Reconnaissance Survey (G4 Stage) for Graphite and Vanadium in Matena-Sirar Area, Almora District, Uttarakhand

Commodity: Graphite and Vanadium

By

Geovale Services Private Limited

Place: Kolkata

Date: 30th May 2024

Contents

Summary of the Block for Reconnaissance Survey

(G4 Stage)

GENERAL INFORMATION ABOUT THE BLOCK

	Features	Details
	Block ID	GSPL/NMET/UK/2024/BLOCK-2
	Exploration Agency	Geovale Services Private Limited
	Commodity	Graphite, vanadium
	Mineral Belt	Almora Crystalline of the Inner Lesser Himalaya
	Completion Period with entire Time schedule to complete the project	12 months
	Objectives	i. Demarcate the dimensions of graphite bands and their depth continuations. ii. Characterization of graphite bands by sampling for graphite crystallinity iii. Explore the distribution and mineral phase of vanadium within graphite.
	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 outsource agency	Primarily M/s. Geovale Services would carry out the work.
	Name/ Number of Geoscientists	
	Expected Field days (Geology)	Total field man-days (Geologist): approximately 200 man-days

	Geological Party Days	Geological Party Days: Approximately 6 months in phases
1.	**Location**	
	Latitude (N)	29.596478° to 29.674219°
	Longitude (E)	79.649098°to 79.750003°
	Localities	Matena, Falsima, Sirar, Birora, Balta (Plates 2, 3 and 4)
	Tehsil/ Taluk	Almora
	District	Almora
	State	Uttarakhand
2.	**Area (hectares/ square kilometers)**	
	Block Area	60 square kilometers
	Forest Area	
	Government Land Area	Not known
	Private Land Area	Not known
3.	**Accessibility**	
	Nearest Rail Head	Haldwani, Kathgodam
	Road	NH-309A and NH-309B
	Airport	Pantnagar Airport, Pithoragarh
4.	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	Radial dendritic pattern
	Rivers/ Streams	Ram Ganga, Suyal River
5.	**Climate**	
	Mean Annual Rainfall	1300 to 1800 millimeters
	Temperatures	Minimum (December to February): 2 to 5 ºC

		Maximum (May to June): 25-30ºC
6.	**Topography**	Rugged topography
	Topo sheet Number	53O/10
	Morphology of the Area	The area forms a part of the Inner Lesser Himalayas, which is usually very rugged.
7.	**Availability of baseline geoscience data**	Baseline data available from Bhukosh (GSI) and NGDR
	Geological Map (1:50K/ 25K)	1:50000 scale geological map available (Bhukosh, GSI)
	Geochemical Map	NGCM data available (NGCM, GSI)
	Geophysical Map (Aeromagnetic, ground geophysical, Regional/ local scale GP maps)	Not Available in public domain
8.	**Justification for taking up reconnaissance survey / Regional Exploration**	Inner Lesser Himalayan rocks of the Almora Crystalline include medium to high amphibolite grade metapelllites, quartzites, carbonaceous phyllite/schists that are intimately associated with ~1.8 Ga and ~500 Ma granites. At places, the younger granite occurs as lit-par-lit injections to the metapelites. Thick carbonaceous phyllite/schists (or graphite schist) occur multiple stratigraphic horizons in the area. At places these horizons are quite thick (5-10m) and have substantial sulphide minerals in them (Rawat and Sharma, 2011; many GSI reports and personal communication). GSI's recent Specialized Thematic Mapping (STM) study brought out many exciting information on these metamorphosed black shales (Santosh and Yadav, 2021; Bauri and Raut, 2021, GSI FS 2019-21): i. Many of the metamorphosed black shale horizons are HCHS [High Carbon (>7%) High Sulphur (>4%)] category as classified by the USGS. ii. Some spot sample analyses by GSI have yielded V concentration >0.4% and Ba concentration >4% in addition to very high concentration of a host of critical metals like Mo, U, REE etc.

Black shale horizons worldwide have received considerable attention for exploration for their potential as source of critical metals for green energy revolution (like V, Ni, Co, W, REE etc.).

An exploration work by GSI (Santosh and Yadav, FS 2020-21) using detailed stream sampling and few channel samplings in a part of the present block also reported tungsten and tin from stream sediment and bed rock samples.

The block is prospective for three different commodities and type of mineralization:

i. **Graphite:** The carbonaceous phyllite/schist (or graphite schist) is in close association with medium to high-amphibolite grade to possibly up to sillimanite grade metamorphic rocks and lit-par-lit injection of granite. There is thus significant chance of getting zones of flake-type graphite.

ii. **Vanadium** within Carbonaceous phyllites /schists (or graphite schist)**.**

It is proposed to carry out a G4 scale exploration in 60 sq. km area northeast of Almora. The program would do the following:

i. A comprehensive evaluation of the HCHS horizons of metamorphosed black shale horizons for identification of potentially mineable zones for graphite and V etc. The work would involve understanding of the structural disposition of black shale horizon to locate possible zones of graphite and vanadium mineralization.

ii. An evaluation of graphite characteristics (crystallinity, sizes and extent) in the graphite schist (or carbonaceous phyllites /schists) horizons of the block. and all these metals are critical for green energy technology.

DETAILED DESCRIPTION OF THE BLOCK

I. Block Summary

Physiography

Major physiographical features of this region consist gently sloping hills, widened V-shaped valleys adorned with terraced cultivation, and expansive flat ridges. The primary drainage in the vicinity is the Mahadev Gad, which runs in a northwest-southeast direction before merging with the Sual River, a tributary of the Kosi River. Numerous smaller streams and nalas crisscross the landscape, draining into the Mahadev Gad. Vegetation predominantly comprises thorny shrubs, with pine trees dominating the higher elevations above 2000 meters. However, the growth of pine trees is hindered due to the prevalence of mica schist as the underlying country rock.

Background Geology (Regional Geology, Geology of the Block)

Regional geology:

The Almora Crystalline, spanning approximately 6000 square kilometers across segments of Pauri, Nainital, Almora, and Pithoragarh districts of Uttar Pradesh, presents itself as a significant asymmetrical overturned synform, with the southern limb exhibiting overturning. Stratighraphically this unit has been given the status of a Group and a new name Almora Crystalline Group has been given to it.

The Almora Crystalline Group consists of a series of metamorphosed pelitic and psammo-pelitic rocks accompanied by both acidic and basic intrusive rocks (Fig.1 & 2). This predominant rock category encompasses meta greywacke, slate, phyllite, quartzite, mica schist (occasionally carbonaceous), garnetiferous mica schist, kyanite-sillimanite schist, graphitic schist, calc silicates, phyllonite, mylonite, granite, magnetite, amphibole, and an assortment of acidic and basic intrusives.

The rocks within the Almora Crystalline Group have undergone two stages of prograde metamorphism and one stage of retrograde metamorphism, all of which are associated with folding phases. The initial prograde metamorphism is syn-to post-tectonic in relation to the first folding event, F1. The mineral assemblage suggests that this metamorphic process extended into the upper amphibolite facies (Malaviya and Chakravorty, 1985).

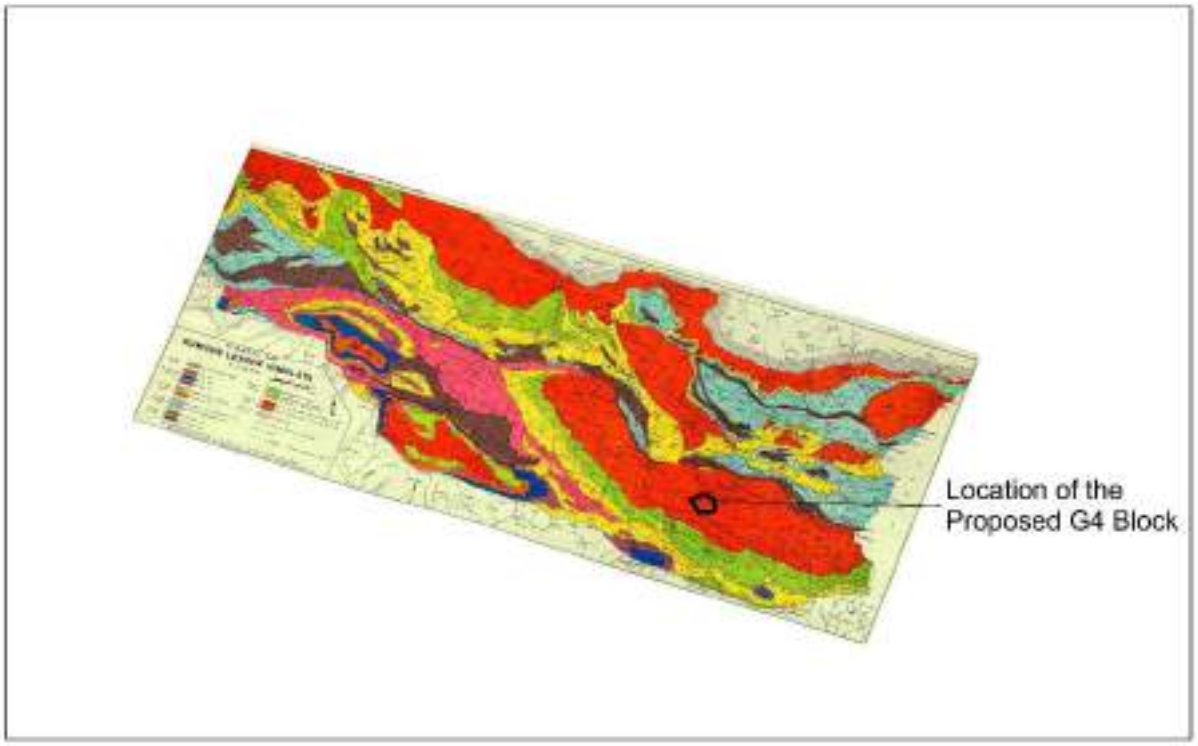


Figure 1 Location of the Almora North Prospect Block in the geological map by Valdiya (1980)

