PROPOSAL FOR PRELIMINARY EXPLORATION (G-3 STAGE) FOR IRON, PGE AND ASSOCIATED MINERALS IN CHITRANGI BLOCK (21.00 SQ.KM) DISTRICT: SINGRAULI, MADHYA PRADESH

COMMODITY: IRON, PGE and Associated minerals

BY

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NAGPUR (MH)

PLACE: NAGPUR
DATE: 15.05.2024

Summary of the Block for Preliminary Exploration (G-3 Stage)

1.	Features	Details
	Block ID	Chitrangi
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	Iron, PGE and Associated minerals
	Mineral Belt	
	Budget & Time schedule to complete the project	Rs. 294.45 lakhs & 14 months
	Objectives	The Mahakoshal belt represents a volcano-sedimentary sequence exposed proximal to the ENE-WSW to E-W trending Son-Narmada Lineament Zone (SNLZ) in the Central India and has an aerial extent of approximately 9000 sq. km. The Paleoproterozoic Mahakoshal belt is well known for hosting numerous economic mineralization like Sulphides, Gold, PGE, Manganese, Iron (BHQ/BMQ) etc. The presence of supporting lithology for Iron and PGE mineralization viz. BHQ and mafic-ultramafic rocks respectively encourages in taking up the G-3 Exploration in the area. Based on the evaluation of exploration data of previous work, the present exploration program has been formulated to fulfil the following objectives: i) To carry out detailed geological mapping on 1: 4000 scale for demarcation of Iron, PGE and associated mineral bearing formations (host rock) with the structural features to identify the surface manifestations and lateral disposition of the mineralized zones. ii) To carry out Topographical Survey at 1:2000 scale at 2m contour interval. iii) To collect surface (Bedrock/Channel) samples & analyze for Iron, PGE and associated minerals and decide further course of Exploration program. iv) To carry out trenching to expose Iron, PGE and associated mineral bearing formations concealed under soil. v) If phase-I exploration data will give positive results, 800m of drilling (800m spaced section interval) shall be drilled in the anomalous zones designated after the geochemical and trench sampling, to

		establish the lateral and depth continuity of the mineralization which in turn will decide the future course of Exploration program at G-2 category of UNFC. This will further facilitate the state government to put up the block for auctioning. vi) To estimate geological resources (333 category) of Iron and PGE as per UNFC norms and Minerals (Evidence of Mineral Content) Rules-2015 at G-3 level.
	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 (MECL).
	Name/Number of Geoscientists	
	Expected Field days(Geology, Geophysics, surveyor)	Geologist Party days: Field -180 days & HQ-40 days
		Sampling Party days: 132 days

<table>
<tr><td>1.</td><td>Location</td><td></td></tr>
<tr><td></td><td>Latitude and Longitude</td><td>
<table>
<tr><th rowspan="2">Corner points of the block</th><th colspan="2">WGS-84</th><th colspan="2">UTM (Zone: 44 N)</th></tr>
<tr><th>Longitude
E</th><th>Latitude
N</th><th>Easting
m</th><th>Northing
m</th></tr>
<tr><td>A1</td><td>82° 29' 58.523" E</td><td>24° 29' 15.069" N</td><td>651956.271</td><td>2709027.805</td></tr>
<tr><td>B1</td><td>82° 29' 59.607" E</td><td>24° 27' 57.048" N</td><td>652012.819</td><td>2706627.998</td></tr>
<tr><td>C1</td><td>82° 34' 41.526" E</td><td>24° 28' 36.108" N</td><td>659937.131</td><td>2707917.936</td></tr>
<tr><td>D1</td><td>82° 34' 41.645" E</td><td>24° 30' 9.559" N</td><td>659907.658</td><td>2710792.870</td></tr>
</table>
</td></tr>
<tr><td></td><td>Villages</td><td>Chitrangi</td></tr>
<tr><td></td><td>Tehsil/Taluk</td><td>Chitrangi</td></tr>
<tr><td></td><td>District</td><td>Singrauli</td></tr>
<tr><td></td><td>State</td><td>Madhya Pradesh</td></tr>
<tr><td>2.</td><td>Area (hectares/ square kilometres)</td><td></td></tr>
<tr><td></td><td>Block Area</td><td>21.00 sq.km</td></tr>
<tr><td></td><td>Forest Area</td><td>Partial Forest Land (the ridges are occupied by forest)</td></tr>
<tr><td></td><td>Government Land Area</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>Most of the area is covered under forest especially the hilly ridges. The remaining area is cultivated private land.</td></tr>
<tr><td>3.</td><td>Accessibility</td><td>Chitrangi block, bounded by the latitudes 24° 27' 57.048" N - 24° 30' 9.559" N and longitudes 82° 29' 58.523" E and 82° 34' 41.645" E (Topo Sheet Nos. 63L/10 & 63L/11) is located in the northern part of Singrauli district.</td></tr>
<tr><td></td><td>Nearest Rail Head</td><td>Singrauli (SGRL) railway station on the East Central Railway is 45 km from the block. Being near to the state border, the area can also be visited from Chopan (CPU) railway station about 70 km from Chitrangi.</td></tr>
<tr><td></td><td>Road</td><td>It is located 46 km towards North from District head quarters Singrauli via Singrauli-Chitrangi road. It is 689 km from State capital Bhopal via NH-45 and NH-30.</td></tr>
<tr><td></td><td>Airport</td><td>Bamrauli Airport (Prayagraj) is the nearest airport situated 207 km from 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 drainage pattern is mainly dendritic to sub dendritic in both toposheet no. 63L/10 and 63 L/11 covering the present proposed block.</td></tr>
<tr><td></td><td>Rivers/ Streams</td><td>Son River is the main drainage in the nearby area that flows from E-W. Several small distributaries and tributaries in the form of small channels flow in the area.</td></tr>
</table>

5.	**Climate**	
	Mean Annual Rainfall	The normal rainfall of the region is about 1100 mm.
	Temperature	Minimum temperature 8^{O}C. Maximum temperature up to 42^{O}C.
6.	**Topography**	
	Toposheet Number	63L/10 & 63L/11
	Morphology of the Area	Chitrangi is composed of high hills and valleys. The area is highly undulating and having hills of contour 524 m above sea level. The valleys are sharp edged and covered with high canopy of trees.
7.	**Availability of baseline geosciences data**	
	Geological Map (1:50K/25K)	LSM in 1:12500 scale (source: GSI)
	Geochemical Map	NGCM data available.
	Geophysical Map (Aeromagnetic, ground geophysical, Regional as well as local scale GP maps)	NGPM data available.
8.	**Justification for taking up Reconnaissance Survey/ Regional Exploration**	i) GeoMysore Services (India) Pvt. Ltd. carried out exploration work in and around Sidhi covering an area of 2700 sq km. In the course of the exploration, stream sediment shows more than 30 ppb Pt+Pd and rock chip samples in meta-basalt and volcanoclastics showed more than 50 ppb of Pt+Pd from the proposed area. ii) During the Field Season 1995-96 and 1997-98, GSI undertook investigation of PGE, Gold, Copper and Nickel in Ultramafic-mafic rocks near Thapna and Karhiya, Sidhi district, M.P. GSI reported Chemical analysis of bedrock samples revealed anomalous content of gold. Samples of ultramafic rocks around Thapna have analysed 0.15% Cu, 0.20% Ni and 0.56ppm Au. Ultramafic body have recorded upto 200 ppb Pt, 8 ppb Pd and 12 ppb Ir. Ultramafic rock samples from Karhiya have analysed 58 ppb Pt, 118 ppb Pd and 1.5 ppb Ir. Further investigation in terms of gold, PGE, Nickel and associated minerals were recommended. The ultramafics found within the proposed block may be the eastern extension of Thapna ultramafics.

		iii)	During the Field Season 2021-22, GSI undertook Reconnaissance Survey for Gold and Associated Sulphide Mineralization in part of Toposheet no. 63L/11. GSI reported BIFs across the block trending ENE-WSW which yielded Fe_2O_3 content upto 59.21% with a minimum value upto 31.11%. It was mentioned that one sample of quartz vein (near Khatai turn) intruded within BMQ has yielded 7700 ppb of gold and other sample has yielded 470ppb of Au and thus recommended to be investigated further.
		iv)	MECL Team carried out field work in and around block area and identified BIF, mafic-ultramafic rocks in the area. The ultramafic rocks may be the eastern extension of Thapna ultramafics which lies adjacent to the block. Thapna ultamafics shows positive for investigating for PGE by both GSI and Geomysore.
		v)	The Preliminary Exploration will help in planning of higher stages of exploration program (in case upgraded to G-2 level) which in turn will facilitate the state Government for Auction of the block.

