PROPOSAL FOR RECONAISSANCE SURVEY (G4) FOR REE AND ASSOCIATED MINERALS IN PATHARKATA BLOCK AREA (105.364 SQ KM) DISTRICT-NAYAGARH, ODISHA

COMMODITY: REE AND ASSOCIATED MINERALS

BY
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PLACE: NAGPUR
DATE: JUNE, 2026

Summary of the proposed area for reconnaissance survey (G4)

<table>
<tr><td></td><td>Features</td><td>Details</td></tr>
<tr><td></td><td>Block ID</td><td>Patharkata</td></tr>
<tr><td></td><td>Exploration Agency</td><td>Mineral Exploration and Consultancy Limited (MECL)</td></tr>
<tr><td></td><td>Commodity</td><td>REE and associated minerals</td></tr>
<tr><td></td><td>Mineral Belt</td><td>Eastern Ghat Mobile Belt, Odisha</td></tr>
<tr><td></td><td>Budget & Time schedule to complete the project</td><td>213.21 Lakhs& 10 months</td></tr>
<tr><td></td><td>Objectives</td><td>The main objective of the investigation is to search the REE & RM mineralization in magmatic intrusive rocks of EGMB by delineating REE-enriched zone through LSM,pitting andsystematic collection of samples from different media, like, bedrock, pit, regolith, stream sediment, auger drilling and heavy minerals. After the positive outcomes of the above activities scout drilling will be carried out to intersect REE bearing rocks in subsurface at 30m vertical depth. In addition, assessment of quality and quantity of the resources (334) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015 will be carried out.</td></tr>
<tr><td></td><td>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</td><td>Work will be carried out by the proposed agency.</td></tr>
<tr><td></td><td>Name/Number of Geoscientists</td><td>Will be provided during execution.</td></tr>
<tr><td></td><td rowspan="2">Expected Field days (Geology, Survey)</td><td>Geologist Party days: Field -120 days & HQ-45 days</td></tr>
<tr><td></td><td>Sampling Party days: 50 days</td></tr>
<tr><td>1.</td><td>Location</td><td>The proposed Patharkata Block comprises of 105.364 sq km area and lies in Nayagarh District (Toposheet No: 73H/4), Odisha. Nayagarh town is located 3.5 km east of the proposed block.</td></tr>
<tr><td></td><td>Latitude and Longitude</td><td>
<table>
<tr><td colspan="5">Coordinates of Patharkata Area (Area -105.364 Sq km)</td></tr>
<tr><td>Cardinal</td><td>Latitude</td><td>Longitude</td><td>Northing</td><td>Easting</td></tr>
</table>
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		Points	WGS 1984 DMS		Degree Decimal	
		A	20° 09' 7.57" N	85° 00' 15.02" E	2233359.49	918715.1512
		B	20° 09' 8.39" N	85° 04' 21.28" E	2233559.11	925876.8961
		C	20° 06' 22.18" N	85° 04' 22.07" E	2228440.96	926043.8734
		D	20° 06' 22.09" N	85° 09' 00.00" E	2228637.55	934111.8574
		E	20° 03' 54.01" N	85° 09' 00.00" E	2224076.32	934225.518
		F	20° 03' 56.41" N	85° 09' 00.00" E	2223777.49	918973.5412
	Villages	Banamalipur, Ladukeshwarpur, Patharkata, Raghunathpur and others				
	Tehsil/Taluk	Nayagarh				
	District	Nayagarh				
	State	Odisha				
2.	**Area (hectares/ square kilometres)**					
	Block Area	105.364 sq.km				
	Forest Area	Western part of the area is forest land				
	Government Land Area (Bilanam)	Data not available				
	Charagaha	Data not available				
	Private Land Area	Data not available				
3.	**Accessibility**					
	Nearest Rail Head	Nayagarh town in Odisha, India. Broadguage railway line of Khurda Road-Visakhapatnam section of the East Coast Railway passes in the southwestern part of the block.				
	Road	National highway NH-57 passes through the north eastern part of the block which connects Khorda in the east via Nayagarh and Balangir in the west via Daspalla and Boudagarh. Many villages including Banamalipur, Ladukeshwarpur, Patharkata, Raghunathpur are located within the area and which are connected with the district and village level roads. Western parts of the area are occupied by hillocks and forest. Nayagarh town in Odisha, India. Broadguage railway line of Khurda Road-Visakhapatnam section of the East Coast Railway passes in the eastern part of the block. Nayagarh town railway station on the same line located within the block.				
	Airport	The nearest airport is at Bhubaneswar, which is about 100 km east of the block.				
4.	**Hydrography**					
	Local Surface Drainage Pattern (Channels)	This area is showing mainly dendritic to sub-dendritic pattern with 1st order to 4th order streams. mainly drained by Kusumi Nadi flowing from south to north towards the east of the block and Lunijhara Nadi, a tributary of Kusumi Nadi towards the north of the block.				
	Rivers/ Streams	Tributaries of Kusumi River				
5.	**Climate**					
	Mean Annual Rainfall	Average annual rainfall is 1400mm				
	Temperature	Minimum temperatures: 15°C (Dec-Feb), Maximum temperatures: up to 47°C (March-June)				

6.	**Topography**	
	Toposheet Number	73H/04
	Morphology of the Area	Western part of the area is occupied by hillocks. Maximum elevation has been observed in the Western corner of the proposed block which is around 685mRL based on toposheet. North Eastern and Eastern part of the block is plain to gently undulating and mainly covered by agricultural land and settlement with an elevation of 110 mRL. Few isolated hills and ridges occur in this part.
7.	**Availability of baseline geoscience data**	
	Geological Map (1:50K/25K)	Bhukosh Map (1:50000), Plate-III:
	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 Preliminary Exploration**	1 The proposed block has been carved out on the basis of anomalous values of stream sediment samples collected during NGCM programme in the TS No. 73H/4. A total 24 Nos. of samples falling within the proposed block. Out of which 5Nos. of samples are more than 1000ppm and 02Nos. of samples are more than 2500ppm. These anomalous values indicate for the further investigation in the area for the source of REE mineralization. Total REE, LREE and HREE anomaly maps are provided in thePlate V to VII. 2 During FS: 2022-23, 100 sq.km area (part of TS No. 73H/4) around Notara-Baulasahi area, was mapped on a larger scale. Khondalite, leptinite and charnockite form the major lithotypes of the Eastern Ghats Mobile Belts, exposed in the area. The EGMB suite of rocks is intruded by pyroxene-bearing syenite, syenite and pyroxenite, which act as the host rocks for REEs in the area. The pyroxenite, in turn, are either apatite-bearing, or are traversed by apatite veins, which are REE-rich. Analytical results indicated ∑REE content of regolith samples varies from 102.54ppm to 18,415ppm, whereas in stream sediment samples, it varies from 93.57ppm to 5,447.70ppm and for BRS samples, it varies from 902ppm to 52,743ppm. The LREE concentration is predominant compared to HREE in all the samples of different

		media. EPMA studies of samples from y from the syenite-pyroxenite suit allanite, monazite, bastnaesite and Ce-rich REE phases have been identified. 3 Specialized thematic mapping carried out by Bhattacharjee & Sreenivas during FS: 2018-20 in TS No. 73H/3 brought out the first ever presence of REE-bearing phases in the heart of EGMB, hosted by bands of syenite-pyroxenite. Sphene along with allanite, thorite, monazite and other REE bearing phases were recorded. 4 During FS: 2021-22,Khuntapada area by Swain & Behera was taken under STM programme. Large scale mapping of the area revealed that granite gneissic country rock is intruded by several leucocratic coarse grained to pegmatoidal syenite veins. EPMA study confirmed the presence of bastnaesite, thorite, allanite, and baddeleyite as significant REE/RM phases associated with sphene and apatite. Analytical results indicated ∑REE content of regolith samples varies from 228.86ppm to 4,031.67ppm whereas in stream sediment samples it varies from 214.86ppm to 2,225.67ppm and for BRS sample it varies from 89.409ppm to 24,689.11ppm. The LREE concentration is predominant compared to HREE in all the samples of different media. 5 The proposed block is adjacent to the above mentioned blocks and in the same geological set up. Hence, the proposed area has been selected for further investigation.

PROPOSAL FOR RECONAISSANCE SURVEY (G4) FOR REE AND ASSOCIATED MINERALS IN PATHARKATA AREA (105.364 SQ.KM) DISTRICT: NAYAGARH, ODISHA

1.0.0 INTRODUCTION

1.1.0 The rare-earth elements (REE), also called the rare-earth metals or rare earths, and sometimes the lanthanides or lanthanoids (although scandium and yttrium, which do not belong to this series, are usually included as rare earths), are a set of 17 nearly indistinguishable lustrous silvery-white soft heavy metals. Scandium and yttrium are considered rare-earth elements because they tend to occur in the same ore deposits as the lanthanides and exhibit similar chemical properties, but have different electrical and magnetic properties. The term 'rare-earth' is a misnomer because they are not actually scarce, although historically it took a long time to isolate these elements. REEs are not rare in terms of overall abundance in the Earth's crust, but they are rarely found in large, concentrated deposits that are economically viable to mine.

1.2.0 Because of their unusual physical and chemical properties, the REEs have diverse defense, energy, industrial, and military technology applications. The glass industry is the leading consumer of REE raw materials, which are used for glass polishing and as additives that provide color and special optical properties to the glass. Lanthanum-based catalysts are used in petroleum refining, and cerium-based catalysts are used in automotive catalytic converters. The use of REEs in magnets is a rapidly increasing application. Neodymium-iron-boron magnets, which are the strongest known type of magnets, are used when space and weight are restrictions. Nickel-metal hydride batteries use anodes made of a lanthanum-based alloys.

1.3.0 China holds the largest share of global REE reserves (44 million metric tons) and is the world's leading producer, with a 2024 production of 270,000 metric tons of rare earth oxide equivalent. United States has significant reserves (1.9 million metric tons) and is the second-largest producer, but relies heavily on imports from China for refined rare earths. Other major players are Brazil, Vietnam, and Russia with substantial REE reserves.

1.4.0 India possesses the fifth-largest rare earth mineral deposits globally, with significant deposits in monazite minerals.

1.5.0 It is almost over a decade after the REE crisis that dawned on world commodity supplies in 2010 due to China’s monopoly on REE resources, production and their export policy. The economic importance of the REE resources in relation to the supply chain risk is considered first, followed by their resource status both in the world and India. Very briefly, the policy changes in India that have taken place in the Mines and Minerals (Development and Regulation) MMDR Amendment Act, 2015 and the Atomic Minerals Concession Rules, 2016 for survey and exploration of

mineral resources is considered. Many amendments have been thereafter to achieve own substantial reserves and the need for a diversified and secure supply chain with the following objectives:

a) **Geopolitical Context:** China currently dominates the global REE supply, and India seeks to reduce its dependence on China for these critical materials.

b) **Diversifying Supply Chains:** By exploring and developing its own REE resources, India aims to build a more secure and diversified supply chain.

c) **Supporting Economic Growth:** The development of REE industries can create jobs and boost economic growth in the mining and processing sectors.

d) **Energy Transition:** REEs are crucial for the transition to a low-carbon economy, and India's exploration efforts are aligned with its commitment to achieving net-zero emissions by 2070.

e) **National Security:** Securing access to REEs is vital for India's national security and technological independence.

