PROPOSAL FOR RECONNAISSANCE SURVEY (G-4) FOR PHOSPHORITE IN KATHYUR BLOCK (9.00 Sq. Km), DISTRICT- DEHRADUN, UTTARAKHAND

COMMODITY: PHOSPHORITE

BY

MINERAL EXPLORATION & CONSULTANCY LIMITED
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SEMINARY HILLS
NAGPUR, MAHARASHTRA

PLACE: NAGPUR
DATE: 16.06.2023

Summary of the Block for Reconnaissance Survey (G-4)

GENERAL INFORMATION ABOUT THE BLOCK

	Features	Details
	Block ID	Kathyur Block
	Exploration Agency	Mineral Exploration & Consultancy Limited (MECL)
	Commodity	Phosphorite
	Mineral Belt	Mussoorie Syncline
	Completion period with entire Time schedule to complete the project	15 months (due to tough terrain and monsoon period)
	Objectives	The objectives of current program would be: 1. Preparation of Geological map at 1:10,000 Scale. 2. To prove the mineralized zones by bedrock/channel sampling from outcrops and trenches. Trenches to be opened at convenient intervals, in the blocks exposing sections of Krol-Tal contact, cherts, phosphate rock and the overlying shales in order to measure the thickness of phosphatic and associated rocks and to study their lateral and vertical relationship. 3. To upgrade the block in G-3 and facilitate the state govt. for auctioning of the block.
	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	Work will be carried out by the proposed agency.
	Name/Number of Geoscientists	Two nos. Geoscientist
	Expected Field days (Geology, surveyor)	Geologist Field days: 120 days
1.	**Location**	The proposed block area for G-4 falls under the majorly under Survey of India Toposheet number 53J/3. The prominent places in the area are Kathyur, Rangargaon, Silkoti, Kaligad, Sera and Sarona of Raipur Block, Dehradun district. Dehradun city is located about 25km west of the block and could be

<table>
<tr><td></td><td></td><td>approached by all weathered metalled roads from Dehradun.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td><table><tr><th>LABEL</th><th>LONGITUDE</th><th>LATITUDE</th></tr><tr><td>A</td><td>78° 07' 58.6921" E</td><td>30° 24' 27.9535" N</td></tr><tr><td>B</td><td>78° 09' 22.6730" E</td><td>30° 25' 06.6742" N</td></tr><tr><td>C</td><td>78° 09' 31.2349" E</td><td>30° 22' 47.0448" N</td></tr><tr><td>D</td><td>78° 08' 08.5050" E</td><td>30° 22' 36.1021" N</td></tr></table></td></tr>
<tr><td></td><td>Villages</td><td>Kathyur, Rangargaon, Silkoti, Kaligad, Sera and Sarona.</td></tr>
<tr><td></td><td>Tehsil/Taluk</td><td>Raipur</td></tr>
<tr><td></td><td>District</td><td>Dehradun</td></tr>
<tr><td></td><td>State</td><td>Uttarakhand</td></tr>
<tr><td>2.</td><td>Area (hectares/ square kilometres)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>9.00 sq.km</td></tr>
<tr><td></td><td>Forest Area</td><td>Chamasari and Motidhar Reserved Forest falls in the Block area</td></tr>
<tr><td></td><td>Government Land Area (Bilanam)</td><td>Data not available</td></tr>
<tr><td></td><td>Charagaha</td><td>Data not available</td></tr>
<tr><td></td><td>Private Land Area</td><td>Data not available</td></tr>
<tr><td>3.</td><td>Accessibility</td><td></td></tr>
<tr><td></td><td>Nearest Rail Head</td><td>Dehradun is the nearest railway station about 25 km.</td></tr>
<tr><td></td><td>Road</td><td>The Maldevta Dubra metaled Road passes nearh the block. Motorable/ metaled roads are available in the area.</td></tr>
<tr><td></td><td>Airport</td><td>Jolly Grant, Dehradun is the nearest airport about 35km.</td></tr>
<tr><td>4.</td><td>Hydrography</td><td></td></tr>
<tr><td></td><td>Local Surface Drainage Pattern (Channels)</td><td>The drainage of the area is of consequent type. The water of southern slope of Mussoorie ridge (between Mussoorie and Agarakhal–Nagani) drains into the Ganga through many streams, the prominent among them are Suswa Nadi, Song, Jakhan Rao, Chandna Rao and Huinl (Hewnal) river. Among these, these Song River carries the maximum water, and its main tributaries are Kaligad, Bandal and Chiphaldi nala. Song River and its tributaries drains the proposed block. The water of the northern slope of Mussoorie</td></tr>
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		ridge, flows through various streams into the Aglar, a tributary of the river Yamuna.
	Rivers/ Streams	Song River.
5.	**Climate**	
	Mean Annual Rainfall	The rains are generally heavy and continue upto early September. The mean annual rainfall is about 250 cm.
	Temperatures (December) (Minimum) Temperatures (June) (Maximum)	The area experiences fairly warm temperate climate with warm summer and cold winter. Particularly, the valley floor is warmer. Winter spans from November to February. The area experiences appreciable amount of rainfall during the monsoons which ranges from the middle of June to middle of September. The prevailing climate is sub-tropical below altitudes of 1,200m from March to June, whereas in areas above 1,600m, the temperature is comparatively lower, a few places experience snow-fall during the winters. By and large the area is forested. The vegetation consists mainly of pine forest in the high hills. The slopes support prolific growth of dense mixed forest of pines and some other trees too with some bushy and shrubby vegetation occurring here and there.
6.	**Topography**	
	Toposheet Number	53J/03
	Morphology of the Area	The area under report lies on the outermost fringe of the Lesser–Himalaya of Garhwal, immediately to the north and north-east of the Siwalik foothills and the Doon Valley. The main topographic feature of the area is the imposing ridge, trending roughly NW-SE to NNW-SSE lying to the north of the broad Dehradun Valley between the rivers Yamuna on the west and Ganga on the east. Numerous spurs branch off in diverse directions from this main ridge. Rugged topography, so characteristic of the Himalaya and typical of any young fold mountain, with hill ranges rising steeply from 1370 meters above m.s.l. to over 1770 meter above m.s.l. and deeply cut valleys, clothes with a verdant cover of Pine, Deodar, Rhododendron and Oaks at higher reaches and bushes and shrubs at lower altitudes dominate the landscape. The geomorphologic character of the alignment of ridges and valleys at places suggest that the topography is somewhat mature and of second order. The synclines forming the ridges e.g. the Lal-Tibba ridge forming the

		core of main Mussoorie Syncline and Castle-Hill-Paritibba ridges–reflecting the minor synclinal digitation.
7.	**Availability of baseline geoscience data**	
	Geological Map (1:50K/25K)	Bhukosh
	Geochemical Map	Bhukosh
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	Gravity & Magnetic Data (Bhukosh)
8.	**Justification for taking up Reconnaissance Survey/ Regional Exploration**	i) The proposed Kathyur Block situated in popular Mussoorie syncline and falls in between famous phosphorite deposits of Maledevta, Chamsari-Paritibba, Surkhet, Dubra and Mathet, which was explored by GSI. Chiphaldi Block marks the beginning of one of the best developed phosphorite bands in Mussoorie area i.e., the Maldeota phosphate band. In Maldeota area, the phosphate band could be divided into two parts–(a) Maldeota East and (b) Maldeota West (Maldeota Main)–the two parts being separated by the Bandal river. The eastern part comprises the following three blocks from east to west i.e. (a) Chiphaldi, (b) Dubra and (c) Mathet, while the western part comprises Maldeota Main Block. The Maldeota Main block lies to the west of Bandal river and covers 1.5 km. of Krol–Tal contact between Tamotwala and Timli villages. Phosphate unit occurs towards the upper part of the The phosphorite bed is conformable with the black cherts and the overlying shales of the Argillaceous member of Tal formation but laterally they are found to have intertonguing relationship. The shale of these areas also phosphatic. Chert member over black chert and associated shales. Wherever the black chert bed is not developed, phosphate unit directly overlies the Krol limestone and dolomite. The average thickness of the phosphate unit varies from 0.40 m. to little over 9.0 metres and the grade of the phosphate band varies from 15% P2O5 to 30% P2O5 ii) The adjacent Paritibba–Chamasari block accounts for the 1050 m of Krol–Tal contact, in which phosphorite band has been traced for a strike length of 950 metres. The main zone of phosphorite, varying in thickness from 0.83 m. to 3.86 m and ranging in grade

		from 16.4% to 31.6% P2O5, occurs at the top of the Chert unit. The upper phosphate band and the underlying intercalations of chert and shale gradually decreases in thickness and interfingers with shale. This phosphatic sequence of Lower Tal Formation and shale also exposed in the proposed block. iii) In view of the above, it is inferred that the grade of the phosphorite in the adjacent two blocks are high and same formation continue in the proposed block. The previous exploration history of the proposed area is not available. Therefore, it is the need of the hour to initiate the systematic exploration to established the continuity of phosphorite deposits.