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1.0.0 PREAMBLE

1.1.0 Platinum is well known for its use as jewellery and as an investment commodity, the major applications of PGE are industrial. Their leading use is in catalytic converters, which decrease hydrocarbon, carbon monoxide, and nitrous oxide emissions in automobile exhaust. The chemical industry uses platinum or platinum-rhodium alloys to manufacture specialty silicones and to make nitric oxide, the raw material for fertilizers, explosives, and nitric acid. In the petrochemical industry, platinum-supported catalysts are needed to refine crude oil and to produce high-octane gasoline. In the electronics industry, PGE components increase storage capacities in computer hard disk drives and are ubiquitous in electronic devices, multilayer ceramic capacitors, and hybridized integrated circuits. The glass manufacturing industry uses PGE to produce fibreglass and liquid-crystal and flat-panel displays. PGE alloys are exceptionally hard and durable, making them the best coating for the industrial crucibles used to manufacture chemicals and synthetic materials, including the high-purity sapphire crystals used to make light-emitting diodes. Because platinum does not corrode inside the human body and allergic reactions to platinum are rare, it is used in medical implants such as pacemakers. PGE are also used in cancer-fighting drugs. Their white coloration, strength, and tarnish resistance make platinum alloys an ideal choice for jewellery. Platinum, palladium, and rhodium are used for investment in the form of coins and bars, and as stocks, mutual funds, or exchange-traded funds.

1.1.1 Platinum Group of Elements (PGE) is a family comprised of 6 elements—platinum, palladium, rhodium, iridium, osmium and ruthenium. They have similar physical and chemical properties and tend to occur together in the same mineral deposits. These six elements are classified into two groups with reference to the specific gravity of gold (19.2). The elements, Ru, Rh, Pd (sp. gr. 12–12.4) are lighter, while the other three specific gravity elements, Os, Ir and Pt are heavier than gold but within the range of 21.0–21.5. Platinum is an extremely rare metal occurring at a concentration of only 0.005 ppm in earth's crust. Major applications of platinum and palladium are in Automotive Sector for emission control and in chemical and petroleum refining.

1.1.2 A study, conducted by the Council on Energy Environment and Water, identified 12 minerals out of 49 that were evaluated as **'**most critical**'** for India's manufacturing sector by Vision 2030 which makes more thrust for exploration in Strategic Mineral, Precious Metals, Platinum Group of Elements by Government of India.

1.1.3 The Exploration for strategic, critical, rare metals, rare earths elements, PGE and precious metals is given top priority by Govt. of India after amendment of MMDR act 2015. Keeping this in view, the present proposal is being put up for Preliminary Exploration (G-3) for PGE in Chitrangi Block, Singrauli district, Madhya Pradesh.

1.1.4 The world reserves of PGE are estimated at 69,000 tonnes concentrated mostly in South Africa (91%) followed by Russia (6%), Zimbabwe (2%) and USA (1%) World mine production of PGE decreased slightly by 2% to 457 tonnes of metal content in 2019 from 466 tonnes of metal content in 2018, total at 132 tonnes of metal content, reported about 3% decrease from that in 2018. Global mine production of palladium in 2019 at 211.07 tonnes showed a slight decrease of 2% from 214.58 tonnes in metal content in 2018. Russia accounted for 41% and was followed by South Africa (38%), Canada (8%), USA (7%) and Zimbabwe (6%). A negligible 1% was contributed by other countries.

1.1.5 The world's leading PGE producer, Anglo American Platinum Ltd (Amplats), reported primary equivalent refined production of 30,100 kg for palladium and 41,700 kg for platinum in 2017- 6% and 17% less respectively as compared with the production in 2016. Amplats' Bokoni Mine was placed on care-and-maintenance status in the third quarter of 2017, and the jointly owned Mototolo Mine was temporarily closed from August to December for safety work. In 2017, Glencore produced 778 kg of palladium and 1,280 kg of platinum, which reportedly showed a decrease of 31% and 29% respectively. Production at Implats' South African mining operations in 2017 was about 15,200 kg of palladium and 26,300 kg of platinum. The production essentially remained unchanged for palladium and showed a decrease of 5% for platinum as compared with the production in 2016.

1.1.6 Reserves/Resources of PGE in the country as on 1.4.2015 as per NMI Database, based on UNFC System, are placed at 15.71 tonnes of metal content. Reserves/Resources are grouped under Remaining Resources category. By State, Odisha alone accounts for 90% of country's reserves/resources of PGE followed by Karnataka (10%) and Uttar Pradesh with negligible amount. Boula-Nausahi, a 3 km-long belt, 170 km NE of Bhubaneswar, Odisha, is the only proven Platinum Group of Elements (PGE) deposit in the country.

1.1.8 The major part of 15.7 tonnes of metal content UNFC reserves/resources of PGE estimated so far about 14.2 tonnes of metal content of PGE are located in Niligiri, Tamil Nadu and Boula-Nuasahi and Sukinda areas in Odisha and the remaining 1.5 tonnes of metal content of PGE in Hanumalpura area in Shivamogga schist belt of Karnataka. About 49% resources are under Indicated category and the remaining under Inferred and Reconnaissance categories. The reserves/ resources of PGE in Uttar Pradesh have been reported here for the first time in consonance with NMI as on 1.4.2015.

1.2.0 Location and Accessibility

1.2.1 Chitrangi village is located in Chitrangi Tehsil of Singrauli district in Madhya Pradesh, India. It is located 46 km towards North from District head quarters Singrauli via Singrauli-Chitrangi road. It is 689 km from State capital Bhopal via NH-45 and NH-30.

1.2.2 Chitrangi block, bounded by the latitudes 24° 27' 57.048" N - 24° 30' 9.559" N and longitudes 82° 29' 58.523" E and 82° 34' 41.645" E (Topo Sheet Nos. 63L/10 & 63L/11) is located in the northern part of Singrauli district. Singrauli (SGRL) railway station on the East Central Railway is 45 km from the block. Being near to the state border, the area can also be visited from Chopan (CPU) railway station about 70 km from Chitrangi. Bamrauli Airport (Prayagraj) is the nearest airport situated 207 km from the block.

The Co-ordinates of the corner points of the block are given in both DMS and UTM in **Table No.-I**.

Table No. I

Co-Ordinates of the Corner Points of the Chitrangi Block (WGS-84)

Corner points of the block	WGS-84		UTM (Zone: 44 N)	
	Longitude E	Latitude N	Easting m	Northing m
A1	82° 29' 58.523" E	24° 29' 15.069" N	651956.271	2709027.805
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1.3.0 Physiography and Drainage

1.3.1. Chitrangi is composed of high hills and valleys of Agori Formation of Mahakoshal Group of rocks. The area is highly undulating and having hills of contour 524 m above sea level. The valleys are sharp edged and covered with high canopy of trees. BIFs beaing resisitent to weathering occupies the high contours and low-lying area or samller contour hills occupied by soft and weathering susceptible rocks like that of metabasalt.

1.3.2 Son River is the main drainage in the nearby area that flows from E-W that is nearly regional strike of the lithologies. Several small distributaries and tributaries in the form of small channels flow in the areas that are in accordance to the regional strike and sometimes across the strike.

1.4.0 Climate

1.4.1 The climate of the area is characterized by hot summer, cold winter & well distributed rainfall during south west monsoon. The year can be divided into four seasons. The winter comes at far end of November and lasts till first week of March. The period for

March to middle of June conditions hot weather. May is the hottest month of the year. The south west monsoon starts form middle of June and continues till end of September. The daily mean maximum temperature in May is 42° C and daily mean minimum is 25° C. The day temperature on individual days during the period April to first week June gets up to 44° C to 45° C. January is generally coldest month of the year. The maximum daily mean temperature in January is 24° C and minimum daily temperature about 8° C.

1.5.0 Flora and Fauna

1.5.1 The area under investigation is covered with densly thick forest land and some part is covered with revenue land where agricultural activities are major. Many temperate type forests are visible with thick canopy and high six feet tall grassland. Wild varities of shrubs like that of jungle tulsi is dominantly acquiring the remaining portions of forest land and making inhabitant for wider varities of fauna. The principal floral species found are Sal (*Shorea robusta)*, Saja, Tendu (*Diospyros metanoxylon)*, Dhaora (*Woodfordia frusticasa)*,Salai (*Boswellia serrate)*, Shisam, Mahua (*Mudhuca indica)*, Palas and Bhira. Among dry mixed deciduous forest there are axe-wood (*Anogeissus latifolia*), bijasar (*Pterocarpus marsupium*) and in shrub forest, the katha (*Acacia catechu*), ber (*Zizyphus jujube*) and karanda (*Carissa spinarum*) comes.

1.5.2 The area has been rich in the wildlife including monkey, fox, snakes, hare, scorpions, hyenas and sambars.

1.4.0 Regional Geology

Volcano – sedimentary sequence of Mahakoshal belt (MB) is exposed from Barmanghat of Narsinghpur to Palamau in Bihar with a maximum width and length of about 20 km and 600 km respectively and covers an area of about 9000 sq km. Harda inlier is in the west of this belt (Ramakrishnan & Vaidyanadhan, 2010). Two major faults bound the MB and separates it from Proterozoic Vindhyan basin in the north with interveining local slivers of Sidhi gneiss, which is regarded as equivalents of Bundelkhand granite, known as Son Narmada North Fault (SNNF) and Son Narmada South Fault (SNSF). In the south and in vast extent it is separated from Proterozoic gneiss and granites of CITZ by SNSF**.** Deccan trap, Gondwana sediments and quarternary alluvium covers the most part of MB. The general trend of MB is E – W to ENE – WSW and the area under investigation falls in the eastern part of it.

