

Regional Exploration Proposal (G-4 level) for Diamond in
Kalyandurg-Timmasamudram Block (Block-ID SR-AP-02)
District: Anantpur, (Andhra Pradesh)

1.0.0 Introduction:

- 1.1.1 Diamond being one of the highly priced gem have lured the mankind since time immemorial, with the development of the nation at economic front, now the general population have also risen to the affordability of Diamond Jewelry. Due to the affordability the demand of diamonds got increased drastically. India though is a center for Diamond cutting industry but majority of rough diamond are imported. The increasing demand of Diamonds has been accorded high priority in the XIIth Plan document.
- 1.1.2 Since last century, no large diamond deposit has been discovered in India. However, the possibility of working of small mineral bodies in proximity to each other, through technological advances and increased operational efficiency, cannot be ruled out. Therefore, it is necessary to locate and explore such small sized deposits in clusters.
- 1.1.3 In view of the MMDR amendments act – 2015, Mineral (Evidence of Mineral Contents) Rule 2015 and Mineral Auction Rule – 2015, Ministry of Mines, GSI identified the block for exploration & MECL decided to take up the block for G-4 level of exploration under NMET funding. MECL requested Ministry of Mines, Government of India to reserve the block to carry regional exploration

1.2.0 Location of the Block:

- 1.2.1 The Eastern boundary of the block area is about 24 km from Anantpur district township Kalyandurg in the south west and Atmakuratownship in the eastern portion of the block are the important townships within the block area. The block area is traversed by many road and moterable tracts providing the block a very good accessibility. The block is located in Survey of India Toposheet No. 57 F/2 and 57 F/6. The Co-ordinates of the corner points of the block is given below and covers an area of 1172 sq km.

A) 14° 30' 00" N and 77° 00' 03"EB) 14° 44' 59" N and 77° 00' 03"E

C) 14° 44' 55" N and 77° 22' 50"ED) 14° 30' 00" N and 77° 22' 50"E

1.3.0 **Physiology and Drainage:**

- 1.3.1 The block area is of undulating terrain with isolated hillocks in general. In the south-western part of the block the terrain is hilly around Kalyandurg and towards western and north-western part of the township. The highest peak of 763 m reduced level from mean sea level is in the north-western portion of the block. The general ground level is about 470 m to 480 m from mean sea level.
- 1.3.2 The area being mostly of undulating terrain with isolated hillocks, the stream density is quite high forming dendritic drainage pattern. The streams generally flow north-westerly and south-easterly forming Nalas contributing to the tributary system of Vedavativriver in the western part or the Penneru river in the eastern part of the block.

2.0.0 **Previous work:**

- 2.1.1 Starting from Robert Bruce foote (1886), Sastry (1951-52 & 52-53) Sinha & Sisodia (1977), Rao & Jayaraman (1981), Sundara-vanam and Rao (1989), Gopal Reddy & Suresh (1994), Nayak & Reddy (1995) have worked in the area. Chowdary & Bhaskara Rao (2003-04) discovered TK-1 & TK-2 Kimberlites to the west of Timmasamudram. NMDC located 4 bodies in the Kalyandurg area.
- 2.1.2 In Kalyandurg cluster consisting of six pipes have been discovered by GSI of which only data of KL-1, 2 & 3 have been explored by GSI & rest by NMDC. KL-1 is NNW-SSE trending elongate body of 350 m x 250 m covered by 2 to 3 m thick layer of soil, KL-2 (100m x 80m) capped by calcretic soil with distinct darker tone compared to the surrounding reddish brown granitoid-derived soil. KL-3 pipe is an ENE-WSW trending elongate body (450m x 250m) capped by calcretic soil with a few, small isolated outcrops of greenish block Kimberlite. Macrocrysts of Ilmenite upto 1.5 cm are found in all of the Kalyandurg pipes.
- 2.1.3 Six Kimberlite pipes (TK-1 to TK-6) have been discovered during 2004-07 are located near Timmasamudram-Maukthipuram village. The lithounits strike NW-SE and fractures ENE-WSW and NNE-SSW in this area, Reconnaissance stage (UNFC G-4) investing actions have been carried out by GSI in TK-1, 2 & 3 while in TK-4 pipes prospecting (UNFC G-3) stage investigation was carried out by GSI. Except TK-4, all other pipes are devoid of diamonds. TK-1 and Tk-2 kimberlite bodies measures 30m x 50m approximately and are located along a major ENE-WSW fracture in TGA suite of granitoidsof about 2.5 km (TK-1) and 1.5 km (TK-2) WSW of Timmasamudram village. TK-2 pipe is located along the same fracture & have calcrete spread. Kimberlite shows large rounded macrocryst of olivine (upto 1 cm across) embedded in a fine grained groundmass of serpentinised and carbonated olivine, mantle peridotites and crustal granitoid nodules occur in these bodies. The heavy mineral populations include