PROPOSAL FOR RECONNAISSANCE SURVEY (G-4) FOR PHOSPHORITE IN KATHYUR BLOCK, BLOCK-RAIPUR, DISTRICT- DEHRADUN, UTTARAKHAND

1.0.0. Preamble

Agriculture, including its allied sector, is the largest source of income in India. The agricultural sector's success largely depends on the fertilizer industry, which manufactures some of the most important raw materials required for production of crops. Phosphate rock is processed to produce phosphorous, which is one of the three main nutrients most commonly used in fertilizers (the other two are nitrogen and potassium). India's dependency on import at present is to the extent of 90% in case of phosphates either as raw material or finished fertilizers. The increasing demand of phosphorus in the country could be eased with the exploration of new phosphorus deposits of economic importance.

1.1.1 India's phosphate demand

1.1.1 There is no substitute for phosphorus in agriculture. The reserves/resources of chemical and fertilizer grades apatite and rock phosphate in India are very limited. Till the domestic resources of these two minerals are improved, the country has no alternative but to depend on imports. Only about 10-15% requirement of raw material for phosphate fertilizer production is met through indigenous sources. The remaining requirement is met through imports in the form of rock phosphate, phosphoric acid and direct fertilizers. Demand for phosphatic fertilizer is expected to increase gradually in tandem with the growth in population and corresponding increase in food requirements.

1.1.2 India aims to be self-reliant in overall fertilizer production by 2023 as the government is constructing new manufacturing units to reduce dependency on imports. "India to explore indigenous deposits of phosphatic rock, a step towards becoming Aatma Nirbhar in fertilizer production," informed Minister of Chemicals and Fertilizers, Mansukh Mandaviya in the Parliament on Monday, July 26. In addition, the government is likely to spend Rs. 1.19 trillion (US$ 15.97 billion) in FY2021 in the form of subsidy components to the farmers for the fertilizers.

1.2.0 Background

1.2.1 The production of phosphorite/ rock phosphate in India was reported from four State Public Sector mines. Of these, Chhatarpur, Sagar and Jhabua districts of Madhya Pradesh have one

mine each, while Udaipur district of Rajasthan has the fourth mine. Rajasthan continued to be the principal producing State contributing 92% of the total production and the remaining 8% share was contributed by Madhya Pradesh. Of the total reserves/ resources, 34% are in Jharkhand, 31% in Rajasthan, 19% in Madhya Pradesh, 8% each in Uttar Pradesh & Uttarakhand, respectively. (Indian Minerals Yearbook 2019)

1.2.2 In order to improve the availability of phosphatic fertilisers and to reduce the dependence on imports by making India truly Aatma nirbhar in fertilisers, MECL prepared a proposal of the Bijawar block for G-4 level of exploration and put up to the upcoming 46th meeting of TCC, NMET for technical evaluation. Hence the proposal is being put up for reconnaissance survey, which may facilitate state government for auctioning of the block.

2.0.0. Introduction

2.1.0. Block Description

The Kathyur Block area falls in Survey of India Toposheet No. 53J/03 and covers an area of 9.0 sq.km in and around villages Kathyur, Rangargaon, Silkoti, Kaligad, Sera and Sarona of District Dehradun, state Uttarakhand. The block is situated in Mussoorie Syncline. The block location in toposheet is given in PLATE-I. The Co-ordinates of the corner points of the block area both geodetic and UTM are given in Table No:2.1.

Table 2.1

Co-ordinates of Corner Points of Kathyur Block.

LABEL	DMS		UTM (44N)	
	LONGITUDE	LATITUDE	X(E)	Y(N)
A	78° 07' 58.6921" E	30° 24' 27.9535" N	224562.603	3367460.286
B	78° 09' 22.6730" E	30° 25' 06.6742" N	226834.64	3368596.304
C	78° 09' 31.2349" E	30° 22' 47.0448" N	226955.181	3364289.901
D	78° 08' 08.5050" E	30° 22' 36.1021" N	224737.376	3364008.537

2.2.0 Location and Accessibility

2.2.1 The Kathyur Block area falls in Survey of India Toposheet No. 53J/03 and covers an area of 12.0 sq.km in and around villages Kathyur, Rangargaon, Silkoti, Kaligad, Sera and Sarona of District Dehradun, state Uttarakhand. The proposed block is well connected from Dehradun via Maldevta, Sahsradhara and situated approximately 25km to the north east. Dehradun and Rishikesh is the nearest railway stations. Jolly Grant Airport of Dehradun is the nearest airport about 35km away from the block. The important tourist places nearby the proposed block are Mussoorie, Sahsradhara, Haridwar, Dehradun.

2.3.0 Physiography

2.3.1 The proposed area lies on the outermost fringe of the Lesser–Himalaya of Garhwal, immediately to the north and north-east of the Siwalik foothills and the Doon Valley. The main topographic feature of the area is the imposing ridge, trending roughly NW-SE to NNW-SSE lying to the north of the broad Dehradun Valley between the rivers Yamuna on the west and Ganga on the east. Numerous spurs branch off in diverse directions from this main ridge. Rugged topography, so characteristic of the Himalaya and typical of any young fold mountain, with hill ranges rising steeply from 610 meters above m.s.l. to over 2590 meter above m.s.l. and deeply cut valleys, clothes with a verdant cover of Pine, Deodar, Rhododendron and Oaks at higher reaches and bushes and shrubs at lower altitudes dominate the landscape. The geomorphologic character of the alignment of ridges and valleys at places suggest that the topography is somewhat mature and of second order, with anticlines forming valleys e.g., Dhobighat-Manjkhet valley and the synclines forming the ridges e.g., the Lal-Tibba ridge forming the core of main Mussoorie Syncline and Castle-Hill-Paritibba ridges–reflecting the minor synclinal digitation.

2.3.2 The climate is tropical monsoon type, modified to some extent by the effects of altitude and the situation of the area in the continental interior. Winter is fairly severe with occasional snow falls between December and March. Summer season starts from April and the outdoor activities can best be done upto the end of June, when the monsoon breaks out. The rains are generally heavy and continue upto early September. The mean annual rainfall is about 250 cm. The drainage of the area is of consequent type. The water of southern slope of Mussoorie ridge (between Mussoorie and Agarakhal–Nagani) drains into the Ganga through many streams, the prominent among them are Suswa Nadi, Song, Jakhan Rao, Chandna Rao and Huinl (Hewnal) river. Among these, the Song River drain the proposed area, and its main tributaries are Kaligad, Bandal and Chiphaldi *nala*. The water of the northern slope of Mussoorie ridge, flows through various streams into the Aglar, a tributary of the river Yamuna.

2.4.0. Flora & Fauna

2.4.1. The advancing influx of population has scared away the wild animals from the area around the township of Mussoorie and other easily approachable places but the interior parts and densly forested areas are still infested with variety of wild animals, the most common ones panther, wild bear, barking deer, wild goad and jungle fowl.