MB is composed of quartzite, carbonate, chert, BIF, graywacke-argillite and mafic volcanic due to which some of the authors called it as greenstone belt rather the term is not appropriate since the belt has predominant sediments rather than basic volcanics or greenstones.

Nair et.al. (1995) has carried out work in MB and proposed three-fold stratigraphic classification to the belt. The three formations in the order of younging are Chitrangi formation, Agori Formation and Parsoi Formation. The Chitrangi Formation is mainly

dominated by the mafic and ultramafics with sedimentary sequences of BIF interbanded with Metabasalt. Main lithology exposed in the lower part of MB is metabasalt in deformed form, grading in to schist rock and pillow basalt that at places is weathered and deformed also. Younger to Chitrangi formation is Agori Formation that is exposed in the eastern as well as western part of MB.

Agori Formation is flanked with chemogenic sediments such as carbonates, cherts and BIF interbanded with phyllite and schist. The phyllite also metamorphosed and graded from greenschist facies to lower amphibolites facies. Clastic dominated with thick sequence of argillites and greywacke with intercalation of quartzite bands is the typical cahracterstics of Parsoi Formation of MB. Along with that the formation also includes BIF interbanded with phyllites and garnet bearing Banded Magnetite Grunerite Quartzite (BMGQ) and forms the upper part of the MB. With time there has been a lot of modification regarding the stratigraphy of MB has been done by many worker. Recently Roy and Devrajan (2000) and Devrajan (2006) have brought out some changes to the stratigraphic nomenclature of different Formation of MB. They coined the younger Formation of Mahakoshal as Dudhamiya Formation in areas of Chitrangi-Deosar and Gurhar pahar and Agori Formation as sleemnabad Formation. Dudhmaniya Formation is the upper part of the Parsoi Formation and consists of BIF-argillite sequences. The lower Chitrangi becomes part of Agori Formation. Eastern part of MB comprises all the Formations of it and they are well exposed and established by many workers.

Lastly at the closing of the basin the MB have been intruded by ultramafic –mafic, alkaline rocks and granitoids during the time gap of 2.045 Ga to 1.75 Ga (Sarkar, et al., 1995;Roy and Deverajan, 2000). These granotids play an important role in the crustal evolution and formation of Mahakoshal belt. The most recent work related to the geology of MB has been carried out by Devrajan in 2006.

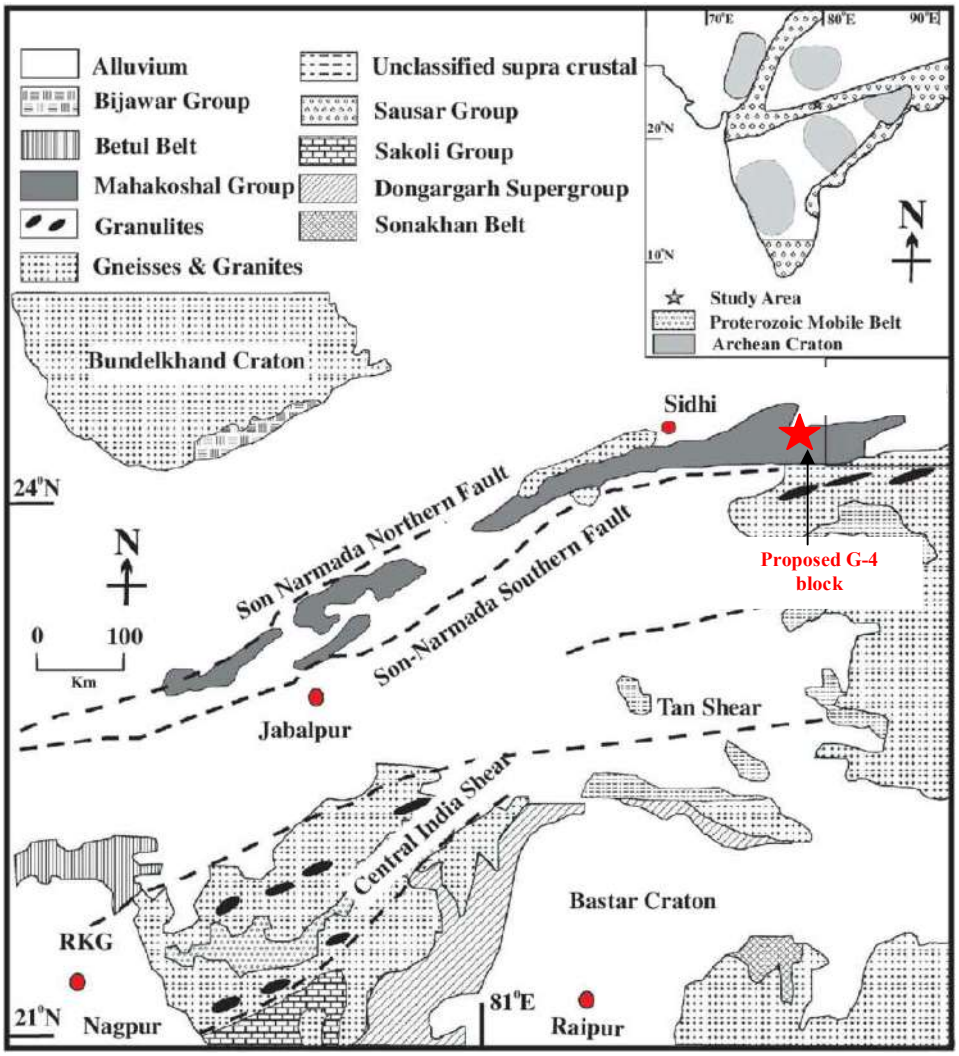


Fig- Map showing Proterozoic Mobile belt, Mahakoshal Group and the proposed G4 block (Modified After Bora, S and Kumar, S., 2015)

The stratigraphic Succession of the Mahakoshal Group as proposed by Nair et al., (1995) is as followed:

Formation	Litho units
Intusives	Gold bearing quartz–carbonate veins, quartz reefs, dolerite. Granitegranodiorite-intrusive plutonite belt along the southern margin. Jhigradandi granite and equivalents and syenite-barite in Sidhi
Parsoi Formation	Tuffaceous and carbonaceous phyllites, feldspathic quartzite, conglomerate, tuffaceous phyllite with metabasalt intercalations.

Formation	Litho units
Agori Formation	Banded hematite/magnetite quartzite and jasperoid with associated tuffs and ash beds. Impure marble, dolomite and interbedded calc-chlorite schist with occasional metabasalt lenses and conglomerate.
Chitrangi Formation	Basic and ultrabasic plugs and dykes including peridotites and serpentinite, agglomerates, metabasalt and peridotitic pillow lava

1.5.0 Regional Structure

1.5.1 **Diastropic Structures**

The overall structural framework of the Mahakoshal belt is represented by a series of upright to slightly overturned folds on southerly dipping axial planes and the folds developed during the initial stage of deformation were refolded into nearly vertical to reclined folds during the course of the progressive deformation, especially in the vicinity of the shear zones. According to Roy and Bandyopadhyay (1990), the Supracrustal rocks of the Mahakoshal belt have been involved in folding of at least three generations (D1, D2 & D3) and the present day ENE-WSW disposition of the belt is due to the development of D1 and D2 structures. The shear zone rocks include as part of the Mahakoshal Supracrustal and the granitoids occurring further on the southern margin. The mylonitic foliation within the shear zone is parallel to the schistosity of the dominant folds (D1) and sheath like folds are found in the mylonites. The North to NNW subhorizontal shortening across a large terrain of the deformed rocks and a shearing movement superimposed over the regional strain along the steep southerly dipping slip/shear planes represented by slip faults (Abhinaba Roy and M. K. Devarajan).

1.5.2 The regional strike of the Mahakoshal Group of rocks is ENE-WSW to East-West with dips ranging from 55° to 80°. Presence of isoclinal folds, asymmetrical folds and cross folds, reflect the deformational events. The earliest recognized folding which has generated tight, isoclinal, reclined folds with sub vertical axial planes is represented by a closure at Pan Umariya village located at south west of the Imaliya village. The pervasive foliation in the volcano sedimentary sequence, which strikes in ENE-WSW direction and was generated during this deformation, is seen in this part of the Mahakoshal belt. The plunge of the folds is towards SSE. The second event of the deformation has developed folds with sub vertical axial planes with axis plunging very gently either ENE or WSW. Both of these events have developed folds which are co-axial but one has a gentle plunge whereas the other has steep plunge of axis. Topography in this part is also representing ENE-WSW trending alternate hills and valleys. The third event, which has NNW-SSE axial trend with open warps where

cross faults are present, has caused discontinuity or gap in these ridges. This particular activity is most important in the Mahakoshal belt for localization of mineralisation. The above mentioned diastrophic structures like foliation, mesoscopic and minor folds, are reflecting the deformational history of the supracrustals in the present area. In the central part of Mahakoshal belt fold closures of the major folds as such are not well preserved, however, some of the F2 fold closures seen in the central part are at Pan Umariya, Sihora and Tindni which also represent the large scale folds of the Mahakoshal belt. The map scale folds and minor folds have varying plunges which are either plane cylindrical or non-planar and non-cylindrical, tight to isoclinal, upright to reclined folds. These may overall represent sheath geometry. These are seen in the Sarda area (23°28'31":80°08'41", 64A/3) in the central part of the Mahakoshal belt (Singhai and Keshava Prasad, 1997-98). Plunge in the minor fold of Tindni closure, which is plane, cylindrical, upright to reclined fold, varies from 15° to 80° both towards ENE and WSW as observed in this part of the Mahakoshal belt. Such variations have been attributed to inhomogeneous nature of the strata in the area (Roy and Bandyopadhyay, 1990).