picroilmenite, chromespinels, chrome-diopside and pyrope garnet in the order of abundance. The pipe TK-3 is located on left bank of penner river at about 1.5 km WSW of the Timmasamudram village, it's a northerly elongated body measuring 50m x 30m in dimension and covered by 1 m thick calcrete cover.

2.1.4 The pipe TK-4 is located 1.5 km WSW of Timmasamudram village measuring 14m x 6m with 1 m calcrete cover inplaced in TTG gneissoids along an ENE-WSW parallel fracture. In 228 tonnes of Kimberlite sample from this pipe yielded 509 diamonds out of which 489 are of gem variety, ranging from few cents to 4.5 carat. The pipes TK-5 & 6 got discovered by ground geophysical evaluation of the area.

2.1.5 The Rio Tinto Exploration (RTE) discovered one kimberlite pipe located approximately 12 km Northeast of Kalyandurg cluster of kimberlites. The Raailu cluster is currently defined by two kimberlites located 22 km directly to the east of Kalyandurg Kimberlites and 16 km south of Brahmanapalle cluster in Anantpur district.

3.0.0 Geology and Structure:

3.1.0 Regional Geology and structure of the area.

3.1.1 The lithounits of Peninsular gneissic complex of Archean age are forming the basement in and around the area. The Dharwar super group of rocks of Archaean to lower proterozoic age overlie the peninsular gneissic complex. The granite, lamprophyre bodies and kimberlite pipe are reported in the region. The Regional Stratigraphic Sequence of the lithounits exposed in the area (after GSI, District Resource map) is given below.

Regional Stratigraphic Sequence of the lithounits (after GSI)

Age	Super Group	Group	Lithounits
Recent	-	-	Alluvium
-	-	-	Kimberlite, Lamprophyre, Dolerite dykes and Vein quartz
Lower Proterozoic		Equivalents to lower Proterozoic	Gray granite / Pink granite
Archaen to Lower Proterozoic	Dharwar	Ramgiri Metamorphics	Meta-andesite
		Penakacherta Metamorphics	Meta-basalt (Hornblende schist) Amphibolite.
Archaean	Peninsular Gneissic Complex	-	Granite and Granodiorite
			Hornblende-biotite gneiss, Hornblende-gneiss, Biotite gneiss, Migmatite
		Sargur	Sillimanite (Graphite) Quartzite, Kyanite-staurolite-garnet-graphite-biotite schist, amphibolites, Crystalline limestone, Calc-silicate rocks

3.2.0 Geology and Structure of the Area:

- 3.2.1 The lithounits exposed in the block area are of Peninsular gneissic complex of Archaen age as basement, overlain by Penakacherta metamorphic of Dharwar Super group belonging to Archaen-lower proterozoic age. Gray / Pink granite equivalent to close pet granite of lower proterozoic age is present in the western part of the block. Dolerite dykes, lamprophyres & kimberlite pipes.
- 3.2.2 The lithounits generally trend NW-SE dipping 40° to 60° due east in the west of Timmasamudram. 6 pipes of Kimberlite and 6 bodies in Kalyandurg area have been reported. Kimberlite shows large rounded microcrystal of olivine (up to 1 cm across) embedded in a fine grained groundmass of serpentinised and carbonated olivine, mantle peridotites and crustal granitoid nodules occur in these bodies. The heavy mineral populations include picroilmenite, chrome-spinels, chrome-diopside and pyrope garnet in the order of abundance. The Stratigraphic Sequence of lithounits exposed in the block area (after GSI) is given below.