3.0.0 Regional Geology

3.1.0 Regionally the proposed area falls under Mussoorie Syncline. On a regional scale of Mussoorie Syncline and part of the northern limb of Garhwal Syncline. The following stratigraphic was established by Ravi Shanker, A. Ghose & V.M.K. Puri

Table- 3.1: Litho-stratigraphic classification of Mussoorie Syncline

Garhwa	Schistose phyllites Limestone and quartzite Volcanic	Older
L Trust Unit	Tuffs	Palaeozoic (?)
	Garhwal Thrust	
Subathu formation	Olive shale, shell–marl and limestone.	Ir. to Mid Eocene.
	Unconformity (?)	
Upper Tal Formation	(ii) Limestone member (Shely calcareous grits)	20 m. Lr. and/or Middle Cretaceous
	(i) Quartzite member	1300 m.
(Sequence of quartzite, arkoses, grits and thin grey to green shales, red siltstone, often mudcracked).		
Disconformity		
Lower Tal Formation	(iv) Calcareous member	5 m.
	(iii) Arenaceous member (massive banded siltstone/subgreywacke)	300–500 m.
	(ii) Agrillaceous member	150 m.
	Silty shale/siltstone	
	Splintery shale	
	Finely cleaved, banded shale, often calcareous; buff on weathering.	Mid Jurassic to Lower Cretaceous.
	Black micaceous shale, pyretic, often carbonaceous and sandy.	
	(i) Chert Member	
	Phosphate Unit	10 m.
	Chert Unit	200 m.
---------- Disconformity (Submarine diastem) Overlap--- Transition at places---------		
Transition Zone	Argillaceous limestone (Often phosphatic interlayered with thin streaks of phosphate rock and chert, brecciated at places.	
Upper Krol Formation	Light grey, argillaceous limestone purple and grey shale/slate.	Triassic (?)
	Grey to bluish grey dolomitic limestone and dolomites and associated shales.	

3.2.0 **Tal Formation**: Classification of Tal Rocks Distinctive lithology and its mappability, sharpness and easy recognition of the surface of contacts, warrant by and large, division of the Tal rocks into two formations viz. Lower Tal formation and Upper Tal formation. It has been found that the surface of contact between these formations, represents also a break in sedimentation in parts of the area and sharp change in the environment of deposition, from essentially marine to subaqueous or sub-aerial (non–marine). Thus, the boundary between the Lower and Upper Tal formations is both natural and distinct. The Lower Tal formation is further divisible into four members, viz. Chert, Argillaceous, Arenaceous and Calcareous, depending upon the dominance of chert, shale, sand/ silt or carbonate in the sediments. The

boundaries of the various members are more or less gradational. The upper Tal formation is subdivided into a lower Quartzite member and an upper Limestone member, which is very thin as compared to the Quartzite member.

Lower Tal Formation: **Chert Member** invariably the oldest Tal rocks developed in the area belong to this member, and contain phosphatic rocks towards the top. They comprise of a thick sequence of black, bedded cherts with thin intercalations of light to dark grey shale. The black chert is often thickly bedded and is generally nodular towards its upper portion, but, below the main phosphatic zone. The phosphate content of these nodules seems to vary considerably, by and large, inversely proportional 15 to the size; i.e., smaller the nodule higher is usually the phosphate content. These nodules range in diameter upto two or three centimeters and are usually highly phosphatic, whereas the cherty matrix in which they are embedded is generally non–phosphatic or only mildly so. Tiny phosphatic nodules also occur in the shaly intercalations. Thin bands of black carbonaceous limestone are also found occasionally in the Chert member. Pyrite is often developed in the rocks of the Chert member.

Upper Tal Formation: It is dominantly a quartzitic sequence with a thin calcareous capping and therefore has been divided into a lower quartzite member and an upper Limestone member

3.3.0 **Krol Formation:** The Krols form the oldest rock types in the area mapped normally underlying the Tal formation. Dolomitic limestone and dolomite overlain conformably by yellow weathering argillaceous limestone and calcareous shale constitute the uppermost two members of the Krol formation, mapped in this area (equivalent to the Upper Krol Limestone or Krol ‘E’ stage of Auden, 1935).

Dolomitic Limestone and Dolomite: These rock units occur in thickly bedded sequence sometimes massive in character. Megascopically these rocks are hard, mostly fine grained and compact with very high degree of grain contact, generally light coloured with shades varying from grayish white, cream white to bluish white on fresh surface; at times the rocks omit foetid odour on fracturing. These rocks with characteristic elephant skin weathering, showing cusps and hollows, form high, rugged precipitous hills and scraps. These rocks are highly jointed and bedding is generally obscure in more massive varieties though, occasionally and specially in the upper part, these are banded with grayish white and grayish black bands representing bedding. They are occasionally traversed by ramifying veins of calcite and/or quartz as could be seen at places in Midland and Company Khad area. These rocks show some algal structure, locally.

Argillaceous Limestone: Dolomitic limestone and dolomite are overlain by softer yellow weather argillaceous limestone and calcareous shale. The passage is marked by a prominent change in the topography with the precipitous slopes and scraps composed of former members being replaced by gently slopes in the terrain formed of the uppermost member of the Krol formation. In the latter case, exposures are few because of the soft nature of the rock. Megascopically the argillaceous limestone is comparatively non-resistant, fine grained, grayish to cream in colour on fresh surface and weathering with characteristic yellow coating on weathered surface. In general, these rocks are finely laminated as opposed to the underlying dolomitic rocks. Nodules and pockets of pyrite (limonitised at most places) are present in these rocks.

3.4.0 **Subathu Formation**: The rocks of this formation are developed, intermittently as a ring, around the three "Klippes" considered to have been brought in by the Garhwal Thrust. The exposures, are thus seen between longitude 78°15' E –past Tonetha, Silla and Ringalgarh, and then as a small patch near Kudni in Satengal Klippe, around Darak Klippe; and south of Banali and, above Mathiangaon (in the Song valley) around Banali Klippe. It comprises olive shale, shell marl and foraminiferal limestone. Shell marl is best developed near Ringalgarh and the foraminiferal limestone (Nummulitic) is seen below Ghena.

3.5.0. Geology of the Block

3.5.1 In the area under consideration predominantly comprises rocks of the Tal formation normally overlies the limestone sequence of the Krol formation. The local stratigraphic succession is as below (after GSI)

Lower Tal formation	i) Calcareous member	Silliceous limestone and shales. Banded siltstone (Sub–greywackes)
	ii) Arenaceous member	and associated shales. Grey, black shales, sandy, splintery, calcareous at places.
	(ii) Argillaceous member	Phosphorite with or without chert, the latter underlying or intercalated
	(i) Chert member	with bands of phosphorite.
Disconformity /overlap		
Transition Zone (developed locally)	Argillaceous limestone (often phosphatised) interlayered with thin streaks of phosphorite rock, brecciated at places.	
Krol formation	ii) Light grey to bluish grey argillaceous limestone and associated grey pyretic shales and pink calcareous shales. (i) Grey dolomitic limestone and associated shales.	

4.0.0. Previous Work / Background information

4.1.0 Earliest record of work on the Tal rocks, though not formally named, is found in a paper entitled "Geological Sketch of Musuri and Landour in the Himalaya" by Fisher (1832). Fisher recognized the difference between the Tal rocks of Landour and the Krol limestone of Mussoorie. Later on Medlicott (1864) did the mapping between the Ravi and Ganges rivers. He described and named the Tal rocks in the Tal Valley, east of the Ganga. In 1882, R.D. Oldham traversed from Almora to Mussoorie. Mapping of Middlemiss (1887) and Auden (1934–35) revealed the existence of Tal beds in four separate basins. Although the occurrence of phosphatic rocks in Midlands, Mussoorie was first reported by King (1885) the presence of phosphatic nodules in shales was discovered much earlier by Rev. J. Parson during the course of his search for fossils. The detailed geological background of the area was given by Auden (1934 and 1935), who mapped the Krol belt to Himachal Pradesh and Uttar Pradesh. Auden suggested the following sequence in his progress report for the field season 1934–35.

