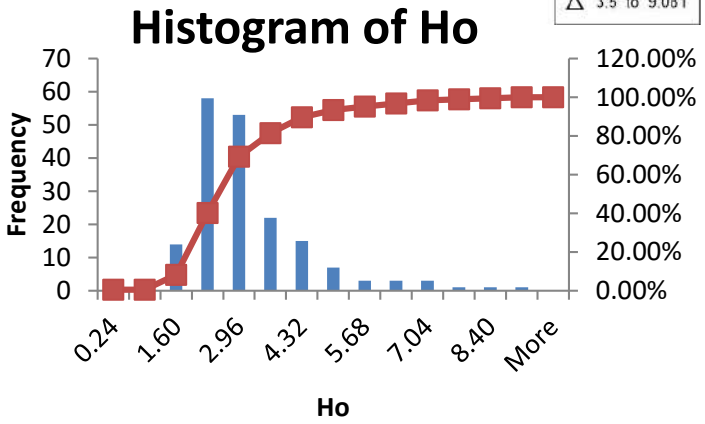
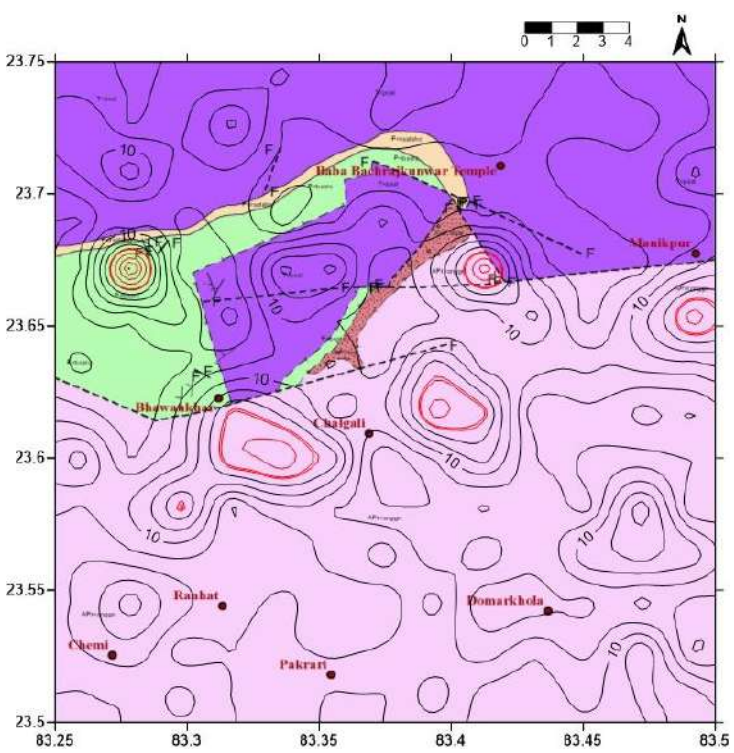
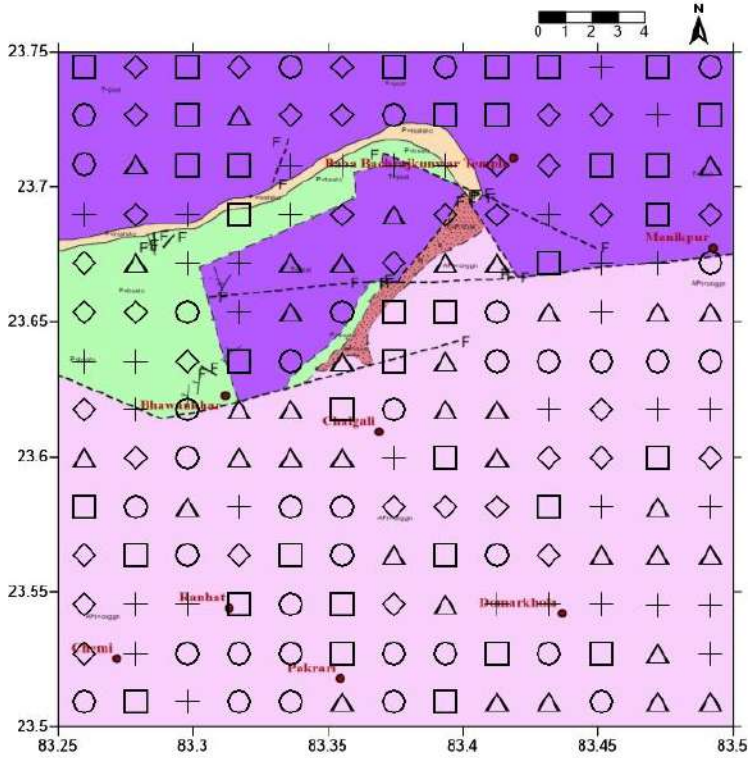


Plate 53: Geochemical distribution and classed post map of Erbium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 0.64 to 5.48
- 5.48 to 6.49
- 6.49 to 7.98
- 7.98 to 10.25
- 10.25 to 25.42

Statistical parameters of Erbium

Mean	8.15
Standard Error	0.28
Median	7.27
Mode	5.71
Standard Deviation	3.76
Sample Variance	14.16
Kurtosis	3.53
Skewness	1.62

Range	24.77
Minimum	0.64
Maximum	25.41
Sum	1483.35
Count	182
Threshold Value	15.67676
UCC Average	2.3

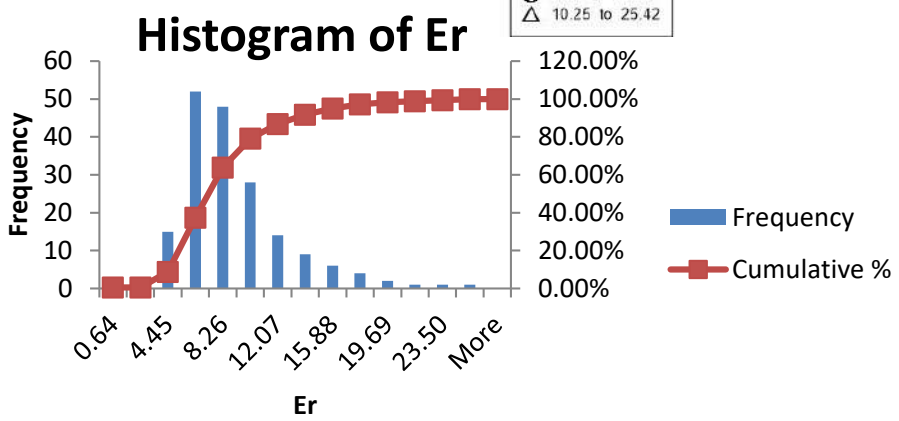
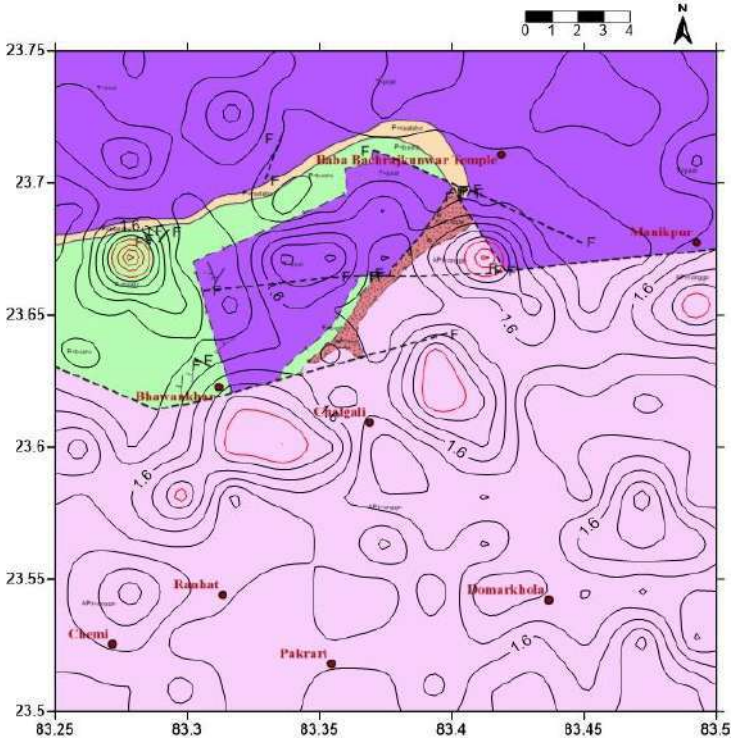
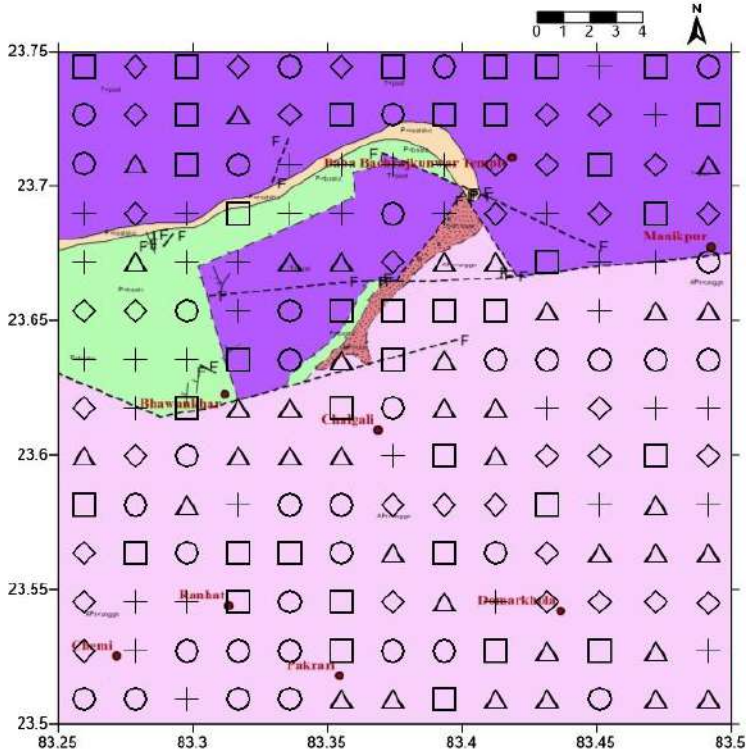


Plate 54: Geochemical distribution and classed post map of Thulium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Values in ppm
- 0.09 to 0.89
- 0.89 to 1.05
- 1.05 to 1.28
- 1.28 to 1.7
- 1.7 to 3.831

Statistical parameters of Thulium

Mean	1.31
Standard Error	0.04
Median	1.18
Mode	1.14
Standard Deviation	0.58
Sample Variance	0.34
Kurtosis	2.39
Skewness	1.35

Range	3.74
Minimum	0.09
Maximum	3.83
Sum	238.19
Count	182
Threshold Value	2.47274
UCC Average	0.3

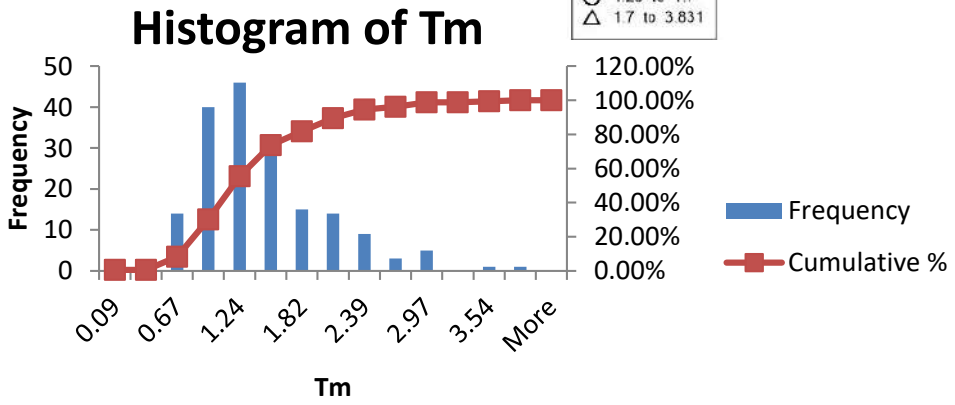
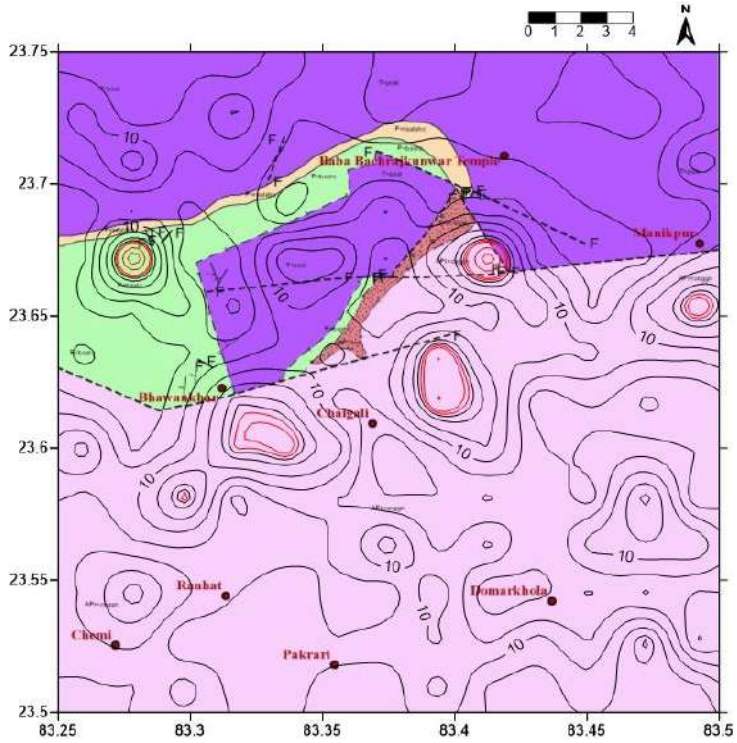
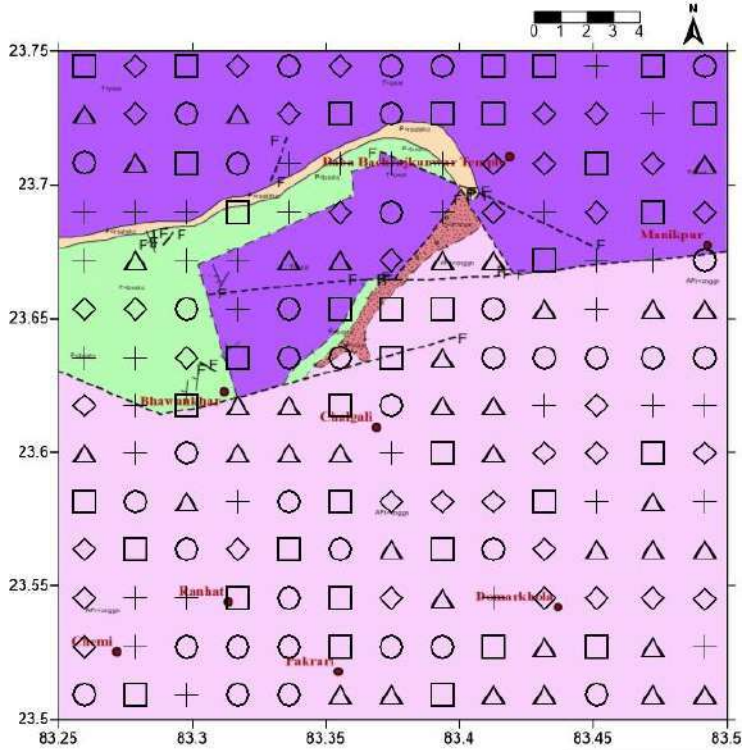


Plate 55: Geochemical distribution and classed post map of Ytterbium in T.S. No.64M/06 (values in ppm)





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T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Ytterbium

Mean	8.33
Standard Error	0.27
Median	7.44
Mode	4.05
Standard Deviation	3.59
Sample Variance	12.89
Kurtosis	2.12
Skewness	1.27

Range	22.21
Minimum	0.69
Maximum	22.90
Sum	1516.82
Count	182
Threshold Value	15.5142
UCC Average	1.96

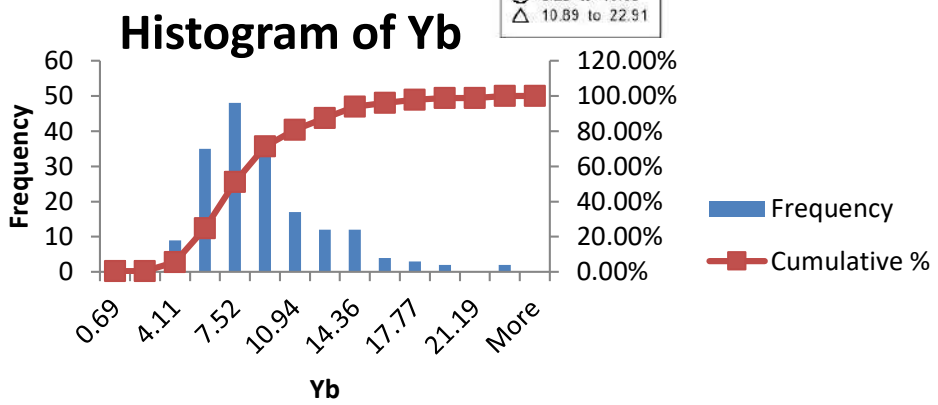
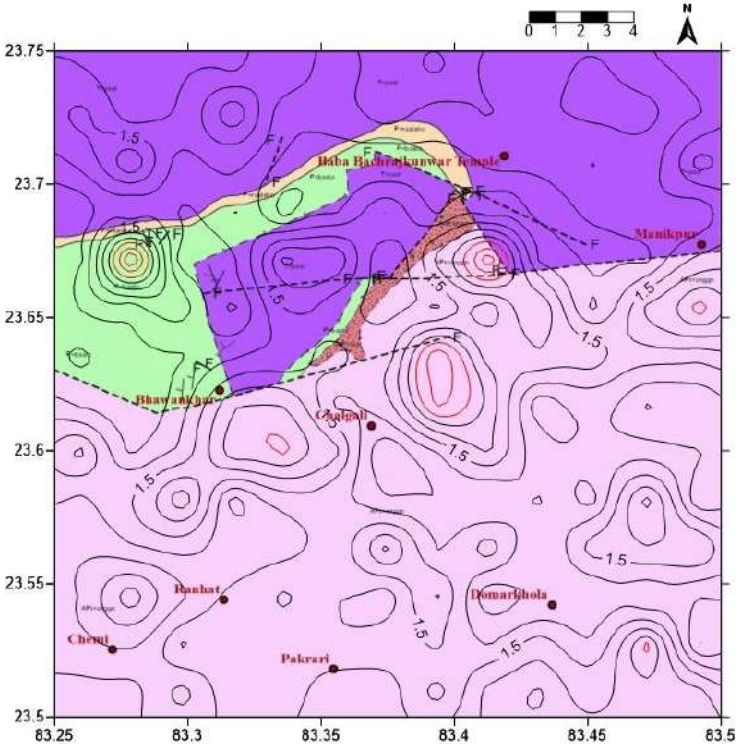
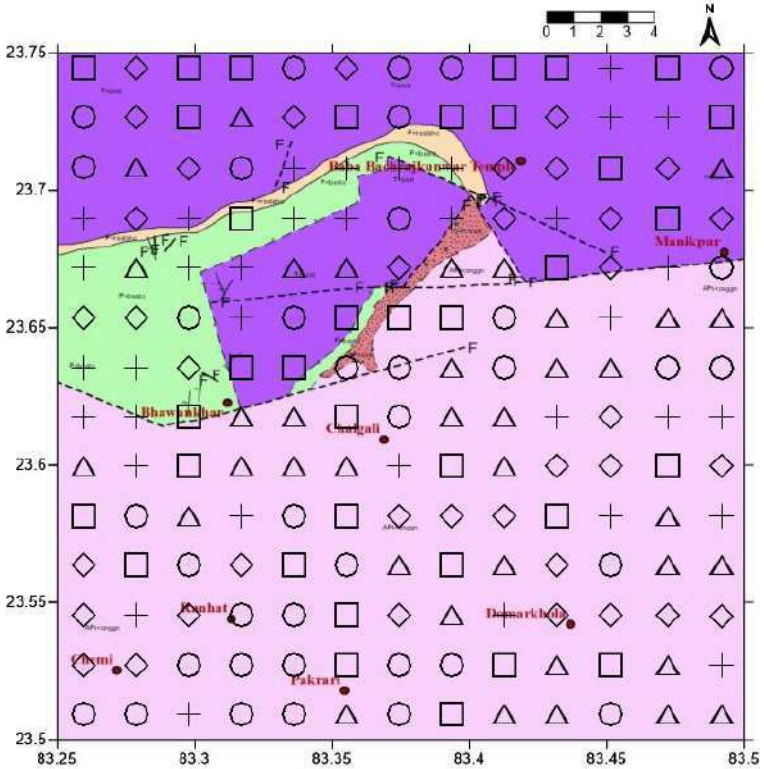


Plate 56: Geochemical distribution and classed post map of Lutetium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Lutetium

Mean	1.28
Standard Error	0.04
Median	1.17
Mode	0.92
Standard Deviation	0.54
Sample Variance	0.29
Kurtosis	2.06
Skewness	1.22

Range	3.36
Minimum	0.09
Maximum	3.45
Sum	233.78
Count	182
Threshold Value	2.363524
UCC Average	0.31

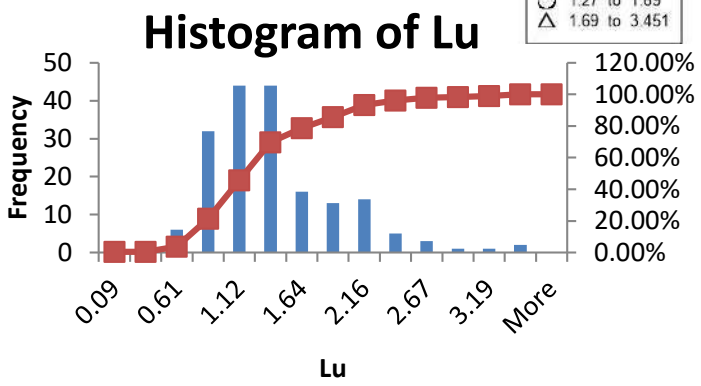
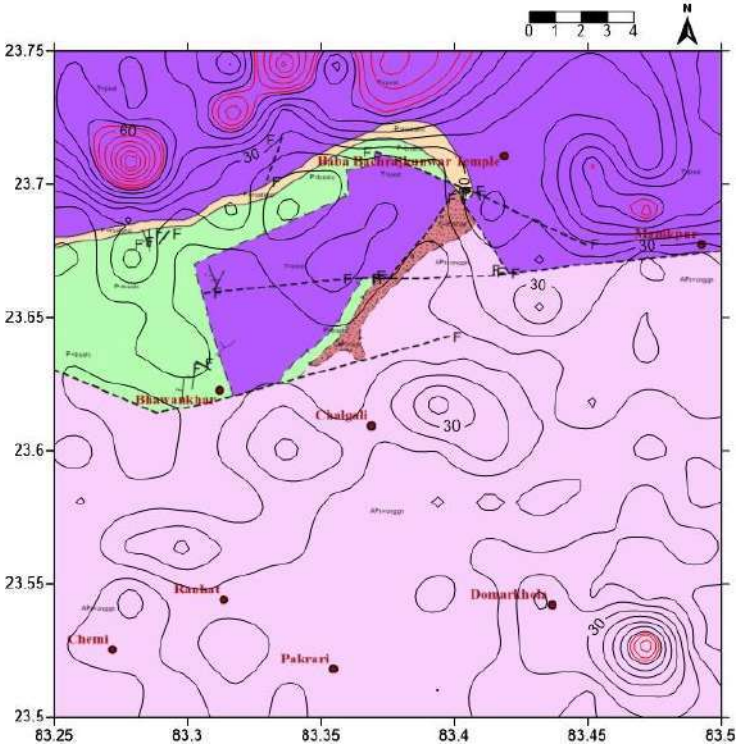
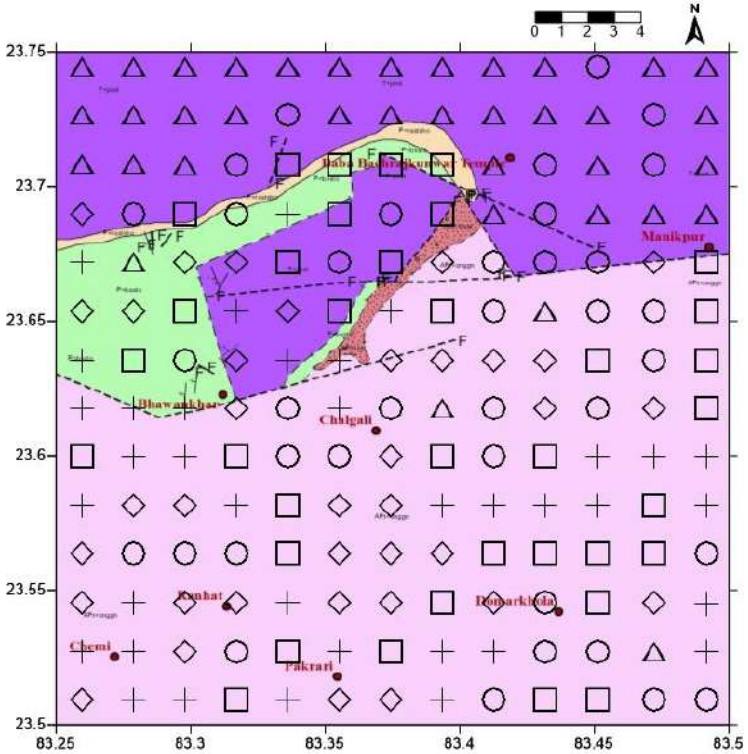


Plate 57: Geochemical distribution and classed post map of Hafnium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Hafnium

Mean	25.04
Standard Error	1.17
Median	20.00
Mode	12.33
Standard Deviation	15.81
Sample Variance	249.91
Kurtosis	4.24
Skewness	1.88

Range	98.00
Minimum	2.01
Maximum	100.01
Sum	4556.53
Count	182
Threshold Value	56.65271
UCC Average	5.3

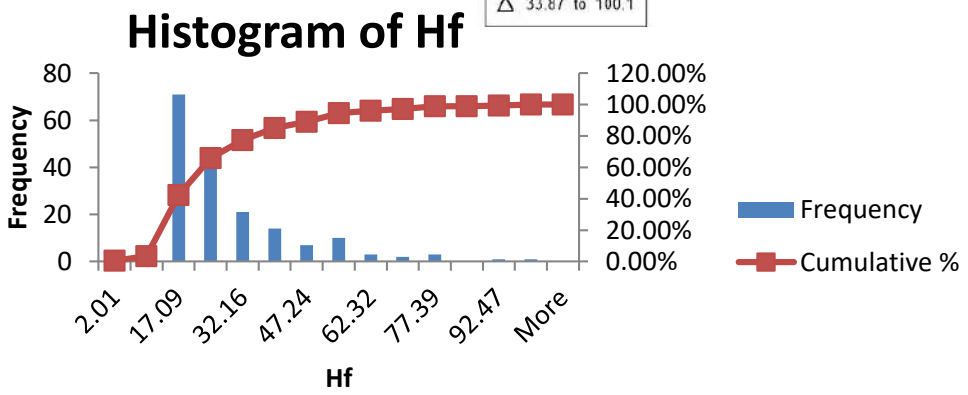
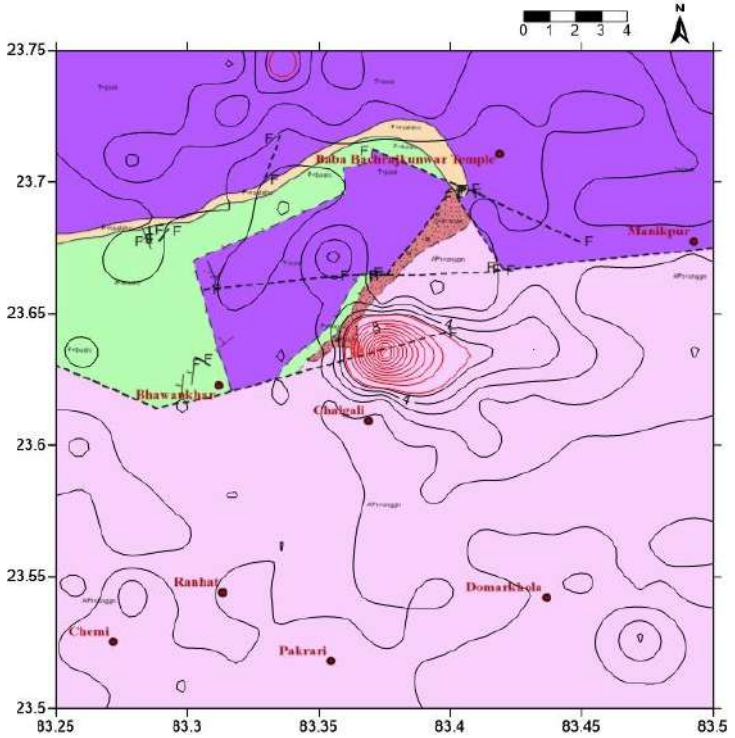
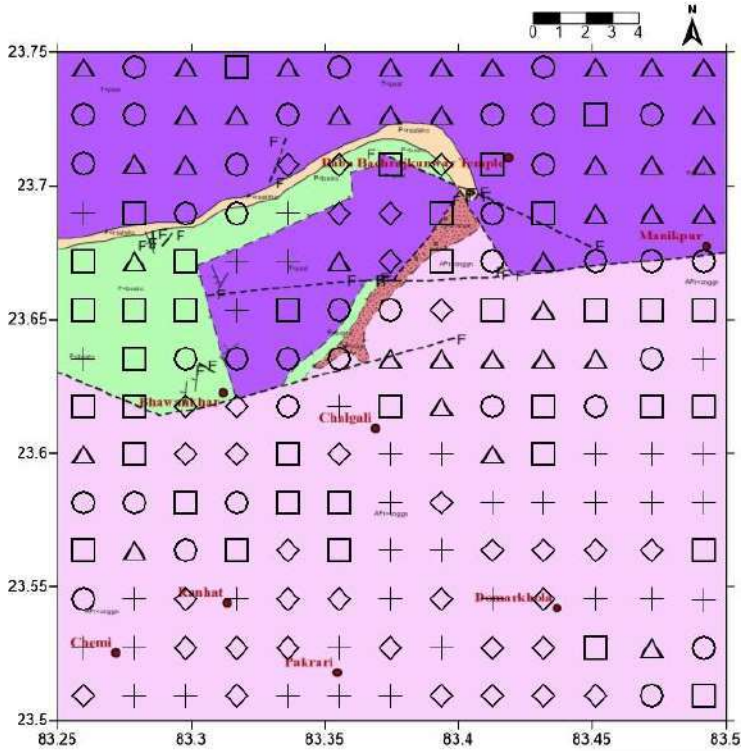


Plate 58: Geochemical distribution and classed post map of Tantalum in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

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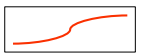
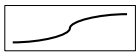
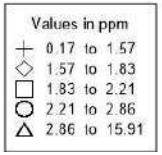


Above threshold value



Below threshold value



Statistical parameters of Tantalum

Mean	2.32
Standard Error	0.10
Median	1.99
Mode	1.56
Standard Deviation	1.40
Sample Variance	1.95
Kurtosis	49.98
Skewness	5.67

Range	15.73
Minimum	0.17
Maximum	15.90
Sum	421.59
Count	182
Threshold Value	5.107567
UCC Average	0.9

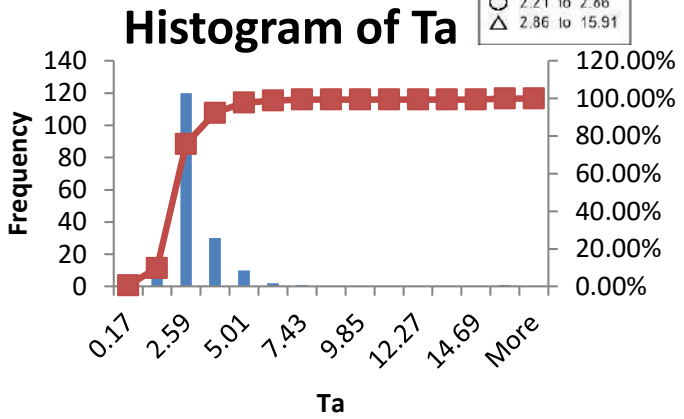
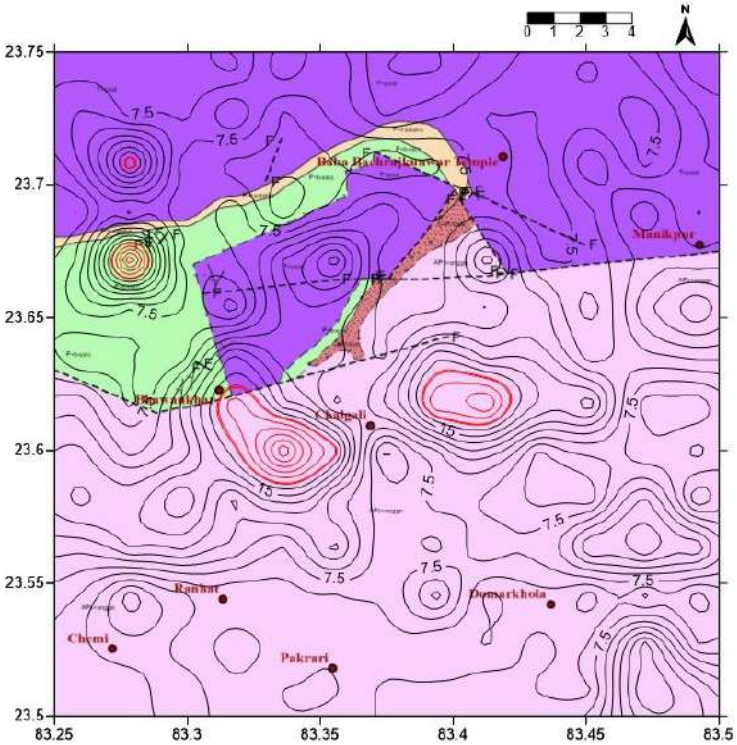
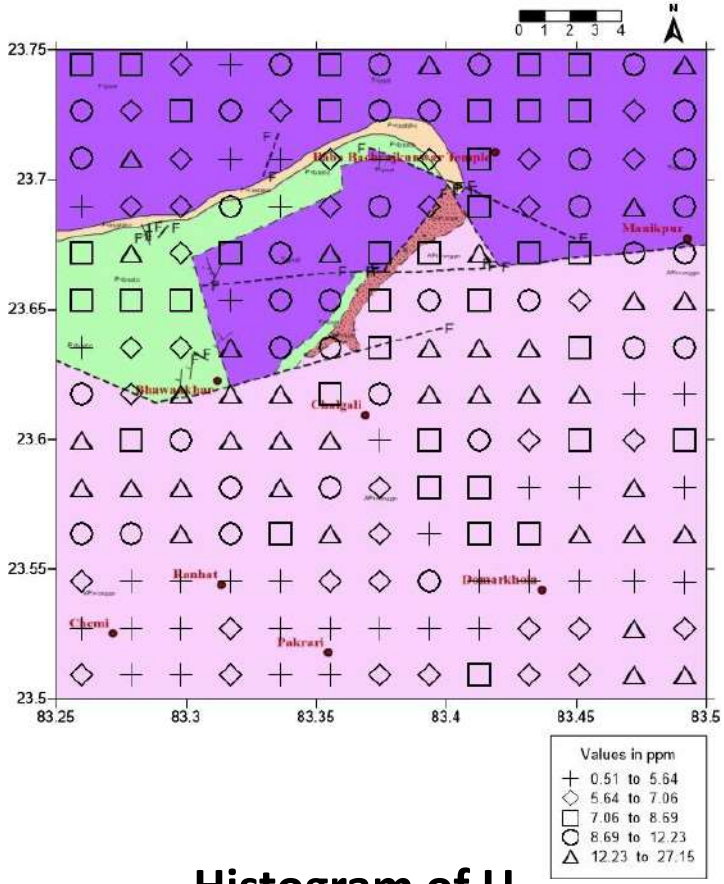


Plate 59: Geochemical distribution and classed post map of Uranium in T.S. No.64M/06 (values in ppm)





Index

T1psst	Panchet Formation
P2rsstshc	Raniganj Formation
P1bsstc	Barakar Formation
C2P1tfsst	Talchir Formation
APt1cnggn	CGC

Symbol

- Bedding
- Inferred Fault
- Observed Fault
- Interpreted Formation Boundary
- Map boundaries
- Observed Formation Boundary

INDEX

Above threshold value

Below threshold value

Statistical parameters of Uranium

Mean	9.03
Standard Error	0.32
Median	7.97
Mode	8.67
Standard Deviation	4.36
Sample Variance	19.05
Kurtosis	2.51
Skewness	1.35

Range	26.63
Minimum	0.51
Maximum	27.14
Sum	1643.33
Count	182
Threshold Value	17.75874
UCC Average	2.7

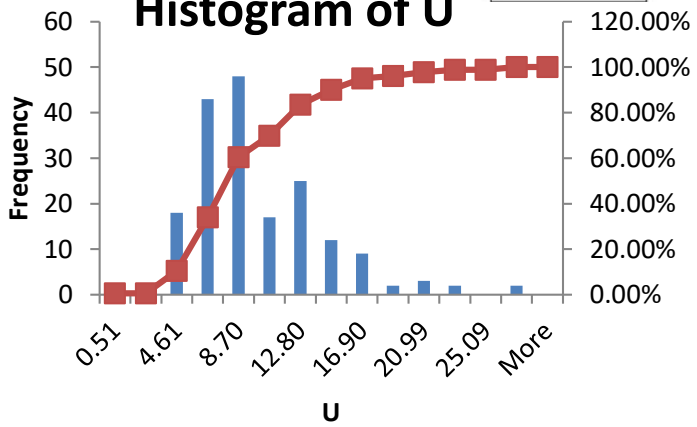
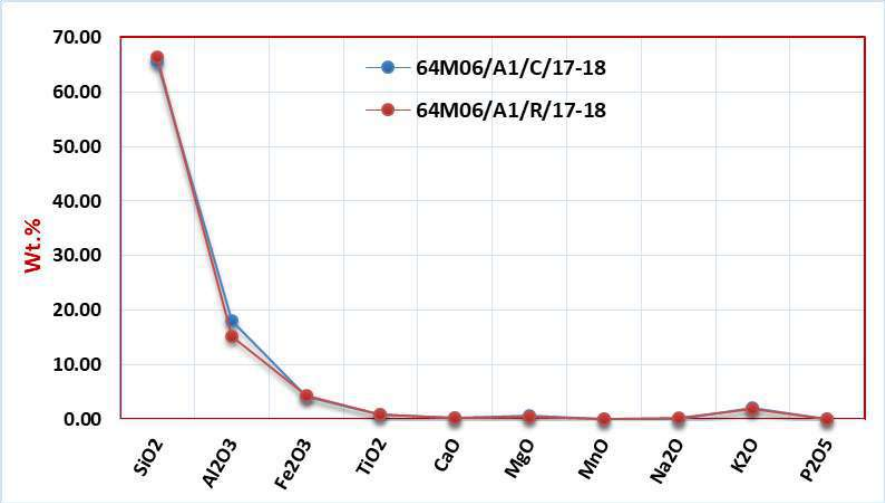
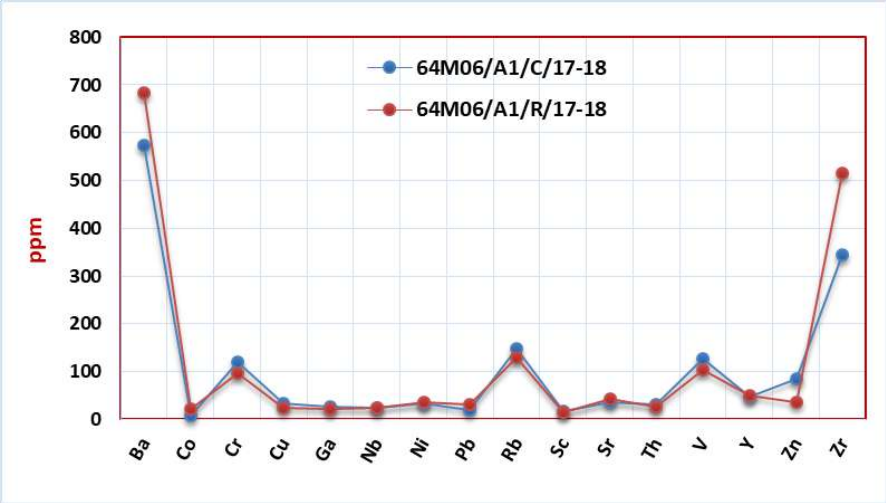


Plate 60: Elemental variation in Soil and Regolith sample of A1 quadrant in T.S. No.64M/06





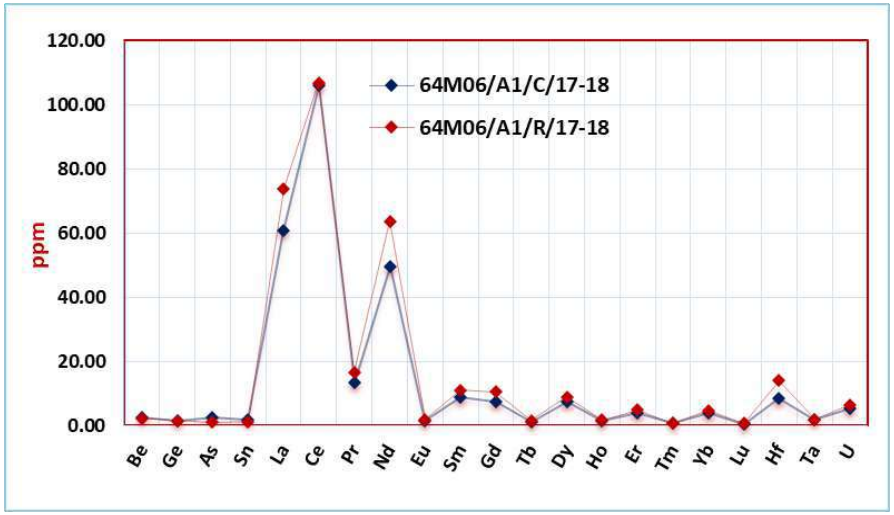
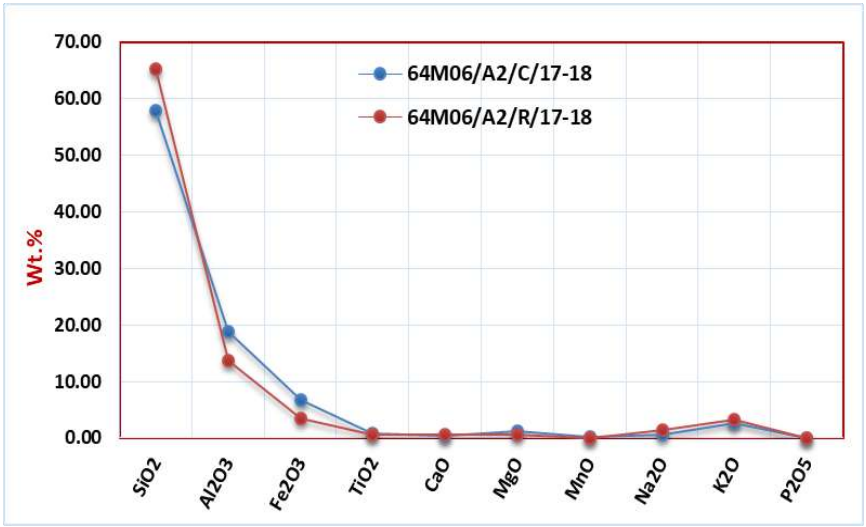
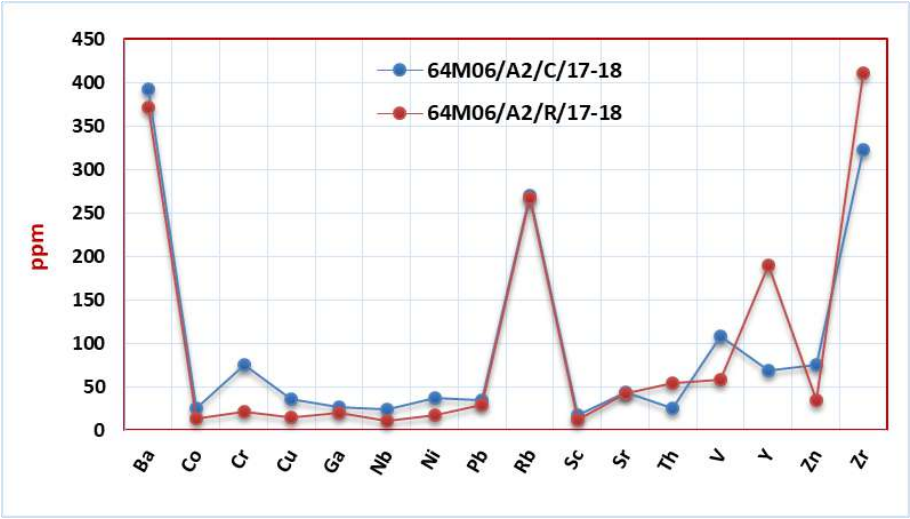


Plate 61: Elemental variation in Soil and Regolith sample of A2 quadrant in T.S. No.64M/06





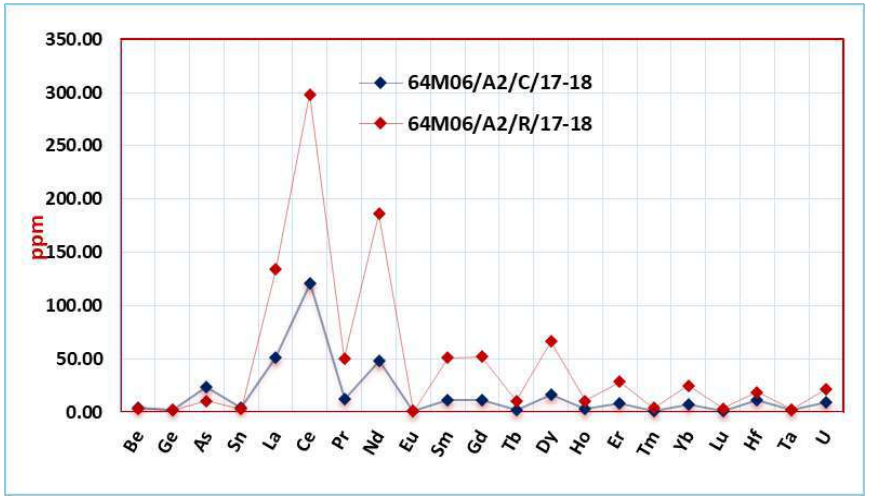
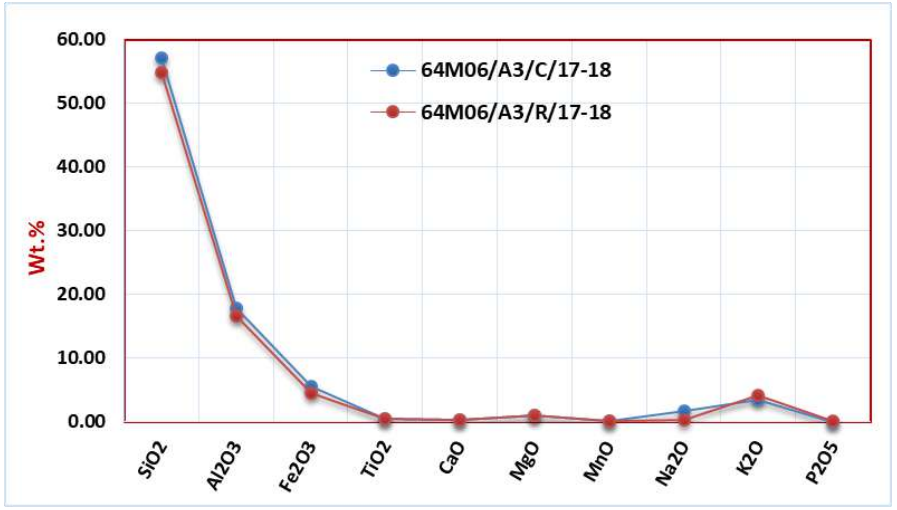
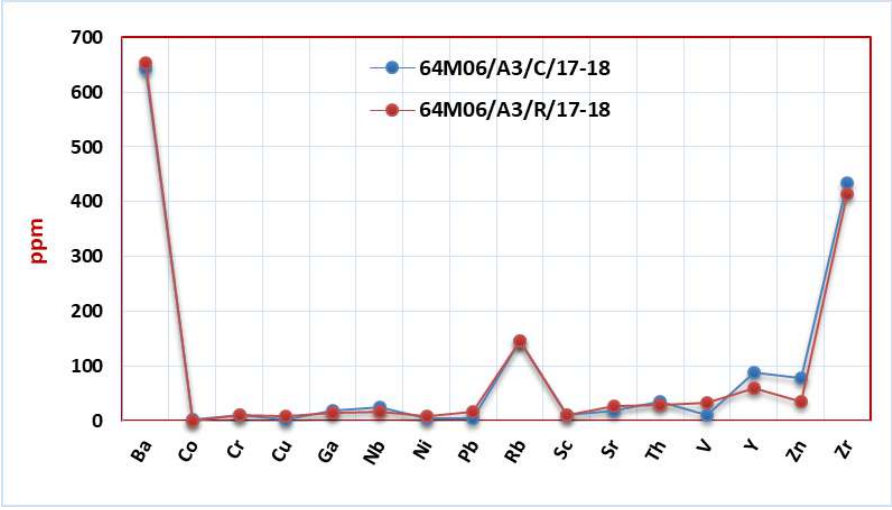