Geology of the Block area:

The area has been mapped by Bhattacharji in 1964-65, Malaviya and Chakraborty in GSI Field Season 1970-71 to 1985 and by Bauri and Raut in 2021.
In and around Sirar, the mica schist of this region exhibits tight folding, compactness, and brittleness, with occasional small garnet crystals scattered throughout. In some instances, thin bands of interbedded quartzite, fine-grained, hard, and yellow with grey hues, are observed. Nodule samples collected from Sirar hill indicate a fixed carbon content of 30.9% and 0.23% of P_2O_5 (Bhattacharji, 1965,). Graphitic quartzite, appearing dark steel grey and fine-grained, displays schistose characteristics in certain areas. The dark grey graphite schist, thinly layered and varying in hardness from soft to moderately hard, presents a metallic lustre due to the presence of graphite. It is interbedded with thin bands of graphitic quartzite and mica schist.
In and around Phalsima, the Phalsima block, the graphite schist band extends east-west for approximately 500 meters between the villages of Phalsima and Kaleth. Structurally, it occupies the

closure of a westward-plunging anticline. The geological sequence of rock formations encountered in the area is as follows:

Garnetiferous mica schist
Graphite schist
Mica schist with intercalated quartzite

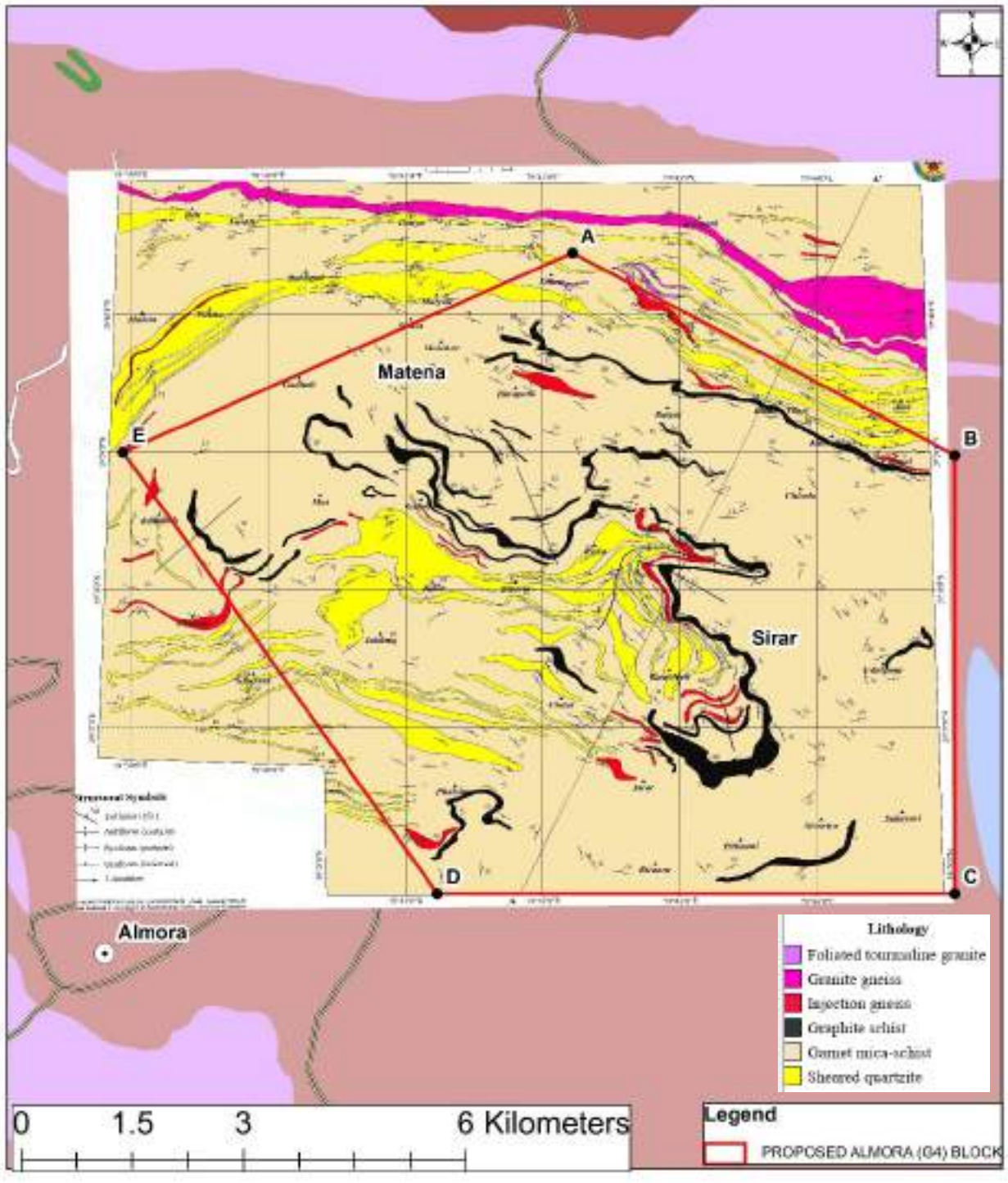


Figure 2 Geological map of Almora North Prospect Block (Source: Bhukosh)

Mineral potentiality of the block based on geology and ground geochemistry:

The block is prospective for two different commodities:

i. Graphite
ii. Vanadium

i. Graphite potentiality:

a. Presence of graphite in the area is known for very long time. Heim and Gansser (1939), Nautiyal (1942) noted presence of graphite in the Almora area.

b. Investigation of the graphite schists (including large scale mapping in 1:2,000 scale for 0.3 sq. km and pitting) was done by Bhattacharji (F.S.P 1964-65) in around Sirar, Persal and kalimath area. In recent times, during FS 2019-20 there had been two GSI programs in the area one is a research project on the origin of carbonaceous schists in the area (Bauri and Raut, 2021; FS 2019-2020). The other work on tungsten exploration in part of the present block by Santosh and Yadav (2021; GSI FS 2019-20). Both these works mentioned significant presence of HCHS (High Carbon High Sulfur) carbonaceous schist in the area that occur in different stratigraphic horizons.

ii. Vanadium potentiality:

GSI's recent works (Bauri and Raut, 2021; FS 2019-2020 and Santosh and Yadav, 2021; GSI FS 2019-20) has brought to light significant vanadium potentiality of the area with very high vanadium content (over 4000ppm for some samples) along with other critical minerals.

GSI's NGCM mapping in this area:

The proposed block area is covered by GSI's NGCM (National Geochemical Mapping) survey. In this area the geochemical data shows the high values for Tungsten in parts of the proposed block (Fig.3).

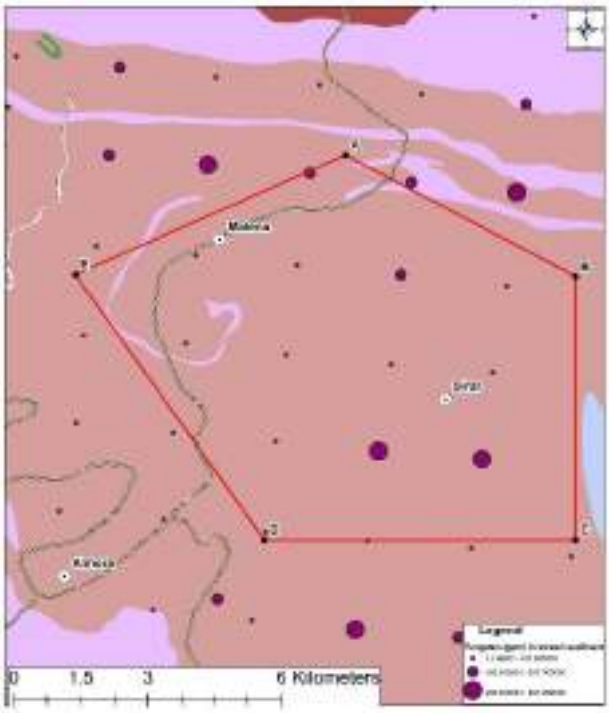


Figure 3 Anomaly of Tungsten from NGCM data

Geophysical data in this area:

Chauhan et al. (FP: 1977-78) pursued self-potential and limited resistivity soundings in a small are of ~0.3 sq. km around Phalsima and Sirar area for tracing the graphite bands under cover. Through the survey the graphite band could be traced for a strike length of ~ 250 m.