1.6.0 **Initiatives taken to achieve objectives are as follows:**

I. **National Critical Minerals Mission:** The government has allocated funds for domestic and international mineral exploration, including REEs.

II. **Geological Survey of India (GSI):** GSI is actively involved in exploring for REEs and other critical minerals.

III. **Indian Rare Earths Limited (IREL):** IREL is a government-owned company involved in the mining and processing of rare earth minerals.

IV. **International Partnerships:** India is engaging with other countries to secure access to critical mineral assets.

V. **Central Govt. PSUs, National Exploration Agency (NEA) and Notified Exploration Agency (NPEA):** With an objective to boost the mineral exploration activities in the country ‘National Mineral Exploration Trust’ (NMET)plays a crucial role in supporting and expediting mineral exploration in the country by funding special studies, regional and detailed exploration, and capacity building for personnel engaged in mineral exploration.

1.2.0 BACKGROUND

1.2.1 In light of above,emphasis has been given to explore prospective areas for critical and strategic minerals especially REE and RM. Mineral Exploration and Consultancy Limited (MECL) plays a crucial role in India's mineral exploration sector, serving as a premier public sector enterprise under the Ministry of Mines. More and more areas are being explored to align the nation objective. KatharpataArea (105.364Sq.Km) District Nayagarh, Odisha part of the SOI toposheet 73H/4 and within the Eastern Ghat Mobile Belt (EGMB) by MECL through NMET funding is an approach towards the same.

1.2.2 Adjacent to the proposed block, GSI in its field season 2022-23 has established occurrences of REE and RM with in the EGMB part of the SOI toposheet 73H/4 where apatite veins, which transacted a suite of syenite-pyroxenite bodies, intruding the charnockites of Eastern Ghats Mobile Belt.

1.2.3 Recently we have carried out few traverses in the proposed Patharkata Block and collected few samples from exposed bedrocks (Granite gneiss, Pegmatite veins and Pyroxinite), lateritic soil and stream sediments. The stream sediments in the block are enriched with secondary dispersion of heavy minerals. The analysis of the samples are awaited.

2.1.0 LOCATION AND ACCESSIBILITY

2.1.1 The proposed Patharkata Area comprises of 105.364sqkm area and lies in Nayagarh District (Toposheet No: 73H/4), Odisha. Nayagarh town is located 3.5km east of the proposed block. National highway NH-57 passes within the area in theNorth- Eastern part of the block which connects Chandibasta in the North East via Nayagarh and Nuagaon in the North-SouthSH-21 via Nayagarh and Odagaon. Many villages including Kirailarji. Chandibasta, Mandhatapur, Jamujhola, Khuntabandha, etc are located within the area and which are connected with the district and village level roads. Western parts of the area are occupied by hillocks and reserved forest area of Sulia RF and Patharakata RF. Broadguage railway line of Khurda Road-Visakhapatnam section of the East Coast Railway passes in the northeastern part of the block. Nayagarh town railway station is located 5km away on the eastern side from the block. Location map of the area is provided as Plate I and co-ordinates of the proposed block is tabulated below.

Table 2.1

Coordinates of Corner Points of Proposed Patharkata Block over an extent of 105.364sq km, Nayagarh District, Odisha

Coordinates of Patharkata Block Boundary (Area -105.364Sqkm)				
Cardinal Points	Latitude	Longitude	Northing	Easting
	WGS 1984 DMS		Degree Decimal	
A	20° 09' 07.57" N	85° 00' 15.02" E	2233359.497	918715.1512
B	20° 09' 08.39" N	85° 04' 21.28" E	2233559.118	925876.8961
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F	20° 03' 56.41" N	85° 00' 15.97" E	2223777.494	918973.5412

2.2.0 PHYSIOGRAPHY AND DRAINAGE

2.2.1 Western part of the area is occupied by hillocks with NW-SE trend. Maximum elevation has been observed in the western corner of the proposed block which is around 685mRL based on toposheet. Northern and eastern part of the block are plain

to gently undulating and mainly covered by agricultural land and settlement with a minimum elevation of 110 mRL. Few isolated hills and ridges occur in this part.

2.2.2 Drainage map of the area has been prepared on the basis of SOI toposheet to understand the catchment area morphology, structural fabrics, sampling strategy, identification of sample point, etc.Within the block area (Toposheet No. 73H/4), the region is mainly drained by the Kusumi Nadi, which flows from west to east south of the proposed block, and the Dahuka Nadi, which flows from west to east north of the proposed block. In addition, the Sulia Nala flows through the central part of the proposed block from west to east.The main tributaries of Kusumi Nadi are Dabukanadi, Lunijharanadi, Sulia nala etc. By observing this drainage pattern and direction, the slope of the area is assumed to be towards south east. From southeastern corner of the area the slope changes towards Northwest. This area is showing mainly dendritic to sub-dendritic pattern with 1st order to 4th order streams.

2.3.0 CLIMATE

2.3.1 Dry weather prevails over the area throughout the major part of the year. The average annual rainfall is about 1,400 mm that is received mostly between June and September. During the peak summer, the temperature rises to as high as 47°C. A pleasant weather prevails during the winter in this area. In winter, the temperature goes down upto 15°C.

2.4.0 FLORA AND FAUNA

2.4.1 The northern and western parts of the area are thickly forested. Tectonograndes (Teak), Shorea robusta (Sal), Melia tudice (neem), Modhuca latifolia (Mahua), Bamboos arundance (Bamboo) and Tamarindus indica (Imli) are the major plant species. Cultivation of mostly rice, bajra and various kinds of pulses are done in the plain lands.

2.4.2 Rare birds like Hornbills, Fishing Eagles, Black Drongo, wild animals as rare flying squirrels, malabar giant squirrels, star tortoise, King Cobra, rock python, monitor lizard, leopard, wild dog Indian wolf, spotted deer, wild boar, elephant and a number of poisonous and non-poisonous snakes are the wild animals residing in the dense forests.

3.1.0 REGIONAL GEOLOGY

3.1.1 Precambrian orogenic belts are black boxes of extinct supercontinents whose fragments are now dispersed in present day continents. The supercontinent Rodinia is interpreted to have assembled, stabilized and broken up during the ca. 1300-780 Ma time frame. A key component to the assembly of Rodinia is the erstwhile contiguous terranes of Raynar complex - Eastern Ghats Belt (R-EG), which represents the orogenic belt during ca. 1140-900Ma suturing landmasses of India and East Antarctica. Published literature from EGB shows no clear record of deep crustal exhumation while it was reported that pan African orogeny caused only localized

thermal rejuvenation along the boundary shear zones. The geologically complex Eastern Ghats Belt thus concealed this history over the years creating ambiguity on the post Rodinia history of the belt. One major reason for this lacuna is the dearth of comprehensive P T-t study in the Indian counterpart compared to that of the East. Eastern Ghats Belt (EGB) is interpreted as a collage of several crustal domains each having unique isotopic characters and style of evolution (Dobmeier and Raith 2003, Rickers 2001). This lithologically varied and structurally complex belt reveals three important events of supercontinent juxtaposition. Eastern Ghats Mobile Belt (EGMB) is a 1000 km long NE-SW trending regional granulite facies metamorphic belt. The Eastern Ghats Province is characterized by an intensely deformed and metamorphosed assemblage of meta- sedimentary, basic and enteritic granulite's, interspersed with massif-type anorthosites and probably multi-intrusive granite-charnockite complexes. The dominant meta-sedimentary lithologies are khondalites and diatexitic quartzo feldspathic gneisses, both frequently interlayered with sillimanite and garnet bearing quartzites and leucocratic garnetiferous gneisses, commonly termed leptinite. Calcareous rocks occur as rare layers or lenses of calc silicate granulites. Generalized map of EGMB with location of the proposed map is provided in the following figure 3.1

3.1.2 Regional stratigraphy Ramakrishnan et al., (1998) proposed the following stratigraphic column in modification of Ramakrishnan et al. (1994)

Table: 3.1: Stratigraphy of Ramakrishnan et al. (1998)

800 - 900 Ma	Alkaline rocks, granitoid
1000 -1100 Ma	Eastern Ghats Orogeny
	(Development of Eastern Ghat Front of upgrade cratonic rocks)
1300 - 1400 Ma Khondalite Group (WKZ, CMZ, EKZ)	Incipient and massive charnockite and garnet-Hornblendebiotite gneisses Emplacement of alkaline rocks (feldspathoidal gneisses and anorthosites) Garnet-sillimanite-graphite gneisses Cordierite-saphirine-spinel rocks, Calc-silicate rocks and rare marbles Quartzite rich in garnet (and some sillimanites)
1600-1800 Ma (WCZ)	Evolution of Purana basin
2600-2800 Ma	Charnockites with enclaves of basic granulites, High grade schists including BIF, and layered basic Complexes, presenting original cratonic basement in migmatite, Amphibolite facies
3000 Ma	Vestigial events

3.1.3 Major lithounits found in the area are described below:

Khondalite: Khondalite, typically represented by garnetiferous quartzo-feldspathic sillimanite schist or gneiss is found primarily in the south-eastern part the mapped

area, in form of linear bands and patches, in association with either leptinite or charnockite. They have a broad mineralogical assemblage of garnet + sillimanite + biotite + quartz + K-feldspar ± plagioclase ± graphite ± Mn oxide. Porphyroblasts of garnet and acicular sillimanites are present. The khondalites are well foliated and show various shades of greyish, brownish, red and yellowish colour in hand specimens. The colour variation depends considerably on the degree of weathering undergone by the khondalites.