Plate 62: Elemental variation in Soil and Regolith sample of A3 quadrant in T.S. No.64M/06





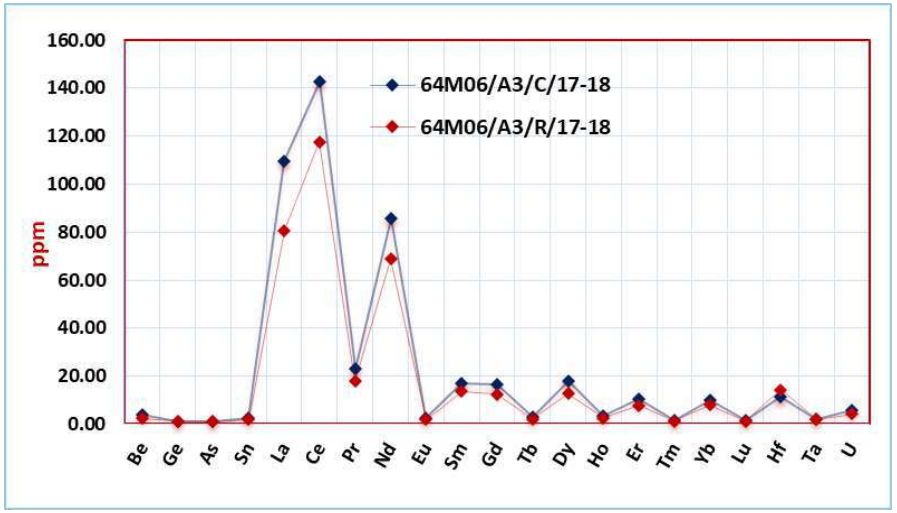
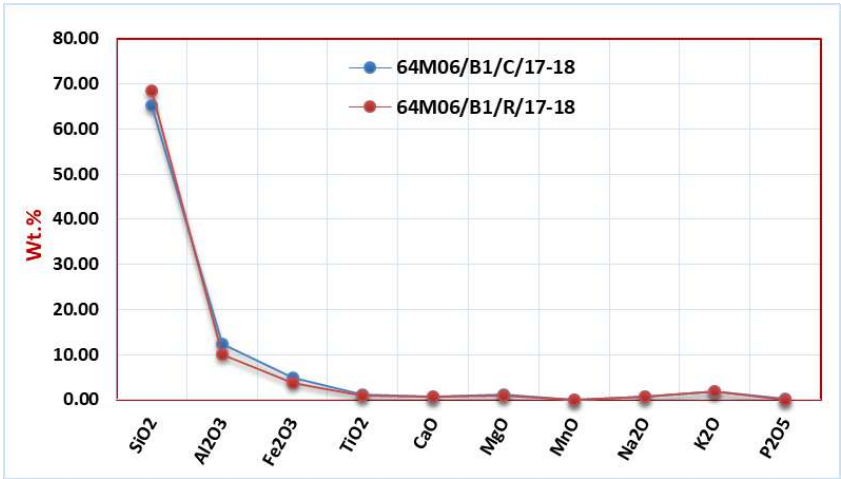
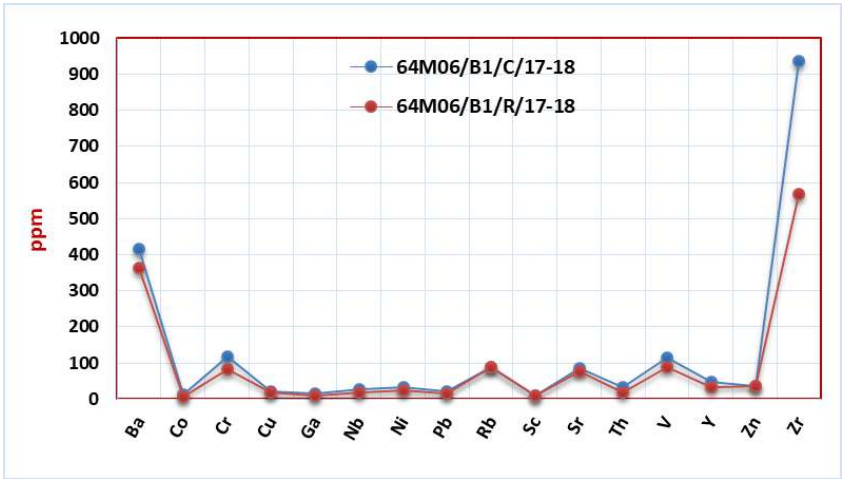


Plate 63: Elemental variation in Soil and Regolith sample of B1 quadrant in T.S. No.64M/06





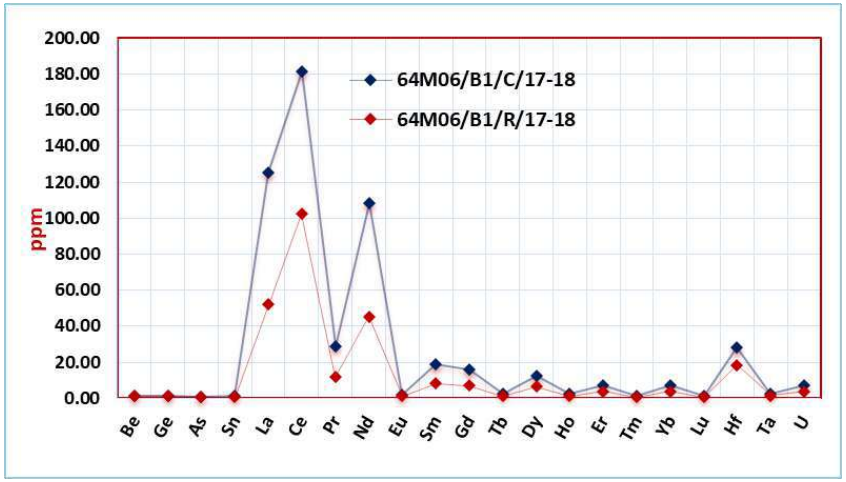
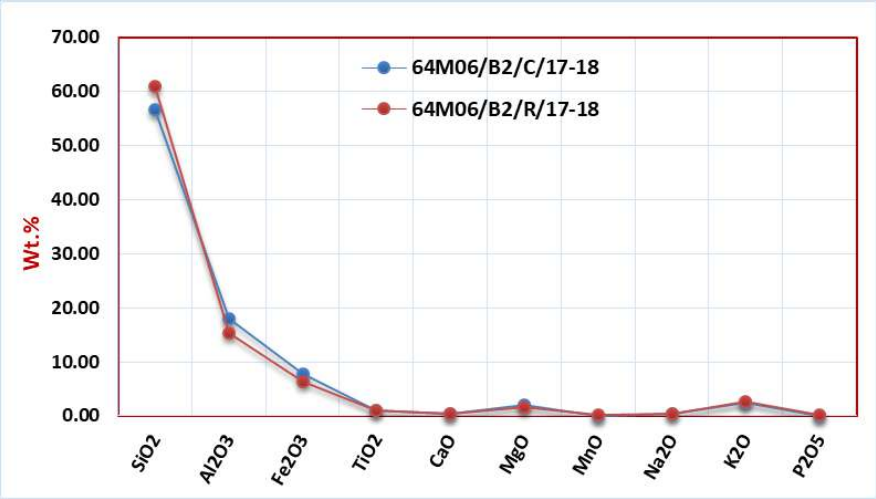
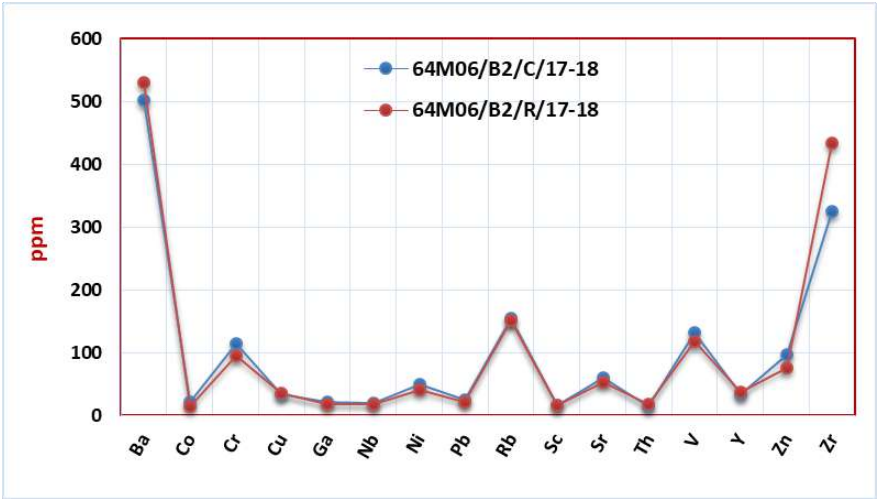


Plate 64: Elemental variation in Soil and Regolith sample of B2 quadrant in T.S. No.64M/06





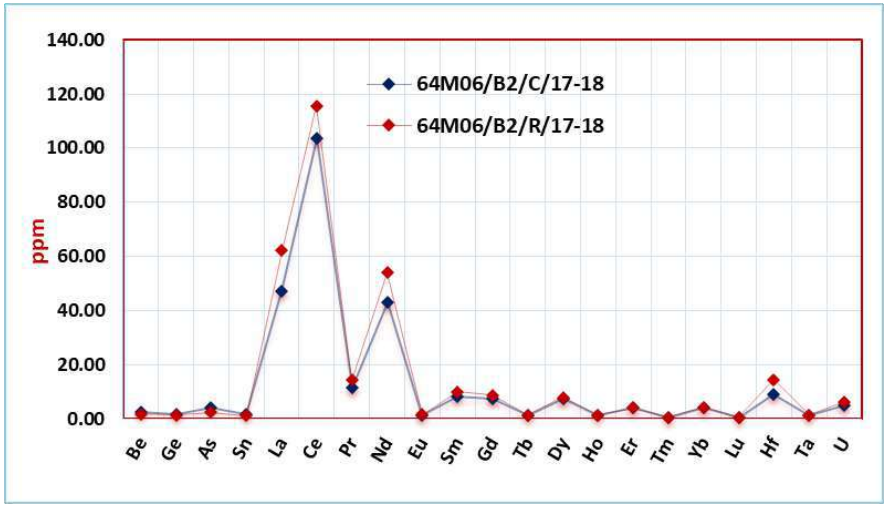
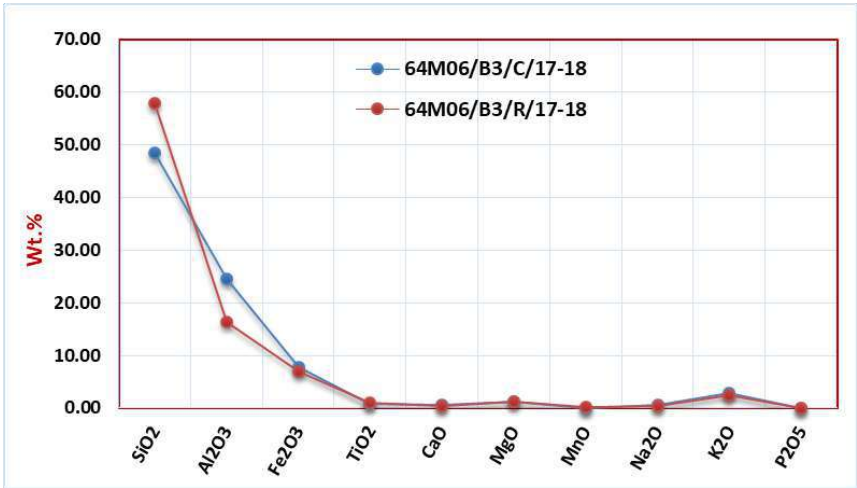
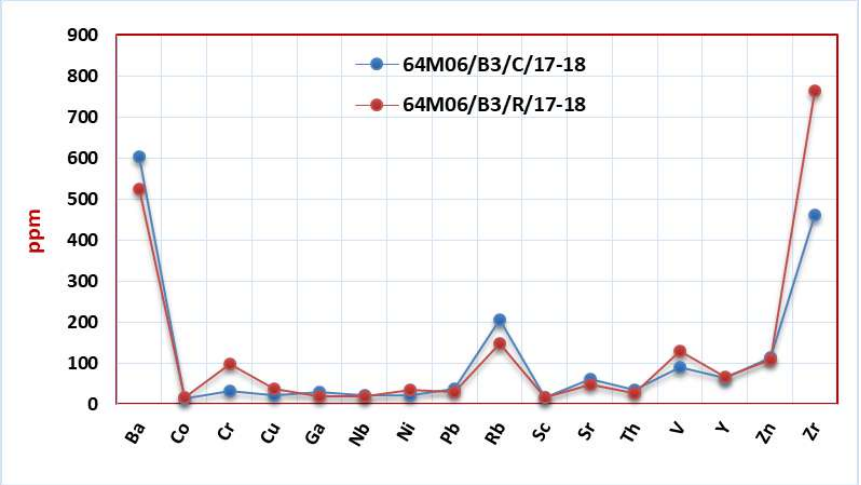


Plate 65: Elemental variation in Soil and Regolith sample of B3 quadrant in T.S. No.64M/06





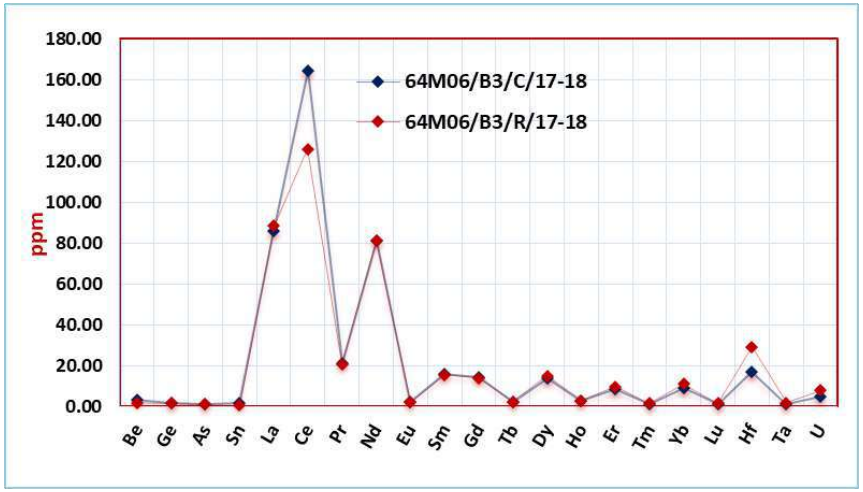
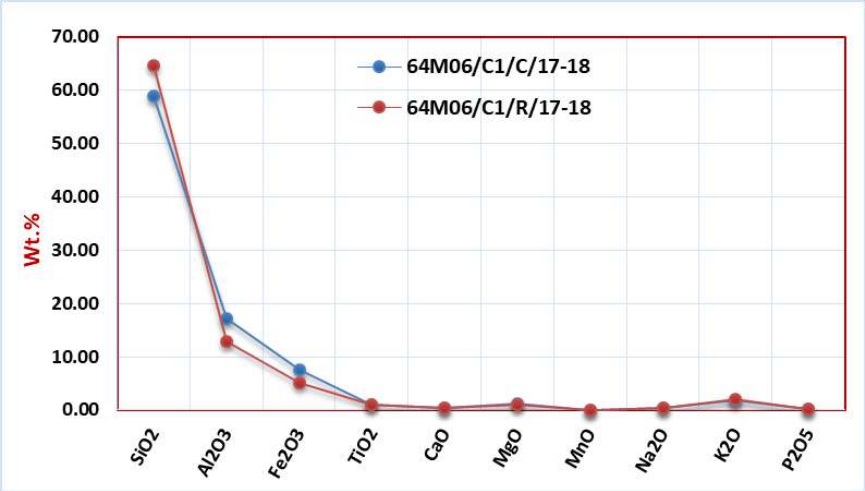
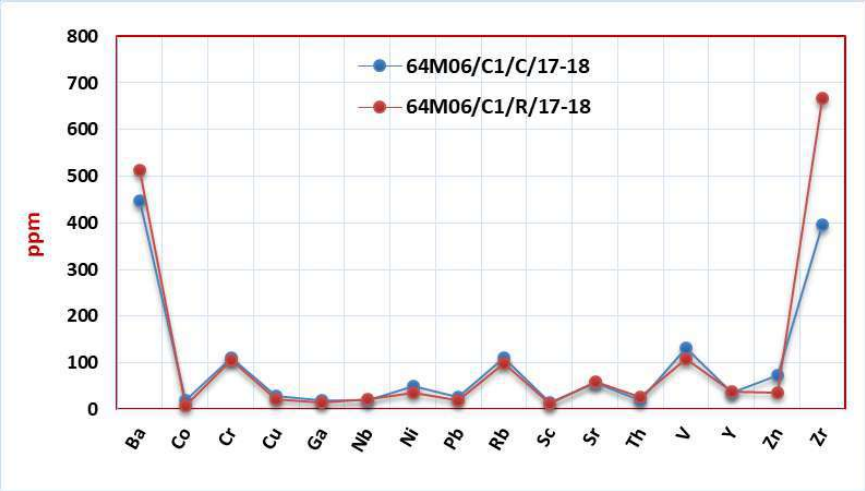


Plate 66: Elemental variation in Soil and Regolith sample of C1 quadrant in T.S. No.64M/06





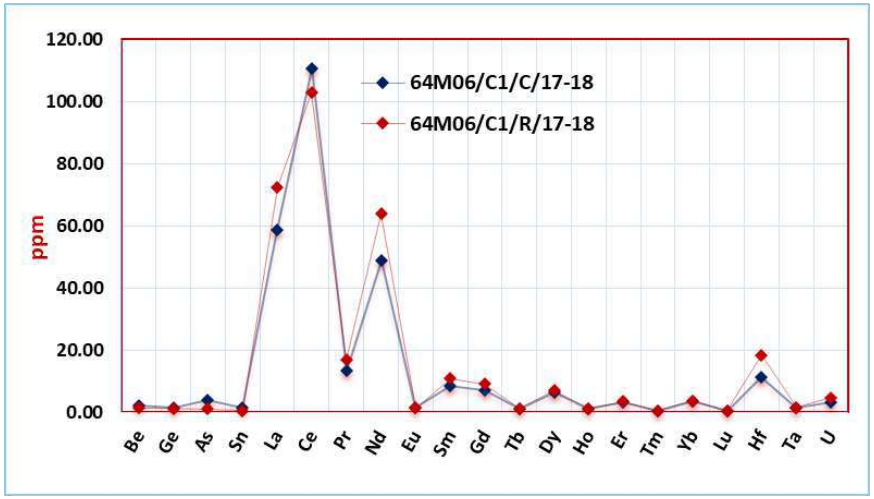
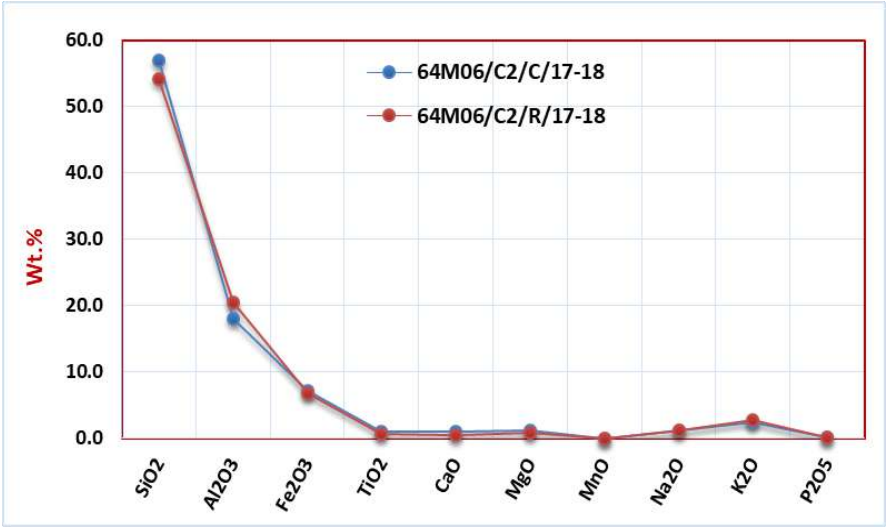
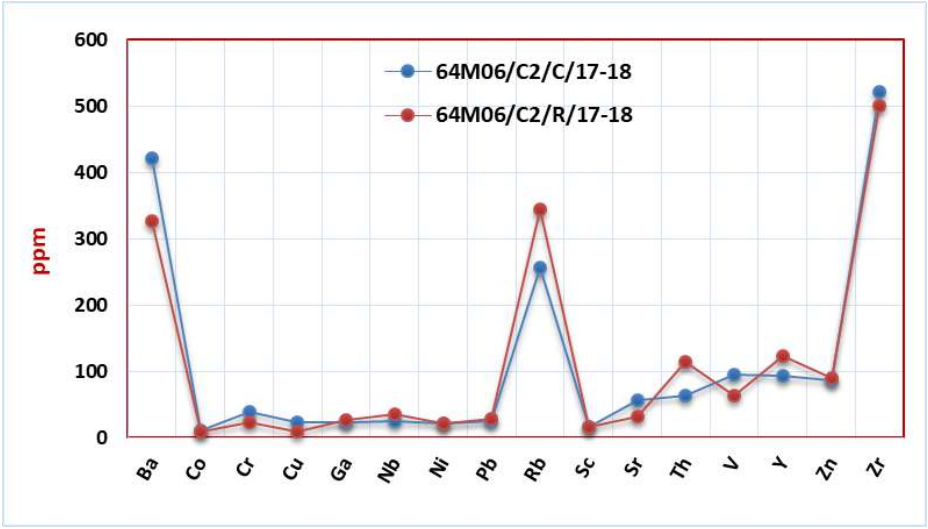


Plate 67: Elemental variation in Soil and Regolith sample of C2 quadrant in T.S. No.64M/06





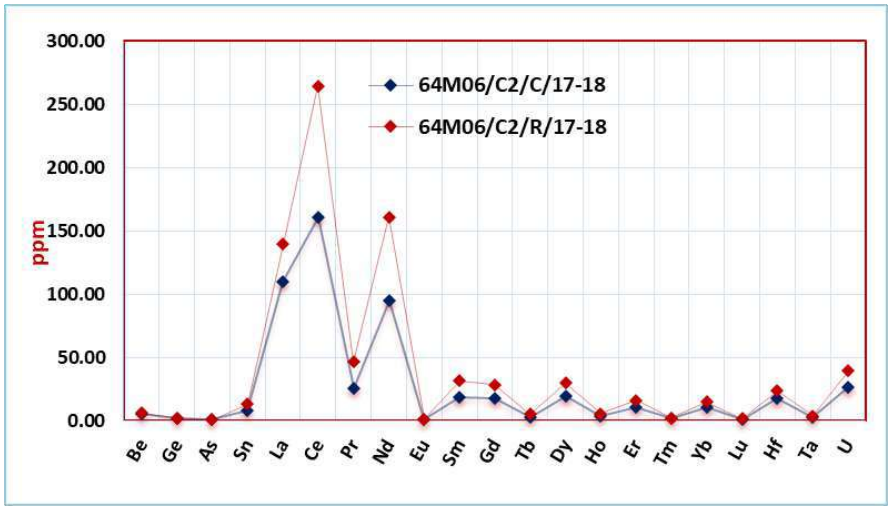
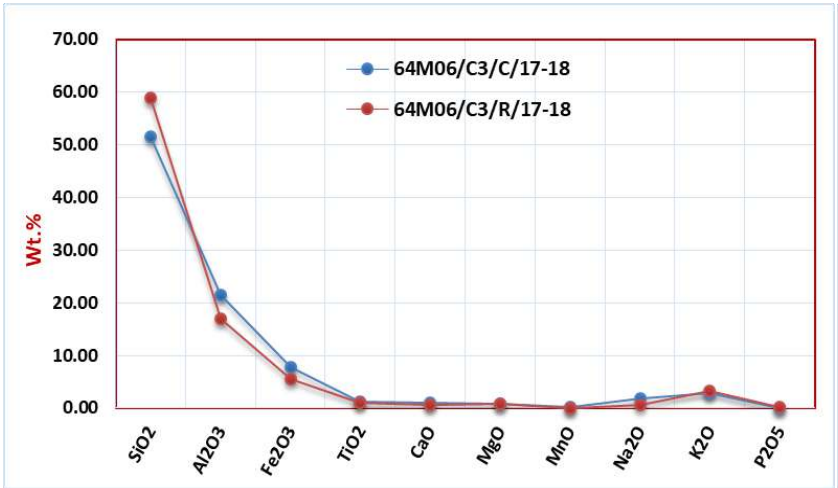
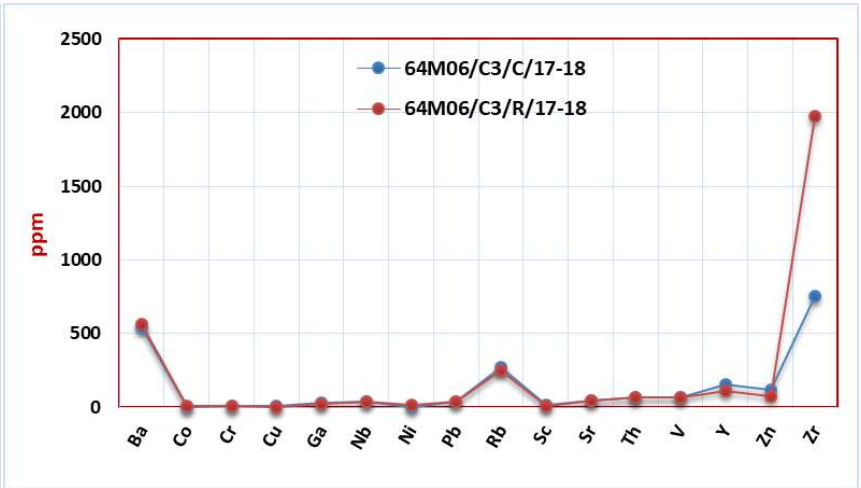
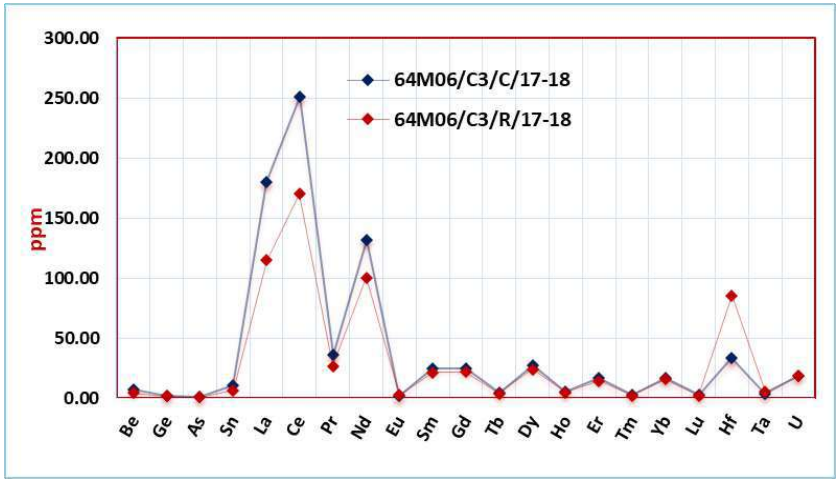


Plate 68: Elemental variation in Soil and Regolith sample of C3 quadrant in T.S. No.64M/06







ANNEXURE- I: ANALYTICAL RESULTS OF MAJOR OXIDES IN STREAM SEDIMENT / SLOPE-WASH SAMPLES FROM T.S. NO. 64M/06											
Sl. No.	**Composite Sample No.**	**SiO_2 (%)**	**Al_2O_3 (%)**	**Fe_2O_3 (%)**	**TiO_2 (%)**	**CaO (%)**	**MgO (%)**	**MnO (%)**	**Na_2O (%)**	**K_2O (%)**	**P_2O_5 (%)**
1	64M06/S/001/17-18	55.34	16.68	5.14	0.72	0.92	1.56	0.12	0.84	3.13	0.14
2	64M06/S/002/17-18	57.78	17.78	4.82	0.75	0.44	1.44	0.25	0.47	3.45	0.12
3	64M06/S/003/17-18	53.55	14.72	4.57	0.54	2.02	1.96	0.10	0.55	3.75	0.06
4	64M06/S/004/17-18	62.02	14.40	4.49	0.78	0.57	0.95	0.09	0.93	2.74	0.08
5	64M06/S/005/17-18	60.26	17.21	3.69	0.58	0.35	1.30	0.11	0.41	4.35	0.07
6	64M06/S/006/17-18	61.05	15.99	2.35	0.35	0.26	1.05	0.10	0.56	5.32	0.07
7	64M06/S/007/17-18	53.97	17.47	5.81	1.10	0.73	1.79	0.14	0.53	3.43	0.09
8	64M06/S/008/17-18	50.42	19.17	6.07	0.84	0.45	1.85	0.06	0.44	3.78	0.10
9	64M06/S/009/17-18	51.82	18.80	7.25	1.03	1.19	1.39	0.13	0.98	2.84	0.19
10	64M06/S/010/17-18	53.66	17.34	5.74	0.77	0.96	1.33	0.17	1.27	2.84	0.10
11	64M06/S/011/17-18	52.95	17.04	6.28	0.73	1.23	1.53	0.16	1.67	2.81	0.10
12	64M06/S/012/17-18	52.02	19.20	6.05	1.05	1.15	1.00	0.09	1.45	3.31	0.11
13	64M06/S/013/17-18	51.15	18.86	6.61	1.05	1.17	1.03	0.09	1.36	3.18	0.11
14	64M06/S/014/17-18	58.38	16.23	5.24	0.68	0.74	1.59	0.08	0.78	3.11	0.09
15	64M06/S/015/17-18	64.24	15.21	3.84	0.57	0.35	0.86	0.08	0.28	3.61	0.08
16	64M06/S/016/17-18	61.88	17.80	5.18	0.73	0.40	1.02	0.11	0.28	3.76	0.07
17	64M06/S/017/17-18	57.86	16.99	5.66	0.93	0.92	1.19	0.15	0.61	3.09	0.10
18	64M06/S/018/17-18	58.60	18.22	5.41	0.76	0.65	1.18	0.09	0.52	3.30	0.07
19	64M06/S/019/17-18	58.11	16.89	4.78	0.73	0.85	1.24	0.10	0.64	3.65	0.11
20	64M06/S/020/17-18	58.65	16.80	5.88	1.05	0.62	1.24	0.12	0.53	2.99	0.08
21	64M06/S/021/17-18	62.88	14.45	3.67	0.68	0.62	0.98	0.09	0.60	3.75	0.09
22	64M06/S/022/17-18	58.61	15.77	5.98	0.82	0.67	1.12	0.11	0.68	2.65	0.12
23	64M06/S/023/17-18	60.02	15.12	5.97	1.17	0.80	0.82	0.11	0.77	2.81	0.18
24	64M06/S/024/17-18	65.47	14.14	4.81	0.95	0.34	0.82	0.11	0.34	3.18	0.16
25	64M06/S/025/17-18	62.67	14.49	4.38	0.93	0.68	0.77	0.07	0.83	3.22	0.09
26	64M06/S/026/17-18	61.07	15.61	4.55	0.74	0.82	0.84	0.10	1.21	3.55	0.09
27	64M06/S/027/17-18	54.41	17.09	4.96	0.73	2.16	2.56	0.09	0.82	2.83	0.09
28	64M06/S/028/17-18	55.63	18.53	5.63	0.99	0.71	1.27	0.13	0.54	3.56	0.11
29	64M06/S/029/17-18	56.94	17.81	6.60	0.93	0.72	1.32	0.12	0.38	3.03	0.10
30	64M06/S/030/17-18	54.45	18.10	7.49	0.92	1.14	1.78	0.16	0.52	2.84	0.13
31	64M06/S/031/17-18	56.04	17.14	7.00	0.94	1.04	1.68	0.13	0.46	2.53	0.08
32	64M06/S/032/17-18	57.16	16.66	6.33	0.92	1.16	1.53	0.15	0.56	2.98	0.07
33	64M06/S/033/17-18	53.23	17.75	6.67	0.90	1.58	1.73	0.14	0.83	2.90	0.07
34	64M06/S/034/17-18	56.98	15.90	5.58	0.95	1.09	1.42	0.12	0.73	2.86	0.09
35	64M06/S/035/17-18	57.56	16.62	6.05	0.87	0.88	1.53	0.12	0.48	2.77	0.10
36	64M06/S/036/17-18	66.15	12.96	4.05	0.88	0.56	0.82	0.09	0.47	3.02	0.09

ANNEXURE- I: Continued…

Sl. No.	Composite Sample No.	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	MnO (%)	Na_2O (%)	K_2O (%)	P_2O_5 (%)
37	64M06/S/037/17-18	64.04	14.42	4.96	0.79	0.53	0.74	0.12	0.54	3.01	0.11
38	64M06/S/038/17-18	61.96	15.06	4.87	0.80	0.63	0.93	0.08	0.72	2.95	0.08
39	64M06/S/039/17-18	54.01	15.75	6.14	0.80	1.55	1.53	0.10	1.00	2.64	0.09
40	64M06/S/040/17-18	57.15	17.71	5.68	0.77	0.70	1.24	0.09	0.67	3.34	0.11
41	64M06/S/041/17-18	55.34	18.34	5.49	0.82	0.79	1.12	0.08	0.81	3.43	0.10
42	64M06/S/042/17-18	60.52	16.52	5.50	0.88	0.45	1.10	0.08	0.46	3.40	0.09
43	64M06/S/043/17-18	50.39	15.77	5.94	1.00	2.32	3.40	0.09	0.47	2.56	0.14
44	64M06/S/044/17-18	51.18	17.68	7.02	1.07	1.21	2.14	0.08	0.38	2.98	0.15
45	64M06/S/045/17-18	50.65	18.70	7.77	0.91	0.74	2.27	0.07	0.40	3.11	0.11
46	64M06/S/046/17-18	50.13	20.17	7.52	1.00	1.47	1.79	0.09	0.93	2.80	0.09
47	64M06/S/047/17-18	50.47	17.82	7.38	0.91	2.11	2.21	0.10	1.01	2.53	0.11
48	64M06/S/048/17-18	50.85	17.49	6.71	0.90	1.96	2.19	0.11	0.92	2.74	0.12
49	64M06/S/049/17-18	52.58	15.45	5.32	0.82	2.02	1.77	0.16	0.69	2.94	0.12
50	64M06/S/050/17-18	51.04	16.4	6.54	0.9	1.97	1.85	0.12	0.69	2.54	0.13
51	64M06/S/051/17-18	53.09	16.65	6.01	0.85	1.38	1.63	0.1	0.63	2.88	0.11
52	64M06/S/052/17-18	54.66	15.66	5.99	0.96	1.15	1.53	0.12	0.65	2.76	0.09
53	64M06/S/053/17-18	54.72	18.75	4.83	0.65	0.69	0.88	0.08	1.03	3.45	0.09
54	64M06/S/054/17-18	53.51	17.72	5.42	0.81	0.91	1.25	0.1	0.81	3.04	0.11
55	64M06/S/055/17-18	54.54	16.51	6.62	0.88	0.97	1.43	0.11	0.8	2.92	0.09
56	64M06/S/056/17-18	55.32	17.2	6.9	0.82	0.71	1.31	0.08	0.72	2.87	0.11
57	64M06/S/057/17-18	56.83	15.46	5.98	0.95	0.64	1.32	0.09	0.46	2.79	0.1
58	64M06/S/058/17-18	52.34	17.88	6.59	1.03	0.69	1.57	0.11	0.32	3.12	0.1
59	64M06/S/059/17-18	52.82	17.23	6.52	0.97	0.79	2.03	0.11	0.29	2.76	0.1
60	64M06/S/060/17-18	49.47	18.43	7.83	0.87	0.7	1.97	0.11	0.61	3.06	0.13
61	64M06/S/061/17-18	46.44	18.61	9.31	1.01	1.01	2.52	0.08	0.69	2.58	0.13
62	64M06/S/062/17-18	48.96	18.69	8.65	0.96	0.92	2.26	0.12	0.67	2.55	0.14
63	64M06/S/063/17-18	50.4	17.15	7.35	0.88	1.1	1.85	0.1	0.78	2.71	0.11
64	64M06/S/064/17-18	50.8	15.4	7.28	1.08	1.6	2.06	0.1	1.01	2.16	0.07
65	64M06/S/065/17-18	51.92	16.61	7.96	1	1.32	2.18	0.11	0.73	2.25	0.12
66	64M06/S/066/17-18	51.43	17.01	5.16	0.69	1.28	1.05	0.09	1.14	2.89	0.14
67	64M06/S/067/17-18	54.99	17.69	7.63	0.84	0.79	1.83	0.1	0.58	3.11	0.1
68	64M06/S/068/17-18	48.26	18.07	7.62	0.95	1.27	2.11	0.11	0.72	3.05	0.12
69	64M06/S/069/17-18	51.55	17.83	4.91	0.72	1.31	1.05	0.09	0.99	3.65	0.15
70	64M06/S/070/17-18	58.57	16.25	4.87	0.82	0.81	1.04	0.08	0.97	3.19	0.13
71	64M06/S/071/17-18	55.45	17.39	5.29	0.78	0.74	1.24	0.09	0.71	3.06	0.13
72	64M06/S/072/17-18	56.75	17.13	6.6	0.93	0.82	1.5	0.1	0.5	2.83	0.09
73	64M06/S/073/17-18	54.08	16.26	7.07	1.06	0.93	2.73	0.12	0.46	2.66	0.12

ANNEXURE- I: Continued…

Sl. No.	Composite Sample No.	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	MnO (%)	Na_2O (%)	K_2O (%)	P_2O_5 (%)
74	64M06/S/074/17-18	48.74	16.99	8.71	2.39	0.98	1.46	0.14	0.59	2.28	0.15
75	64M06/S/075/17-18	50.49	18.32	7.01	1.46	0.65	1.12	0.10	0.51	2.90	0.12
76	64M06/S/076/17-18	47.06	18.44	9.31	1.10	0.92	2.26	0.13	0.60	2.63	0.14
77	64M06/S/077/17-18	49.62	19.05	8.11	0.96	0.75	2.14	0.10	0.70	3.08	0.14
78	64M06/S/078/17-18	46.36	18.32	8.81	1.08	0.96	3.01	0.11	0.60	2.98	0.18
79	64M06/S/079/17-18	56.46	16.18	5.38	0.66	0.81	1.11	0.09	0.83	3.66	0.12
80	64M06/S/080/17-18	59.97	15.89	6.25	0.85	0.50	1.17	0.08	0.57	2.83	0.07
81	64M06/S/081/17-18	59.68	15.69	5.48	0.84	0.42	1.16	0.10	0.41	3.33	0.07
82	64M06/S/082/17-18	56.70	15.19	5.32	0.89	0.83	1.34	0.09	0.65	3.37	0.09
83	64M06/S/083/17-18	51.61	15.36	7.25	1.24	1.55	1.56	0.14	0.67	2.85	0.17
84	64M06/S/084/17-18	53.35	16.91	7.07	0.93	1.06	1.96	0.17	0.43	2.56	0.09
85	64M06/S/085/17-18	62.57	13.21	4.61	0.88	0.52	0.92	0.06	0.53	2.75	0.07
86	64M06/S/086/17-18	61.74	13.91	4.80	0.89	0.58	1.13	0.06	0.52	2.78	0.12
87	64M06/S/087/17-18	53.49	18.94	5.28	0.69	0.74	1.05	0.10	0.85	3.31	0.17
88	64M06/S/088/17-18	59.57	15.27	4.75	0.80	0.61	1.11	0.07	0.63	2.93	0.10
89	64M06/S/089/17-18	54.20	17.19	5.47	0.81	1.12	1.19	0.09	1.12	3.00	0.18
90	64M06/S/090/17-18	48.82	18.13	6.24	0.95	1.22	1.47	0.07	0.77	2.86	0.16
91	64M06/S/091/17-18	53.84	16.23	5.41	0.86	1.14	1.23	0.08	1.07	2.87	0.12
92	64M06/S/092/17-18	69.06	12.06	2.75	0.90	0.28	0.37	0.04	0.23	2.36	0.07
93	64M06/S/093/17-18	66.28	14.10	3.09	0.91	0.23	0.42	0.04	0.23	2.95	0.08
94	64M06/S/094/17-18	63.83	13.31	4.96	0.85	0.53	1.06	0.07	0.57	2.46	0.06
95	64M06/S/095/17-18	61.64	15.09	4.23	0.77	0.33	0.69	0.06	0.35	3.28	0.06
96	64M06/S/096/17-18	62.05	14.07	4.18	0.90	0.59	0.77	0.06	0.45	2.74	0.06
97	64M06/S/097/17-18	66.52	12.47	3.63	1.12	0.40	0.50	0.07	0.32	2.05	0.10
98	64M06/S/098/17-18	60.65	14.40	5.18	0.88	0.59	0.85	0.11	0.86	2.98	0.09
99	64M06/S/099/17-18	61.13	15.24	5.43	0.85	0.39	0.99	0.07	0.37	3.22	0.07
100	64M06/S/100/17-18	58.33	15.95	6.03	0.88	0.47	1.20	0.08	0.48	3.01	0.10
101	64M06/S/101/17-18	54.02	18.13	5.42	0.72	0.68	0.99	0.08	0.81	3.06	0.10
102	64M06/S/102/17-18	60.23	14.08	5.25	0.83	0.79	1.22	0.06	0.68	2.52	0.07
103	64M06/S/103/17-18	57.15	15.77	5.89	0.90	0.88	1.09	0.14	0.84	2.95	0.10
104	64M06/S/104/17-18	49.65	16.60	6.20	0.93	1.41	1.46	0.09	0.98	2.68	0.13
105	64M06/S/105/17-18	70.22	9.03	2.87	0.91	0.22	0.38	0.05	0.24	1.82	0.07
106	64M06/S/106/17-18	65.76	12.34	4.19	0.94	0.31	0.65	0.07	0.29	2.19	0.08
107	64M06/S/107/17-18	63.18	13.10	4.63	0.90	0.45	0.88	0.09	0.41	2.55	0.09
108	64M06/S/108/17-18	63.25	13.98	4.86	0.88	0.44	0.81	0.06	0.53	2.51	0.07
109	64M06/S/109/17-18	63.75	13.02	3.99	0.83	0.30	0.55	0.05	0.35	2.68	0.05
110	64M06/S/110/17-18	65.75	12.50	3.12	1.04	0.29	0.36	0.05	0.34	2.09	0.06

ANNEXURE- I: Continued…

Sl. No.	Composite Sample No.	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	MnO (%)	Na_2O (%)	K_2O (%)	P_2O_5 (%)
111	64M06/S/111/17-18	60.49	14.48	4.72	0.72	0.66	0.74	0.11	0.88	2.47	0.07
112	64M06/S/112/17-18	56.40	16.11	6.91	0.91	0.73	0.96	0.14	0.88	2.41	0.10
113	64M06/S/113/17-18	52.16	17.12	8.97	1.26	0.80	1.69	0.19	0.70	2.58	0.09
114	64M06/S/114/17-18	53.27	15.96	7.29	1.12	1.44	1.53	0.14	0.81	2.76	0.09
115	64M06/S/115/17-18	54.13	16.97	6.80	0.91	0.88	1.19	0.10	0.79	2.67	0.14
116	64M06/S/116/17-18	55.39	16.61	6.54	0.79	0.71	1.23	0.09	0.80	2.86	0.08
117	64M06/S/117/17-18	54.86	16.21	5.62	0.82	1.37	1.06	0.08	1.20	2.77	0.13
118	64M06/S/118/17-18	64.50	13.12	4.29	1.08	0.21	0.52	0.09	0.21	2.50	0.06
119	64M06/S/119/17-18	61.13	13.38	5.07	0.95	0.63	1.04	0.08	0.50	2.27	0.09
120	64M06/S/120/17-18	60.46	12.10	4.67	0.83	0.53	0.96	0.09	0.55	2.31	0.08
121	64M06/S/121/17-18	65.75	13.31	3.67	0.83	0.31	0.56	0.04	0.24	2.44	0.06
122	64M06/S/122/17-18	65.47	13.84	3.19	0.8	0.26	0.5	0.05	0.24	3.26	0.07
123	64M06/S/123/17-18	63.36	15.14	3.76	0.89	0.25	0.61	0.05	0.26	3.03	0.07
124	64M06/S/124/17-18	64.36	14.39	4.71	0.97	0.33	0.81	0.05	0.35	2.22	0.05
125	64M06/S/125/17-18	63.76	14.14	4.86	0.86	0.77	0.87	0.11	0.58	2.66	0.1
126	64M06/S/126/17-18	64.61	13.52	5.32	0.99	0.64	0.96	0.09	0.61	2.91	0.08
127	64M06/S/127/17-18	65.49	12.46	4.66	1.06	0.35	0.72	0.07	0.35	2.34	0.07
128	64M06/S/128/17-18	63.62	13.3	5.21	1.26	0.89	0.74	0.12	0.32	1.56	0.17
129	64M06/S/129/17-18	58.32	16.5	6.6	1.02	1.22	0.86	0.08	0.68	2.05	0.09
130	64M06/S/130/17-18	62.14	13.47	5.02	0.94	0.84	0.97	0.1	0.68	2.43	0.1
131	64M06/S/131/17-18	69.09	11.26	3.99	0.99	0.4	0.66	0.06	0.31	2.03	0.09
132	64M06/S/132/17-18	61.95	14.59	5.55	1.1	0.46	0.8	0.07	0.27	1.79	0.1
133	64M06/S/133/17-18	64.77	13.74	4.1	1.24	0.41	0.6	0.11	0.35	1.46	0.11
134	64M06/S/134/17-18	66.58	11.3	4.15	1.18	0.49	0.8	0.06	0.5	2.01	0.08
135	64M06/S/135/17-18	68.24	12.21	4.51	0.89	0.36	0.72	0.06	0.36	2.21	0.09
136	64M06/S/136/17-18	66.85	11.87	3.39	0.83	0.41	0.64	0.08	0.39	2.65	0.07
137	64M06/S/137/17-18	66.36	12.63	2.87	0.84	0.33	0.51	0.06	0.33	3.17	0.08
138	64M06/S/138/17-18	66.31	13.54	4.28	1.07	0.47	0.8	0.07	0.44	2.16	0.06
139	64M06/S/139/17-18	66.31	12.75	4.82	1.12	0.31	0.67	0.06	0.3	1.88	0.08
140	64M06/S/140/17-18	67.63	11.53	4.39	1.04	0.38	0.71	0.06	0.41	1.7	0.09
141	64M06/S/141/17-18	66.48	12.75	4.69	1.65	0.26	0.57	0.09	0.27	1.23	0.09
142	64M06/S/142/17-18	65.93	12.13	4.77	1.71	0.33	0.7	0.06	0.36	1.7	0.08
143	64M06/S/143/17-18	69.03	10.89	4.28	1.77	0.28	0.62	0.08	0.29	1.54	0.09
144	64M06/S/144/17-18	59.37	14.82	4.07	1.53	0.67	0.57	0.12	0.33	1	0.14
145	64M06/S/145/17-18	63.93	11.95	4.61	1.63	0.41	0.54	0.07	0.31	1.28	0.1
146	64M06/S/146/17-18	63.4	14.56	4.78	1.28	0.4	0.58	0.08	0.28	1.23	0.13
147	64M06/S/147/17-18	61.91	14.87	5.64	1.11	0.35	0.82	0.08	0.27	1.68	0.1

