PROPOSAL FOR RECONNAISSANCE SURVEY (G-4)

FOR WOLLASTONITE IN BHADLI WOLLASTONITE PROSPECTING BLOCK

(174.00 SQ. KM AREA)

DISTRICT- BANASKANTHA, GUJARAT

COMMODITY: WOLLASTONITE

BY

MINERAL EXPLORATION AND CONSULTANCY LIMITED

DR. BABASAHAB AMBEDKAR BHAWAN

SEMINARY HILLS

NAGPUR (MH)

PLACE: NAGPUR

DATE: January, 2025

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

	Features	**Details**
	Block ID	**Bhadli Wollastonite Prospecting Block**
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	**Wollastonite**
	Mineral Belt	Delhi Supergroup, Gujarat
	Budget & Time schedule to complete the project	174.14 Lakhs & 10 months
	Objectives	The present exploration program (G4) has been formulated on the basis of the outcomes of previous work to fulfill the following objectives: i. Geological mapping on 1:12,500 scale to demarcate the skarn zones developed at the contact of granite and marble along with other lithounits in the area. ii. Collection of bedrock samples by channel sampling, targeting the wollastonite bearing skarn zone and other wollastonite occurrences to prove the surface extension of mineralization. iii. Trenching will be carried out in the mineralized skarn zone identified by geological mapping and bedrock sampling to establish the continuity of the mineralization along strike direction, which is covered by soil. iv. To validate the outcomes of the above activities, scout drilling will be carried out. v. Assessment of quality and quantity of the resources (334) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules-2015.
	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	

<table>
<tr><td></td><td>Expected Field days (Geology, Survey)</td><td>Geologist Party days: Field -180 days & HQ-60 days</td></tr>
<tr><td></td><td></td><td>Sampling Party days: 52 days</td></tr>
<tr><td>1.</td><td>Location</td><td>The proposed Bhadli Wollastonite Block lies in Banaskantha District (Toposheet No: 45D/06, 45D/07), Gujarat. The district headquarter Palanpur is about 50 km south of the block and the nearest town Deesa is approximately 40 km south of the proposed block.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td>
<table>
<tr><th rowspan="2">Sl. No.</th><th rowspan="2">Point</th><th colspan="2">GCS WGS 1984 (DMS)</th><th colspan="2">UTM Zone: 43N (m)</th></tr>
<tr><th>Latitude</th><th>Longitude</th><th>Northing</th><th>Easting</th></tr>
<tr><td>1</td><td>A</td><td>24°31'55.94"N</td><td>72°15'24.27"E</td><td>2715915.14</td><td>222069.65</td></tr>
<tr><td>2</td><td>B</td><td>24°33'50.41"N</td><td>72°19'41.37"E</td><td>2719296.17</td><td>229376.97</td></tr>
<tr><td>3</td><td>C</td><td>24°25'16.86"N</td><td>72°24'35.43"E</td><td>2703332.71</td><td>237357.78</td></tr>
<tr><td>4</td><td>D</td><td>24°20'59.76"N</td><td>72°20'40.75"E</td><td>2695545.10</td><td>230593.01</td></tr>
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</td></tr>
<tr><td></td><td>Villages</td><td>Bhadli, Gangudra, Jegol, Rengali Panswal and Panthawada villages</td></tr>
<tr><td></td><td>Tehsil/Taluk</td><td>Dhanera Taluk</td></tr>
<tr><td></td><td>District</td><td>Banaskantha</td></tr>
<tr><td></td><td>State</td><td>Gujarat</td></tr>
<tr><td>2.</td><td>Area (hectares/ square kilometres)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>174.00 sq.km</td></tr>
<tr><td></td><td>Forest Area</td><td>Mostly Non-Forest 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>The Delhi-Ahmedabad metre-guage railway line passes through Palanpur, Ghoda and Dhanpura villages, the nearest railway station is at Deesa at 40 km south of the block accessible by SH-132 and NH-168.</td></tr>
<tr><td></td><td>Road</td><td>All the villages in the area are well connected to each other and to the highways by motorable roads and tracks. The block is well connected with National Highway 168, State Highway 7 and State highway 132.</td></tr>
<tr><td></td><td>Airport</td><td>The nearest airport is at Gandginagar, which is about 190 km south of the block.</td></tr>
<tr><td>4.</td><td>Hydrography</td><td></td></tr>
<tr><td></td><td>Local Surface Drainage Pattern (Channels)</td><td>The terrain is very flat and mostly covered by cultivated land and has an undulatory topography. Here the low lying area is mostly occupied by the wind-blown sand to the north and south of the block. Central part is occupied by the flood-plains of southwesterly flowing Banas River. A linear ridge extending from Nani-Mahudi village to south of Akhri village in the north east striking NE-SW direction passes through the centre. The area is mainly drained by the south westerly flowing Banas River and its innumerable tributaries. The two dams, the Dantiwada dam and the Sipu</td></tr>
</table>

		dam act as the water reservoirs for water supply though out the year. The Ground water in this area also serves well for irrigation purpose.
	Rivers/ Streams	Banas River and its tributaries
5.	**Climate**	
	Mean Annual Rainfall	Average annual rainfall is 20-30 inches
	Temperature	Minimum temperatures: 5°C (Dec-Feb), Maximum temperatures: up to 46°C (May-June)
6.	**Topography**	
	Toposheet Number	45D/06, 45D/07
	Morphology of the Area	The highest elevation is~250 m above M.S.L. and lowest elevation is ~200 m above M.S.L.
7.	**Availability of baseline geoscience data**	
	Geological Map (1:50K/25K)	Bhukosh Map (1:50000)
	Geochemical Map	NGCM data available in Bhukosh
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	NGPM Gravity and Magnetic data available in Bhukosh
8.	**Justification for taking up Reconnaissance Survey/ Regional Exploration**	I. GSI, 1969 carried out preliminary studies in the adjacent toposheet 45D/11 for wollastonite and reported a well developed wollastonite zone of 250 m long, 25 m wide from the Ghora village area. Inferred reserve was calculated to be 30,000 tonnes in total having an average wollastonite content of 80%. II. GSI, 1992 carried out investigation for wollastonite in parts of toposheet no. 45D/11. Skarns zones were located near the contact of calc-silicate rocks and intrusive granites. Three wollastonite deposits were reported from the area having dimension of 35 m x 4 m located 1.5 km WNW of Ghora, 100 m x 2 m located 1.5 km NE of Dhanpura and 300 m x 2 m also located 1.5 km NE of Dhanpura. The wollastonite of Ghoda and Dhanpura analysed SiO_2 - 46.16%, CaO-44.75%, Fe_2O_3- 0.37%, LOI-3.21% and MgO -0.65% in average. It was also recommended that the assessment of wollastonite was to be carried out in future. III. Wollastonite is a calcium silicate mineral commonly formed in the calcareous skarn. Skarns have developed as a result of the intrusion of granite into the calcareous metasedimentaries. At Ghoda and

		Dhanpura villages, wollastonite skarns had developed over a length of 3 km zone from which several important wollastonite deposits of small to medium dimensions had been recorded (GSI, 1992). In the Ghora area, blades of wollastonite as long as 50 cm was observed, the accessory minerals like garnet, feldspar, hornblende, quartz, calcite and apatite also attain considerable length and size. In the proposed Bhadli Wollastonite Block, similar geological set up prevails where marble and mica schist of Reodar Formation have been intruded by granites of Erinpura Intrusives. This geological setting is conducive for the formation of wollastonite bearing skarn zone. IV. The Commissioner of Geology and Mining (CGM), Gujarat has identified the proposed block for exploration of wollastonite based on previous works. They have formulated the block near the previously reported wollastonite mineralization and geology of the area. The lithology of the area has Sirohi Group representing argillicious shale-carbonate sediments, is in association with Erinpura Granite Gneiss which indicate a suitable anvironment for wollastonite formation. V. The Wolkem Industries Limited is the largest producer of wollastonite in the country, has produced 103590 tonnes of wollastonite, out of total production of 103902 tonnes in the F.Y. 2020-2021. The Wolkem Mines, Udaipur District, Rajasthan is located in the same geological setup, to the north of the proposed block. VI. There is an increasing demand for wollastonite in the international markets, especially in ceramic, metallurgy, paint, construction and as asbestos substitute. Augmentation of wollastonite resources would help India to be in a formidable position and the surplus wollastonite can be exported which in return will generate increased revenue.