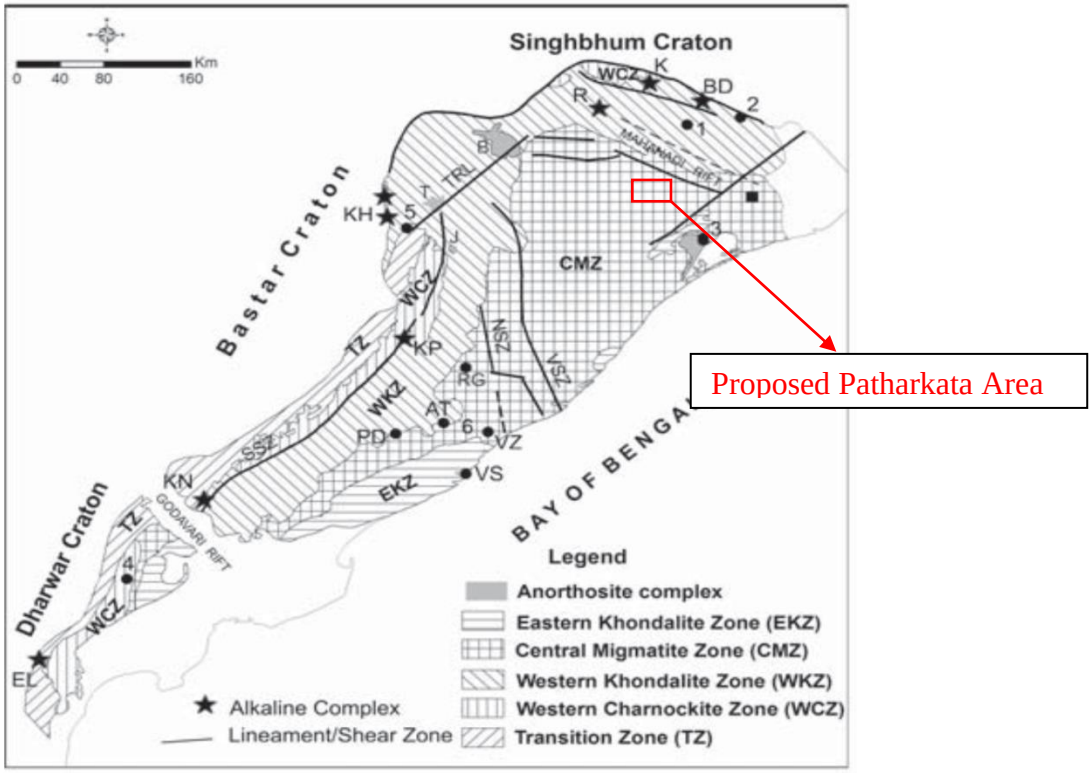

Fig. 3.1: Generalized map of EGMB showing litho-zones (after Ramakrishnan et al., 1998), major shear zones/ lineaments, alkaline and anorthosite complexes. Anorthosite Complexes: B-Bolangir, T-Turkel, J-Jugsaipatna, 3 Chilka Lake. Alkaline Complexes: BD-Badadangua, K-Kankarakhol, R-Rairakhol, KH-Khariar, KP-Koraput, KN-Kunavaram and EL-Elchuru. 1-Angul region, 2-Chadeidhra-Jenapur segment, 3-Chilka Lake region, 4-Kondapalle, 5-Deobhog-Dharamgarh region, 6-VisakhapatnamVizianagaram-Raygada-Anantagiri-Paderu sector (VsVisakhapatnam, Vz-Vizianagaram, RG-Rayagada, ATAnantagiri, PD-Paderu). SSZ-Sileru Shear Zone, TRLTel River Lineament (Tel River Shear Zone), NSZ-Nagavalli Shear Zone.

Charnockite: The rock is medium to coarse grained and displays a smoky and cloudy appearance. The mineralogy is defined by quartz, K-feldspar and biotite. The rock is intersected by a number of quartz and pegmatite veins. The charnockites show the effect of migmatization at places. Sometimes, the surface is found to be weathered, for which, thinning and stretching of grains, as imparted due to shearing, become prominent. This signifies that, though this charnockite appears massive, it has also been affected by shearing, but due to its density and compactness, the shearing signatures became recessive.

Calc-granulite: It is a medium grained rock, greenish white in colour. The mineral assemblages are diopside, scapolite, quartz, calcite with a little feldspar. In some cases presence of garnet is noted in minor amounts.

Granite gneiss: The granite gneiss is of two types' i.e. garnetiferous granite gneiss and porphyroblastic garnetiferous granite gneiss. The non-porphyroblastic type is the older as evidenced by xenoliths of this rock found in porphyroblasstic granite gneiss. Bands of these rocks are concordant with migmatised khondalite. The porphyroblastic garnetiferous granite gneiss is the most predominant and occupies extensive areas. The rock is very coarse grained with porphyroblasts of feldspar in a groundmass of quartz, feldspar, garnet.

Pegmatite and quartz veins: Pegmatite and quartz veins are very common within the migmatite zone. Most of the veins are aligned parallel to the foliation of the migmatite host rock. The combination of minerals are noted in the pegmatite i) quartz and feldspar, ii) quartz-feldspar-muscovite-biotite, iii) feldspar, quartz-biotite-tourmaline. Quartz veins of variable thickness occupy the joint planes. Sometimes it contains graphite flakes and clots.

3.1.4 **STRUCTURE**: Well developed foliation due to parallel arrangement of sillimanite needles, graphite and biotite flakes is displayed by the rocks of the khondalite formation. Banding displayed by concentration of garnet quartzo-feldspathic matters is prominent in the gneissic variety of the khondalites. In the non-porphyroblastic granite gneiss, flattened quartz and biotite rich bands impart the gneissosity. An indistinct gneissosity is observed in porphyroblastic granite gneiss by a rough alignment of feldspar porphyroblasts. The strike of foliation is dominantly NW-SE to NE-SW with steep south easterly dips. The general steep dip (70° to 80°) of foliation is a common feature in the whole area.

3.1.5 **METAMORPHISM:**High grade metamorphism under granulite facies conditions characterizes the Eastern Ghats Super Group of rocks. The mineral assemblages of Khondalite (quartz-feldspar-garnet-sillimanite+graphite), Granulite (plagioclase-hypersthene-diopside) and calc-silicate (diopside-plagioclase-calcite-quartz-scapolite) indicate pyroxene granulite sub-facies under granulite facies of Eskola.

3.2.0 GEOLOGY OF THE BLOCK

3.2.1 Based on the available geological map on 50K scale, the area falls in the Central Migmatite Zone of the EGMB. The block is located north of the Nayagarh town. Central, eastern and southern part of the area is occupied by lateritic soil. Adjacent to the southern boundary granite gneiss and small patches of charnockite occupied the area. In the eastern part pyroxene granulites occurs as mounds. Northern and western part of the block is occupied by NE-SW trending hillocks which comprises of khondalite, charnockite and pyroxene granulite. At places small patches of quartzites are exposed within the khondalite. Geological map of the area in 50K scale is provided in the Plate III.

3.2.2 Large scale geological mapping(1:12,500) during FSP 2022-23 by GSI in the adjacent area i.e. southeast of the proposed block has established the following stratigraphy.

Table No 3.2

Stratigraphy in the adjacent area (after GSI)

	Recent	Soil/Alluvium
		Laterite
	Intrusives	Syenite/Pyroxenite
		Pyroxene-bearing syenite
Eastern Ghat Supergroup	Charnockite Group	Sheared Charnockite/Charnockite
	Khondalite Group	Leptinite Khondalite

3.3.0 PREVIOUS WORK AND RECOMMENDATION

Numerous researches have been carried out in EGMB on its geological setup, tectonic framework, petrological and mineralogical aspects, age-dating and EGMB-East Antarctica correlation. Amongst these magnum findings, the ones relevant to the present study are being discussed here sequentially

3.3.1 Specialized thematic mapping was carried out in the southern bank of Mahanadi River in the central part of EGMB between Kantilo-Khalisahi in the east and Malatiputa Kumbharpara in the west in parts of T.S. Nos. 73H/03 by Mahapatro & Tripathy during FS 2007- 08. They mapped interbanded sequence of high grade metapelitic schists/ gneisses belonging to the Khondalite Group, charnockite, garnetiferous granitoid gneisses, leptinite, stromatic migmatite and mafic granulites. The regional strike of the dominant foliation and the litho-boundaries of the area were marked as WNW-ESE. Mahanadi Shear Zone (MSZ) was mapped between Kalatangi in the southeast, 4 km west of Ganian in the west for ~26 km stretch. It was described as WNW-ESE to E-W trending and 2- 3 km wide shear zone with mylonitic foliation having moderate to steep dip (45°-65°) towards northeast. Down dip stretching lineation was also marked.

3.3.2 Specialized thematic mapping carried out by Bhattacharjee & Sreenivas during FS: 2018-20 brought out the first ever presence of REE-bearing phases in the heart of EGMB, hosted by bands of syenite-pyroxenite. Bhattacharjee et al., 2022 has elaborated over the presence of this REE-HFSE enriched magmatic suite in Nayagarh area. The coarse grained syenite, composed mainly of Ba-bearing (with upto 8 wt% BaO) K-feldspar (hyalophane), and accessory greenish clinopyroxene is the main rock type of this magmatic unit. Segregation and local concentration of the clinopyroxene (ferrosalite) cumulates has formed a greenish grey coarse-grained pyroxenite. Sporadic concentration of sphene (titanite) in irregular patches in the syenite is also observed which display high radioactivity. Sphene along with allanite, thorite,

monazite and other REE bearing phases are characterized by high total-REE and HFSE abundance. Following this, a one-year exploration item for REE was taken up by GSI, SU: Odisha during FS: 2021-22 by Swain & Behera in Khuntapada area, as a spin-off of the STM programme. Large scale mapping of the area revealed that granite gneissic country rock is intruded by several leucocratic coarse grained to pegmatoidal syenite veins. A dark colored pyroxenite dyke was delineated near Khuntapada whose intrusive nature into the granite gneiss country rock is evident from straight and sharp contact between pyroxenite and country rock, cross cutting the foliation in the granite gneiss. EPMA study confirmed the presence of bastnaesite, thorite, allanite, and baddeleyite as significant REE/RM phases associated with sphene and apatite. Analytical results indicated ∑REE content of regolith samples varies from 228.86ppm to 4,031.67ppm whereas in stream sediment samples it varies from 214.86ppm to 2,225.67ppm and for BRS sample it varies from 89.409ppm to 24,689.11ppm. The LREE concentration is predominant compared to HREE in all the samples of different media.

3.3.3 During FS: 2022-23 Bhattacharjee M. and Swain S. P. carried out reconnaissance survey on 1:12,500 scale for REE and RM mineralization in 100 sq.km area around Notara-Baulasahi, covering south-eastern quadrant of Toposheet No. 73H/4. The large-scale geological mapping (LSM) brought out the lithological assemblages likekhondalite, leptinite and charnockite of the Eastern Ghats Mobile Belts later intruded by pyroxene-bearing syenite, syenite and pyroxenite, which act as the host rocks for REEs mineralization. Pyroxenites in the area are associated with profuse apatite veinsrich in REEs. The highest value for ∑REE detected was 52,744ppm from these apatite veins. The rocks are strongly enriched in LREEs in comparison to HREEs. Major REE bearing minerals are titanite, bastnaesite, allanite and minor minerals are monazite, xenotime, euxenite. The pyroxene-bearing syenite were observed in a number of places, which shows the extension of the band from Baulasahi in the south to Jamusahi in north along N30°E for an approximate stretch of 10 km. Analytical results indicated ∑REE content of regolith samples varies from 102.54ppm to 18,415ppm, in stream sediment samples it varies from 93.57ppm to 5,447.70ppmand in BRS samples it varies from 902ppm to 52,743ppm. The LREE concentrationis predominant compared to HREE in all the samples of different media.Based on the concentration of ∑REE values of stream (raw & heavy fraction), regolith (clay & heavy fraction) and bedrock medium, three anomalous zones viz. Zone I (Baulasahi), Zone II (Notara) and Zone III (Nacchipur-Ikiri) were identified.