ANNEXURE- I: Continued…

Sl. No.	Composite Sample No.	SiO_2 (%)	Al_2O_3 (%)	Fe_2O_3 (%)	TiO_2 (%)	CaO (%)	MgO (%)	MnO (%)	Na_2O (%)	K_2O (%)	P_2O_5 (%)
148	64M06/S/148/17-18	71.33	9.94	3.46	0.92	0.29	0.51	0.06	0.26	1.78	0.08
149	64M06/S/149/17-18	64.81	12.94	5.02	0.95	0.47	1.03	0.09	0.44	2.16	0.12
150	64M06/S/150/17-18	66.92	11.29	3.69	1.06	0.51	0.65	0.09	0.36	1.71	0.12
151	64M06/S/151/17-18	67.2	11.24	4.4	1.04	0.44	0.77	0.08	0.42	2.06	0.07
152	64M06/S/152/17-18	63.99	12.51	4.69	1.2	0.43	0.85	0.08	0.34	1.8	0.12
153	64M06/S/153/17-18	63.03	13	5.06	1.19	0.47	0.66	0.09	0.35	1.45	0.12
154	64M06/S/154/17-18	61.6	13.84	5.92	1.34	0.49	0.82	0.09	0.33	1.51	0.12
155	64M06/S/155/17-18	62.53	15.1	5.83	1.25	0.29	0.7	0.08	0.24	1.44	0.1
156	64M06/S/156/17-18	59.57	16.86	6.37	1.24	0.45	0.66	0.06	0.22	1.15	0.1
157	64M06/S/157/17-18	57.87	15.64	5.92	1.42	0.64	0.79	0.12	0.31	1.09	0.17
158	64M06/S/158/17-18	56.9	15.95	5.31	1.28	0.8	0.67	0.12	0.28	0.98	0.18
159	64M06/S/159/17-18	61.54	16.11	6.37	1.17	0.4	0.97	0.07	0.39	1.56	0.11
160	64M06/S/160/17-18	59.69	16.59	6.2	2.04	0.35	0.52	0.07	0.19	0.84	0.14
161	64M06/S/161/17-18	63.89	13.19	4.33	1.18	0.47	0.62	0.08	0.28	1.43	0.14
162	64M06/S/162/17-18	63.76	14.32	4.86	1.51	0.34	0.66	0.07	0.28	1.45	0.08
163	64M06/S/163/17-18	63.58	14.84	5.16	1.57	0.31	0.45	0.1	0.23	1.12	0.1
164	64M06/S/164/17-18	62.34	15.12	4.44	1.71	0.37	0.44	0.11	0.26	0.91	0.13
165	64M06/S/165/17-18	64.89	12.48	5.23	1.28	0.53	0.55	0.08	0.29	1.02	0.11
166	64M06/S/166/17-18	61.4	14.66	5.02	1.32	0.6	0.56	0.08	0.27	1.01	0.12
167	64M06/S/167/17-18	60.43	15.03	5.81	1.2	0.42	0.68	0.08	0.32	1.23	0.14
168	64M06/S/168/17-18	59.92	14.45	4.35	1.34	0.76	0.53	0.1	0.3	0.93	0.14
169	64M06/S/169/17-18	59.48	17.29	6.54	1.59	0.35	0.52	0.05	0.25	0.78	0.1
170	64M06/S/170/17-18	62.43	13.25	5.6	1.57	0.66	0.65	0.11	0.35	1.22	0.21
171	64M06/S/171/17-18	63.88	14.67	5.7	1.63	0.37	0.55	0.08	0.3	0.95	0.15
172	64M06/S/172/17-18	60.11	15.4	6.35	1.47	0.5	0.59	0.06	0.34	0.89	0.16
173	64M06/S/173/17-18	65.14	13.56	4.98	1.33	0.43	0.68	0.11	0.37	1.4	0.18
174	64M06/S/174/17-18	65.67	11.17	3.56	3.08	0.61	0.38	0.1	0.23	0.61	0.17
175	64M06/S/175/17-18	66.41	13.37	4.39	1.26	0.33	0.72	0.1	0.34	1.48	0.2
176	64M06/S/176/17-18	61.99	14.07	5.06	1.48	0.6	0.8	0.08	0.45	1.47	0.14
177	64M06/S/177/17-18	63.83	12.78	4.62	1.82	0.59	0.59	0.07	0.33	0.97	0.14
178	64M06/S/178/17-18	64.18	12.38	4.89	1.43	0.64	0.56	0.08	0.27	1.04	0.12
179	64M06/S/179/17-18	59.6	15.61	5.37	1.35	0.37	0.56	0.1	0.28	0.92	0.17
180	64M06/S/180/17-18	65.95	13.36	4.55	1.49	0.41	0.53	0.09	0.28	1.17	0.18
181	64M06/S/181/17-18	64.6	13.85	4.46	1.63	0.41	0.64	0.14	0.36	1.39	0.27
182	64M06/S/182/17-18	60.86	15.66	4.33	1.76	0.53	0.55	0.09	0.33	0.9	0.15

ANNEXURE II: RESULTS OF CHEMICAL ANALYSIS OF TRACE ELEMENTS IN STREAM SEDIMENT / SLOPE-WASH SAMPLES FROM T.S. NO. 64M/06																	
Sl. No.	**Composite Sample No.**	**Ba (mg/Kg)**	**Co (mg/Kg)**	**Cr (mg/Kg)**	**Cu (mg/Kg)**	**Ga (mg/Kg)**	**Nb (mg/Kg)**	**Ni (mg/Kg)**	**Pb (mg/Kg)**	**Rb (mg/Kg)**	**Sc (mg/Kg)**	**Sr (mg/Kg)**	**Th (mg/Kg)**	**V (mg/Kg)**	**Y (mg/Kg)**	**Zn (mg/Kg)**	**Zr (mg/Kg)**
1	64M06/S/001/17-18	735	14	89	22	19	23	35	33	186	14	91	38	73	85	120	517
2	64M06/S/002/17-18	835	4	51	43	20	20	31	204	182	10	92	32	77	72	251	475
3	64M06/S/003/17-18	685	19	387	20	14	10	114	62	122	15	50	22	70	48	151	260
4	64M06/S/004/17-18	665	9	58	24	19	23	26	28	144	13	55	28	72	70	35	635
5	64M06/S/005/17-18	638	2	21	37	21	18	24	100	213	9	43	39	49	93	253	459
6	64M06/S/006/17-18	684	5	10	40	15	12	10	163	179	6	33	30	26	77	333	496
7	64M06/S/007/17-18	751	11	28	39	19	17	23	88	161	13	49	33	108	78	248	508
8	64M06/S/008/17-18	422	7	36	29	18	20	24	37	202	12	52	35	108	58	143	355
9	64M06/S/009/17-18	628	13	24	24	26	27	22	47	183	18	67	31	105	101	179	645
10	64M06/S/010/17-18	716	14	10	23	21	18	19	61	151	15	53	25	81	99	147	653
11	64M06/S/011/17-18	706	8	31	18	20	22	18	42	128	17	60	26	81	81	157	515
12	64M06/S/012/17-18	485	7	10	13	24	32	16	39	253	13	53	68	66	112	102	837
13	64M06/S/013/17-18	434	8	10	9	24	31	11	34	260	19	50	68	67	115	109	633
14	64M06/S/014/17-18	588	9	52	26	16	14	30	23	152	14	48	22	91	49	78	291
15	64M06/S/015/17-18	700	6	26	17	15	12	22	27	180	11	43	22	63	49	35	320
16	64M06/S/016/17-18	801	17	23	21	22	20	29	30	218	13	43	35	74	88	72	475
17	64M06/S/017/17-18	631	15	44	25	18	19	22	30	161	14	57	37	86	71	35	673
18	64M06/S/018/17-18	585	9	41	25	21	17	31	25	176	16	51	34	89	74	79	421
19	64M06/S/019/17-18	594	10	25	19	18	15	21	27	166	16	66	26	85	56	35	378
20	64M06/S/020/17-18	599	10	56	36	20	17	33	35	152	15	54	26	119	70	106	525

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
21	64M06/S/021/17-18	628	12	34	20	17	14	21	59	182	15	51	25	71	72	84	400
22	64M06/S/022/17-18	538	9	71	24	19	21	32	24	145	16	44	20	99	69	85	469
23	64M06/S/023/17-18	586	10	58	24	20	17	27	29	138	17	61	21	125	79	73	807
24	64M06/S/024/17-18	575	14	51	24	17	20	28	29	174	15	45	27	88	69	35	786
25	64M06/S/025/17-18	495	5	30	14	19	24	21	28	190	11	52	41	72	65	35	883
26	64M06/S/026/17-18	684	10	21	15	20	20	18	27	164	11	56	37	71	75	96	1082
27	64M06/S/027/17-18	304	13	46	20	20	26	28	41	236	15	48	31	85	36	81	309
28	64M06/S/028/17-18	537	15	40	21	21	21	28	35	236	14	55	32	103	55	80	510
29	64M06/S/029/17-18	624	15	60	37	21	18	37	34	206	19	52	23	123	57	103	462
30	64M06/S/030/17-18	576	22	60	46	22	14	44	36	155	25	54	23	131	61	110	371
31	64M06/S/031/17-18	645	24	102	42	18	13	55	30	144	20	52	21	139	54	89	353
32	64M06/S/032/17-18	576	18	63	35	19	17	35	35	176	19	58	19	106	55	92	443
33	64M06/S/033/17-18	498	20	64	31	21	17	36	33	173	17	66	22	116	59	91	419
34	64M06/S/034/17-18	497	10	56	29	19	16	32	26	149	14	60	49	97	94	76	681
35	64M06/S/035/17-18	599	14	67	40	19	15	34	30	164	16	87	20	106	39	103	394
36	64M06/S/036/17-18	612	10	55	18	17	18	28	22	156	11	61	26	82	54	35	905
37	64M06/S/037/17-18	690	13	44	17	18	18	29	20	131	14	51	18	84	51	35	583
38	64M06/S/038/17-18	685	10	46	12	16	16	26	20	133	13	51	22	81	52	35	438
39	64M06/S/039/17-18	613	7	38	18	16	14	21	22	124	19	107	19	107	42	82	308
40	64M06/S/040/17-18	484	13	54	27	20	17	31	39	233	18	58	44	94	55	77	437
41	64M06/S/041/17-18	361	13	44	29	21	26	25	37	243	13	55	47	99	59	75	431

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
42	64M06/S/042/17-18	490	9	53	26	20	18	32	22	196	11	53	56	97	78	35	716
43	64M06/S/043/17-18	346	11	72	27	17	19	33	28	177	15	58	49	103	64	95	616
44	64M06/S/044/17-18	538	11	68	33	19	17	35	21	185	20	62	42	128	63	106	597
45	64M06/S/045/17-18	464	13	72	41	20	17	53	40	168	18	65	43	160	61	120	461
46	64M06/S/046/17-18	413	16	77	28	23	15	35	29	152	21	77	21	128	54	90	423
47	64M06/S/047/17-18	440	18	85	33	20	15	34	31	147	20	85	25	130	56	104	427
48	64M06/S/048/17-18	485	12	48	36	19	15	28	25	157	17	84	38	109	65	99	457
49	64M06/S/049/17-18	362	18	50	17	16	15	27	24	196	15	82	30	92	52	75	538
50	64M06/S/050/17-18	403	17	69	33	18	20	29	26	175	21	90	44	98	72	105	659
51	64M06/S/051/17-18	447	17	61	23	20	18	29	17	206	20	81	52	91	71	94	591
52	64M06/S/052/17-18	358	20	50	21	19	17	26	19	191	17	62	56	101	86	79	673
53	64M06/S/053/17-18	220	14	22	15	25	24	20	49	329	14	41	55	69	88	35	355
54	64M06/S/054/17-18	205	19	44	18	22	26	26	35	294	20	47	52	86	113	88	449
55	64M06/S/055/17-18	316	18	65	17	20	20	35	21	241	19	60	48	100	91	81	465
56	64M06/S/056/17-18	259	20	60	25	23	26	35	33	259	19	53	30	99	55	93	355
57	64M06/S/057/17-18	359	15	70	28	20	21	32	29	206	15	50	50	108	76	72	642
58	64M06/S/058/17-18	466	18	73	31	19	20	37	36	164	13	45	33	113	63	84	525
59	64M06/S/059/17-18	440	18	66	28	19	18	33	32	180	16	43	24	107	57	80	555
60	64M06/S/060/17-18	431	24	53	34	21	20	32	39	227	16	60	27	123	60	106	358
61	64M06/S/061/17-18	363	21	76	39	21	18	42	30	196	19	64	18	166	54	138	416
62	64M06/S/062/17-18	484	20	59	31	22	17	32	35	176	22	76	18	131	65	124	405

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
63	64M06/S/063/17-18	488	15	47	27	18	16	25	32	178	17	115	21	135	42	80	385
64	64M06/S/064/17-18	432	18	30	23	17	13	18	25	97	19	133	35	141	63	77	638
65	64M06/S/065/17-18	368	23	68	41	18	15	26	37	124	19	109	14	150	36	96	356
66	64M06/S/066/17-18	281	8	37	24	22	30	25	39	312	12	46	52	69	131	94	663
67	64M06/S/067/17-18	344	16	79	39	20	19	42	28	259	15	55	36	104	62	108	351
68	64M06/S/068/17-18	325	15	58	36	18	18	33	31	246	17	64	43	122	82	121	429
69	64M06/S/069/17-18	270	11	28	13	21	13	24	32	278	13	57	92	62	132	35	750
70	64M06/S/070/17-18	382	11	46	21	21	13	28	13	230	14	59	138	64	172	35	991
71	64M06/S/071/17-18	349	12	53	28	20	16	30	26	209	13	55	83	85	121	71	881
72	64M06/S/072/17-18	453	18	72	31	21	19	39	32	171	16	58	21	117	57	87	458
73	64M06/S/073/17-18	464	21	171	34	19	16	56	23	143	20	65	31	129	57	80	531
74	64M06/S/074/17-18	417	22	77	22	23	35	32	23	123	26	52	35	191	104	101	947
75	64M06/S/075/17-18	446	21	49	26	21	24	35	35	165	18	64	31	138	60	80	593
76	64M06/S/076/17-18	401	19	61	37	21	18	36	27	174	21	70	30	140	60	111	494
77	64M06/S/077/17-18	490	20	44	31	22	16	31	29	186	22	85	20	147	55	126	371
78	64M06/S/078/17-18	370	22	53	25	21	16	33	26	177	23	102	22	188	51	122	475
79	64M06/S/079/17-18	318	11	38	19	20	13	28	34	290	17	52	36	80	74	76	349
80	64M06/S/080/17-18	397	18	82	30	21	20	43	36	220	17	52	21	109	44	78	381
81	64M06/S/081/17-18	399	16	55	24	18	14	34	32	204	13	47	45	94	80	35	488
82	64M06/S/082/17-18	393	15	49	24	18	14	29	30	217	18	58	63	98	97	35	535
83	64M06/S/083/17-18	297	19	68	27	19	27	36	27	202	20	65	42	117	86	99	577

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
84	64M06/S/084/17-18	429	20	66	23	20	17	35	41	201	20	53	32	126	75	107	499
85	64M06/S/085/17-18	374	10	70	21	16	16	29	27	186	14	64	39	90	68	35	723
86	64M06/S/086/17-18	420	15	59	19	18	17	27	28	170	18	62	33	93	61	35	658
87	64M06/S/087/17-18	229	12	34	11	25	21	26	34	288	18	55	73	61	122	76	937
88	64M06/S/088/17-18	372	12	53	18	19	17	32	31	207	14	70	45	88	96	35	704
89	64M06/S/089/17-18	353	11	28	13	20	17	23	27	257	16	89	48	84	97	73	739
90	64M06/S/090/17-18	371	16	37	14	22	20	25	26	249	21	90	51	91	96	89	780
91	64M06/S/091/17-18	441	10	30	17	20	16	21	23	219	18	90	80	77	125	35	1306
92	64M06/S/092/17-18	427	11	59	13	16	20	25	32	160	14	44	33	82	61	35	665
93	64M06/S/093/17-18	488	12	58	16	19	20	26	35	211	13	41	83	76	152	35	1034
94	64M06/S/094/17-18	378	13	81	27	17	18	37	26	162	15	63	24	97	51	35	459
95	64M06/S/095/17-18	388	14	44	17	18	14	29	36	201	14	54	41	81	87	35	547
96	64M06/S/096/17-18	382	12	62	19	18	19	32	32	172	16	63	43	93	76	35	762
97	64M06/S/097/17-18	557	10	67	16	17	21	25	27	126	17	62	34	97	54	35	928
98	64M06/S/098/17-18	426	12	38	17	21	33	24	34	232	15	60	38	80	111	82	1092
99	64M06/S/099/17-18	551	14	59	23	19	17	34	57	193	14	61	34	93	57	35	784
100	64M06/S/100/17-18	401	17	67	28	21	19	36	31	212	16	63	32	96	60	35	734
101	64M06/S/101/17-18	312	12	42	14	22	18	25	35	251	13	62	48	76	86	72	756
102	64M06/S/102/17-18	357	13	72	25	18	15	35	29	182	16	74	27	102	69	35	469
103	64M06/S/103/17-18	417	12	46	14	20	25	31	34	268	14	63	41	88	78	90	767
104	64M06/S/104/17-18	392	13	40	20	20	20	23	32	244	16	84	46	98	102	90	702

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
105	64M06/S/105/17-18	396	12	84	16	13	19	22	21	109	10	45	20	78	42	35	673
106	64M06/S/106/17-18	416	16	100	24	16	19	32	25	139	13	53	28	98	55	35	639
107	64M06/S/107/17-18	414	16	83	25	16	18	36	30	160	15	57	26	93	57	35	642
108	64M06/S/108/17-18	430	13	76	22	19	18	36	29	171	16	61	27	100	54	35	475
109	64M06/S/109/17-18	422	13	49	15	16	15	26	31	156	14	50	36	84	76	35	781
110	64M06/S/110/17-18	420	12	57	13	17	23	24	33	118	16	52	52	87	82	35	1138
111	64M06/S/111/17-18	370	14	53	13	21	28	26	41	241	16	59	24	76	85	35	692
112	64M06/S/112/17-18	282	13	62	31	24	28	34	35	258	20	72	23	110	85	78	534
113	64M06/S/113/17-18	380	20	71	33	25	31	40	37	295	19	52	21	146	112	96	408
114	64M06/S/114/17-18	428	20	68	26	22	29	35	36	277	22	75	26	134	64	96	587
115	64M06/S/115/17-18	336	17	55	34	22	32	33	37	244	21	64	30	113	81	102	487
116	64M06/S/116/17-18	321	12	52	28	22	25	33	44	244	14	59	31	97	61	96	449
117	64M06/S/117/17-18	349	16	33	10	20	24	22	41	223	16	111	45	101	66	86	531
118	64M06/S/118/17-18	528	21	95	26	17	22	35	26	141	16	49	27	104	44	35	820
119	64M06/S/119/17-18	442	21	94	26	16	19	41	20	126	17	68	24	109	47	35	611
120	64M06/S/120/17-18	437	16	77	28	15	18	35	27	141	14	65	19	93	38	35	475
121	64M06/S/121/17-18	587	9	64	22	16	18	27	27	135	10	46	29	86	52	35	600
122	64M06/S/122/17-18	631	12	43	15	16	17	18	34	167	13	49	48	72	83	35	730
123	64M06/S/123/17-18	606	10	52	18	17	16	28	32	169	11	49	65	88	106	35	916
124	64M06/S/124/17-18	501	9	88	29	17	19	33	26	125	13	53	34	101	59	35	706
125	64M06/S/125/17-18	440	11	71	22	19	21	32	39	178	15	58	31	86	86	35	503

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
126	64M06/S/126/17-18	476	14	66	24	18	18	30	16	193	14	57	92	94	181	35	944
127	64M06/S/127/17-18	453	8	76	22	17	28	28	28	160	11	46	34	95	64	35	788
128	64M06/S/128/17-18	446	20	89	20	16	27	27	27	91	14	82	42	107	50	35	825
129	64M06/S/129/17-18	433	12	69	21	23	30	33	30	150	16	115	27	135	50	35	515
130	64M06/S/130/17-18	553	10	65	20	16	21	26	25	158	15	89	39	91	66	35	642
131	64M06/S/131/17-18	604	10	95	19	15	21	30	20	109	13	57	22	91	40	35	616
132	64M06/S/132/17-18	501	12	104	24	18	24	34	28	103	14	54	37	113	47	35	754
133	64M06/S/133/17-18	507	12	94	21	16	27	26	32	96	12	62	38	113	48	35	767
134	64M06/S/134/17-18	556	8	91	19	15	26	26	20	107	10	66	39	99	60	35	1014
135	64M06/S/135/17-18	548	16	86	24	16	20	33	27	128	10	53	22	99	42	35	545
136	64M06/S/136/17-18	639	15	56	14	13	17	23	30	144	11	56	26	79	54	35	627
137	64M06/S/137/17-18	543	6	44	16	14	16	21	41	165	11	52	50	68	73	35	778
138	64M06/S/138/17-18	581	11	82	21	18	24	28	27	126	11	68	36	105	49	35	739
139	64M06/S/139/17-18	466	10	97	20	17	23	32	19	109	11	50	39	104	50	35	986
140	64M06/S/140/17-18	565	12	106	22	15	22	30	23	89	14	58	31	103	41	35	823
141	64M06/S/141/17-18	397	19	106	17	16	39	28	19	55	14	40	57	125	52	35	1382
142	64M06/S/142/17-18	611	10	88	18	16	37	26	5	73	11	54	111	125	53	35	1554
143	64M06/S/143/17-18	465	12	82	14	15	44	25	15	64	13	45	58	124	42	35	1200
144	64M06/S/144/17-18	434	13	99	17	17	30	26	31	48	11	60	76	120	58	35	1146
145	64M06/S/145/17-18	489	9	116	16	14	34	22	5	55	13	52	135	123	95	35	2981
146	64M06/S/146/17-18	491	14	108	19	18	30	28	34	65	13	73	51	119	58	35	973

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
147	64M06/S/147/17-18	506	16	131	24	17	24	38	28	93	17	53	33	118	54	35	877
148	64M06/S/148/17-18	443	9	75	19	13	19	20	21	94	10	44	19	79	45	35	630
149	64M06/S/149/17-18	555	14	93	22	15	21	35	21	116	12	64	28	97	46	35	645
150	64M06/S/150/17-18	538	10	94	14	13	22	25	24	91	11	58	26	89	41	35	629
151	64M06/S/151/17-18	599	13	76	20	15	22	25	23	112	11	63	30	97	49	35	807
152	64M06/S/152/17-18	482	17	107	27	16	26	33	19	92	13	58	57	112	57	35	1336
153	64M06/S/153/17-18	515	17	100	22	16	26	31	27	76	14	57	37	109	49	35	992
154	64M06/S/154/17-18	475	16	111	26	18	32	37	23	87	13	55	61	121	61	77	1511
155	64M06/S/155/17-18	391	24	113	26	20	29	39	30	78	16	47	43	124	51	35	1027
156	64M06/S/156/17-18	347	15	128	19	21	28	36	34	61	13	61	62	122	58	35	1164
157	64M06/S/157/17-18	662	19	126	24	18	30	33	36	59	14	89	52	126	65	35	1636
158	64M06/S/158/17-18	467	11	108	18	17	25	29	33	53	14	77	59	119	48	35	1076
159	64M06/S/159/17-18	461	11	122	22	20	26	37	29	79	16	76	42	111	52	35	1096
160	64M06/S/160/17-18	445	14	122	14	21	55	26	33	38	14	71	73	146	82	35	2263
161	64M06/S/161/17-18	483	10	98	16	16	27	26	26	79	13	54	36	109	49	35	891
162	64M06/S/162/17-18	445	9	110	19	19	40	28	21	76	12	52	53	124	59	35	1377
163	64M06/S/163/17-18	454	13	135	13	19	37	23	29	54	13	51	66	116	65	35	1588
164	64M06/S/164/17-18	427	9	105	22	18	40	26	32	42	11	56	78	127	59	35	1473
165	64M06/S/165/17-18	436	18	110	20	15	27	30	29	50	13	48	39	112	60	35	1194
166	64M06/S/166/17-18	442	18	118	24	18	32	36	23	48	12	48	58	113	62	35	1304
167	64M06/S/167/17-18	428	13	122	27	17	26	37	28	71	13	47	46	110	56	71	966

ANNEXURE II: Continued…

Sl. No.	Composite Sample No.	Ba (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Ga (mg/Kg)	Nb (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Rb (mg/Kg)	Sc (mg/Kg)	Sr (mg/Kg)	Th (mg/Kg)	V (mg/Kg)	Y (mg/Kg)	Zn (mg/Kg)	Zr (mg/Kg)
168	64M06/S/168/17-18	418	16	107	17	17	31	27	31	45	14	45	57	115	50	35	1201
169	64M06/S/169/17-18	333	16	115	15	23	41	33	36	37	14	70	67	133	61	35	1397
170	64M06/S/170/17-18	545	13	116	20	16	33	26	22	53	17	70	46	120	55	35	1142
171	64M06/S/171/17-18	458	12	118	16	20	38	24	31	42	15	70	49	126	60	35	1518
172	64M06/S/172/17-18	382	12	111	15	19	34	26	26	43	13	70	45	121	64	35	1422
173	64M06/S/173/17-18	676	15	104	19	17	29	29	35	73	12	85	40	109	61	35	983
174	64M06/S/174/17-18	315	6	81	9	13	72	15	22	19	16	51	68	162	55	35	2232
175	64M06/S/175/17-18	553	11	107	16	17	28	29	29	84	14	81	41	104	59	35	1126
176	64M06/S/176/17-18	508	14	108	21	18	37	29	21	71	12	68	61	113	60	35	1428
177	64M06/S/177/17-18	412	11	112	15	14	42	23	21	44	13	52	79	114	61	35	1778
178	64M06/S/178/17-18	343	14	105	19	15	32	31	21	47	12	43	55	114	66	35	1474
179	64M06/S/179/17-18	416	15	131	26	19	31	35	32	49	16	49	52	124	61	35	1276
180	64M06/S/180/17-18	459	11	97	20	17	34	28	27	55	15	54	53	119	52	35	1070
181	64M06/S/181/17-18	556	14	100	15	17	40	25	20	68	12	62	72	120	61	35	1460
182	64M06/S/182/17-18	393	12	93	16	19	46	22	28	40	14	47	86	132	57	35	1217

ANNEXURE III: RESULTS OF CHEMICAL ANALYSIS OF REE IN STREAM SEDIMENT / SLOPE-WASH SAMPLES FROM T.S. No.64M/06 (All values are in ppm)																						
Sl. No.	**Composite Sample Number**	**Be**	**Ge**	**As**	**Sn**	**La**	**Ce**	**Pr**	**Nd**	**Eu**	**Sm**	**Gd**	**Tb**	**Dy**	**Ho**	**Er**	**Tm**	**Yb**	**Lu**	**Hf**	**Ta**	**U**
1	64M06/S/001/17-18	2.62	1.07	3.10	3.17	94.59	154.85	20.43	76.36	2.22	14.70	13.34	2.36	14.00	2.85	8.32	1.37	8.36	1.29	14.64	1.75	5.65
2	64M06/S/002/17-18	2.77	1.05	3.58	2.30	80.52	146.86	18.18	68.54	2.17	13.07	11.86	2.09	12.37	2.62	7.89	1.29	8.11	1.31	13.51	1.56	5.46
3	64M06/S/003/17-18	1.57	0.89	2.43	0.5	40.11	80.25	9.35	37.01	1.23	7.85	7.25	1.32	8.08	1.67	4.94	0.80	4.89	0.77	7.76	0.69	3.14
4	64M06/S/004/17-18	2.41	1.10	4.10	1.61	79.14	146.59	18.57	69.94	1.93	13.85	12.77	2.28	13.40	2.69	8.09	1.37	8.74	1.40	17.29	1.60	5.74
5	64M06/S/005/17-18	1.69	0.84	3.20	1.15	75.06	145.46	16.72	63.95	1.63	12.86	12.19	2.27	13.71	2.85	8.71	1.42	8.67	1.34	10.22	1.24	4.43
6	64M06/S/006/17-18	1.75	0.84	2.40	0.5	56.59	116.75	12.78	49.67	1.88	10.63	11.42	2.35	15.51	3.50	10.37	1.82	11.73	1.74	14.96	1.17	4.37
7	64M06/S/007/17-18	2.29	1.24	3.62	1.16	98.35	180.88	21.75	84.18	2.12	16.79	16.56	2.93	17.54	3.60	10.18	1.72	11.17	1.65	15.47	1.28	6.42
8	64M06/S/008/17-18	3.05	2.02	7.90	2.89	113.59	211.50	24.86	92.08	2.19	17.28	15.19	2.40	12.86	2.49	6.84	1.14	7.07	1.08	11.65	1.79	6.46
9	64M06/S/009/17-18	3.57	1.75	6.34	5.72	100.91	198.85	23.53	90.84	3.09	18.21	17.52	3.18	19.33	3.96	11.09	1.89	12.36	1.91	23.15	1.82	7.38
10	64M06/S/010/17-18	3.38	1.25	3.36	9.95	68.73	132.35	16.22	64.71	2.35	14.08	14.71	2.94	18.74	4.02	11.81	2.07	13.54	2.15	21.50	1.68	5.95
11	64M06/S/011/17-18	2.93	1.24	2.80	3.38	66.23	127.32	15.87	63.93	2.43	13.79	13.78	2.50	15.10	3.17	9.03	1.54	10.09	1.57	16.84	1.73	5.67
12	64M06/S/012/17-18	5.19	1.70	4.33	8.16	111.14	244.37	25.05	96.75	2.25	19.71	19.54	3.47	20.70	4.24	12.20	2.08	13.72	2.06	30.89	2.35	16.51
13	64M06/S/013/17-18	4.69	1.57	4.48	6.49	115.75	232.24	26.24	98.11	2.11	19.01	18.40	3.26	19.30	3.96	11.27	1.94	12.59	1.91	24.16	1.97	13.56
14	64M06/S/014/17-18	1.98	1.39	5.75	0.5	73.37	139.69	15.94	61.35	1.67	11.35	10.45	1.81	10.30	2.13	6.10	1.03	6.60	1.02	10.65	1.19	4.83
15	64M06/S/015/17-18	1.78	1.18	5.81	0.5	56.00	101.95	12.38	47.99	1.42	9.60	8.68	1.48	8.58	1.73	4.78	0.81	5.42	0.86	9.39	1.04	3.54
16	64M06/S/016/17-18	2.52	1.35	5.68	1.67	99.15	188.76	22.02	86.07	2.15	17.56	16.27	2.79	16.31	3.29	9.27	1.56	10.21	1.56	16.46	1.82	5.24
17	64M06/S/017/17-18	2.29	1.68	4.18	0.5	92.82	188.03	21.12	80.77	1.97	15.67	14.64	2.41	14.00	2.82	7.98	1.35	8.62	1.36	24.38	1.68	6.97
18	64M06/S/018/17-18	2.68	1.66	4.42	1.08	95.28	179.36	21.36	81.47	2.15	16.01	15.42	2.60	14.86	3.01	8.20	1.37	8.85	1.35	16.91	1.58	5.63
19	64M06/S/019/17-18	1.90	1.36	3.72	1.15	82.85	157.44	17.66	67.96	1.93	13.01	12.66	2.18	13.12	2.73	7.54	1.26	8.06	1.24	12.49	1.52	4.59
20	64M06/S/020/17-18	2.02	1.37	4.70	1.15	82.59	162.01	19.28	75.77	2.14	14.93	14.39	2.47	14.46	2.91	8.30	1.38	9.02	1.36	17.91	1.70	5.32
21	64M06/S/021/17-18	1.83	1.17	3.00	1.38	72.53	113.12	16.23	61.44	1.81	12.95	13.11	2.44	15.27	3.25	9.15	1.57	10.26	1.54	13.44	1.44	4.42
22	64M06/S/022/17-18	2.25	1.31	4.20	0.5	54.11	97.92	12.90	50.46	1.78	10.50	10.20	1.83	11.30	2.42	6.89	1.21	7.66	1.19	13.77	1.60	4.36
23	64M06/S/023/17-18	2.25	1.34	3.51	0.5	63.83	116.01	15.56	61.07	2.26	13.63	13.72	2.65	16.58	3.47	9.83	1.70	10.92	1.71	29.57	1.67	6.77
24	64M06/S/024/17-18	2.07	1.42	6.40	1.09	82.99	138.52	19.15	74.09	2.22	14.91	13.59	2.33	13.03	2.60	7.27	1.19	7.89	1.21	30.80	2.14	6.08
25	64M06/S/025/17-18	5.38	2.37	6.76	6.19	131.78	267.73	30.78	117.26	3.38	23.48	22.70	4.06	23.51	4.90	14.15	2.40	15.74	2.49	73.76	4.23	15.90

ANNEXURE III: Continued…

Sl. No.	Composite Sample Number	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
26	64M06/S/026/17-18	4.10	1.67	5.82	2.66	44.17	86.28	10.25	39.42	1.33	8.19	7.54	1.24	6.83	1.34	3.56	0.58	3.71	0.58	12.91	2.21	5.98
27	64M06/S/027/17-18	3.09	1.77	5.02	1.32	96.65	192.55	22.19	83.22	1.90	16.30	14.09	2.16	11.31	2.09	5.73	0.89	5.82	0.89	16.56	2.65	5.95
28	64M06/S/028/17-18	0.5	0.18	1	0.5	10.71	21.91	2.50	9.91	0.23	1.91	1.74	0.24	1.27	0.24	0.64	0.09	0.69	0.09	2.01	0.17	0.51
29	64M06/S/029/17-18	3.01	1.38	13.09	1.03	63.18	126.61	14.42	56.10	1.82	11.32	10.22	1.73	9.72	1.87	5.14	0.85	5.47	0.86	14.43	1.82	3.96
30	64M06/S/030/17-18	2.25	1.78	4.09	1.18	75.99	144.42	17.07	64.85	1.91	13.06	12.81	2.17	13.33	2.68	7.50	1.26	7.92	1.27	13.83	1.38	4.73
31	64M06/S/031/17-18	2.13	1.42	5.49	0.5	82.52	152.88	18.06	66.94	1.80	12.97	13.36	2.22	14.03	2.92	8.56	1.52	9.79	1.56	12.66	1.66	5.04
32	64M06/S/032/17-18	2.32	1.82	4.95	1.02	71.27	131.87	16.54	62.60	2.03	12.25	11.92	1.95	11.53	2.37	6.66	1.14	7.28	1.21	16.47	1.66	5.77
33	64M06/S/033/17-18	2.41	1.75	3.67	1.00	78.21	156.66	18.20	69.42	1.80	13.76	12.67	1.93	11.14	2.08	5.91	0.99	6.42	1.01	15.26	1.54	6.24
34	64M06/S/034/17-18	1.96	1.55	4.80	3.32	159.51	332.08	37.20	139.30	1.78	26.43	24.87	3.92	22.41	4.10	11.03	1.86	11.46	1.85	20.70	1.70	11.28
35	64M06/S/035/17-18	2.18	1.83	4.96	5.65	62.84	121.10	14.32	53.37	1.62	10.00	9.08	1.37	7.64	1.40	3.77	0.61	4.05	0.64	14.59	1.51	4.00
36	64M06/S/036/17-18	1.82	1.36	4.51	0.5	70.58	122.37	15.88	59.29	1.54	11.23	10.40	1.66	9.82	1.89	5.25	0.90	5.65	0.93	31.88	1.60	5.50
37	64M06/S/037/17-18	1.61	1.29	5.21	0.5	53.39	107.99	12.82	49.83	1.67	9.76	9.55	1.57	9.67	1.93	5.42	0.92	5.78	0.92	17.19	1.53	3.66
38	64M06/S/038/17-18	2.16	1.42	4.47	0.5	62.20	113.76	14.30	54.48	1.74	10.53	9.91	1.61	9.55	1.85	5.19	0.89	5.65	0.92	14.70	1.56	4.03
39	64M06/S/039/17-18	2.54	1.34	3.25	5.45	45.41	93.88	10.93	43.04	1.49	8.92	8.44	1.42	9.17	1.87	5.35	0.93	5.79	0.90	9.84	1.27	3.80
40	64M06/S/040/17-18	2.73	1.67	6.82	0.5	119.77	235.83	26.98	99.69	1.74	18.91	17.36	2.42	12.90	2.33	6.27	1.03	6.33	0.97	15.75	1.86	9.45
41	64M06/S/041/17-18	3.42	1.69	8.07	2.66	140.49	275.31	31.99	116.59	1.72	22.32	20.29	2.90	16.00	2.93	7.67	1.22	7.70	1.16	26.25	3.22	12.20
42	64M06/S/042/17-18	2.29	1.66	7.79	0.5	182.95	366.61	41.64	155.88	1.80	30.54	25.82	3.59	18.23	3.19	8.42	1.33	8.29	1.31	32.63	2.54	12.41
43	64M06/S/043/17-18	2.67	1.80	6.36	0.5	132.33	271.82	31.17	117.96	1.96	22.40	20.13	2.80	14.52	2.54	6.47	1.05	6.53	1.00	23.92	1.83	10.23
44	64M06/S/044/17-18	1.83	1.56	9.04	4.33	135.60	276.04	31.58	118.68	2.08	21.41	19.06	2.55	14.16	2.62	6.83	1.14	6.88	1.11	20.39	1.59	7.42
45	64M06/S/045/17-18	1.71	1.74	9.82	0.5	184.39	354.33	41.24	155.03	2.64	26.94	25.06	3.43	18.36	3.35	8.69	1.37	8.23	1.30	15.99	1.83	12.66
46	64M06/S/046/17-18	1.72	1.72	4.29	0.5	72.09	142.58	15.90	60.85	2.00	12.27	12.83	2.38	16.96	3.81	11.49	2.06	13.45	2.21	15.80	1.29	6.29
47	64M06/S/047/17-18	1.80	1.48	2.85	0.5	53.54	108.57	12.17	47.70	1.34	10.14	10.10	1.77	11.42	2.31	6.65	1.16	7.38	1.17	14.37	1.25	5.50
48	64M06/S/048/17-18	2.06	1.59	3.74	1.08	109.93	213.69	25.04	92.35	1.74	17.91	16.96	2.68	16.80	3.38	9.82	1.69	10.64	1.69	20.71	1.77	8.60
49	64M06/S/049/17-18	2.64	2.61	2.74	2.35	88.74	171.34	19.41	70.47	1.50	13.35	12.00	2.09	11.44	2.21	6.25	1.02	6.16	0.96	16.67	1.70	8.11
50	64M06/S/050/17-18	3.09	2.33	2.58	2.17	160.10	312.49	36.03	131.50	2.20	24.61	22.34	3.89	22.29	4.29	11.86	1.85	10.89	1.64	20.40	1.80	13.55
51	64M06/S/051/17-18	2.23	2.12	1	1.03	209.09	413.53	47.42	172.54	2.37	32.09	28.56	4.78	25.92	4.79	13.22	2.03	11.95	1.79	16.60	1.59	15.17
52	64M06/S/052/17-18	2.28	1.90	2.70	2.13	196.24	391.29	44.88	166.08	2.09	31.93	28.20	4.40	21.95	4.03	11.25	1.87	11.67	1.85	23.30	2.01	13.19

ANNEXURE III: Continued…

Sl. No.	Composite Sample Number	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
53	64M06/S/053/17-18	4.15	1.80	3.99	4.70	101.50	201.92	23.25	84.75	1.14	16.30	14.87	2.66	14.73	2.76	7.82	1.23	7.44	1.13	11.29	2.29	14.01
54	64M06/S/054/17-18	5.04	1.80	2.96	5.50	140.04	276.03	32.17	119.31	1.53	25.45	22.15	3.86	20.69	3.66	10.14	1.59	9.70	1.49	14.15	2.70	12.69
55	64M06/S/055/17-18	3.76	1.73	4.20	5.15	171.07	334.78	39.00	142.90	1.75	27.61	25.31	4.58	27.72	5.55	16.77	2.69	16.45	2.35	13.92	2.00	16.70
56	64M06/S/056/17-18	4.05	1.70	3.53	4.60	70.48	138.39	16.00	59.25	1.42	11.68	10.85	1.89	10.32	1.96	5.47	0.85	5.13	0.76	10.99	2.47	10.13
57	64M06/S/057/17-18	2.39	1.62	3.21	2.16	159.75	318.39	36.39	135.81	2.22	25.25	21.56	3.50	18.24	3.40	9.56	1.45	8.79	1.34	19.71	2.12	14.07
58	64M06/S/058/17-18	2.03	1.56	5.69	1.06	134.78	266.86	30.69	115.64	2.45	21.68	19.04	3.03	15.76	2.93	8.02	1.29	8.02	1.24	16.57	1.83	9.42
59	64M06/S/059/17-18	2.68	1.80	5.43	1.38	98.86	189.87	22.11	82.80	2.13	15.45	13.75	2.19	11.60	2.18	6.03	0.97	5.98	0.93	15.48	1.55	6.65
60	64M06/S/060/17-18	2.98	1.89	3.70	3.36	110.20	206.21	23.43	86.41	1.85	15.66	13.72	2.18	11.47	2.16	6.06	0.97	5.96	0.90	11.64	1.73	8.31
61	64M06/S/061/17-18	2.42	1.61	2.77	1.55	95.86	181.59	21.46	78.46	1.86	14.79	12.73	2.03	10.43	1.95	5.59	0.90	5.58	0.86	10.49	1.20	7.27
62	64M06/S/062/17-18	2.77	1.50	1.82	1.43	79.35	149.45	18.27	69.86	2.10	13.59	12.30	2.19	12.62	2.62	7.79	1.27	7.89	1.23	10.00	1.19	5.55
63	64M06/S/063/17-18	2.46	1.26	1.76	1.99	59.35	113.56	13.50	51.07	1.76	10.07	9.23	1.60	9.01	1.77	5.01	0.81	4.97	0.77	12.65	1.20	5.10
64	64M06/S/064/17-18	1.82	1.41	5.47	0.5	196.01	375.77	44.85	171.56	3.48	32.00	29.20	4.65	27.00	5.18	15.33	2.45	14.89	2.22	22.73	1.30	12.33
65	64M06/S/065/17-18	2.11	1.33	6.39	1.72	34.35	67.23	7.93	30.71	1.47	6.25	5.88	1.07	6.48	1.29	3.83	0.66	4.05	0.62	9.64	1.19	3.11
66	64M06/S/066/17-18	5.24	1.74	9.26	6.12	119.77	232.76	28.81	103.85	1.22	23.07	21.70	4.17	24.38	4.58	13.25	2.15	13.08	1.91	22.11	3.49	12.37
67	64M06/S/067/17-18	3.42	1.97	22.00	2.91	109.61	205.30	23.70	87.23	1.68	16.08	13.61	2.12	11.51	2.03	5.71	0.91	5.50	0.83	9.08	1.92	8.38
68	64M06/S/068/17-18	3.69	1.70	10.43	3.65	136.40	272.68	31.26	113.79	1.81	21.81	19.52	3.29	18.38	3.25	9.06	1.41	8.63	1.26	12.64	1.77	10.88
69	64M06/S/069/17-18	4.28	1.75	7.28	2.16	241.50	475.85	56.11	202.94	1.39	40.91	37.16	6.43	35.97	6.42	17.66	2.67	15.75	2.30	22.17	1.78	16.99
70	64M06/S/070/17-18	3.04	2.06	10.91	1.73	384.89	778.41	91.12	332.78	1.91	66.42	60.23	9.53	47.91	7.86	20.15	2.92	16.82	2.43	32.73	1.86	27.14
71	64M06/S/071/17-18	2.58	1.71	10.38	1.62	235.48	478.22	56.33	205.04	1.74	40.85	37.83	6.24	33.31	5.83	15.36	2.32	13.33	1.92	26.43	1.75	19.02
72	64M06/S/072/17-18	1.61	1.20	9.22	0.5	77.99	147.24	16.89	60.70	1.63	10.48	8.56	1.25	6.79	1.25	3.69	0.60	3.73	0.58	15.59	1.52	3.90
73	64M06/S/073/17-18	2.03	1.38	1	0.5	133.64	206.18	30.56	110.12	2.42	20.21	17.46	2.79	14.32	2.80	7.90	1.25	7.86	1.19	17.22	1.53	8.48
74	64M06/S/074/17-18	2.06	1.44	1	1.19	139.07	281.52	41.68	158.37	2.78	30.47	28.70	4.72	24.77	4.58	12.76	1.95	12.06	1.85	28.29	2.86	11.35
75	64M06/S/075/17-18	2.29	1.56	1	0.5	85.00	132.95	18.99	74.28	1.91	13.39	12.10	1.88	10.27	1.98	6.02	0.97	6.28	1.02	16.92	2.04	5.68
76	64M06/S/076/17-18	2.55	1.68	1	1.22	122.50	184.70	25.80	97.14	1.77	17.32	15.51	2.28	11.98	2.22	6.43	1.01	6.51	0.99	12.35	1.39	7.93
77	64M06/S/077/17-18	2.80	1.42	1	1.56	61.16	124.06	14.79	56.34	1.87	11.42	10.90	2.00	11.61	2.33	6.97	1.12	7.13	1.06	10.48	1.44	6.44
78	64M06/S/078/17-18	2.15	1.26	1	1.80	105.09	156.58	23.29	86.24	2.16	16.17	14.32	2.20	11.76	2.17	6.05	0.95	5.99	0.92	12.33	1.22	8.06
79	64M06/S/079/17-18	4.22	1.82	6.07	2.83	103.37	159.94	23.53	84.78	1.40	16.84	15.00	2.55	13.64	2.40	6.44	0.99	6.07	0.84	11.06	2.02	10.10