1.5.3 Non Diastrophic Structures

The non-diastrophic structures and planar features like bedding is represented by compositional layering within the BIF, colour banding in the chert and jasper bands and alternate silica rich and mica rich layers within the metapelites of the Mahakoshal belt. The colour banding in the dolomite and chert, which is a dominant unit in this part, is exhibited by light to dark greyish tone and pink to pinkish & purple impurities in chert bands. Intercalations of phyllite within the dolomite and calcareous intercalations in argillaceous rocks are reflecting the depositional characters. Thin sedimentary units, which are of arenaceous nature, are also found in the calcareous and argillaceous rocks. The variation in grain size, fineness and coarseness are characteristic of these units. Presence of intra-formational conglomerate and its gradation towards coarseness or fineness is indicative of its depositional nature. In this part, the regional stratification is ENE-WSW to WNW-ESE with sub vertical dips varying from 70° to 80° due south. Meta basaltic flows, which occur in Shahdar and Madhana area upto east of Pan Umaria show flow structures like vesicles filled with secondary materials or minerals. Flows may contain Pahaehoe like features and these may have development of pillow structure as has been suspected form the north eastern part of Dungaria in Sleemanabad area.

2.0.0 Geology of the Block

Geologically, the area exposes rocks belonging to Mahakoshal Supracrustal belt of Archean to Lower Proterozoic age. The proposed area comprises of the rocks of Agori and Chitrangi formation (Nair et al.,). The ridges are occupied by BIFs and meta-basalt and the low lying areas are occupied by phyllites. The area forms a part of the ENE-WSW trending Son-Narmada composite megalineament zone and exposes the Mahakoshal Group of rocks in the form of a linear belt trending ENE-WSW

supracrustal belt. Nair et al (1985) and Jain et al (1995) divided the Mahakoshal belt into Chitrangi Formation, Agori Formation and Parsoi Formation. The Chitrangi Formation is made up of highly altered perioditic lava, metabasalt with Pillows, epidiorite, agglomerate and calc-chlorite schist in the lower part and minor andesitic lavas in the upper part of the lava piles. The Agori Formation overlies the Chitrangi Formation and comprises tuffs with metabasic lenses, BIF and Quartzite. The Parsoi Formation is represented by phyllite with intercalations of quartzite bands.

The main rock types exposed are:

i) **Banded Magnetite Quartzite/Jasper:** Banded Iron Formation in the area is exposed in the form of Banded Magnetite Quartzite (BMQ) and at places magnetite is interbanded with Jasper (BMJ) in place of quartzite. The bands follow regional strike i.e. ENE-WSW direction dipping steeply towards south.

ii) **Metabasalt:** Metabasalts occupy mostly the ridges of the area. Vesicular metabasalt, carbonated metabasalts, amygdaloidal metabasalts, olivine metabasalts and ferruginous metabasalts are the different types observed in the area. Among all the types carbonated metabasalt was the most extensive lithology exposed.

iii) **Phyllite:** Phyllite is exposed as finguring unit within the metabasalt. Phyllite with typical character of phyllitic sheen and foliation was observed. Buff coloured and soft to break the phyllite is graded in to tuffaceous phyllite at some places.

iv) **Ultramafic:** The rocks are observed near Piparwan and Sherwa village. The rock types forms a sporadic occurance following the regional trend of the Mahakoshal belt.

v) **Gritty Quartzite:** The lithology is striking ENE-WSW and dipping at high angle towards south. This lithology is also having quartz veins that are very thin in thickness and signatures of shearing are also seen in it.

Lithostratigraphic succession of the Block after Nair et al., (1995)

Formation	Litho units
Intusives	Dunite, gabbro, dolerite, quartz porphyry, quartz veins, alkaline rocks, carbonatites, barite
Parsoi Formation	Tuffaceous and carbonaceous phyllites, feldspathic quartzite, conglomerate, tuffaceous phyllite with metabasalt intercalations.
Agori Formation	Banded hematite/magnetite quartzite and jasperoid with associated tuffs and ash beds associated tuffs and ash beds. Impure marble, dolomite and Impure marble, dolomite and interbedded calc-chlorite schist with occasional metabasalt lenses and conglomerate.

Formation	Litho units
Chitrangi Formation	Basic and ultrabasic plugs and dykes including peridotites and serpentinite, agglomerates, metabasalt and peridotitic pillow lava.

3.0.0 Previous Work and its Recommendations

The volcano sedimentary sequences of Mahakoshal Group (MG) are the prime important part of investigation through decades by many researchers and scientist. Breakthrough work was carried out by Narain and Thambi (1978), who propounded the name of Mahakoshal over the historic name of the geographic name of Bijawars of Son valley. Among all the three parts, western, central and eastern, the later one has been extensively studied by the earlier workers. Predominance of clastic sediments over non-clastic in eastern part and non-clastic over clastic sediments in western part is the general character of MG. Mallet (1869) followed by Oldham et.al. (1901) has contributed to the scientific information about MG by conducting geological traverses in the area. Nair et.al. 1995 detailed the stratigraphy, structure and geochemistry of Mahakoshal Greenstone belt.

Gold exploration in the area was carried out by Khan et al., 1994 in Gurhar Pahar (part of toposheet no. 63L/11), Son valley gold belt, Singrauli district, Madhya Pradesh and explained that gold mineralisation is mainly associated with bluish to grey quartz veins, quartzcarbonate sulphide veins and tuffaceous variegated and carbonaceous phyllite. Gold occurs in fine particles (30-50 micron in size) in native form. In Gurhar Pahar area gold mineralisation reported to have extended over a strike length of 3.4 km with a width varying 10-110 m with barren partings. Pockmarked with ancient workings were also reported.

Jha and Agasty (2008), Jha et al, 2001, 2002, Bage et.al. 2016, 2017 and Gupta and Maurya, 2019 had carried out investigation for gold prospect in different parts of eastern Mahakoshal belt among which chakariya gold prospect was carried out up to G-2 stage of investigation. Exploration for gold in Randhor area, Sidhi district, Madhya Pradesh (E-1stage) brought to light a 2.5 km long and 05 m to 10 m wide gold bearing zones with barren partings. The mineralised zone occurs within the Mahakoshal Group of rocks.

During the FS 2018-20 Singh et.al. from GSI NR has carried out Regional Mineral Targeting project in parts of toposheet no. 63L/07,10,11,12,14 and 15 and 63P/03,04 and 07 and prepared various prospective maps for localisation of gold mineralisation and other sulphides. They have collected 30 nos. BRS samples from the area and reported Au values ranging from 0.05 ppm to 0.12 ppm and one BRS shows value of 1.37 ppm.

Khadse and Roy (1997) carried out Investigation of PGE & Gold associated with Copper and Nickel mineralization in Ultra-Mafic suite near Thapna, Sidhi district, Madhya Pradesh. Chemical analysis of bedrock samples revealed anomalous content of gold. Samples of ultramafic rocks around Thapna have analysed 0.15% Cu, 0.20% Ni and 0.30 to 0.70 ppm Au. Ultramafic body have recorded upto 200 ppb Pt, 8 ppb Pd and 12 ppb Ir. Ultramafic rock samples from Karhiya have analysed 58 ppb Pt, 118 ppb Pd and 1.5 ppb Ir. Further investigation in terms of gold, PGE, Nickel and associated minerals were recommended.

Bage and Kewat (2016) undertook Geochemical Mapping of the Toposheet Nos 63L/11 and 64I/5(Part) in Sidhi District, Madhya Pradesh and Mirzapur District of Uttar Pradesh and had reported good values of Iron and gold in the area in soil samples.

Paul and Sikdar (2016) undertook Geochemical Mapping of the Toposheet nos 63L/3, 6 & 7 covering parts of Mirzapur district of Uttar Pradesh and Rewa & Sidhi districts of Madhya Pradesh. The concentration of Cr, Ni, Zr and Hg is considerably higher than the average crustal abundance of these elements. The values of Co, Cu, V, Zn, La, Ce, Nd shows slightly higher values as compared to the average crustal abundance of these elements but does not show any anomaly as none of these elements cross the threshold value. Higher concentration of Au was found in northern part of toposheet nos. 63L03 & 07 at the contact of Mahakoshal and Semri Group of rocks and recommended to be taken up for further investigation. Presence of ultramafic and feldspathoid rocks in northern part of toposheeet no. 63L07 was recommended for further attention. Therefore, the area was recommended for further systematic geological prospecting of minerals of interest.