A Mineral System Analyses of mineralization potential of the area:

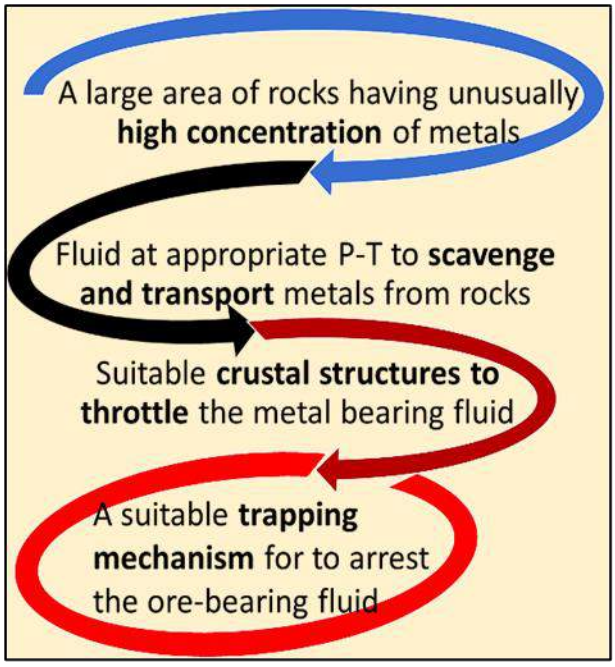


Figure 4. Principal components of Mineral System Analysis (MSA) and their relationship

A mineral system analyses revolves round four important components (Fig. 4)

(i) A fertile host rock terrain

(ii) Fluids to scavenge metals from fertile host rocks

(iii) Tectonic force and architecture to channelize the metal bearing fluids and

(iv) Suitable structural or lithological traps

Graphite and graphite-hosted vanadium are syngenetic to the metasediments of the Almora Crystallines that are considered to be of ~1.8 Ga age (based on dating done on other nearby Crystallines). Graphite and graphite-hosted vanadium is syngenetic and strata-bound.

Design of the proposed exploration:

<u>For graphite and carbonaceous schist hosted vanadium:</u>

Of the two commodities that are targeted for exploration, the graphite and the carbonaceous schist hosted poly-metal are stratiform and strata-bound in nature, even though they may occur in different parts of the lithostratigraphic sections, their exploration design would be similar that would involve

essentially to delineate carbonaceous schist horizons through mapping and through SP Survey and then systematic sampling and chemical (polymetal) and both chemical and physical (for graphite) assaying.

Scope of the present exploration:

The exploration task flow is proposed to be done in two phases, each having distinct tasks and milestone. A summary of activities and milestones in both phases of the proposed exploration is given below:

Phase I (Approximately 6 to 8 months):

For graphite and carbonaceous schist-hosted vanadium:

i. Review of the existing map of the area in 1:12,500 scale and marking zones of carbonaceous schists.
ii. Systematic channel sampling on exposed carbonaceous schist sections to get a preliminary assessment of metal content and degree of crystallinity of graphite
iii. Pitting and trenching in unexposed areas
iv. Geochemical assay and petrographic study
v. SP survey for drilling target identification.

Phase II (Approximately 6 to 8 months after review):

Core drilling and geochemical assay.

Finally identification of the potential zones for G3 level exploration.

II. Previous work:

Previous reports of mineralization in the adjoining area (regional area):

Exploration for graphite:

The graphite rocks of the area have received attention from earlier workers.

- Merbert (1829) reported graphite in the form of nodules weathered out from a bond of mica schist on the ridge between Almora and Kalimat. Medlicott (1865) and Drumond obtained samples of graphite in the neighborhood of Almora.
- Heim & Ganseser (1939) noted the occurrence of graphite schist northeast of Almora (at Pirsal and near Bari Chhina), Nautiyal (1972) reported the occurrence of graphite (poor quality) in the schist of Kalimat and Sirar and good quality at Phalsima in Almora.

- Raina (1949) investigated the occurrence of graphite at Deveri, Lakakot and Barechia of Almora district and was of the view that these were of no economic importance. Tiwari (1962-63) (1963-64) noted the occurrence of graphite schist at Chhani-Khastiwari (near Bari chhina) Deolikhan-Diodiya and Channa. Bhattacharyya (1965) examined the occurrence of Kalimat,Sirar,andPirsalandmappedthese areas in detail.
- Investigation for graphite was taken up by Raina (1949), Tewari (1963-64). Tewari (op cit) reported fixed carbon content as much as 31.5% in some part of the Almora Tehsil.
- Bhattacharji (1965) reported graphite bands from a very wide area with fixed carbon content varying between 2.38% and 8.36%. Further exploration for graphite was pursued using electrical surveys (Srivastava et al., 1975) to delineate prospective graphite horizons.

  However, graphite is not classified in terms of its crystallinity, which is very crucial in determining economic prospect of any graphite deposit.

  Recently, GSI carried out comprehensive research for origin and prospectivity of carbonaceous horizons in the Almora Crystallines (Bauri and Raut, FS 2020-2021). Another important recent work in the area has been by Santosh and Yadav (FS 2020-2021). These works brought out several interesting things that warrants a relook on the prospectivity of the graphite horizons of the whole Almora Crystallline belt).

  a. Graphite horizons are very extensive and ran as continuous layers alternated by late quartzite, mica schist, even though intricately folded and dismembered by later deformation.
  b. At many locations, late granites (part of ~500Ma old Almora Granite) injected lit-par-lit into the graphite bearing metasediments. This intrusion resulted in significant crystallinity of the graphite along with other high-grade minerals like sillimanite etc. This brings out possibility of identifying horizons of flake graphite in the area that are very demanding economically.

III. Block description with boundary coordinates:

Corner	Latitude	Longitude
A	29.67419714	79.70360564
B	29.6496541	79.75000285
C	29.596502	79.75

D	29.59650189	79.68720717
E	29.65003641	79.64906903

IV. Exploration task flow, Planned methodology and broad exploration approach as proposed:

Exploration activities are elaborated below (Fig.5):

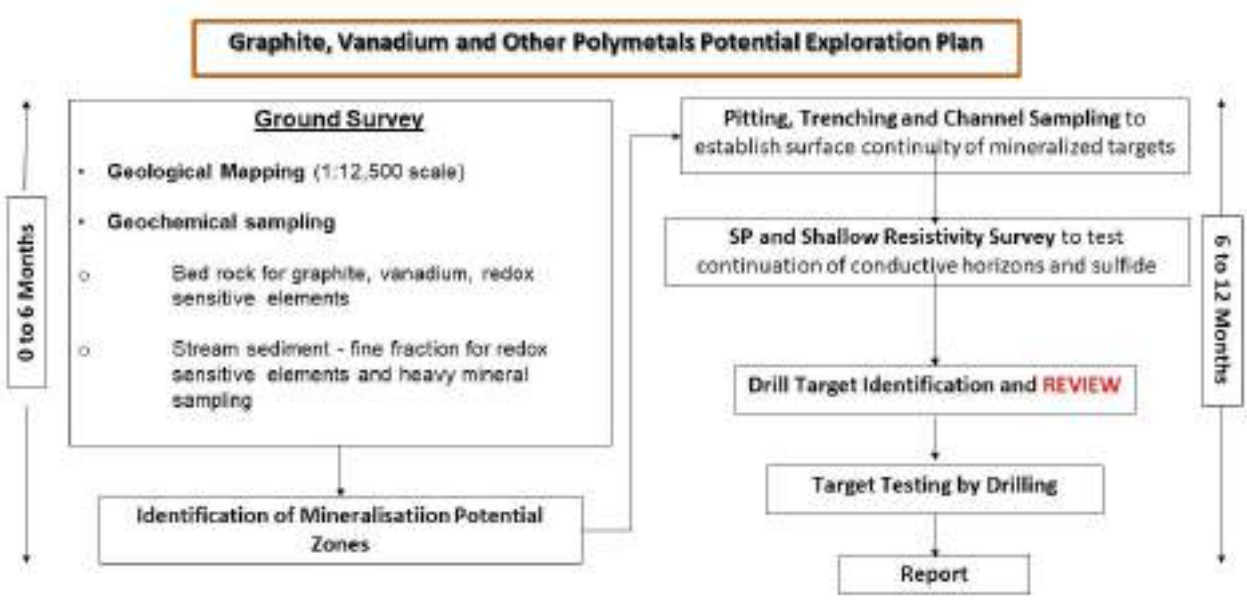


Figure 5 Exploration workflow for Almora North Prospect Block

Methodology

1. Geological mapping and regional geochemistry

a. Study and interpretation of maps, reports, NGCM and NGPM data of the areas for creating a geological Base Map of the Blocks.

b. Preparation of detailed geological map and review of the previous map by traversing, to identify and demarcate different lithological components like schists, granites, quartzites, volcanic rocks etc.

c. Bed Rock/Channel sampling of graphite.

d. Regional Stream Sediment sampling from micro-catchment pour points (Fig.6)