ANNEXURE III: Continued…

Sl. No.	Composite Sample Number	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
80	64M06/S/080/17-18	4.12	1.55	8.76	2.11	53.79	100.93	11.85	44.97	1.14	8.49	7.83	1.37	7.80	1.50	4.30	0.66	4.30	0.62	8.63	1.83	5.64
81	64M06/S/081/17-18	2.66	1.67	4.72	1.53	148.05	274.25	40.49	144.76	1.70	28.86	25.36	4.08	19.83	3.41	8.67	1.25	7.58	1.08	12.33	1.57	12.33
82	64M06/S/082/17-18	2.68	1.67	3.43	7.60	145.29	285.11	40.64	151.00	1.85	30.49	30.44	5.46	32.35	5.83	16.42	2.35	14.88	2.05	16.48	1.76	20.46
83	64M06/S/083/17-18	3.58	1.77	7.36	14.27	126.61	201.95	29.65	109.60	2.21	21.92	20.69	3.71	22.25	4.32	13.18	2.13	13.87	2.07	24.12	2.54	13.76
84	64M06/S/084/17-18	3.80	1.35	10.27	3.69	95.80	153.08	22.12	82.89	1.85	15.83	14.34	2.36	13.04	2.48	7.03	1.14	7.21	1.12	13.04	1.55	8.67
85	64M06/S/085/17-18	2.80	1.57	2.62	1.39	108.98	175.87	25.39	94.07	1.46	18.94	17.81	3.37	18.90	3.54	9.72	1.50	9.01	1.38	23.26	1.97	12.16
86	64M06/S/086/17-18	5.28	3.49	10.06	21.50	238.73	472.97	66.57	248.35	3.75	46.53	41.40	6.60	35.49	6.55	19.29	2.81	18.20	2.80	40.76	4.37	21.05
87	64M06/S/087/17-18	4.03	2.12	1	2.19	229.20	451.62	64.02	244.51	1.72	47.22	44.28	7.05	37.75	6.02	16.46	2.26	13.49	2.01	27.33	2.21	22.79
88	64M06/S/088/17-18	2.99	1.17	1	0.5	84.40	157.13	15.28	50.77	1.12	8.74	8.08	1.28	7.14	1.33	4.11	0.61	4.20	0.67	16.55	2.13	14.84
89	64M06/S/089/17-18	3.35	1.28	3.15	1.43	93.89	175.20	17.36	59.82	1.40	10.45	9.85	1.59	9.30	1.81	5.71	0.93	6.18	1.02	25.32	2.53	16.02
90	64M06/S/090/17-18	2.76	1.05	1.45	0.5	44.66	102.70	9.26	33.98	1.04	6.25	5.71	0.92	5.38	1.03	3.26	0.53	3.47	0.56	14.01	2.01	5.18
91	64M06/S/091/17-18	2.51	1.08	3.50	0.5	74.74	116.39	13.88	48.59	1.42	8.21	7.20	1.17	6.43	1.25	3.83	0.63	4.11	0.67	20.88	1.90	5.03
92	64M06/S/092/17-18	2.05	1.23	2.67	0.5	71.41	116.32	12.58	42.96	1.34	7.22	6.73	1.03	6.07	1.14	3.61	0.53	3.60	0.55	12.36	1.41	4.68
93	64M06/S/093/17-18	2.49	1.56	3.71	0.5	76.11	147.46	16.93	62.94	1.58	11.49	10.09	1.68	9.31	1.76	5.34	0.82	5.39	0.84	17.75	1.93	6.01
94	64M06/S/094/17-18	2.15	1.52	1.93	1.29	81.74	158.46	17.63	67.42	1.50	11.61	10.18	1.66	9.48	1.77	5.48	0.84	5.73	0.88	23.45	2.39	6.56
95	64M06/S/095/17-18	4.50	1.45	4.57	3.95	86.59	176.89	19.65	73.16	1.36	14.23	13.27	2.24	12.60	2.46	7.37	1.18	7.19	1.16	15.43	2.40	15.46
96	64M06/S/096/17-18	4.47	1.52	13.75	3.82	74.27	146.24	17.26	62.83	1.49	13.06	12.25	2.27	13.30	2.59	8.11	1.28	8.23	1.26	12.69	2.44	11.01
97	64M06/S/097/17-18	5.12	1.40	5.10	4.07	70.72	141.52	16.04	61.60	1.39	12.74	13.24	2.60	16.34	3.30	10.40	1.73	10.85	1.68	13.32	2.66	11.27
98	64M06/S/098/17-18	11.81	1.74	10.29	13.55	58.39	113.27	12.97	51.16	1.48	9.98	9.43	1.74	10.51	2.18	6.88	1.16	8.19	1.31	16.34	15.90	8.67
99	64M06/S/099/17-18	13.56	2.29	17.76	11.04	116.07	175.67	26.76	99.64	2.03	20.48	19.85	3.71	22.62	4.67	14.98	2.68	18.30	3.03	13.87	7.28	16.01
100	64M06/S/100/17-18	6.31	1.63	3.65	4.86	57.18	113.29	13.55	51.58	1.35	11.21	11.19	2.24	13.83	2.76	8.78	1.49	10.31	1.63	15.18	5.18	12.81
101	64M06/S/101/17-18	6.52	1.67	3.98	4.52	61.79	117.59	14.36	53.61	1.46	11.42	11.18	2.15	13.76	2.72	8.94	1.55	10.83	1.78	15.72	4.86	12.95
102	64M06/S/102/17-18	5.29	1.44	1	3.58	54.83	108.10	12.67	48.94	1.16	10.19	10.41	1.98	12.91	2.57	8.64	1.49	10.68	1.70	18.03	3.58	8.07
103	64M06/S/103/17-18	2.08	1.99	1	0.5	167.41	262.01	35.82	135.46	2.01	23.60	20.63	3.12	16.42	2.94	8.86	1.32	8.55	1.34	25.53	2.49	10.10
104	64M06/S/104/17-18	2.07	1.51	1	0.5	116.94	185.83	26.30	98.36	1.63	18.49	17.71	2.98	16.94	3.16	9.23	1.34	8.61	1.29	19.72	1.56	10.89
105	64M06/S/105/17-18	2.66	1.40	3.55	2.29	69.76	136.33	16.37	60.27	1.52	12.02	10.54	1.83	10.17	1.95	5.79	0.95	6.01	0.91	15.38	2.05	7.88
106	64M06/S/106/17-18	2.07	1.35	1	0.5	73.88	147.99	16.98	63.48	1.47	11.65	11.03	1.86	10.71	2.10	6.34	0.99	6.24	0.98	16.54	1.84	7.25

ANNEXURE III: Continued…

Sl. No.	Composite Sample Number	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
107	64M06/S/107/17-18	2.34	1.51	1	1.12	72.13	147.15	17.21	65.40	1.65	13.03	12.38	2.26	13.54	2.86	8.76	1.41	8.85	1.39	17.33	1.96	7.58
108	64M06/S/108/17-18	1.32	1.09	1	0.5	43.90	81.81	10.11	36.46	0.99	6.78	5.68	0.95	5.36	1.02	3.13	0.51	3.28	0.52	12.10	1.47	3.61
109	64M06/S/109/17-18	4.68	1.45	1	4.87	108.26	168.53	23.01	88.82	1.42	17.04	16.87	2.96	17.55	3.42	10.25	1.59	9.88	1.51	15.86	1.85	10.92
110	64M06/S/110/17-18	4.34	1.71	2.13	4.51	96.91	180.36	20.91	80.43	1.58	15.27	13.96	2.41	13.86	2.66	7.98	1.26	8.00	1.24	22.47	2.45	11.25
111	64M06/S/111/17-18	3.16	1.38	3.36	3.15	69.10	132.55	15.52	60.03	1.41	11.83	10.77	1.96	11.64	2.28	6.95	1.07	6.83	1.08	13.69	2.24	8.42
112	64M06/S/112/17-18	3.12	1.47	2.14	2.82	100.72	186.72	21.99	81.43	1.59	16.22	14.83	2.49	13.27	2.57	7.40	1.09	6.88	1.14	19.53	1.74	8.69
113	64M06/S/113/17-18	2.42	1.59	12.69	2.07	114.27	203.24	25.53	92.53	1.80	17.14	14.65	2.43	13.45	2.62	8.23	1.27	8.84	1.28	25.19	1.91	8.67
114	64M06/S/114/17-18	4.56	1.37	12.19	5.03	104.21	183.32	23.66	86.32	1.67	17.22	16.78	3.18	19.75	4.05	12.54	2.08	13.53	2.10	37.74	3.82	11.73
115	64M06/S/115/17-18	2.38	2.23	2.33	0.5	83.10	157.79	17.81	66.52	1.51	12.21	10.40	1.65	9.10	1.69	5.15	0.79	5.55	0.83	23.93	2.00	6.75
116	64M06/S/116/17-18	2.59	1.66	2.28	1.68	143.43	224.35	32.35	116.77	1.69	22.55	19.88	3.50	19.32	3.82	11.44	1.84	12.03	1.87	24.10	1.96	13.18
117	64M06/S/117/17-18	2.56	1.73	2.83	1.59	133.43	212.01	31.53	114.69	1.62	25.60	26.36	5.50	34.07	6.76	19.60	2.82	17.64	2.50	20.27	1.91	16.50
118	64M06/S/118/17-18	2.78	1.55	3.59	1.57	96.45	188.59	22.47	81.96	1.56	15.77	13.68	2.25	11.66	2.06	5.71	0.81	5.35	0.79	11.74	2.04	7.94
119	64M06/S/119/17-18	2.45	1.87	3.09	1.19	226.92	461.23	64.17	242.76	2.71	48.05	46.17	8.18	47.29	9.08	25.41	3.83	22.90	3.45	34.54	3.15	26.12
120	64M06/S/120/17-18	2.12	1.68	1	5.05	82.66	167.30	18.27	71.19	1.29	13.73	11.89	1.71	8.96	1.59	4.44	0.64	4.24	0.66	16.02	2.07	6.99
121	64M06/S/121/17-18	1.72	1.52	1	0.5	86.83	119.66	19.41	75.17	1.55	13.76	12.10	1.90	10.28	1.89	5.47	0.84	5.36	0.85	15.29	1.56	7.37
122	64M06/S/122/17-18	1.59	1.63	1	0.5	104.38	205.77	33.55	127.24	2.17	24.04	22.46	4.14	24.84	4.93	14.58	2.36	14.10	2.20	22.68	1.55	12.18
123	64M06/S/123/17-18	1.77	2.02	1	1.59	174.31	339.44	56.59	204.65	2.83	37.96	34.10	5.60	29.76	5.53	14.70	2.34	13.47	2.10	29.42	4.45	17.50
124	64M06/S/124/17-18	1.96	1.95	2.57	0.5	123.95	167.74	27.76	103.38	1.92	18.58	15.64	2.39	12.19	2.15	5.89	0.90	5.74	0.89	20.62	1.80	7.83
125	64M06/S/125/17-18	3.04	1.86	3.93	3.06	79.84	112.04	18.14	68.64	1.78	13.34	13.11	2.42	15.76	3.22	10.52	1.77	11.99	1.88	14.33	1.98	7.99
126	64M06/S/126/17-18	3.03	1.77	3.06	4.75	157.18	319.98	51.57	195.43	1.93	38.40	36.19	6.34	38.81	7.25	21.90	3.41	22.02	3.29	28.71	2.30	16.11
127	64M06/S/127/17-18	2.09	1.37	1	2.94	94.94	136.23	22.10	79.50	1.44	14.84	13.38	2.20	11.91	2.35	6.85	1.12	7.26	1.15	22.95	2.89	7.60
128	64M06/S/128/17-18	2.45	1.56	1	2.71	116.51	189.15	30.46	115.35	1.96	19.11	15.42	2.11	10.13	1.84	5.16	0.82	5.13	0.86	28.74	2.53	7.85
129	64M06/S/129/17-18	4.04	1.92	3.24	3.17	81.21	116.13	17.78	67.33	1.70	11.87	10.46	1.62	9.13	1.75	5.25	0.81	5.27	0.83	15.76	2.61	10.79
130	64M06/S/130/17-18	2.80	1.56	4.85	13.16	101.63	136.13	22.77	87.36	1.85	16.44	15.12	2.67	16.15	3.27	9.80	1.55	10.01	1.57	19.32	2.32	10.87
131	64M06/S/131/17-18	1.19	1.28	4.16	0.5	68.06	127.02	15.54	60.27	1.55	10.91	8.23	1.31	7.20	1.30	3.70	0.57	4.05	0.62	15.61	1.56	4.36
132	64M06/S/132/17-18	1.91	1.53	1	1.02	114.95	164.56	25.96	97.77	1.86	16.64	13.92	2.01	10.21	1.95	5.56	0.89	5.49	0.90	24.19	2.02	6.82
133	64M06/S/133/17-18	1.70	1.48	1	1.65	124.35	175.05	28.30	105.73	2.32	17.99	13.99	2.03	10.24	1.90	5.42	0.84	5.52	0.85	22.29	2.46	5.96

ANNEXURE III: Continued…

Sl. No.	Composite Sample Number	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
134	64M06/S/134/17-18	1.61	1.55	10.90	2.20	104.05	209.39	33.81	124.24	2.00	21.70	18.78	2.75	14.32	2.59	7.35	1.19	7.80	1.24	32.03	2.43	8.76
135	64M06/S/135/17-18	1.34	0.92	1	0.5	37.55	78.61	8.62	32.41	0.96	5.83	5.42	0.86	4.83	0.94	2.71	0.45	2.74	0.44	8.57	0.59	3.05
136	64M06/S/136/17-18	1.64	1.51	3.28	1.94	84.06	116.78	19.34	71.38	1.62	13.28	11.59	1.85	10.39	1.92	5.58	0.88	5.72	0.85	18.91	1.65	6.59
137	64M06/S/137/17-18	1.28	1.68	1	1.71	123.11	164.29	27.67	101.85	1.94	19.30	18.30	3.30	19.30	3.72	10.60	1.65	10.31	1.53	26.52	1.76	10.28
138	64M06/S/138/17-18	2.15	2.03	3.64	2.55	116.65	155.67	25.86	92.53	2.09	15.59	13.09	2.00	10.56	1.94	5.48	0.87	5.48	0.84	20.96	2.18	7.00
139	64M06/S/139/17-18	1.92	1.65	5.29	2.71	103.34	179.67	29.63	106.98	2.02	18.18	15.21	2.27	11.83	2.15	6.26	0.99	6.63	1.05	39.45	2.56	8.45
140	64M06/S/140/17-18	1.75	1.59	4.28	2.39	101.83	135.17	23.51	84.29	1.75	14.49	12.05	1.74	9.21	1.67	4.81	0.75	4.96	0.76	30.07	1.99	6.08
141	64M06/S/141/17-18	1.34	1.59	10.02	1.65	121.92	249.76	40.41	145.02	2.18	23.11	18.62	2.32	11.32	1.99	5.66	0.91	5.93	0.95	53.10	3.53	8.69
142	64M06/S/142/17-18	1.39	1.77	3.56	1.43	237.93	494.42	78.83	283.33	2.30	44.54	32.81	3.97	16.44	2.86	7.57	1.20	7.44	1.15	63.26	3.45	13.38
143	64M06/S/143/17-18	1.41	1.45	3.01	0.5	136.86	272.23	46.86	161.33	1.77	26.54	19.95	2.59	12.21	2.10	6.09	0.95	6.52	0.95	49.75	3.65	8.84
144	64M06/S/144/17-18	1.55	1.43	1	3.36	146.03	297.44	47.32	169.96	2.51	28.23	21.96	3.07	15.46	2.85	8.25	1.31	8.62	1.28	40.90	2.64	8.92
145	64M06/S/145/17-18	1.38	1.89	2.37	1.16	359.11	710.86	82.97	407.80	3.97	63.70	48.46	6.16	28.07	4.88	13.70	2.18	13.88	2.13	100.01	4.30	19.86
146	64M06/S/146/17-18	1.67	1.55	4.46	1.92	102.22	200.06	32.69	118.57	2.63	19.82	16.60	2.43	13.28	2.38	6.88	1.06	7.21	1.05	39.85	3.09	6.99
147	64M06/S/147/17-18	1.92	1.49	6.12	2.06	91.46	131.26	21.05	76.43	1.95	13.78	12.23	2.13	12.58	2.55	7.79	1.32	8.49	1.29	28.75	2.45	5.62
148	64M06/S/148/17-18	1.46	1.41	4.62	1.48	63.54	118.99	14.69	53.31	1.60	9.72	8.80	1.46	8.41	1.63	4.86	0.80	5.14	0.82	21.62	1.74	5.06
149	64M06/S/149/17-18	1.88	1.57	4.48	1.41	109.44	153.18	25.22	90.33	1.76	16.52	13.58	1.99	9.50	1.65	4.44	0.70	4.58	0.69	19.29	1.74	5.99
150	64M06/S/150/17-18	1.46	1.44	2.22	1.24	74.55	103.51	17.15	62.77	1.55	11.14	9.56	1.46	7.80	1.41	4.07	0.65	4.32	0.64	19.14	1.84	4.50
151	64M06/S/151/17-18	1.69	1.44	3.34	0.5	96.20	139.78	22.95	83.90	1.81	14.34	12.29	1.86	9.43	1.70	4.75	0.77	4.99	0.77	22.29	1.81	5.75
152	64M06/S/152/17-18	1.51	1.45	3.16	1.38	132.08	254.65	42.10	150.53	2.02	24.72	19.22	2.51	11.94	2.00	5.67	0.90	5.88	0.92	35.34	2.11	8.63
153	64M06/S/153/17-18	2.00	1.49	3.80	0.5	120.65	165.77	27.20	98.96	1.99	16.19	13.54	1.94	10.62	1.96	5.71	0.96	6.21	0.95	33.67	2.32	6.76
154	64M06/S/154/17-18	2.23	1.82	8.62	2.11	171.65	354.61	57.56	204.67	2.81	33.19	26.09	3.36	15.72	2.77	7.76	1.21	7.94	1.23	57.94	2.96	12.02
155	64M06/S/155/17-18	1.91	1.54	6.69	0.5	100.16	203.21	32.06	119.48	2.18	19.23	16.05	2.19	11.94	2.25	6.63	1.01	6.78	1.03	28.97	3.00	7.01
156	64M06/S/156/17-18	1.56	1.59	6.85	2.47	158.16	313.63	51.21	177.26	3.27	29.30	24.80	3.72	20.40	4.13	12.66	2.04	13.34	1.95	50.55	3.08	10.48
157	64M06/S/157/17-18	1.49	1.38	4.09	1.22	97.67	200.96	31.70	116.64	2.52	20.61	17.18	2.77	16.19	3.20	10.04	1.57	10.96	1.59	53.64	2.64	9.20
158	64M06/S/158/17-18	1.35	1.31	3.38	1.22	110.84	190.57	30.95	108.82	2.62	18.94	15.47	2.19	10.75	2.03	5.64	0.96	6.02	0.98	41.59	2.40	6.68
159	64M06/S/159/17-18	1.72	1.60	5.83	1.64	103.42	207.54	33.34	121.70	2.39	20.64	17.26	2.58	13.84	2.59	7.54	1.22	8.32	1.25	41.66	3.05	7.18
160	64M06/S/160/17-18	1.50	1.57	4.55	1.42	169.27	339.83	51.29	187.45	3.38	30.10	26.19	4.07	21.83	4.16	12.79	2.15	12.53	2.08	73.02	4.80	10.87

ANNEXURE III: Continued…

Sl. No.	Composite Sample Number	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
161	64M06/S/161/17-18	1.43	1.35	5.01	0.5	89.35	125.71	19.67	74.94	1.90	12.93	11.37	1.77	9.84	1.94	5.81	0.93	6.18	0.98	31.19	2.51	5.71
162	64M06/S/162/17-18	1.61	1.58	4.78	0.5	106.33	211.92	34.09	125.61	2.40	21.17	17.42	2.45	11.61	2.20	6.30	1.05	6.85	1.11	53.85	3.82	8.04
163	64M06/S/163/17-18	1.29	1.43	2.57	0.5	170.45	327.04	54.78	197.90	2.73	32.63	25.35	3.44	17.28	2.99	8.74	1.38	9.26	1.39	56.37	3.02	10.82
164	64M06/S/164/17-18	1.59	1.32	1	0.5	153.12	316.46	49.95	186.59	2.60	29.90	23.08	2.98	14.14	2.35	6.69	1.05	6.92	1.06	47.60	3.46	9.34
165	64M06/S/165/17-18	1.42	1.35	2.90	1.21	115.39	159.60	26.06	95.93	2.14	16.75	13.94	2.23	12.45	2.41	7.27	1.22	7.87	1.23	37.32	2.33	7.41
166	64M06/S/166/17-18	1.68	1.41	4.12	1.39	109.40	216.10	34.50	128.14	2.03	21.33	16.63	2.30	11.30	2.00	5.77	0.93	5.90	0.92	33.87	2.48	7.49
167	64M06/S/167/17-18	2.13	1.50	6.23	0.5	103.53	213.95	33.77	126.89	2.43	20.35	16.71	2.32	11.21	2.04	5.49	0.89	5.63	0.85	35.14	2.11	8.46
168	64M06/S/168/17-18	1.40	1.32	4.21	0.5	100.27	193.28	30.14	108.83	1.94	17.41	14.31	1.94	9.43	1.71	4.83	0.76	4.78	0.76	31.49	2.23	6.52
169	64M06/S/169/17-18	1.66	1.46	5.67	0.5	147.16	299.18	46.70	176.96	2.68	28.08	22.14	2.88	13.94	2.47	6.96	1.15	7.41	1.17	54.85	3.91	10.29
170	64M06/S/170/17-18	1.24	1.17	2.61	0.5	117.12	170.21	27.52	101.52	2.03	17.23	14.58	2.21	11.89	2.30	6.87	1.14	7.32	1.20	48.20	2.89	7.06
171	64M06/S/171/17-18	1.24	1.19	1	10.63	129.07	185.66	29.57	110.92	1.76	18.17	14.88	2.00	10.41	1.92	5.72	0.93	6.17	0.98	40.09	2.76	7.07
172	64M06/S/172/17-18	1.14	1.18	1	9.18	102.06	141.71	22.45	83.23	1.82	13.84	12.35	1.98	11.21	2.22	6.63	1.13	7.44	1.14	52.63	3.20	6.32
173	64M06/S/173/17-18	1.24	1.19	3.18	0.5	85.13	119.04	19.82	72.72	1.93	12.79	11.21	1.77	9.97	2.06	6.26	1.02	6.82	1.10	33.91	2.18	5.47
174	64M06/S/174/17-18	0.5	1.22	5.58	0.5	153.03	311.75	50.58	184.71	2.64	30.33	24.24	3.25	15.74	2.88	8.31	1.39	9.04	1.46	87.25	6.15	10.24
175	64M06/S/175/17-18	1.30	1.37	1	0.5	104.59	210.35	33.63	127.38	2.43	21.61	18.08	2.54	12.64	2.26	6.40	1.04	6.59	1.05	38.04	2.41	7.54
176	64M06/S/176/17-18	1.43	1.61	2.42	10.12	229.96	451.13	73.65	262.00	2.61	41.40	31.18	3.90	17.42	2.82	7.88	1.26	8.39	1.32	76.17	3.59	11.99
177	64M06/S/177/17-18	1.29	1.49	2.90	0.5	181.54	374.69	59.24	214.41	2.54	33.93	26.85	3.67	18.35	3.34	9.70	1.53	9.83	1.57	65.40	3.72	12.23
178	64M06/S/178/17-18	1.39	1.52	1	1.03	141.24	286.07	46.45	171.06	2.23	27.89	21.81	2.92	13.97	2.42	6.75	1.08	7.23	1.11	49.93	2.90	9.94
179	64M06/S/179/17-18	1.68	1.36	1	0.5	115.58	229.39	37.58	136.59	2.42	22.98	18.48	2.62	12.61	2.30	6.49	1.06	6.84	1.06	38.65	2.58	8.08
180	64M06/S/180/17-18	1.62	1.36	1	0.5	106.62	197.12	31.04	117.67	2.13	18.69	15.59	2.17	10.42	1.88	5.29	0.85	5.26	0.84	33.19	2.86	7.30
181	64M06/S/181/17-18	1.49	1.61	2.02	0.5	137.39	284.72	44.83	166.25	2.62	26.43	21.64	2.90	14.43	2.63	7.43	1.18	7.37	1.15	41.32	3.12	9.29
182	64M06/S/182/17-18	1.44	1.72	3.47	1.23	220.16	444.12	70.90	259.92	2.91	42.43	31.79	3.88	17.07	2.88	8.28	1.31	9.10	1.38	54.74	4.52	13.27

ANNEXURE IV: RESULTS OF CHEMICAL ANALYSIS OF MAJOR OXIDES IN REGOLITH & C-HORIZON SAMPLES FROM T.S. No. 64M/06

								Annexure IV		
Composite No	**SiO_2**	**Al_2O_3**	**Fe_2O_3**	**TiO_2**	**CaO**	**MgO**	**MnO**	**Na_2O**	**K_2O**	**P_2O_5**
64M06/A1/C/17-18	65.63	18.14	4.26	0.94	0.21	0.67	0.02	0.16	2.06	0.04
64M06/A2/C/17-18	57.81	18.78	6.66	0.73	0.47	1.31	0.12	0.54	2.7	0.05
64M06/A3/C/17-18	57.12	17.88	5.52	0.56	0.32	1.11	0.08	1.67	3.56	0.03
64M06/B1/C/17-18	65.22	12.26	4.86	1.16	0.68	1.2	0.05	0.74	1.89	0.11
64M06/B2/C/17-18	56.71	18.01	7.74	0.92	0.47	1.94	0.08	0.49	2.47	0.06
64M06/B3/C/17-18	48.56	24.51	7.74	0.86	0.63	1.3	0.06	0.54	2.94	0.04
64M06/C1/C/17-18	58.86	17.17	7.64	0.95	0.43	1.15	0.06	0.42	1.89	0.1
64M06/C2/C/17-18	56.9	18.08	7.26	0.97	0.97	1.15	0.06	1.13	2.48	0.08
64M06/C3/C/17-18	51.44	21.43	7.72	1.14	0.95	0.84	0.09	1.8	2.89	0.05

								Annexure IV		
Composite No	**SiO_2**	**Al_2O_3**	**Fe_2O_3**	**TiO_2**	**CaO**	**MgO**	**MnO**	**Na_2O**	**K_2O**	**P_2O_5**
64M06/A1/R/17-18	66.33	15.31	4.42	0.98	0.26	0.54	0.1	0.22	1.99	0.1
64M06/A2/R/17-18	65.26	13.65	3.37	0.7	0.61	0.64	0.07	1.45	3.25	0.06
64M06/A3/R/17-18	54.88	16.68	4.49	0.57	0.34	1.1	0.1	0.37	4.24	0.09
64M06/B1/R/17-18	68.46	9.99	3.75	0.92	0.62	0.94	0.04	0.78	1.93	0.08
64M06/B2/R/17-18	60.98	15.3	6.37	0.92	0.42	1.64	0.1	0.36	2.66	0.11
64M06/B3/R/17-18	57.78	16.26	6.99	1.1	0.46	1.27	0.09	0.36	2.46	0.08
64M06/C1/R/17-18	64.64	12.97	5.09	1.02	0.38	1.03	0.06	0.48	1.99	0.12
64M06/C2/R/17-18	54.16	20.53	6.76	0.77	0.57	0.94	0.07	1.28	2.8	0.08
64M06/C3/R/17-18	58.86	17.02	5.45	1.07	0.51	0.8	0.08	0.69	3.34	0.09

ANNEXURE V: RESULTS OF CHEMICAL ANALYSIS OF TRACE ELEMENTS IN C-HORIZON SAMPLES & REGOLITH OF T.S. No. 64M/06

						(All values are in ppm)									**Annexure V**	
COMPOSITE SAMPLES	**Ba**	**Co**	**Cr**	**Cu**	**Ga**	**Nb**	**Ni**	**Pb**	**Rb**	**Sc**	**Sr**	**Th**	**V**	**Y**	**Zn**	**Zr**
64M06/A1/C/17-18	574	8	120	33	26	25	33	20	147	17	35	32	126	47	86	345
64M06/A2/C/17-18	393	25	75	36	27	24	37	35	270	18	44	25	108	69	76	323
64M06/A3/C/17-18	644	2	10	2.5	20	26	5	5	145	11	20	35	10	88	79	435
64M06/B1/C/17-18	416	14	117	23	16	26	32	23	88	10	85	32	115	47	35	937
64M06/B2/C/17-18	502	22	115	34	22	20	50	25	155	16	60	15	132	34	97	325
64M06/B3/C/17-18	602	13	32	23	29	21	21	39	205	16	61	35	91	65	114	462
64M06/C1/C/17-18	448	19	111	30	20	20	51	26	110	15	56	19	131	35	73	396
64M06/C2/C/17-18	422	11	39	23	24	26	22	25	256	16	57	63	95	94	86	521
64M06/C3/C/17-18	547	4	10	9	31	40	6	39	273	19	48	67	69	154	122	755

															Annexure V	
COMPOSITE SAMPLES	Ba	Co	Cr	Cu	Ga	Nb	Ni	Pb	Rb	Sc	Sr	Th	V	Y	Zn	Zr
64M06/A1/R/17-18	683	22	96	25	21	24	36	32	130	14	42	27	103	50	35	516
64M06/A2/R/17-18	371	13	22	15	20	11	18	30	268	12	42	55	58	190	35	411
64M06/A3/R/17-18	654	1	10	8	16	18	9	17	146	11	27	30	33	60	35	414
64M06/B1/R/17-18	363	8	84	19	11	20	24	17	90	11	78	20	89	34	35	569
64M06/B2/R/17-18	531	15	96	35	18	18	41	22	152	16	53	18	118	38	76	433
64M06/B3/R/17-18	525	17	99	37	20	20	34	30	149	17	48	28	129	67	110	763
64M06/C1/R/17-18	514	7	106	23	16	22	35	20	100	13	60	27	108	39	35	667
64M06/C2/R/17-18	327	10	23	10	27	36	21	28	345	16	33	114	63	124	90	501
64M06/C3/R/17-18	565	10	10	5	24	36	16	38	250	12	43	67	71	111	79	1977

ANNEXURE VI: RESULTS OF CHEMICAL ANALYSIS OF REE IN C-HORIZON OF T.S. No. 64M/06

						(All values are in ppm)							
Composite Number	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy
64M06/A1/C/17-18	2.56	1.58	2.52	1.72	60.91	106.02	13.38	49.53	1.60	8.96	7.62	1.27	7.31
64M06/A2/C/17-18	4.82	1.95	23.90	4.75	51.93	121.46	12.67	48.25	1.01	11.76	12.02	2.72	16.59
64M06/A3/C/17-18	4.07	1.17	1	2.42	109.58	142.81	23.30	85.73	2.58	16.96	16.38	3.01	17.84
64M06/B1/C/17-18	1.65	1.38	1	1.20	125.19	181.29	28.95	108.43	1.92	18.87	15.79	2.40	12.74
64M06/B2/C/17-18	2.44	1.62	4.15	1.63	47.28	103.77	11.55	43.18	1.56	8.19	7.36	1.26	7.34
64M06/B3/C/17-18	3.43	1.97	1	1.71	85.76	164.24	21.28	81.42	2.22	16.02	14.45	2.47	14.04
64M06/C1/C/17-18	2.08	1.56	3.95	1.46	58.84	110.74	13.37	48.94	1.59	8.71	7.29	1.20	6.32
64M06/C2/C/17-18	5.84	1.77	1	8.11	109.58	160.50	25.82	95.08	1.55	19.11	17.61	3.30	19.73
64M06/C3/C/17-18	7.71	1.79	1	10.91	179.80	251.24	36.05	131.78	2.41	25.22	24.47	4.46	27.45

Composite Samples	**Ho**	**Er**	**Tm**	**Yb**	**Lu**	**Hf**	**Ta**	**U**
64M06/A1/C/17-18	1.36	3.94	0.65	3.97	0.62	8.38	1.76	5.25
64M06/A2/C/17-18	2.99	8.05	1.22	7.50	1.05	11.17	2.65	10.05
64M06/A3/C/17-18	3.54	10.28	1.60	10.06	1.52	11.24	2.14	5.65
64M06/B1/C/17-18	2.45	7.31	1.13	7.34	1.19	28.10	2.41	7.26
64M06/B2/C/17-18	1.41	4.21	0.67	4.17	0.66	9.29	1.46	5.25
64M06/B3/C/17-18	2.81	8.44	1.39	9.20	1.45	17.05	1.27	5.13
64M06/C1/C/17-18	1.21	3.44	0.57	3.56	0.58	11.32	1.64	3.43
64M06/C2/C/17-18	3.69	10.81	1.71	10.60	1.51	18.04	2.91	26.52
64M06/C3/C/17-18	5.47	16.78	2.71	17.26	2.72	33.90	4.18	18.55

ANNEXURE VI: RESULTS OF CHEMICAL ANALYSIS OF REE IN REGOLITH OF T.S. No. 64M/06													
Composite Number	**Be**	**Ge**	**As**	**Sn**	**La**	**Ce**	**Pr**	**Nd**	**Eu**	**Sm**	**Gd**	**Tb**	**Dy**
64M06/A1/R/17-18	2.24	1.58	1	1.31	73.82	106.87	16.67	63.68	1.96	11.08	10.61	1.63	9.04
64M06/A2/R/17-18	3.58	2.18	10.97	3.11	134.64	298.09	50.80	186.19	1.26	51.11	52.47	11.02	66.75
64M06/A3/R/17-18	2.34	1.28	1	2.02	80.59	117.59	17.84	68.87	2.01	13.55	12.50	2.18	12.74
64M06/B1/R/17-18	1.33	1.23	1	0.5	52.00	102.46	11.84	45.31	1.33	8.15	7.16	1.17	6.54
64M06/B2/R/17-18	1.84	1.56	2.41	1.18	62.24	115.58	14.37	54.01	1.72	10.15	8.91	1.47	7.99
64M06/B3/R/17-18	1.93	1.74	1	0.5	88.54	126.02	20.85	80.99	2.08	15.57	14.05	2.47	14.97
64M06/C1/R/17-18	1.44	1.33	1	0.5	72.45	102.82	16.95	63.90	1.42	10.90	9.19	1.31	7.00
64M06/C2/R/17-18	6.43	2.24	1	13.04	139.57	264.49	46.66	160.80	1.39	31.77	28.61	5.20	30.05
64M06/C3/R/17-18	4.58	1.70	1	6.47	114.82	170.12	26.79	100.45	2.58	21.64	21.80	3.97	24.40

Composite Number	**Ho**	**Er**	**Tm**	**Yb**	**Lu**	**Hf**	**Ta**	**U**
64M06/A1/R/17-18	1.74	4.92	0.81	4.82	0.78	14.07	1.96	6.46
64M06/A2/R/17-18	11.04	28.55	4.37	25.32	3.46	19.05	2.42	21.93
64M06/A3/R/17-18	2.63	7.69	1.28	8.07	1.29	14.25	2.00	4.15
64M06/B1/R/17-18	1.24	3.71	0.60	3.88	0.61	18.44	1.57	3.97
64M06/B2/R/17-18	1.48	4.21	0.69	4.29	0.66	14.49	1.55	6.47
64M06/B3/R/17-18	3.02	9.67	1.62	10.99	1.75	29.14	1.89	7.87
64M06/C1/R/17-18	1.28	3.61	0.60	3.78	0.59	18.49	1.67	4.68
64M06/C2/R/17-18	5.67	16.30	2.46	15.07	2.05	23.96	3.88	39.58
64M06/C3/R/17-18	4.71	14.40	2.40	15.83	2.48	85.62	5.29	19.03

ANNEXURE-VII: LIST OF COMPOSITE SAMPLES IN T.S. NO. 64M/06

Composite Sample No.	Latitude	Longitude	Elevation (m)
64M06/S/001/17-18	23° 30' 33.568" N	83° 15' 34.037" E	645.6
64M06/S/002/17-18	23° 30' 33.539" N	83° 16' 42.994" E	606.3
64M06/S/003/17-18	23° 30' 33.510" N	83° 17' 52.088" E	619.6
64M06/S/004/17-18	23° 30' 33.481" N	83° 19' 01.260" E	600.2
64M06/S/005/17-18	23° 30' 33.452" N	83° 20' 10.496" E	625.3
64M06/S/006/17-18	23° 30' 33.424" N	83° 21' 18.834" E	624.8
64M06/S/007/17-18	23° 30' 33.395" N	83° 22' 27.801" E	634.2
64M06/S/008/17-18	23° 30' 33.366" N	83° 23' 36.499" E	680.5
64M06/S/009/17-18	23° 30' 33.337" N	83° 24' 46.069" E	680.7
64M06/S/010/17-18	23° 30' 33.309" N	83° 25' 54.453" E	667.1
64M06/S/011/17-18	23° 30' 33.279" N	83° 27' 05.038" E	773.7
64M06/S/012/17-18	23° 30' 33.248" N	83° 28' 19.459" E	939.7
64M06/S/013/17-18	23° 30' 33.219" N	83° 29' 30.181" E	724.7
64M06/S/014/17-18	23° 31' 37.278" N	83° 15' 34.032" E	621.7
64M06/S/015/17-18	23° 31' 37.250" N	83° 16' 42.989" E	639.2
64M06/S/016/17-18	23° 31' 37.221" N	83° 17' 52.083" E	620.9
64M06/S/017/17-18	23° 31' 37.192" N	83° 19' 01.256" E	613.7
64M06/S/018/17-18	23° 31' 37.163" N	83° 20' 10.491" E	625.2
64M06/S/019/17-18	23° 31' 37.134" N	83° 21' 18.829" E	638.4
64M06/S/020/17-18	23° 31' 37.106" N	83° 22' 27.797" E	632.4
64M06/S/021/17-18	23° 31' 37.077" N	83° 23' 36.494" E	657.7
64M06/S/022/17-18	23° 31' 37.048" N	83° 24' 46.064" E	673.8
64M06/S/023/17-18	23° 31' 37.019" N	83° 25' 54.448" E	682.7
64M06/S/024/17-18	23° 31' 36.990" N	83° 27' 05.033" E	688.9
64M06/S/025/17-18	23° 31' 36.959" N	83° 28' 19.455" E	706.1
64M06/S/026/17-18	23° 31' 36.929" N	83° 29' 30.176" E	714
64M06/S/027/17-18	23° 32' 42.915" N	83° 15' 34.027" E	692.5
64M06/S/028/17-18	23° 32' 42.886" N	83° 16' 42.984" E	691
64M06/S/029/17-18	23° 32' 42.857" N	83° 17' 52.078" E	644.6
64M06/S/030/17-18	23° 32' 42.828" N	83° 19' 01.251" E	642.3
64M06/S/031/17-18	23° 32' 42.799" N	83° 20' 10.486" E	645.8
64M06/S/032/17-18	23° 32' 42.771" N	83° 21' 18.824" E	656.3
64M06/S/033/17-18	23° 32' 42.742" N	83° 22' 27.792" E	780.6
64M06/S/034/17-18	23° 32' 42.713" N	83° 23' 36.489" E	685.5
64M06/S/035/17-18	23° 32' 42.684" N	83° 24' 46.059" E	666.3
64M06/S/036/17-18	23° 32' 42.656" N	83° 25' 54.443" E	673.6
64M06/S/037/17-18	23° 32' 42.626" N	83° 27' 05.028" E	668.4
64M06/S/038/17-18	23° 32' 42.595" N	83° 28' 19.450" E	670.4
64M06/S/039/17-18	23° 32' 42.566" N	83° 29' 30.171" E	682.4
64M06/S/040/17-18	23° 33' 48.873" N	83° 15' 34.022" E	631.3
64M06/S/041/17-18	23° 33' 48.845" N	83° 16' 42.979" E	650.2
64M06/S/042/17-18	23° 33' 48.816" N	83° 17' 52.073" E	648.7
64M06/S/043/17-18	23° 33' 48.787" N	83° 19' 01.246" E	721.3
64M06/S/044/17-18	23° 33' 48.758" N	83° 20' 10.481" E	687.1
64M06/S/045/17-18	23° 33' 48.730" N	83° 21' 18.819" E	631.3
64M06/S/046/17-18	23° 33' 48.701" N	83° 22' 27.787" E	606.2
64M06/S/047/17-18	23° 33' 48.672" N	83° 23' 36.484" E	740.8
64M06/S/048/17-18	23° 33' 48.643" N	83° 24' 46.054" E	895.6
64M06/S/049/17-18	23° 33' 48.615" N	83° 25' 54.438" E	735.1
64M06/S/050/17-18	23° 33' 48.585" N	83° 27' 05.023" E	679.9
64M06/S/051/17-18	23° 33' 48.554" N	83° 28' 19.445" E	610.5
64M06/S/052/17-18	23° 33' 48.525" N	83° 29' 30.166" E	647.1
64M06/S/053/17-18	23° 34' 53.976" N	83° 15' 34.017" E	692.1
64M06/S/054/17-18	23° 34' 53.947" N	83° 16' 42.974" E	725.8
64M06/S/055/17-18	23° 34' 53.919" N	83° 17' 52.068" E	783.4
64M06/S/056/17-18	23° 34' 53.890" N	83° 19' 01.241" E	585.7
64M06/S/057/17-18	23° 34' 53.861" N	83° 20' 10.476" E	580.2

ANNEXURE-VII: LIST OF COMPOSITE SAMPLES IN T.S. NO. 64M/06

Composite Sample No.	Latitude	Longitude	Elevation (m)
64M06/S/058/17-18	23° 34' 53.832" N	83° 21' 18.814" E	592.3
64M06/S/059/17-18	23° 34' 53.804" N	83° 22' 27.782" E	625.8
64M06/S/060/17-18	23° 34' 53.775" N	83° 23' 36.479" E	585.2
64M06/S/061/17-18	23° 34' 53.746" N	83° 24' 46.049" E	615.5
64M06/S/062/17-18	23° 34' 53.717" N	83° 25' 54.433" E	655.6
64M06/S/063/17-18	23° 34' 53.688" N	83° 27' 05.018" E	673.1
64M06/S/064/17-18	23° 34' 53.657" N	83° 28' 19.440" E	691
64M06/S/065/17-18	23° 34' 53.627" N	83° 29' 30.161" E	602.3
64M06/S/066/17-18	23° 35' 59.077" N	83° 15' 34.012" E	638.8
64M06/S/067/17-18	23° 35' 59.049" N	83° 16' 42.969" E	880.1
64M06/S/068/17-18	23° 35' 59.020" N	83° 17' 52.063" E	673
64M06/S/069/17-18	23° 35' 58.991" N	83° 19' 01.236" E	624.4
64M06/S/070/17-18	23° 35' 58.962" N	83° 20' 10.471" E	605.4
64M06/S/071/17-18	23° 35' 58.934" N	83° 21' 18.809" E	579.7
64M06/S/072/17-18	23° 35' 58.905" N	83° 22' 27.777" E	549
64M06/S/073/17-18	23° 35' 58.876" N	83° 23' 36.474" E	548.9
64M06/S/074/17-18	23° 35' 58.847" N	83° 24' 46.044" E	776.1
64M06/S/075/17-18	23° 35' 58.819" N	83° 25' 54.429" E	620
64M06/S/076/17-18	23° 35' 58.789" N	83° 27' 05.013" E	666.6
64M06/S/077/17-18	23° 35' 58.758" N	83° 28' 19.435" E	713
64M06/S/078/17-18	23° 35' 58.729" N	83° 29' 30.156" E	658.1
64M06/S/079/17-18	23° 37' 03.124" N	83° 15' 34.007" E	530.2
64M06/S/080/17-18	23° 37' 03.095" N	83° 16' 42.964" E	526.5
64M06/S/081/17-18	23° 37' 03.066" N	83° 17' 52.058" E	502.6
64M06/S/082/17-18	23° 37' 03.038" N	83° 19' 01.231" E	521.6
64M06/S/083/17-18	23° 37' 03.009" N	83° 20' 10.467" E	539.7
64M06/S/084/17-18	23° 37' 02.980" N	83° 21' 18.804" E	567.1
64M06/S/085/17-18	23° 37' 02.951" N	83° 22' 27.772" E	542
64M06/S/086/17-18	23° 37' 02.923" N	83° 23' 36.469" E	529.1
64M06/S/087/17-18	23° 37' 02.894" N	83° 24' 46.039" E	551.9
64M06/S/088/17-18	23° 37' 02.865" N	83° 25' 54.424" E	544.9
64M06/S/089/17-18	23° 37' 02.836" N	83° 27' 05.008" E	590
64M06/S/090/17-18	23° 37' 02.805" N	83° 28' 19.430" E	751.2
64M06/S/091/17-18	23° 37' 02.775" N	83° 29' 30.151" E	643
64M06/S/092/17-18	23° 38' 07.699" N	83° 15' 34.002" E	508.2
64M06/S/093/17-18	23° 38' 07.670" N	83° 16' 42.959" E	488.3
64M06/S/094/17-18	23° 38' 07.641" N	83° 17' 52.053" E	486.9
64M06/S/095/17-18	23° 38' 07.613" N	83° 19' 01.226" E	480.6
64M06/S/096/17-18	23° 38' 07.584" N	83° 20' 10.462" E	521
64M06/S/097/17-18	23° 38' 07.555" N	83° 21' 18.799" E	517.3
64M06/S/098/17-18	23° 38' 07.526" N	83° 22' 27.767" E	552.1
64M06/S/099/17-18	23° 38' 07.498" N	83° 23' 36.464" E	529.4
64M06/S/100/17-18	23° 38' 07.469" N	83° 24' 46.035" E	560.2
64M06/S/101/17-18	23° 38' 07.440" N	83° 25' 54.419" E	544.9
64M06/S/102/17-18	23° 38' 07.411" N	83° 27' 05.003" E	559.1
64M06/S/103/17-18	23° 38' 07.380" N	83° 28' 19.425" E	578.3
64M06/S/104/17-18	23° 38' 07.350" N	83° 29' 30.146" E	568.4
64M06/S/105/17-18	23° 39' 12.691" N	83° 15' 33.998" E	472.7
64M06/S/106/17-18	23° 39' 12.662" N	83° 16' 42.954" E	464.2
64M06/S/107/17-18	23° 39' 12.633" N	83° 17' 52.048" E	472.5
64M06/S/108/17-18	23° 39' 12.605" N	83° 19' 01.221" E	475.5
64M06/S/109/17-18	23° 39' 12.576" N	83° 20' 10.457" E	531.9
64M06/S/110/17-18	23° 39' 12.547" N	83° 21' 18.794" E	534.5
64M06/S/111/17-18	23° 39' 12.518" N	83° 22' 27.762" E	522.7
64M06/S/112/17-18	23° 39' 12.490" N	83° 23' 36.459" E	504.7
64M06/S/113/17-18	23° 39' 12.461" N	83° 24' 46.030" E	569.5
64M06/S/114/17-18	23° 39' 12.432" N	83° 25' 54.414" E	550