Maurya, Kewat and Gupta (2022) carried out Reconnaissance survey for Gold and basemetals in Mishirgawan area were they observed sulphide and iron mineralization. Sulphides in the area are observed mainly in the form of veins or in the disseminated forms. Iron mineralisation was observed in the form of Banded Magnetite Quartzite (BMQ) running all along the mapped area and striking the regional strike of Mahakoshal Belt. Sulphides of copper and iron in the form chalcopyrite, malachite and pyrite in vein of quartz carbonate and in disseminated form were observed within the carbonated metabasalt. They have reported the occurrence of gold mineralization in the area in different form within different lithounits which indicates the association of mineralization with the carbonates and/or quartz carbonate veins and quartz veins within the area. BIFs in the form of BMQ has yielded Fe_2O_3 varying from 24% to 59% can be explored for iron since the band is running along the strike throughout the mapped area and has considerable width varying from 10-20 m. It was mentioned that one sample of quartz vein (near Khatai turn) intruded within BMQ has yielded 7700 ppb of gold and other sample has yielded 470ppb of Au and thus recommended to be investigated further.

Apart from GSI, the GeoMysore (2006) Karnataka was engaged in exploration study for gold, PGE and Nickel in Sidhi district, Madhya Pradesh under Reconnaissance Permit. During the course of investigation Geomysore reported Stream samples with analytical values of more than 30 ppb of Pt+pd and 5 rock chip samples with analytical value of more than 50 ppb of Pt.+Pb. In addition to that in the studied area Au more than >100ppb were reported in 2 samples and more than >30ppb in 4 samples of stream sediments were reported.

4.0.0 Field visit by MECL:

MECL has conducted field visit in the proposed block. During geological traverses, our team has identified the host rocks viz. BIF, ultamafics, meta-basalt etc at several places. A total of 04 BRS/Chip samples were collected from inside the proposed block area and were analysed in MECL Chemical Lab.

Sample No.	Easting	Northing	Rock type	Ru PPM	Rh PPM	Pd PPM	Os PPM	Ir PPM	Pt PPM	PGE PPM
CTR-01	658816	2708532	Contact of BIF & meta-basalt	BDL	0.16	0.23	BDL	0.39	BDL	0.79
CTR-03	657003	2709951	Ultrabasic	BDL	BDL	0.30	BDL	BDL	BDL	0.30
CTR-04	655260	2709708	Ultrabasic	BDL	BDL	0.43	BDL	BDL	BDL	0.43

Sample No.	Easting	Northing	Rock type	Fe%	Au PPB (DL = 20PPB
CTR-01	658816	2708532	Contact of BIF & meta-basalt	48.36	175.86
CTR-02	659049	2710434	BMQ	36.99	12.27

5.0.0 Objective of the exploration

The Mahakoshal belt represents a volcano-sedimentary sequence exposed proximal to the ENE-WSW to E-W trending Son-Narmada Lineament Zone (SNLZ) in the Central India and has an aerial extent of approximately 9000 sq. km. The Paleoproterozoic Mahakoshal belt is well known for hosting numerous economic mineralization like Sulphides, Gold, PGE, Manganese, Iron (BHQ/BMQ) etc. The presence of supporting lithology for Iron and PGE mineralization viz. BHQ and mafic-ultramafic rocks respectively encourages in taking up the G-3 Exploration in the area.

Based on the evaluation of exploration data of previous work, the present exploration program has been formulated to fulfil the following objectives:

i) To carry out detailed geological mapping on 1: 4000 scale for demarcation of Iron, PGE and associated mineral bearing formations (host rock) with the structural features to identify the surface manifestations and lateral disposition of the mineralized zones.
ii) To carry out Topographical Survey at 1:2000 scale at 2m contour interval.
iii) To collect surface (Bedrock/Channel) samples & analyze for Iron, PGE and associated minerals and decide further course of Exploration program.
iv) To carry out trenching to expose Iron, PGE and associated mineral bearing formations concealed under soil.
v) If phase-I exploration data will give positive results, 800m of drilling (800m spaced section interval) shall be drilled in the anomalous zones designated after the geochemical and trench sampling, to establish the lateral and depth continuity of the mineralization which in turn will decide the future course of Exploration program at G-2 category of UNFC. This will further facilitate the state government to put up the block for auctioning.
vi) To estimate geological resources (333 category) of Iron and PGE as per UNFC norms and Minerals (Evidence of Mineral Content) Rules-2015 at G-3 level.

6.0.0 Scope of Proposed Exploration

The proposed Preliminary Exploration (G-3) program comprises:

i) Detailed Geological mapping (1:400 scale)
ii) Topographical Survey (1:2000 scale)
iii) Surface sampling (Bedrock/Channel)
iv) Exploratory Trenching to observe the sub-surface continuation of mineralization
v) Drilling of 10 no of boreholes involving about 800m drilling with associated survey, chemical analysis, physical analysis to observe the lateral and depth wise continuity.
vi) Geological report preparation.

7.0.0 Planned Methodology

The exploration program is proposed in accordance with the objective set for the Preliminary Exploration (G-3) the block. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rules-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:

7.1.0 Geological mapping:

Detailed geological mapping on 1:4000 scale will be carried out in the entire 21.00 sq km of the block area by taking geological traverses. The contacts of different formations, identification of different lithological units, structural features, etc., will

be carried out in detail. The geological map on 1:4000 scale will be generated based on the detail geological mapping of the block and interpretation of exploration data.

7.2.0 Geochemical Sampling

7.2.1 Surface sampling (Bed Rock/ Channel):

During the course of geochemical sampling, bed rock/ channel samples (rock chips) shall be collected from the outcrops. A total of 120 nos. of primary samples from bed rock (from ultramafic rocks) will be collected and analyzed for PGE and 50 samples will be collected for Ni, Co, Cr and Cu. Total 17 no of check samples (10% external) will also be analyzed for PGE, Ni, Co, Cr, Cu.

Similarly, a total of 20 nos. of primary samples from bed rock (from BIF) will be collected and analyzed for Total Fe, Total Mn, Al_2O_3, P_2O_5, Cao, SiO_2, TiO_2, MgO, SO_2, LOI and Acid insolubles. Total 2 no of check samples (10% external) will also be analyzed for Total Fe, Total Mn, Al_2O_3, P_2O_5, Cao, SiO_2, TiO_2, MgO, SO_2, LOI and Acid insolubles

A total of 10 nos. of primary samples from bed rock along with 1 no. of check samples (10% external) will be analyzed for Au.

7.2.2 Exploratory Mining (Trenching/Pitting)

A provision of shallow trenching on mineralized zones (if any) (1m wide X 2m deep) with 100 cubic meters is kept.

Shallow trenching (Excavation) shall be carried out in the PGE, Ni, Co, Cr and Cu anomaly zones identified based on the results of geochemical sampling. Trenching will be carried out on surface up to a depth of 2 m (maximum 2 m depth from surface) after removal of soil/weathered column in the area. Locations of trenches on ground will be decided by field geologist based on anomaly zones identified and field observations.

A provision of 60 no of primary & 6 check (10% External) trench/channel samples are kept for analysis of PGE.

A provision of 20 no of primary & 2 check (10% External) trench/channel samples are kept for analysis of Ni, Co, Cr, and Cu.

10 no of primary & 1 check (10% external) trench/channel samples are kept for analysis of Au by fire Assay method.

The trench walls will be mapped on 1:200 scales.

7.2.3 Whole Rock Analysis of major oxides:

Whole Rock analysis for SiO_2, Al_2O_3, Fe_2O_3, TiO_2, MnO, CaO, Na_2O, K_2O+H_2O, MgO, P_2O_5, CO_2, LOI & S will be carried out on 10 No's samples will be collected from ultramafic rocks to check the rock types, their variation in chemical composition.

7.3.0 Trace element analysis:

7.3.1 10 number of Trace element analysis by ICPMS of 34 elements will be done.

7.4.0 Petrological & Mineralogical Studies:

7.4.1 During the course of geochemical sampling and core logging 10 samples from various litho units from surface and borehole cores will be studied for petrography in thin section and 10 samples from mineralized zones will be studied for the mineragraphy (ore mineral assemblages and their distribution, alteration, enrichment etc) in polished sections.

7.5.0 EPMA and SEM studies:

7.5.0 During the course of the investigation 10 samples each will be collected from the ultramafic rock (bedrock/trench/BH) for EPMA and SEM studies.

7.6.0 Drilling:

7.6.1 A provision of 800m drilling in 10 boreholes (800m section interval) has been kept subject to the first phase of exploration to delineate the vertical and lateral continuity of mineralization.

20 samples for PGE and 20 samples for Ni, Co, Cr and Cu and 30 samples for Gold will be analyzed from borehole core samples. 4 check (10% external) samples for PGE, Ni, Co, Cr and Cu and 3 check (10% external) samples for Gold will be analyzed.