PROPOSAL FOR RECONNAISSANCE SURVRY (G-4)
OF WOLLASTONITE IN BHADLI BLOCK (174.00 SQ. KM AREA)
DISTRICT- BANASKANTHA, GUJARAT

1.0.0 INTRODUCTION

1.1.0 Wollastonite is a chemically simple mineral named in honour of English Mineralogist and Chemist Sir W. H. Wollaston. Wollastonite is composed of calcium and silica with a chemical formula CaSiO3. Wollastonite is formed when limestone/ dolomite is subjected to high temperature and pressure in the presence of silica-bearing fluid as in skarn deposits or metamorphic rocks. It occurs as aggregates of bladed or needle-like crystals with hardness of 4.5 to 5 on Mohs scale.

1.2.0 Major deposits of wollastonite have been found in Ajmer, Dungarpur, Pali, Sirohi and Udaipur districts in Rajasthan. Besides, in Ghoda area, Banaskantha district in Gujarat and in Dharmapuri and Tirunelveli districts in Tamil Nadu, occurrences of a few deposits have been reported. As on 1.4.2020, the reserves/resources of wollastonite, as per NMI database, based on UNFC system are placed at 25.11 million tones. Out of the total resources, about 92% (23.11 million tonnes) is located in Rajasthan and the remaining about 8% resources (1.99 million tonnes) in Gujarat. Meagre resources are also located in Tamil Nadu (3,533 tonnes). Production of wollastonite was 1,03,902 tonnes during F.Y. 2020-21.

1.4.0 The use of wollastonite depends on the acicularity or the aspect ratio, i.e., ratio between length and width of a crystal, chemical composition, brightness and fibre length. The consumption of wollastonite is primarily confined to ceramic, metallurgical fluxes and simple filler and coating applications. It improves tear strength, dielectric properties and retains mechanical properties at elevated temperatures. Wollastonite is used primarily in automobile brakes, ceramics, metallurgical processing, paper, paint, plastic, cosmetics, adhesives and as a replacement of asbestos in asbestos-cement boards and sheets. Bulk of the demand for wollastonite in the country is in the Ceramic Industry for the manufacture of floor and wall tiles. In ceramics, wollastonite decreases shrinkage and gas evolution during firing. In metallurgical applications, wollastonite serves as a flux for welding, a source for calcium oxide, as slag conditioners and to protect the source of molten metal during the continuous casting of steel. The addition of wollastonite to metallurgical fluxes provides ready fusibility, good insulating qualities and low viscosity. A new development with very large potential is the use of wollastonite as a sequestration mineral for carbon dioxide, a major factor in global warming. Unlike other methods, sequestration by wollastonite is permanent and results in a mixture of precipitated calcium carbonate and silica that may have filler applications in paper, plastics & rubber.

1.5.0 World reserves of wollastonite exceed 100 millon tonnes. The large deposits of wollastonite have been identified in China, Finland, India, Mexico and the United States. The Ceramic Industry probably accounts for the major consumption of wollastonite worldwide, followed by polymers (plastic and rubber) and paint.

1.6.0 The existing mines in the country are in a position to meet the domestic requirements of the Ceramic Industry as well as export demand. There is an increasing demand for wollastonite in the international markets, especially in ceramic, metallurgy, paint, construction and as asbestos substitute. The exports of processed wollastonite with high- aspect-ratio and powdered wollastonite may have to be encouraged for the betterment of export of value-added products. The augmentation of resources of wollastonite in the States of Tamil Nadu and Gujarat, India would to be in a formidable position and cope with any futuristic demand.

1.2.0 BACKGROUND

1.2.1 The Commissioner of Geology and Mining (CGM), Gujarat has identified several blocks for exploration of wollastonite based on their previous works. They published the information of these blocks in Gujarat's Mineral Wealth. CGM, Gujarat (via official email dated 14/11/2024) sent MECL a NOC approval to take up exploration investigation in those blocks. The proposed Bhadli Wollastonite Prospecting Block (G-4 stage) is one of them.

1.2.2 GSI (1969, 1992) has carried out preliminary investigations for wollastonite in the adjacent toposheet 45D/11 and identified 4 wollastonite bands. The most noticeable and promising band was reported from Ghora village having wollastonite zone of 250 m length and 25 m wide, where the individual wollastonite bands had an average thickness of 0.50 m. The other three wollastonite zones reported from the area had dimensions of 35 m x 4 m located 1.5 km WNW of Ghora, 100 m x 2 m located 1.5 km NE of Dhanpura and 300 m x 2 m also located 1.5 km NE of Dhanpura.

1.2.3 In light of above, a Proposal for Reconnaissance Survey for wollastonite in Bhadli Block over an extent of 174.00 sq km is prepared and submitted for discussion. The details of the proposal are described in the following paragraphs.

2.1.0 LOCATION AND ACCESSIBILITY

The proposed Bhadli Wollastonite Block comprises of 174.00 sq km area and lies in Dhanera Taluk of Banaskantha District (Toposheet No: 45D/06, 45D/07), Gujarat. Bhadli, Gangudra, Jegol, Rengali Panswal and Panthawada villages fall within the proposed area. All the villages in the area are well connected to each other and to the highways by motorable roads and tracks. The district headquarter Palanpur is about 50 km south of the block and the nearest town Deesa is approximately 40 km south of the proposed block. The block is well connected with National Highway 168,

State Highway 7 and State highway 132. The Delhi-Ahmedabad metre-guage railway line passes through Palanpur, Ghoda and Dhanpura villages, the nearest railway station is at Deesa which is accessible by SH-132 and NH-168. The nearest airport is at Gandginagar, which is about 190 km south of the block. The block proposed is bounded by latitude 24° 20' 50" N to 24° 33' 55" N and longitude 72° 15' 20" E to 72° 24' 40" E (Plate No I).

Table 2.1

Coordinates of Corner Points of Proposed Bhadli Wollastonite Block, Banaskantha District, Gujarat

Sl. No.	Point	GCS WGS 1984 (DMS)		UTM Zone: 43N (m)		Area (sq km)
		Latitude	Longitude	Northing	Easting	
1	A	24°31'55.94"N	72°15'24.27"E	2715915.14	222069.65	174.00
2	B	24°33'50.41"N	72°19'41.37"E	2719296.17	229376.97	
3	C	24°25'16.86"N	72°24'35.43"E	2703332.71	237357.78	
4	D	24°20'59.76"N	72°20'40.75"E	2695545.10	230593.01	

2.2.0 PHYSIOGRAPHY AND DRAINAGE

2.2.1 The terrain is very flat and mostly covered by cultivated land and has an undulatory topography. Here the low lying area is mostly occupied by the wind-blown sand to the north and south of the block. Central part is occupied by the flood-plains of southwesterly flowing Banas River. A linear ridge extending from Nani-Mahudi village to south of Akhri village in the north east striking NE-SW direction passes through the centre. The marble form the linear, sharp and narrow ridges whereas the valleys are mostly occupied by granites. The highest elevation is~250 m above M.S.L. and lowest elevation is ~200 m above M.S.L.

2.2.2 The water supply in the area is contributed both by the streams flowing in the area and the groundwater. The area is mainly drained by the south westerly flowing Banas River and its innumerable tributaries. The streams are ephemeral due to the arid climate of the area. Hence two dams, the Dantiwada dam and the Sipu dam act as the water reservoirs for water supply though out the year. The Ground water in this area also serves well for irrigation purpose.

2.3.0 CLIMATE

2.3.1 The climate is semi-arid to arid. From March to June the area experiences summer season during which temperature generally ranges between 42° to 46°C and at night it drop down to range between 18° to 25°C. Monsoon starts in the middle of June and continues up to September in which average annual rainfall is about 20 to 30 inches per season. Winter season spreads from October to middle of March in which temperature decreases up to 5°C to 15°C. February, March, October and November are pleasant months.