3.3.4 During FS: 2023-24 Bhattacharjee M. and Swain S. P. carried out preliminary exploration on 1:4000 scale in Khuntapada-Arakhapal Block in 1 sq km area. Detailed mapping on 1:4000 scale, drilling of 644.95 m, pitting and trenching of 100 cubic m, BRS, PS, Regolith, Drill Core Samples, Petrography, EPMA and XRD Samples were carried out. The major lithounits are granite gneiss, charnockite, syenite, leptynite, pyroxene granulite, pyroxenite and pegmatite. Titanite, carbonate and apatite arefound associated with the pyroxenite bodies which are an important source of REE. On

subsurface drilling, pyroxene-bearing syenite is identified for substantial depth, which serves as the primary host for REE mineralization.Out of 25 nos. of bedrock samples the tREE values of two collected from apatite veins exposed on the surface are 56,803 ppm and 67,073ppm respectively and another 06 BRS from pegmatites shows tREE in the range of 1566 to 4135 ppm. The maximum tREE value from the core sample is 50,049 ppm. The main host rock for REEs in the area are pyroxene-bearing syenite and the apatite veins and titanite patches present within the pyroxenite. The REEs are mainly dominated by Ce, followed by La, Nd and Pr. The primary band in the areais of apatite-titanite-bearing pyroxenite, flanked by pyroxene-bearing syenite on both sideshaving an estimated length of 220 m and width of 40 m. Three (03) parallel to subparallel REE Lodes were established by drilling in 7 boreholes at average 50m spacing. Out of which, Lode-I has been explored over a strike length of 240.55 m, however, Lode-II and Lod-III are yet to be fully explored. The Total Rare Earth Elements (tREO) Resources in Khuntapada Block by Cross section method is 389114.12 tonnes or 0.39 million tonnes with an average of 0.55% tREO at 0.2% cut-off and 2 m stopping width and it falls in Inferred Mineral Resource (333) category of UNFC classification.Further systematic exploration in the explored strike length of 220.0 m with deeper intersection at least 2nd & 3rd level and exploration in strike length further beyond in the north direction, was recommended.

3.3.5 National Geophysical mapping (NGPM) has been carried out in Survey of India (SOI) Toposheet No. 73H/04 under the Project National Geophysical Mapping (NGPM).

3.3.6 The National Geochemical Mapping (NGCM) was carried out in Toposheet No. 73H/04. In the proposed Patharkata Block 24 nos of stream sediment sample points are present having ∑REE range between 363 ppm to 3324 ppm. The ∑LREE concentration ranges from 311 ppm to 3146 ppm whereas ∑HREE concentration ranges from 52 ppm to 226 ppm. In all the 24Nos. samples the values of ∑LREE dominate over ∑HREE. Among these, only 07 Nos. of composite samples contain very ∑REE values >1000ppm and02 nos of samples show ∑REE values > 2000ppm.

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

4.1.0 The present reconnaissance survey has been formulated on the basis of the anomalous values of REE recorded in the stream sediments within the toposheet 73H/4 and documentation of occurrences of REE & RM within the EGMB by GSI in the adjacent areas.

4.1.1 The main objective of the investigation is to search the REE & RM mineralization in magmatic intrusive rocks of EGMB through delineation of REE-enriched zone through LSM, followed by pitting-trenching and thereby systematic collection of samples from different media, like, bedrock, pit-trench, regolith, stream sediment and heavy minerals. After the positive outcomes of the above activities scout drilling will

be carried out to intersect REE bearing rocks in subsurface at 30m vertical depth. In addition, assessment of quality and quantity of the resources (334) if any as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015 will be carried out.

5.0.0 PLANNED METHODOLOGY

5.1.0 In accordance to the objective set above for reconnaissance survey for REE and associated minerals in the area, the exploration programme is proposed. The Exploration shall be carried out as per Minerals (Evidence of Mineral Contents) Rule-2015 amended up to 2021. 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.

5.2.0 GEOLOGICAL MAPPING: Geological mapping will be carried out in the 105.364 sq.km area on 1:12,500 scale to establish the geological setup of the area. Rock types, their contact, structural features will be mapped. Surface manifestations of the REE mineralisation along with their surface disposition will be marked on map. 10 Nos. of surface samples of various lithounits will be studied for petrography and 05 nos of samples for minerography will be collected.

5.3.0 BEDROCK SAMPLE (Chip/ channel): A total of 50Nos. of bedrock samples have been proposed to collect from the surface exposures / mineralized area to know the REE distribution in primary rocks within the block area. Bedrock samples will be collected by means of chips/ channels and analysed for 14 REE & 9 trace elements by ICP-MS sequential technique.

5.4.0 **STREAM SEDIMENT:** Total 55 Nos. of stream sediment/ slopewash samples have been proposed based on the drainage pattern of the area. The samples will be collected systematically primarily from 2nd and 3rd order streams, which have a larger catchment area, so that, if there is any tertiary dispersion of REEs, that can be deduced and will be helpful to target the source, collected stream sediment samples will be analysed for 14 REE & 9 trace elements by ICP-MS sequential technique. Proposed location of stream sediments in the area is provided in the Plate VIII.

5.5.0 PITTING: To assess the secondary nature of mineralization or expose the mineralized host rock under soil cover, 05Nos. of orientation pits (15Cu.m) have been proposed in the said area to sample the regolith zone systematically. Depth of the pits will be 3m considering the thick soil cover in the area. These pits will serve as orientation pits for future course of action. A total of 15Nos. of samples will be generated from the 05Nos. of pits which will be analyzed for 14 REE & 9 trace elements by ICP-MS sequential techniqueto identify high REE bearing zones. The proposed orientation pit locations are shown in Plate-X.

5.6.0 **AUGER DRILLING:** On the basis of outcomes of the analytical results of the pit samples, auger drilling will be carried out in block where thick soil is present. The

auger drilling will be carried out in a systematic grid pattern of 1x1km. At each point the depth of drilling will be 4 m. 55 such points have been proposed to cover the soil cover area. A total of 220 m of auger drilling will be carried out. Sampling will be carried out at 1m interval from the mineralized portion and 150 Nos. of samples will be generated. The generated samples will be analyzed for 14 REE & 9 trace elements by ICP-MS sequential technique to identify high REE bearing zones. Proposed auger drilling location is provided in Plate IX along with the geological map of the area. Location of data points may change after large scale mapping and anomalous values obtained from geochemical samples.

5.7.0 EXPLORATORY DRILLING: Based on the positive outcomes of above activities boreholes will be planned to establish subsurface continuity of mineralization. Scout core drilling of 500m has been proposed. Number and location of boreholes will be determined after the LSM and mineralized zone established in the area. 50Nos. of core borehole samples have been proposed to generated during the drilling from the mineralized area and will be analyzed for 14 REE & 9 trace elements by ICP-MS sequential technique to identify high REE bearing zones. Mineralized zones to be intersected in the boreholes will be sampled at 1m interval or depending on the nature of mineralization and host rock and any other.

5.8.0 CORE LOGGING: 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 mineralization type would be recorded.

5.9.0 EPMA STUDIES: It is proposed to carry out 10 hours of Electron Probe Microanalysis (EPMA) of few samples to analyze the chemical composition of heavy mineral grains obtained from manual panning of the stream and soil samples, determining the conditions under which rocks formed, and studying the chemical zoning within minerals. Hence, 05 Nos. of samples will be analyzed from the mineralized/ hostrock of REE. Location of samples will be determined after the LSM, stream sediment and soil sampling.

5.10.0 XRD Analysis: 20 Nos. of sample will be studies under XRD for to assess the information about the arrangement of atoms, crystal structure, and phase composition.

5.11.0 PETROLOGICAL AND MINERAGRAPHIC STUDIES: Thin and polished section studies of samples from litho units exposed in the area or drill cores would be done for ascertaining the petrographic and mineragraphic characteristics. These samples would be drawn from ore zones and host rocks. A provision of 10 specimens for petrographic and 05 specimens for mineragraphic studies has been kept in the block.

5.12.0 WHOLE ROCK ANALYSIS: It is proposed10 Nos. of samples to understand host rock chemistry and delineate prospective zones for further exploration and drilling.

Representative samples from outcrops, drill cores will be crushed and pulverized and analysed using XRFtechniques.

6.1.0 QUANTUM OF WORK:

6.1.1 The quantum of work proposed by MECL in Patharkata Block over an extent of 105.364 sq km, Nayagarh District, Odisha is given in Table 6.1.

Table: 6.1

Sl. No.	Item of Work	Unit	Proposed Quantum of work
1	Geological Mapping (1:12,500)	sq. km	105.364
2	Bedrock Sample	Nos..	50
3	Stream Sediment Samples	Nos..	55
4	Pitting	Cu. m	15
5	Auger Drilling (55 nos, 4 m depth)	m	220
6	Scout Drilling	m.	500
7	Primary Sample Preparation & Chemical Analysis		
	i)Bedrock(50) + Stream Sediment(55)+ Pitting(15)+ Auger sample(150)+ Drill core(50) analysis for 14 REE & 9 trace elements by ICP-MS sequential technique	Nos..	335
	ii) External Check sample (10 % of Primary samples)- for 14 REE & 9 trace elements by ICP-MS sequential technique	Nos.	34
	iii) Major Oxides (WD XRF) (oxides + traces-24 elements)	Nos.	10
8	Petrographic Studies	Nos.	10
9	Mineragraphic Studies	Nos.	05
10	XRD studies	Nos.	20
11	EPMA studies	Hrs	10
12	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 for REE and associated minerals. The work activities 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) for REE and associated minerals in Patharkata Area, District: Nayagarh, State: Odisha [Block area- 105.36 sq. km; Schedule timeline- 10 months]													
Sl.	**Particulars**	**Months**	**1**	**2**	**3**	**4**	**5**		**6**	**7**	**8**	**9**		**10**
1	Camp Setting/ mobilization	Months						REVIEW					REVIEW	
2	Geologist days (Mapping, BR Sampling, Orientation Pitting, Stream Sediment Sampling)	days												
3	Geologist days (Auger and Scout Drilling)	days												
4	Drilling (1 rig) Auger and Core Drilling	m												
5	Sampling days	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. 213.21 Lakh.** The summary of tentative cost estimates for reconnaissance survey (G4) is given in **Table No.-6.3** and details of tentative cost estimates are given as Annexure-I.

Table No.-6.3: Summary of Tentative cost estimates for Reconnaissance survey in Patharkata Area, Nayagarh District, Odisha.

Sl. No.	Item	Total
1	Geological Work & Survey Work	50,69,658
2	Drilling	88,58,864
3	Laboratory Studies	30,21,100
	Sub total	**1,69,49,622**
4	Report	7,50,000
5	Peer Review	30,000
6	Proposal Prepration	3,38,992.44
	Total	**1,80,68,614**
7	GST (18%)	32,52,350.60
Total cost including 18% GST		**2,13,20,965**
SAY, in Lakhs		**213.21**

7.0.0 JUSTIFICATION

6 The proposed block has been carved out on the basis of anomalous values of stream sediment samples collected during NGCM programme in the TS No. 73H/4. A total 24 Nos. of samples falling within the proposed block. Out of which 5Nos. of samples are more than 1000ppm and 02Nos. of samples are more than 2500ppm. These

anomalous values indicate for the further investigation in the area for the source of REE mineralization. Total REE, LREE and HREE anomaly maps are provided in thePlate V to VII.