The Stratigraphic Sequence of Lithounits of the Block area (after GSI)

Age	Super Group	Group	Lithounits
Recent			Alluvium
			Dolerite dykes, Kimberlite, Lamprophyre
Lower Proterozoic		Equivalents to closepet granite	Gray granite, Pink granite
Archaen to Lower Proterozoic	Dharwar	PenakachertaMetamorphics	Meta-basalt (Hornblende schist) Amphibolite.
Archaean	Peninsular Gneissic Complex		Granite and Granodiorite
			Hornblende-biotite gneiss, Hornblende-gneiss, Biotite gneiss, Migmatite

4.0.0 Objective of the proposed exploration programme:

4.1.1 The present exploration programme has been formulated to fulfill the following objectives.

i) To carry out geological mapping on 1:12,500 scale and demarcate the rock types ofDiamondbearing formations with the structural features to identify the surface manifestations and lateral disposition of the probable ore body.

ii) To collect surface samples to separate and analyze them forheavy minerals picroilmenite, chrom-diopside, chrome-spinels, pyrope garnet by their weight percentage, plotting them on maps and demarcating anomaly zone and decide further course of exploration programme.

iii) In case, surface samples give positive results supported by Remote sensing studies for mineral targeting and Geophysical survey giving sub-surface positive details for the extension of the ore body then5 no's scout boreholes shall be drilled in the Kalyandurg - Timmasamudram block in the 1172 sq.km. area which in turn will decide the future course of exploration programme at G-3/G-2 category of UNFC.

iv) To estimate reconnaissance resources of Diamond bearing formations as per UNFC norms and minerals (Evidence of Mineral Contents) Rule-2015 at G-4 level.

5.0.0 Proposed scheme of Exploration:

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

5.1.0 Remote Sensing:

5.1.1 The entire 1172sq km area will be subjected for remote sensing studies to identify the lineaments and other structural features and the mineral potential zones by mineral targeting process.

5.2.0 Stream Sediment Sampling:

5.2.1 The stream sediment samples shall be collected from the entire study area of 1172 sq. km. The samples shall be collected depending upon the Forest cover and accessibility of the area. A total of 1500 stream sediment samples shall be collected from the study area.

5.3.0 Geological mapping:

5.3.1 Geological Mapping will be done on 1:12,500 scales. Rock types, their contact, structural features will be mapped. Surface manifestations of the ore bodies available along with their surface disposition will be marked on map. Surface samples of various litho-units for petrological studies and from probable ore bodies for heavy mineral analysis with accessory minerals will be taken during the course of geological mapping.

5.4.0 Surveying:

5.4.1 The block boundary will be surveyed by DGPS and total station in WGS-84 datum for demarcation of block boundary points. Survey party will be associated with stream sediment sample and Bed rock sample collection by taking up the points and plotting its location on map for proper interpretation of the sample data. Survey party will also be associated with Geological Mapping will be observed during Geological mapping and the Litho-contacts will be plotted for finalization of Geological map on 1:12,500 scale. During drilling scout borehole fixation and determination of reduced level and Co-ordinates of the boreholes only will be undertaken. If mineralized zones are identified, contouring of the surrounding areas of ore bodies would be done on 2 m contour intervals along with survey of surface features.

5.5.0 **Geophysical Survey:**

5.5.1 The area of the block is nearly 1172 sq.km. the litho units hosting mineralisation are Kimberlite & Lamprophyres will be occupying valley portion or the slope of hills covered mostly by rubble & Soil. Hence, to assess the strike of the sub-surface ore body continuation need of Geophysical survey is felt. 10 sq. km area will be split in smaller areas. Magnetic and gravity survey will be carried out in the Geophysical survey at 50 m grid interval over an area of 10 sq km in split areas.

5.6.0 **Pitting:**

5.6.1 If any new Kimberlite pipe is found, then as reported that the known pipes are covered by 1 to 1.5 m calcrete at least 1m x 1m of 2m depth of pitting shall be undertaken for verification of probable location of kimberlite pipes.

5.7.0 **Core Drilling:**

5.7.1 The remote sensing studies and Geophysical survey will be helpful in adding new area in the block for Kimberlite clusters. Hence 5 scout boreholes involving 600 m of drilling will be undertaken for upper level of intersection.