2.4.0 FLORA AND FAUNA

2.4.1 The Jasore sloth bear wild life sanctuary falls to the east of the block. It is covered by dense mixed jungle, fairly dense jungle and open mixed jungle. The remaining area in the eastern and southern part of the toposheet consists of dense jungle and open scrub respectively. Except for those areas which are hilly and has boulder pattern in the north, and north-eastern, rest of the area is mostly under extensive and intensive cultivation. The common vegetation of the forest area is Babool (*Acasiaarabica*). The main crops of the area are cotton, tuvar, rice, bajra, jawar, maize, groundnut, wheat and castor and potato etc.

2.4.2 Amongst the fauna encountered are Sloth bear, Rabbit, Deer, Leopard, Wild Bore, variety of Snakes, Lizards and various kinds of migratory birds etc. Birds like parrots, peacock and pigeons are in plenty in this area.

3.1.0 REGIONAL GEOLOGY

3.1.1 Regionally the area is occupied by rocks of Delhi Supergroup intruded by Delhi and post Delhi intrusives of Neoproterozoic to Paleo proterozoic age. A major part of the area is covered by sediments from Holocene age. The Delhi supergroups of rocks in the area are represented by the metasediments of Todgarh, Basangarh formations of Kumbalgarh Group, Jiyapura and Reodar formations of Sirohi Group. The metasediments of Kumbalgarh is predominantly calcareous intruded by Phulad Ophiolite Suite and Sendra-Ambaji Granite Gneiss. The younger Sirohi Group comprises of mica schist, quartzite, migmatite and marble. The delhi supergroup of rocks are subjected to still youger igneous activities represented by basic metavolcanics of Goyari Formation of Sindreth Group and Jhalor Granite of Malani Igneous Suite. Sediments of Vend and Miliolite formations of Porbandar Group of Pleistocene age occur in patches. The fluvio-aeolian- marine sediments of Akhaj, Jnatral, Katpur, Varahi, Rann and Thar desset formations of Holocene age occur in patches. The major part of the area is covered by Aeolian plain.

3.1.2 On the basis of structural and stratigraphical relationship, the tentative stratigraphic succession of the area (After GSI) may be given as follows:

Table: 3.1

Regional Stratigraphic succession (After GSI)

Age	Supergroup/ Group	Formation	Lithology
Holocene		Thar Desert	Fine aeolian sand with silt and kankar
	Narmada-Tapi Group	Varahi	Sand, Silt and Clay
		Katpur	Clay, silt and sand

Age	Supergroup/ Group	Formation	Lithology
		Akhaj	Fine Aeolian sand, Oolitic Calcareous sand
Neoproterozoic	Malani Igneous Suite/ Jalore Plutonics Group	Jalore Granite (Intrusive)	Biotite Granite
	Malani Intrusives	Sankra Dykes	Granite Porphyry
			Doletite
		Erinpura Granite and Gneiss Intrusive	Migmatite
			Granite Gneiss
			Fine grained granite and gneiss
			Medium grained granite
			Coarse grained granite
			Granite
Palaeo-Mesoproterozoic	Sindreth Group	Goyali	Basic Metavolcanics
	Delhi Super group – Sirohi Group	Reodar	Quartzite Marble Mica Schist/ Schist
		Jiyapura	Biotite Schist, Migmatite
		Phulad Ophiolite Suite	Gabbro Epidiorite, Amphibolite, Pyroxene Granulite
	Delhi Super group – Kumbhalgarh Group	Basantgarh Formation	Quartzite, brecciated and cherty at places Biotite Schist Calc Gneiss

3.2.0 GEOLOGY OF THE BLOCK

3.2.1 The proposed block area represents the southernmost part of the Delhi Synclinorium that extends in NE-SW direction from Delhi in the NE to Palanpur in the SW. The Sirohi Group of metasediments of the Ajabgarh seies viz. the mica schist and followed by the marble are the predominant rock types. The northern, north western and south western part of the block are covered by fine aeolian sand with silt and occasional kankar of thar formation and fine aeolian sand of Akhaj Formation. All these rocks in turn are intruded by acid igneous rock represented by granites, granite gneiss and migmatite of Erinpura Granite and Gneiss Formation. Younger acid and basic dykes/veins are dolerite dykes and felsic dykes which have intruded the Delhi Supergroup Rocks.

3.2.2 The details of lithologies present in the block are described in the successive paragraphs. The generalized stratigraphy of the proposed area (After GSI) is given in **Table No 3.2.**

Table No 3.2

Geology of the Block (After GSI)

AGE	SUPERGROUP	FORMATION	LTHOLOGY
Holocene		Thar Desert	Fine aeolian sand with silt and kankar
		Varahi	Sand, silt, clay
		Katpur	Clay, silt and sand
		Akhaj	Fine Aeolian sand
Neoproterozoic		Erinpura Granite and Gneiss	Granite Gneiss Granite
Mesoproterozoic-Palaeoproterozoic	Delhi Supergroup	Reodar Formation (Sirohi Group)	Marble Mica Schist/ Schist

3.2.1.1 **Mica-schist:** These metasedimentaries of Delhi Supergroup are represented in the area by mica schist of Reodar Formation, Sirohi group. This is the predominant rocktype of the area. These rock types along with calc-schist and calc-gneisses had been studied in detail to locate possible wollastonite deposit in the skarn zones by earlier workers.

3.2.1.2 **Marble:** The marble is coarse grained, crystalline and composed of calcite and tremolite/actinolite mainly. Calcite pockets with calc-silicate rock in were also reported by GSI. The formation of the marble bands is attributed to the existance of pure limestone phase within calc silicate rock which when intruded by granitic rocks has given rise to marble in the outermost front of the skarn zone. Wollastonite skarn is developed in the intermediate zone. Marble lithounit to the south east of the block is intricately folded into a synform whose axes trend NE-SW. They occupy continuous ridges and isolated hills in close contact with granite.

3.2.1.3 **Granite:** This is one of the predominant rock types and has intruded all the rocks of the area. This is classified at least into three types a. Porphyritic consisting of abundant coarse feldspar crystals, biotite is also common (Rapakivi structure are very common) b. Medium grained rock showing gradation to porphyritic one (Cross-cutting relationship with the above granite was also reported by earlier workers) c. Gneissic granite-shows faint gneissosity all along the contact with Calc-silicate Rocks. By far contact between porphyritic granite and calc-silicate rook is more important as wollastonite and other skarn minerals have developed very well in this zone.

3.2.1.4 **Acid and basic dykes:** They are intrusive into all the rock types and have been emplaced along the fractures and joints of the rock. Dolerite dykes are predominant in the area, also with a few bands of felsic dykes have intruded into marble and granite.

3.2.2 **STRUCTURE**: Primary bedding plane are defined in the area by the alternate banding of carbonate and silicate layers in a calc-silicate rock. The bedding planes change their orientation due to the repeated folding. These folds belong to different generation, schistosity lineation, faults and lineaments have been observed and reported by previous workers from GSI. The common fold is characterised by tight overturned isoclinal folding with axes along NE-SW.

3.2.3 **MINERALIZATION IN SKARN ZONE:** Skarn zone is an important thermal metamorphic aureole where in characteristic minerals of economic importance have formed. Skarns have developed as a result of the intrusion of granite into the calcareous metasedimentaries, wollastonite is one of the predominant skarn minerals. The wollastonite which was reported by GSI during the F.S. 1991-1992, in the adjoining toposheet 45D/11 was coarse grained, prismatic, often lathshaped, fibrous developed in criss-cross arrangements. At Ghoda and Dhanpura village, wollastonite skarns had developed over a length of 3 km zone from which several important wollastonite deposits of small to medium dimensions had been recorded.

In the Ghora area, blades of wollastonite as long as 50 cm was observed, the accessory minerals like garnet, feldspar, hornblende, quartz, calcite and apatite also attain considerable length and size. It was also noticed by earlier workers that garnet essentially of grossular-andradite variety formed as a result of reaction between impure limestone, silica and iron at the time of formation of the skarn zone.