Similarly, a total of 600 nos. of primary samples from borehole cores (from BIF) will be collected and analyzed for Total Fe, Total Mn, Al_2O_3, P_2O_5, Cao, SiO_2, TiO_2, MgO, SO_2, LOI and Acid insolubles. Total 60 no of check samples (10% external) will also be analyzed for Total Fe, Total Mn, Al_2O_3, P_2O_5, Cao, SiO_2, TiO_2, MgO, SO_2, LOI and Acid insolubles.

8.0.0 Nature, Quantum and Target

8.1.0 The particulars and quantum/ target of the exploratory work envisaged are tabulated in **Table No.-II.**

Table No-II

Envisaged quantum of proposed exploratory work in Chitrangi Block

Sl. No.	Item of Work	Unit	Proposed Quantum of work
1	Geological Mapping (on 1:4000 Scale)	sq km	21.00

Sl. No.	Item of Work	Unit	Proposed Quantum of work
2	Survey Work		
	i) Topographical Survey (1:2000 scale)	sq km	21.00
	ii) Bore Hole Fixation, RL & Coordinate Determination by DGPS	Nos	14
3	Trenching	cu m	100
4	Core Drilling (10 BHs)	m	800
5	Sample Preparation & Chemical Analysis		
	Primary samples for Iron-PGE & Associated minerals (Channel /Core Samples)		
A.	i) Primary samples for Total Fe, Total Mn, Al_2O_3, P_2O_5, Cao, SiO_2, TiO_2, MgO, SO_2, LOI and Acid insolubles	Nos.	620 (Surface+Trench+BH)
B.	External (10%) Check samples for 4 Total Fe, Total Mn, Al_2O_3, P_2O_5, Cao, SiO_2, TiO_2, MgO, SO_2, LOI and Acid insolubles	Nos.	62
C.	Total Primary samples for PGE	Nos.	200 (Surface+Trench+BH)
D.	External (10%) Check samples for PGE	Nos.	20
E.	Total Primary samples for Ni, Cr, Co, Cu	Nos.	90 (Surface+Trench+BH)
F.	External (10%) Check samples for Ni, Cr, Co, Cu	Nos.	9
G.	Primary Samples for Au by Fire Assay	Nos.	50 (Surface+Trench+BH)

Sl. No.	Item of Work	Unit	Proposed Quantum of work
H.	External (10%) Check samples for Au by Fire Assay	Nos.	5
6	Trace Elements Studies (34 Elements)	Nos.	10
7	Whole Rock Analysis (Ultramafic and Mafic rocks) For SiO_2, Al_2O_3, Fe_2O_3, TiO_2, MnO, CaO, Na_2O, K_2O+H_2O, MgO, P_2O_5, CO_2, S and LOI.	Nos.	10
9	EPMA studies	Nos.	10
10	SEM studies	Nos.	10
11	Petrographic Studies	Nos.	10
12	Mineragraphic Studies	Nos.	10
13	Bulk Density	Nos.	10
14	Report Preparation (Digital format)	Nos.	1

Table No-III

Summary table for Geochemical and BH core samples proposed

Types of sampling	PGE	BIF	BM	Au	Total
Bedrock/Channel	120	20	50	10	**200**
Trench	60	0	20	10	**90**
BH	20	600	20	30	**670**
Total	**200**	**620**	**90**	**50**	**960**

9. 0.0 The Manpower deployment

9.1.0 Manpower deployment List may be provided later.

10.0.0 Break-up of Expenditure

10.1.0 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. 294.45 Lakh.** The summary of tentative cost estimates for Reconnaissance Survey is given in **Table No.-IV** and a detail of tentative cost estimates is given as annexure**.** Tentative Time schedule/action plan for proposed Preliminary Exploration (G-3 Level) for Iron-PGE and associated minerals is given in **Table No.-V.**

Table No-IV

Summary of Tentative Cost Estimates for Preliminary Exploration (G-3 Level) Exploration

Sl. No.	Item	Total
1	Geological Work	41,00,016
2	Pitting & Trenching	3,33,000
3	Laboratory Studies	62,46,844
	Drilling	1,30,19,400
	Sub total	2,36,99,260
4	Report	7,50,000
5	Peer Review	30,000
6	Proposal Prepration	4,73,985.20
	Total	2,49,53,245
7	GST (18%)	44,91,584.14
Total cost including 18% GST		**2,94,44,829**
SAY, in Lakhs		**294.45**

Table No-V

Estimated cost for Preliminary Exploration (G-3) for Iron- PGE and associated minerals in Chitrangi Block, Districts: Singrauli, State: Madhya Pradesh
[Block area- 21.00 sq. km; Schedule timeline- 14 months]

S. No.	Particulars	Months/Days	1	2	3	4	5	6		7	8	9	10	11	12	13	14
1	Camp Setting	months															
2	Geological Mapping	months															
3	Survey days	days															
4	Trenching	cu.m															
5	Drilling (2 rigs)	m															
6	Geologist days	days							Review								
7	Sampling days, BRS, Trench & Core Sampling	days															
8	Camp winding	months															
9	Laboratory Studies	months															

10	Geologist days, HQ	**days**																
11	Report Writing with Peer Review	**months**																

11.0.0 Justification:

i) GeoMysore Services (India) Pvt. Ltd. carried out exploration work in and around Sidhi covering an area of 2700 sq km. In the course of the exploration, stream sediment shows more than 30 ppb Pt+Pd and rock chip samples in meta-basalt and volcanoclastics showed more than 50 ppb of Pt+Pd from the proposed area.

ii) During the Field Season 1995-96 and 1997-98, GSI undertook investigation of PGE, Gold, Copper and Nickel in Ultramafic-mafic rocks near Thapna and Karhiya, Sidhi district, M.P. GSI reported Chemical analysis of bedrock samples revealed anomalous content of gold. Samples of ultramafic rocks around Thapna have analysed 0.15% Cu, 0.20% Ni and 0.56ppm Au. Ultramafic body have recorded upto 200 ppb Pt, 8 ppb Pd and 12 ppb Ir. Ultramafic rock samples from Karhiya have analysed 58 ppb Pt, 118 ppb Pd and 1.5 ppb Ir. Further investigation in terms of gold, PGE, Nickel and associated minerals were recommended. The ultramafics found within the proposed block may be the eastern extension of Thapna ultramafics.

iii) During the Field Season 2021-22, GSI undertook Reconnaissance Survey for Gold and Associated Sulphide Mineralization in part of Toposheet no. 63L/11. GSI reported BIFs across the block trending ENE-WSW which yielded Fe_2O_3 content upto 59.21% with a minimum value upto 31.11%. It was mentioned that one sample of quartz vein (near Khatai turn) intruded within BMQ has yielded 7700 ppb of gold and other sample has yielded 470ppb of Au and thus recommended to be investigated further.

iv) MECL Team carried out field work in and around block area and identified BIF, mafic-ultramafic rocks in the area. The ultramafic rocks may be the eastern extension of Thapna ultramafics which lies adjacent to the block. Thapna ultamafics shows positive for investigating for PGE by both GSI and Geomysore.

v) The Preliminary Exploration will help in planning of higher stages of exploration program (in case upgraded to G-2 level) which in turn will facilitate the state Government for Auction of the block

12.0.0 References

i) Maurya, Vivek Kumar., Kewat, Manish Kumar. and Gupta, Shalini (2022):Reconnaissance Survey For Gold And Associated Sulphide Mineralization In Agori Formation Of Mahakoshal Belt In Mishirgawan Area Singrauli District, Madhya Pradesh (Stage: G4) (Unpublished Progress Report for F.S. 2021-22).

ii) Consolidated report on the Exploration work carried out under three year Reconnaissance Permit in the 2700 sq km Sidhi R.P Block, Sidhi district, Madhya Pradesh by GeoMysore Services (India) Pvt. Ltd (2006).

iii) Khadse, V.K. (2000): Report on Investigation for PGE, Gold, Copper and Nickel in Ultramafic-Mafic rocks near Thapna and Karhiya, Sidhi district, Madhya Pradesh.

iv) Sharma, D.P., Khan, M.A., Mehrotra, R.D. (1997): Report on Gold Exploration at Gurhar Pahar, Son Valley Gold Belt, Sidhi district, Madhya Pradesh. (Progress Report for F.S 1990-94).