7 During FS: 2022-23, 100 sq.km area (part of TS No. 73H/4) around Notara-Baulasahi area, was mapped on a larger scale. Khondalite, leptinite and charnockite form the major lithotypes of the Eastern Ghats Mobile Belts, exposed in the area. The EGMB suite of rocks is intruded by pyroxene-bearing syenite, syenite and pyroxenite, which act as the host rocks for REEs in the area. The pyroxenite, in turn, are either apatite-bearing, or are traversed by apatite veins, which are REE-rich. Analytical results indicated ∑REE content of regolith samples varies from 102.54ppm to 18,415ppm, whereas in stream sediment samples, it varies from 93.57ppm to 5,447.70ppm and for BRS samples, it varies from 902ppm to 52,743ppm. The LREE concentration is predominant compared to HREE in all the samples of different media. EPMA studies of samples from y from the syenite-pyroxenite suit allanite, monazite, bastnaesite and Ce-rich REE phases have been identified.

8 Specialized thematic mapping carried out by Bhattacharjee & Sreenivas during FS: 2018-20 in TS No. 73H/3 brought out the first ever presence of REE-bearing phases in the heart of EGMB, hosted by bands of syenite-pyroxenite. Sphene along with allanite, thorite, monazite and other REE bearing phases were recorded.

9 During FS: 2021-22,Khuntapada area by Swain & Behera was taken under STM programme. Large scale mapping of the area revealed that granite gneissic country rock is intruded by several leucocratic coarse grained to pegmatoidal syenite veins. EPMA study confirmed the presence of bastnaesite, thorite, allanite, and baddeleyite as significant REE/RM phases associated with sphene and apatite. Analytical results indicated ∑REE content of regolith samples varies from 228.86ppm to 4,031.67ppm whereas in stream sediment samples it varies from 214.86ppm to 2,225.67ppm and for BRS sample it varies from 89.409ppm to 24,689.11ppm. The LREE concentration is predominant compared to HREE in all the samples of different media.

10 The proposed block is adjacent to the above mentioned blocks and in the same geological set up. Hence, the proposed area has been selected for further investigation.

8.0.0 References:

1. Mousumi Bhattacharjee &Smaranika Priyadarsini Swain, FSP 2022-23- Report on Reconnaissance Survey for REE & RM mineralization around Notara-Baulasahi area, Nayagarh District, Odisha (G4 stage).
2. S.N. Mahapatro& A.K. Tripathy, FSP 2007-08-Report on specialised thematic mapping of the terrain south of mahanadi graben in daspalla-khandaparakantilo segment of the eastern ghats mobile belt.
3. J. K. Nanda, M. Mohanty and S. N. Mahapatro, 2022-Geology of Odisha.

9.0.0 List of Plates:

i. Plate-I: Location Map
ii. Plate-II: Regional Geology Map (Source: Bhukosh, GSI).
iii. Plate-III: Geological Map(Source: Bhukosh, GSI).
iv. Plate-IV: Geological map showing distribution of REE anomalous values in the proposed block.
v. Plate-V: Total REE Anomaly map of the proposed area.
vi. Plate-VI: Total LREE Anomaly map of the proposed area.
vii. Plate-VII: Total HREE Anomaly map of the proposed area.
viii. Plate-VIII: Drainage Map of the proposed area along with the TREE anomaly and proposed location of stream sediment samples.
ix. Plate-IX: Geological Map showing location of proposed auger drilling locations.
x. Plate-X:Geological Map showing location of proposed orientation pit locations.

10.0.0 List of Annexures:

i) Consent to take up exploration in Patharkata Block.
ii) Estimated Time Schedule and Details of Tentative Cost for in Patharkata Block over an extent of 105.364Sq km, Nayagarh District, Odisha

By e-mail

DIRECTORATE OF MINES& GEOLOGY
STEEL AND MINES DEPARTMENT, GOVT. OF ODISHA,
BHUBANESWAR
Heads of Department Building, Unit-V, Pin-751001
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Email ID: dir.mines@orissaminerals.gov.inodisha@rediffmail.com

No. DGO-INV-INVG-0012-2023-13101/DoMG Dt. 30-12-2025

From

Sri Rajat Kumar Kar
Additional Director (Geology)

To

The Director, NMET,
Ministry of Mines,
Govt. of India, New Delhi.

Sub: Consent to take up exploration in five(5) blocks for REE at G-4 level by MECL through NMET funding-regarding.

Ref: E-mails dt.04.02.2025 dt.18.10.20205 received from MECL, Nagpur.

Sir,

With reference to the e-mails on the subject cited above, I am directed to intimate you that MECL may be allowed for G-4 level exploration for REE in following 5(five) Blocks in Sambalpur, Angul & Nayagarh District of Odisha.

1. Patrapali Block, Sambalpur district.
2. Abhaypur Block, Nayagarh district.
3. Hatibahal Block, Angul & Sambalpur district.
4. Patarkata Block, Nayagarh district.
5. Dalki-Kusumkhol Bock, Sambalpur district.

Yours faithfully,

30.12.25

ADDITIONAL DIRECTOR(GEOLOGY)

Memo No. 13102 **/DoMG** **Dt.** 30-12-2025

Copy to the General Manager (Exploration), MECL, Nagpur for information.

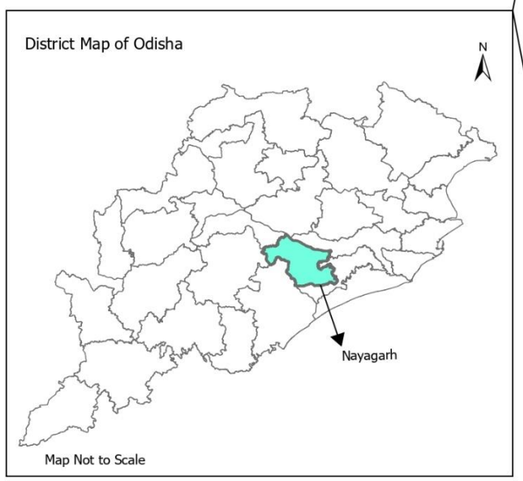
30.12.25

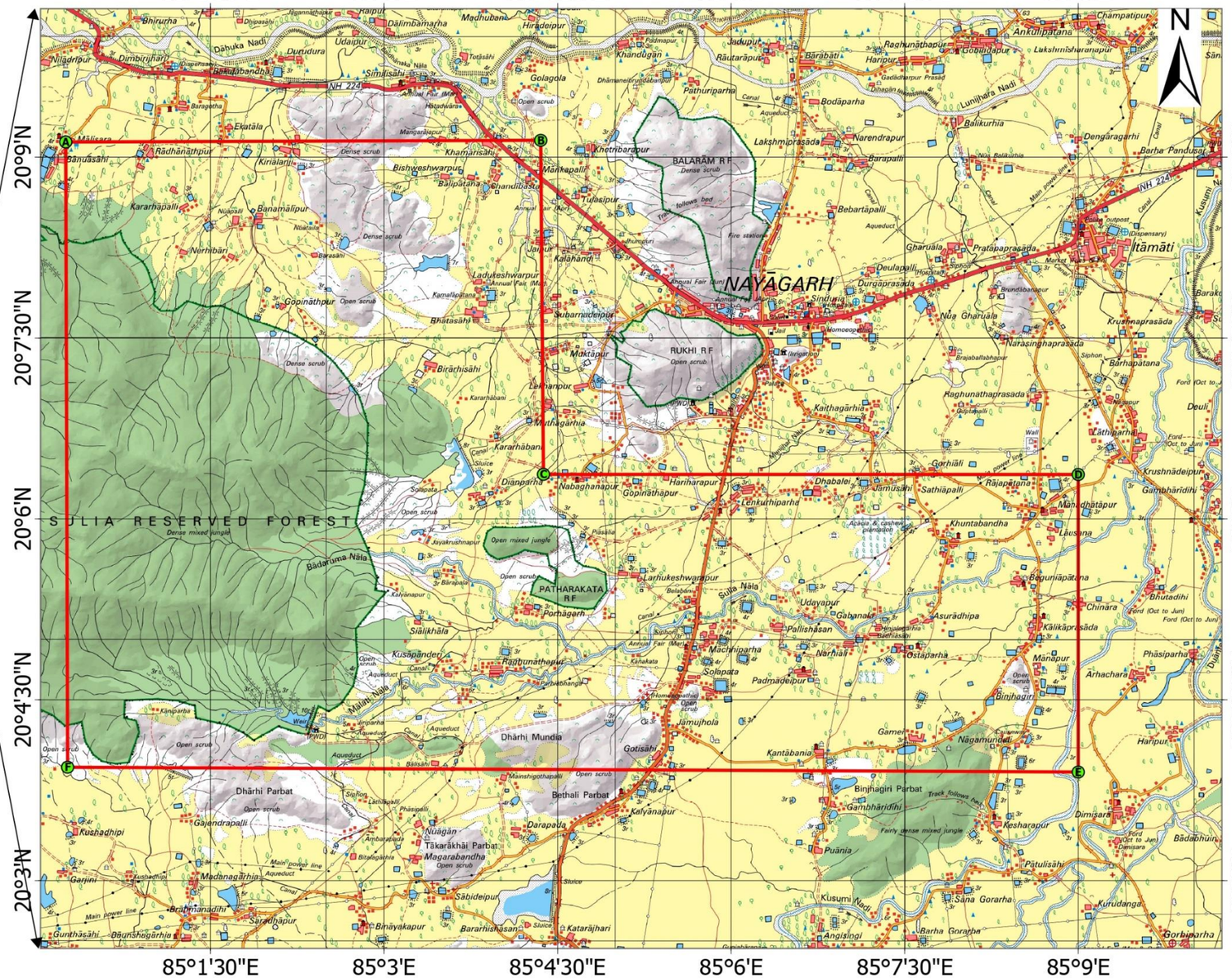
ADDITIONAL DIRECTOR(GEOLOGY)