Genesis of wollastonite: Wollastonite, a naturally occurring CaSiO3 mineral, is found in the calcareous skarn formed as a result of intrusion of acid igneous rock. In an ideal calcareous skarn, the anhydrous minerals developed near the intrusive contact followed by wollastonite rich skarn and ultimately by marble away from the contact zone. The chemical reaction in the formation of wollastonite mineral took place as follows:-

$CaCO_3 + SiO_2 = CaSiO_3 + CO_2$ (g)
(Calcite) (Silica) = (Wollastonite)

Pure limestone gives rise to marble formation after reaction. In this area, the calcareous sediments were deposited in the basin margin with other material forming pure and impure limestone bands alternated with ferromagnesian minerals. These have been subjected to tectonic deformation with F1 fold movement and subsequent to tectonic deformation granitic activity. Tectonic deformation represented by F2 fold movement and final granitic intrusion into the already metamorphosed calcareous rocks formed the wollastonite minerals. The absence of typical anhydrous minerals like garnet hedenbergite-diopside rock in the near vicinity of the contact may indicate that the conditions were not favourable for the formation of an absolute anhydrous skarn zone. On the other hand, garnet, amphibole ore found along with wollastonite in the wollastonite skarn indicate an

environment where reaction took place in semi-hydrous condition. Formation of grosular and andradite garnet is ascribed to the induction of more iron and silica in the reaction from the adjacent bodies.

3.3.0 PREVIOUS WORK AND RECOMMENDATION

3.3.1 Shekar N.C. and Bhan S.K. during the field season 1968-69 carried out preliminary studies for wollastonite on the basis of an occurrence of wollastonite reported in Jan,'69 at Gora village in Banaskantha district by R.C. Mookhey. Calc-gneiss and patches of impure limestone of the Ajabgarh series were observed in the area which was intruded by two phases of granites. Three different disposition of wollastonite bearing veins w.r.t the host rock were reported: 1. Cross cutting the trend of foliation generally in the form of veins in which the long blades of wollastonite occur in 'cross fibre' pattern, 2. Veins or elongated lenses of wollastonite disposed parallel to the foliation, 3. Bounded or slightly oblong lumps of wollastonite, up to 30 cms in diameter embedded in the calc-gneiss, with the axes of elongation being parallel to the foliation.

The mineral assemblage of the wollastonite vein reported from the area showed mineral zoning in which the long blades of wollastonite form the core of the vein, followed on either side by a zone of hornblende and feldspars. All the mineral assemblages were characteristically in large crystalline form, the blades of wollastonite extending in length upto 0.5 metre. A well developed wollastonite zone of 250 m long, 25 m wide having a striking ENE-WSW was reported from the area, where the individual wollastonite vein vary in thickness from a few centimeters to a meter, most of the wollastonite veins had a thickness of 0.50 m. The length of these veins was traced upto 10 m.

Inferred reserves for the 250 m long, upto 10 metres depth, for a cumulative thickness of 5 m of bigger wollastonite bearing portion on the average wollastonite content of 80 percent of the total mineral assemblage was calculated to be 28,000 tonnes. In addition 2,000 tonnes of float ore were inferred in the area, thus the total inferred reserves estimated was about 30,000 tonnes.

3.3.2 Saha T.K. during the field season 1991-1992 carried out investigation for wollastonite in parts of toposheet no. 45D/11, Banaskantha District, Gujrat. 40 sq km area in and around Ghoda-Dhanpura was examined on 1:50,000 scale to locate wollastonite deposit.

The rock-types observed in the area were mica schists and marble of Ajabgarh Group of Delhi Supergroup, intruded by granites, acid and basic veins. Skarns zones were located near the contact of calc-silicate rock and intrusive granites, where the wollastonite skarns were reported to have formed several deposits of medium to small dimensions. Three wollastonite deposits were located in Ghoda-Dhanpura

areas by Saha. T.K. (1992) in addition to the one reported by Shekhar and Bhan (1969).

1. Wollastonite vein of 35 m x 4 m dimension was reported 1.5 km WNW of Ghora. Wollastonite blades vary in length between 2 cm to 30 cm and occur as bands ranging in thickness from 0.5 m to 2 m.

2. 1.5 km NE of Dhanpura wollastonite vein having 100 m x 2 m dimension was reported.

3. 1.5 km NE of Dhanpura another wollastonite vein of 300 m x 2 m dimension was also reported.

The wollastonite of Ghoda and Dhanpura analyses SiO2 - 46.16%, C2e-44.75%, Fe2O3- 0.37%, LOI-3.21% and MgO -0.65%. It was also recommended that the assessment of wollastonite was to be carried out in future.

4.0.0 OBJECTIVE OF THE PROPOSED RECONNAISSANCE SURVEY (G-4 STAGE):

4.1.0 The present exploration program (G4) has been formulated on the basis of the outcomes of previous work to fulfill the following objectives:

I. Geological mapping on 1:12,500 scale to demarcate the skarn zones developed at the contact of granite and marble, which are the possible locales of wollastonite mineralization along with other lithounits in the area.

II. Collection of bedrock samples by channel sampling, targeting the wollastonite bearing skarn zone and other wollastonite occurrences to prove the surface extension of mineralization.

III. Trenching will be carried out in the mineralized skarn zone identified by geological mapping and bedrock sampling to establish the continuity of the mineralization along strike direction, which is covered by soil.

IV. To validate the outcomes of the above activities, scout drilling will be carried out.

V. Assessment of quality and quantity of the resources (334) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

5.0.0 PLANNED METHODOLOGY

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

5.1.0 GEOLOGICAL MAPPING

5.1.1 Geological mapping will be carried out over 174.00 sq.km area on 1:12,500 scale. Rock types, their contact, structural features will be mapped. The main objective of mapping wil be demarcation of skarn zones along the contact of calcaroues formations and younger granite. Surface manifestations of the wollastonite mineralisation along with the skarn zones will be marked on map. 10 numbers of surface samples of various lithounits will be studied for petrology and 05 nos of studies for minerography.

5.2.0 CHANNEL AND BEDROCK SAMPLING

5.2.1 During the course of Geological mapping, channel samples shall be collected from wollastonite bearing calc silicate rocks and other wollastonite occurrences observed in the proposed block area. A total of 100 samples will be collected from mineralized zones which would be analysed for major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI). Bedrock samples would be collected from channels, which would be carried out across the mineralized zones during geological mapping. The length of each sample would be 1.00 m in the mineralized zone.

5.2.2 Additionally 10 bedrock samples would be collected from Granite present in the block area, to ascertain the possibility of REE mineralization in the younger Erinpura Granites. The collected samples would be analysed for REEs and few other elements by whole rock analysis (34 element ICPMS study).

5.3.0 TRENCHING

5.3.1 20 trenches (400 cubic m) have been proposed in the area to ascertain the continuity of wollastonite mineralization identified within the skarn zone at the contact of Granite and Marble identified during geological mapping. A total of 200 Nos of primary & 10% of Primary samples i.e. 20 samples will be sent to NABL External Labs for major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI).

5.4.0 EXPLORATORY DRILLING

5.4.1 Approximately 500.00 m of scout drilling will be carried out for after establishing the wollastonite mineralized zone by means of geological mapping, bedrock sampling and trenching. The boreholes will be carried out only after the positive outcome of above mentioned activities to establish the continuity of mineralization at subsurface.

5.5.0 CORE LOGGING

5.5.1 The borehole cores would be logged systematically. Viz. details of the litho units, colour, structural feature, texture, mineralization, besides the recovery, rock quality designation (RQD) and wollastonite ore type would be recorded.

5.6.0 CORE SAMPLING

5.6.1 The mineralized wollastonite part of drill core will be sampled as Primary sample. The length of each sample will be kept 1.00 m within the ore zone depending upon the thickness of wollastonite and its physical character. The primary core samples for wollastonite will be analysed for major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI). The rocks which are on immediate with hangwall and footwall will also be sampled for 3m at 1.0 m interval, depending upon the intensity of mineralization, change in lithology and core recovery etc.

The surfacial thickness of wollastonite established by earlier workers in the adjacent toposheet 45D/11 is 5 m. A total 10 no of scout boreholes will be carried out having an average length of 50.00 m in each borehole. Based on the maximum mineralized thickness of wollastonite established by earlier workers, 11 nos. of primary samples (Primary Samples: 05 nos, Footwall sample: 03 nos, Hangwall Samples: 03 nos) will be collected from each borehole. Hence, a total 110 numbers of primary core samples will be analyzed for major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI). Around 10% of Primary samples i.e. 11 numbers of sample for wollastonite will be sent to NABL External Labs for analysis of major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI).