List of Plates:

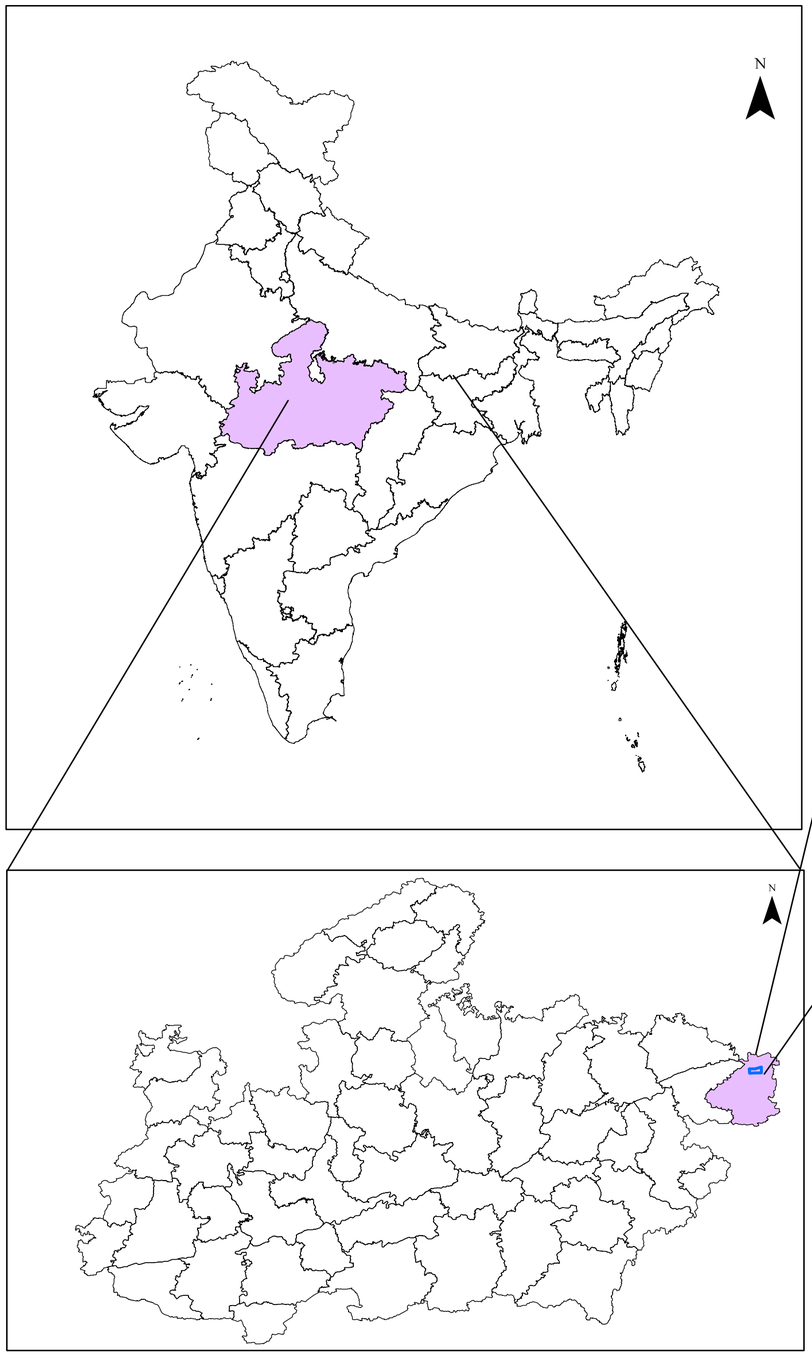
Plate-I: Location Map of Chitrangi Block, District: Singrauli, Madhya Pradesh (1:50000).

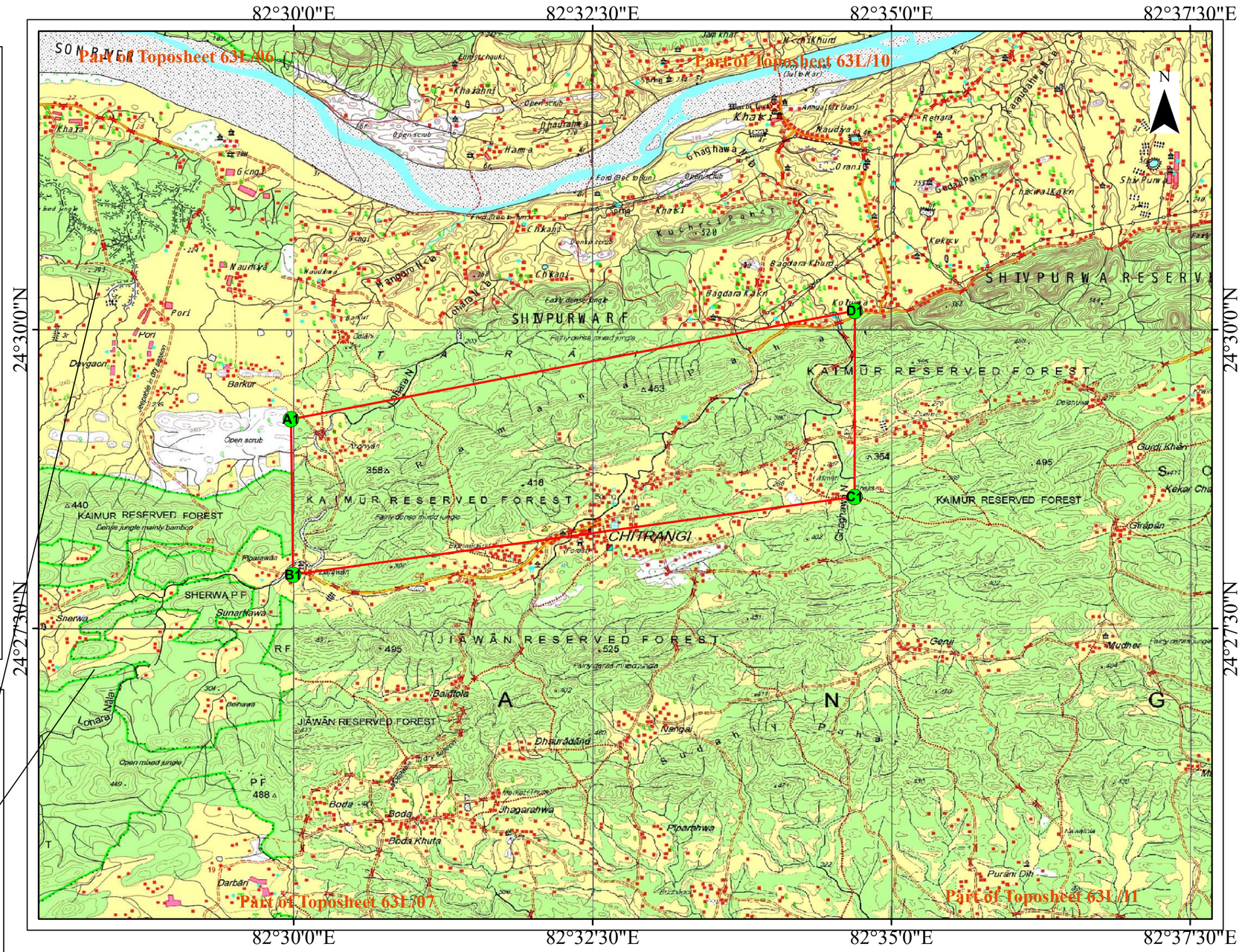
Plate-II: Large Scale Geological Map of the Study Area, District: Singrauli, Madhya Pradesh (1:12500).

List of Annexure:

1. **Detailed cost sheet of Chitrangi Block.**

Location Map for Preliminary Exploration (G-3) of Proposed Chitrangi Block for Iron-PGE & associated minerals over an Area of 21.00 sq.km
District-Singrauli, State- Madhya Pradesh





Legend

- BLOCK BOUNDARY POINTS
- CHITRANGI BLOCK (G-3)

Co-ordinates of the block boundary points of the proposed Chitrangi Block (G-3) for Iron-PGE & associated minerals, District- Singrauli, State- Madhya Pradesh

Corner points of the block	WGS-84		UTM (Zone: 44 N)	
	Longitude E	Latitude N	Easting m	Northing m
A1	82° 29' 58.523" E	24° 29' 15.069" N	651956.271	2709027.805
B1	82° 29' 59.607" E	24° 27' 57.048" N	652012.819	2706627.998
C1	82° 34' 41.526" E	24° 28' 36.108" N	659937.131	2707917.936
D1	82° 34' 41.645" E	24° 30' 9.559" N	659907.658	2710792.870