ANNEXURE-VII: LIST OF COMPOSITE SAMPLES IN T.S. NO. 64M/06

Composite Sample No.	Latitude	Longitude	Elevation (m)
64M06/S/115/17-18	23° 39' 12.403" N	83° 27' 04.998" E	565
64M06/S/116/17-18	23° 39' 12.372" N	83° 28' 19.420" E	614.8
64M06/S/117/17-18	23° 39' 12.342" N	83° 29' 30.141" E	570.9
64M06/S/118/17-18	23° 40' 19.001" N	83° 15' 33.993" E	449.2
64M06/S/119/17-18	23° 40' 18.972" N	83° 16' 42.949" E	459.6
64M06/S/120/17-18	23° 40' 18.943" N	83° 17' 52.043" E	455.8
64M06/S/121/17-18	23° 40' 18.914" N	83° 19' 01.216" E	475.4
64M06/S/122/17-18	23° 40' 18.885" N	83° 20' 10.452" E	492.4
64M06/S/123/17-18	23° 40' 18.857" N	83° 21' 18.789" E	533.1
64M06/S/124/17-18	23° 40' 18.828" N	83° 22' 27.757" E	521
64M06/S/125/17-18	23° 40' 18.799" N	83° 23' 36.454" E	501.4
64M06/S/126/17-18	23° 40' 18.770" N	83° 24' 46.025" E	530.6
64M06/S/127/17-18	23° 40' 18.742" N	83° 25' 54.409" E	525.5
64M06/S/128/17-18	23° 40' 18.712" N	83° 27' 04.993" E	544
64M06/S/129/17-18	23° 40' 18.681" N	83° 28' 19.415" E	518.1
64M06/S/130/17-18	23° 40' 18.652" N	83° 29' 30.136" E	499
64M06/S/131/17-18	23° 41' 23.287" N	83° 15' 33.988" E	480.4
64M06/S/132/17-18	23° 41' 23.259" N	83° 16' 42.945" E	474.5
64M06/S/133/17-18	23° 41' 23.230" N	83° 17' 52.038" E	466.1
64M06/S/134/17-18	23° 41' 23.201" N	83° 19' 01.211" E	469.9
64M06/S/135/17-18	23° 41' 23.172" N	83° 20' 10.447" E	466.3
64M06/S/136/17-18	23° 41' 23.144" N	83° 21' 18.785" E	471.8
64M06/S/137/17-18	23° 41' 23.115" N	83° 22' 27.752" E	522.5
64M06/S/138/17-18	23° 41' 23.086" N	83° 23' 36.450" E	489.5
64M06/S/139/17-18	23° 41' 23.057" N	83° 24' 46.020" E	495.9
64M06/S/140/17-18	23° 41' 23.029" N	83° 25' 54.404" E	534.4
64M06/S/141/17-18	23° 41' 22.999" N	83° 27' 04.988" E	636.8
64M06/S/142/17-18	23° 41' 22.968" N	83° 28' 19.410" E	567.9
64M06/S/143/17-18	23° 41' 22.939" N	83° 29' 30.132" E	571.1
64M06/S/144/17-18	23° 42' 29.303" N	83° 15' 33.983" E	497.5
64M06/S/145/17-18	23° 42' 29.274" N	83° 16' 42.939" E	530.2
64M06/S/146/17-18	23° 42' 29.245" N	83° 17' 52.033" E	506.5
64M06/S/147/17-18	23° 42' 29.216" N	83° 19' 01.206" E	500.1
64M06/S/148/17-18	23° 42' 29.187" N	83° 20' 10.442" E	484
64M06/S/149/17-18	23° 42' 29.159" N	83° 21' 18.780" E	465
64M06/S/150/17-18	23° 42' 29.130" N	83° 22' 27.747" E	488.2
64M06/S/151/17-18	23° 42' 29.101" N	83° 23' 36.445" E	502.6
64M06/S/152/17-18	23° 42' 29.072" N	83° 24' 46.015" E	519.7
64M06/S/153/17-18	23° 42' 29.044" N	83° 25' 54.399" E	594.4
64M06/S/154/17-18	23° 42' 29.014" N	83° 27' 04.983" E	612.8
64M06/S/155/17-18	23° 42' 28.983" N	83° 28' 19.405" E	586
64M06/S/156/17-18	23° 42' 28.954" N	83° 29' 30.127" E	636
64M06/S/157/17-18	23° 43' 35.864" N	83° 15' 33.978" E	536.7
64M06/S/158/17-18	23° 43' 35.835" N	83° 16' 42.934" E	540.7
64M06/S/159/17-18	23° 43' 35.806" N	83° 17' 52.028" E	515.7
64M06/S/160/17-18	23° 43' 35.777" N	83° 19' 01.201" E	544.3
64M06/S/161/17-18	23° 43' 35.748" N	83° 20' 10.437" E	582.6
64M06/S/162/17-18	23° 43' 35.720" N	83° 21' 18.774" E	583.4
64M06/S/163/17-18	23° 43' 35.691" N	83° 22' 27.742" E	590
64M06/S/164/17-18	23° 43' 35.662" N	83° 23' 36.440" E	546.8
64M06/S/165/17-18	23° 43' 35.633" N	83° 24' 46.010" E	620.9
64M06/S/166/17-18	23° 43' 35.605" N	83° 25' 54.394" E	592.7
64M06/S/167/17-18	23° 43' 35.575" N	83° 27' 04.978" E	575.1
64M06/S/168/17-18	23° 43' 35.544" N	83° 28' 19.400" E	642.5
64M06/S/169/17-18	23° 43' 35.515" N	83° 29' 30.122" E	642.4
64M06/S/170/17-18	23° 44' 40.310" N	83° 15' 33.973" E	518.6
64M06/S/171/17-18	23° 44' 40.282" N	83° 16' 42.930" E	518.8

ANNEXURE-VII: LIST OF COMPOSITE SAMPLES IN T.S. NO. 64M/06

Composite Sample No.	Latitude	Longitude	Elevation (m)
64M06/S/172/17-18	23° 44' 40.253" N	83° 17' 52.024" E	507.6
64M06/S/173/17-18	23° 44' 40.224" N	83° 19' 01.196" E	510.8
64M06/S/174/17-18	23° 44' 40.195" N	83° 20' 10.432" E	517.2
64M06/S/175/17-18	23° 44' 40.166" N	83° 21' 18.770" E	566.6
64M06/S/176/17-18	23° 44' 40.138" N	83° 22' 27.737" E	582.3
64M06/S/177/17-18	23° 44' 40.109" N	83° 23' 36.435" E	632.5
64M06/S/178/17-18	23° 44' 40.080" N	83° 24' 46.005" E	664.7
64M06/S/179/17-18	23° 44' 40.051" N	83° 25' 54.389" E	667.4
64M06/S/180/17-18	23° 44' 40.022" N	83° 27' 04.973" E	681.2
64M06/S/181/17-18	23° 44' 39.991" N	83° 28' 19.395" E	644.6
64M06/S/182/17-18	23° 44' 39.961" N	83° 29' 30.117" E	500.5

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/1A/S/2017	23° 30' 24.980"N	83° 15' 33.869"E	638.3
64M06/1B/S/2017	23° 30' 27.122"N	83° 16' 7.448"E	590.2
64M06/1C/S/2017	23° 30' 36.415"N	83° 15' 28.008"E	649.2
64M06/1D/S/2017	23° 30' 36.894"N	83° 15' 54.580"E	616.3
64M06/2A/S/2017	23° 30' 16.160"N	83° 16' 16.843"E	582.1
64M06/2B/S/2017	23° 30' 13.681"N	83° 17' 7.572"E	582.2
64M06/2C/S/2017	23° 30' 43.688"N	83° 16' 42.554"E	611.1
64M06/2D/S/2017	23° 30' 53.729"N	83° 16' 59.008"E	611
64M06/3A/S/2017	23° 30' 5.053"N	83° 17' 42.053"E	588
64M06/3B/S/2017	23° 30' 19.016"N	83° 18' 0.393"E	597.7
64M06/3C/S/2017	23° 30' 37.716"N	83° 17' 37.055"E	598.6
64M06/3D/S/2017	23° 30' 40.677"N	83° 17' 52.500"E	617.4
64M06/4A/S/2017	23° 30' 22.919"N	83° 18' 32.885"E	611
64M06/4B/S/2017	23° 30' 3.799"N	83° 19' 28.633"E	591.5
64M06/4C/S/2017	23° 30' 49.953"N	83° 18' 58.480"E	607.4
64M06/4D/S/2017	23° 30' 54.785"N	83° 19' 24.178"E	612.4
64M06/5A/S/2017	23° 30' 1.564"N	83° 19' 40.317"E	592.1
64M06/5B/S/2017	23° 30' 11.563"N	83° 20' 28.454"E	613.4
64M06/5C/S/2017	23° 30' 39.887"N	83° 19' 46.604"E	610.3
64M06/5D/S/2017	23° 31' 3.184"N	83° 20' 19.962"E	620.3
64M06/6A/S/2017	23° 30' 23.029"N	83° 21' 18.357"E	622.8
64M06/6B/S/2017	23° 30' 11.890"N	83° 21' 47.561"E	612.9
64M06/6C/S/2017	23° 30' 34.319"N	83° 20' 52.638"E	628.4
64M06/6D/S/2017	23° 30' 38.577"N	83° 21' 38.170"E	618.7
64M06/7A/S/2017	23° 30' 17.264"N	83° 22' 10.403"E	619.6
64M06/7B/S/2017	23° 30' 17.442"N	83° 22' 29.349"E	624.1
64M06/7C/S/2017	23° 30' 50.966"N	83° 22' 15.107"E	623.7
64M06/7D/S/2017	23° 30' 56.448"N	83° 22' 57.501"E	623.7
64M06/8A/S/2017	23° 30' 10.829"N	83° 23' 2.938"E	644.7
64M06/8B/S/2017	23° 30' 23.655"N	83° 23' 37.082"E	674.1
64M06/8C/S/2017	23° 30' 56.720"N	83° 23' 10.870"E	625.1
64M06/8D/S/2017	23° 30' 58.353"N	83° 24' 2.455"E	651.5
64M06/9A/S/2017	23° 30' 30.036"N	83° 24' 26.631"E	687.2
64M06/9B/S/2017	23° 30' 11.710"N	83° 24' 54.128"E	672.7
64M06/9C/S/2017	23° 30' 51.043"N	83° 24' 35.273"E	663.1
64M06/9D/S/2017	23° 30' 50.098"N	83° 24' 46.668"E	669.5
64M06/10A/S/2017	23° 30' 10.662"N	83° 25' 39.156"E	651.7
64M06/10B/S/2017	23° 30' 23.297"N	83° 26' 23.057"E	686.2
64M06/10C/S/2017	23° 30' 52.850"N	83° 25' 46.651"E	687.4
64M06/10D/S/2017	23° 30' 47.111"N	83° 26' 7.570"E	677.8
64M06/11A/S/2017	23° 30' 6.771"N	83° 26' 29.647"E	672.6
64M06/11B/S/2017	23° 30' 22.950"N	83° 27' 5.581"E	837.1
64M06/11C/S/2017	23° 30' 45.980"N	83° 26' 42.925"E	715
64M06/11D/S/2017	23° 31' 1.476"N	83° 27' 26.668"E	715.9
64M06/12A/S/2017	23° 30' 32.489"N	83° 27' 53.584"E	892.9
64M06/12B/S/2017	23° 30' 21.991"N	83° 28' 55.116"E	820.6
64M06/12C/S/2017	23° 31' 3.237"N	83° 28' 9.306"E	759.2
64M06/12D/S/2017	23° 30' 49.609"N	83° 28' 54.653"E	708.9
64M06/13A/S/2017	23° 30' 27.803"N	83° 29' 23.721"E	712.1
64M06/13B/S/2017	23° 30' 11.536"N	83° 29' 47.218"E	695.7
64M06/13C/S/2017	23° 30' 35.212"N	83° 29' 20.797"E	710.6
64M06/13D/S/2017	23° 31' 1.969"N	83° 29' 46.295"E	718.6
64M06/14A/S/2017	23° 31' 36.156"N	83° 15' 33.824"E	622
64M06/14B/S/2017	23° 31' 36.101"N	83° 15' 46.396"E	623.4
64M06/14C/S/2017	23° 31' 49.986"N	83° 15' 25.217"E	606.6
64M06/14D/S/2017	23° 31' 57.163"N	83° 15' 47.471"E	610.2
64M06/15A/S/2017	23° 31' 14.998"N	83° 16' 41.307"E	634

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/15B/S/2017	23° 31' 20.407"N	83° 17' 13.010"E	628.6
64M06/15C/S/2017	23° 32' 5.063"N	83° 16' 24.706"E	628.2
64M06/15D/S/2017	23° 31' 43.725"N	83° 16' 53.745"E	638.8
64M06/16A/S/2017	23° 31' 9.143"N	83° 17' 19.811"E	622.1
64M06/16B/S/2017	23° 31' 28.623"N	83° 18' 25.838"E	615
64M06/16C/S/2017	23° 31' 41.047"N	83° 17' 51.422"E	623.5
64M06/16D/S/2017	23° 31' 41.084"N	83° 18' 2.218"E	620.3
64M06/17A/S/2017	23° 31' 20.146"N	83° 18' 52.034"E	608.4
64M06/17B/S/2017	23° 31' 9.588"N	83° 19' 19.670"E	602.9
64M06/17C/S/2017	23° 31' 46.094"N	83° 18' 38.685"E	616.3
64M06/17D/S/2017	23° 31' 39.476"N	83° 19' 31.260"E	612
64M06/18A/S/2017	23° 31' 30.859"N	83° 19' 41.155"E	607.9
64M06/18B/S/2017	23° 31' 6.672"N	83° 20' 26.829"E	621.2
64M06/18C/S/2017	23° 31' 46.973"N	83° 19' 51.659"E	607.3
64M06/18D/S/2017	23° 31' 55.852"N	83° 20' 10.968"E	615.6
64M06/19A/S/2017	23° 31' 5.012"N	83° 21' 15.986"E	631.9
64M06/19B/S/2017	23° 31' 34.471"N	83° 21' 27.283"E	634.6
64M06/19C/S/2017	23° 31' 37.859"N	83° 21' 1.345"E	625.3
64M06/19D/S/2017	23° 32' 0.379"N	83° 21' 19.856"E	636.3
64M06/20A/S/2017	23° 31' 12.439"N	83° 22' 6.989"E	632.3
64M06/20B/S/2017	23° 31' 33.327"N	83° 22' 52.475"E	626.8
64M06/20C/S/2017	23° 31' 42.163"N	83° 22' 12.799"E	626.8
64M06/20D/S/2017	23° 32' 3.749"N	83° 22' 46.309"E	636
64M06/21A/S/2017	23° 31' 5.378"N	83° 23' 21.087"E	628.1
64M06/21B/S/2017	23° 31' 21.893"N	83° 23' 51.340"E	644.2
64M06/21C/S/2017	23° 31' 40.554"N	83° 23' 30.811"E	657.8
64M06/21D/S/2017	23° 32' 8.522"N	83° 24' 7.645"E	651.4
64M06/22A/S/2017	23° 31' 26.280"N	83° 24' 10.925"E	648
64M06/22B/S/2017	23° 31' 35.573"N	83° 25' 11.097"E	670.1
64M06/22C/S/2017	23° 32' 10.181"N	83° 24' 20.189"E	647.3
64M06/22D/S/2017	23° 32' 2.317"N	83° 24' 58.044"E	653.8
64M06/23A/S/2017	23° 31' 21.566"N	83° 25' 20.646"E	681.7
64M06/23B/S/2017	23° 31' 28.840"N	83° 26' 1.972"E	685.7
64M06/23C/S/2017	23° 31' 51.968"N	83° 25' 31.314"E	664.7
64M06/23D/S/2017	23° 32' 10.090"N	83° 25' 55.035"E	669.5
64M06/24A/S/2017	23° 31' 6.451"N	83° 26' 55.405"E	711.5
64M06/24B/S/2017	23° 31' 17.005"N	83° 27' 36.522"E	689.4
64M06/24C/S/2017	23° 32' 10.210"N	83° 26' 37.609"E	677
64M06/24D/S/2017	23° 31' 55.588"N	83° 27' 40.390"E	679.5
64M06/25A/S/2017	23° 31' 25.946"N	83° 27' 42.165"E	690.6
64M06/25B/S/2017	23° 31' 36.274"N	83° 28' 28.827"E	699.8
64M06/25C/S/2017	23° 31' 42.521"N	83° 28' 15.096"E	693.1
64M06/25D/S/2017	23° 32' 2.079"N	83° 28' 39.851"E	680.9
64M06/26A/S/2017	23° 31' 36.298"N	83° 29' 21.133"E	702.7
64M06/26B/S/2017	23° 31' 33.369"N	83° 29' 59.257"E	693.5
64M06/26C/S/2017	23° 32' 7.521"N	83° 29' 25.611"E	682.2
64M06/26D/S/2017	23° 32' 1.154"N	83° 29' 46.421"E	686.3
64M06/27A/S/2017	23° 32' 25.117"N	83° 15' 14.599"E	623
64M06/27B/S/2017	23° 32' 11.866"N	83° 15' 41.455"E	620.2
64M06/27C/S/2017	23° 33' 12.437"N	83° 15' 7.773"E	643.1
64M06/27D/S/2017	23° 33' 14.304"N	83° 15' 52.828"E	659.5
64M06/28A/S/2017	23° 32' 12.324"N	83° 16' 16.601"E	627.3
64M06/28B/S/2017	23° 32' 14.641"N	83° 17' 5.783"E	640.4
64M06/28C/S/2017	23° 33' 6.672"N	83° 16' 42.326"E	671.4
64M06/28D/S/2017	23° 33' 5.388"N	83° 16' 45.907"E	673.2
64M06/29A/S/2017	23° 32' 32.768"N	83° 17' 46.180"E	635.6
64M06/29B/S/2017	23° 32' 12.098"N	83° 18' 8.794"E	628.3

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/29C/S/2017	23° 32' 43.432"N	83° 17' 49.029"E	642.2
64M06/29D/S/2017	23° 32' 44.363"N	83° 18' 8.585"E	640.3
64M06/30A/S/2017	23° 32' 14.789"N	83° 18' 27.202"E	626.3
64M06/30B/S/2017	23° 32' 24.726"N	83° 19' 16.042"E	628
64M06/30C/S/2017	23° 32' 53.865"N	83° 18' 36.806"E	642.7
64M06/30D/S/2017	23° 32' 57.719"N	83° 19' 10.996"E	658.3
64M06/31A/S/2017	23° 32' 16.606"N	83° 20' 7.055"E	623.9
64M06/31B/S/2017	23° 32' 36.805"N	83° 20' 18.140"E	635.8
64M06/31C/S/2017	23° 32' 53.849"N	83° 20' 9.942"E	648.8
64M06/31D/S/2017	23° 32' 53.033"N	83° 20' 24.314"E	648.9
64M06/32A/S/2017	23° 32' 31.050"N	83° 21' 9.718"E	642.9
64M06/32B/S/2017	23° 32' 34.720"N	83° 21' 48.422"E	660.9
64M06/32C/S/2017	23° 32' 43.510"N	83° 20' 57.745"E	657.5
64M06/32D/S/2017	23° 32' 46.992"N	83° 21' 28.344"E	661.4
64M06/33A/S/2017	23° 32' 35.031"N	83° 21' 54.188"E	668.5
64M06/33B/S/2017	23° 32' 29.066"N	83° 22' 46.496"E	659.7
64M06/33C/S/2017	23° 33' 14.019"N	83° 22' 16.620"E	714
64M06/33D/S/2017	23° 32' 43.454"N	83° 22' 53.176"E	725.4
64M06/34A/S/2017	23° 32' 17.580"N	83° 23' 22.982"E	639.8
64M06/34B/S/2017	23° 32' 30.093"N	83° 23' 46.342"E	646.4
64M06/34C/S/2017	23° 32' 43.128"N	83° 23' 17.187"E	711.5
64M06/34D/S/2017	23° 32' 43.606"N	83° 24' 2.560"E	673.3
64M06/35A/S/2017	23° 32' 19.124"N	83° 24' 11.092"E	648.1
64M06/35B/S/2017	23° 32' 21.060"N	83° 24' 56.372"E	652.4
64M06/35C/S/2017	23° 32' 45.060"N	83° 24' 36.660"E	668.6
64M06/35D/S/2017	23° 33' 0.350"N	83° 24' 58.674"E	687.6
64M06/36A/S/2017	23° 32' 19.065"N	83° 25' 40.054"E	665
64M06/36B/S/2017	23° 32' 33.099"N	83° 26' 28.247"E	676.2
64M06/36C/S/2017	23° 32' 43.061"N	83° 25' 24.841"E	671.7
64M06/36D/S/2017	23° 32' 43.103"N	83° 26' 3.586"E	676.4
64M06/37A/S/2017	23° 32' 36.242"N	83° 27' 0.978"E	669.4
64M06/37B/S/2017	23° 32' 29.942"N	83° 27' 37.926"E	665.8
64M06/37C/S/2017	23° 32' 43.166"N	83° 27' 2.694"E	669.1
64M06/37D/S/2017	23° 33' 4.548"N	83° 27' 16.350"E	664.1
64M06/38A/S/2017	23° 32' 24.258"N	83° 27' 55.916"E	672.7
64M06/38B/S/2017	23° 32' 27.350"N	83° 28' 42.327"E	669.8
64M06/38C/S/2017	23° 33' 6.109"N	83° 28' 18.952"E	650.1
64M06/38D/S/2017	23° 33' 10.771"N	83° 28' 34.628"E	648.9
64M06/39A/S/2017	23° 32' 24.114"N	83° 29' 1.079"E	680
64M06/39B/S/2017	23° 32' 31.106"N	83° 29' 50.395"E	674
64M06/39C/S/2017	23° 33' 13.358"N	83° 29' 9.442"E	652.1
64M06/39D/S/2017	23° 32' 51.409"N	83° 29' 32.266"E	673.5
64M06/40A/S/2017	23° 33' 24.842"N	83° 15' 33.649"E	629.1
64M06/40B/S/2017	23° 33' 35.963"N	83° 15' 42.794"E	625.6
64M06/40C/S/2017	23° 33' 52.670"N	83° 15' 5.296"E	656.9
64M06/40D/S/2017	23° 33' 49.530"N	83° 15' 50.469"E	640.1
64M06/41A/S/2017	23° 33' 33.977"N	83° 16' 8.665"E	638.2
64M06/41B/S/2017	23° 33' 48.026"N	83° 17' 0.644"E	614
64M06/41C/S/2017	23° 33' 59.572"N	83° 16' 28.262"E	615.1
64M06/41D/S/2017	23° 33' 57.391"N	83° 17' 6.642"E	600.7
64M06/42A/S/2017	23° 33' 48.343"N	83° 17' 40.714"E	639.5
64M06/42B/S/2017	23° 33' 29.784"N	83° 17' 52.532"E	732.6
64M06/42C/S/2017	23° 34' 7.634"N	83° 17' 33.237"E	595.9
64M06/42D/S/2017	23° 34' 4.129"N	83° 18' 5.283"E	590.4
64M06/43A/S/2017	23° 33' 34.444"N	83° 18' 54.553"E	694.9
64M06/43B/S/2017	23° 33' 15.296"N	83° 19' 7.224"E	663.5
64M06/43C/S/2017	23° 34' 8.848"N	83° 19' 0.177"E	607.1

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/43D/S/2017	23° 34' 13.206"N	83° 19' 15.015"E	612.8
64M06/44A/S/2017	23° 33' 26.917"N	83° 19' 55.649"E	656.7
64M06/44B/S/2017	23° 33' 38.593"N	83° 20' 36.447"E	628.3
64M06/44C/S/2017	23° 34' 18.647"N	83° 19' 57.757"E	636.5
64M06/44D/S/2017	23° 33' 53.086"N	83° 20' 43.457"E	631.7
64M06/45A/S/2017	23° 33' 46.757"N	83° 21' 6.200"E	618.2
64M06/45B/S/2017	23° 33' 29.462"N	83° 21' 38.192"E	624
64M06/45C/S/2017	23° 34' 13.487"N	83° 21' 9.046"E	611.1
64M06/45D/S/2017	23° 34' 2.261"N	83° 21' 51.981"E	597.9
64M06/46A/S/2017	23° 33' 31.033"N	83° 22' 4.258"E	623.1
64M06/46B/S/2017	23° 33' 44.897"N	83° 22' 36.589"E	614.4
64M06/46C/S/2017	23° 34' 15.296"N	83° 22' 2.935"E	601.7
64M06/46D/S/2017	23° 34' 7.811"N	83° 22' 59.216"E	589.6
64M06/47A/S/2017	23° 33' 47.962"N	83° 23' 3.211"E	638.1
64M06/47B/S/2017	23° 33' 47.917"N	83° 23' 47.069"E	744.8
64M06/47C/S/2017	23° 33' 57.553"N	83° 23' 13.534"E	606.9
64M06/47D/S/2017	23° 34' 19.053"N	83° 23' 54.738"E	628.3
64M06/48A/S/2017	23° 33' 31.181"N	83° 24' 10.818"E	960
64M06/48B/S/2017	23° 33' 15.022"N	83° 25' 6.300"E	751.9
64M06/48C/S/2017	23° 34' 12.081"N	83° 24' 30.331"E	623.2
64M06/48D/S/2017	23° 34' 18.898"N	83° 24' 48.383"E	622.6
64M06/49A/S/2017	23° 33' 14.953"N	83° 25' 40.343"E	703.9
64M06/49B/S/2017	23° 33' 15.733"N	83° 26' 16.886"E	694.9
64M06/49C/S/2017	23° 34' 18.911"N	83° 25' 40.458"E	725.4
64M06/49D/S/2017	23° 34' 15.907"N	83° 26' 28.218"E	671.6
64M06/50A/S/2017	23° 33' 40.817"N	83° 26' 53.163"E	680.1
64M06/50B/S/2017	23° 33' 34.354"N	83° 27' 40.653"E	676
64M06/50C/S/2017	23° 33' 57.668"N	83° 26' 47.354"E	668.5
64M06/50D/S/2017	23° 33' 57.727"N	83° 27' 35.260"E	662.6
64M06/51A/S/2017	23° 33' 17.844"N	83° 27' 52.003"E	661.1
64M06/51B/S/2017	23° 33' 46.214"N	83° 28' 47.100"E	583.3
64M06/51C/S/2017	23° 34' 16.377"N	83° 28' 12.188"E	595.2
64M06/51D/S/2017	23° 34' 5.558"N	83° 28' 46.855"E	572
64M06/52A/S/2017	23° 33' 48.011"N	83° 29' 7.803"E	624.4
64M06/52B/S/2017	23° 33' 47.622"N	83° 29' 36.911"E	646.3
64M06/52C/S/2017	23° 34' 9.149"N	83° 29' 16.241"E	589.7
64M06/52D/S/2017	23° 34' 14.205"N	83° 29' 38.233"E	581.2
64M06/53A/S/2017	23° 34' 39.312"N	83° 15' 16.315"E	683
64M06/53B/S/2017	23° 34' 53.626"N	83° 15' 46.678"E	689.1
64M06/53C/S/2017	23° 35' 26.348"N	83° 15' 11.193"E	597.1
64M06/53D/S/2017	23° 35' 3.530"N	83° 15' 45.645"E	662.8
64M06/54A/S/2017	23° 34' 32.635"N	83° 16' 42.193"E	682
64M06/54B/S/2017	23° 34' 24.463"N	83° 17' 2.049"E	627.6
64M06/54C/S/2017	23° 35' 2.321"N	83° 16' 21.314"E	712.9
64M06/54D/S/2017	23° 34' 56.694"N	83° 16' 57.157"E	731.9
64M06/55A/S/2017	23° 34' 20.169"N	83° 17' 40.496"E	601.4
64M06/55B/S/2017	23° 34' 37.418"N	83° 18' 25.573"E	597.7
64M06/55C/S/2017	23° 35' 26.498"N	83° 17' 47.994"E	757.7
64M06/55D/S/2017	23° 35' 14.136"N	83° 18' 26.038"E	731.9
64M06/56A/S/2017	23° 34' 29.983"N	83° 18' 57.401"E	571.2
64M06/56B/S/2017	23° 34' 37.812"N	83° 19' 7.100"E	567.4
64M06/56C/S/2017	23° 35' 2.656"N	83° 18' 51.799"E	597.1
64M06/56D/S/2017	23° 34' 57.171"N	83° 19' 32.544"E	572.8
64M06/57A/S/2017	23° 34' 34.375"N	83° 20' 8.689"E	592.8
64M06/57B/S/2017	23° 34' 48.308"N	83° 20' 42.882"E	568.9
64M06/57C/S/2017	23° 35' 11.982"N	83° 20' 8.933"E	562
64M06/57D/S/2017	23° 35' 14.127"N	83° 20' 43.367"E	554.5

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/58A/S/2017	23° 34' 52.680"N	83° 21' 1.898"E	579.4
64M06/58B/S/2017	23° 34' 53.340"N	83° 21' 25.847"E	599.3
64M06/58C/S/2017	23° 35' 22.321"N	83° 21' 17.465"E	579.7
64M06/58D/S/2017	23° 35' 6.345"N	83° 21' 38.023"E	580.4
64M06/59A/S/2017	23° 34' 22.858"N	83° 22' 20.852"E	582.2
64M06/59B/S/2017	23° 34' 30.310"N	83° 22' 38.198"E	577.8
64M06/59C/S/2017	23° 34' 57.615"N	83° 22' 13.648"E	588.6
64M06/59D/S/2017	23° 35' 18.239"N	83° 22' 59.780"E	572.3
64M06/60A/S/2017	23° 34' 51.481"N	83° 23' 28.724"E	589
64M06/60B/S/2017	23° 34' 37.870"N	83° 23' 53.961"E	584.3
64M06/60C/S/2017	23° 35' 12.123"N	83° 23' 16.741"E	557.3
64M06/60D/S/2017	23° 35' 25.443"N	83° 24' 3.281"E	684.6
64M06/61A/S/2017	23° 34' 36.831"N	83° 24' 18.812"E	593.4
64M06/61B/S/2017	23° 34' 48.740"N	83° 24' 47.753"E	625.9
64M06/61C/S/2017	23° 35' 7.506"N	83° 24' 38.084"E	602.2
64M06/61D/S/2017	23° 35' 18.607"N	83° 25' 1.413"E	625.4
64M06/62A/S/2017	23° 34' 41.122"N	83° 25' 32.828"E	631.3
64M06/62B/S/2017	23° 34' 51.469"N	83° 26' 4.325"E	655
64M06/62C/S/2017	23° 35' 26.170"N	83° 25' 41.394"E	636.4
64M06/62D/S/2017	23° 35' 8.566"N	83° 25' 57.678"E	643
64M06/63A/S/2017	23° 34' 35.499"N	83° 26' 47.102"E	656.3
64M06/63B/S/2017	23° 34' 26.062"N	83° 27' 37.249"E	613.7
64M06/63C/S/2017	23° 35' 24.970"N	83° 26' 46.739"E	661.6
64M06/63D/S/2017	23° 34' 57.620"N	83° 27' 27.474"E	672.8
64M06/64A/S/2017	23° 34' 42.674"N	83° 28' 17.258"E	648
64M06/64B/S/2017	23° 34' 26.261"N	83° 28' 53.555"E	567.8
64M06/64C/S/2017	23° 35' 16.938"N	83° 28' 16.594"E	668.3
64M06/64D/S/2017	23° 34' 55.180"N	83° 28' 52.508"E	645.6
64M06/65A/S/2017	23° 34' 24.565"N	83° 29' 17.643"E	565.9
64M06/65B/S/2017	23° 34' 33.046"N	83° 29' 46.896"E	572.1
64M06/65C/S/2017	23° 35' 4.686"N	83° 29' 7.184"E	623.4
64M06/65D/S/2017	23° 35' 14.155"N	83° 29' 58.527"E	635.7
64M06/66A/S/2017	23° 35' 50.528"N	83° 15' 16.312"E	565.9
64M06/66B/S/2017	23° 35' 56.558"N	83° 15' 58.227"E	633.7
64M06/66C/S/2017	23° 36' 9.860"N	83° 15' 2.852"E	551.7
64M06/66D/S/2017	23° 36' 12.377"N	83° 15' 37.086"E	561.1
64M06/67A/S/2017	23° 35' 52.318"N	83° 16' 11.847"E	702.2
64M06/67B/S/2017	23° 35' 43.329"N	83° 17' 15.698"E	798.6
64M06/67C/S/2017	23° 36' 8.907"N	83° 16' 9.466"E	629
64M06/67D/S/2017	23° 36' 28.913"N	83° 17' 3.117"E	610.2
64M06/68A/S/2017	23° 35' 43.321"N	83° 17' 46.105"E	654.6
64M06/68B/S/2017	23° 35' 46.267"N	83° 18' 15.486"E	635.9
64M06/68C/S/2017	23° 36' 14.419"N	83° 17' 39.712"E	563.1
64M06/68D/S/2017	23° 36' 27.855"N	83° 17' 58.189"E	525.4
64M06/69A/S/2017	23° 35' 53.917"N	83° 18' 43.176"E	620.1
64M06/69B/S/2017	23° 35' 57.205"N	83° 19' 23.994"E	625.5
64M06/69C/S/2017	23° 36' 15.882"N	83° 18' 40.752"E	598.2
64M06/69D/S/2017	23° 36' 29.499"N	83° 19' 22.593"E	593.5
64M06/70A/S/2017	23° 35' 50.836"N	83° 20' 8.229"E	609.7
64M06/70B/S/2017	23° 35' 57.244"N	83° 20' 27.275"E	612.5
64M06/70C/S/2017	23° 36' 16.436"N	83° 19' 53.932"E	600
64M06/70D/S/2017	23° 36' 20.779"N	83° 20' 35.927"E	584.4
64M06/71A/S/2017	23° 35' 39.132"N	83° 21' 3.505"E	554.6
64M06/71B/S/2017	23° 35' 51.427"N	83° 21' 38.702"E	548
64M06/71C/S/2017	23° 36' 27.584"N	83° 20' 50.428"E	575.4
64M06/71D/S/2017	23° 36' 12.506"N	83° 21' 36.569"E	560.3
64M06/72A/S/2017	23° 35' 55.509"N	83° 22' 6.416"E	541

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/72B/S/2017	23° 35' 56.108"N	83° 22' 59.258"E	550.3
64M06/72C/S/2017	23° 36' 11.455"N	83° 22' 24.372"E	539.4
64M06/72D/S/2017	23° 36' 24.198"N	83° 22' 43.479"E	537.1
64M06/73A/S/2017	23° 35' 54.690"N	83° 23' 25.149"E	546.1
64M06/73B/S/2017	23° 35' 50.773"N	83° 23' 47.201"E	562
64M06/73C/S/2017	23° 36' 11.545"N	83° 23' 22.277"E	534.8
64M06/73D/S/2017	23° 36' 10.946"N	83° 23' 37.414"E	549.5
64M06/74A/S/2017	23° 35' 57.446"N	83° 24' 20.418"E	608.5
64M06/74B/S/2017	23° 35' 30.423"N	83° 25' 11.287"E	633.3
64M06/74C/S/2017	23° 36' 29.925"N	83° 24' 36.093"E	571.4
64M06/74D/S/2017	23° 36' 27.184"N	83° 24' 52.334"E	581.3
64M06/75A/S/2017	23° 35' 45.977"N	83° 25' 40.886"E	623.9
64M06/75B/S/2017	23° 35' 52.460"N	83° 26' 1.325"E	627.2
64M06/75C/S/2017	23° 36' 8.174"N	83° 25' 52.608"E	635.1
64M06/75D/S/2017	23° 36' 26.155"N	83° 26' 11.608"E	610.9
64M06/76A/S/2017	23° 35' 55.972"N	83° 26' 32.591"E	647
64M06/76B/S/2017	23° 35' 57.217"N	83° 27' 16.796"E	667.2
64M06/76C/S/2017	23° 36' 25.730"N	83° 26' 30.693"E	638.3
64M06/76D/S/2017	23° 36' 30.223"N	83° 27' 18.673"E	675.5
64M06/77A/S/2017	23° 35' 43.429"N	83° 28' 1.818"E	683.7
64M06/77B/S/2017	23° 35' 45.749"N	83° 28' 44.478"E	676.5
64M06/77C/S/2017	23° 36' 29.195"N	83° 27' 58.454"E	649.4
64M06/77D/S/2017	23° 36' 15.111"N	83° 28' 54.551"E	673.3
64M06/78A/S/2017	23° 35' 38.640"N	83° 29' 27.779"E	622.7
64M06/78B/S/2017	23° 35' 30.529"N	83° 29' 53.400"E	635.4
64M06/78C/S/2017	23° 36' 21.072"N	83° 29' 12.232"E	653.9
64M06/78D/S/2017	23° 36' 11.019"N	83° 29' 57.675"E	645.6
64M06/79A/S/2017	23° 36' 43.689"N	83° 15' 16.077"E	525.4
64M06/79B/S/2017	23° 37' 0.797"N	83° 16' 1.607"E	527.6
64M06/79C/S/2017	23° 37' 6.347"N	83° 15' 1.986"E	498.8
64M06/79D/S/2017	23° 37' 24.932"N	83° 15' 40.091"E	501.9
64M06/80A/S/2017	23° 36' 44.615"N	83° 16' 38.533"E	522.6
64M06/80B/S/2017	23° 36' 53.923"N	83° 16' 59.960"E	513.2
64M06/80C/S/2017	23° 37' 21.784"N	83° 16' 23.867"E	507.1
64M06/80D/S/2017	23° 37' 26.239"N	83° 17' 12.157"E	500.5
64M06/81A/S/2017	23° 36' 53.326"N	83° 17' 30.203"E	503.4
64M06/81B/S/2017	23° 37' 1.285"N	83° 17' 54.377"E	503.4
64M06/81C/S/2017	23° 37' 23.244"N	83° 17' 29.371"E	497.7
64M06/81D/S/2017	23° 37' 35.011"N	83° 18' 6.572"E	489
64M06/82A/S/2017	23° 36' 52.887"N	83° 18' 41.883"E	508.7
64M06/82B/S/2017	23° 36' 58.541"N	83° 19' 2.784"E	529.4
64M06/82C/S/2017	23° 37' 21.085"N	83° 18' 59.754"E	505.7
64M06/82D/S/2017	23° 37' 28.548"N	83° 19' 32.910"E	491.9
64M06/83A/S/2017	23° 37' 0.629"N	83° 19' 52.998"E	549.3
64M06/83B/S/2017	23° 37' 0.084"N	83° 20' 36.904"E	550.2
64M06/83C/S/2017	23° 37' 22.527"N	83° 19' 47.931"E	514.9
64M06/83D/S/2017	23° 37' 35.075"N	83° 20' 25.664"E	523.4
64M06/84A/S/2017	23° 36' 54.743"N	83° 20' 59.594"E	556
64M06/84B/S/2017	23° 37' 34.836"N	83° 21' 27.388"E	544.7
64M06/84C/S/2017	23° 36' 48.384"N	83° 21' 52.292"E	549.3
64M06/84A/S/2017	23° 37' 10.438"N	83° 20' 45.946"E	544.2
64M06/85A/S/2017	23° 36' 46.534"N	83° 22' 11.017"E	540.1
64M06/85A/S/2017	23° 36' 49.727"N	83° 22' 53.566"E	529
64M06/85C/S/2017	23° 37' 35.504"N	83° 22' 9.225"E	553.7
64M06/85D/S/2017	23° 37' 10.792"N	83° 23' 1.138"E	533.5
64M06/86A/S/2017	23° 36' 56.409"N	83° 23' 6.587"E	528.1
64M06/86B/S/2017	23° 36' 36.901"N	83° 24' 9.032"E	548.7

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/86C/S/2017	23° 37' 16.891"N	83° 23' 32.866"E	518.4
64M06/86D/S/2017	23° 37' 26.733"N	83° 24' 4.493"E	521.7
64M06/87A/S/2017	23° 36' 46.084"N	83° 24' 16.638"E	538.7
64M06/87B/S/2017	23° 36' 35.202"N	83° 24' 54.732"E	575.2
64M06/87C/S/2017	23° 37' 12.547"N	83° 24' 37.186"E	531.2
64M06/87D/S/2017	23° 37' 7.374"N	83° 25' 18.118"E	566.6
64M06/88A/S/2017	23° 36' 37.928"N	83° 25' 44.505"E	563.2
64M06/88B/S/2017	23° 36' 47.056"N	83° 26' 4.683"E	558.3
64M06/88C/S/2017	23° 37' 32.096"N	83° 25' 23.429"E	531.9
64M06/88D/S/2017	23° 37' 25.334"N	83° 26' 5.794"E	540.5
64M06/89A/S/2017	23° 36' 41.016"N	83° 26' 59.759"E	598.8
64M06/89B/S/2017	23° 36' 57.463"N	83° 27' 7.109"E	580.5
64M06/89C/S/2017	23° 37' 21.577"N	83° 26' 35.259"E	543
64M06/89D/S/2017	23° 37' 23.418"N	83° 27' 24.841"E	579.8
64M06/90A/S/2017	23° 36' 47.184"N	83° 27' 50.076"E	619.3
64M06/90B/S/2017	23° 36' 42.764"N	83° 28' 22.764"E	636.9
64M06/90C/S/2017	23° 37' 14.372"N	83° 27' 42.932"E	657.3
64M06/90D/S/2017	23° 37' 22.811"N	83° 28' 20.263"E	698.1
64M06/91A/S/2017	23° 36' 51.849"N	83° 29' 15.379"E	651.6
64M06/91B/S/2017	23° 36' 52.527"N	83° 29' 44.457"E	620.2
64M06/91C/S/2017	23° 37' 24.129"N	83° 29' 10.543"E	656.5
64M06/91D/S/2017	23° 37' 31.676"N	83° 29' 33.522"E	603.8
64M06/92A/S/2017	23° 38' 6.879"N	83° 15' 13.465"E	495.5
64M06/92B/S/2017	23° 37' 59.431"N	83° 16' 6.339"E	490.2
64M06/92C/S/2017	23° 38' 28.894"N	83° 15' 3.345"E	477.1
64M06/92D/S/2017	23° 38' 38.242"N	83° 15' 42.406"E	477
64M06/93A/S/2017	23° 38' 3.360"N	83° 16' 14.009"E	483.6
64M06/93B/S/2017	23° 37' 55.685"N	83° 17' 14.841"E	496.5
64M06/93C/S/2017	23° 38' 34.789"N	83° 16' 20.565"E	473.4
64M06/93D/S/2017	23° 38' 29.675"N	83° 17' 0.000"E	480.2
64M06/94A/S/2017	23° 37' 53.372"N	83° 17' 22.036"E	498.6
64M06/94B/S/2017	23° 38' 6.071"N	83° 18' 10.282"E	483.6
64M06/94C/S/2017	23° 38' 31.281"N	83° 17' 48.363"E	481
64M06/94D/S/2017	23° 38' 24.693"N	83° 18' 24.075"E	475.9
64M06/95A/S/2017	23° 38' 4.492"N	83° 18' 37.426"E	478
64M06/95B/S/2017	23° 38' 3.232"N	83° 19' 9.763"E	479.7
64M06/95C/S/2017	23° 38' 27.907"N	83° 18' 36.293"E	470.4
64M06/95D/S/2017	23° 38' 24.242"N	83° 19' 22.711"E	489.5
64M06/96A/S/2017	23° 37' 49.145"N	83° 20' 7.209"E	511
64M06/96B/S/2017	23° 38' 4.243"N	83° 20' 35.815"E	511.8
64M06/96C/S/2017	23° 38' 10.924"N	83° 20' 7.073"E	521.6
64M06/96D/S/2017	23° 38' 24.801"N	83° 20' 26.949"E	524.8
64M06/97A/S/2017	23° 37' 52.714"N	83° 21' 6.843"E	514.3
64M06/97B/S/2017	23° 38' 3.250"N	83° 21' 36.499"E	529.5
64M06/97C/S/2017	23° 38' 10.266"N	83° 20' 55.844"E	525.4
64M06/97D/S/2017	23° 38' 17.871"N	83° 21' 33.013"E	518.1
64M06/98A/S/2017	23° 38' 1.361"N	83° 21' 57.234"E	544.6
64M06/98B/S/2017	23° 37' 51.305"N	83° 22' 59.442"E	535
64M06/98C/S/2017	23° 38' 27.679"N	83° 22' 3.836"E	537.4
64M06/98D/S/2017	23° 38' 34.936"N	83° 23' 1.989"E	534.9
64M06/99A/S/2017	23° 37' 51.476"N	83° 23' 19.521"E	528.2
64M06/99B/S/2017	23° 37' 59.288"N	83° 23' 48.234"E	518.1
64M06/99C/S/2017	23° 38' 38.637"N	83° 23' 24.021"E	519.8
64M06/99D/S/2017	23° 38' 14.776"N	83° 23' 50.358"E	512.6
64M06/100A/S/2017	23° 37' 53.095"N	83° 24' 19.657"E	520.6
64M06/100B/S/2017	23° 37' 46.650"N	83° 25' 4.685"E	528.4
64M06/100C/S/2017	23° 38' 31.856"N	83° 24' 16.873"E	516.5

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/100D/S/2017	23° 38' 31.732"N	83° 25' 4.801"E	528.6
64M06/101A/S/2017	23° 37' 51.810"N	83° 25' 24.759"E	531.3
64M06/101B/S/2017	23° 37' 51.545"N	83° 26' 6.958"E	536.3
64M06/101C/S/2017	23° 38' 28.785"N	83° 25' 26.593"E	541.6
64M06/101D/S/2017	23° 38' 7.940"N	83° 26' 12.715"E	542.3
64M06/102A/S/2017	23° 38' 1.143"N	83° 26' 43.883"E	548.9
64M06/102B/S/2017	23° 38' 5.177"N	83° 27' 14.979"E	553.9
64M06/102C/S/2017	23° 38' 12.904"N	83° 26' 53.924"E	546.9
64M06/102D/S/2017	23° 38' 19.071"N	83° 27' 17.395"E	552.4
64M06/103A/S/2017	23° 37' 44.743"N	83° 27' 42.200"E	576.1
64M06/103B/S/2017	23° 37' 59.022"N	83° 28' 20.877"E	581.5
64M06/103C/S/2017	23° 38' 25.411"N	83° 27' 50.883"E	556.9
64M06/103D/S/2017	23° 38' 40.079"N	83° 28' 44.902"E	569.7
64M06/104A/S/2017	23° 38' 2.373"N	83° 29' 17.566"E	571.2
64M06/104B/S/2017	23° 38' 3.149"N	83° 29' 57.668"E	566.1
64M06/104C/S/2017	23° 38' 21.640"N	83° 29' 28.567"E	574.1
64M06/104D/S/2017	23° 38' 12.613"N	83° 29' 51.866"E	562.7
64M06/105A/S/2017	23° 39' 10.171"N	83° 15' 15.722"E	462.5
64M06/105B/S/2017	23° 39' 5.040"N	83° 15' 38.442"E	468.6
64M06/105C/S/2017	23° 39' 42.418"N	83° 15' 3.995"E	458.5
64M06/105D/S/2017	23° 39' 42.418"N	83° 15' 53.100"E	460.9
64M06/106A/S/2017	23° 39' 8.949"N	83° 16' 27.058"E	463.9
64M06/106B/S/2017	23° 39' 9.926"N	83° 16' 54.420"E	465.5
64M06/106C/S/2017	23° 39' 31.669"N	83° 16' 29.012"E	454.3
64M06/106D/S/2017	23° 39' 41.197"N	83° 17' 1.016"E	454.7
64M06/107A/S/2017	23° 39' 10.171"N	83° 17' 24.713"E	469.8
64M06/107B/S/2017	23° 39' 2.842"N	83° 18' 5.267"E	475.8
64M06/107C/S/2017	23° 39' 40.953"N	83° 17' 21.049"E	466
64M06/107D/S/2017	23° 39' 30.448"N	83° 18' 2.091"E	462.6
64M06/108A/S/2017	23° 38' 44.030"N	83° 18' 32.873"E	464.6
64M06/108B/S/2017	23° 39' 6.262"N	83° 19' 3.899"E	474.5
64M06/108C/S/2017	23° 39' 38.998"N	83° 18' 36.538"E	465.5
64M06/108D/S/2017	23° 39' 39.487"N	83° 19' 11.228"E	475.5
64M06/109A/S/2017	23° 38' 53.070"N	83° 19' 38.102"E	498.8
64M06/109B/S/2017	23° 38' 56.978"N	83° 20' 17.923"E	548.9
64M06/109C/S/2017	23° 39' 30.692"N	83° 19' 41.766"E	483.6
64M06/109D/S/2017	23° 39' 43.580"N	83° 20' 36.605"E	502.9
64M06/110A/S/2017	23° 39' 2.805"N	83° 21' 2.280"E	536.9
64M06/110B/S/2017	23° 39' 6.017"N	83° 21' 35.688"E	518
64M06/110C/S/2017	23° 39' 32.189"N	83° 21' 4.386"E	543.3
64M06/110D/S/2017	23° 39' 24.172"N	83° 21' 44.349"E	514.9
64M06/111A/S/2017	23° 39' 3.707"N	83° 22' 10.773"E	533.5
64M06/111B/S/2017	23° 39' 9.074"N	83° 22' 51.978"E	526.2
64M06/111C/S/2017	23° 39' 31.930"N	83° 22' 17.661"E	512.1
64M06/111D/S/2017	23° 39' 33.873"N	83° 22' 40.371"E	505.9
64M06/112A/S/2017	23° 38' 52.240"N	83° 23' 24.740"E	508.3
64M06/112B/S/2017	23° 38' 56.078"N	83° 23' 46.909"E	515
64M06/112C/S/2017	23° 39' 17.728"N	83° 23' 24.149"E	507.9
64M06/112D/S/2017	23° 39' 37.058"N	83° 23' 55.668"E	513
64M06/113A/S/2017	23° 39' 2.108"N	83° 24' 11.717"E	543.3
64M06/113B/S/2017	23° 38' 52.156"N	83° 25' 4.230"E	526.7
64M06/113C/S/2017	23° 39' 42.124"N	83° 24' 44.371"E	537
64M06/113D/S/2017	23° 39' 43.546"N	83° 25' 8.595"E	535.5
64M06/114A/S/2017	23° 38' 56.904"N	83° 25' 37.923"E	531.7
64M06/114B/S/2017	23° 39' 3.157"N	83° 26' 8.375"E	540.1
64M06/114C/S/2017	23° 39' 23.536"N	83° 25' 21.958"E	541.5
64M06/114D/S/2017	23° 39' 14.910"N	83° 26' 2.996"E	553.8