Estimated cost for Reconnaisance Survey (G-4) for REE and associated minerals in Patharkata Area, District: Nayagarh, Odisha. [Block area- 105.36 sq. km; Auger Drilling: 220 m (55 nos); Core Drilling-500m (8 nos.), Borehole depth range: 60 m; Schedule timeline- 10 months, Review after: 5 and 9 months]							
S. No.	**Item of Work**	**Unit**	**Rates as per NMEDT Revised SoC 2025**		**Estimated Cost of the Proposal**		**Remarks**
			SoC-Item -Sl No.	**Rates as per SoC**	**Qty.**	**Amount (Rs)**	
A	**GEOLOGICAL MAPPING**						
i	Large Scale Mapping (1:12,500)	per sq km	1.1	18,300	105	19,28,088	
B	**OTHER GEOLOGICAL WORK/ ACTIVITIES**						
i	Charges for one Geologist-Field	per day	1.2.1a (b)	14,500	120	17,40,000	
ii	Charges for one Geologist - HQ	per day	1.2.1a (a)	10,500	45	4,72,500	
iii	2 labours/ party (As per rates of Central Labour Commissioner)	per day	5.8	556	240	1,33,440	Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher. EPF, ESIC and Bonus will be extra as mandatory by GoI on its gazzatte notification 21.01.2025
iv	Sampling -1 Samplers Labour charge not included	per day	1.2.1b	7,850	50	3,92,500	
v	4 labours/ party (As per rates of Central Labour Commissioner)	per day	5.8	556	200	1,11,200	Amount will be reimbursed as per the notified rates by the Central Labour Commissioner or respective State Govt. whichever is higher. EPF, ESIC and Bonus will be extra as mandatory by GoI on its gazzate notification 21.011.2025
C	**SURVEY WORK**						
i	Demarcation of lease boundary, Fixation of borehole and determination of co-ordinates & Reduced Level (RL) of the boreholes by DGPS	Per Point of observation	1.3.2	24,000	8	1,92,000	Proposed Boreholes: 8
D	**PITTING AND TRENCHING**						
i	Orientation Pitting (5 nos)	per cu. m.	2.1.3	6662	15	99,930	
					Sub Total- A TO D	**50,69,658**	
E	**EXPLORATORY DRILLING**						
1	**AUGER DRILLING (Outsourcing)**						
i	Mechanized Auger Drilling for soft strata upto 30 m depth	per m	2.2.2.1	4,760	220	10,47,200	55 Boreholes
ii	Technical Supervision cost	One time	6	10% of the sum of all the outsourced work components with a maximum ceiling of 20 lakh.		1,04,720	
iii	Tendering Processing cost	One time	5.9	2% of the approved project cost or Rs. 5 Lakhs which is lower		20,944	
2	**CORE DRILLING (Inhouse)**						
i	Drilling in very hard rock upto 400 m in HQ Size	m	2.2.1.1e	12,650	500	63,25,000	08 Boreholes
ii	Concrete Pillar Construction	Per Borehole	2.2.7	2000	8	16,000	
iii	Borehole Plugging	Lumpsum per borehole	2.2.8	10000	8	80,000	
iv	Miscellaneous Charges	Lumpsum per borehole	2.2.9	For drilling cost more than 50 lakhs and less than 1 crore: 20% of drilling cost with a maximum ceiling of 50 lakhs		12,65,000	
					Sub Total- E	**88,58,864**	

F	**LABORATORY STUDIES**						
1	**Chemical Analysis**						
	a- Analysis of 14 REE & 9 tace element by ICP-MS sequential technique	per sample	4.1.15	7,400	335	24,79,000	Bedrock: 50, Pit Samples: 15, Stream Sediment Samples: 55, Auger samples: 150, Drillcore Samples: 50, Heavy Mineral Concentration: 15 (Including Radioactive minerals)
	b- External (10%) Check samples from NABL Lab of 14 REE & 9 tace element by ICP-MS sequential technique	per sample	4.1.15	7,400	34	2,51,600	
	c- Major Oxides (WD XRF) (oxides + traces-24 elements)	per sample	4.1.17a	4,200	10	42,000	
2	**Physical & Petrological Stusies**						
ii	XRD analysis for identification of mineral phase	per sample	4.5.2	4,000	20	80,000	
iii	Preparation of thin section	per sample	4.3.1	500	10	5,000	
iv	Complete petrographic study report	per sample	4.3.4	2,800	10	28,000	
v	Preparation of polished section	per sample	4.3.2	800	5	4,000	
vi	Complete mineragraphic study report	per sample	4.3.4	2,800	5	14,000	
vii	EPMA studies	Hrs	4.4.1	10,500	10	1,05,000	
viii	Preparation of thin section for EPMA	Nos	4.3.1	500	5	2,500	
ix	Density studies (BH core)	Per Sample	4.8.3	2,500	4	10,000	
					Sub Total- F	**30,21,100**	
G					**Total A to F**	**1,69,49,622**	
H	**Geological Report Preparation**		**5.2.iii**	Total cost of the project exceeding 150 lakh, 7.5 lakhs		**7,50,000**	
I	**Peer review Charges**		**As per EC decision**			**30,000**	
J	**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		**3,38,992**	
K	**Total Estimated Cost without GST**					**1,80,68,614**	
L	**Provision for GST (18% of K)**					**32,52,351**	GST will be reimburse as per actual and as per notified prescribed rate
M	**Total Estimated Cost with GST**					**2,13,20,965**	
					or Say Rs. In Lakhs	***213.21***	

Location map of Proposed Patharkata Block for REE Exploration at G4 Stage (Area-105.364 sq.km), Nayagarh District, Odisha





INDEX

- Boundary Corner points
- Patharkata Block

0 500 1,000 2,000 3,000 4,000 Meters

Source: Part of Survey of India Toposheet no. 73H04

MECL

Co-ordinate of Corner Points of Proposed Patharkata Block				
Points	WGS 1984 (DMS)		UTM ZONE 44N	
	Latitude	Longitude	Northing	Easting
A	20° 09' 7.57" N	85° 00' 15.02" E	2233359.497	918715.1512
B	20° 09' 8.39" N	85° 04' 21.28" E	2233559.118	925876.8961
C	20° 06' 22.18" N	85° 04' 22.7" E	2228440.96	926043.8734
D	20° 06' 22.09" N	85° 09' 0.0" E	2228637.557	934111.8574
E	20° 03' 54.01" N	85° 09' 0.0" E	2224076.324	934225.518
F	20° 03' 56.41" N	85° 00' 15.97" E	2223777.494	918973.5412

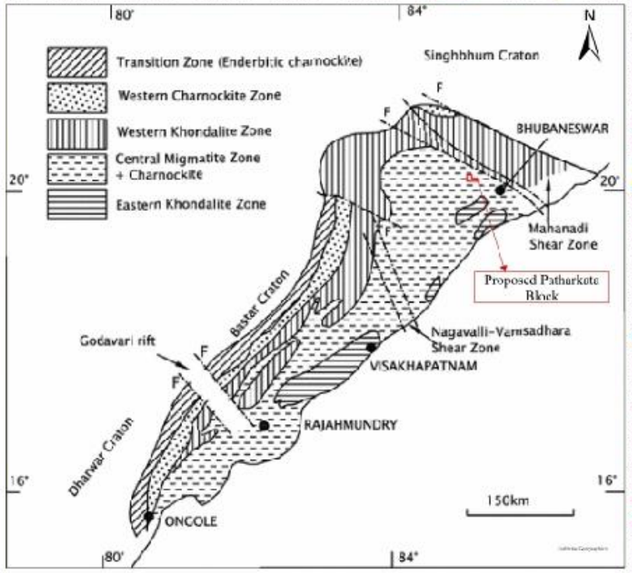
PLATE I

Regional Geological Map Showing Proposed Patharkata Block (Area-105.364 sq.km.) Nayagarh District, Odisha

84°50'0"E 84°55'0"E 85°0'0"E 85°5'0"E 85°10'0"E 85°15'0"E

20°15'0"N 20°10'0"N 20°50'0"N 20°0'0"N 19°55'0"N

N



A B C D E F

LEGEND

- CORNER ID
- BLOCK BOUNDARY

LITHOLOGY

- ACID TO INTERMEDIATE CHARNOCKITE
- ANORTHOSITE
- BLACK CLAY
- CALC GRANULITE
- COMPACT CLAY WITH CALICHE NODULES
- GRANITE GNEISS
- LATERITE
- LATERITIC SOIL
- LEPTYNITE
- PEGMATITE & QUARTZ VEIN
- PYROXENE GRANULITE/ BASIC CHARNOCKITE
- QUARTZ VEIN/REEF
- QUARTZ-GARNET-SILLIMANITE-GRAPHITE SCHIST/GNEISS
- QUARTZITE
- SAND, SILT & GRAVEL
- SAND, SILT AND CLAY
- SANDSTONE, SHALE
- UNCLASSIFIED SOIL AND ALLUVIUM
- WATER