4.1.1 H.N. Singh (1960-61) mapped the area around Mussoorie and examined the occurrences of phosphatic nodules and rocks. He subdivided the Tal formation into three units viz. Lower, Middle and Upper Tals. His Middle Tal corresponds to the banded shales/slates/greywackes sequence of Auden. He also indicated the occurrence of phosphatic rocks within the black shale and cherts of the Lower Tals. Similarly, a part of Lower Tal–Krol limestone contact zone in the adjoining area of Sirmur district, H.P. was examined with initial success (Dass, 1961). The attempt of exploring the phosphate potentialities of the Lower Tal rocks was continued in the following seasons by R.N.Srivastava and K.N. Ali not only in parts of Mussoorie Syncline, but also in parts of the Srivastava & Roy, 1966, Srivastava and Ali.). Srivastava also favoured the three-fold classification of Tal Formation as suggested by Singh. Thus, the preliminary work of Singh and Srivastava, suggesting the possibility of the entire Lower Tal black shale-chert association overlying the Krol limestone being the only horizon for the occurrence of phosphorite, culminated in the present intensified exploration programme for phosphorite, started in April, 1966. However, the visit of Dr. R. P. Sheldon of U.S.G.S. in March, 1966 to the country and the discovery of the Birmania occurrence in Rajasthan based on the data furnished by the O.N.G.C. gave a great fillip to the programme of search for inland deposits of phosphate in the country. Accordingly, the search for phosphate in Mussoorie area was given a priority of attention resulting in progressive intensification of activities over the entire Mussoorie Syncline. The search for phosphate in the Lower Tal–Upper Krol contact in the adjoining Sirmur district, H.P. and Tehri and Pauri–Garhwal districts, U.P. met with initial success.

4.1.2 The results of the investigations carried out by GSI in the Mussoorie area during the period April, 1966 to February, 1971 (May 1971). The investigation had been divided into various stages which included,

Stage I Reconnaissance mapping, followed by structural mapping on scale 1**:**31,680, in order to single out the potential phosphatic horizons and promising areas for detailed survey and prospecting.

Stage II Detailed and large scale geologic–cum–topographic m apping (with the help of plane-table and tele-scopic alidade) of promising areas and deposits along with prospecting by pitting, trenching, sampling and analysis to assess the reserves, grade and potentialities of the individual deposits.

Stage III Based on the results of the above surface exploration, a programme of sub-surface exploration by drilling was taken up in Nagani, Kimoi, Masrana, Maldeota, Durmala, Paritibba– Chamasari and Bhusti-Jalikhal deposits. The programme of drilling had to be periodically reviewed based on the gradually, emerging picture of the subsurface behaviour, grade, and possible reserves of the phosphatic zones met with at depths. Drilling was intensified in Maldeota (West), Durmala and later on to Bhusti areas, based on available information. A programme of exploratory mining was also taken up in selected blocks, particularly in Maldeota, Durmala and in Bhusti-Jalikhal areas. Efforts, in this direction, were mainly aimed at collection of fresh/unweathered bulk samples of phosphorite from depths for beneficiation and other utilization tests. Apart from these, a number of pits, short inclines and adits were also driven in Masrana, Chamasari and Maldeota areas with a view to ascertaining the depth of weathering and nature of variation in grade of phosphorite from surface down-dip.

4.1.3 From an assessment of the data collected during the above investigation including large scale geological mapping, pitting trenching, sampling and analyses in the various blocks, it could be seen that phosphate rock and phosphorites (i.e., phosphate rock with more than 15% P_2O_5) have been located in almost all the blocks in the Mussoorie Syncline. However, these bands vary in thickness, lateral extent and in chemical grade. Due to operational difficulties, particularly the problems posed by thick cover of superincumbent rocks, soil debris and terrain conditions, it has not been possible to establish precisely the persistence or otherwise of the phosphatic zone along strike in some of the blocks of which special mention needs be made of the Nagani block and the Bagi–Mathiangaon block. A broad picture however has emerged about the general mode of occurrence of comparatively persistent and generally better grade phosphate occurring in bands having thickness of more than one meter which is considered to be the minimum minable thickness. It is also seen that the phosphate band as seen in the different block, generally improves towards SE in thickness, grade and

strike continuity. Thus, from Toneta on the north–west where the phosphate band is 0.45 m to 4.58 m. in thickness with around 10.0% P2O5 content there is general improvement noticed in Kimoi–Masrana–Durmala and Bhusti–Jalikhal–Mathiangaon blocks on the northern limb and in Paritibba and Chamasari and Maldeota area on the southern limb (including the digitated limbs of the Mussoorie Syncline i.e. the Castle Hill Syncline) towards the southeast. Again, in the south–eastern part of the Mussoorie Syncline, phosphate bands located in the various blocks are generally of lesser extent and have given evidences of rapid changes in thickness and discontinuity along strike where effects of sedimentary overlap, and tectonic elimination, apart from original sedimentary pinching and swelling of phosphate bands have been noticed. It is also clear from the available information that the phosphate bands, though predominantly present in the Chert member of the Lower Tal formation, phosphatisation had no doubt also a feature noticeable in the Upper horizons of the underlying Krol formation as seen in Nagani, Chaunpa–Kumali blocks. Based on these data, it has been possible not to summarise the pertinent information about the strike length, thickness, range of P_2O_5 content, weighted average P_2O_5 content of the phosphate bands in the different blocks as is given in the table below**:**

Sl. No.	Block	Strike length of Phosphate band	Thickness	Range of weigthed average P_2O_5 content
1	Toneta–Kaphulti	2 km.	0.60 m.	15 %
2	Kolti	3.2 km.	0.77-1.04 m.	10-12.7 %
3	Kimoi	1.0 km.	0.50-4.48 m.	11-29.3 %
4	Masrana	1.4 km.	0.20-8.58 m.	11-33 %
5	Durmala	1.52 km.	3.0-9.00 m.	23.32 %
6	Silagaon–Bhusti	2.8 km.	0.12-0.65 m.	33.7-36.9 %
7	Bhusti–Jhamtialgaon	3.1 km.	0.46-2.55 m.	26.4-35.5 %
8	Bhusti–Jalikhal	1.32 km.	1.70-6.28 m.	20.5-32.3 %
9	Bagi–Mathiangaon	2.72 km.	0.45-2.95 m.	22.8-32.3 %
10	Nagani	1.25 km.	few cm–2.45 m.	13.9-19.2 %
11	Chaunpa–Kumali	1.2 km.	0.10-2.4 m.	15-34.0 %
12	Bemunda	0.75 km.	0.15-0.90 m.	3-21 %
13	Malas	1.7 km.	0.90-2.40 m.	7-11 %
14	Chiphaldi	2.36 km.	0.20-2.00 m.	21.8-36 %
15	Dubra	2.5 km.	0.13-2.04 m.	17.2-31.1 %
16	Mathet	2.5 km.	0.60-1.20 m.	20.4-32.5 %
17	Maldeota	1.30 km.	0.45-7.8 m.	15-30.9 %
18	Chamasari (Part of northern limb of minor syncline)	1.1 km.	0.55-3.92 m.	11-27.5 %
19	Paritibba (part of Block 'D' northern limb of minor syncline)	1.10 km.	1.2-7.2 m.	15-31.2 %
20	Dhobighat–Manjhkhet	2.00 km.	Traces-1.70 m.	22-30.0 %
21	Paritibba–Chamasari Block E (Southern limb of minor syncline)	1.80 km.	1.00-3.5 m.	14-31 %

It needs be mentioned here that the matrix of the phosphorite, being also formed of carbonate minerals, the samples collected from surface trenches have at times yielded higher content of P_2O_5 due to removal of carbonate during the process of weathering near surface.

Thus, the range of P_2O_5 given in the above table would not be taken to be the grade of the material likely to be met with at depth i.e., below the zone of weathering. It has already been indicated that in some cases a perceptible downward change in grade has been noticed in phosphate bands when sampled along exposure downdip. Keeping this in view, and also for the purpose of exploring the possibilities of economic exploitation of the phosphorites of these blocks, it was considered necessary to undertake a programme of subsurface exploration through drilling and exploratory mining. The drilling programme aimed at collection of information regarding the nature and behaviour of the phosphate zone at depth.

The objective of exploratory mining was also to collected bulk samples of fresh/unweathered phosphorite for beneficiation and other tests for eventual utilization. For the purpose of subsurface explorations, priorities of attention were given to the following blocks**:** (1) Maldeota West, Bhusti, Masrana, Durmala. In view of the structural complexities noticed in Kimoi and Nagani areas, a few exploratory structural holes were drilled in three areas.