5.8.0 **Drill Core Logging:**

5.8.1 The drill core will be logged for rock types, structural features, textures, intersection of ore zones, type of mineralization and occurrence of various Heavy minerals. The logging for determining the Rock quality determination will also be undertaken.

5.9.0 **Sampling:**

a) **Surface sampling:** During the course of Geological mapping the Bed rock and Soil samples shall be collected from the out crops and soil covered area respectively. A total of 150 no's bed rock samples and 500 no's soil samples shall be collected, prepared and analyzed for heavy mineral analysis.

b) **Drill core sampling:** During the geological logging of drill core, mineralized zones will be marked, 300 no's of samples (primary) will be analyzed for Heavy mineral analysis, 100 no's primary samples will be given for check.

5.10.0 **Petrological Studies:**

5.10.1 During the course of core logging & mapping 100 samples from various litho units intersected will be studied for petrography.

5.11.0 Whole Rock Analysis:

5.11.1 To check the rock types, their variation in chemical composition, whole rock analysis will be done for 10 samples.

5.12.0 Specific gravity Determination:

5.12.1 For the specific gravity determination 30 samples from the mineralized zones intersected in the boreholes will be sent to lab.

5.13.0 Quantum of Work Proposed

5.13.1 The details of proposed quantum of work is given in the table below:

Regional Exploration Proposal (G-4 level) for Diamond in Chelima Block (Block-ID SR-AP-01), District: Kurnool &Prakasham, Andhra Pradesh			
Sl. No.	Item of work	Unit (m)	Proposed Quantum of Work
1	Remote Sensing (Structural Mapping) & Reconnaissance Mapping (on 1: 50000 Scale)	Scene	1 Scene 1172sq km
2	Geological Mapping (on 1:12,500 Scale)	Sq. Km	1172 sq.km
3	Topographical Survey (on 1:12,500 Scale in potential Zone Areas)	Sq. Km	As per requirement
	Bore Hole Fixation (Scout Boreholes)	Nos	5 Nos
	& Coordinate Determination	Nos	5 Nos
4	Geochemical Sampling (Will be carried out in anomalous areas)		
	a) Bed Rock Sampling	N0s.	150 Nos
	b) Soil Sampling	N0s.	500 Nos
	c) Stream Sediment Sampling	N0s.	1500 Nos
5	Ground Geophysical Survey (Will be carried out in anomalous areas)		
	a) Magnetic Survey	No of Sts.	2100 Nos
	b) Gravity Survey	No of Sts.	2100 Nos
6	Drilling (coring)	m	600m (5 Bhs)
7	Geological work		
	a) Geological Core Logging, Sample Preparation etc.	m	600m (5 Bhs.)
8	Laboratory Studies (To be carried out on samples collected from anomalous areas)		
	I) Surface Sampling (Primary samples)		
	i) Bed Rock samples		
	a) Heavy Mineral analysis	Nos	150 Nos
	ii)) Soil Samples		
	a) Heavy Mineral analysis	Nos	500 Nos
	iii) Stream Sediment Samples		
	a) Heavy Mineral analysis	Nos	1500 Nos
	iv) Check Samples (Bed Rock / Soil/ Stream sediment)		

	a) Heavy Mineral analysis	Nos	100 Nos
	v) Drill Core Primary Samples		
	a) Heavy Mineral analysis	Nos	300 Nos
9	Petrological Samples (Surface & Bh Core Samples)		
	a) Preparation of Thin Section	N0s	100 Nos
	b) Study of Thin Section	N0s	100 Nos
10	Whole Rock Analysis -		
	SiO ₂ , Al ₂ O ₃ , Fe ₂ O ₃ , TiO ₂ , MnO, CaO, Na ₂ O, K ₂ O+H ₂ O, MgO, P ₂ O ₅ , CO ₂ , & S.	Nos	10 Nos
11	Specific gravity Determination	Nos.	30 Nos
12	Report Preparation [As per Mineral (Evidence of Mineral Contents) Rule-2015]	N0s	1

6.0.0 Time schedule and cost Estimate:

6.1.0 Time schedule

6.1.1 The proposed block area is nearly of 1172 sq. km. there is possibility of getting sub-surface extension of the ore body already recognized two no's of areas and some new prospective areas. The details are indicated in bar chart given below.