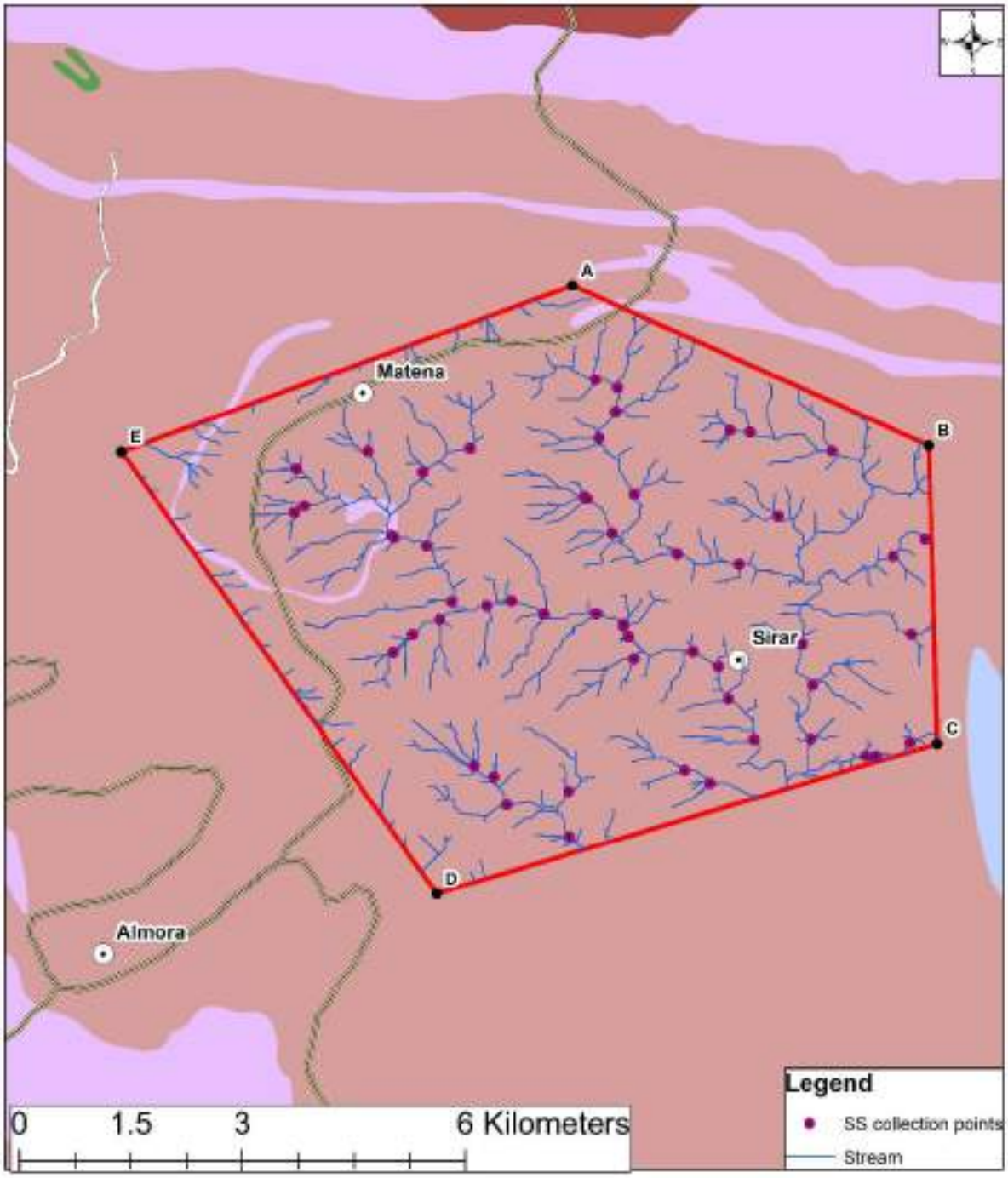


Figure 6 Micro catchment areas and possible stream sediment collection points (green points) for regional geochemical analysis

2. Pitting/trenching and geophysical survey and on identified fertile area:

a. A total of 400 cubic meter pitting and trenching in carbonaceous shale for **graphite and vanadium exploration** will be done for tracing out the potential zones in covered area.

b. 30 line km SP survey at 200 m interval

3. Core Drilling, Logging and Sample Assay

Based on geological mapping, geochemical analysis and geophysical survey the potential target areas will be marked. To find out the disposition of potential graphite and vanadium a total of 800

m core drilling in approximately 10 boreholes have been planned.

4. Final Report Submission

a. Providing targets for G3 stage additional ore bodies.

b. Generate a detailed Report (Final G4 level Report).

V. Nature Quantum and Target

A table containing the NQT table is given in *Annexure I.*

Borehole spacing (As per MEMC, 2015)

Type of deposit	Bedded Stratiform and Tabular deposit of regular habit minerals to be identified	Bedded stratiform and tabular deposits of irregular habit (Minerals to be identified)	Lenticular bodies occurring en echelon Lenses, pockets. (Different minerals)
G4 Stage	Not Applicable	Approximately 10 core drilling with an average of 800 m depth in an area of approximately 60 sq. km	Not Applicable
(Vertical depth of intersection of mineralized zone should be specified (first level), number of boreholes, approximate borehole spacing, approximate length of boreholes may be specified)			

Geophysical Studies

Regional Geophysical studies will be introduced in early stage where Self Potential survey (200 m interval) will be carried out to identify the continuation of graphite beds/potential fertile zones.

VI. Manpower deployment:

A table containing the manpower deployment table is given in *Annexure II*.

VII. Breakup of Expenditure

The breakup expenditure for each phase is given in *Annexure III*.

VIII. Summary Expenditure

The summary expenditure for each phase is given in *Annexure IV*.

IX. Timeline

Time Schedule /Action Plan For Reconnaissance Survey (G4 Stage) for Graphite and Vanadium in Matena-Sirar Area, Almora District, Uttarakhand															
Sl. No.	Activities	Unit	MONTHS												
			1	2	3	4	5	6		7	8	9	10	11	12
1	Geological Mapping and Sampling (1:12,500)	Days													
2	Sampling Party days	Days													
3	Pitting/Trenching	Cu.m													
4	Laboratory Studies	Nos.													
5	Petrographic Studies	Nos.													
6	Geophysical Survey	Days													
7	Geological Work (after review) (drilling)	m													
8	Laboratory Studies (after review)	Nos.													
9	Petrographic Studies (after review)	Nos.													
10	Report Writing	Months													
12	Peer Review	Months													

Review

NOTE	
1	**Commencement of project may be reckoned from the day the exploration acreage is available along with all statutory clearances.**
2	**Time loss on account of monsoon/agricultural activity/forest clearance / local law & order problem/ lockdown etc will be additional to above time line.**

X. References

Barui, D., and Raut, D., (2021), To study the palaeoenvironment, depositional setting and evaluation of metallogenic potential of metamorphosed black shale horozons in the Almora Grroup in Uttrakhand.

Bhattacharji, T.K., An interim note on the graphite Schist occurrence of Sirar, Persal and Kalimath areas, Almora district, Item No. 2 (b) F.S.P 1964-65, Geological Survey of India, Northern Region, Lucknow

Chauhan, D.P.S., Pathak, R. C. and Srivastava, V.N. Report on the Continuation of geophysical investigations for graphite in the Sirar and Phalsima area of Almora Distt., U.P., Field Season 1977-78.

Ghose, A., Chakraborti, B. and Singh, R.K. (1974); Structure and metamorphic history of the Almora Group, Kumaon Himalaya, U.P. Him. Geol. V. 4, P. 171-194.

Geology and Mineral Resources of the States of India, Miscellaneous Publication No- 30, Part XIII A, Uttarakhand, pp. 29

Heim, A., and Ganssar, A., (1939). Central Himalayas Douscher, Schweiz, Netsurf, Gesel. Vol. 73.

Malaviya, A.K., and Chakraborty, S. K., Report on the lithology, structure and metamorphism of the Almora Crystalline Group (Field Season 1970-71 to 1985), Geological Survey of India, Northern Region, Lucknow

Medlicott, H.B., 1864. On the geological structure and relations of the southern portion of the Himalayan ranges between

rivers Ganges and the Ravi. Mem. Geol. Surv. Ind. 3 (2) 122 pp.

Santosh V.J and Yadav,S.K (2020) Report On Reconnaissance Survey For Tungsten, Tin, And Associated Mineralization Around Almora District, Uttarakhand

Valdiya, K.S., 1962. An outline of the stratigraphy and structure of the southern part of Pithoragarh district, Uttar Pradesh. Journal Geological Soc. India Vol. 3. pp 27-48.

Valdiya, K. S., 1980. Geology of Kumaun Lesser Himalaya. Wadia Institute of Himalayan Geology, Dehradu

List of Plates

Plate 1: Geological map on 1:50K of proposed block in Matena-Sirar area with location index.

Plate 2: Geological map on 1:50K of proposed block in Matena-Sirar area without location index.

Plate 3: Not available

Plate 4: Not available

Plate 5: Proposed block boundary in Matena-Sirar area over existing Geological map on 1:50k.

Plate 6A: Proposed block boundary over land use land cover map in Matena-Sirar area

Plate 6B: Proposed block boundary over accessibility map of Bataldeon-Deora Block

Plate 7: Proposed block boundary over topographic map on 1:50,000.