4.2.0 Observation and recommendations of previous work

4.2.1 The present area is widely known for its phosphorite occurrences. GSI prospected the Mussoorie area during the period April, 1966 to February, 1971. From an assessment of the data collected during the above investigation including large scale geological mapping, pitting trenching, sampling and analyses in the various blocks, it could be seen that phosphate rock and phosphorites (i.e., phosphate rock with more than 15% P_2O_5) have been located in almost all the blocks in the Mussoorie Syncline. However, these bands vary in thickness, lateral extent and in chemical grade. Due to operational difficulties, particularly the problems posed by thick cover of superincumbent rocks, soil debris and terrain conditions, it has not been possible to establish precisely the persistence or otherwise of the phosphatic zone along strike in some of the blocks of which special mention needs be made of the Nagani block and the Bagi–Mathiangaon block. A broad picture however has emerged about the general mode of occurrence of comparatively persistent and generally better grade phosphate occurring in bands having thickness of more than one meter which is considered to be the minimum minable thickness. It is also seen that the phosphate band as seen in the different block, generally improves towards SE in thickness, grade and strike continuity. Thus from Toneta on the north–west where the phosphate band is 0.45 m to 4.58 m. in thickness with around 10.0% P2O5 content there is general improvement noticed in Kimoi–Masrana–Durmala and Bhusti–Jalikhal–Mathiangaon blocks on the northern limb and in Paritibba and Chamasari and Maldeota area on the southern limb (including the digitated

limbs of the Mussoorie Syncline i.e. the Castle Hill Syncline) towards the southeast. Again, in the south–eastern part of the Mussoorie Syncline, phosphate bands located in the various blocks are generally of lesser extent and have given evidences of rapid changes in thickness and discontinuity along strike where effects of sedimentary overlap, and tectonic elimination, apart from original sedimentary pinching and swelling of phosphate bands have been noticed. It is also clear from the available information that the phosphate bands, though predominantly present in the Chert member of the Lower Tal formation, phosphatisation had no doubt also a feature noticeable in the Upper horizons of the underlying Krol formation as seen in Nagani, Chaunpa–Kumali blocks. Based on these data, it has been possible not to summarise the pertinent information about the strike length, thickness, range of P_2O_5 content, weighted average P_2O_5 content of the phosphate bands in the different blocks as is given in the table below:

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8	Bhusti–Jalikhal	1.32 km.	1.70-6.28 m.	20.5-32.3 %
9	Bagi–Mathiangaon	2.72 km.	0.45-2.95 m.	22.8-32.3 %
10	Nagani	1.25 km.	few cm–2.45 m.	13.9-19.2 %
11	Chaunpa–Kumali	1.2 km.	0.10-2.4 m.	15-34.0 %
12	Bemunda	0.75 km.	0.15-0.90 m.	3-21 %
13	Malas	1.7 km.	0.90-2.40 m.	7-11 %
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16	Mathet	2.5 km.	0.60-1.20 m.	20.4-32.5 %
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19	Paritibba (part of Block 'D' northern limb of minor syncline)	1.10 km.	1.2-7.2 m.	15-31.2 %
20	Dhobighat–Manjhkhet	2.00 km.	Traces-1.70 m.	22-30.0 %
21	Paritibba–Chamasari Block E (Southern limb of minor syncline)	1.80 km.	1.00-3.5 m.	14-31 %

4.3.0. Justification

4.3.1 The proposed Kathyur Block situated in popular Mussoorie syncline and falls in between famous phosphorite deposits of Maledevta, Chamsari-Paritibba, Surkhet, Dubra and Mathet, which was explored by GSI. Chiphaldi Block marks the beginning of one of the best developed phosphorite bands in Mussoorie area i.e. the Maldeota phosphate band. In Maldeota area, the phosphate band could be divided into two parts–(a) Maldeota East and (b) Maldeota West (Maldeota Main)–the two parts being separated by the Bandal river. The eastern part comprises the following three blocks from east to west i.e. (a) Chiphaldi, (b) Dubra and (c) Mathet, while the western part comprises Maldeota Main Block. The Maldeota Main block lies to the west of Bandal river and covers 1.5 km. of Krol–Tal contact between Tamotwala and Timli villages. Phosphate unit occurs towards the upper part of the The phosphorite bed is conformable with the black cherts and the overlying shales of the Argillaceous member of Tal formation but laterally they are found to have intertonguing relationship. The shale of these areas also phosphatic. Chert member over black chert and associated shales are generally phosphatic. Wherever the black chert bed is not developed, phosphate unit directly overlies the Krol limestone and dolomite. The average thickness of the phosphate unit varies from 0.40m. to about 9.0 metres and the grade of the phosphate band varies from 15% P2O5 to 30% P2O5. Maldevta deposit form a part of southern limb of Missoorie Syncline has a strike length of 1280m between Timli and Tamotwala village. Total area of Maldevta Mines (Maldeota) lease area is 84.759 ha. The total geological reserve calculated by PPCL in Maldevta Mines upto 300 MRL is 9.373 million tonnes having 19.20% P_2O_5.

4.3.2 The adjacent Paritibba–Chamasari block accounts for the 1050 m of Krol–Tal contact, in which phosphorite band has been traced for a strike length of 950 metres. The main zone of phosphorite, varying in thickness from 0.83 m. to 3.86 m and ranging in grade from 16.4% to 31.6% P2O5, occurs at the top of the Chert unit. The upper phosphate band and the underlying intercalations of chert and shale gradually decreases in thickness and interfingers with shale.

This phosphatic sequence of Lower Tal Formation and shale also exposed in the proposed block.

4.3.3 In view of the above, it is inferred that the grade of the phosphorite in the adjacent blocks are high and same formation continue in the proposed block. The previous exploration history of the proposed area is not available. Therefore, it is the need of the hour to initiate the systematic exploration to established the continuity of phosphorite deposits.

4.5.0. Objective:

The exploration is proposed with the following objectives:

a) Preparation of Geological map at 1:10,000 Scale.

b) To prove the mineralized zones by bedrock/channel sampling from outcrops and trenches. Trenches to be opened at convenient intervals, in all the blocks exposing sections of Krol-Tal contact, cherts, phosphate rock and the overlying shales in order to measure the thickness of phosphatic and associated rocks and to study their lateral and vertical relationship.

c) To upgrade the block in G-3 level and facilitate the state govt. for auctioning of the block.

5.0.0 Proposed Exploration Scheme

5.1.0 In accordance to the objective set for Kathyur Block, the following scheme of exploration has been formulated. The details of different activities to be carried out are presented in subsequent paragraphs.

5.3.0 Geological Map

The geological map (1:10,000 scale) will be prepared based on structural data, surface samples, borehole locations, trenches etc. carried out during G-4 stage. This map will be used as base map for future work.

5.4.0 Surface Samples (Channel/Chip Samples):

During the large scale mapping 120 nos. of channel/Chip samples will be collected from phosphorite bearing rocks. To delineate the potential phosphate bearing chert - black shale association of Lower Tal Formation.

5.5.0 Exploratory Mining (Trenching)

After surface mapping a provision of shallow trenching of 100 cubic meters has been kept at suitable location to study their lateral and vertical relationship and continuity of the mineralized zone. Locations of trenches on ground will be decided by field geologist based on field observations and depending upon the availability of the trenching site, stability of hill slope etc. On the basis of results, boreholes will be drilled. Trenching shall be done for correlation of mineralized zone on surface up to a depth of 1-2 m after removal of soil/weathered column in the area. A provision of 80 nos. of primary & 12 nos. of check (5% Internal +10% External) trench samples is kept for analysis of P_2O_5.

5.6.0 Laboratory Studies

Chemical Analysis:

i) **Primary Samples**- All the primary (120 Nos) and check samples (18 Nos. around 5% internal and 10% external samples) will be analyzed for 5 radicals i.e., P_2O_5%, SiO_2%, Al_2O_3%, Fe_2O_3%& LOI%. External sample will be sent to NABL accredited laboratory as

external check samples for analysis of 5 radicals i.e., P_2O_5%, SiO_2%, Al_2O_3%, Fe_2O_3%& LOI%.

ii) ICP-MS studies will be done on 20 nos of samples to know the presence of trace elements and REE.

iii) XRD studies will be done on 10 nos of samples to know the presence of mineral phases.