05 samples are kept for XRD analysis to determine the phase of Ca bearing mineral .

5.7.0 PETROLOGICAL AND MINERAGRAPHIC STUDIES

5.7.1 Thin and polished section studies on drill cores and bedrock sample will be carried out for ascertaining the petrographic and mineragraphic characteristics. These samples would be drawn from ore zones and host rocks. Mineragraphic Studies will be carried out to ascertain any possible basemetal mineralization in the skarn zone. Samples for mineragraphic studies shall be collected from locations where basemetal mineralization would be observed. Modal analysis would be carried in all the Petrographic samples, for quantitative analysis of wollastonite present in the sample. A provision of 20 specimens for petrographic and 10 specimens for mineragraphic studies has been reserved in the block.

5.7.2 05 bedrock samples will be selected to carry out analysis of aspect ratio of wollastonite.

5.8.0 SPECIFIC GRAVITY

5.8.1 A provision of 05 samples for specific gravity determination has been kept.

6.1.0 QUANTUM OF WORK:

6.1.1 The quantum of work proposed by MECL in Bhadli Wollastonite Block (G-4 Stage of Exploration) is given in Table 6.1.

Table: 6.1

Proposed Quantum of Exploratory Work in Bhadli Block, District- Banaskantha, Gujarat.

Sl. No.	Item of Work	Unit	Proposed Quantum of work
1	Geological Mapping (1:12500)	sq. km	174.00
2	Trenching (1m x 2m x10m) x 20 trenches	Cu. m	400
3	Scout Drilling	m.	500
5	Sample Preparation & Chemical Analysis		
	i) Primary Samples for Major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI).	Nos.	100+200+110= 410
	ii) External Check sample (10 % of Primary samples) for Major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI).	Nos.	10+20+11= 41
	iii) ICPMS Study for REE	Nos.	10
6	XRD analysis	Nos.	5
7	i)Petrographic Studies	Nos.	20
	ii)Modal Analysis of thin section	Nos.	20
8	Mineragraphic Studies	Nos	10
9	Aspect Ratio Analysis foe Wollastonite	Nos	5
10	Specific Gravity studies	Nos	5
11	Report Preparation (Digital format)	Nos.	1

6.2.0 MANPOWER DEPLOYMENT

6.2.1 Manpower deployment List may be provided later.

6.3.0 TIMELINE AND BREAK-UP OF EXPENDITURE

6.3.1 The proposed exploration programme is planned for reconnaissance survey (G-4). The work activities like camp setting, geological work, geophysical survey, drilling & laboratory work, report writing will be completed within 10 months' time. The bar chart showing activities wise time schedule is placed at **Table-6.2.**

Table-6.2.

Estimated time schedule for Reconnaissance Survey (G-4) of Wollastonite in Bhadli Block (174.00 sq km), District: Banaskantha, State: Gujarat [Schedule timeline- 10 months]												
Sl. No.	**Particulars**	**Months**	**1**	**2**	**3**	**4**	**5**	**6**		**7**	**8**	**9**	**10**
1	Camp Setting/ mobilization	Months											
2	Geologist days (1 party)	days											
3	Pitting &Trenching												
4	Drilling (2 rig)	m							REVIEW				
5	Sampling days (1 party)	days											
6	Camp winding	Months											
7	Laboratory Studies	days											
8	Geologist days, HQ	days											
9	Report Writing with Peer Review	days											

6.3.2 Tentative cost has been estimated based on Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. 01/04/2020 and the total estimated cost is **Rs. 174.14 Lakh.** The summary of tentative cost estimates for Reconnaissance Survey is given in **Table No.-6.3** and details of tentative cost estimates are given as Annexure-I.

Table No.-6.3

Sl. No.	Item	Total
1	Geological Work	3,275,968
2	Trenching	1,332,000
3	Drilling	6,896,280
4	Laboratory Studies	2,259,700
	Sub total	**13,763,948**
5	Report	688,197
6	Peer Review	30,000
7	Proposal Prepration	275,279
	Total	**14,757,424**
8	GST (18%)	2,656,336
Total cost including 18% GST		**17,413,761**
SAY, in Lakhs		**174.14**

7.0.0 JUSTIFICATION

7.1.0 GSI, 1969 carried out preliminary studies in the adjacent toposheet 45D/11 for wollastonite and observed three different disposition of wollastonite bearing veins having: 1. Cross cutting the trend with the foliation, 2. parallel trend to the foliation and 3. lumps of wollastonite having 30 cm diameter embedded in calc-gneiss. A well

developed wollastonite zone of 250 m long, 25 m wide was reported from the area. Inferred reserve for the 250 m long zone and wollastonite float ore having an average wollastonite content of 80 percent was calculated to be 30,000 tonnes in total.

7.2.0 GSI, 1992 carried out investigation for wollastonite in parts of toposheet no. 45D/11, covering 40 sq km area in and around Ghoda-Dhanpura to locate wollastonite deposit. Skarns zones were located near the contact of calc-silicate rock of Ajabgarh Group and intrusive granites. Three wollastonite deposits were reported from the area having dimension of 35 m x 4 m located 1.5 km WNW of Ghora, 100 m x 2 m located 1.5 km NE of Dhanpura and 300 m x 2 m also located 1.5 km NE of Dhanpura. The wollastonite of Ghoda and Dhanpura analysed SiO2 - 46.16%, CaO-44.75%, Fe2O3- 0.37%, LOI-3.21% and MgO -0.65%. It was also recommended that the assessment of wollastonite was to be carried out in future.

7.3.0 Wollastonite is a calcium silicate mineral having chemical formula CaSiO3, it is commonly formed in the calcareous skarn. Skarns have developed as a result of the intrusion of granite into the calcareous metasedimentaries, Wollastonite is one of the predominant skarn minerals. In the adjoining toposheet 45D/11, GSI (1969, 1992) has carried out preliminary investigations for wollastonite where the calcitic marble and calc gneiss lithology of Kumbhalgarh Formation, Ajabgarh Group, Delhi Supergroup has been intruded by granites and granite gneisses of Erinpura Intrusives, resulting in the development of skarn zones. In an ideal calcareous skarn, the anhydrous minerals develops near the intrusive contact followed by wollastonite rich skarn and ultimately by marble away from the contact zone. At Ghoda and Dhanpura, wollastonite skarns had developed over a length of 3 km zone from which several important wollastonite deposits of small to medium dimensions had been recorded. In the Ghora area, blades of wollastonite as long as 50 cm was observed, the accessory minerals like garnet, feldspar, hornblende, quartz, calcite and apatite also attain considerable length and size.

The proposed Bhadli Wollastonite Block, similar set up prevails where marble and mica schist of Reodar Formation, Ajabgarh Group, Delhi Supergroup have been intruded by granites of Erinpura Intrusives. The geology in the central part of the proposed block shows inliers of older marble surrounded by younger granites. This geological setting is conducive for the formation of wollastonite bearing skarn zone.

7.4.0 The Commissioner of Geology and Mining (CGM), Gujarat has identified the proposed block for exploration of wollastonite based on previous works. They have formulated the block near the previously reported wollastonite mineralization and geology of the area. The lithology of the area has Sirohi Group representing argillicious shale-carbonate sediments, is in association with Erinpura Granite Gneiss which indicate a suitable anvironment for wollastonite formation.

7.5.0 The Wolkem Industries Limited is the largest producer of wollastonite in the country, has produced 103590 tonnes of wollastonite, out of total production of 103902 tonnes in the F.Y. 2020-2021. The Wolkem Mines, Udaipur District, Rajasthan is located in the same geological setup, to the north of the proposed block.

7.6.0 There is an increasing demand for wollastonite in the international markets, especially in ceramic, metallurgy, paint, construction and as asbestos substitute. Augmentation of wollastonite resources would help India being in a formidable position and help to export the surplus wollastonite which in return will generate increased revenue.