MECL

LARGE SCALE MAPPING OF AGORI FORMATION OF MAHAKOSHAL BELT IN MISHIRGAWAN AREA SINGRAULI DISTRICT, MADHYA PRADESH

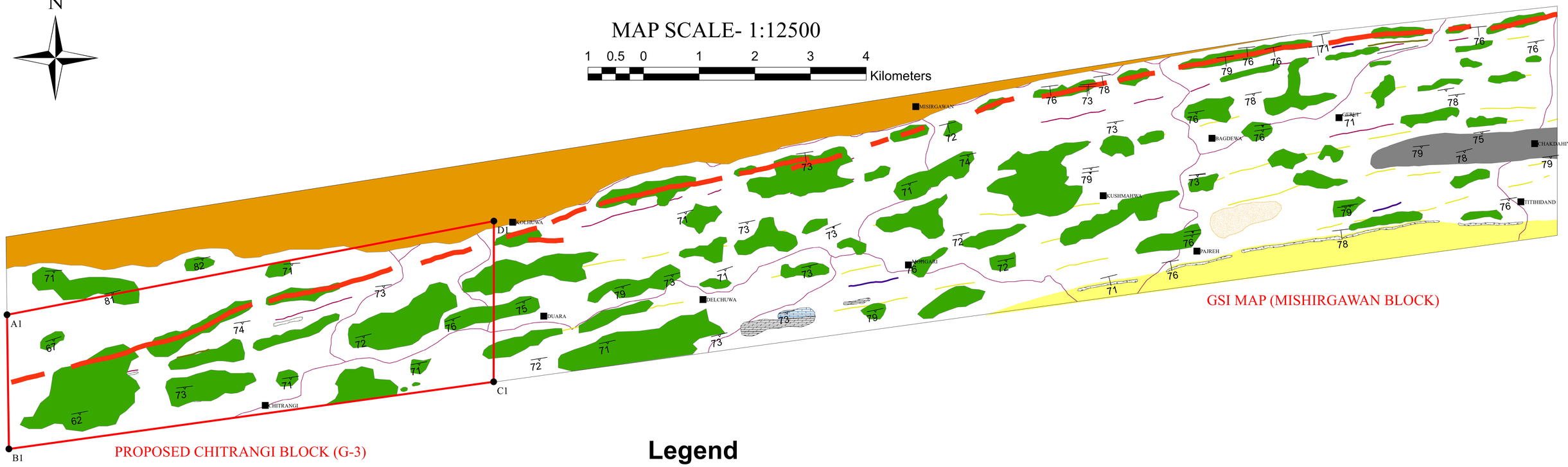
MAP SCALE- 1:12500

1 0.5 0 1 2 3 4 Kilometers

N

82°30'0"E 82°32'30"E 82°35'0"E 82°37'30"E 82°40'0"E 82°42'30"E 82°45'0"E

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



PROPOSED CHITRANGI BLOCK (G-3)

GSI MAP (MISHIRGAWAN BLOCK)

Legend

Vindyan Super Group

- Soil
- Gabbro
- Peridotite

Mahakoshal Group

- BIF
- Phyllite
- Metabasalt
- Pillow_basalt
- Laterite
- Ferruginous brecciated_quartzite
- BIF_interlayered with vescicular meta-basalt
- Dolomite
- Limestone
- Quartz Pebble Conglomerate
- Conglomerate
- Gritty Quartzite

- Locations
- Proposed Chitrangi Block (G-3)
- Mishirgawan Block for Gold & Basemetals (GSI)

MAP SOURCE: RECONNAISSANCE SURVEY FOR GOLD AND ASSOCIATED SULPHIDE MINERALIZATION IN AGORI FORMATION OF MAHAKOSHAL BELT IN MISHIRGAWAN AREA SINGRAULI DISTRICT, MADHYA PRADESH (STAGE: G4) FSP-2021-2022

Estimated cost for Preliminary Exploration (G-3) for Iron- PGE and associated minerals in Chitrangi Block, Districts: Singrauli, State: Madhya Pradesh.
[Block area- 21.00 sq. km; Schedule timeline- 14 months; BH-10 nos; Drilling- 800m; Review- 6 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 (1:4000 scale) & TOPOGRAPHICAL SURVEY**						
i	Charges for one Geologist- Field	day	1.2	11,000	180	19,80,000	
ii	Charges for one Geologist per- HQ	day	1.2	9,000	40	3,60,000	
iii	2 labours/ party (Rs 504/day/labour) (As per rates of Central Labour Commissioner)	day	5.7	522	360	1,87,920	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
iv	Sampling party days-1 Samplers Labour charge not included	day	1.5.2	5,100	132	6,73,200	
v	4 labours/ party (Rs 504/day/labour) (As per rates of Central Labour Commissioner)	day	5.7	522	528	2,75,616	Amount will be reimburse as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher
vi	Survey Party Days for topographical contour survey, block boundary and borehole points fixation	day	1.6. 1a	8,300	60	4,98,000	
vii	4 labours for surveyor	day	5.7	522	240	1,25,280	
					Sub Total- A	**41,00,016**	
B	**PITTING AND TRENCHING**						
i	Trenching	Cu m	2.1.1	3330	100	3,33,000	
					Sub Total- B	**3,33,000**	
C	**LABORATORY STUDIES**						
1	**Chemical Analysis**						
i	**Primary & Check samples for Iron-PGE & associated minerals BRS/Chip/Channel/Trench/BH samples)**						
	a. Primary Samples for PGE (ICP-MS, Ni-S fire Assay)	Nos	4.1.5d	11,800	200	23,60,000	Surface Samples-120, Trench Samples-60, BH Samples-20
	b.External (10%) Check samples for PGE	Nos	4.1.5d	11,800	20	2,36,000	
	c. Primary samples Ni, Cr, Co, Cu	Nos	4.1.7a	2,506	90	2,25,540	Surface Samples-50, Trench Samples-20, BH Samples-20
	d.External (10%) Check samples for Ni, Cr, Co, Cu	Nos	4.1.7a	2,506	9	22,554	
	e. Primary Samples for Iron	No.	4.1.15a	4,200	620	26,04,000	Surface Samples-20, Trench Samples-0, BH Samples-600
	f.External (10%) Check samples for Iron	No.	4.1.15a	4,200	62	2,60,400	
ii	**Primary & Check samples for gold (BRS/Channel/Core)**						
	a. Primary Samples for Au by Fire Assay	Nos	4.1.5a	2,380	50	1,19,000	Selective samples (BRS-10, Trench-10, BH-30)
	b.External (10%) Check samples for Au by Fire Assay	Nos	4.1.5a	2,380	5	11,900	
2	**Physical,Petrological, Mineralogical Studies**						
i	Preparation of thin section	Nos	4.3.1	2,353	10	23,530	
ii	Complete petrographic study report	Nos	4.3.4	4,232	10	42,320	
iii	Preparation of polished section	Nos	4.3.2	1,549	10	15,490	
iv	Complete mineragraphic study report	Nos	4.3.4	4,232	10	42,320	
v	Digital Photographs	Nos	4.3.7	280	10	2,800	
vi	Estimation of Major oxides by XRF technique (Whole Rock Analysis)	Nos	4.1.15a	4,200	10	42,000	
vii	Analysis of rock sample for determination of a package by 34 elements by ICPMS (Trace element vstudies)	Nos	4.1.14	7,731	10	77,310	
viii	EPMA studies	per hour	4.4.1	8,540	10	85,400	Outsource component
ix	SEM studies	per hour	4.4.2	2,940	10	29,400	Outsource component
x	Operational Charge = (viii+ix) X 10%		6.0 (i)	10% of total outsourced Cost in case of total ousouce cost up to 50 lakh	-	11,480	
xi	Bulk Density	Nos	4.10	3540	10	35,400	
					Sub Total- C	**62,46,844**	
D	**DRILLING**						
i	Drilling upto 300m (Very Hard Rock) (1 rigs)	m	2.2.1.4b	12,650	800	1,01,20,000	
ii	Land / Crop Compansation	per BH	5.6	20,000	10	2,00,000	
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	Km	2.2.8	36	2,600	93,600	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	4	2,00,000	
vi	Drilling Camp Setting Cost	Nos	2.2.9a	2,50,000	2	5,00,000	
vii	Drilling Camp Winding up Cost	Nos	2.2.9b	2,50,000	2	5,00,000	
viii	Approach Road Making (Hilly Terrain)	Km	2.2.10b	32,200	10	3,22,000	Road Making will be considered as per the requirement and Road Making Charges will be reimbursed for max. 4 km.
ix	Bore Hole Fixation and determination of co-ordinates & Reduced Level of the boreholes by DGPS	Nos	1.6.2	19,200	14	2,68,800	10 Boreholes+ 4 Block Boundary points
x	One complete borehole plus mineralised cores of all the remaining Bhs	m	5.3	1,590	500	7,95,000	This amount will be reimbursed after successful delivery of the cores to concerned libraries/authorities
					Sub Total- D	**1,30,19,400**	
E					**Total A to D**	**2,36,99,260**	
F	**Geological Report Preparation**		**5.2**	For the projects having cost exceeding Rs. 150 lakhs but less than Rs. 300 lakhs - A minimum of Rs. 7.5 lakhs or 3% of the value of work whichever is more		**7,50,000**	Reimbursement will be made after submission of the final Geological Report in Hard Copies (5 Nos) and the soft copy to NMET.
G	**Peer review Charges**		**As per EC decision**			**30,000**	
H	**Preparation of Exploration Proposal**	**5 Hard copies with a soft copy**	**5.1**	2% of the Cost or Rs. 5.0 Lakhs whichever is lower		**4,73,985**	EA has to submit the final proposal along with Maps and Plan as suggested by the TCC-NMET in its meeting while clearing the proposal.
I	**Total Estimated Cost without GST**					**2,49,53,245**	
J	**Provision for GST (18% of I)**					**44,91,584.14**	GST will be reimburse as per actual and as per notified prescribed rate
K	**Total Estimated Cost with GST**					**2,94,44,829.34**	
					or Say Rs. In Lakhs	**294.45**	
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						