5.7.0 Petrological Studies: Petrological studies will be done on around 10 nos of rock specimen.

5.8.0 Mineragraphic Studies: Mineragraphic studies will be done on around 10 nos of rock specimen.

5.9.0 Whole Rock Analysis: Whole Rock Analysis will be done on around 10 nos of Surface Samples.

5.10.0. Quantum of Work

The details of quantum of work block in Kathyur Block have been furnished below:

Proposed Nature of Quantum for Reconnaissance Survey (G-4) for Phosphorite in Kathyur Block District: Dehradun, Uttarakhand			
Sl. No.	**Item of Work**	**Unit**	**Proposed Quantum of work**
1	**Geological Mapping** (on 1:10,000 Scale)	Sq km	12.00
2	**Geochemical Sampling** Bed rock sampling/channel sampling	Nos.	120
3	**Exploratory Mining**		
	Excavation (Trenching)	Cu. m.	100
4	**Laboratory Studies**		
	A. Surface samples (channel/Chip sampling)		
	i) Chemical Analysis; Primary for 5 radicals i.e., P_2O_5, SiO_2, Al_2O_3, Fe_2O_3 and LOI	Nos.	120
	ii) Internal Check samples (5% of Primary samples) for analysis of 5 radicals i.e., P_2O_5, SiO_2, Al_2O_3, Fe_2O_3 and LOI	Nos.	6
	iii) External Check sample (10 %of Primary samples) for analysis of 5 radicals i.e., P_2O_5, SiO_2, Al_2O_3, Fe_2O_3 and LOI	Nos.	12
	B. Trench samples		
	i) Chemical Analysis; Primary for 5 radicals i.e., P_2O_5, SiO_2, Al_2O_3, Fe_2O_3 and LOI	Nos.	80
	ii) Internal Check samples (5% of Primary samples) for analysis of 5 radicals i.e., P_2O_5, SiO_2, Al_2O_3, Fe_2O_3 and LOI	Nos.	4
	iii) External Check sample (10 %of Primary samples) for analysis of 5 radicals i.e., P_2O_5, SiO_2, Al_2O_3, Fe_2O_3 and LOI	Nos.	8
5	**Physical Studies**		
6	Trace element study by IC-PMS (34 elements)	Nos.	20
7	XRD studies	Nos	10
8	Petrographic Studies	Nos	10
9	Mineragraphic Study	Nos	10

Proposed Nature of Quantum for Reconnaissance Survey (G-4) for Phosphorite in Kathyur Block District: Dehradun, Uttarakhand			
10	Whole rock analysis	Nos.	10
11	Report Preparation (Digital format)	Nos.	1 No.

7.0.0 Cost Estimate

Cost has been estimated based on actual schedule of rates mandated in the circular OM No. 61/1/2018/NMET dated 31st March 2020 for NMET Funded Projects. The total estimated cost is Rs. 143.41 Lakhs. The summary and details of cost estimates is given below:

Sl. No.	Item	Estimated Cost (Rs.)
1	Geology Work	2,274,020
2	Excavation	333,000
	Sub Total (1 to 2)	**2,607,020**
	Additional 3.35 times Himalayan terrain	**8,733,517**
3	Laboratory	2,615,430
4	Exploration Report	567,447
5	Exploration Proposal	226,979
6	Peer Reviewer Charges	10,000
	Grand Total	**12,153,373**
7	GST 18%	2,187,607
	Total:	**14,340,980**
	Say Rs. in Lakhs	**143.41**

7.1.0 Timeline

The proposed exploration programme envisages geological mapping, surface sampling, trenching, sample preparation and laboratory studies, which will be completed within 11 months, geological report preparation with peer review will take 4 months. Therefore, a total of **15 months** is planned for completion of the entire proposed programme in view of tough hilly terrain and monsoon period. Tentative Time schedule/action plan for proposed Reconnaissance Survey (G-4) for Phosphorite is given in **Table No.- 2.**

8.0.0 References:

Bhukosh website, Hosted by GSI, Ministry of mines, Government of India

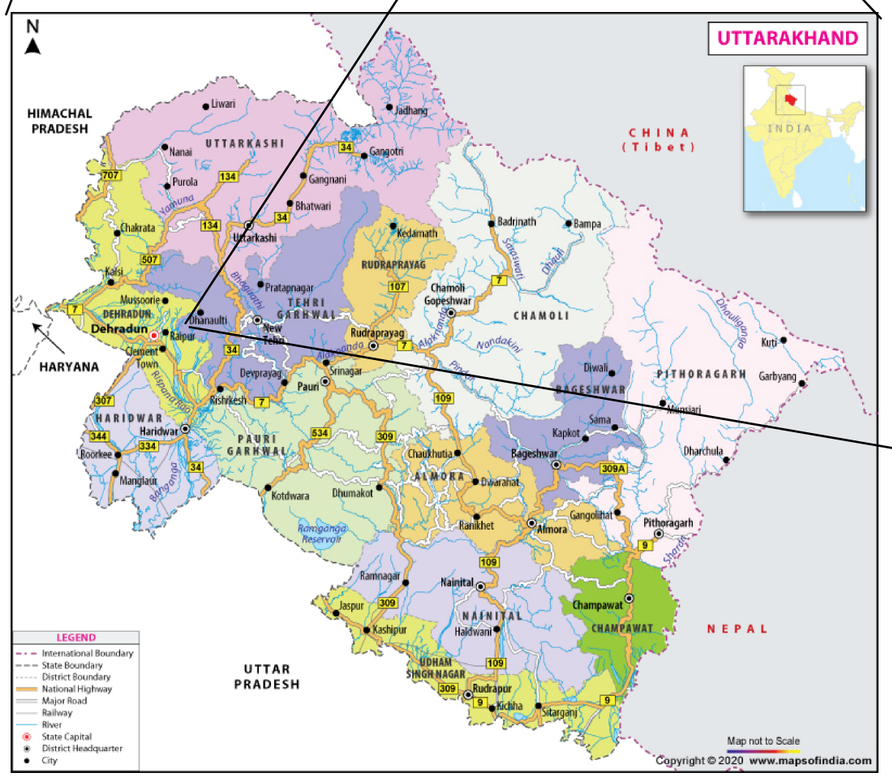
Indian Mineral Yearbook 2019 (Part-III: Mineral Reviews) 58th Edition, Apatite and Rock Phosphate, Government of India Ministry of Mines, Indian Bureau of Mines.

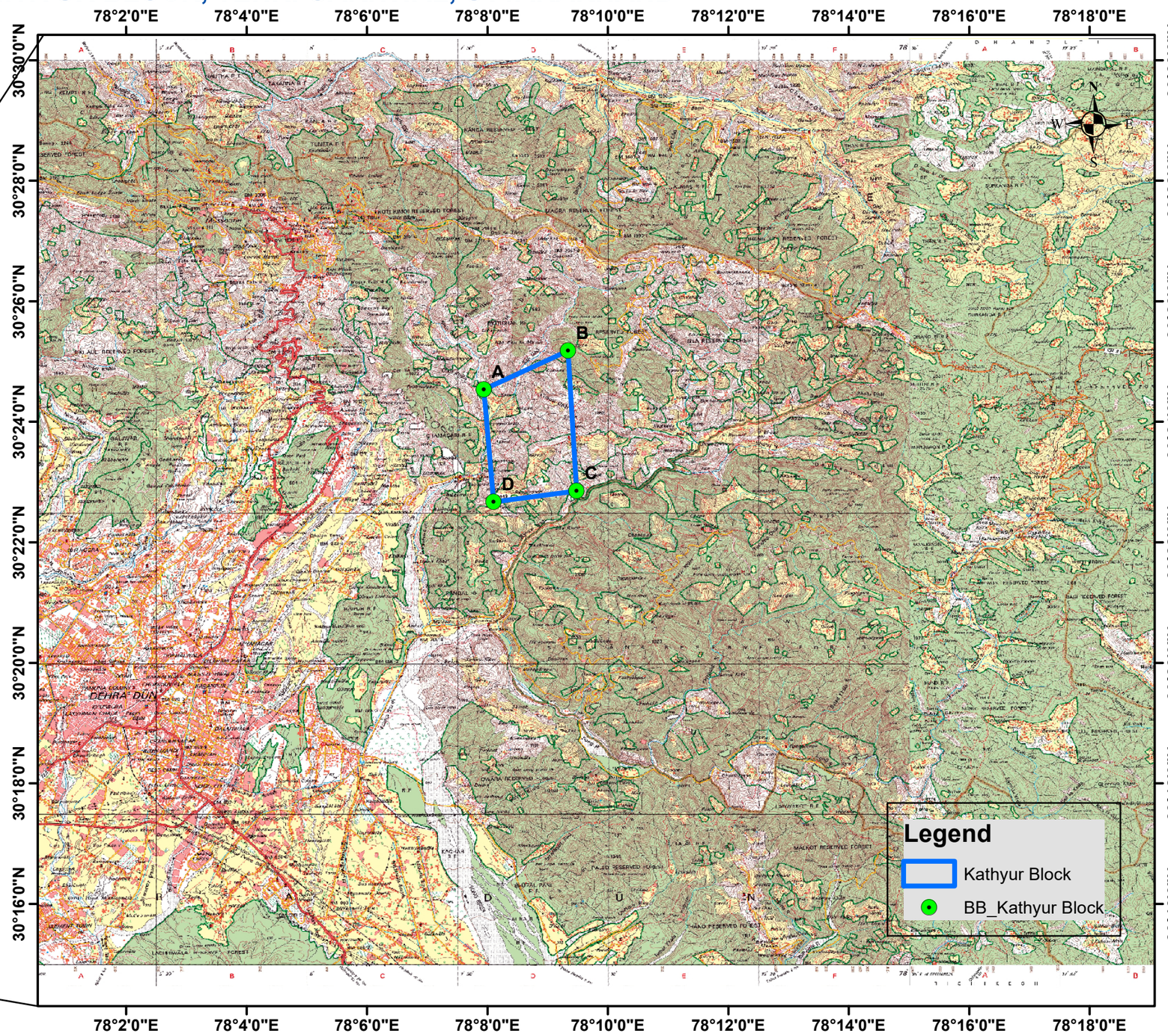
Officers of Geological Survey of India (May 1971): Report on the investigation of Phosphorite in parts of the Mussorie Syncline, Districts Dehradun and Tehri, Uttar Pradesh (April, 1966 to February, 1971).