8.0.0 References:

- Shekar N.C. and Bhan S.K., A Note On The Preliminary Investigation For Wollastonite At Gora Village, Banaskantha District, Gujarat, Field Season 1968-69, GSI
- Saha T.K, Investigation for Wollastonite in Parts of the Toposheet No. 45 D/11, Banaskantha District, Gujarat (Field Season 1991-92), GSI
- Basu S., Garg S., Report on National Geochemical Mapping In Toposheet 45D/07 In Banaskantha District, Gujarat And Sirohi District, Rajasthan
- Indian Mineral year Book 2021, Part-III: Minerals Review, 60th Edition, Wollastonite, Published March 2023, IBM

9.0.0 List of Plates:

i. Plate-I: Location Map of Bhadli Wollastonite Block in Toposheet no. 45D/06, 45D/07, Banaskantha District, Gujarat.
ii. Plate-II: Regional Geological Map showing Bhadli Wollastonite Block (Source: Bhukosh, GSI).
iii. Plate-III: Geological map of Bhadli Wollastonite Block (Scale 1:50,000, Bhukosh, GSI).

10.0.0 List of Annexures:

- Estimated Time Schedule and Details of Tenative Cost for Reconnaissance Survey (G-4) for Wollastonite in Bhadli Block (Area- 174.00 sq. Km), Districts: Banaskantha, State: Gujarat

Geological Map showing location of Proposed Bhadli Wollastonite Block, Banaskantha District, Gujarat.

72°17'30"E 72°20'0"E 72°22'30"E

24°32'30"N 24°30'0"N 24°27'30"N 24°25'0"N 24°22'30"N 24°20'0"N

N

Legend

PROPOSED BHADLI WOLLASTONITE BLOCK

LITHOLOGY

- CLAY, SILT AND SAND
- FINE AEOLIAN SAND
- FINE AEOLIAN SAND, SILT WITH KANKAR
- GRANITE
- GRANITE GNEISS
- MARBLE
- MICA SCHIST / SCHIST
- MIGMATITE
- SAND, SILT AND CLAY

DYKE

- DOLERITE
- FELSIC DYKE
- FOLD
- FAULT

STRUCTURAL DATA

- BEDDING
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)
- JOINT

1:50,000

0 0.5 1 2 3 4 Kilometers

Regional Geological Map showing location of Proposed Bhadli Wollastonite Block, Banaskantha District, Gujarat.

72°5'0"E 72°10'0"E 72°15'0"E 72°20'0"E 72°25'0"E 72°30'0"E 72°35'0"E 72°40'0"E

24°40'0"N 24°35'0"N 24°30'0"N 24°25'0"N 24°20'0"N

Legend

PROPOSED BHADLI WOLLASTONITE BLOCK

LITHOLOGY

- BASIC META-VOLCANICS
- BIOTITE GRANITE
- BIOTITE SCHIST
- BIOTITE SCHIST, MIGMATITE
- CALC-GNEISS, CALC-SCHIST
- CALCITIC MARBLE AND CALC-GNEISS
- CLAY, SILT AND SAND
- COARSE GRAINED GRANITE
- DOLERITE
- EPIDIORITE,AMP.LITE,PYX.GRANULITE,GABRO&HB SCHIST
- FINE AEOLIAN SAND
- FINE AEOLIAN SAND, SILT WITH KANKAR
- FINE GRAINED GRANITE AND GNEISS
- GABBRO
- GRANITE
- GRANITE GNEISS
- GRANITE PORPHYRY
- MARBLE
- MEDIUM GRAINED GRANITE
- MICA SCHIST / SCHIST
- MIGMATITE
- OOLITIC CALCAREOUS SAND
- QUARTZ VEIN/REEF
- QUARTZITE
- QUARTZITE, BRECCIATED AND CHERTY AT PLACES
- RHYOLITE PORPHYRY
- SAND, SILT AND CLAY
- FOLD
- FAULT
- SHEAR

STRUCTURAL DATA

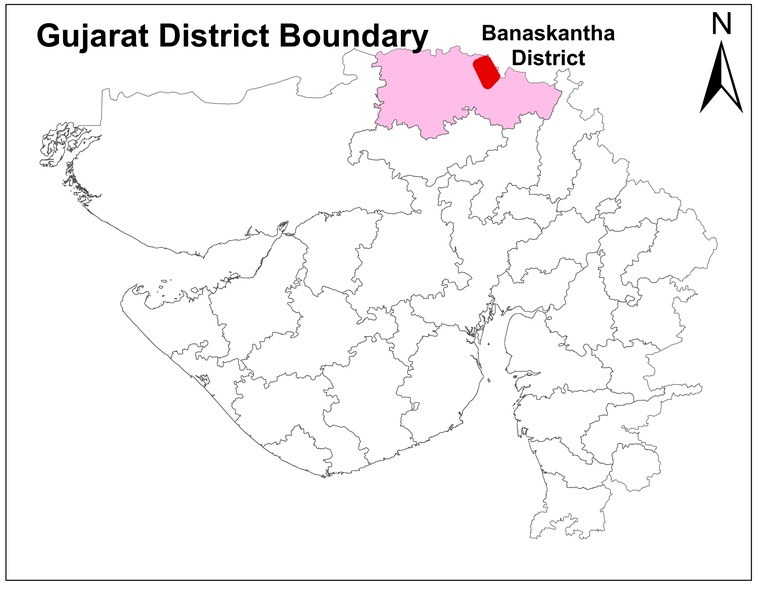
- AXIAL PLANE
- BEDDING
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)
- JOINT

1:100,000

0 1 2 4 6 8 Kilometers

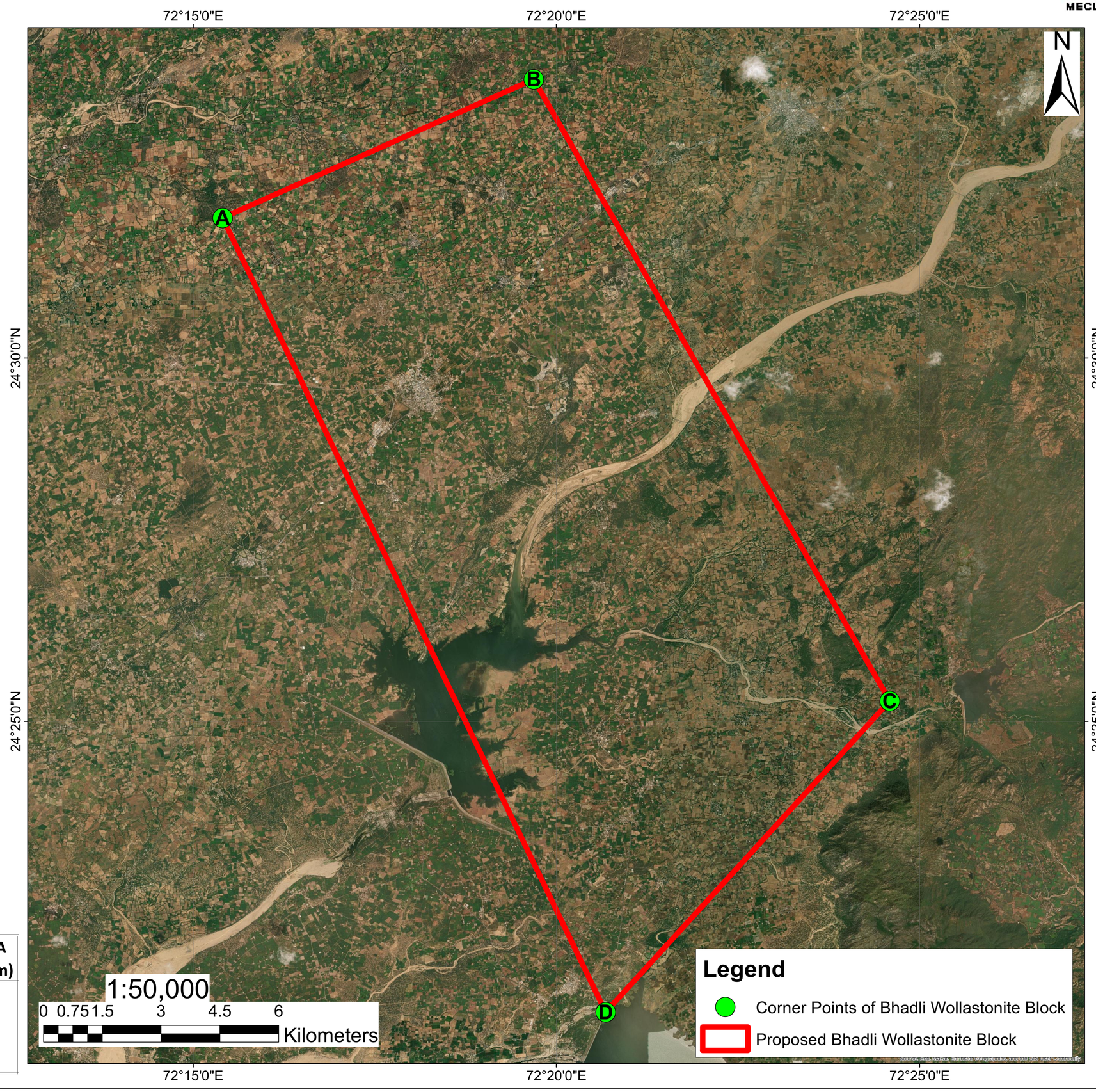
Location Map showing proposed Bhadli Wollastonite Block (G-4) (174.00 sq km), District: Banaskantha, State: Gujarat