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/115A/S/2017	23° 38' 43.365"N	83° 26' 51.422"E	576.2
64M06/115B/S/2017	23° 38' 47.305"N	83° 27' 33.430"E	575.7
64M06/115C/S/2017	23° 39' 20.460"N	83° 26' 31.118"E	560
64M06/115D/S/2017	23° 39' 42.384"N	83° 27' 7.045"E	544
64M06/116A/S/2017	23° 38' 55.774"N	83° 28' 17.305"E	581.7
64M06/116B/S/2017	23° 38' 55.120"N	83° 28' 53.250"E	577.8
64M06/116C/S/2017	23° 39' 33.797"N	83° 28' 2.604"E	566.9
64M06/116D/S/2017	23° 39' 31.793"N	83° 28' 45.109"E	555.2
64M06/117A/S/2017	23° 38' 56.117"N	83° 29' 20.333"E	569.7
64M06/117B/S/2017	23° 38' 57.725"N	83° 29' 43.965"E	550.3
64M06/117C/S/2017	23° 39' 42.689"N	83° 29' 10.139"E	528.8
64M06/117D/S/2017	23° 39' 14.622"N	83° 29' 52.895"E	558.6
64M06/118A/S/2017	23° 40' 9.799"N	83° 15' 4.340"E	450.7
64M06/118B/S/2017	23° 40' 16.318"N	83° 15' 46.172"E	451.1
64M06/118C/S/2017	23° 40' 26.369"N	83° 15' 11.402"E	448.9
64M06/118D/S/2017	23° 40' 24.739"N	83° 15' 38.023"E	458.6
64M06/119A/S/2017	23° 39' 53.500"N	83° 16' 17.140"E	453.7
64M06/119B/S/2017	23° 39' 57.846"N	83° 16' 57.886"E	453.7
64M06/119C/S/2017	23° 40' 26.641"N	83° 16' 10.892"E	464.9
64M06/119D/S/2017	23° 40' 25.282"N	83° 16' 58.701"E	457.7
64M06/120A/S/2017	23° 40' 3.551"N	83° 17' 19.889"E	457.8
64M06/120B/S/2017	23° 40' 11.972"N	83° 17' 59.277"E	459
64M06/120C/S/2017	23° 40' 39.679"N	83° 17' 33.743"E	453.6
64M06/120D/S/2017	23° 40' 37.235"N	83° 18' 2.809"E	455.9
64M06/121A/S/2017	23° 39' 48.339"N	83° 18' 38.394"E	465.5
64M06/121B/S/2017	23° 39' 52.957"N	83° 19' 3.657"E	473.8
64M06/121C/S/2017	23° 40' 38.050"N	83° 18' 48.988"E	460.4
64M06/121D/S/2017	23° 40' 46.470"N	83° 19' 26.475"E	464
64M06/122A/S/2017	23° 39' 47.252"N	83° 19' 42.773"E	488
64M06/122B/S/2017	23° 40' 8.441"N	83° 20' 28.952"E	486.9
64M06/122C/S/2017	23° 40' 44.569"N	83° 19' 54.997"E	470
64M06/122D/S/2017	23° 40' 36.148"N	83° 20' 21.618"E	476.9
64M06/123A/S/2017	23° 40' 12.515"N	83° 21' 15.403"E	527.9
64M06/123B/S/2017	23° 40' 1.106"N	83° 21' 36.048"E	523.2
64M06/123C/S/2017	23° 40' 34.247"N	83° 20' 47.153"E	486.5
64M06/123D/S/2017	23° 40' 44.569"N	83° 21' 39.580"E	494.9
64M06/124A/S/2017	23° 39' 54.858"N	83° 22' 13.263"E	505.6
64M06/124B/S/2017	23° 39' 55.673"N	83° 22' 32.550"E	499.8
64M06/124C/S/2017	23° 40' 20.393"N	83° 22' 4.299"E	519.7
64M06/124D/S/2017	23° 40' 45.112"N	83° 22' 29.562"E	517.9
64M06/125A/S/2017	23° 40' 5.452"N	83° 23' 7.863"E	491.2
64M06/125B/S/2017	23° 40' 16.861"N	83° 23' 43.449"E	501.7
64M06/125C/S/2017	23° 40' 39.679"N	83° 23' 15.469"E	496.9
64M06/125D/S/2017	23° 40' 44.026"N	83° 23' 46.980"E	486.7
64M06/126A/S/2017	23° 40' 15.232"N	83° 24' 12.514"E	514.2
64M06/126B/S/2017	23° 40' 16.047"N	83° 25' 8.744"E	521.9
64M06/126C/S/2017	23° 40' 45.927"N	83° 24' 25.010"E	509.1
64M06/126D/S/2017	23° 40' 35.876"N	83° 25' 12.819"E	511.2
64M06/127A/S/2017	23° 40' 3.442"N	83° 25' 36.589"E	525.1
64M06/127B/S/2017	23° 40' 0.907"N	83° 26' 16.541"E	525.6
64M06/127C/S/2017	23° 40' 40.918"N	83° 25' 31.104"E	516.1
64M06/127D/S/2017	23° 40' 27.181"N	83° 26' 0.542"E	523.4
64M06/128A/S/2017	23° 40' 6.112"N	83° 26' 49.956"E	527.2
64M06/128B/S/2017	23° 40' 12.335"N	83° 27' 12.035"E	538.2
64M06/128C/S/2017	23° 40' 44.696"N	83° 26' 32.225"E	563.6
64M06/128D/S/2017	23° 40' 38.713"N	83° 27' 39.646"E	532.1
64M06/129A/S/2017	23° 40' 16.763"N	83° 28' 8.912"E	523.1

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/129B/S/2017	23° 40' 15.722"N	83° 28' 35.325"E	515.7
64M06/129C/S/2017	23° 40' 35.019"N	83° 28' 17.210"E	520.8
64M06/129D/S/2017	23° 40' 28.036"N	83° 28' 33.308"E	512.6
64M06/130A/S/2017	23° 40' 3.504"N	83° 29' 27.665"E	505.1
64M06/130B/S/2017	23° 39' 55.784"N	83° 29' 57.119"E	495.5
64M06/130C/S/2017	23° 40' 38.617"N	83° 29' 11.412"E	513.5
64M06/130D/S/2017	23° 40' 32.406"N	83° 29' 44.606"E	505.1
64M06/131A/S/2017	23° 41' 10.170"N	83° 15' 14.851"E	464
64M06/131B/S/2017	23° 41' 7.505"N	83° 15' 55.112"E	467.9
64M06/131C/S/2017	23° 41' 54.280"N	83° 15' 8.930"E	510.7
64M06/131D/S/2017	23° 41' 25.860"N	83° 15' 52.448"E	480.5
64M06/132A/S/2017	23° 40' 54.479"N	83° 16' 19.979"E	464.8
64M06/132B/S/2017	23° 40' 53.591"N	83° 17' 5.570"E	465.8
64M06/132C/S/2017	23° 41' 25.268"N	83° 16' 23.236"E	478
64M06/132D/S/2017	23° 41' 25.564"N	83° 17' 12.083"E	470.1
64M06/133A/S/2017	23° 40' 54.183"N	83° 17' 28.957"E	457.1
64M06/133B/S/2017	23° 41' 7.801"N	83° 18' 10.106"E	462.6
64M06/133C/S/2017	23° 41' 30.004"N	83° 17' 45.535"E	465.4
64M06/133D/S/2017	23° 41' 24.972"N	83° 18' 9.810"E	462
64M06/134A/S/2017	23° 40' 55.368"N	83° 18' 41.191"E	461
64M06/134B/S/2017	23° 41' 11.650"N	83° 19' 17.012"E	459.3
64M06/134C/S/2017	23° 41' 30.596"N	83° 18' 31.421"E	465.6
64M06/134D/S/2017	23° 41' 37.701"N	83° 19' 31.221"E	469.5
64M06/135A/S/2017	23° 41' 12.242"N	83° 19' 42.471"E	465.9
64M06/135B/S/2017	23° 41' 11.354"N	83° 20' 33.390"E	468
64M06/135C/S/2017	23° 41' 43.326"N	83° 19' 52.240"E	470.1
64M06/135D/S/2017	23° 41' 37.701"N	83° 20' 35.758"E	472
64M06/136A/S/2017	23° 41' 11.058"N	83° 20' 57.073"E	481.3
64M06/136B/S/2017	23° 41' 13.722"N	83° 21' 26.677"E	478.3
64M06/136C/S/2017	23° 41' 45.694"N	83° 20' 52.929"E	475.9
64M06/136D/S/2017	23° 41' 35.925"N	83° 21' 27.269"E	480.1
64M06/137A/S/2017	23° 41' 14.610"N	83° 22' 8.123"E	500.4
64M06/137B/S/2017	23° 40' 56.256"N	83° 22' 48.680"E	508.5
64M06/137C/S/2017	23° 41' 36.221"N	83° 21' 56.281"E	488.7
64M06/137D/S/2017	23° 41' 37.405"N	83° 22' 52.825"E	501
64M06/138A/S/2017	23° 41' 11.615"N	83° 23' 16.664"E	495.2
64M06/138B/S/2017	23° 41' 8.644"N	83° 23' 57.710"E	483
64M06/138C/S/2017	23° 41' 50.771"N	83° 23' 8.292"E	486.9
64M06/138D/S/2017	23° 41' 51.581"N	83° 23' 51.499"E	489
64M06/139A/S/2017	23° 41' 17.286"N	83° 24' 12.562"E	494
64M06/139B/S/2017	23° 41' 11.075"N	83° 24' 50.638"E	499.7
64M06/139C/S/2017	23° 41' 45.370"N	83° 24' 15.533"E	496.3
64M06/139D/S/2017	23° 41' 33.488"N	83° 25' 11.971"E	507.3
64M06/140A/S/2017	23° 40' 55.142"N	83° 25' 23.853"E	512.8
64M06/140B/S/2017	23° 41' 9.184"N	83° 26' 8.680"E	536.8
64M06/140C/S/2017	23° 41' 54.551"N	83° 25' 37.625"E	519.4
64M06/140D/S/2017	23° 41' 41.589"N	83° 26' 0.308"E	532.1
64M06/141A/S/2017	23° 41' 12.425"N	83° 26' 49.726"E	581.8
64M06/141B/S/2017	23° 41' 5.944"N	83° 27' 7.548"E	583.3
64M06/141C/S/2017	23° 41' 37.269"N	83° 26' 43.245"E	575.7
64M06/141D/S/2017	23° 41' 52.661"N	83° 27' 24.021"E	541.8
64M06/142A/S/2017	23° 40' 57.573"N	83° 28' 10.738"E	535.7
64M06/142B/S/2017	23° 40' 52.982"N	83° 28' 48.543"E	529.9
64M06/142C/S/2017	23° 41' 39.429"N	83° 27' 52.915"E	564.6
64M06/142D/S/2017	23° 41' 44.290"N	83° 28' 32.881"E	562.6
64M06/143A/S/2017	23° 40' 54.062"N	83° 29' 12.577"E	523.8
64M06/143B/S/2017	23° 41' 3.243"N	83° 29' 32.830"E	530.4

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/143C/S/2017	23° 41' 25.117"N	83° 29' 4.746"E	540.1
64M06/143D/S/2017	23° 41' 40.509"N	83° 29' 56.864"E	548.5
64M06/144A/S/2017	23° 42' 2.652"N	83° 15' 22.473"E	509.1
64M06/144B/S/2017	23° 42' 15.344"N	83° 15' 37.055"E	518.3
64M06/144C/S/2017	23° 42' 33.437"N	83° 15' 14.911"E	503.5
64M06/144D/S/2017	23° 42' 32.627"N	83° 15' 46.776"E	509.8
64M06/145A/S/2017	23° 41' 59.412"N	83° 16' 25.392"E	508.6
64M06/145B/S/2017	23° 42' 24.256"N	83° 16' 48.075"E	527.1
64M06/145C/S/2017	23° 42' 44.239"N	83° 16' 15.941"E	513.6
64M06/145D/S/2017	23° 43' 0.981"N	83° 17' 9.409"E	533
64M06/146A/S/2017	23° 42' 0.222"N	83° 17' 41.273"E	478.5
64M06/146B/S/2017	23° 42' 8.593"N	83° 17' 56.936"E	490.6
64M06/146C/S/2017	23° 42' 31.817"N	83° 17' 36.953"E	504.5
64M06/146D/S/2017	23° 42' 42.348"N	83° 18' 11.518"E	496
64M06/147A/S/2017	23° 42' 16.965"N	83° 18' 53.914"E	486.3
64M06/147B/S/2017	23° 42' 22.095"N	83° 19' 22.539"E	506.3
64M06/147C/S/2017	23° 42' 31.007"N	83° 18' 52.294"E	497.3
64M06/147D/S/2017	23° 42' 50.720"N	83° 19' 4.716"E	508
64M06/148A/S/2017	23° 42' 13.454"N	83° 19' 52.513"E	474
64M06/148B/S/2017	23° 42' 11.294"N	83° 20' 37.340"E	469
64M06/148C/S/2017	23° 42' 32.087"N	83° 20' 4.395"E	486.3
64M06/148D/S/2017	23° 42' 37.758"N	83° 20' 40.850"E	475.4
64M06/149A/S/2017	23° 42' 4.273"N	83° 20' 51.922"E	474.8
64M06/149B/S/2017	23° 42' 26.146"N	83° 21' 34.048"E	480.2
64M06/149C/S/2017	23° 42' 33.167"N	83° 21' 2.454"E	471.4
64M06/149D/S/2017	23° 42' 36.407"N	83° 21' 24.867"E	468.6
64M06/150A/S/2017	23° 42' 16.695"N	83° 22' 24.276"E	516.9
64M06/150B/S/2017	23° 42' 23.716"N	83° 22' 59.111"E	482.2
64M06/150C/S/2017	23° 42' 38.568"N	83° 22' 6.183"E	480
64M06/150D/S/2017	23° 42' 38.568"N	83° 22' 31.027"E	473.1
64M06/151A/S/2017	23° 42' 11.024"N	83° 23' 18.014"E	481.7
64M06/151B/S/2017	23° 42' 3.463"N	83° 23' 45.558"E	488.6
64M06/151C/S/2017	23° 42' 52.070"N	83° 23' 8.292"E	476.6
64M06/151D/S/2017	23° 42' 52.340"N	83° 23' 38.807"E	491.7
64M06/152A/S/2017	23° 42' 0.222"N	83° 24' 29.035"E	491.3
64M06/152B/S/2017	23° 42' 18.045"N	83° 24' 49.288"E	500.8
64M06/152C/S/2017	23° 42' 30.737"N	83° 24' 23.634"E	506.3
64M06/152D/S/2017	23° 42' 31.277"N	83° 24' 54.418"E	517
64M06/153A/S/2017	23° 42' 3.192"N	83° 25' 38.435"E	514.9
64M06/153B/S/2017	23° 42' 6.163"N	83° 25' 57.338"E	523
64M06/153C/S/2017	23° 42' 40.188"N	83° 25' 39.245"E	558.7
64M06/153D/S/2017	23° 42' 48.559"N	83° 26' 9.760"E	566.4
64M06/154A/S/2017	23° 42' 17.505"N	83° 26' 49.456"E	551.8
64M06/154B/S/2017	23° 42' 4.813"N	83° 27' 19.970"E	551.2
64M06/154C/S/2017	23° 42' 46.669"N	83° 26' 30.823"E	586.9
64M06/154D/S/2017	23° 42' 44.239"N	83° 27' 31.042"E	566.6
64M06/155A/S/2017	23° 42' 18.045"N	83° 27' 46.164"E	558.9
64M06/155B/S/2017	23° 42' 1.572"N	83° 28' 28.831"E	573.4
64M06/155C/S/2017	23° 42' 43.429"N	83° 27' 59.126"E	558.2
64M06/155D/S/2017	23° 42' 48.289"N	83° 28' 21.809"E	563.9
64M06/156A/S/2017	23° 42' 16.965"N	83° 28' 58.805"E	616.9
64M06/156B/S/2017	23° 42' 19.935"N	83° 29' 56.054"E	554.1
64M06/156C/S/2017	23° 42' 36.948"N	83° 29' 12.307"E	604.8
64M06/156D/S/2017	23° 42' 57.741"N	83° 29' 37.151"E	590.4
64M06/157A/S/2017	23° 43' 13.085"N	83° 15' 2.012"E	513.8
64M06/157B/S/2017	23° 43' 21.565"N	83° 15' 43.900"E	513.9
64M06/157C/S/2017	23° 43' 37.498"N	83° 15' 15.889"E	519.4

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/157D/S/2017	23° 43' 48.291"N	83° 15' 35.420"E	527.7
64M06/158A/S/2017	23° 43' 17.968"N	83° 16' 22.962"E	516.7
64M06/158B/S/2017	23° 43' 16.426"N	83° 16' 44.291"E	528.2
64M06/158C/S/2017	23° 43' 47.007"N	83° 16' 25.275"E	531.9
64M06/158D/S/2017	23° 43' 37.241"N	83° 17' 6.135"E	528.7
64M06/159A/S/2017	23° 43' 10.258"N	83° 17' 36.459"E	529
64M06/159B/S/2017	23° 43' 11.286"N	83° 18' 12.436"E	509.4
64M06/159C/S/2017	23° 43' 52.660"N	83° 17' 27.464"E	535.8
64M06/159D/S/2017	23° 43' 54.459"N	83° 18' 7.039"E	519.5
64M06/160A/S/2017	23° 43' 11.800"N	83° 18' 51.497"E	507.1
64M06/160B/S/2017	23° 43' 20.537"N	83° 19' 8.458"E	515.1
64M06/160C/S/2017	23° 44' 4.738"N	83° 18' 27.855"E	528.4
64M06/160D/S/2017	23° 44' 3.453"N	83° 19' 15.653"E	523.5
64M06/161A/S/2017	23° 43' 25.420"N	83° 19' 52.402"E	551.5
64M06/161B/S/2017	23° 43' 6.660"N	83° 20' 43.027"E	487.8
64M06/161C/S/2017	23° 44' 1.141"N	83° 20' 4.480"E	525.2
64M06/161D/S/2017	23° 43' 58.571"N	83° 20' 42.256"E	520.5
64M06/162A/S/2017	23° 43' 5.889"N	83° 21' 4.357"E	480.9
64M06/162B/S/2017	23° 43' 11.286"N	83° 21' 20.804"E	485.8
64M06/162C/S/2017	23° 44' 1.654"N	83° 21' 7.441"E	528
64M06/162D/S/2017	23° 43' 45.722"N	83° 21' 43.675"E	506
64M06/163A/S/2017	23° 43' 5.118"N	83° 22' 8.088"E	478.8
64M06/163B/S/2017	23° 43' 23.364"N	83° 22' 46.893"E	484.5
64M06/163C/S/2017	23° 44' 6.023"N	83° 22' 1.921"E	550.6
64M06/163D/S/2017	23° 43' 56.515"N	83° 22' 49.976"E	563.9
64M06/164A/S/2017	23° 43' 15.398"N	83° 23' 12.591"E	485.3
64M06/164B/S/2017	23° 43' 12.314"N	83° 23' 38.289"E	492.9
64M06/164C/S/2017	23° 43' 36.470"N	83° 23' 16.445"E	512.9
64M06/164D/S/2017	23° 43' 54.202"N	83° 24' 8.356"E	534.3
64M06/165A/S/2017	23° 43' 23.364"N	83° 24' 28.657"E	528.2
64M06/165B/S/2017	23° 43' 13.599"N	83° 25' 18.255"E	558.9
64M06/165C/S/2017	23° 43' 52.403"N	83° 24' 31.741"E	544.9
64M06/165D/S/2017	23° 43' 37.498"N	83° 25' 15.428"E	583
64M06/166A/S/2017	23° 43' 4.605"N	83° 25' 35.473"E	602.8
64M06/166B/S/2017	23° 43' 5.118"N	83° 26' 15.305"E	565
64M06/166C/S/2017	23° 43' 38.526"N	83° 25' 51.662"E	602.8
64M06/166D/S/2017	23° 43' 40.325"N	83° 26' 16.590"E	571.7
64M06/167A/S/2017	23° 43' 26.962"N	83° 26' 45.886"E	606.1
64M06/167B/S/2017	23° 43' 4.348"N	83° 27' 16.980"E	561.9
64M06/167C/S/2017	23° 43' 42.381"N	83° 26' 30.210"E	595.9
64M06/167D/S/2017	23° 43' 42.381"N	83° 27' 12.098"E	592.2
64M06/168A/S/2017	23° 43' 15.141"N	83° 27' 58.868"E	567
64M06/168B/S/2017	23° 43' 12.314"N	83° 28' 27.907"E	569.6
64M06/168C/S/2017	23° 43' 47.007"N	83° 28' 6.064"E	594.8
64M06/168D/S/2017	23° 43' 46.236"N	83° 28' 29.449"E	589.1
64M06/169A/S/2017	23° 43' 5.118"N	83° 29' 0.030"E	598.8
64M06/169B/S/2017	23° 43' 21.565"N	83° 29' 34.466"E	594.6
64M06/169C/S/2017	23° 43' 44.951"N	83° 29' 4.142"E	586.2
64M06/169D/S/2017	23° 43' 37.241"N	83° 29' 34.980"E	611.8
64M06/170A/S/2017	23° 44' 18.279"N	83° 15' 8.220"E	510.9
64M06/170B/S/2017	23° 44' 28.815"N	83° 15' 53.192"E	508.2
64M06/170C/S/2017	23° 44' 57.083"N	83° 15' 13.874"E	500.6
64M06/170D/S/2017	23° 44' 51.687"N	83° 15' 45.483"E	503.9
64M06/171A/S/2017	23° 44' 38.838"N	83° 16' 19.918"E	515.1
64M06/171B/S/2017	23° 44' 39.351"N	83° 16' 50.499"E	519.1
64M06/171C/S/2017	23° 44' 50.402"N	83° 16' 11.952"E	508.8
64M06/171D/S/2017	23° 44' 56.569"N	83° 17' 14.398"E	506.7

ANNEXURE-VIII: LIST OF UNIT CELL SAMPLES IN T.S. NO. 64M/06

UNIT CELL NO	LATITUDE	LONGITUDE	ALTITUDE (m)
64M06/172A/S/2017	23° 44' 39.351"N	83° 17' 39.583"E	506
64M06/172B/S/2017	23° 44' 39.608"N	83° 18' 0.141"E	507.1
64M06/172C/S/2017	23° 44' 56.055"N	83° 17' 30.074"E	499.7
64M06/172D/S/2017	23° 44' 52.972"N	83° 17' 56.286"E	500.8
64M06/173A/S/2017	23° 44' 38.838"N	83° 18' 46.398"E	519.6
64M06/173B/S/2017	23° 44' 36.525"N	83° 19' 7.984"E	513.3
64M06/173C/S/2017	23° 44' 50.659"N	83° 18' 56.677"E	514.7
64M06/173D/S/2017	23° 44' 49.374"N	83° 19' 15.437"E	504.9
64M06/174A/S/2017	23° 44' 35.497"N	83° 19' 54.241"E	507.3
64M06/174B/S/2017	23° 44' 30.614"N	83° 20' 12.230"E	516.5
64M06/174C/S/2017	23° 44' 58.111"N	83° 19' 50.386"E	497.2
64M06/174D/S/2017	23° 44' 56.055"N	83° 20' 30.732"E	492.1
64M06/175A/S/2017	23° 44' 33.698"N	83° 20' 46.151"E	511.1
64M06/175B/S/2017	23° 44' 38.838"N	83° 21' 43.458"E	533
64M06/175C/S/2017	23° 44' 50.145"N	83° 20' 47.950"E	505.8
64M06/175D/S/2017	23° 44' 55.284"N	83° 21' 45.000"E	517.3
64M06/176A/S/2017	23° 44' 14.167"N	83° 22' 13.782"E	557.1
64M06/176B/S/2017	23° 44' 21.363"N	83° 22' 38.195"E	560.4
64M06/176C/S/2017	23° 44' 58.625"N	83° 22' 21.749"E	535.8
64M06/176D/S/2017	23° 44' 57.340"N	83° 22' 58.240"E	531.1
64M06/177A/S/2017	23° 44' 13.910"N	83° 23' 35.502"E	582.7
64M06/177B/S/2017	23° 44' 14.681"N	83° 24' 9.167"E	580.2
64M06/177C/S/2017	23° 44' 41.664"N	83° 23' 30.877"E	607.5
64M06/177D/S/2017	23° 44' 42.949"N	83° 24' 8.910"E	572.1
64M06/178A/S/2017	23° 44' 9.542"N	83° 24' 43.859"E	560
64M06/178B/S/2017	23° 44' 15.966"N	83° 25' 6.217"E	578.2
64M06/178C/S/2017	23° 44' 46.547"N	83° 24' 23.301"E	568.1
64M06/178D/S/2017	23° 44' 40.893"N	83° 25' 1.848"E	587.8
64M06/179A/S/2017	23° 44' 12.111"N	83° 25' 47.591"E	601.7
64M06/179B/S/2017	23° 44' 8.514"N	83° 26' 15.602"E	662.7
64M06/179C/S/2017	23° 44' 40.893"N	83° 25' 30.373"E	648.1
64M06/179D/S/2017	23° 44' 41.407"N	83° 26' 25.110"E	662
64M06/180A/S/2017	23° 44' 16.223"N	83° 26' 42.585"E	618.2
64M06/180B/S/2017	23° 44' 24.704"N	83° 27' 29.613"E	602.5
64M06/180C/S/2017	23° 44' 42.178"N	83° 26' 36.161"E	613.9
64M06/180D/S/2017	23° 44' 41.150"N	83° 27' 13.680"E	618.8
64M06/181A/S/2017	23° 44' 23.419"N	83° 28' 0.451"E	610
64M06/181B/S/2017	23° 44' 9.028"N	83° 28' 32.316"E	598.4
64M06/181C/S/2017	23° 44' 41.150"N	83° 27' 52.227"E	609
64M06/181D/S/2017	23° 44' 56.569"N	83° 28' 51.590"E	498.6
64M06/182A/S/2017	23° 44' 38.581"N	83° 29' 16.260"E	503.3
64M06/182B/S/2017	23° 44' 34.983"N	83° 29' 51.724"E	499
64M06/182C/S/2017	23° 44' 57.854"N	83° 29' 26.796"E	485.8
64M06/182D/S/2017	23° 44' 56.569"N	83° 29' 44.271"E	479

Annexure-IX

Correlation matrix of elements in 64M/06

	Si	Al	Fe	Ti	Ca	Mg	Mn	Na	K	P	Ba	Co	Cr	Cu	Ga	Nb	Ni	Pb	Rb	Sc	Sr	Th	V	Y	Zn	Zr	Be	Ge	As	Sn	La	Ce	Pr	Nd	Eu	Sm	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Hf	Ta	U
Si	1																																														
Al	-0.8676	1																																													
Fe	-0.805	0.69968	1																																											
Ti	0.21074	-0.2803	0.04166	1																																										
Ca	-0.733	0.49404	0.50935	-0.2163	1																																								
Mg	-0.8123	0.64163	0.71711	-0.3163	0.72237	1																																							
Mn	-0.4581	0.41812	0.43699	-0.0155	0.40278	0.41784	1																																						
Na	-0.601	0.51622	0.35613	-0.4243	0.62011	0.40968	0.30793	1																																					
K	-0.411	0.49148	0.10031	-0.766	0.27859	0.46059	0.18469	0.49377	1																																				
P	-0.2468	0.18431	0.26642	0.4198	0.168	0.07464	0.29062	0.03792	-0.3347	1																																			
Ba	0.27972	-0.1278	-0.2484	-0.1326	-0.191	-0.0908	0.22524	-0.1234	0.16016	-0.1277	1																																		
Co	-0.3737	0.22923	0.56928	0.08157	0.25163	0.37345	0.26388	-0.0529	-0.1014	0.11335	-0.2635	1																																	
Cr	0.25983	-0.3497	-0.0534	0.39939	-0.1118	-0.1588	-0.1247	-0.5035	-0.5742	0.10575	0.01684	0.24933	1																																
Cu	-0.4221	0.42041	0.53365	-0.2334	0.21616	0.59766	0.39647	0.0039	0.29411	-0.0699	0.12601	0.32721	-0.0195	1																															
Ga	-0.6532	0.81168	0.62557	-0.1661	0.30601	0.36261	0.3253	0.52897	0.33134	0.1506	-0.2836	0.22691	-0.3521	0.22086	1																														
Nb	0.25945	-0.2422	-0.0874	0.84246	-0.2572	-0.4466	-0.0439	-0.2611	-0.6972	0.3695	-0.2019	-0.082	0.30362	-0.3675	-0.0086	1																													
Ni	-0.1845	0.11575	0.31768	-0.1024	0.17974	0.33178	0.10033	-0.1838	0.02951	-0.1036	-0.0076	0.47007	0.6808	0.41001	0.04065	-0.2094	1																												
Pb	-0.144	0.27316	-0.0748	-0.2827	-0.0184	0.12294	0.39187	0.09082	0.38766	-0.0853	0.28726	-0.2029	-0.1645	0.33388	0.16197	-0.154	-0.0224	1																												
Rb	-0.5269	0.54414	0.267	-0.6651	0.36007	0.43378	0.18313	0.60909	0.80873	-0.1936	-0.2763	0.04532	-0.5965	0.18105	0.57575	-0.4832	-0.006	0.19953	1																											
Sc	-0.6547	0.49954	0.73797	0.01447	0.53103	0.57931	0.34461	0.34751	0.12942	0.22823	-0.2912	0.58132	-0.0826	0.31702	0.49951	-0.1444	0.26964	-0.1711	0.30413	1																									
Sr	-0.3772	0.21032	0.39908	-0.0189	0.45407	0.34324	0.19195	0.32628	-0.0697	0.27485	-0.0315	0.17935	-0.0591	0.08523	0.13541	-0.1172	-0.0286	-0.017	0.00671	0.36769	1																							
Th	0.10997	-0.0706	-0.226	0.39927	-0.127	-0.3226	-0.2173	-0.0774	-0.2791	0.24397	-0.2519	-0.2275	0.07904	-0.3828	0.00324	0.42296	-0.2449	-0.1797	-0.1517	-0.2379	-0.1298	1																						
V	-0.2713	0.13472	0.62483	0.64892	0.1006	0.27667	0.16504	-0.251	-0.507	0.34104	-0.2006	0.51545	0.3288	0.30599	0.11387	0.37284	0.26148	-0.2806	-0.3935	0.48711	0.30679	-0.0484	1																					
Y	-0.2417	0.28473	0.02048	-0.1611	0.11233	-0.0039	0.0888	0.41824	0.34935	0.06303	-0.1881	-0.154	-0.3685	-0.1492	0.42946	-0.0676	-0.2125	0.08693	0.49377	0.07293	-0.108	0.52711	-0.3385	1																				
Zn	-0.5824	0.57703	0.38047	-0.3082	0.37361	0.58595	0.51825	0.38426	0.54151	0.0327	0.21296	0.00808	-0.2608	0.56379	0.36749	-0.2646	0.0818	0.69918	0.37088	0.22049	0.07907	-0.2604	-0.0434	0.14328	1																			
Zr	0.4149	-0.4147	-0.2875	0.75267	-0.3689	-0.5589	-0.2311	-0.3909	-0.6996	0.3076	-0.0669	-0.1716	0.36252	-0.4538	-0.2569	0.73905	-0.2376	-0.242	-0.6262	-0.3053	-0.1036	0.68478	0.22435	0.08294	-0.4152	1																		
Be	-0.2059	0.21013	0.09189	-0.3361	0.11547	0.09508	-0.0031	0.35926	0.36858	-0.1625	-0.2183	0.0061	-0.337	-0.0497	0.35437	-0.1729	-0.0561	0.11347	0.51208	0.16172	0.00822	-0.0533	-0.2695	0.30312	0.08302	-0.2046	1																	
Ge	-0.1299	0.08658	0.12544	-0.0751	0.16525	0.0997	-0.0988	0.10895	0.07243	-0.0403	-0.3335	0.11067	-0.1511	0.01292	0.14347	-0.0357	-0.0284	-0.2354	0.22482	0.14765	0.00102	0.1818	-0.0133	0.13709	-0.1381	-0.0157	0.37785	1																
As	-0.1155	0.17537	0.187	-0.0978	0.06651	0.15564	0.04779	0.06045	0.17849	-0.1171	-0.065	0.02261	-0.0922	0.21515	0.1748	-0.0482	0.12129	0.00289	0.23807	0.04979	-0.1265	0.01449	0.01471	0.0962	0.08306	-0.0971	0.40499	0.26896	1															
Sn	-0.0838	0.03116	0.05794	-0.0824	0.07148	-0.0081	0.01623	0.23729	0.09919	0.00525	-0.125	-0.0292	-0.168	-0.1114	0.16812	0.02946	-0.1291	0.02934	0.19529	0.09912	0.07774	0.01243	-0.1358	0.19535	0.01285	-0.0246	0.57063	0.37982	0.25049	1													
La	-0.0302	-0.0206	0.00474	0.31153	-0.0204	-0.069	-0.1068	-0.0616	-0.195	0.17744	-0.2939	-0.0245	0.07031	-0.144	0.01054	0.26277	-0.0864	-0.2268	-0.0853	-0.0519	-0.0497	0.74655	0.1113	0.34799	-0.1752	0.46088	-0.0582	0.48285	0.10449	0.10378	1												
Ce	-0.0644	0.0268	0.01141	0.30867	0.00839	-0.0466	-0.0923	-0.031	-0.1645	0.17282	-0.2964	-0.0178	0.05008	-0.1218	0.04945	0.2668	-0.0853	-0.217	-0.0692	-0.0367	-0.0771	0.76551	0.10107	0.37246	-0.1379	0.46007	-0.0462	0.46586	0.13498	0.08407	0.97523	1											
Pr	0.08504	-0.1118	-0.0615	0.47218	-0.1214	-0.19	-0.1368	-0.1819	-0.354	0.22222	-0.2554	-0.0243	0.18395	-0.2058	-0.0558	0.42348	-0.0905	-0.2434	-0.262	-0.1221	-0.0943	0.77828	0.18547	0.26362	-0.247	0.58986	-0.1367	0.41906	0.06504	0.07793	0.94452	0.94779	1									
Nd	0.08278	-0.1137	-0.0604	0.46361	-0.1184	-0.1851	-0.1313	-0.1747	-0.3426	0.21065	-0.2353	-0.0351	0.17809	-0.2019	-0.0633	0.41043	-0.097	-0.2418	-0.261	-0.1147	-0.095	0.78402	0.1827	0.27089	-0.2344	0.61111	-0.1319	0.41661	0.05314	0.07603	0.95155	0.95473	0.99044	1							
Eu	0.01177	-0.0003	0.1034	0.50202	-0.0906	-0.065	0.07388	-0.1997	-0.3851	0.28374	0.11401	-0.0137	0.19363	-0.0483	-0.0352	0.40671	-0.1018	-0.0474	-0.4641	-0.0142	0.03835	0.36302	0.35467	-0.0062	-0.0163	0.50634	-0.174	0.32895	0.06078	0.09563	0.56804	0.56757	0.63692	0.6556	1						
Sm	0.01298	-0.0472	-0.0362	0.35415	-0.0547	-0.123	-0.1026	-0.0768	-0.2162	0.18151	-0.2541	-0.0287	0.09017	-0.1753	-0.0005	0.30383	-0.0978	-0.2139	-0.1357	-0.0683	-0.0878	0.75684	0.1111	0.3628	-0.1866	0.50136	-0.0523	0.46595	0.09141	0.11959	0.96546	0.97042	0.97537	0.9814	0.60977	1					
Gd	-0.0495	0.01582	-0.0085	0.25733	0.00221	-0.0682	-0.0786	0.01104	-0.1038	0.1563	-0.2535	-0.0243	0.00828	-0.1492	0.05565	0.20405	-0.0997	-0.1765	-0.0347	-0.0151	-0.0672	0.70772	0.05447	0.43417	-0.1347	0.40141	0.01568	0.49268	0.11301	0.15653	0.94452	0.95051	0.93053	0.93495	0.57103	0.9836	1				
Tb	-0.1191	0.08176	0.00976	0.09897	0.06815	-0.0158	-0.0432	0.13881	0.05671	0.09772	-0.2477	-0.0165	-0.103	-0.1284	0.12512	0.06363	-0.1102	-0.1005	0.12179	0.04423	-0.0357	0.60022	-0.0539	0.52303	-0.0589	0.24406	0.13427	-0.50395	0.12707	0.22066	0.8552	0.85861	0.81145	0.81308	0.47788	0.90331	0.96218	1			
Dy	-0.1642	0.12966	0.03091	-0.0036	0.12717	0.02729	-0.0115	0.2228	0.15521	0.05598	-0.2122	-0.0141	-0.1706	-0.0993	0.16416	-0.0313	-0.1124	-0.0404	0.20138	0.09151	0.00416	0.49839	-0.1104	0.55335	0.00233	0.13443	0.20213	0.48338	0.13856	0.26254	0.75132	0.75572	0.69426	0.69595	0.41547	0.8072	0.89401	0.97912	1		
Ho	-0.1855	0.15598	0.04747	-0.0429	0.15178	0.04868	0.02144	0.26254	0.20138	0.02806	-0.1559	-0.0198	-0.2016	-0.0766	0.18034	-0.0645	-0.1191	0.01674	0.21944	0.11275	0.02392	0.41929	-0.1279	0.53957	0.05829	0.08233	0.23709	0.45632	0.13719	0.28745	0.67037	0.67573	0.61057	0.61432	0.41761	0.73106	0.82981	0.94105	0.98699	1	
Er	-0.1731	0.13961	0.04638	-0.0378	0.14195	0.02961	0.0217	0.26224	0.18741	0.01402	-0.1576	-0.0116	-0.1938	-0.0906	0.18308	-0.0501	-0.1207	0.03803	0.21593	0.11981	0.04428	0.38952	-0.1259	0.5345	0.05536	0.08776	0.27622	0.44218	0.13337	0.32234	0.6233	0.62602	0.57001	0.5747	0.40978	0.68799	0.78778	0.90908	0.96788	0.99221	1
Tm	-0.1828	0.16026	0.05921	-0.0366	0.15579	0.04048	0.04347	0.27651	0.19811	0.00552	-0.1084	-0.0323	-0.2052	-0.0733	0.18994	-0.0491	-0.133	0.06599	0.20081	0.11777	0.03765	0.35862	-0.1258	0.52207	0.08897	0.0845	0.3038	0.41562	0.15071	0.33305	0.57562	0.5824	0.52459	0.53175	0.42662	0.64199	0.74267	0.86828	0.9373	0.97626	0.99056	1	
Yb	-0.1642	0.14674	0.05767	-0.0194	0.14049	0.02115	0.04941	0.27522	0.18016	0.00048	-0.0949	-0.0395	-0.2004	-0.082	0.19361	-0.0249	-0.1408	0.075	0.18512	0.11149	0.03252	0.34181	-0.1196	0.50914	0.08263	0.09822	0.3344	0.41149	0.15826	0.36728	0.54261	0.54838	0.50138	0.50985	0.43623	0.61459	0.71164	0.83579	0.90945	0.95474	0.97798	0.9935	1
Lu	-0.154	0.14231	0.05622	-0.0056	0.13577	0.01402	0.05308	0.26537	0.16911	-0.0007	-0.0742	-0.0497	-0.1949	-0.0828	0.19226	-0.0127	-0.1397	0.07811	0.16627	0.1112	0.03492	0.32488	-0.1119	0.4918	0.07576	0.1128	0.35295	0.41099	0.1594	0.37462	0.52309	0.52948	0.48493	0.49505	0.44904	0.59512	0.69046	0.81102	0.8855	0.93531	0.9622	0.98579	0.99502	1	
Hf	0.33813	-0.3415	-0.1824	0.75097	-0.2658	-0.4536	-0.1719	-0.3268	-0.6648	0.31701	-0.0909	-0.1704	0.3554	-0.3645	-0.2155	0.75281	-0.1915	-0.238	-0.5897	-0.2609	-0.0845	0.61234	0.28191	-0.012	-0.363	0.87595	-0.2653	0.12635	-0.0295	0.02752	0.55786	0.55914	0.68897	0.69845	0.66148	0.60101	0.507	0.34904	0.24138	0.20018	0.19934	0.20168	0.22219	0.23594	1	
Ta	0.19415	-0.1819	-0.13	0.34122	-0.2027	-0.3044	-0.1432	-0.0982	-0.263	0.06656	-0.2006	-0.095	0.06822	-0.2862	0.02557	0.49181	-0.138	-0.0948	-0.1214	-0.1099	-0.0781	0.28364	0.0569	0.11124	-0.2385	0.46043	0.54153	0.25365	0.22399	0.40683	0.1983	0.20686	0.27419	0.27494	0.24084	0.24311	0.212	0.17152	0.1404	0.13567	0.16673	0.18461	0.22342	0.25109	0.42175	1	
U	-0.1075	0.0457	-0.0121	0.05487	0.04752	-0.0699	-0.1831	0.17728	0.04988	0.05775	-0.458	-0.0098	-0.1375	-0.2388	0.16542	0.08363	-0.1188	-0.1635	0.24056	0.04893	0.00762	0.59428	-0.0956	0.49688	-0.1797	0.23932	0.33904	0.56004	0.14228	0.32048	0.77202	0.77408	0.71203	0.71081	0.30851	0.78621	0.83644	0.8691	0.84637	0.80396	0.78744	0.74148	0.71944	0.70092	0.313	0.29498	1

Legend

- Strong positive correlation
- Moderate positive correlation
- Weak positive correlation
- Weak negative correlation
- Moderate negative correlation
- Strong negative correlation

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GOVERNMENT OF INDIA
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भारतीय भूवैज्ञानिक सर्वेक्षण
GEOLOGICAL SURVEY OF INDIA

GEOLOGY OF A PART OF SURAJPUR TAHSIL, SURGUJA DISTRICT, MADHYA PRADESH

(Field Season 1965-1966)

By

T.S. Radhakrishna,
Geologist,
Geological Survey of India

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CR-004991

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ABSTRACT

An area of 385 Sq km was mapped on scale of 1:63,260 within latitudes 23°25' & 23°37' and longitudes 83°00' & 83°20' included in Toposheets 64M/SW and 64M/NW. The area is underlain by Archaean and Gondwana rocks. Biotite gneiss, albite-oligoclase gneiss and biotite-microcline gneiss comprise the metamorphics which contain relics of Sausar metasediments consisting of schistose quartzite, biotite-muscovite-chlorite schist, biotite-Muscovite schist, calc-gneiss with intrusives of amphibolites**,** Granite, aplite, pegmatite and quartz also occur in the area. The general trend of the Archaeans is in accordance with Satpura strike (ENE-WSW) along which there has been migmatisation of Sausars and emplacement of granite.

Lower Gondwanas comprise Talchirs, Karharbaris (?) and Barakars with intrusives of dolerites. The Archaean-Gondwana contact of Ramkola coalfield is at places faulted. A few faults are also recorded in the coalfield.

There are indications of occurrence of beryl, muscovite, and garnet in the pegmatites localised in schists in Rampur, Bheria, Paharkarwa and Khunsi areas. There are also indications of occurrence of coal and fire-clay in Ramkola coalfields. Biotite gneiss in Paharkarwa area, granite at Chanrell and dolerite at Pakni are good source of building material and road metal.

Preliminary reconnaissance of certain reported occurrences of minerals in Surajpur and Ambikapur Tahsils indicate the presence of ochres near Lalea, Kamaleshwarpur, Kasira, Barma and Serbhanja. There are also indications of occurrence of bauxite on plateau adjoining Shikariadand and Sapnadand. The quartz magnetite rock near Batauli are small in extent but are significant in that they contain manganese as indicated by preliminary chemical analysis. Mapping of the above said areas is recommended to locate more occurrences and to assess the known ones.

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I. INTRODUCTION

In pursuance of Item No. 4, page 124 of Field Programme of Geological Survey of India, I continued systematic geological mapping in Surajpur Tahsil, Surguja District, Madhya Pradesh, from November to May 1966 and covered an area of 385 sq km on 1:63,360 scale. I carried out mapping on photostat enlargement of Toposheet 64M/SW and 64M/NW. The area is within latitudes 23°25' & 23°37' and longitudes 83°00' & 83°20'.

I also carried out preliminary reconnaissance of a few mineral occurrences suggested by Government of Madhya Pradesh, in Ambikapur and Surajpur Tahsils, for about two weeks. A note concerning this is given separately at the end of this report.

Communications:

The area mapped is 40 km north of Ambikapur (District headquarters). Bishrampur, on the Anuppur-Bishrampur branch line of the South Eastern Railway is the nearest railhead which is 25 km west of Ambikapur. Ambikapur is connected by all-weather roads with Raigarh and Mahendragarh which are 200 km and 130 km away respectively. Raigarh is located on the Howrah-Nagpur section and Mahendragarh on the Anuppur-Chirimiri section of South Eastern Railway. A fair-weather road between Ambikapur and Basanthpur by way of Partabpur passes through the area. A few forest tracks branch out from the above said road. Another fair-weather road between Jhilimili and Chandrapur also passes through Partabpur in the area. There are no communications in the interior between July and October. Manual labour and mules are the only means of transport in the interior.

Topography and drainage:

The area being a part of Surguja plateau, has rugged topography with low and high hills. The maximum elevation is that of Chirven Pahar Δ 2546 (776.01m above msl). The average elevation of the country is 2100 feet (640.07m) The trends of Hari Pahar, Chhuripat, Amar Pahar and hills around Jhor are in ENE-WSW whereas those of Raikoh and Satpurka Pahar are in east-west direction, Kathauta Pahar with a maximum elevation of 2512 feet (765.64m above msl) trends in NNE-SSW. Major

part of the area has westerly slope. The terrain east of Kathauta Pahar including Jhor area has northerly slope. The area being a part of Rihand Basin is drained by Mahan River and its tributaries: Banki Nadi, Kolua Nala and Jhoj Nala with their numerous feeders**.**

Climate:

Surguja District has a tropical climate. Tropic of Cancer passes through the area. Winters are cold and the summers are pleasant. It receives an averages rainfall of 150 cm from June to October, the maximum being 200 cm.

Flora and Fauna:

The area, in general is covered by mixed forests. Sal (Shorea robusta), Saja (Terminalia tomentosa), Tendu (Tiospyro malenoxylon), Seedha (Legestromia pariflora) are timber yielding tress. Khair (Accaia Katchu), Bamboo (Dendrocalamus strictus), and Mahua (Madhuka Latifolia) also occur in these forests. Wild life has dwindled but for a few deer, bears, hyenas, cheetas, tigers and blue bulls. Notable among birds are peafowls and sarus.

Acknowledgements:

The work was carried out under the guidance of Shri D.R.S. Mehta, Superintending Geologist-in-charge, MP Circle, Geological Survey of India. I am grateful to him for his valuable guidance in the field and for scrutiny of the report. Thanks are due to the officials of Surguja District for the co-operation extended by them during the course of investigation.

Previous work:

The area was mapped by C.L. Greisbach in 1880. His work was published in the Memoirs of Geological Survey of India, Vol. V, part 2. Gneiss, schists, granite, Talchirs, Kaharbaris, Barakars and Trap rocks have been recorded by him.