List of Plates:

1. **Location map of Kathyur Block, District-Dehradun, Uttarakhand.**
2. **Sketch Map of Mussoorie Syncline showing proposed Block.**
3. **Regional Geological map of Kathyur Block, District-Dehradun, Uttarakhand (Source: Bhukosh).**

LOCATION MAP OF KATHYUR BLOCK, TEHRI GARHWAL, UTTARAKHAND





LABEL	LONGITUDE	LATITUDE
A	78° 07' 58.6921" E	30° 24' 27.9535" N
B	78° 09' 22.6730" E	30° 25' 06.6742" N
C	78° 09' 31.2349" E	30° 22' 47.0448" N
D	78° 08' 08.5050" E	30° 22' 36.1021" N

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SKETCH MAP OF THE MUSSOORIE SYNCLINE SHOWING VARIOUS WORKING BLOCKS IN PHOSPHORITE INVESTIGATION, U.P.

78° 5' 10' 15' 20' 78° 25'

30° 30' 25' 20' 15' 30° 10'

SCALE

KMs. 2 0 2 4 6 KMs.

MILES 2 0 2 4 MILES

KEY MAP.

MUSSOORIE

DELHI

SECTOR-I

SECTOR-II

Toneta

Kaphulti

Kolti

Landour

Castle Hill

MOSSOORIE

Midland

Pari

Dhobighat

Surkhet

Chamasari

Masrana

Dhaunuilti

Silgaon

Bhusti

Rajpur

Surkhet

Majgaon

Mathiangaon

Nagani

DEHRADUN

Raipur

Rangargaon

Chaunpa

Kumali

Kukhui

Nagu

Agrakhal

Narendranagar

BLOCK INDEX

- Toneta-Kaphulti
- Kolti
- Kimoi
- Masrana
- Durmala
- Silagaon Bhusti
- Bhusti-Jhamthiogaon
- Bhusti- Jalikhal
- Bagi-Mathiangaon
- Nagani
- Chaunpa Kumali
- Areas showing for mining & drilling
- Areas showing for only drilling
- Bemunda
- Malas-Kasmoli
- Chipholdi
- Dubra
- Mathet
- Maldeota
- Chamasari Paritibba
- Paritibba
- Dhobighat
- Paritibba
- Chamasari

INDEX

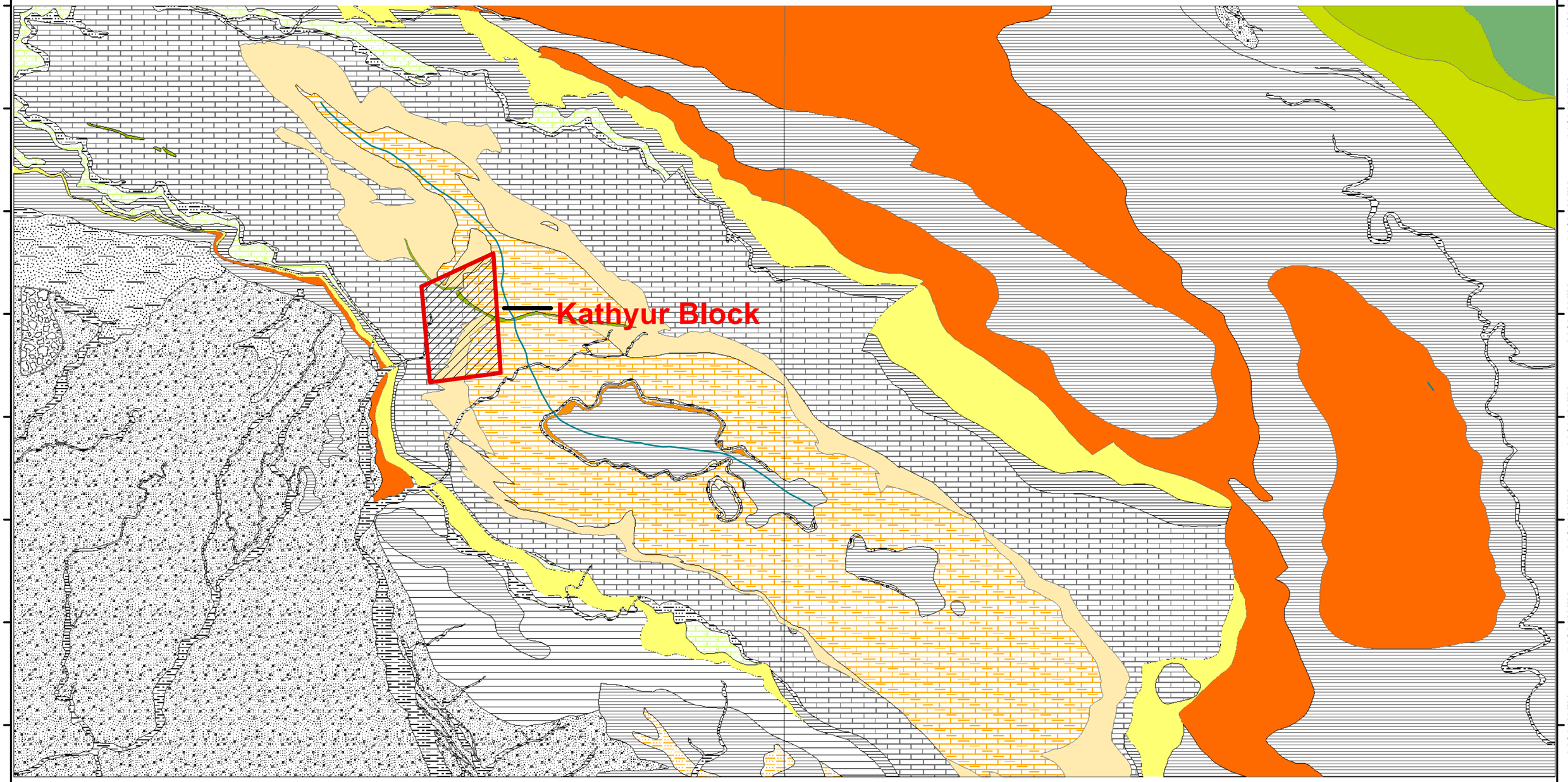
- Tectonic outlines
- 3 Upper Tal
- 2 Lower Tal
- 1 Krol limetone
- Road
- Railway
- Kathyur Block