MECL



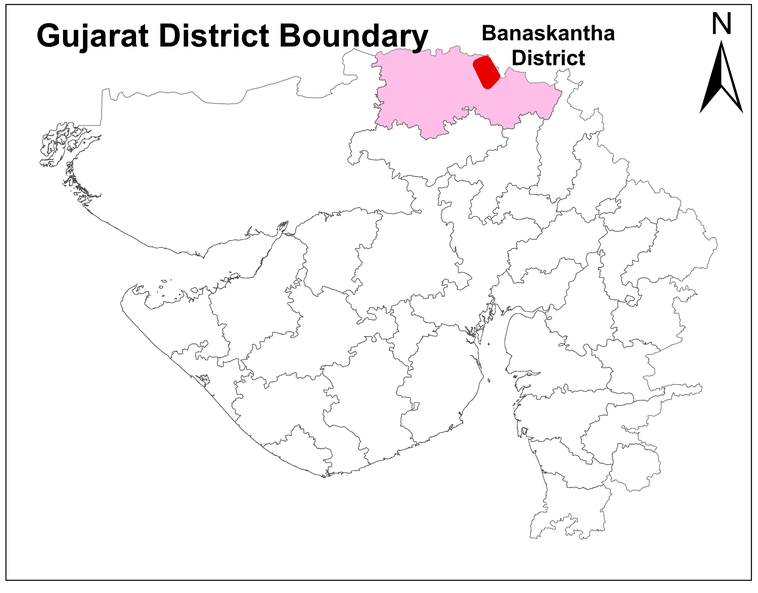
Coordinates Of Corner Points of Bhadli Wollastonite Block for G-4 exploration over 174.00 sq km area, Bnaskantha District, Gujarat.

SL	POINT	DD Coordinates (DD)		UTM Coordinates (43N)		AREA
		Latitude	Longitude	Northing (m)	Easting (m)	(sq km)
1	A	24.53	72.26	2715915.14	222069.65	174
2	B	24.56	72.33	2719296.17	229376.97	
3	C	24.42	72.41	2703332.71	237357.78	
4	D	24.35	72.34	2695545.10	230593.01	



Location Map showing proposed Bhadli Wollastonite Block (G-4) (174.00 sq km), District: Banaskantha, State: Gujarat

MECL



Coordinates Of Corner Points of Bhadli Wollastonite Block for G-4 exploration over 174.00 sq km area, Bnaskantha District, Gujarat.

SL	POINT	DD Coordinates (DD)		UTM Coordinates (43N)		AREA
		Latitude	Longitude	Northing (m)	Easting (m)	(sq km)
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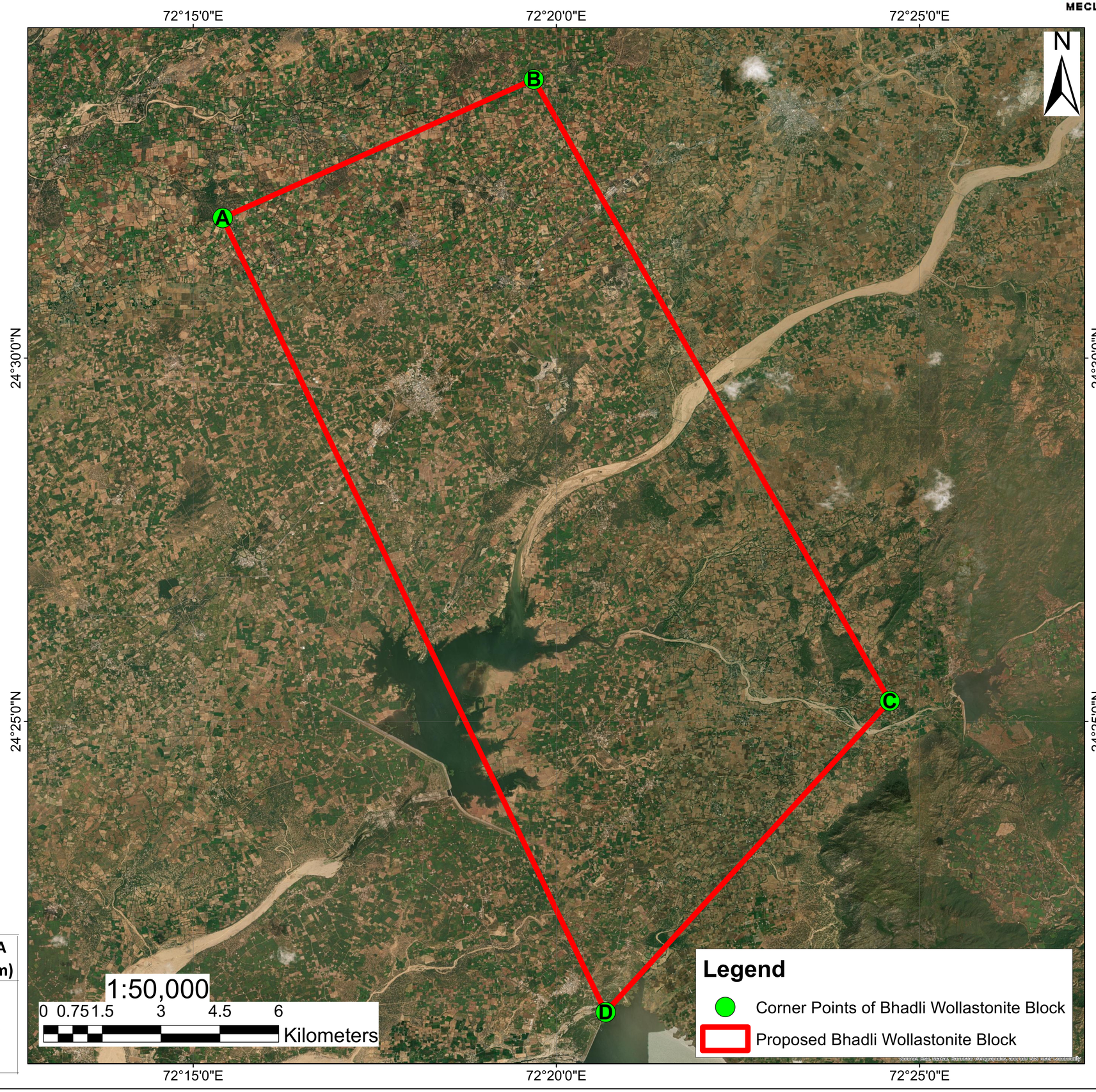

Regional Geological Map showing location of Proposed Bhadli Wollastonite Block, Banaskantha District, Gujarat.