**Time schedule (in months) for Exploration Programme in Kalyandurg –
Timmasamudran Block, Distt: Anantpur, Andhra Pradesh**

Item of Work	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Remote Sensing with Ground Check	←			→												
Remote sensing report					←	→										
Stream Sediment Samplings	←			→												
Geological Mapping (2 Party Days)	←					→										
Bed Rock Sampling/ Soil Sampling			←		→											
Surveying (1 Party Days) for Sampling etc	←			→												
Sample Preparation Soil/Bed Rock/Stream (4 Party Days)		←				→										
Analytical Work					←				→							
Geophysical Survey							←			→						
Geophysical Report											←	→				
Surveying in Geophysical Survey (2 Party's)							←			→						
Drilling (600 m)											←	→				
Pitting (20 cu.m)											←	→				
Surveying (1 Party) for drilling, contouring and surface features											←		→			
Sample Preparation (Drill Core) (1 Party)												←	→			
Sample Preparation pitting											←			→		
Geologist Party days for Drilling, pitting and Sampling work & report work (1 Party)											←		→			
Analytical Work Drill Core Samples													←	→		
Pit Samples													←		→	
Camp winding													←	→		
Geological Report														←		→

6.2.0 Cost Estimate:

The Project cost with provisional escalation is estimated at say Rs. 2.96Crore. The details of item wise cost estimate with inbuilt actual escalation as on 31.3.2016 is given below.

Sl No.	Item	Total Estimated Cost (Rs.)
1	Remote Sensing & Report	20,00,000.00
2	Geological, Survey & Sampling Work	1,07,26,830.00
3	Geophysical Survey & Report	44,08,800.00
4	Drilling	70,11,426.00
5	Exploratory Mining	64,100.00
6	Laboratory Studies	51,18,800.00
	Subtotal	2,93,29,956.00
7	Report	2,93,300.00
	Total	2,96,23,256.00

Or Say Rs. 296.23 Lakhs (Rs. 2.96 Crore)

7.0.0 Justification:

- i) In view of MMDR Amendment & Mineral Auction Rule, 2015, GSI has identified this block for exploration MECL decided to take up the work under NMET funding.
- ii) In the proposed study area, numbers of known Kimberlite clusters have been already explored. Apart from these there is possibility of getting few more prospects. The Geophysical surveys and Remote sensing studies will add to the Geological mapping for targeting Kimberlite pipes.
- iii) The exploration will be helpful in estimation of reconnaissance resources of Diamond bearing Kimberlites in block area.
- iv) The Regional Exploration will help in planning of detailed exploration programme which in turn will facilitate the State govt. for auctioning of block.