Annexure I

NQT: Reconnaissance Survey (G4 Stage) for Graphite and Vanadium in Matena-Sirar Area, Almora District, Uttarakhand			
S.N	**Item of work**	**Quantum**	**Remarks**
1	**Geological Work**		
A	**Geological Mapping & Sampling**	50 sq km	
a	Geologists (HQ) days (1 No)	40 Man-days	
b	Geologist field-days (including channel sampling)	200 Man-days	50 sq.km
c	Labor (Field days) (2 workers per geologist)	400 labor day	Amount will be reimbursed as per the notified rates by the Central Labor Comission or respective State Govt. whichever is higher
	Sub-Total 1		
B	**Pitting/Trenching**		
a	Pitting/trenching (200 cubic meter for graphite and V)	400 cubic meter	200 cu, m trench, 200 cu.m pit
2	**Laboratory Studies**		
A	**Geochemical Analysis for regional survey**		Total 300 Sample: 100 BR, 50 SS and 150 pitting/trenching
a	Separation of heavy minerals from stream sediment samples of - 2mm size through gravity and magnetic separation	25 samples	
b	XRF (major oxides)	300 samples	
c	Check samples for XRF	30 samples	
d	XRF sample for 2 additional elememts	30 samples	
e	Check samples XRF samples for 2 additional samples)	3 samples	
f	Proximate analysis of Graphite	50 samples	
h	Sampler man-days	55 mandays	
i	Labor (Man days) (4 labours per sampler)	220 mandays	Amount will be reimburse as per the notified rates by the Central Labor Comission or respective State Govt. whichever is higher
3	**Petrological studies**		
a	Raman Spectrometry/XRD (graphite crystallinity and mineral phase identification of W)	2 samples	
b	XRD (Graphite crystallinity)	5 samples	
c	Thin section preparation (for size and morphometry of graphite flakes)	20 samples	
d	Microscopic study	20 samples	
5	**Geophysical Survey**		

a	Self-Potential and Shallow Electrical Resistivity	30 line km	
b	Geophysicist mandays	20 mandays	
Review			
6	**Geological Work (After Review Drilling)**		
B	**Drilling**		
a	Core drilling 1100 m (10*80m, 2*150m)	800 m	No of samples 200 samples
b	Construction of concrete Pillar (12"x12"x30")	12 nos	
c	Land / Crop Compansation	12 nos	
d	Transportation of Drill Rig & Truck associated per drill (2 rigs)-Two way	6000 km	Transportation from Jamnagar, Gujarat to Almora, Uttarakhand @1500 km for 2 drill-rigs in 2 trucks, to and fro 2(1500*2)
e	Monthly Accomodation Charges for drilling Camp	4 months	
f	Drilling Camp Setting Cost	1	
g	Drilling Camp Winding up Cost	1	
h	Approach Road making for rugget/hilly terrain	12 nos	
i	Drill Core Preservation	300 m	
7	**Laboratory Studies (After Review, BH samples)**		
A	**Geochemical Analysis (BH samples)**		250 sample
a	XRF (Major oxides)	250 samples	
b	External check samples for XRF	25 samples	
c	XRF 10% sample for 2 additional elememts- Sn, W	25 samples	
d	Check samples XRF 10% samples for 2 elements-- Sn, W	3 samples	
e	Proximate analysis of Graphite	50 samples	
f	Sampler man-days	44 mandays	
g	Labor (Man days) (4 labours per sampler)	176 mandays	Amount will be reimburse as per the notified rates by the Central Labor Comission or respective State Govt. whichever is higher
8	**Petrological studies (BH samples)**		
a	Thin section preparation	25	
b	Microscopic study	25	

9	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	1	This amount will be reimbursed after submission of the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC NMET in its meeting while clearing the proposal.
10	Final report preparation	1	Final report submission, peer review and project conclusion
11	Report Peer Review	1	

Annexure II

Manpower Deployment: Reconnaissance Survey (G4 Stage) for Graphite and Vanadium in Matena-Sirar Area, Almora District, Uttarakhand					
Activity	**Type of Job**	**Geologist HQ (mandays)**	**Geologist (mandays)**	**Labour (mandays)**	**Sampler (mandays)**
Remote sensing, multispectral and DEM data analysis	Desktop	5			
Geological Mapping	Field	10	150	300	
Laboratory Studies	desktop	10		55	210
Petrographic Studies	Desktop	15			
Geophysical Survey	Field		20		
Review					
Pitting/trenching,Core drilling, minerology and chemical assay	Field		50	144	176
Report Preparation and Recommendation	Desktop				
Discussion with State authorities and NMET	Desktop				

Annexure III

Title of Project - Reconnaissance Survey (G4 Stage) for Graphite and Vanadium in Matena-Sirar Area, Almora District, Uttarakhand
Name of the Exploration Agency - Geovale Services Pvt. Ltd.
Total Area - 60 sq. km; Bhs: 12 nos (30m vertical depth), Core drilling: 800 m; Completion Time -12 Months, Review: 6 months

Breakup of Expenditure

S.N	Item of work	Unit	Rates as per NMET SoC		Estimated Cost of the Proposal		Remarks
			SoC-Item -Sl No.	Rates as per SOC	Quantum	Total Amount (Rs)	
1	**Geological Work**						
A	**Geological Mapping (upgradation) & Sampling**	**60 sq km**					
a	Geologists (HQ) days (1 No)	Man-days	1.2	9,000.00	40	3,60,000.00	
b	Geologist field-days (including stream sediment sampling)	Man-days	1.2	11,000.00	200	22,00,000.00	60 sq.km
c	Labor (Field days) (2 workers per geologist)	per labor day	5.7	522.00	400	2,08,800.00	Amount will be reimbursed as per the notified rates by the Central Labor Commission or respective State Govt. whichever is higher
	Sub-Total 1					**27,68,800.00**	
2	**Pitting/Trenching**						
a	Pitting/trenching (200 cubic metre for graphite and V)	per cubic meter	2.1.2	3,800.00	400	15,20,000.00	200 cu, m trench, 200 cu.m pit
	Sub-Total 2					**15,20,000.00**	
3	**Laboratory Studies**						
A	**Geochemical Analysis for regional survey**						Total 300 Sample: 100 BR, 50 SS and 150 pitting/trenching
a	Separation of heavy minerals from stream sediment samples of -2mm size through gravity and magnetic separation	per sample	4.3.6b	13,820.00	25	3,45,500.00	
b	XRF (Major oxides)	per sample	4.1.15a	4,200.00	300	12,60,000.00	BRS
c	External check samples for XRF	per sample	4.1.15a	4,200.00	30	1,26,000.00	
d	XRF sample for 2 additional elememts	per sample	4.1.15b	4,210.00	30	1,26,300.00	
e	Check samples XRF samples for 2 additional samples)	per sample	4.1.15b	4,210.00	3	12,630.00	
f	Proximate analysis of Graphite	per sample	4.1.16	3,000.00	50	1,50,000.00	
h	Sampler man-days	one sampler per day	1.5.2	5,100.00	55.00	2,80,500.00	

i	Labor (Man days) (4 labours per sampler)	per labor day	5.7	522.00	220.00	1,14,840.00	Amount will be reimburse as per the notified rates by the Central Labor Comission or respective State Govt. whichever is higher
	Sub-Total 3					**24,15,770.00**	
4	**Petrological studies**						
a	Thin section preparation	per sample	4.3.1	2,353.00	20	47,060.00	
b	Microscopic study	per sample	4.3.4	4,232.00	20	84,640.00	
d	Raman Spectrometry/XRD (graphite crystallinity)	per sample	not in SoC	5,000.00	2	10,000.00	As per actual
e	XRD (Graphite crystallinity)	per sample	4.5.1	4,000.00	5	20,000.00	
	Sub-Total 4					**1,61,700.00**	
5	**Geophysical Survey (in house)**						
a	Self-Potential (8-20 line km)- 30 Line KM	per line km	3.3a	29,600.00	30	8,88,000.00	
b	Geophysicist mandays			11,000.00	20	2,20,000.00	
	Sub-Total 5					**11,08,000.00**	
Review							
6	**Geological Work (After Review Drilling)**						
B	**Drilling (in house)**						
a	Core drilling 800m	per meter	2.2.2	11,500.00	800	92,00,000.00	No of samples 250 samples
b	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2000	12	24000	as per actual
c	Land / Crop Compansation	per BH	5.6	20000	12	240000	
d	Transportation of Drill Rig & Truck associated per drill (2 rigs)-Two way	km	2.2.8	36	6000	216000	Transportation from Jamnagar, Gujarat to Almora, Uttarakhand @1500 km for 2 drill-rigs in 2 trucks, to and fro 2(1500*2)
e	Monthly Accomodation Charges for drilling Camp	month	2.2.9	50000	4	200000	
f	Drilling Camp Setting Cost	Nos	2.2.9a	250000	1	250000	
g	Drilling Camp Winding up Cost	Nos	2.2.9b	250000	1	250000	
h	Approach Road making for rugget/hilly terrain	km	2.2.10b	32200	12	386400	As per actual