72°5'0"E 72°10'0"E 72°15'0"E 72°20'0"E 72°25'0"E 72°30'0"E 72°35'0"E 72°40'0"E

24°40'0"N 24°35'0"N 24°30'0"N 24°25'0"N 24°20'0"N

Legend

PROPOSED BHADLI WOLLASTONITE BLOCK

LITHOLOGY

- BASIC META-VOLCANICS
- BIOTITE GRANITE
- BIOTITE SCHIST
- BIOTITE SCHIST, MIGMATITE
- CALC-GNEISS, CALC-SCHIST
- CALCITIC MARBLE AND CALC-GNEISS
- CLAY, SILT AND SAND
- COARSE GRAINED GRANITE
- DOLERITE
- EPIDIORITE,AMP.LITE,PYX.GRANULITE,GABRO&HB SCHIST
- FINE AEOLIAN SAND
- FINE AEOLIAN SAND, SILT WITH KANKAR
- FINE GRAINED GRANITE AND GNEISS
- GABBRO
- GRANITE
- GRANITE GNEISS
- GRANITE PORPHYRY
- MARBLE
- MEDIUM GRAINED GRANITE
- MICA SCHIST / SCHIST
- MIGMATITE
- OOLITIC CALCAREOUS SAND
- QUARTZ VEIN/REEF
- QUARTZITE
- QUARTZITE, BRECCIATED AND CHERTY AT PLACES
- RHYOLITE PORPHYRY
- SAND, SILT AND CLAY
- FOLD
- FAULT
- SHEAR

STRUCTURAL DATA

- AXIAL PLANE
- BEDDING
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)
- JOINT

1:100,000

0 1 2 4 6 8 Kilometers

Geological Map showing location of Proposed Bhadli Wollastonite Block, Banaskantha District, Gujarat.

72°17'30"E 72°20'0"E 72°22'30"E

24°32'30"N 24°30'0"N 24°27'30"N 24°25'0"N 24°22'30"N 24°20'0"N

N

Legend

PROPOSED BHADLI WOLLASTONITE BLOCK

LITHOLOGY

- CLAY, SILT AND SAND
- FINE AEOLIAN SAND
- FINE AEOLIAN SAND, SILT WITH KANKAR
- GRANITE
- GRANITE GNEISS
- MARBLE
- MICA SCHIST / SCHIST
- MIGMATITE
- SAND, SILT AND CLAY

DYKE

- DOLERITE
- FELSIC DYKE
- FOLD
- FAULT

STRUCTURAL DATA

- BEDDING
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)
- JOINT

1:50,000

0 0.5 1 2 3 4 Kilometers

Estimated cost for Reconnaissance Survey (G-4) for Wollastonite in Bhadli Wollastonite Block (174.00 sq km), District: Banaskantha,Gujarat. [Nos. of Borehole- 10; Borehole depth range: 50m; Schedule timeline- 10 months]							
S. No.	Item of Work	Unit	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal		Remarks
			SoC-Item -Sl No.	Rates as per SoC	Qty.	Amount (Rs)	
A	**GEOLOGICAL WORK**						
1	**Geological Mapping (1:4000), Borehole logging, sampling & Report writing**						
i	Charges for Geologist- Field (1 party)	day	1.2	11,000	180	19,80,000	
ii	Charges for one Geologist - HQ	day	1.2	9,000	60	5,40,000	
iii	2 labours/ party (Rs 522/day/labour) (As per rates of Central Labour Commissioner)	day	5.7	526	360	1,89,360	Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
iv	Bedrock, Trench and Core Sampling -1 Sampler Labour charge not included	day	1.5.2	5,100	52	2,65,200	
v	4 labours/ party (Rs 522/day/labour) (As per rates of Central Labour Commissioner)	day	5.7	526	208	1,09,408	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
2	**Survey**						
i	Bore Hole Fixation and determination of co-ordinates & Reduced Level of the boreholes by DGPS and boundary coordinates	Per Point of observation	1.6.2	19,200	10	1,92,000	10 BHs
					Sub Total- A	**32,75,968**	
B	**TRENCHING & PITTING**						
i	Trenching (1m X 2m X 10m)	per cubic m	2.1.1	3330	400	**13,32,000**	
					Sub Total- B	**13,32,000**	
C	**DRILLING**						
i	Drilling upto 300m (1 rig)	m	2.2.1.4a	11,500	500	57,50,000	Scout Drilling
ii	Land / Crop Compansation	per BH	5.6	20,000	10	2,00,000	Amount will be reimburse as per actuals or max. Rs. 20000 per BH with certification from local authorities
iii	Construction of concrete Pillar (12"x12"x30")	per borehole	2.2.7a	2,000	10	20,000	
iv	Transportation of Drill Rig & Truck associated per drill (2 rigs)	Km	2.2.8	36	2,200	79,200	Certification in this regard is required to be provided
v	Monthly Accomodation Charges for drilling Camp (up to 2 Rigs)	month	2.2.9	50,000	2	1,00,000	
vi	Drilling Camp Setting Cost (1 rigs)	Nos	2.2.9a	2,50,000	1	2,50,000	
vii	Drilling Camp Winding up Cost (1 rigs)	Nos	2.2.9b	2,50,000	1	2,50,000	
viii	Approach Road Making (Flat Terrain)	Km	2.2.10a	22,020	4	88,080	Road Making will be considered as per the requirement and Road Making Charges will be reimbursed later
ix	Core Preservation: One complete borehole plus mineralised cores of all the remaining Bhs	m	5.3	1,590	100	1,59,000	This amount will be reimbursed after successful delivery of the cores to concerned libraries/authorities
					Sub Total- D	**68,96,280**	
D	**LABORATORY STUDIES**						
1	**Chemical Analysis**						
i	**Primary & Check samples for Wollastonite**						
	a. Channel Primary samples for major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI) by XRF method.	Nos	4.1.15a	4,200	100	4,20,000	BRS samples would be collected from Channel
	b. Trench Primary samples for major oxide studies (i.e. SiO_2, Al_2O_3, Fe_2O_3, TiO_2, FeO, MnO, P_2O_5, CaO, MgO, Na_2O, K_2O, LOI) by XRF method.	Nos	4.1.15a	4,200	200	8,40,000	
	c. Borehole Primary samples for 9 radicals i.e., CaO, MgO, SiO_2, Fe_2O_3, Al_2O_3, SO_3, P_2O_5, K_2O, Na_2O & LOI	Nos	4.1.15a	4,200	110	4,62,000	
	d. External(10%) Check samples from NABL Lab for 9 radicals i.e., CaO, MgO, SiO_2, Fe_2O_3, Al_2O_3, SO_3, P_2O_5, K_2O, Na_2O & LOI	Nos	4.1.15a	4,200	41	1,72,200	
	e. 34 element ICPMS Study for REEs from Granite	Nos	4.1.14	7,731	10	77,310	
2	**Physical & Petrological Stusies**						
i	Preparation of thin section	Nos	4.3.1	2,353	20	47,060	
ii	Complete petrographic study report	Nos	4.3.4	4,232	20	84,640	
iii	Modal analysis of thin section	Nos	4.3.8	3,780	20	75,600	
iv	Aspect Ratio Study	Nos	4.3.4	4,232	5	21,160	
v	Preparation of polished section	Nos	4.3.2	1,549	5	7,745	
vi	Complete mineragraphic study report	Nos	4.3.4	4,232	5	21,160	
vii	Digital Photographs	Nos	4.3.7	280	10	2,800	
viii	Specific Gravity studies	Nos	4.8.1	1,605	5	8,025	
ix	XRD Analysis for mineral phase study	Nos	4.5.1	4,000	5	20,000	
					Sub Total- D	**22,59,700**	
D					**Total A to D**	**1,37,63,948**	
E	**Geological Report Preparation**		**5.2**	For the projects having cost exceeding Rs. 50 lakhs - A minimum of Rs. 2.5 lakhs or 5% of the value of work whichever is more. 3000 per each additional copy		**6,88,197**	Reimbursement will be made after submission of the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET. For 2 separate geological report.
F	**Peer review Charges**		**As per EC decision**			**30,000**	

S. No.	Item of Work	Unit	Rates as per NMET SoC 2020-21		Estimated Cost of the Proposal		Remarks
			SoC-Item -Sl No.	Rates as per SoC	Qty.	Amount (Rs)	
G	**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		**2,75,279**	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.
H	**Total Estimated Cost without GST**					**1,47,57,424**	
I	**Provision for GST (18% of I)**					**26,56,336**	GST will be reimburse as per actual and as per notified prescribed rate
J	**Total Estimated Cost with GST**					**1,74,13,761**	***or Say Rs. 174.14 Lakh***
Note :							
1	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.						