1:150,000

0 2.5 5 10

Kilometers

MECL

PLATE II

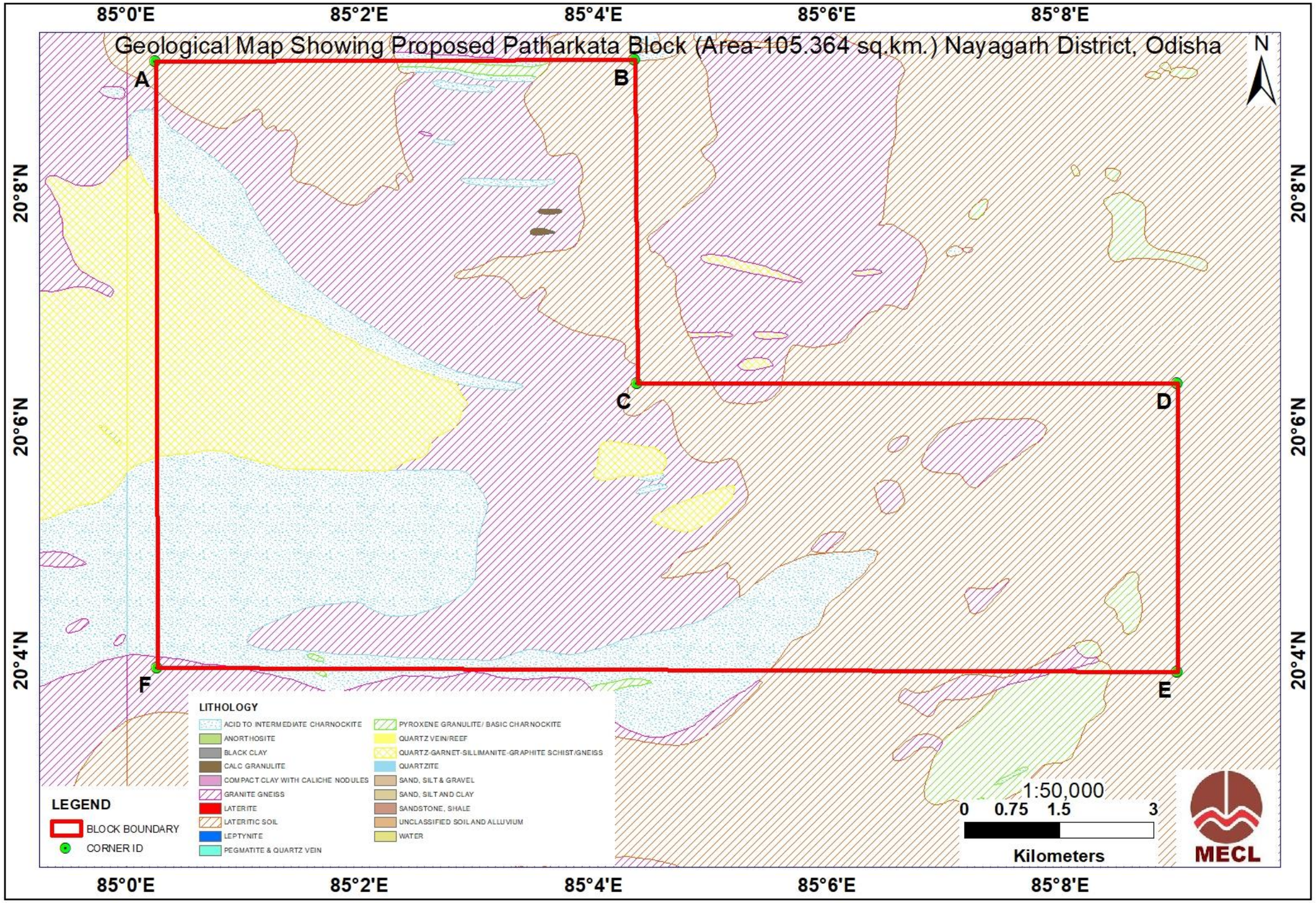

Geological Map Showing Proposed Patharkata Block (Area-105.364 sq.km.) Nayagarh District, Odisha
85°0'E
85°2'E
85°4'E
85°6'E
85°8'E
20°8'N
20°6'N
20°4'N
A
B
C
D
E
F
N
LITHOLOGY
ACID TO INTERMEDIATE CHARNOCKITE
ANORTHOSITE
BLACK CLAY
CALC GRANULITE
COMPACT CLAY WITH CALICHE NODULES
GRANITE GNEISS
LATERITE
LATERITIC SOIL
LEPTYNITE
PEGMATITE & QUARTZ VEIN
PYROXENE GRANULITE/ BASIC CHARNOCKITE
QUARTZ VEIN/REEF
QUARTZ-GARNET-SILLIMANITE-GRAPHITE SCHIST/GNEISS
QUARTZITE
SAND, SILT & GRAVEL
SAND, SILT AND CLAY
SANDSTONE, SHALE
UNCLASSIFIED SOIL AND ALLUVIUM
WATER
LEGEND
BLOCK BOUNDARY
CORNER ID
1:50,000
0 0.75 1.5 3
Kilometers
MECL

PLATE III

Geological Map Showing the Stream Sediment LocationPatharkata Block (Area-105.364 sq.km.) Nayagarh District, Odisha

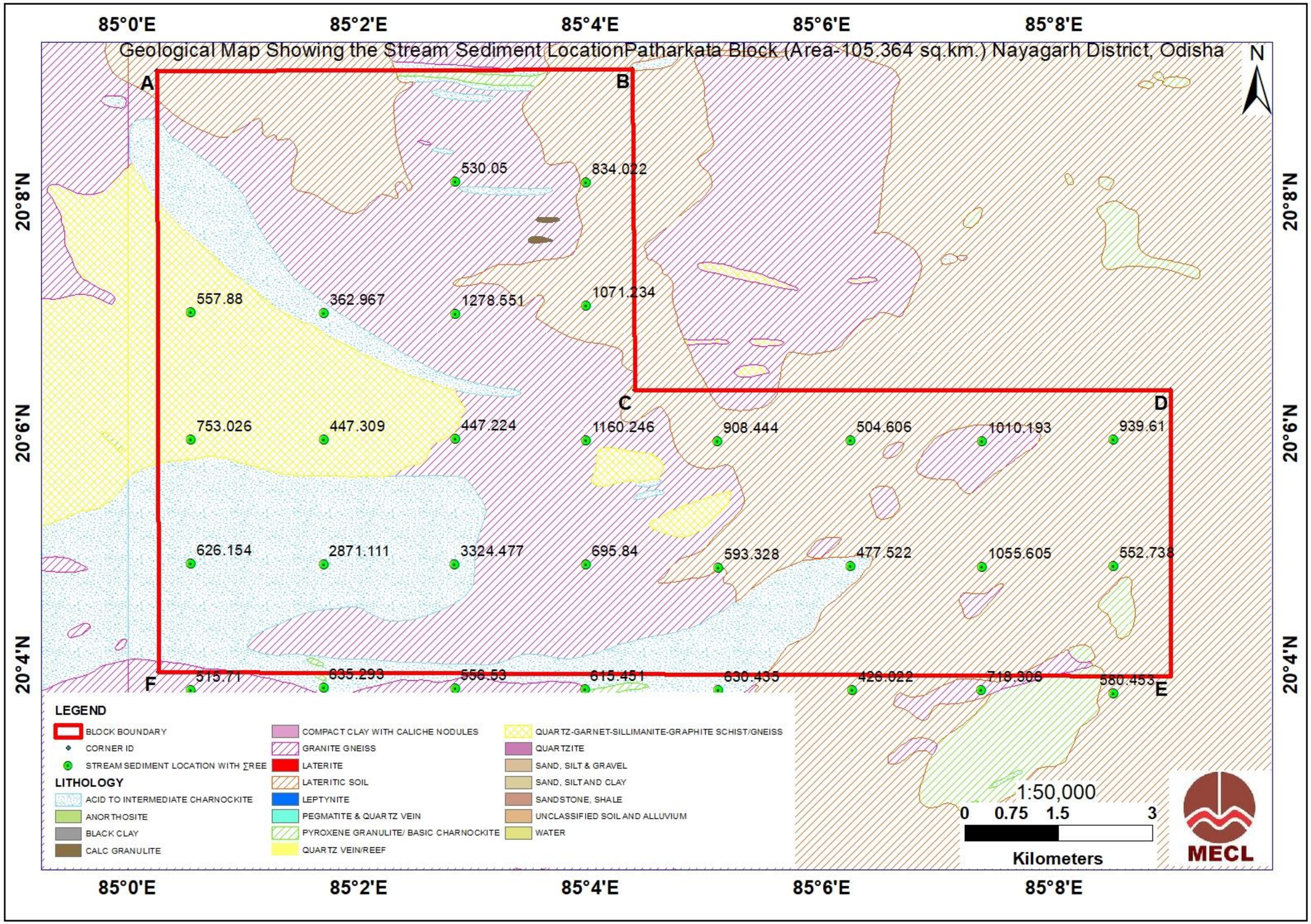


PLATE IV

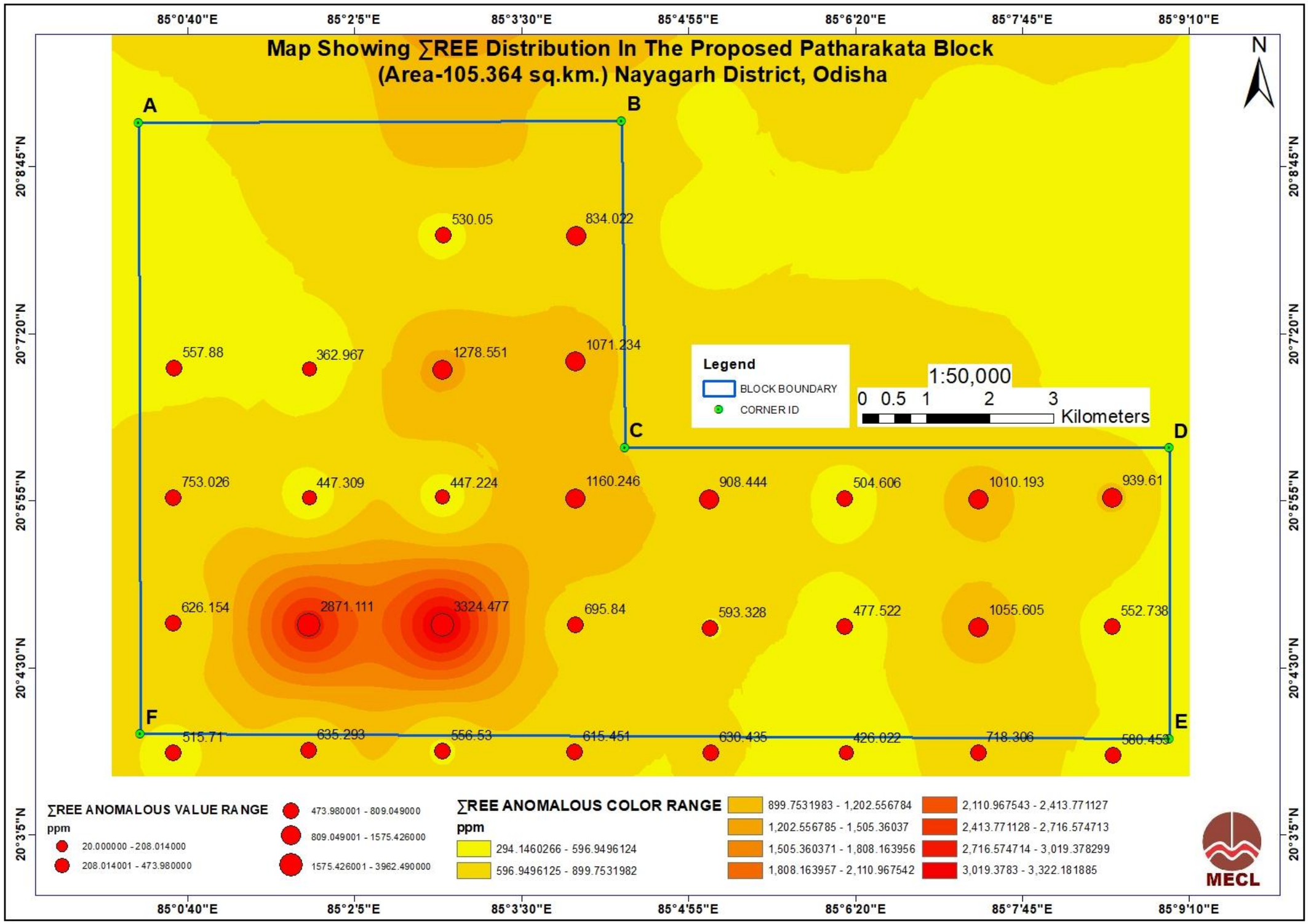

Map Showing ∑REE Distribution In The Proposed Patharakata Block
(Area-105.364 sq.km.) Nayagarh District, Odisha
85°0'40"E
85°2'5"E
85°3'30"E
85°4'55"E
85°6'20"E
85°7'45"E
85°9'10"E
20°8'45"N
20°7'20"N
20°5'55"N
20°4'30"N
20°3'5"N
N
A
B
C
D
E
F
530.05
834.022
557.88
362.967
1278.551
1071.234
753.026
447.309
447.224
1160.246
908.444
504.606
1010.193
939.61
626.154
2871.111
3324.477
695.84
593.328
477.522
1055.605
552.738
515.71
635.293
556.53
615.451
630.435
426.022
718.306
580.453
Legend
BLOCK BOUNDARY
CORNER ID
1:50,000
0 0.5 1 2 3
Kilometers
∑REE ANOMALOUS VALUE RANGE
ppm
20.000000 - 208.014000
208.014001 - 473.980000
473.980001 - 809.049000
809.049001 - 1575.426000
1575.426001 - 3962.490000
∑REE ANOMALOUS COLOR RANGE
ppm
294.1460266 - 596.9496124
596.9496125 - 899.7531982
899.7531983 - 1,202.556784
1,202.556785 - 1,505.36037
1,505.360371 - 1,808.163956
1,808.163957 - 2,110.967542
2,110.967543 - 2,413.771127
2,413.771128 - 2,716.574713
2,716.574714 - 3,019.378299
3,019.3783 - 3,322.181885
MECL