Plate-II

Regional Geological Map of Kathyur Block, Tehri Garhwal, Uttarakhand

78°0'0"E 78°2'0"E 78°4'0"E 78°6'0"E 78°8'0"E 78°10'0"E 78°12'0"E 78°14'0"E 78°16'0"E 78°18'0"E 78°20'0"E 78°22'0"E 78°24'0"E 78°26'0"E 78°28'0"E 78°30'0"E

30°30'0"N 30°28'0"N 30°26'0"N 30°24'0"N 30°22'0"N 30°20'0"N 30°18'0"N 30°16'0"N 30°14'0"N 30°12'0"N



0 2 4 8 12 16
Kilometers

Source: Bhukosh

Parts of Toposheet Nos.: 53J/3 & 53J/7

Legend

- Kathyur Block
- ARGILLACEOUS LIMESTONE AND CLAY
- BASIC META-VOLCANICS
- BASIC ROCKS (DOLERITE DYKE)
- CARBONACEOUS SHALE, SLATE, GREYWACKE
- CONGLOMERATE, IMPERSISTENT SANDSTONE AND CLAY
- DIAMICTITE, QUARTZITE, SLATE AND BOULDER BED
- GRAVEL, PEBBLE AND BOULDER IN OXIDISED SANDY MTRX
- GRAVEL, PEBBLE, SAND, SILT AND CLAY
- GREY SAND, SILT AND CLAY
- LIMESTONE, DOLOMITIC LIMESTONE WITH SHALE
- MASSIVE SANDY LIMESTONE
- PHYLLITE, QTZ, SHALE,DOLOMITE, TUFF WITH DOLERITE
- QUARTZITE AND SLATE WITH BASIC METAVOLCANICS
- QUARTZITE, LIMESTONE AND OCCASSIONAL CONGLOMERATE
- QUARTZITE, SANDY LIMESTONE AND PEBBLE BED
- QUARTZITE, SHALE, PHYLLITE AND CONGLOMERATE
- QUARTZITE, SILTSTONE, CHERT AND PHOSPHATIC SHALE
- QUARTZITE, SLATE, LENSOIDAL LIMESTONE AND TUFF
- SANDSTONE WITH CLAY INTERCALATION
- SANDSTONE, CLAYSTONE, SILTSTONE AND SHALE
- SHALE WITH LENTICLES OF LIMESTONE
- SHALE, QUARTZITE, LIMESTONE AND DOLOMITE
- SPLINTERY SHALE WITH NODULAR LIMESTONE
- Fold

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78°0'0"E 78°2'0"E 78°4'0"E 78°6'0"E 78°8'0"E 78°10'0"E 78°12'0"E 78°14'0"E 78°16'0"E 78°18'0"E 78°20'0"E 78°22'0"E 78°24'0"E 78°26'0"E 78°28'0"E 78°30'0"E

COST SHEET FOR RECONNAISSANCE SURVEY (G-4) FOR PHOSPHORITE IN KATHYUR BLOCK
DISTRICT: DEHRADUN, UTTARAKHAND
Total Area - 9.00 Sq Km; Completion Time - 15 Months

S.N	Item of Work	Unit	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal for FY 23-24		Remarks
			SoC-Item -Sl No.	Rates as per SoC	Qty.	Total Amount (Rs)	
A	**GEOLOGICAL WORK**						
1	**Mapping (1:10,000), sampling & report writing**						
a	Charges for one Geologist per day at HQ for monitoring, data processing etc.	day	1.3	9,000	60	5,40,000	
b	Charges for Geologist per day at field for mapping, channel sampling and logging.	day	1.3	11,000	120	13,20,000	
c	Labour Charges(4 Nos) for Geologist;	day	5.7	494	480	2,37,120	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher Calculated on the basis of 2 partys
d	Charges for Sampler (1 party)	one sampler per day	1.5.2	5,100	25	1,27,500	
e	Labour Charges (4 Nos)for Sampling Work;	day	5.7	494	100	49,400	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
	Total - A					**22,74,020**	
B	**EXCAVATION**						
1	Trenching	per Cu.m	2.1.1	3,330	100	3,33,000	
	Total - B					**3,33,000**	
	Sub Total (A to B)					**26,07,020**	
	Additional Rate for exploration work in remote and inaccessible terrain in North Eastern States and Hilly Terrain of Himalaya		para 5 of SoC	3.35 times higher than the normal SoC		**87,33,517**	
C	**LABORATORY STUDIES**						
1	**Chemical Analysis**						
i)	**Primary samples (Channel)**						
	a. For 5 radicals i.e. P2O5, SiO2, Al2O3, Fe2O3 and LOI	Nos	4.1.3	9,805	120	11,76,600	
	Check samples Internal (5%) and External(10%)						
	a. For 5 radicals i.e. P2O5, SiO2, Al2O3, Fe2O3 and LOI	Nos	4.1.3	9,805	18	1,76,490	
ii)	**Primary samples (Trench)**						
	a. For 5 radicals i.e. P2O5, SiO2, Al2O3, Fe2O3 and LOI	Nos	4.1.3	9,805	80	7,84,400	
	Check samples Internal (5%) and External(10%)						
	a. For 5 radicals i.e. P2O5, SiO2, Al2O3, Fe2O3 and LOI	Nos	4.1.3	9,805	12	1,17,660	
	Trace element study by ICP-MS (34 elements) Ti, V, Cr, Ni, Ga, Cr, Co, Ba, Sr, Rb, Zr, Y, Nb, Ce, Nd, Ta Cd, Sb, Sc, As, Th, U & REE	Nos	4.1.14	7,731	20	1,54,620	
	XRD study	Nos	4.5.1	4,000	10	40,000	
iii)	**Petrographic Study**						
i	Preparation of thin section	Nos	4.3.1	2,353	10	23,530	
ii	Study of Thin Section	Nos	4.3.4	4,232	10	42,320	
iv)	**Mineragraphic Study**	Nos					
i	Preparation of polished section	Nos	4.3.3	1,549	10	15,490	
ii	Study of polished section	Nos	4.3.4	4,232	10	42,320	
v)	**Whole rock analysis (Major oxides)**	No.	4.1.15a	4,200	10	42,000	
	TOTAL - C					**26,15,430**	
D	**Sub Total (A to C)**					**1,13,48,947**	
E	**Geological Report Preparation**		5.2	**For the projects exceeding Rs. 50 Lakhs but less than 150 lakhs : A Minimum of Rs. 2.5 lakhs or 5% of the work whichever is more**	1	**5,67,447**	EA has to submit the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.

S.N	Item of Work	Unit	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal for FY 23-24		Remarks
			SoC-Item -Sl No.	Rates as per SoC	Qty.	Total Amount (Rs)	
F	**Preparation of Exploration Proposal (5 Hard copies with a soft copy)**	**5 Hard copies with a soft copy**	5.1	**2% of the Cost or Rs. 5 Lakhs whichever is lower**	1	**2,26,979**	EA has to submit 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.
G	**Peer review Charges**		As per EC decision			**10,000**	
H	**Total Estimated Cost without GST**					**1,21,53,373**	
I	**Provision for GST (18% of GST)**	**%**				**21,87,607**	GST will be reimburse as per actual and as per notified prescribed rate
J	**Total Estimated Cost with GST**					**1,43,40,980**	
				or Say Rs. In Lakhs		***143.41***	

Note - If any part of the project is outsourced, the amount will be reimbursed as per the Paragraph 3 of NMET SoC and Item no. 6 of NMET SoC. In case of execusion of the project by NEA on its own, a Certifiate regarding non outsourcing of any component/project is required.

Table: 2 Schedule timeline for Reconnaissance Survey (G-4) for Phosphorite in Kathyur Block
District: Dehradun, Uttarakhand

Sl. No.	Activities	Unit	MONTHS														
			1	2	3	4	5	6	Review	7	8	9	10	11	12	13	14	15
1	Camp Mobilisation	Month																
2	Geologist Days-Field	Day																
3	Trenching	Cu.M																
4	Laboratory Studies	Nos.																
5	Sampling Party	day																
6	Geologist days in HQ	day																
7	Geological Report Writing with Peer review	Month																

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 may be additional to above time line.