The adjoining area, in sheet 64M/SW was mapped by me during field seasons 1961-1962[1], 1962-1963[2], 1963-1964[3], 1964-1965[4].

[1] Radhakrishna T.S. 1962. Progress Report for Field Season 1961-1962.
[2] Radhakrishna T.S. 1963. Progress Report for Field Season 1962-1963.
[3] Radhakrishna T.S. 1964. Progress Report for Field Season 1963-1964.
[4] Radhakrishna T.S. 1965. Progress Report for Field Season 1964-1965.

II. GEOLOGY

The geological sequence in the area is as follows:

Lower Gondwana	Damuda	Dolerite
		Pebbly grits, felspathic sandstones (sub-arkoses) with shale and coal (Barakars)
		Conglomeritic grits, pebbly grits (Greywacke?) felspathic sandstones (Sub-arkoses) with shale and coal (Karharbaris?)
	Talchirs	Boulder bed (Till), pebbly grits, sandstones and shales.
----------Unconformity----------		
Archaeans		Pegmatite and quartz veins Felsite, granite
		Porphyry and aplite granite.
	Metamorphics	Gneissic complex: Biotite gneiss, albite-oligoclase porphyritic gneiss and biotite-microcline porphyritic gneiss.
	Older metamorphics (Sausars)	Amphibolites
		Schistose quartzites, biotite-muscovite-chlorite schist, biotite-muscovite schist and calc gneiss.

Description of rocks

Archaeans

Older metamorphics:

Schistose quartzites, biotite-muscovite-chlorite schist, biotite-muscovite schist and calc-gneiss with intrusives of amphibolites form the older metamorphics which occur as relics in gneisses and granite. These occur between Raisara (23°27':83°00'; 64M/SW) and Partabpur (23°29':83°13'; 64M/SW). The relics also occur to the north of the above said area but as isolated and scanty patches except the schists exposed near Rampur (23°36':83°12'; 64M/NW).

Schistose quartzites occur as lenticular masses and range in thickness from a fraction of a metre to as much as 200m and most of them are less than 50m. The bands exposed on Raikoh Pahar are traceable over strike length of three kilometres. These are generally massive, white, fine to medium grained, hard and contain essentially granular quartz with minor amounts of sericite. The beds adjoining calc-gneiss and close to biotite gneiss in Matigada (23°27':83°03'; 64M/SW) area contain minor amounts of diopside, oligoclase, apatite and sphene (Micro-Slide No. 972/MP-66). Some are cherty and flaggy as seen near Kahharpara (23°29':83°06'; 64M/SW). An outcrop at Semra (23°30':83°17'; 64M/SW) contains a few disseminations of pyrite grains less than 2 mm in size.

Biotite-muscovite-chlorite schist occurs over an area of seven square kilometres around Rampur and is lenticular over its length. The schist locally grades into biotite gneiss through a zone gneissose schist and schistose gneiss. The schist also contains a few small lenses of schistose quartzite and calc-gneiss and amphibolite. Small outcrops of biotite gneiss, pegmatites and quartz veins also occur in the schist. It contains essentially biotite, muscovite and chlorite with impregnations of quartz-felspar granular aggregates along the foliation planes. There are thin (0.6 x 10m) pebbly horizons which are exposed a kilometre south-west of Rampur. The pellets and pebbles less than 5 cm in size are ellipsoidal or discoidal is shape. These contain altered basic rock and greywacke?. The altered basic rock contains voids after pyrite with black, irregular shaped specks. Chlorite and muscovite are discernible. Greywacke? consists angular grains of quartz, felspar with minor amounts of detrital tourmaline. There are some irregular shaped colourless or brown masses with black dusty inclusions. These are isotropic and may be glass (Micro-Slide Nos. 973 & 974/MP-66).

Biotite-muscovite schist occurs as lenticular masses associated with other metasedimentary relics in Raisara-Partabpur area. These range in thickness from 10 to 200m and occur for varying lengths of less than two kilometres. These also have gradational contacts with the enclosing biotite gneiss. The schists contain essentially muscovite, biotite, with minor amounts of sericite and garnet. There are also impregnations of quartz-felspar granular aggregates along the foliation planes. Similar schist occurs in the vicinity of Khunsi (23°33':83°13'; 64M/MW). It is about 50m wide and 800m long. Such schist occurs at Jajawal (23°31':83°02'; 64M/NW), Samai (23°31':83°11'; 64 M/NW**),** Deuri (23°32**':**83°07'; 64M/NW) and Semra (23°29':83° 18'; 64M/SW).

Quartz-sericite-muscovite schist is also exposed 800m north of Semra Kalan (23°27':83°06'; 64M/SW**).** It is 60m thick but lenticular over its strike length of 100m. It is purplish grey, fine grained and contains granular quartz and sericite with minor amounts of orthoclase, oligoclase and tourmaline. There are also irregular shaped black grains and dust of iron oxide (Micro-Slide No. 975/MP-66).

Calc-gneiss occurs as thin bands and lenses either associated with other metasedimentary relics or separately in the gneisses and granite. The bands are less than 100m in thickness and three kilometres in length. The lenses range from 0.3 x 1.0m to 10 x 900m in size. Prominent outcrops occur on Amar Pahar (23°29':83°09'; 64M/SW) and near Paharmorni (23°27':83°02'; 64M/SW). These are grey to greenish grey, fine to medium grained, streaky or banded with alternate layers of dark and light minerals. The Salic bands contain granular quartz, calcite and dolomite with minor amounts of microcline, orthoclase and perthite. The mafic bands contain actinolite diopside with minor amounts of albite, oligoclase and microcline. Sphene, apatite, iron oxide, garnet, epidote, clino-zoisite and zoisite are the accessories (Micro-Slide No. 976, 977, 978 and 979/MP-66). Orthoclase and microcline occur as fillings in the fractures of diopside. Vermicular growth of quartz in felspar is also seen. Sphene is either complete in form or as granular aggregates. Symplectite of epidote and diopside is also present. Some of the plagioclase felspars are saussuritised and the twin lamellae are bent and broken. Inclusions of diopside occur in some plagioclase crystals. The garnet is of colourless variety grossularite.

Amphibolites occur as sills and dykes within metasediments. These also occur as relics and pods with or no metasedimentary association, in the gneisses, granite and pegmatites. These range in thickness from a fraction of a metre to a maximum of 30m. The maximum length is 400m and most of them are less than quarter the figure. These are dark greenish grey, fine to medium grained (0.1 to & 8 mm) and hard. The rock contains tabular prisms of andesine, labradorite and hornblende in xenon-ophitic texture (Micro-Slide No. 980/MP-66). Biotite, apatite and iron oxide are the accessories. A few prisms of hornblende are in decussate pattern. It has yellow to green pleochroism and an average extinction angle 10° to 15° (Z c). Some prisms are bent, ruptured and are partly altered to chlorite. Inclusions of plagioclase are seen in them.

The relics that are well within the gneisses are generally altered and show marginal foliation. Very small outcrops are completely foliated. The contact of amphibolites with the enclosing gneiss is gradational. It grades into a biotite gneiss through a thin zone of epidosite and hornblende gneiss. The thickness of hornblende bands (0.1 cm to 2 cm) and proportion of calcic plagioclases decrease whereas the proportion of orthoclase, microcline, albite, oligoclase and biotite increase, away from the relic.

Epidosite and hornblende gneiss closer to the relics are mesocratic, medium grained with alternate band or streaks of salic and mafic minerals in a granoblastic texture. (Micro-Slide No. 981, 982, 983 and 984/MP-66). The mafic bands are comparatively thicker than the salic bands. The salic bands contain andesine, labradorite with minor amounts of orthoclase, quarts, albite and apatite. The mafic bands are composed of hornblende, sporadic augite zoisite, clino-zoisite and epidote. Biotite, sphene with granular as well as porphyroblasts of garnet and iron oxide are common accessories to both the bands. Plagioclases are saussuritised. Hornblende occurs as grains and small as well as big prisms in a decussate pattern. It has yellow to bluish green pleochroism and extinction angle of 10° to 23° (Z c). Inclusions of magnetite, orthoclase, plagioclase and blabs of quartz are present in hornblende. Some are altered to chlorite. Augite is relict and is altered to hornblende. Orthoclase and microcline are little altered. Orthoclase contains inclusions of hornblende, apatite and garnet. Quartz is also found as fracture fillings in hornblende and as vermicular growth in albite. Quartz contains inclusions of apatite, sphene and black dusty inclusions. Porphyroblasts of garnet are pale pink and incomplete in form. These contain inclusions of hornblende (Altered to chlorite), orthoclase, magnetite and blebs of quartz. Sphene occurs as granules as well as euhedral crystals. Some epidote occurs as resorbed material and symplectite with zoisite and clino-zoisite.

Hornblende gneiss closer to biotite gneiss is streaky or banded with comparatively thicker bands of light coloured minerals with a granular texture. Orthoclase, quartz with minor amounts of albite, oligoclase and andesine form the salic bands. The mafic ones are composed of hornblende. Epidote, clino-zoisite, zoisite, allanite, apatite, magnetite, calcite and iron oxide are the accessories (Micro Slide No. 985/MP-66). Andesine is saussuritised whereas albite and oligoclase show little or no alteration. Hornblende is granular or prismatic with pale green to greenish blue pleochroism and an extinction angle of 15 (Z c). Orthoclase is sericitised. Quartz contains black dusty inclusions. Alunite occurs in the core of some prismatic crystals

of clino-zoisite. It has yellow to brown pleochroism and parallel extinction. Calcite appears to be a released product.

Gneissic complex:

Biotite gneiss, albite-oligoclase gneiss and porphyritic biotite-microcline gneiss are included in gneissic complex. Gneisses of granitic composition which are streaky banded or well foliated are grouped in biotite gneiss. Albite-oligoclase-gneiss contains conspicuous is amounts of sodic plagioclases. Gneiss of granitic composition with abundance of microcline forms the porphyritic microcline gneiss. Biotite gneiss is predominant in the area. All these gneisses bear pegmatites and quartz veins. There are also relics of metasedimentary rocks and amphibolites in them.

Biotite gneiss is the dominant rock type in the area and it is prevalent over 20 km across the strike. It is banded, well foliated or streaky with alternate salic and mafic minerals. The salic and mafic layers are less than five centimetres in thickness and most of them are less than quarter the figure. The salic ones are comparatively thicker than the mafic layers. The texture is more or less uniform anhedral granular but for local modifications near the relics of metasedimentary rocks and amphibolites. There is heterogeneity of grain from 0.1 to 1 cm the bigger ones are generally in quartz-felspar stringers. The gneiss varies in mineralogical composition in that garnetiferous type, hornblende gneiss and diopside gneiss are recognisable but these are local features. Biotite which is the chief mafic diminishes locally across the strike to render the rock hard as seen in Jhoj nala between Pakni (23°32':83°07'; 64M/NW) and Dand karwa (23°37':83°07'; 64M/NW) and also along Partabpur (23°29':83°13'; 64M/NW) and Jhor (23°36':83°13'; 64M/NW) sections. The salic minerals are quartz, orthoclase microcline with minor amounts of perthite, albite and oligoclase, (Micro Slide No. 986/ MP/66). Biotite forms the mafic bands, Sphene, magnetite, apatite and zircon are the accessories. Orthoclase is slightly sericitised and contains inclusions of quartz. Microcline occurs as separate grains within orthoclase also some quartz contains inclusions of apatite. Biotite is prismatic with yellow to brown pleochroism.

The gneiss near Deuri (23°31':83°08'; 64M/NW) and Namadhaki (23°34':83°09'**;** 64M/NW) contains garnet of 1 mm to 5 mm size. Hornblende and diopside gneisses occur in the gradational zones of the contact with the relics of amphibolites and calc-gneiss.

Albite-oligoclase gneiss is exposed in Mahan river section NNE of Paharmorni (23°27':83°02'; 64M/SW). It occurs as lenticular mass with a maximum cross section of two kilometres and strike length of 12 km. The gneiss along its contacts, grades locally into biotite-microcline gneiss and biotite gneiss. The rock varies across and along the strike, in that the porphyroblasts of plagioclase and biotite diminish towards the margins. The rock is mesocratic with inequigranular texture comprising alternate streaks, layers or bands of mafic and salic minerals. There are augens and porphyroblasts of plagioclases also. The salic and mafic bands are less than a centimetre in thickness and five metres in length. The bands thin out towards the margins of the gneiss. The salic bands are comparatively thicker than the mafic bands. Both the bands become streaky towards the margins of the gneiss. Salic minerals are quartz, orthoclase, albite and oligoclase. Quartz, albite and oligoclase occur as porphyroblasts some of which are drawn to augens. These are less than 2 cm

x 5 cm in size, the felspars being complete in form or augens and quartz being mostly as incomplete ones. The augens are fractured and some of them are dislodged. (Micro-Slide No. 987/MP-66). The fractures are at a slight angle to the length of the augens and are filled with epidote and biotite. The felspars are altered to epidote and sericite. Some of the plagioclase show compound twinning. Dusty inclusions are seen in quartz. Sphene is either granular or as an overgrowth on magnetite. Biotite is prismatic with yellow to green pleochroism. Micro veins of epidote are also discernible.

Biotite-microcline porphyritic gneiss occurs at Jhor (23°36':83°13'; 64 M/NW). It is also lenticular with a maximum cross section of three kilometres. The contact of the gneiss with biotite gneiss is gradational in that the porphyroblasts of microcline diminish in size and proportion. The rock is light grey with inequigranular texture comprising alternate layers or streaks of salic and mafic minerals with imperfect augens and porphyroblasts of microcline. Salic and mafic bands are less than a fraction of a centimetre in thickness and do not persist beyond 10 cm in length. The essential minerals are quartz, orthoclase, microcline with minor amounts of perthite, albite and oligoclase, Biotite, Muscovite, apatite, zircon and epidote are the accessories. (Micro-Slide No. 988/MP-66) Orthoclase is sericitised. Microcline occurs as small and big crystals, some containing inclusions of biotite and orthoclase. Plagioclases are slightly saussuritised. Quartz is mostly granular with inclusions of biotite, orthoclase and microcline. Biotite is tabular or prismatic with yellow to brown pleochroism Zircon is more or less euhedral.

Similar gneiss also occurs at Kharoli (23°28':83°02'; 64M/SW) and Mani (23°32': 83°13'; 64M/NW).

Porphyritic granite:

Porphyritic granite occurs as plutons near Chanrell (23°27':83°08'; 64M/SW), Singhara (23°27':83°10'; 64M/SW), Parwatipur (23°27':83°08'; 64M/SW) and Semra Kalan (23°27':83°06'; 64M/SW). These range in area from a fraction of a square kilometre to 30 sq km or more. These are lenticular masses with pegmatite, aplite and quartz veins occurring in random directions. Two of the plutons contain conspicuous relics of altered calc-gneiss and amphibolites.

The porphyritic granite near Charnel has inequigranular texture with phenocrysts of microcline. The granite near its margins is pink to grey and medium grained (1 mm to 3 mm) with, scanty number of phenocrysts which are mostly incomplete in form. There is also faint alignment of biotite flakes along the margins. The grain of the rock increases to a maximum of 5 mm towards the central part of the granite. The phenocrysts which are 0.5 x 1 cm in size and incomplete in form along the margins of the granite, increase in size to as much as 3 x 6 cm, towards the central parts of the granite where there are also a few euhedral crystals of microcline. The rock contains essentially quartz-microcline with minor amounts of albite. Biotite muscovite, sphene, apatite and zircon form the accessories. Microcline is granular as small and big crystals, some of them containing inclusions of orthoclase. Biotite is tabular with yellow to brown pleochroism. It has a few pleochroic haloes filled with zircon and apatite (Micro-Slide No. 989/MP-66).

Similar granite forms the plutons near Parwaripur and Singara. These contain relic calc-gneiss and amphibolites which are altered to diopside gneiss and epidosite. The granite is grey to pink, medium grained (0.1 to 1 cm) and has inequigranular texture. Orthoclase, quartz, microcline form the bulk of the rock (Micro-Slide No. 1092 & 1093/MP-66). Albite, oligoclase, perthite, apatite, muscovite, biotite, sphene, zircon, magnetite and leucoxene are the accessories. Some orthoclase crystals contain inclusions of quartz and biotite. Some are sericitised. Quartz contains a few dusty inclusions. Vermicular quartz also occurs in orthoclase. Microcline occurs as phenocrysts, grains and as inclusions in quartz. Biotite is tabular with pale yellow to brown pleochroism. Some of them have pleochroic haloes containing either apatite or zircon.

The intrusive that occurs within the calc-gneiss, a kilometre north of Semra Kalan, is grey, medium grained (1 to 5 mm) and has equigranular texture. It contains quartz, orthoclase, Microcline with minor amounts of biotite, apatite and iron oxide.

Felsite and granite porphyry:

Felsite occurs as minor intrusive within biotite gneiss ESE of Pakni. It also occurs a kilometre south of Jajawal (23°32':83°02'; 64M/NW) where it traversed calc-gneiss across the strike with sharp contact. It is less than 2m to 30m in size. The rocks are grey to pink, aphanitic and break with conchoidal fracture. These contain essentially aphanitic felsic mass with a few tiny phenocrysts of quartz and felspar.

Granite porphyry occurs at the northern end of Singara (23°27':83°10'**;** 64 M/SW). It is 6m to 30m in size. It is grey**,** essentially felsic with a few visible crystals of pink felspar mostly in the central portion of the intrusive. Bigger grains of microcline and quartz are in a felsic mass comprising aphanitic to a few identifiable quartz, orthoclase and microcline. (Micro-Slide No 990/MP-66). Albite, muscovite and chlorite occur in traces. Bigger grains show sutured margins and undulose extinction. A micro vein of epidote is also noticed.

Aplite:

Aplite occurs as lenticular, slender veins within gneisses and granite. These are seldom bigger than 1.5 x 10m in size, pink, fine grained and have equigranular texture. Biotite in some is aligned. It contains quartz, microcline and orthoclase with minor amounts of biotite, muscovite, apatite and albite (Micro-Slide No. 991/MP-66).

Pegmatites:

Pegmatites occur as minor intrusives, conformable bodies and veins in the Archaean rocks. These vary widely in size from 5 cm x 100 cm to 8m x 70m majority of them being less than quarter the figure and lenticular over their lengths. The lenses are either separate or pinch and bulge. Some lenses are connected to each other. These are common in Rampur (23°37':83°12; 64M/NW), Kharoli (23°28':83°01'; 64M/SW) and Khunsi (23°33':83°13'; 64M/NW) areas. Irregular shaped bodies occasionally of branching type have been noticed in Jhor (23°36':83°13'; 64M/NW) area, Maza type of veins are conspicuous in Jajawal (23°32':83°02'; 64M/NW) and Keora (23°26': 83°07'; 64M/SW) areas. Ptygmatic veins have been noticed in Dankara (23°28':

83°06'; 64M/SW) and Khajuri (23°30':83°14'; 64M/SW) areas. Numerous stringers are noticed in the gneisses. Some veins occur along joints and fractures especially in metasedimentary relics. A pegmatite in Rampur area contains pods and relics of altered amphibolites. Another pegmatite a kilometre east of Paharamorni contains pods of aplite.

Major pegmatites are localised in biotite-muscovite-chlorite schist in Rampur and Bheria areas. Similar but of small dimensions also occur in muscovite-biotite schist in Khunsi area. Pegmatites (0.5 to 3m thick) also occur in the gneisses between Raisara (23°27':83°00'; 64M/SW), Partabpur (23°29':83°13': 64M/SW), Jhor, and Chikni (23°31':83°01'; 64M/NW) areas. Some occur in porphyritic granite but less than 1 x 5m in size in random direction. A few are confined to joints.

Pegmatites that occur in biotite-muscovite-chlorite schist in Rampur and Bheria areas range in thickness from fraction of a metre to eight metres. These contain essentially microcline, perthite, orthoclase and quartz with minor amounts of muscovite, garnet, smoky quartz and tourmaline. The pegmatite (8 x 70m) that occurs a kilometre south of Rampur contains opaque beryl associated with quartz segregations. Similar assemblage is observed in a pegmatite dump at Bheria and with sub-translucent beryl. The above said pegmatites contain 60 percent or more quartz, the rest forming felspars, A pegmatite (1m thick) within the schist in Khunsi area contain yellowish green muscovite and garnet. **A** tiny crystal of opaque beryl was recovered from the dump. A beryl crystal (0.5 cm x 1.5 cm) was recovered from old dump 600m west of Pahar Karwa. The pegmatite exposed in a pit adjoining the dump is 1m think and shows little quartz segregations with no visible beryl.

The pegmatites in Raisara-Partabpur, Jhor and Chikni areas contain tiny books (less than 2 cm) of muscovite, and tourmaline with no visible beryl. These contain about 60 percent or more felspars, the rest forming quartz and accessories: Zircon and sphene (Micro-Slide No. 992/ MP-66).

Quartz veins:

Quartz veins less than two metres in thickness and 30m in length traverse Archaean rocks. Sheared bluish grey quartz veins occur 800m west of Dumhath (23° 31':83°10'; 64M/NW). The rest are in larger proportion and are white and massive. Some of the pegmatites in Rampur and Bheria areas contain irregular segregation of quartz mostly in the central parts (probably due to zoning). These have resinous or subvitreous lusture and carry shorl with beryl. Stringers, network and tiny veins of secondary quartz also occur along shear and fault zones in Archaean and Gondwana rocks.

Lower Gondwanas:

Lower Gondwanas comprising Talchirs, Karharbaris (?) and Barakars occur along the southern and eastern boundaries of Ramkola coalfield between Jajawal (23°32':83°02'; 64M/NW) and Kenapara (23°37':83°15'; 64M/NW). Talchirs occur along the northern boundary of Bisrampur coal field between Palma (23°26':83°00'; 64M/SW) and Chitkabahra (23°26':83°12'; 64M/SW). These extend into Metamorphics towards north for about six kilometres as seen in Sattipara (23°26':

83°04'; 64M/SW) and Kharsota (23°29':83°04'; 64M/SW) sections. Outliers of Talchir also occur near Bhurpani (23°34': 83°06'; 64M/NW), Kachharpara (23°29': 83'06'; 64M/SW) and Tukudand (23°28':83°16'; 64M/SW). The Talchirs of Bisrampur coalfield are comparatively thicker than those of Ramkola coalfield.

Talchirs lie unconformably over the Archaeans along the margins of Ramkola and Bisrampur coalfields in the area. These comprise boulder beds, sandstones and shales. Boulder beds occur as discontinuous patches not exceeding five metres in thickness. These consist of unassorted pebbles and boulders of porphyritic gneiss, granite, aplite, quartz, grey quartzite, purple quartzite, jaspery quartzite and slate in a yellow loose silty clay matrix. An outcrop of boulder bed (2m) 800m south west of Chainpur (23°29':83°05'; 64M/SW) differs, from the former one in that, the matrix is made of greenish grey sandy clay. The pebbles and cobbles of purple quartzite show triangular facets and others have slightly polished surfaces.

Sandstones overlie conformably or overlap the boulder bed. These sandstones have a maximum thickness of 15m as seen in Kachharpara area but less than quarter the figure elsewhere. The basal beds contain pebbles and boulders of grey and purple quartzite, granite, biotite gneiss and quartz. The sandstone is yellow or greenish grey and fine to medium grained with quartz, partially decomposed felspars and muscovite. The sandstones in other areas are mostly interlayered with shales.

Shales in the area are on the average less than three metres in thickness. These are generally grey or yellow with layers of olive green ones. The outlier at Tukudand contains boulder bed, whereas others contain sandstones and shales.

Damuda:

Overlying the Talchirs are the Damuda formations in Ramkola coalfield. The basal beds comprise conglomeritic grits, pebbly-grits (sub-greywacke?), felspathic sandstones (sub-arkoses), shale and thin seams of coal. The conglomeritic grits occur as discontinuous lenses that are less than a metre in thickness. These contain medium to coarse grained quartz, subangular to subrounded small pebble and large cobbles of pink, grey quartzite, pyrite slate, jasperoid breccia, quartz, biotite gneiss and sandstone (Talchir) in purplish white clay matrix. Slate and grey quartzite pebbles are rod shaped whereas others are spheroidal or discoidal. The sandstones are felspathic (sub-arkoses). There are shaly sandstones and shale intercalations in the sandstones 400m north-west of Jajawal which contain plant fossils. These are mainly leaf and stem impressions comprising Voltizia heterophyla or Buriadia Sewardi Sahni and equisetaceous stalks. The above said assemblage has been grouped under the Karharbaris. There is another fossiliferous horizon 200m west of Jajawal within carbonaceous shale above a coal seam consisting of glossopteris browniana and other species with vertibrania Indica. The basal beds that occur kilometre south-west of Namadhaki contain some plant fossils. These are not well preserved and preliminary identification reveals that these are related to Neo-calamytes species.

The rest of the formation with a maximum thickness 125m contain pebbly grits, felspathic sandstone (sub-arkose) shale and thin seams of coal. Pebbly grits contain sub-rounded quartz with spheroidal, ellipsoidal and discoidal pebbles of grey quartzite and slate in a clay matrix. Garnet is also present. The felspathic gritty

sandstones are pinkish white medium to coarse grained with sub-rounded quartz and decomposed felspars in a clay matrix. The above assemblage has been grouped under the Barakars.

A section recorded about one kilometre north of Pakni over dolerite consists of the following rocks.

Lithology	**Thickness (metres)**
Laterite and weathered hematite rich sandstone (1 cm to 5 cm)	0.3
Locality	
Sandstone, felspathic, gritty, with sub-angular to subrounded grains (1 mm to 3 mm) of quartz, altered felspar and detritals of garnet. Jasper and muscovite also present	10.00
Shale, ash grey with plant fossils (stalk impressions)	1.5
Sandstone, felspathic, gritty with sub-angular to sub-rounded quartz (1 to 5 mm) kaolinised felspar and minor amounts of jasper, slate and garnet. Thin lens of fire-clay present in the basal portion Dolerite, massive, medium grained	18.00

Sandstone is also exposed on Chirven Pahar Δ2546 and is about 60m thick. It is slightly ferruginous with red and yellow shades. Sub-rounded quartz with minor amount of kaolinised felspars occur in this in a ferruginous clay matrix. Thin pebble bed layers are present and these contain ellipsoidal and spheroidal quartz and jasper.

Dolerite:

Dolerite occurs as sills and dykes in the area. The capping over coal measures between Jajawal and Namadhaki has maximum thickness 130m as seen on Kathauta Pahar Δ2512 and a minimum thickness of 15m in Jajawal area. The fallowing section is exposed in a stream section north-east of Anjini (23°32': 83°04'; 64M/NW).

Lithology	**Thickness (Metres)**
Ferruginous sandstones on Chirven Pahar 2546	60
Dolerite, melanocratic, medium grained, dense and hard with visible brown glass	60
Felspathic gritty sandstone	10
Dolerite, melanocratic, medium grained, dense and hard with visible brown glass	90
Sandstone, felspathic, gritty, with muscovite	10
Dolerite, melanocratic, fine grained and hard	20
Talchir shale and sandstone, indurated and baked	15

The dolerite that occurs over Talchirs at Anjini is melanocratic, fine grained, dense and hard. It contains titan augite and andesine-labradorite in ophitic texture. Ilmenite, magnetite, palagonite, delessite and glass are the accessories. Ilmenite occurs as skeletal crystals slightly altered to leocoxene (Micro-Slide No. 993/MP-66).

Similar rocks occur at higher level at the base of Chirven Pahar but are medium grained with brown tinge. At Chikni (23°31':83°01'; 64 M/NW) a dyke is exposed. It is about 75m x 800m in extent. It is medium grained and contains titan augite, andesine and labradorite in anophitic texture. Ilmenite, magnetite and palagonite are the accessories. Some of the tabular prisms of plagioclases show micrographic intergrowth of labradorite and andesine (Micro-Slide No. 994/MP-66). Another intrusive (10m x 300m) occurs within Talchirs, a kilometre ESE of Semrakalan. It is also melanocratic, fine to medium grained, hard and dense. It contains augite, andesine, labradorite in glomeroporphyritic texture (Micro-Slide No. 995/MP-66). Ilmenite, palagonite and magnetite are the accessories. A few ilmenite crystals enclose plagioclase prisms.

III. STRUCTURE

Archaean:

In the older metamorphics such as quartzite, schists and calc-gneiss, original stratification is discernible. Quartzites are generally massive but some are flaggy that show alternate laminae of grey and light grey quartz. Bedding is not clear in the schists as they are impregnated with quart felspar aggregates. But these contain thin pebble beds which is primary sedimentary feature. The calc-gneiss contains alternate bands of arenaceous and calcareous composition with minor argillaceous ones. The banding is persistent along strike length; the arenaceous ones stand out as ribs and calcareous ones in furrows.

There is alignment of flaky minerals in the schist parallel to the axes of minor folds which are also parallel or sub-parallel to the general strike of foliation in the schist. A few are at NNE-SSW direction. Minor folds are clear in calc-gneiss relics with wave lengths 1 cm to 1m of which some are chevron type. There is also variation in lengths of the limbs of the minor folds. Drag folds are recognizable within a calc-gneiss relic. The axes in these are in ENE-WSW direction, the relic being in east-west direction. There are wrinkles along the foliation planes of the schists which are sub-parallel to the general trends. The pebbles in pebble beds are aligned with their lengths parallel to the axes of minor fold. Ono set of striations are recognizable in the schists at Rampur. These plunge 30° to the NNE. Major relics of metasedimentary rocks within gneisses have more or less the same trends as that of the gneisses (ENE-WSW). The above data indicate two generations of folds in the metasediments.

The trends of foliation in gneisses range from ENE-WSW to east-west with steep (60°-80°) or vertical dips. The foliation of biotite gneiss is EEN-WWS with very steep (80°-90°) or vertical dips. But in Gotgawan (23°27':83°12'; 64M/SW) areas the trends are N80°W-S80°E with steep (55 to 70) dips. Southerly dips (60° to 80°) are observed south of Jhor. The general foliation is wavy along the strike as seen in Pakni area. The streaks of biotite and stringers of felsic minerals are parallel or sub-parallel to the general trends. Ptygmatic veins of pegmatite are confined more to biotite gneiss and limbs are sub-parallel to the foliation planes. Minor folds are exposed in Jhor area, the axes of which are vertical but parallel to the general trends.

Albite-oligoclase gneiss and general trend of N70°E- S70°W with very steep (70° to 80°) or vertical dips of foliation. Two distinct porphyroblasts are recognizable; well drawn augens and complete or incomplete crystals with clear crystal faces. The former ones are aligned parallel to the general strike bat the latter are either parallel or sub-parallel.

Biotite-microcline porphyritic gneiss in Jhor area trends in N75°E-S75°W with mostly steep (50° to 70°) dips of foliation. The augens are also aligned along foliation planes which are sub-parallel to general trends.

Strike shear near Kharoli (23°28':83°01'; 64M/SW) is marked by breccia which occurs over a width of 200 and is eight kilometres in length. The breccia contains grey and pink quartzite in a brown siliceous matrix. These are silicified and contain secondary and platy quartz. Sporadic specks of pyrite (0.5 mm to 2 mm) occur

in the quartzites. Strike shear between Amadoen (23°29':83°01'; 64M/SW) is traceable for eight kilometres to the east. It is marked by detached mounds of breccia (Maximum width 20m) it contains altered fragments of amphibolite and biotite gneiss which are silicified. A few specks of pyrite (0.1 mm to 2 mm) occur in amphibolite fragments.

Another strike shear marked by discontinuous breccia is traceable for seven kilometres between Mamadhaki (23°34':83°09'; 64M/NW) and Jhor (23°36':83°08'; 64M/NW). It is about 10m thick and contains biotite gneiss, quartz and platy quartz which are silicified. Minor strike shears are traceable at Jajwal, Karanjwar (23°29': 83°11'; 64M/SW), Kakrikhar (23°31':83°14; 64M/NW) and Singara (23°27':83°10'; 64M/SW). A few minor faults are traceable around Jhor.

The following Joints are prominent in the gneisses

1. Vertical Joint N65°E-S65°W to east-west spaced 0.60m to 2m apart.

2. Vertical joints N10°W-S10°E to NNE-SSW spaced 0.5m to 3m apart.

3. Joints WNW-ESE with southerly dips (50° to 70°), spaced 0.6m to 1m apart.

The granite plutons occur as lens shaped bodies with irregular margins. The foliation of gneisses surrounds the pluton as seen in Chanrell area. The relics and calc-gneiss and amphibolite are in random directions, so also the pegmatites, aplites and quartz veins. The longer axes of the plutons are at slight angle to the trends of the gneisses. The pluton at Chanrell shows marginal foliation marked by alignment of biotite. In the central parts, no alignment of biotite or phenocrysts is observed. The cross faults at Karajwar area close to the granite contain quartz and pegmatite material. It is inferred that the granites are intrusive and emplacement has been along the crest of folds in metasediments.

Pegmatites in Rampur area are intrusive and their emplacement has been along crests and troughs of minor folds of two generations in the schist. Pegmatites in Kharoli area are also intrusive and emplacement has been along foliation planes of migmatite. Pegmatites in granite are predominantly filling in fractures and joints.

Lower Gondwanas:

The Archaean-Gondwana boundary along southern and western margins of Ramkola coalfield is unconformable bur is faulted in Jajawal and Kenapara areas. The faults are traceable for four and nine kilometres respectively with northerly down throw. The Archaean-Gondwana contact between Pakni and Dandkarwa is unconformable but the basal beds of the Damudas (Karharbaris ?) show westerly dips of 10° to 25° indicating strike faults which are concealed by the Barakars. Cross faults trending NNE to NW and east-west are also traceable along the boundary at a few places.

The Talchirs dip between 2° and 15° into the basin. The Damuda also dip into the basin, but the dips of basal beds (Karharbaris ?) are 10° to 25° where as the dips of the rest of the formation are 5° to 10°. Cross bedding is the main directional feature, observed at a few places it indication that the direction of palaeocurrent was from south-west.

Dolerite sills are conformable with the Barakars and the dykes have east-west trends.

IV. METAMORPHISM

The biotite gneiss is formed in part by consolidation of potash rich magma and by migmatisation of metasediments which were largely pelitic with minor arenaceous and calcareous ones. Albite-oligoclase-gneiss appears to have resulted of soda metasomatism and Microcline biotite gneiss by potash metasomatism.

The metasediments with assemblages of chlorite, muscovite and biotite are products of low grade metamorphism Occurrence of diopside at the contacts of gneisses and metasediments is a local feature. Mineral assemblages such as epidote and calcite at the contact of amphibolites and the en-closing biotite gneiss or the emplaced granite, suggests contacts metamorphism

V. GEOMORPHOLOGY

Major and minor hills are formed of hard resistant rocks like biotite gneiss, porphyritic gneiss, schistose quartzite, calc-gneiss, granite and fault breccias. Schists and zones of pegmatites in the gneisses form the valleys or the low undulating terrain. The hard basic rocks like amphibolites form low linear mounds. Kathauta Pahar Δ 2512 which is almost flat has a thick covers of dolerite over the lower Gondwanas, There are some isolated mounds of Gondwana formation on the dolerite.

The general course of the drainage is controlled by the trend of the formations. The course of Mahan River is to north-west across the strike of the gneisses, locally cutting across shear zones, Joints, major fractures and zone of pegmatites. It is also controlled by Archaean-Gondwana contact in Sattipara (23°27':83°04'; 64M/SW) area. Banki nadi and Patrenga nala to some extent follow biotite gneiss granite contact. Kolua nala flows to the web along Archaean-Gondwana contact which is in part faulted. The courses of feeders of Kolua nala at Jajawal are along cross faults in Damuda. Jhor nala has its course to NN along Archaean-Gondwana contact close to a few strike faults in the Damuda. In Jhor area the courses of some streams are along minor faults. The drainage developed in Gondwanas is mostly superimposed on those of Archaeans but for a few modifications.

VI. ECONOMIC GEOLOGY

Beryl, muscovite, garnet, potash felspars, abundant building material and road metal occur in the area. Coal a fire-clay are also recorded along the margins of Ramkola co-field in the area. Thin patches of ferruginous laterite occurs on dolerite and Damudas.

There are a few old workings in pegmatites within schists in Rampur, Bheria and Khunsi areas. According to local information these were put by M/s. Direndar Mehra and Kishan Singh for mica. The old workings are in the form of open pits ranging from 1.5 to 6m in depth. But one pit near Pahar karwa is about 10m deep.

Beryl:

Beryl occurs in a pegmatite, a kilometre south of Rampur (23°37':83°12'; 64 M/NW). The pegmatite (8 x 70m) is exposed to a depth of 10m in the old workings. The pegmatite contains essentially quartz and potash felspars with minor amounts of muscovite. Beryl, garnet and tourmaline are also present. The quartz segregations are sparsely buted and are relatively more in the central part of the pegmatites. These contain minor quantities of beryl as irregular segregations and hexagonal crystals. These are greenish yellow and opaque with inclusions of quartz and yellowish green muscovite. A broken crystal of 15 cm in diametre was recovered from the old dumps. There are a few black rectangular, opaque non-magnetic inclusions in beryl. These have yellowish brown coating and may possibly be radioactive. Beryl also occurs in a pegmatite at Bheria (23°35':83°00'; 64M/NW). The pegmatite is concealed by debris and it is reported that it was encountered at a depth of six metres. Old dumps contain essentially pegmatite with pods of amphibolite. The pegmatite contains comparatively more quartz than felspars. A few hexagonal crystals of beryl (Less that 2 cm x 8 cm) occur. These are pale green, sub-translucent to sub-transparent. Smaller crystals are sub-transparent but have inclusions. A tiny crystal was also recovered from the dump of an old working in Khunsi area. A beryl crystal (0.5 x 1.5 cm) was recovered from an old dump 600m west of Pahar Karwa. The pegmatite exposed in a pit adjoining the dump is a metre thick and contains little quartz segregations with no visible beryl.

Muscovite:

Muscovite occurs associated with beryl in pegmatites of Rampur area. The pegmatite (8m x 70m), a kilometre south of Rampur, contains books of muscovite that are (1m to 8 cm) in size. Another pegmatite near Bheria has been worked for muscovite. Muscovite books in the dumps are less than 5 cm^3 in size. The muscovite is yellowish green and generally cracked. There are small books (l cm^3 to 3 cm^3) of muscovite in pegmatite in Khunsi area. Pegmatites in Kharoli and Jhor areas also contain muscovite but the books are less than 3 cm^3 in size.

Garnet:

Garnets are sparsely associated with all pegmatites in Rampur, Bheria and Khunsi areas. Generally these are of sizes less than 2 cm in diametre, opaque and altered. Garnet in a pegmatite in Bheria is semi translucent. A similar occurrence is recorded in a pegmatite 200m WSW of Bheria. The garnets are red or brownish red and hard. These are suitable for abrasives.

Felspars:

Felspars that occur in the pegmatites in Rampur, Bheria, Jhor and Kharoli areas are pale pink to white and range in size from 1 cm to 15 cm. These form major part of the bulk of the pegmatites. These may be useful in ceramic and enamel industry.

Coal:

Damuda formation that occur 10 km north-west of Partabpur (23°29':83°13'; 64M/SW) form a part of Ramkola coalfield. Thin seams of coal occur in the following localities close to the Archaean-Gondwana boundary.

Sr. No.		Thickness (Metres)
1.	About a kilometre south-west of Namadhaki (23°34':83°13'; 64M/NW) in a stream section.	
	Sandstone, medium grained, gritty, felspathic with garnet, muscovite and biotite	3.0
	Carbonaceous shale, interlayered shaly sandstone	0.9
	Sandstone, coarse grained, gritty, felspathic essentially with sub-rounded quartz with minor amounts of garnet, muscovite and biotite.	0.3
	Coal, dull**,** duranous with occasional vitrain streaks (Sample)	0.3
	Carbonaceous shale	0.3
	Sandstone, coarse, gritty, felspathic, essentially sub-rounded quartz with garnet biotite and muscovite in clay matrix	1.0
The outcrop is traceable over a strike length of 30m. The beds dip 15° to the west.		
2.	About 200m west of the occurrence	
	Soil sandy	4.0
	Sandstone, medium grained with complete decomposed felspars and minor amounts of slate muscovite and biotite	1.0
	Coal dull, shaly	0.15
The above outcrop is traceable over 15m along strike		
3.	About 75m of the record occurrence	
	Sandstone, massive, coarse grained felspathic gritty	6.0
	Coal dull, duranous with streaks of vitrain (1 mm) sample	0.5
	Shale sandy with stem and leaf impressions related to Neo-calamytes species	0.3
	Sandstone, purple, coarse grained, felspathic with minor amounts of garnet and muscovite	stream
The above seam is traceable over a strike length of 10m		
4.	About 600m west of Jajawal (23°02':83°02'; 64M/NW).	
	Sandstone, coarse grained, gritty, felspathic	1.0
	Shale	0.6
	Sandstone, coarse grained, gritty, felspathic	1.0
	Shale intercalated with sandstone	0.6
	Carbonaceous shale with glossopteris species and vertibraria indica	0.3
	Coal, dull	0.3
	Carbonaceous shale	Stream bed
The seam is traceable over an area of 100 x 30m		
5.	About two kilometres NNW of Jajawal	
	Shale with intercalations of sandstone	3.0

Sr. No.		Thickness (Metres)
	Sandstone, felspathic, gritty	2.0
	Shale, grey and sandy	2.0
	Coal, dull digamous (Sample)	0.4
	Shale carbonaceous	2.0
	Sandstone, massive, felspathic, gritty	5.0
The seam is traceable over an area of 100 sq m		

Fire-clay:

Fire-clay beds occur in the following localities:

Sr. No.		Thickness (Metres)
1.	North western end of Anjini (23°32’:83°04’; 64M/NW).	
	Dolerite	---
	Hematitic shale with gravelly laterite	1.0
	Fire-clay (Sample)	0.6
It is traceable over an area of 25 sq m		
2.	About one kilometre north-west of Pakni	
	Hematitic shale with gravelly laterite	0.6
	Fire-clay grey and non-gritty (Sample)	0.6
	Sandstone, ferruginous and lateritised	---
It is traceable over an area of 50 sq m		
3.	About 400m WNW of Pakni	
	Dolerite, coarse grained massive sandstone, felspathic, gritty	2.0
	Hematitic shale, gravelly laterite	0.3
	Fire-clay, grey, non-gritty (Sample)	0.6
It is traceable over an area of 50 sq m		
4.	About 200m NNE western end of Pakni.	
	Sandstone, gritty, felspathic with a little garnet, muscovite and biotite	1.5
	Sandstone, lateritised	1.0
	Fire-clay, grey and non-gritty (Sample)	0.6
It is traceable over a length of 10m		

Iron ore:

Thin patches of ferruginous laterite and gravel occur on the dolerite and Damudas. These occur in the vicinity of Pakni, Giria and Jajawal. These are generally less than a fraction of a metre in thickness and 50 m^2 in area. Some portions in these patches are sufficiently rich in iron to be used as ore of iron by Agarias.

Building material and road metal:

The biotite gneiss in Pahar Karwa, Jhor, the granite at Charnell and dolerite near Pakni are good source of building material and road metal.

Water Supply:

The area is within the Rihand basin drained by Mahan River and its tributaries; Banki Nadi, Jhoj Nala, and Kolua Nala which are all perennial and drain away without utilisation.

Dug wells in the gneissic terrain yield water at depths less than seven metres and bear a little water in summer. Dug-wells in the Talchirs yield water at depths less than 10m and there is scarcity of water in summer**.** Potable water is available in the Barakars at depth less to nine metres and the wells seldom dry up in summer. Ground-water is utilised only for small scale gardening and domestic use by the villagers.

Two hot springs near Jhor (23°36':83°14'; 64M/NW) have been recorded. These are 300m apart and are aligned N60°E-S60°W direction. The one in the west yields about 10 imp gallons of water per minute. The temperature recorded on 2 March 1966 was 104°F. The spring to the east yields about 20 imp gallons per minute. The temperature of the water on the same day was 108°F. The water of both the springs is clear with the odour of sulphur and hydrogen sulphide. Thin efflorescent white encrustations are left on the evaporated surfaces closeby. The encrustations are saline and bitter in taste. The water is reported to have medicinal value.

II. Preliminary reconnaissance of certain reported occurrences of minerals, Surajpur and Ambikapur tehsils, Surguja District, Madhya Pradesh

Occurrences of iron-ore, ochre, coal, bauxite and beryl in a few localities in Surajpur and Ambikapur tahsils were suggested by Government of Madhya Pradesh for investigation. Preliminary reconnaissance of the above said minerals occurrences were carried by me. The areas are included in sheets 64J, 64I and 64**N.** The mineral occurrences are described in the following paragraphs.

Iron-ore:

At Lachmangarh (22°51':82°59'; 64J/13)**,** Basan (22°50':82°52'; 64J/13), Saido (22°46':82°47'; 64J/13) and Pindraki (22°46':82°55'; 64J/13), thin patches of ferruginous sandstone occur on the Barakar sandstones. These are lateritised and are less than 50 cm in thickness. These are lateritised and are less than 50 cm in thickness. One metre section occurs on hill 800m south of Tendudih (22°51':82°58'; 64J/13). Thin patches of ferruginous laterite (less than 20 cm in thickness) occur on Gondwana sandstones and basalt around Kharra (23°30':82°50'; 64I/15). Around Gersa (22° 47':83°38'; 64N/09), porphyritic biotite gneiss and biotite gneiss occur. There are no indications of iron-ore in the area. In the vicinity of Giraldih (22°48':83°37'; 64N/09), minor concentrations of magnetite occur in the sand of a stream bed. The ferruginous portions from the above occurrences are used as an ore of iron by the Agarias in the area.

In the vicinity of Batauli (22°59':83°25'; 64N/05), there are a few patches of quartz-magnetite-rock in the biotite gneiss terrain. These range from 1.5 to 9m to 10 x 100m in size within an area of one sq km and contain magnetite, quartz and manganese minerals. These are also used as an ore of iron by the Agarias. Agarias report smelting of this ore to be extremely difficult.

Coal:

The terrain around Argoti (22°47':83°02'; 64N/01) consists of Barakar sandstones interbedded with a few thin seams of coal. Coal seams (8 Nos.) occur in the area ranging in thickness from 0.61 to 1.85m. According to S/Shri H. Nagaraja and A. Choudhury the coals are of inferior grade (Progress Report for Field Season 1962-63 by H. Nagaraja and A. Choudhury, Geologists, Geological Survey of India).

Ochres:

The terrain around Serbhanja (22°48':83°13'; 64N/01) Lalea (22°47':83°11'; 64N/01), Kamaleswarpur (22°49':83°16'; 64N/05) and Narbadapur or Daid (22° 46':83°20'; 64N/05) is covered mostly be ferruginous laterite which is aluminous at a few places. The laterite is on basalt. A band of yellow ochre is exposed 2.4 km N10 W of Lalea. Thin lenses of yellow ochre and ochreous red earth occur in the vicinity of Lalea, Serbhanja, Kasira (22°46':83°16'; 64N/05), Barma (22°47':83°17'; 64N/05), Sapnadand (22°52':83°19'; 64N/05) and Kamaleswarpur. These are less than a metre in thickness under a cover of ferruginous laterite about 1 to 5m. Results of chemical analysis of the samples are given in Appendix-III.

As per Chemical analysis, yellow ochre that occurs near Lalea (Sample No. 2) is of good quality, fully conforming to the requirements of I.S. specifications for ochre for paints. Red ochreous earth from Lalea, Kasira, Barma Sapnadand and Kamaleswarpur, in original state are not up to the requirements, as an ochre, however fair content of Fe_2O_3, indicates that these can be suitably blended with those rich in iron to meet the requirements stipulated in I.S. specifications.

Bauxite:

The terrain around Ambgaon (22°56':83°19'; 64N/05) is covered by basalt, Ambhajheria Hill Δ3698, a kilometre south-west of Ambgaon consists of ferruginous laterite with tiny pockets of aluminous laterite. The plateau south of Ambajheria hill adjoining Shikariadand (22°54':83°19'; 64N/05) is also covered by ferruginous laterite with patches of pisolitic ferruginous laterite which might suggest occurrence of bauxite.