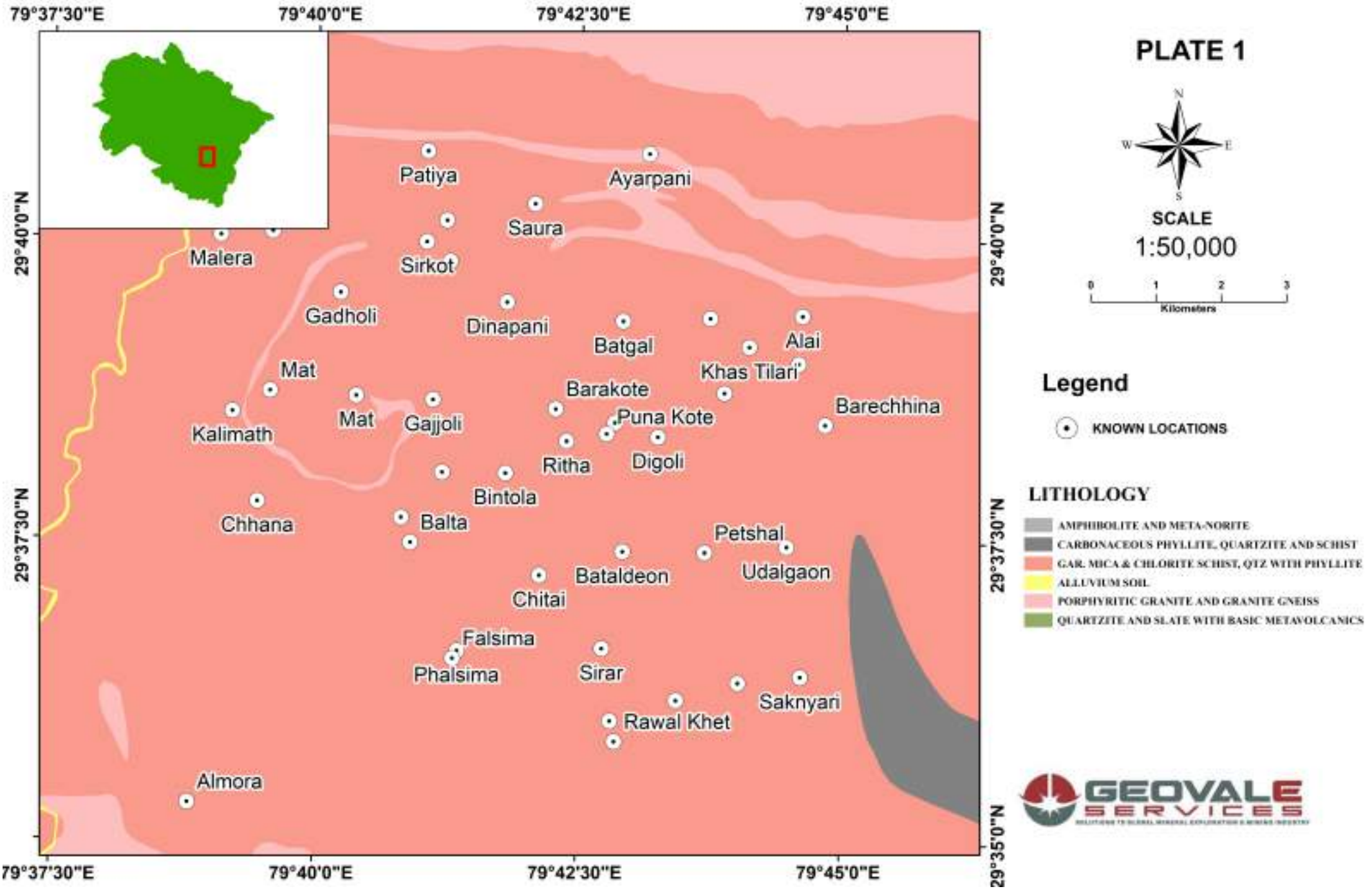
i	Drill Core Preservation	m	5.3.0	1,590.00	300	4,77,000.00	
	Sub-Total 6					**1,12,43,400.00**	
6	**Laboratory Studies (After Review, BH samples)**						
A	**Geochemical Analysis (BH samples)**						250 sample
a	XRF (Major oxides)	per sample	4.1.15a	4,200.00	250	10,50,000.00	BRS
b	External check samples for XRF	per sample	4.1.15a	4,200.00	25	1,05,000.00	
c	XRF 10% sample for 2 additional elememts-Sn, W	per sample	4.1.15b	842.00	25	21,050.00	
d	Check samples XRF 10% samples for 2 elements-- Sn, W	per sample	4.1.15b	842.00	3	2,526.00	
i	Proximate analysis of Graphite	per sample	4.1.16	3000	50	150000	
k	Sampler man-days	per day	1.5.2	5,100.00	44	2,24,400.00	
l	Labor (Man days) (4 labours per sampler)	per labor day	5.7	494.00	176	86,944.00	Amount will be reimbursed as per the notified rates by the Central Labor Comission or respective State Govt. whichever is higher
	Sub-Total 7					**16,39,920.00**	
7	**Petrological studies (BH samples)**						
a	Thin section preparation	per sample	4.3.1	2,353.00	25	58,825.00	
b	Microscopic study	per sample	4.3.4	4,232.00	25	1,05,800.00	
	Sub-Total 8					**1,64,625.00**	
	Total (Sub-Total 1-8)					**2,10,22,215.00**	
8	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	Lumpsum	5.1	2% of approved project cost or 3.8 lakh whichever is lower	1	3,80,000.00	This amount will be reimbursed after submission of the Hard Copies and the soft copy of the final proposal along with Maps and Plan as suggested by the TCC NMET in its meeting while clearing the proposal.
9	Final report preparation	Lumpsum	5.2	Project cost is exceeding ₹150 lakh but less than 300 lakh: A Minimum of ₹7.5 lakh or 3% of the work	1	7,50,000.00	Final report submission, peer review and project conclusion

				whichever is more			
10	Report Peer Review	Lump sum	As per EC	30,000.00	1	30,000.00	
					Project Cost without GST	**2,21,82,215.00**	
					18% GST	**39,92,798.70**	GST will be reimbursed as per actual and as per the applicable notified rate
					Total Project Cost	**2,61,75,013.70**	