Cost Estimate for G-4 Level of Exploration for Diamond in Kalyandurg-Timmasamudram Block, (Block-ID SR-AP-02), District: Anantpur, Andhra Pradesh					
Sl. No.	Item of Work	Unit	Rates (2016-17)	Qty.	Amount
A	REMOTE SENSING & REPORT (1 BLOCK)	Nos	2,000,000.00	1	2000000.00
B	GEOLOGICAL WORK				
1	Survey Party days				
	a) Survey Party days (1party) For Sampling etc	days	6,146.00	150	921900.00
	b) Survey Party days (2 party) For Geophysical Survey etc	days	6,146.00	240	1475040.00
	b) Survey Party days (1party) For Drilling	days	6,146.00	90	553140.00
2	Geologist Party days				
	a) Geological Party days (2 Party) For Geological Mapping etc	days	8,021.00	360	2887560.00
	b) Geological Party days (1 Party) For Drilling, Core Sampling	days	8,021.00	90	721890.00
3	Sampling Party days	day			
	a) Sample Preparation for Bed Rock, Soil , Stream samples (4Partys)	days	2,945.00	600	1767000.00
	b) Sample Preparation Drill Cores (1 Party)	days	2,945.00	60	176700.00
	c) Sample Preparation pit samples (4 Partys)	days	2,945.00	480	1413600.00
4	Transportation (Light Vehicles, 3nos)	day	1,500.00	540	810000.00
	Sub-Total B				10726830.00
C	GEOPHYSICAL SURVEY & REPORT				
	a)Magnetic Stations	Nos.	482.00	4200	2024400.00
	b) Gravity Stations	Nos.	482.00	4200	2024400.00
4	Transportation (Light Vehicles, 2 nos)	day	1,500.00	240	360000.00
	Sub-Total C				4408800.00
D	CORE DRILLING (5 BH)				
1	Surface Drilling (2 rigs)	m	7,268.00	600	4360800.00
2	Transportations (2 Rigs)	Km	34.00	4000	136000.00
3	Accommodation (One time/ Drill)	Nos	728,250.00	2	1456500.00
4	Camp Setting / Winding	Nos	268,723.00	2	537446.00
5	Road Making (Flat Terrain)	Km	20,368.00	10	203680.00
6	GI Core Boxes	Nos	2,000.00	150	300000.00
7	Transportation Charges of Core Boxes	Km	34.00	500	17000.00
	Sub Total D				7011426.00
E	EXPLORATORY MINING				
	a)Pitting	Cu. m	6410.00	10	64100.00
	Sub Total E				64100.00
F	LABORATORY STUDIES				
1	Chemical Analysis				
	i) Surface sampling (Bed Rock Samples)				
	Heavy Mineral analysis	Nos.	1,900.00	150	285000.00
	ii) Soil Samples				
	Heavy Mineral analysis	Nos	1,900.00	500	950000.00
	iii) Stream Sediment Samples				
	Heavy Mineral analysis	Nos	1,900.00	1500	2850000.00
	a) Check Samples (Bed rock/ soil/ stream)	Nos	1,900.00	100	190000.00
	ii) BH Core Sampling, Primary & Check samples				
	Heavy Mineral analysis	Nos.	1,900.00	300	570000.00
2	Physical Analysis				
	i) Petrographic Studies (BH core + Surface Samples)				
	a) Preparation of thin section	Nos	545.00	100	54500.00
	b) Study of thin section	Nos	1,495.00	100	149500.00
	ii) Whole rock analysis	Nos	6,386.00	10	63860.00
	iii) Specific Gravity Determination (BH)	Nos	198.00	30	5940.00
	Sub-Total E				5118800.00
	Total (A+B+C+D+E)				29329956.00
G	EXPLORATION REPORT - 1% of (A+B+C+D+E+F)				293300.00
	GRAND TOTAL (A+B+C+D+E+F+G)				29623256.00
					Say Rs. 2.96 crore
Note	Rates of Goel Committee based on actual escalation as per RBI indices as on 31.3.16 and provisional escalation of @15% points for drilling and 25% points for Geological & Laboratory Studies for subsequent year.				

Cost Estimate for G-4 Level of Exploration for Diamond in Kalyandurg-Timmasamudram Block, (Block-ID SR-AP-02), District: Anantpur, Andhra Pradesh

Sl. No.	Item of Work	Unit	Base Rate	Rates	Qty.	Amount
			1st April-90	(2016-17)		
A	REMOTE SENSING Using ASTER / HYPERSPECTRAL data (1 BLOCK)	Nos		20,00,000	1	2000000
B	GEOLOGICAL WORK					
1	Geologist Party days					
	a) Geological Party days (2 Party) For Geological Mapping etc	days	1541	8,021	360	2887560
2	Sampling Party days	day				
	a) Sample Preparation for Stream samples (1 Partys)	days	525	2,945	360	1060200
3	Transportation (Light Vehicles, 1 nos)	day	Lumpsum	1,500	360	540000
	Sub-Total B					4487760
C	LABORATORY STUDIES					
1	Chemical Analysis					
	i) Stream Sediment Samples					
	Heavy Mineral / Indicator Minerals (1 sample / 25 sq km)	Nos	220	1,286	50	64300
	Total (A+B+C)					6552060
D	EXPLORATION REPORT -Lumpsum					200000
	GRAND TOTAL (A+B+C+D)					6752060
					Say Rs. 67.52 Lakhs	
Note	Revised rate of promotional work by MECL on behalf of Govt. of India vide letter no. 37(I)/2006-MI dated 02.07.2014 and based on actual escalation as per RBI indices as on 31.3.16 and provisional escalation of @15% points for drilling and 25% points for Geological & Laboratory Studies for subsequent year.					