Beryl:

The terrain adjoining Mahan River and Rehr Rivers near Kupa (23°30':82° 52'; 64I/15) consists of garnetiferous mica-schist, calc-gneiss, quartzite, porphyritic biotite gneiss pegmatite and quartz veins. The metasediments are tightly folded over WNW-ESE axes with plunges less than 5 degrees. The pegmatite veins are generally less than a metre in thickness and a four metre thick vein has also been recorded. These contain almost equal proportions of quartz and felspar with minor amounts of muscovite. A few of them contain higher proportions of quartz with minor amounts of tourmaline. Though there are no surface indications for the occurrence of beryl, there is a possibility in view of the occurrence of tourmaline as seen in adjoining area within the District.

Iron ore occurrences at Lachmangarh, Basan, Pindraki. Tendudih, Giraldi and Kharra are extremely small in their extent and no large scale exploitable ore is available. It may meet the demands of only limited number of Agarias for manufacture of local implements in the area.

The occurrences of quartz-magnetite rock near Batauli are small in their extent but are significant in that they contain manganese as indicated by preliminary chemical analysis. There are indications of occurrence of ochres near kamaleshwarpur, Lalea, Kasira, Barma and Serbhanja. There are also indications of occurrence of bauxite in plateau adjoining Shikariadand and Sapnadand. Mapping of the above said areas is recommended to locate more ochres and bauxite and to assess the known occurrences.

Though there are no surface indications for the occurrence of beryl in Kupa area, beryl mineralisation may be kept in view, as there are pegmatites rich in quartz and tourmaline, when systematic mapping is taken up in future.

VII. SUMMARY AND CONCLUSION

The area mapped consists of the Archaean and Lower Gondwana rocks. Biotite gneiss, albite-oligoclase gneiss and biotite microcline gneiss comprise the metamorphics which contain relics of Sausar metasediments (Schistose quartzites, muscovite-biotite-schist, muscovite-biotite-chlorite schist, calc-gneiss with intrusives of amphibolite) Granite, pegmatites, aplites and quartz veins also occur in the area.

The trends of foliation in gneisses range from ENE-WSW to east-west with steep (60° to 80°) or vertical dips. The trends of the relics of metasediments are sub-parallel to those of gneisses. The metasediments afford evidences that they were intensely folded and metamorphosed before migmatisation. There are a few conspicuous strike shears and minor faults in the Archaeans.

Biotite gneiss is formed in part by migmatisation of metasediments which were largely pelitic with minor arenaceous and calcareous ones and in part by consolidation of potash rich magma. Albite-oligoclase gneiss and biotite-microcline gneiss appear to have resulted from soda and potash metasomatism. The granites are intrusive and their emplacement has been along the crest of folds in metasediments. Some of the pegmatites ere intrusive and their emplacement is also along crests of minor folds in the schists.

The general trend of the Archaean is in accordance with Satpura strike along which there has been migmatisation of Sausars and emplacement of granite. The Lower Gondwanas along the boundaries of Ramkola and Bisrampur Coalfields comprise the Talchirs, Karharbaris (?) and Barakars. The Archaean-Gondwana contact is at places faulted. The sediments dip into the basins. The basal beds (Karharbaris ?) dip 10° to 25° in Ramkola coalfield whereas the Barakars dip less than 10 degrees. A few faults are recorded in the Lower Gondwanas.

There are indications of occurrence of beryl, muscovite and garnet in the pegmatites localised in the schists in Rampur, Bheria, Paharkarwa and Khunsi areas. There are also indications of occurrence of coal and fire-clay in Ramkola coalfield. Biotite gneiss in Paharkarwa area and Jhor, the granite at Chanrell and dolerite near Pakni are good source of building material and road metal.

Preliminary reconnaissance of certain reported occurrences of minerals in Surajpur and Ambikapur Tahsils indicates the presence of Ochres near Lalea, Kamaleshwarpur, Kasira, Barma and Serbhanja. There are also indications of occurrence of bauxite on plateau adjoining Shikariadand and Sapnadand. The quartz-magnetite rock occurrences near Batauli are small in their extent but are significant in that they contain manganese as indicated by preliminary chemical analysis. Mapping of the above said areas is recommended to locate more occurrences and to assess the known ones.

INDEX TO LOCALITIES								
Sr. No.	Villages	Latitude			Longitude			Toposheet No.
		Deg	Min	Sec	Deg	Min	Sec	
1	Amadoen	23	29	00	83	01	00	64M/SW
2	Anjini	23	32	00	83	04	00	64M/NW
3	Bagmajharia	23	29	00	83	08	00	64M/SW
4	Bheria	23	35	00	83	10	00	64M/NW
5	Bhurpani	23	34	00	83	06	00	64M/NW
6	Birnidand	23	26	00	83	02	00	64M/SW
7	Chainpur	23	29	00	83	05	00	64M/SW
8	Chanrell	23	27	00	83	08	00	64M/SW
9	Chirmahua	23	37	00	83	12	00	64M/NW
10	Chikni	23	31	00	83	01	00	64M/NW
11	Dandkharwa	23	37	00	83	07	00	64M/NW
12	Dankara	23	28	00	83	06	00	64M/SW
13	Deuri	23	32	00	83	07	00	64M/NW
14	Dharora	23	30	00	83	09	00	64M/NW
15	Dumarkholi	23	31	00	83	12	00	64M/NW
16	Dumath	23	31	00	83	10	00	64M/NW
17	Gotgawan	23	27	00	83	12	00	64M/SW
18	Jajawal	23	31	00	83	02	00	64M/NW
19	Jhor	23	36	00	83	13	00	64M/NW
20	Kachharpara	23	29	00	83	06	00	64M/SW
21	Khakrikar	23	31	00	83	14	00	64M/NW
22	Karanjwar	23	29	00	83	11	00	64M/SW
23	Keora	23	26	00	83	07	00	64M/SW
24	Kenapara	23	37	00	83	15	00	64M/NW
25	Karsota	23	29	00	83	04	00	64M/SW
26	Khajuri	23	30	00	83	14	00	64M/SW
27	Kharoli	23	28	00	83	02	00	64M/SW
28	Khorma	23	28	00	83	12	00	64M/SW
29	Khunsi	23	33	00	83	13	00	64M/NW
30	Mani	23	32	00	83	13	00	64M/NW
31	Matigada	23	27	00	83	03	00	64M/SW
32	Namadhaki	23	34	00	83	09	00	64M/NW
33	Palma	23	26	00	83	00	00	64M/SW
34	Paharmorni	23	27	00	83	02	00	64M/SW

INDEX TO LOCALITIES								
Sr. No.	Villages	Latitude			Longitude			Toposheet No.
		Deg	Min	Sec	Deg	Min	Sec	
35	Pakni	23	32	00	83	07	00	64M/NW
36	Partabpur	23	29	00	83	13	00	64M/SW
37	Parwatipur	23	27	00	83	08	00	64M/SW
38	Pendari	23	33	00	83	10	00	64M/NW
39	Raisara	23	27	00	83	00	00	64M/SW
40	Rampur	23	36	00	83	12	00	64M/NW
41	Sarhari	23	28	00	83	08	00	64M/SW
42	Sattipara	23	26	00	83	04	00	64M/SW
43	Sautar	23	28	00	83	16	00	64M/SW
44	Samai	23	31	00	83	11	00	64M/NW
45	Semra	23	30	00	83	17	00	64M/SW
46	Semrakalan	23	27	00	83	06	00	64M/SW
47	Singara	23	27	00	83	10	00	64M/SW
48	Singari	23	28	00	83	04	00	64M/SW
49	Tukudand	23	28	00	83	16	00	64M/SW

Appendix-I

RESULTS OF CHEMICAL ANALYSIS OF OCHRES IN AMBIKAPUR TAHSIL, SURGUJA DISTRICT, MP.

Sample Number	Locality	Thickness	Description	Determinations		
				Fe_2O_3	Cao%	Mgo%
1	Stream section 800m north-west of Lalea (22°47':83°11'; 64N/01)		Ochre (red)	18.4	0.55	0.39
2	About 2.4 km N10W of Lalea		Ochre (Yellow)	49.6	1.65	1.57
3	About one kilometre S80°W of Serbhanjia (22°48':83°13'; 64N/01)		Ochre (Gritty)	13.2	1.10	0.39
4	About 1.6 km east of Kasira (22°46':83°16'; 64N/05)		Red ochrous earth	15.6	1.10	0.79
5	A kilometre S80W of Barma (22°47':83°17'; 64N/05)		Red ochrous earth	23.6	1.66	0.39
6	From a dug well at Sapnadand (22°52':83°19'; 64N/05)		Red ochrous earth	20	1.10	0.39
7	About 400m south of Kamaleshwarpur (22°49':83°16'; 64N/05)		Red ochrous earth	16.8	1.10	0.39

Analyst: Shri K.P. Modi, Asst. Chemist, GSI, MP. Circle, Bhopal.

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Appendix-II

Hydrologic data from wells in Surajpur Tahsil, Surguja District, MP.
(Sheets 64M/SW) and 64M/NW)

Date	Locality	Latitude		Longitude		Diametre (Metres)	Depth (Metres)	Depth of water (metres) below ground level	Reported water level in summer	Taste	Geological Horizon	Remarks
		Deg	Min	Deg	Min							
21st Nov 65	Birnidand	23	26	83	02	2.5	4.5	2.4	4.3	Good	Biotite gneiss	
27th Nov 65	Raisara	23	25	83	01	1.6	6.0	4.0	6.0	Good	Biotite gneiss	
29th Nov 65	Matigada	23	27	83	03	2.75	6.4	5.0	Dries	Good	Biotite gneiss	
1st Dec 65	Singhai	23	28	83	04	1.83	7.6	5.3	7.0	Good	Debris; Calc-gneiss	
3rd Dec 65	Semra Kalan	23	27	83	06	1.60	5.0	3.0	Dries	Good	Biotite gneiss	
6th Dec 65	Beghma Jharia	23	29	83	08	1.2	7.9	5.3	Dries	Good	Biotite gneiss	
7th Dec 65	Dankara	23	28	83	06	2.1	7.2	4.0	6.2	Good	Biotite gneiss	
7th Dec 65	Chainpur	23	29	83	05	1.6	9.2	6.0	8.6	Good	Biotite gneiss	
8th Dec 65	Saihari	23	28	83	08	2.5	6.6	5.0	6.3	Good	Biotite gneiss	
13th Dec 65	Parwatipur	23	27	83	07	2.13	5.9	3.6	-	Good	Biotite gneiss	
20th Dec 65	Dharora	23	30	83	09	1.7	7.4	4.8	7.2	Good	Biotite gneiss	
22nd Dec 65	Deuri	23	32	83	07	1.6	8.8	7.0	Dries	Good	Biotite gneiss	
31st Jan 66	Khunsi	23	32	83	13	2.6	7.9	5.5	7.3	Good	Biotite gneiss	
1st Feb 66	Pendari	23	33	83	10	1.3	8.4	7.0	8.0	Good	Biotite gneiss	
5th Feb 66	Kakrikharur	23	31	83	14	1.82	11.0	10.0	10.60	Good	Biotite gneiss	
8th Feb 66	Semai	23	31	83	11	1.4	7.2	5.7	7.0	Good	Biotite gneiss	
10th Feb 66	Dumarkheli	23	31	83	12	2.2	8.9	7.0	8.0	Good	Biotite gneiss	
16th Feb 66	Namadhaki	23	34	83	09	3.0	4.0	3.0	-	Good	Quartz Mica schist	
18th Mar 66	Karandhaki	23	29	83	10	2.0	11.3	9.4	11.0	Good	Biotite gneiss	
19th Mar 66	Amadeen	23	29	83	12	2.4	7.50	6.5	7.2	Good	Quartz Mica schist	
25th Mar 66	Khorma	23	28	83	12	1.7	7.8	7.0	7.3	Good	Biotite gneiss	
8th Apr 66	Sautar	23	28	83	16	1.4	7.4	6.8	7.1	Good	Biotite gneiss	
19th Apr 66	Chanrell	23	28	83	13	1.3	6.5	5.0	6.0	Good	Porphyritic granite	
25th Apr 66	Khajuri	23	29	83	14	1.8	1.5	11.1	Dries	Good	Biotite gneiss	
21st Nov 65	Sattipara	23	26	83	04	2.5	7.0	4.0	6.7	Good	Talchirs	
14th Dec 65	Singara	23	26	83	10	2.0	9.9	6.6	Dries	Good	Talchirs	
10th Jan 66	Chikni	23	31	83	00	2.5	8.7	7.7	-	Good	Talchirs	
7th Mar 66	Chhirmahua	23	37	83	12	1.6	8.8	7.3	8	Good	Barakar	

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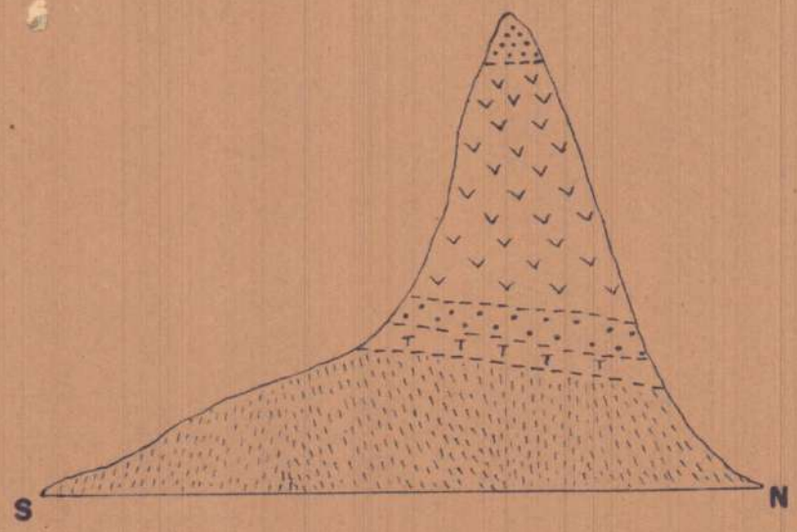
Appendix-III

RESULTS OF CHEMICAL ANALYSIS OF WATER AND SOIL SAMPLES, HOT SPRING, JHOR, SURAJPUR TAHSIL, SURGUJA DISTRICT, MP.

P.R. No.	Sample	CO_3	HCO_3	Cl	SO_4	Total hardness $CaCO_3$	Ca	Mg	Na	K	Specific Conductance m/mhos at 25°C	Ph	B	F	Cu	Pb	Zn
		(PPM)									(PPM)						
449-1	Water	Nil	192	53	63	24	6	2	101	7	594	7.8	1	19	-	-	-
449.2	Soil near Spring	-	-	-	-	-	-	-	-	-	-	-	-	-	50	50	75

Analysts: M/s K.M.S. Bhattathiripad, Mohammed Zafar and S.B. Akolkar, Geological Survey of India, Hyderabad

CHIRVEN PAHAR & ADJOINING TRACT (23°31' & 23°33')



Scale:- Vertical 1cm = 30m
Horizontal 1:63,360

INDEX

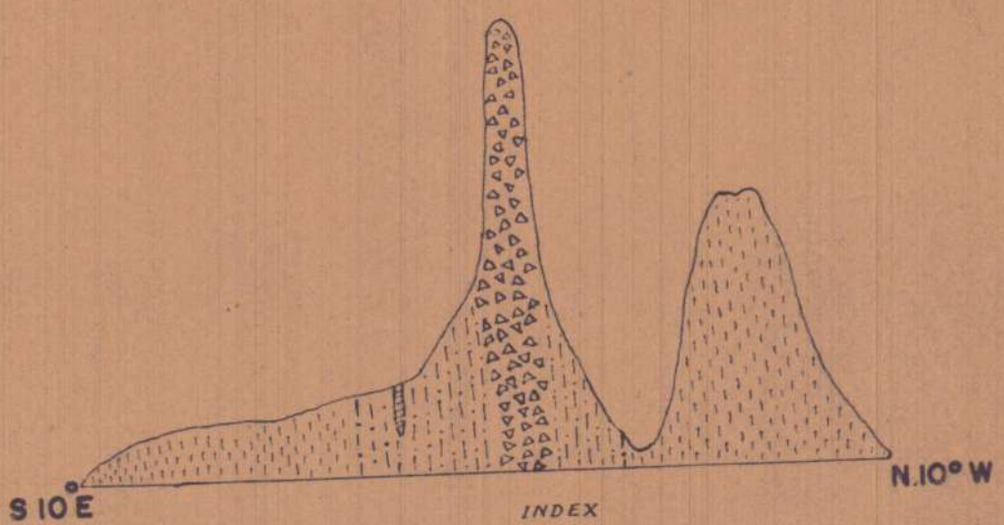
Gondwana Sandstone & Shale

T — Barakar, Talchir boulder bed Sandstone and shale

Dolerite (basaltic)

Biotite gneiss

HARI PAHAR & MAHAN RIVER SECTION NORTH OF PAHARMORNI (23°27; 83°02; 64 M/S.W.)



INDEX

Scale:- Vertical 1cm=30m
Horizontal 1:63,360

Shear brecia

Albite - Oligoclase gneiss

Baitite gneiss

Calc gneiss

T.S. Radhakrishna

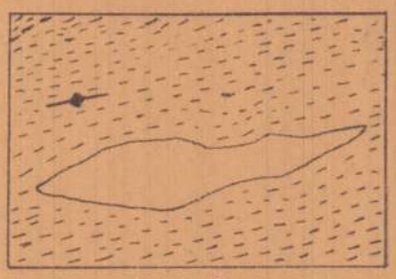
Geological Survey of India

G.S.I. M.P.D.O. No 150/66

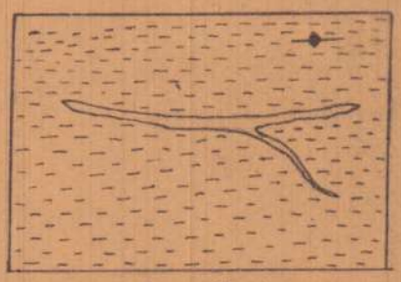
SKETCHES : PEGMATITES IN PARTS OF SURAJPUR TAHSIL

(Sheet No 64M/S.W. & N.W.)

N

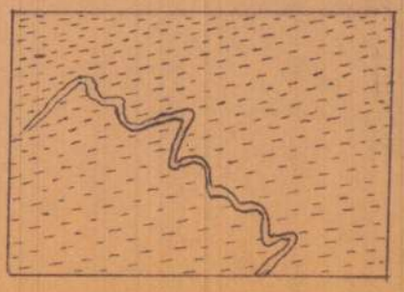


Pinch & swell vein
100 M North of Karoli

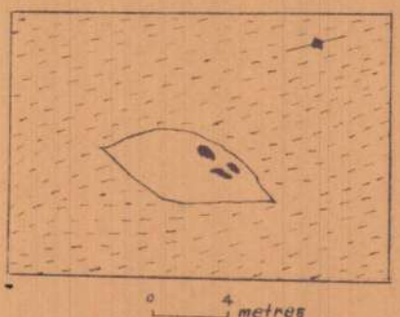


Branching vein in augein gneiss a Kilometre north of Jhor

Maze type of veins
in Biotite gneiss a Km South of Jajawal



Ptygmatic vein across
The foliation strike a Km. north of Semra Kalan



Lens 200m east of Bheria

— amphibolite

Lens in biotite-muscovoite - chlorite Schist
along axes of folds a Km South of Rampur

— quarts segregation

T.S. Radhakrishna

G.S.I.M.P.D.O.No 149/66

Geological Survey of India

जिला संसाधन मानचित्र जिला सरगुजा, छत्तीसगढ़

DISTRICT RESOURCE MAP - SARGUJA DISTRICT, CHHATTISGARH

I. GEOLOGY & MINERALS

SCALE

Km. 6 3 0 6 12 18 Km.

Surguja District is situated in the northern part of Chhattisgarh State. It falls in Survey of India degree sheet Nos. 64M, I, N, J, 73A and 63P between latitudes 22°38'30" : 24°06'30"N Longitudes 82°30': 84°04'30E. It is bordered by Mirzapur District of Uttar Pradesh, Palamau District of Bihar and Sidhi District of Madhya Pradesh in northern parts, Koriya District in west, Raigarh District in south and Jaspur District in southeast. Ambikapur town the district headquarter is situated in the south-central part of the district. Pratapur, Pal, Sitapur, Surajpur, Samri, Lundra and Wadrafnagar are some of the other major towns. All important places within the district and adjacent districts are well connected by a network of state highways and all weather roads.

Physiographically, the area occupied by crystalline rocks is marked by rugged and undulating topography with linear low ridges. The Gondwana and Deccan trap areas are manifested by highly rugged topography with hills and plateaux with steep slopes and scarps.

The river Kanhar forms the main drainage in the northern part of the area. The western part is drained by Gopad River and Rehar River. Regionally the drainage in this part forms a part of the Son River basin. The southern part of the district forms a part of Hadso basin drainage system. The drainage pattern in general is controlled by lithology. The crystalline rocks show dendritic to sub-dendritic drainage, while the drainage pattern over the Gondwana rocks is mostly of rectangular and trellis pattern. The Deccan trap areas show subdendritic and trellis type of drainage.

The district comprises rock formations of Archaean to Eocene age. Granitoids and the metasediments belonging to Chhotanagpur gneissic complex, form the basement to the overlying Gondwana sediments, Lameta beds and Deccan Traps. The Precambrian metamorphics of Archaean to Proterozoic (undifferentiated) age comprise granite gneiss, migmatite and granites with enclaves of calc-silicate rocks, marble, quartzite, amphibolites, mica schist, quartz-garnet-staurolite-kyanite-fibrolite-corrdierite schist and graphite schist. Pegmatite and quartz veins form minor intrusives.

The Gondwana sequence forms a part of south Rewa Gondwana basin. The glacio-fluvial Talchir sediments belonging to the lower Gondwana sequence consist of tillite, khaki green sandstone and shale. The coal bearing Barakar Formation comprises sandstone and shale. Raniganj Formation forms the Upper coal measures in the area. It consists of sandstone, shale and carbonaceous shale with coal seams. The formation is fossiliferous. Glossopteris, Vertebraria and Schizoneura are the important plant fossils, which have been recorded from Raniganj Formation. The Kamthi Formation comprises sandstone, red siltstones and ferruginous pebbles. The Panchet Formation comprises green to whitish feldspathic sandstone and Supra Panchet formation is predominantly made up of quartz arenite with minor shale intercalations and fossil remains of Cladophebis equisetaceous stems. The Lameta beds unconformably overlie the crystalline rocks and comprise cherty limestone and gritty sandstone. They are in turn overlain by Deccan basalts. Laterite forms extensive capping over the basaltic flows. Laterite is aluminous at places and contains pockets of pisolitic and massive bauxite.

Polymetallic mineralisation has been reported in Oranga-Dhulangi mineralized zone. Calc silicate rocks with galena-chalcopyrite-sphalerite-Scheelite association and pyrite-arsenopyrite-chalcopyrite association have been observed on peak Δ398 (24°00'15" : 83°26'15"). Association of silver and gold has been reported in the calc-silicate rocks. Graphite bearing schists have also been recorded in the village Oranga. Occurrence of sillimanite, rock crystals, mica, clay, feldspar, garnet, pyrite, ochre and beryl have also been recorded in different parts of the district. Tatapani - Ramkola coalfield (23°30' : 23°55'::83°00' : 83°40') and mine in the area. Occurrence of aluminous laterite and pockets of pisolitic and massive bauxite have been reported in Jawahargar-Kusmi area.

Tattapani Geothermal field is a hot water reservoir. The hot spring here discharges water of 52° to 97°C at surface. Five borewells drilled by GSI, produced 1800 lpm hot water to 100° on surface. The thermal water from these bore well is alkaline (pH 7.9 to 8.9) indicating bicarbonate-sodium type. Gas analysis has revealed Helium content besides Co_2, O_2 and N_2. The hot water at Tattapani can be used for power generation, greenhouse, sericulture, aquaculture and cold storage.

EXPLANATION

	Lithology	Stratigraphic Status		Age	Nature and Characteristics
11	Laterite with bauxite	Deccan Trap		Cainozoic	Laterite cover with patches of bauxite and lateritic bauxite
10a 10b	Basalt capped by laterite; Trap basalt/dykes			Upper Cretaceous to Eocene	Dark green, dark grey,fine to medium grained, hard and compact, basic rocks of gabbroic And dolomitic composition
9	Cherty limestone, gritty sandstone, clay	Lameta Formation	Lameta beds	Cretaceous	Brownish, whitish grey, hard, cherty limestone and gritty sandstone
8	Sandstone, shale and siltstone	Mahadeva Formation/ Supra Panchet Formation/ Parsora Formation		Lower middle Jurassic to Upper Triassic	Pinkish to red, fine to coarse grained sandstone. Red siltstone and clay, red fossiliferous shale
7	Sandstone, shale	Panchet Formation		Triassic	Greenish to whitish, medium to coarse grained feldspathic sandstone, green buff coloured shale
6	Sandstone, siltstone	Kamthi Formation		Lower Triassic	Dark brown to white, medium to coarse grained, hard, pebbly, ferruginous sandstone; red siltstone
5	Sandstone, shale, carbonaceous shale with coal bands	Raniganj Formation		Upper Permian	Green to greenish grey, felspathic and micaceous sandstone. Buff to yellow shale, carbonaceous shale with coal seams
4	Sandstone, shale with coal seams	Barakar Formation		Lower Permian	Greyish white, fine to coarse grained sandstone and carbonaceous shale with coal seams
3	Sandstone, shale, tillite	Talchir Formation		Lower Permian	**Sandstone:**-Khaki green, fine to medium grained; **Tillite:**- Comprises subangular clasts of quartzite in grey muddy matrix
2a 2b	Granite gneiss, biotite gneiss; granite, biotite granite		Chhota Nagpur Gneissic Complex	Archaean-Proterozoic	Grey to pink, fine to medium grained, with enclaves of meta-sedimantaries
1	Quartzite,mica schist calc silicate rock, Marble, amphibolite, quartz-staurolite-kaynite schist and graphite schist			Archaean	**Quartzite** pink to grey in colour, fine grained. **Schist** are fine grained with well developed schistosity

GENERAL INDEX
- District boundary
- State boundary
- Railway line
- Road
- Settlement
- Reservoir
- Drainage/river, stream
- Height of triangulated station
- Thermal spring

STRUCTURAL INDEX
- Litho-contact
- Litho contact (inferred)
- Attitude of bedding
- Attitude of vertical joints
- Horizontal bedding
- Attitude of foliation
- Fault
- Shear zone
- Probable fault

MINERAL INDEX
- Bauxite
- Beryl
- Coal seam
- Clay
- Copper,lead, zinc ore
- Felspar
- Iron ore
- Lead ore
- Mica
- Ochre

Based upon Survey of India map with the permission of the Surveyor General of India.
The responsibility for the correctness of internal details rests with the publisher.
The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate base line.
The external boundaries and coastlines of India agree with the Record/master Copy certified by Survey of India.

KEY MAP OF CHHATTISGARH

GEOMORPHOLOGY

Geomorphological Units
- EA1 Region of high level plateau (over 900m elevation)
- EA2 Region of middle level plateau (750- 900m elevation)
- SAa2 Lower level structural plateau
- SCa Structural plain on Gondwana rocks
- SD Structural hills and Valleys
- DA Denudational plateau on metamorphic rocks
- DB1a Denudational plateau on Gondwanas rocks
- DC Pediment/pedi plain
- DD2 Denudational hills and valleys

Structural: Meso; Hogback; Fault plane
Denudational: Laterite cover; Dissection
General: Basin divide (main/sub basin); Perennial/ Ephimeral rivers; Geomorphic boundary; State boundary; District boundary; Hot spring

GEOHYDROLOGY

Geology / Yield Range Litres
- 6 Laterite 1-3
- 5 Basic intrusives 1-3
- 4 Supra Barakar 5-15
- 3 Barakar 5-10
- 2 Talchir 1-3
- 1 Granite gneisses 1-3

Observation tubewell; Watertable contour; Ground water flow direction; Surface water divide line; River basin boundary

LAND USE

1 Agricultural Land; 2 Forest Land; 3 Waste Land

District boundary; Road; Railway line; River/stream; Built-up Land; Height of triangulated station

GEOTECHNICAL & NATURAL HAZARDS

Structural symbols
- a. Neotectonic Fault
- b. Fault involving cover
- c. Fault involving basement & cover
- d. Fault involving basement
- Gravity Fault
- Minor Lineament

Other features
- Bouger gravity anomaly contour in m Gal
- Hot spring

Rock type	Permeability	Bearing Capacity	Compressive Strength	Foundation Characteristic
5 Laterite and lateritic soil	Variable	Low to medium	Low to medium	Fair
4 Soft to moderately hard sandstone, shale	Low to moderately high	Soft to moderately high	Low to medium. (150-500 kg/cm²)	Medium to fair
3 Coal measures	Low	Low	Medium to high (500-800kg/cm²)	Fair
2 Basic volcanic flow/ intrusives	Low	Low	Medium to high (500-800kg/cm²)	Very fair
1 Gneiss, khondalite intrusives	Moderately high	Low	Medium (within 500kg/cm²)	Good

SEISMICITY
Data period 1964-1995
Magnitude (Mb) Not Determined
Depth (Km) 0-40

Compiled by : B.K.Mishra, Geologist (Jr.) under the supervision of S.K.Sarkar, Director C(T), N.G.B.Tilak, Dy. Director General, Op. M.P. & C.G., Bhopal
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Scrutinised & Processed by : T.K. Gandhi Prasad, Director, Map compilation and K.G. Bhoskar, Director, Eco. Geology, under the overall supervision of Seva Dass, Dy. Director General, G.S.I., C.R., Nagpur
Hindi Translation by : S.K. Sharma, Geologist (Sr.)
FDO by : Pawan Kumar and P.S. Onkar, Draftsmen

Digitally Processed & Printed by : Print Paper, Nagpur, Ph.3109414

First Edition, 2003

Annexure-2

Gazette Notification of Accreditation

रजिस्ट्री सं. डी.एल.- 33004/99 REGD. No. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

सी.जी.-डी.एल.-अ.-07042022-234959
CG-DL-E-07042022-234959

असाधारण
EXTRAORDINARY

भाग II—खण्ड 3—उप-खण्ड (i)
PART II—Section 3—Sub-section (i)

प्राधिकार से प्रकाशित
PUBLISHED BY AUTHORITY

सं. 270] नई दिल्ली, बृहस्पतिवार, अप्रैल 7, 2022/चैत्र 17, 1944
No. 270] NEW DELHI, THURSDAY, APRIL 7, 2022/CHAITRA 17, 1944

खान मंत्रालय

अधिसूचना

नई दिल्ली, 7 अप्रैल, 2022

सा.का.नि. 284(अ).—केंद्रीय सरकार, खान और खनिज (विकास और विनियमन) अधिनियम, 1957 (1957 का 67) की धारा 4 की उपधारा (1) के दूसरे परंतुक द्वारा प्रदत्त शक्तियों का प्रयोग करते हुए और भारतीय गुणवत्ता परिषद् के राष्ट्रीय शिक्षा और प्रशिक्षण प्रत्यायन बोर्ड (क्यूसीआई-एनएबीईटी) द्वारा प्रदत्त प्रत्यायन के परिणामस्वरूप, उक्त अधिनियम की धारा 4 की उपधारा (1) के उक्त दूसरे परंतुक के प्रयोजनों के लिए भारत सरकार के खान मंत्रालय के आदेश संख्या एम.VI-16/15/2021-खान VI, तारीख 12 अगस्त, 2021 (जिसे इसमें इसके पश्चात् प्रत्यायित प्राइवेट खोज अभिकरणों की अधिसूचना के लिए उक्त मार्गदर्शक सिद्धांत कहा गया है) द्वारा जारी किए गए प्रत्यायित प्राइवेट खोज अभिकरणों की अधिसूचना के लिए मार्गदर्शक सिद्धांतों में यथा विनिर्दिष्ट ''प्रवर्ग 'क' खोज अभिकरण'' के अधीन मैसर्स यूनाईटेड एक्सप्लोरेशन इंडिया प्राइवेट लिमिटेड को अधिसूचित करती है ।

2. अभिकरण, प्रत्यायित प्राइवेट खोज अभिकरणों की अधिसूचनाओं के लिए उक्त मार्गदर्शक सिद्धांतों में विनिर्दिष्ट शर्तों की अनुपालना के साथ भावी संक्रियाएं करेगा ।

3. यह अधिसूचना राजपत्र में इसके प्रकाशन की तारीख को प्रवृत्त होगी और अधिसूचना की तारीख से तीन वर्ष की अवधि के लिए या उसकी समाप्ति तक या प्रदत्त प्रत्यायन की समाप्ति तक, जो भी पहले हो विधिमान्य होगी ।

[फा. सं. एम-VI-16/22/2022-खान VI]

डॉ. वीणा कुमारी डरमल, संयुक्त सचिव

MINISTRY OF MINES

NOTIFICATION

New Delhi, the 7th April, 2022

G.S.R. 284(E).—In exercise of the powers conferred under the second proviso to sub-section (1) of section 4 of the Mines and Minerals (Development and Regulation) Act, 1957 (67 of 1957) and consequent upon accreditation provided by the National Accreditation Board for Education and Training of the Quality Council of India (QCI-NABET), the Central Government hereby notifies the M/s. United Exploration India Private Limited under 'Category A Exploration Agencies' as specified in the guidelines for notification of accredited private exploration agencies issued by the Government of India in the Ministry of Mines vide order No. M.VI-16/15/2021-Mines VI, dated the 12th August, 2021 (hereafter referred to as the said guidelines for notification of accredited private exploration agencies) for the purposes of the said second proviso to sub-section (1) of section 4 of the said Act.

2. The agency shall carry out prospecting operations in compliance with the conditions specified in the said guidelines for notifications of accredited private exploration agencies.

3. This notification shall come into force on the date of its publication in the Official Gazette and shall remain valid for a period of three years from the date of notification or till expiry or termination of the accreditation granted, whichever is earlier.

[F. No. M-VI-16/22/2022-Mines VI]

Dr. VEENA KUMARI DERMAL, Jt. Secy.

Uploaded by Dte. of Printing at Government of India Press, Ring Road, Mayapuri, New Delhi-110064
and Published by the Controller of Publications, Delhi-110054.

Annexure-3

Details of Project Members and Associates

❖ ABOUT UNITED EXPLORATION INDIA PRIVATE LIMITED:

United Exploration India Private Limited (UEIPL) is an emerging consulting firm managed by professionals and performed by a perfect mixture of technical experience and energy, in field of mining, geology & survey wherein end-to-end solutions is being offered to client.

UEIPL is an ISO 9001:2015 company and has also been accredited under the scheme of QCI NABET as an Exploration (APA) and Mine Planning Preparation Agency (MPPA). A detail of the company can be sought out in the company's website www.unitedexploration.co.in.

UEIPL has been engaged in several nos. of exploration projects in India which involves around 4.00 lakhs meter of drilling supervision. Besides Exploration and Drilling Projects in both Coal and Non-Coal, UEIPL has also been engaged by several esteemed clients for carrying out different reports like:

- Geological Report of Coal & Non Coal,
- Mining Plan & Mine Closure Plan (for both Major and Minor Minerals),
- Environmental Impact Assessment & Environmental Management Plan Study,
- Technical Assessment reports during auctioning of both coal and mineral blocks,
- Due-diligence Reports for both Coal & Minerals,
- Forest and Environment Clearances (through our associate M/s CEMC Limited, Bhubaneswar, also a NABET accredited company),
- Hydro-geological Study,
- Geophysical Survey for Groundwater survey and mineral exploration
- GIS and Remote Sensing for Land Information System,
- Topographic and Stack (Volume) Survey work with DGPS and/or ETS.
- Detailed Project Report and Feasibility Reports

- District Survey reports

Besides the knowledge base report preparation, UEIPL also entered to cater the drilling needs of various clients.

❖ **STRENGTHS:**

The strength of the organization is skilled human resources with an enrichedversatility with senior renowned professionals. The team is well composed of:

- 16 Geologists.
- 5 Mining engineers.
- 1 Geophysicist.
- 3 Surveyors.
- 2 drilling operators & other supporting staffs.
- 2 Civil Engineers.
- 1 Electrical Engineer.
- 5 Other Administrative officers and Staffs.

❖ **ASSETS:**

Beside our well-trained human resources UEIPL has a huge support of modern software's & equipment's.

- **SOFTWARE'S:**
  - GEOVIA Minex 6.3.
  - GEOVIA SURPAC 2022
  - ARES Commander 2020 for survey data analysis, volumecalculation.
  - AutoCAD 2020 for survey data analysis, volume calculation.
  - Arc-GIS Software.

- **SURVEY EQUIPMENTS:**
  - Three number of Total Stations: SOKKIA CX 65, SOKKIA CX 101,SOKKIA 107.

- One Scanner: TRIMBLE STS 730

➢ **DRILLING EQUIPMENTS:**

- 1 number KDR-500 and 1 umber KDR 750- 500 to 700m drilling capacity.
- 2 number of Voltas 180 drill rig driven by P4 Engine. Capacity-300 meters.
- 1 number Joy-12B of 250m drilling capacity.

❖ **TEAM PROFILE:**

Name	Qualification	Technical Experience
Mr. Joydeep Banerjee	M.sc. Geology, RQP- IBM. MAusIMM., Project Coordinator under NABET Scheme of Prospecting/ Exploration Agency (APA) & Mining Plan Preparing Agency (MPPA).	Having more than 20 years of experience in the field of mineral industry and has obtained vast experiences in the field of coal exploration, Iron Ore exploration, Bauxite exploration, Chromite Exploration, Graphite Exploration etc. Throughout his career he has worked in both the domestic and overseas environment for exploration and mining project implementations. His strength lies in a thorough understanding of resource modeling and effective utilization of modeling software's. He is also an expert in the field of Remote sensing & GIS.
Dr. Tapan Kumar Chakravarty	M.Sc.Ph.D, Geology. RQP– IBM, Project Coordinator under NABET Scheme of Prospecting/ Exploration Agency (APA) & Mining Plan Preparing Agency (MPPA).	More than 40 years of experience. He has worked with CMPDIL/CIL throughout his career in the field of Geology & Environment. During his tenure at CMPDIL, he has worked in many coal fields which includes Singrauli, Talcher, etc. for both coal exploration and Environmental studies. Upon retirement he has worked in Australia and Indonesia. At present, he is Director in United Exploration India Pvt. Ltd.
Dr. Sukhen	M. Tech (2005) in	14 years of experience. Specialized in

Name	Qualification	Technical Experience
Majumder,	Applied Geology, IIT, Kharagpur. Ph.D. (2009) in Structural Geology, IIT-Kharagpur. MAusIMM. Technical Area Expert (Geo/HG) under NABET Scheme of Prospecting/ Exploration Agency (APA) & Mining Plan Preparing Agency (MPPA).	mineral exploration and project management, particularly in metals. His skills include exploration project management, detailed structural mapping, geological-geotechnical logging and sampling, geochemical surveys, profile mapping, litho-stratigraphic correlation, database management, quality analysis and quality check in compliance with international standards, preparing geological reports. He has worked in various exploration projects, mostly in different parts of India and Africa.
Dr. Sigma Dwivedy	M.Sc. Geology (2014), Ravenshaw University, Odisha. Ph.D., Applied Geology (2022), IIT-ISM, Dhanbad.	7 years experiences in teaching assistantship, ore sampling, sample preparation, chemical analysis different ores and host rocks (petrographic studies, EPMA, XRD, Raman spectroscopy, FE-SEM, ICP-MS, LA-ICPMS,)
Mr. Shouri Dutta	M.Sc in Applied Geology from Calcutta University.	8 years of experience as Resource Geologist. Software modeling through Minex jobs is the foundation of Mr. Dutta. He can independently handle many of the Geological Report Preparation Jobs.
Mr. Debnath Adhikary	M.Sc (Tech) from Banaras Hindu University.	More than 5+ years of experience. Mr. Adhikary is being engaged in exploration job since joining in this organisation. Assisted in different Geological Report Preparation works.
Mr. Deep Konar	M.Sc. in Geology from IIT Bhubaneswar.	3.0 years of experience in managing exploration project. Prepared geological report. Software modeling through Surpac.
Mr. Dillip Kumar Mohanta	M.Sc. in Geology (2017) from NIT Rourkela.	1 year experience in project handling, sample preparation, chemical analysis of coal (Proximate and ultimate analysis, Total gas content petrographic studies, XRD, FE-SEM)

Name	Qualification	Technical Experience
Mr. Shouvik Sen	M. Sc Applied Geology from Calcutta University	1 year experience in project management, geological mapping, sampling, database preparation, geological report preparation.
Mr. Mahafuz Rahaman Khan	M. Sc Applied Geology from Calcutta University	1 year experience in project management, geological mapping, sampling, database preparation, geological report preparation.
Sk. Rabiul Islam	B.Sc. Hons. Surveyors Competency Certificate from DGMS. Technical Area Expert (SUR) under NABET Scheme of Prospecting/ Exploration Agency (APA) & Mining Plan Preparing Agency (MPPA).	More than 15 years of experiences. Surveying & leveling, assist to prepare Mining Plan/Review of Mining, Forest Diversion proposal, liaison work with Indian Bureau of Mines, Forest department, Pollution Control Board.
Ms. Ishani Choudhury	Master of Science in Geoinformatics from Symbiosis International University, Pune	Ms. Choudhury is having an experience of more than 5 years working with the software's like GIS, Remote Sensing and UAV mapping etc. She has been engaged in preparing Map using Geographical Information System and Remote sensing Technique for various projects.
Ms. Jinia Rahaman	M. Sc in Geography from Vidyasagar University; P.G. Diploma in Applied Geoinformatics (Remote Sensing & GIS)	Ms. Rahaman is having 2 years of experience and has been engaged in various GIS related job.

- **ASSOCIATES FOR OUT SOURCE JOBS:**

Job Type	Organization	Expertise
Surface geophysical investigation.	Dept. of Geology and Geophysics, IIT Kharagpur	Expertise in integrated geophysical technique more specifically gravity and magnetic methods for shallow surface investigation and locating mineral deposits. Successfully identified Chromite deposits in the Sukinda belt

		and also identified possible Uranium deposits in the South Purulia Shear Zone to give a lead for exploration.
Chemical analysis	ND International	N.D. International is a multinational organisation located in India and Japan. The laboratory is accreditated by NABL, APEDA, FASSAI, ISO 9001:2015 Certified and recognized by other governmental departments.
Chemical analysis	SGS India Private Limited	World's leading testing, inspection and certification company.

NMET PROPOSAL (For G4 exploration) Nawadih Graphite Block Balarampur, Chhattisgarh

2.7 Project cost

Sl. No.	Item of Work	Unit	Qty.	Cost per unit/ per day/ manday (In Rs.)	Amount (In Rs.)
	Preparation of Exploration Proposal	Lumsum	1	380000.00	380000
1	**Satellite imagery/Aerial photo interpretation studies**				
	Charges for procurement of imageries (As per actual cost incurred)				
	Cost of interpretation in terms of Geologist mandays	Days	30	9000.00	270000
2	**Geophysical Survey**				
	Magnetic Surveys	per station	270	1800.00	486000
	Gravity Method-Regional/Detailed (0.5 to 200 sq.km depending on the objective)	per station	270	3800.00	1026000
	Self-Potential (8-20 line km)	Line Km	90	29600.00	2664000
	Processing + Interpretation Cost (Charges for Expert Geophysicist)	Mandays	30	9000.00	270000
3	**Geological Mapping (Scale 1:12,500)**				
	Charges of Geologist (2 Geo- 4month)	Mandays	240	11000.00	2640000
	Labour Charges (2 Helper for each geo)	Mandays	480	443.00	212640
	Topographical Survey (1 Reg. Surv + 4 Labours) (Duration 30 days)				
	a) Charges of Surveyor (Reg. Surveyor)	Mandays	30	8300.00	249000
	b) Labour Charges (4 Nos.)	Mandays	120	443.00	53160
4	**Geochemical Survey**				
	a) Charges of Geologist	Mandays	60	11000.00	660000
	b) Labour Charges	Mandays	120	443.00	53160
	(Reg. Geo = Rs11,000/day as per NMET SoC),				
	(Unskilled Labour cost @ Rs 443/day as per Min. of Labour rate)				
5	**Trenching**				
	Trenching	cu.m	25	3330.00	83250
6	**Sample Preparation**				
	sampler charges for Sample processing work	Mandays	30	5100.00	153000
7	**Chemical Analysis**				
	a) Bed Rock samples (including 10% check samples)	Nos	110	8157.00	897270
	b) Soil Samples (including 10% check samples)	Nos	220	8157.00	1794540
	c) Drill core samples (including 10% check samples)	Nos	275	8157.00	2243175
	d) Trench samples (including 10% check samples)	Nos	275	8157.00	2243175
	e) Proximate analysis for Graphite	Nos	50	3000.00	150000

8	**CORE DRILLING (500m/ 5 BH)**				
	a) Drilling camp setting cost	Lumsum	1	250000.00	250000
	b) Monthly Accommodation charges for drilling camp	Months	3	50000.00	150000
	c) Transportation of Drill Rig & Truck associated for drill	per km	2000	36.00	72000
	d) Land/Crop Compensation	per BH	5	20000.00	100000
	e) BH fixation and demarcation of Coordinates and RL of BH by DGPS	per BH	5	19200.00	96000
	f) Road Prepartion (Dozzing Charges,Drill site)	Km	5	32200.00	161000
	g) Drilling (NQ Size Core) (5 BH)(Medium Hard Rock of 300m, 20% added for HQ)	Mtr	500	11500.00	5750000
	h) Drill Core Logging, Core Sampling				
	1) Charges of Geologist	Mandays	90	11000.00	990000
	2) Labour Charges	Mandays	180	443.00	79740
	i) Bore Hole Plugging by Cement	per m	500	500.00	250000
	j) Construction of Concrete Pillar (12" X 12" X 30")	per BH	5	2000.00	10000
	k) Drill Core Preservation	per m	500	1590.00	795000
	l) Drill camp winding cost	Lumsum	1	250000.00	250000
9	**Physical Analysis**				
	i) Petrographic Studies (BH core + Surface Samples)				
	a) Preparation & Study of thin section	Nos	50	2,353.00	117650
	b) Study of thin section for petrography	Nos	50	4,232.00	211600
	c) Preparation of polished section	Nos	30	1,549.00	46470
	d) Study of polished section for mineragraphy	Nos	30	4,232.00	126960
	e) Digital photomicrograph of thin polished	Nos	50	280.00	14000
	ii) XRD	Nos	25	4000	100000
	iii) XRF	Nos	25	4200	105000
	Total Exploration Cost				**₹ 26,203,790.00**
	Exploration Report- 0.5% of (Exploration Cost)				**₹ 13,101,895.00**
	GRAND TOTAL				**₹ 39,305,685.00**

NMET PROPOSAL (For G4 exploration) Nawadih Graphite Block Balarampur, Chhattisgarh

2.6 Project schedule

Item of work in weekly time frame	Month-1	Month-2	Month-3	Month-4	Month-5	Month-6	Month-7	Month-8	Month-9	Month-10	Month-11	Month-12
Aerial reconnaissance							Interim Review Report					
Ground Geophysical Survey												
Gravity Survey												
Magnetic Survey												
SP Survey												
Geological Survey												
Large Scale mapping in 1:12,500 Scale												
Surveying												
Geochemical Survey												
Soil Sediment sampling												
Grab Sampling												
Trenching												
Trenching												
Chemical Analysis												
Soil samples analysis												
Surface sample analysis												
Drill core samples												
Scout Drilling (if required)												
Drilling												
Core Logging/sampling												
Petrographic and Mineral graphic studies												
Pterographic study												
XRD/ XRF study												
Geological report												

Prepared By: United Exploration India Pvt. Ltd. (NPEA)