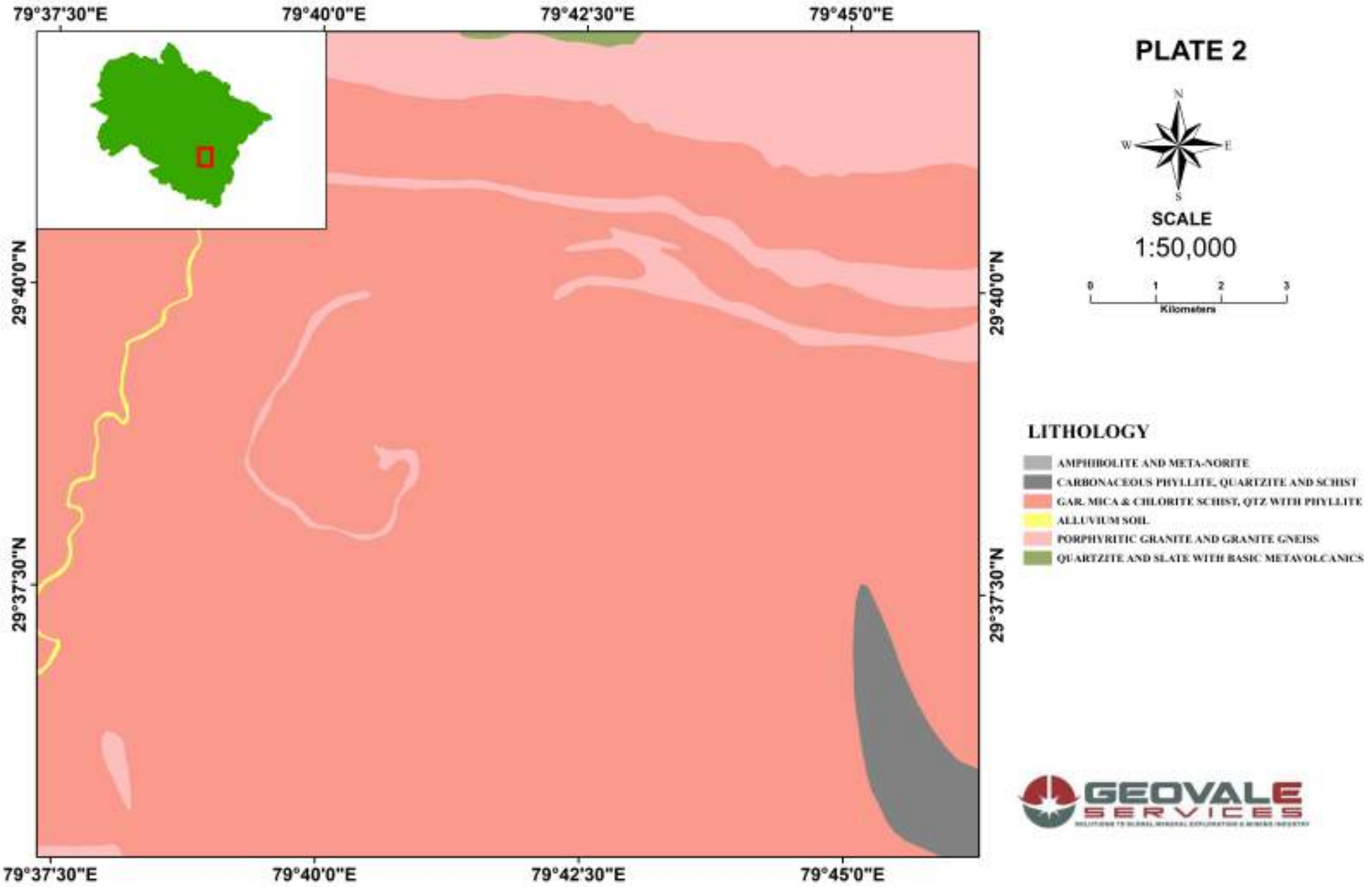
Annexure IV

Summary Expenditure For Reconnaissance Survey (G4 Stage) for Graphite and vanadium in Matena-Sirar Area, Almora District, Uttarakhand		
Sl. No	**Item**	**Estimated Cost in INR**
1	Geological Work	27,68,800
2	Pitting/Trenching	15,20,000
3	Laboratory Studies	24,15,770
4	Petrological studies	1,61,700
5	Geophysical Survey (in house)	11,08,000
6	Geological Work (After Review Drilling)	1,12,43,400
7	Laboratory Studies (After Review, BH samples)	16,39,920
8	Petrological studies (BH samples)	1,64,625
9	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	3,80,000
10	Final report preparation	7,50,000
11	Report Peer Review	30,000
12	GST (18%)	39,92,799
	Grand Total	**2,61,75,014**

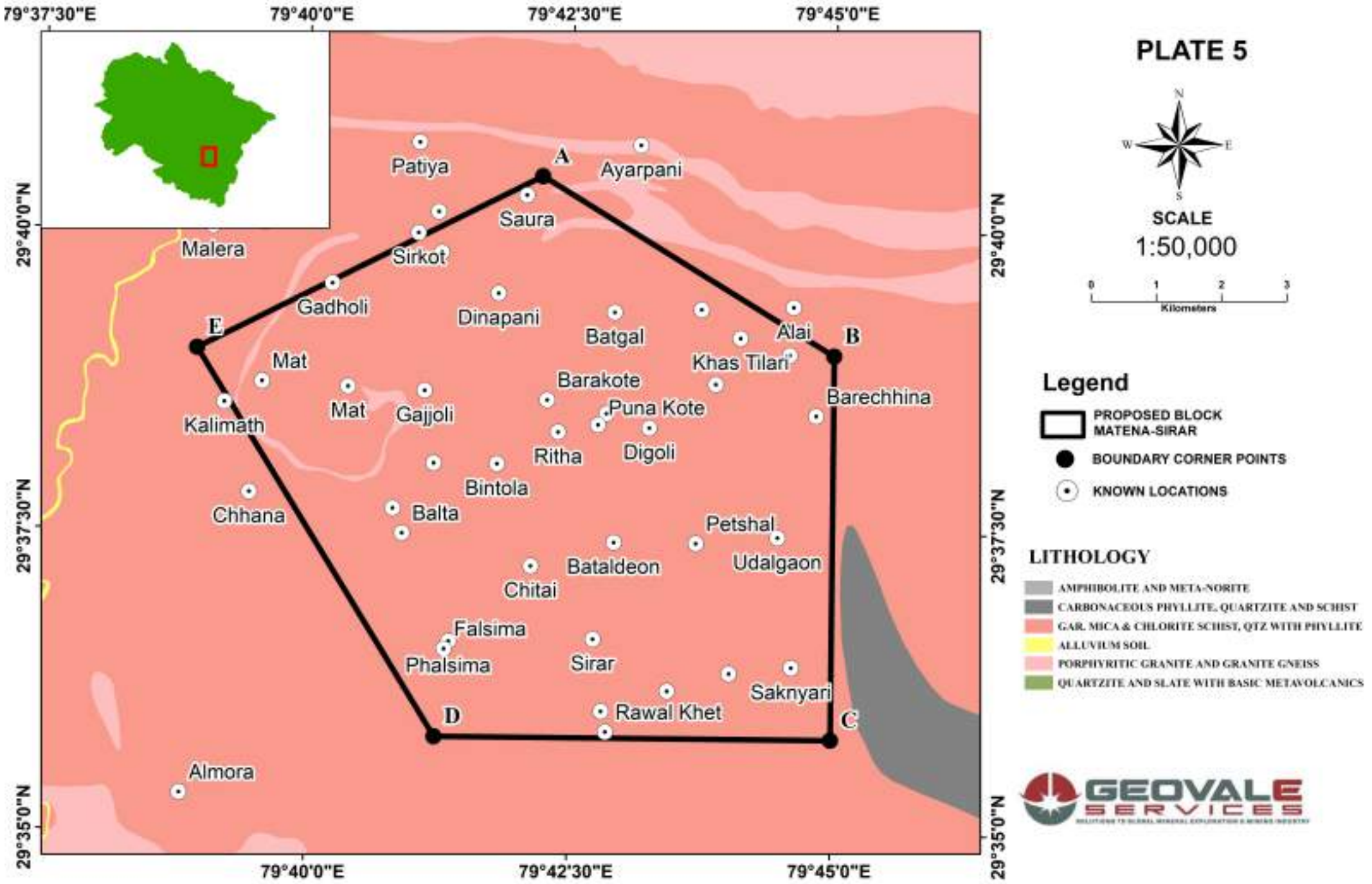
GEOLOGICAL MAP ON 1:50K IN MATENA-SIRAR AREA WITH LOCATION INDEX



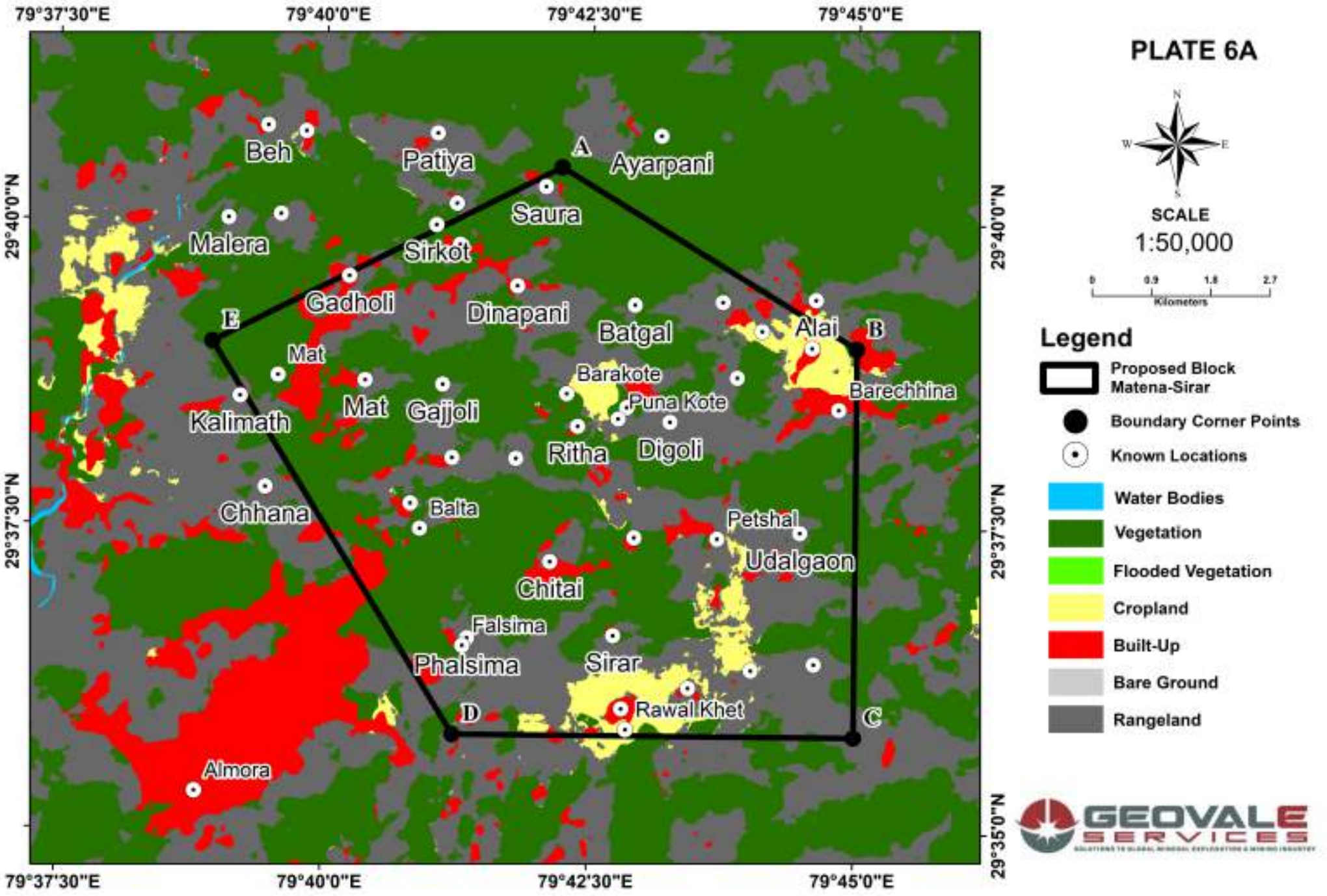
GEOLOGICAL MAP/S ON 1:50K IN MATENA-SIRAR AREA



PROPOSED BLOCK BOUNDARY IN MATENA-SIRAR AREA OVER GEOLOGICAL MAP



PROPOSED BLOCK BOUNDARY IN MATENA-SIRAR AREA OVER LANDUSE AND LANDCOVER (LULC) MAP



PROPOSED BLOCK BOUNDARY IN MATENA-SIRAR AREA OVER ACCESSIBILITY MAP

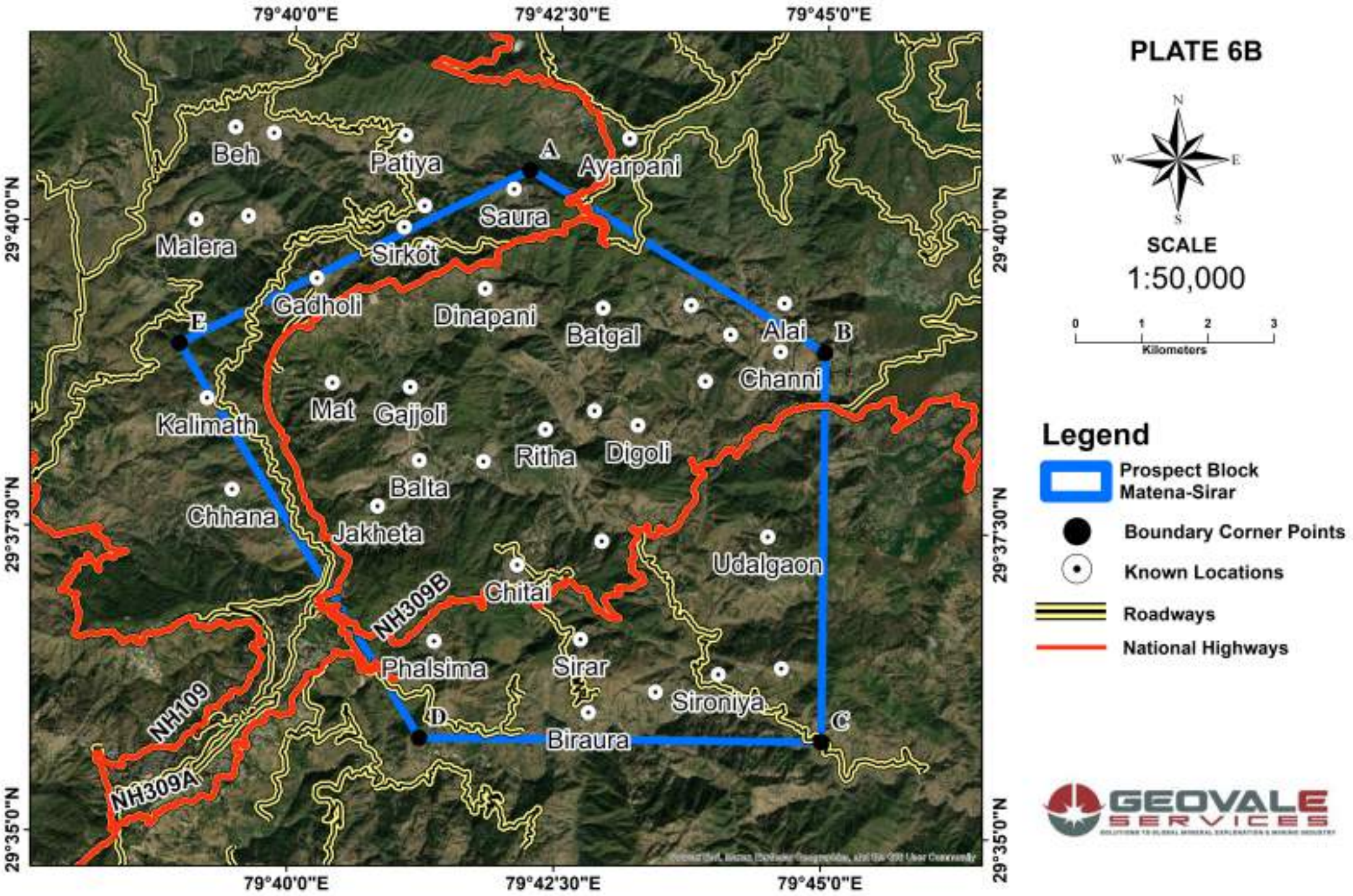


PLATE 6B

N
W
E
S

SCALE

1:50,000

0 1 2 3

Kilometers

Legend

- Prospect Block Matena-Sirar
- Boundary Corner Points
- Known Locations
- Roadways
- National Highways

GEOVALE SERVICES

PROPOSED BLOCK BOUNDARY IN MATENA-SIRAR AREA OVER TOPOGRAPHIC MAP ON 1:50K

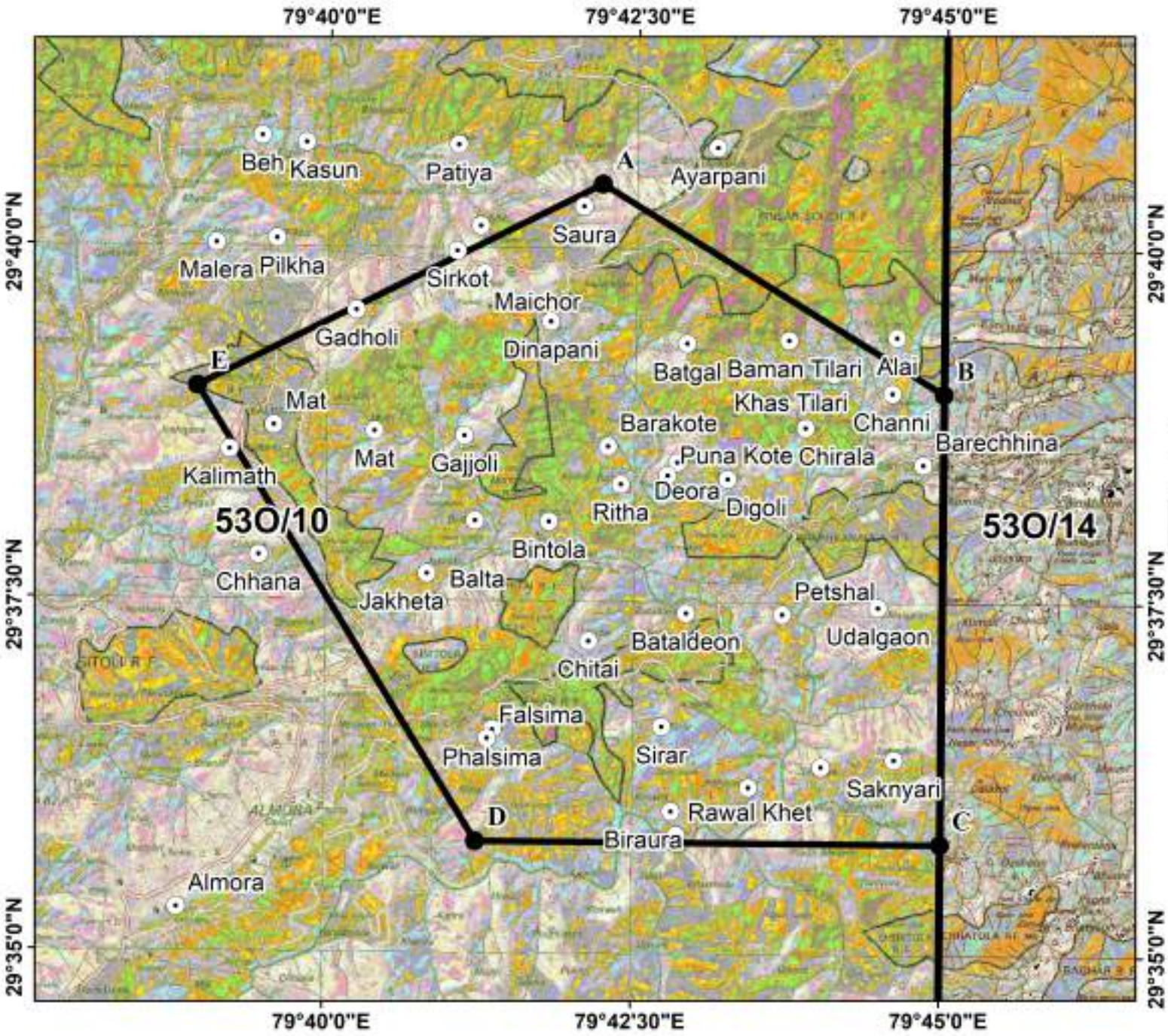


PLATE 7

N
W
E
S

SCALE
1:50,000

0 0.9 1.8 2.7
Kilometers

Legend

- PROPOSED BLOCK MATENA-SIRAR
- BOUNDARY CORNER POINTS
- KNOWN LOCATIONS

GEOVALE SERVICES
SOLUTIONS TO GLOBAL MINERAL EXPLORATION & MINING INDUSTRY