PLATE V

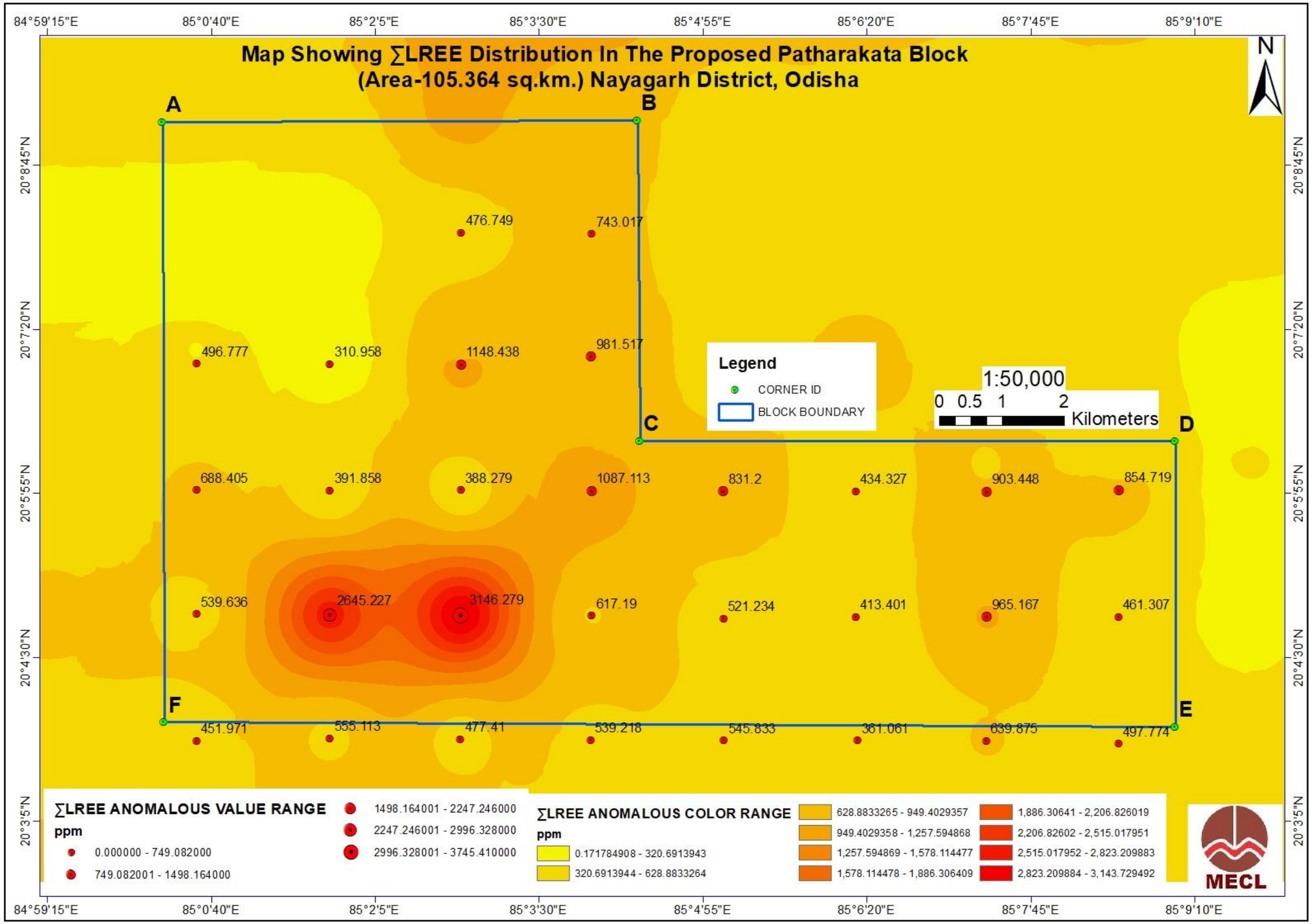

Map Showing ∑LREE Distribution In The Proposed Patharakata Block
(Area-105.364 sq.km.) Nayagarh District, Odisha
84°59'15"E
85°0'40"E
85°2'5"E
85°3'30"E
85°4'55"E
85°6'20"E
85°7'45"E
85°9'10"E
20°8'45"N
20°7'20"N
20°5'55"N
20°4'30"N
20°3'5"N
N
A
B
C
D
E
F
476.749
743.017
496.777
310.958
1148.438
981.517
688.405
391.858
388.279
1087.113
831.2
434.327
903.448
854.719
539.636
2645.227
3146.279
617.19
521.234
413.401
965.167
461.307
451.971
555.113
477.41
539.218
545.833
361.061
639.875
497.774
Legend
CORNER ID
BLOCK BOUNDARY
1:50,000
0 0.5 1 2
Kilometers
∑LREE ANOMALOUS VALUE RANGE
ppm
0.000000 - 749.082000
749.082001 - 1498.164000
1498.164001 - 2247.246000
2247.246001 - 2996.328000
2996.328001 - 3745.410000
∑LREE ANOMALOUS COLOR RANGE
ppm
0.171784908 - 320.6913943
320.6913944 - 628.8833264
628.8833265 - 949.4029357
949.4029358 - 1,257.594868
1,257.594869 - 1,578.114477
1,578.114478 - 1,886.306409
1,886.30641 - 2,206.826019
2,206.82602 - 2,515.017951
2,515.017952 - 2,823.209883
2,823.209884 - 3,143.729492
MECL

PLATE VI

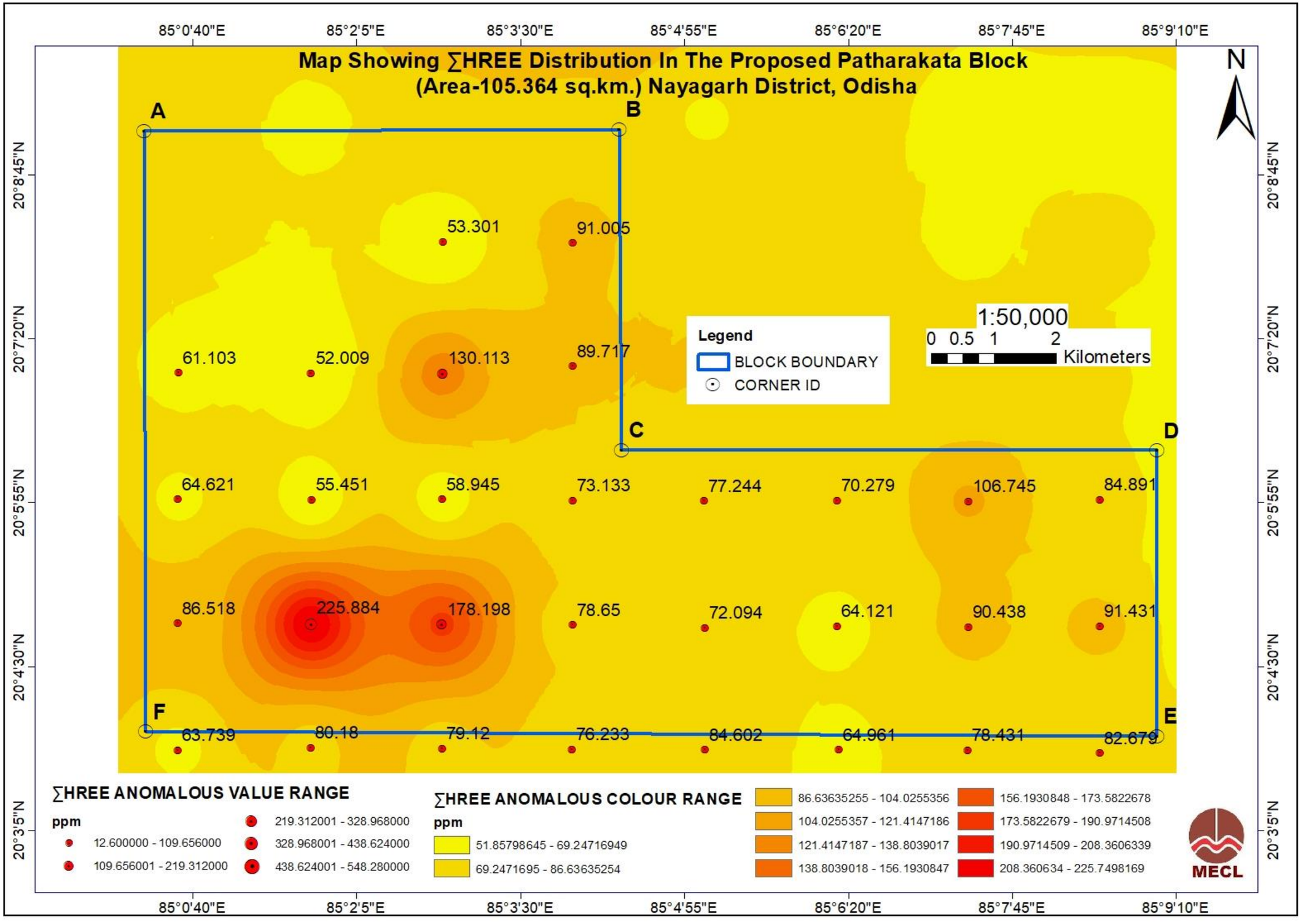

Map Showing ∑HREE Distribution In The Proposed Patharakata Block
(Area-105.364 sq.km.) Nayagarh District, Odisha
85°0'40"E
85°2'5"E
85°3'30"E
85°4'55"E
85°6'20"E
85°7'45"E
85°9'10"E
20°8'45"N
20°7'20"N
20°5'55"N
20°4'30"N
20°3'5"N
N
A
B
C
D
E
F
53.301
91.005
61.103
52.009
130.113
89.717
64.621
55.451
58.945
73.133
77.244
70.279
106.745
84.891
86.518
225.884
178.198
78.65
72.094
64.121
90.438
91.431
63.739
80.18
79.12
76.233
84.602
64.961
78.431
82.679
Legend
BLOCK BOUNDARY
CORNER ID
1:50,000
0 0.5 1 2
Kilometers
∑HREE ANOMALOUS VALUE RANGE
ppm
12.600000 - 109.656000
109.656001 - 219.312000
219.312001 - 328.968000
328.968001 - 438.624000
438.624001 - 548.280000
∑HREE ANOMALOUS COLOUR RANGE
ppm
51.85798645 - 69.24716949
69.2471695 - 86.63635254
86.63635255 - 104.0255356
104.0255357 - 121.4147186
121.4147187 - 138.8039017
138.8039018 - 156.1930847
156.1930848 - 173.5822678
173.5822679 - 190.9714508
190.9714509 - 208.3606339
208.360634 - 225.7498169
MECL

PLATE VIII

DRAINAGE MAP SHOWING LOCATION OF PROPOSED STREAM SEDIMENTS IN PATHARKATA REE AND ASSOCIATED MINERALS, NAYAGARH DISTRICT, ODISHA

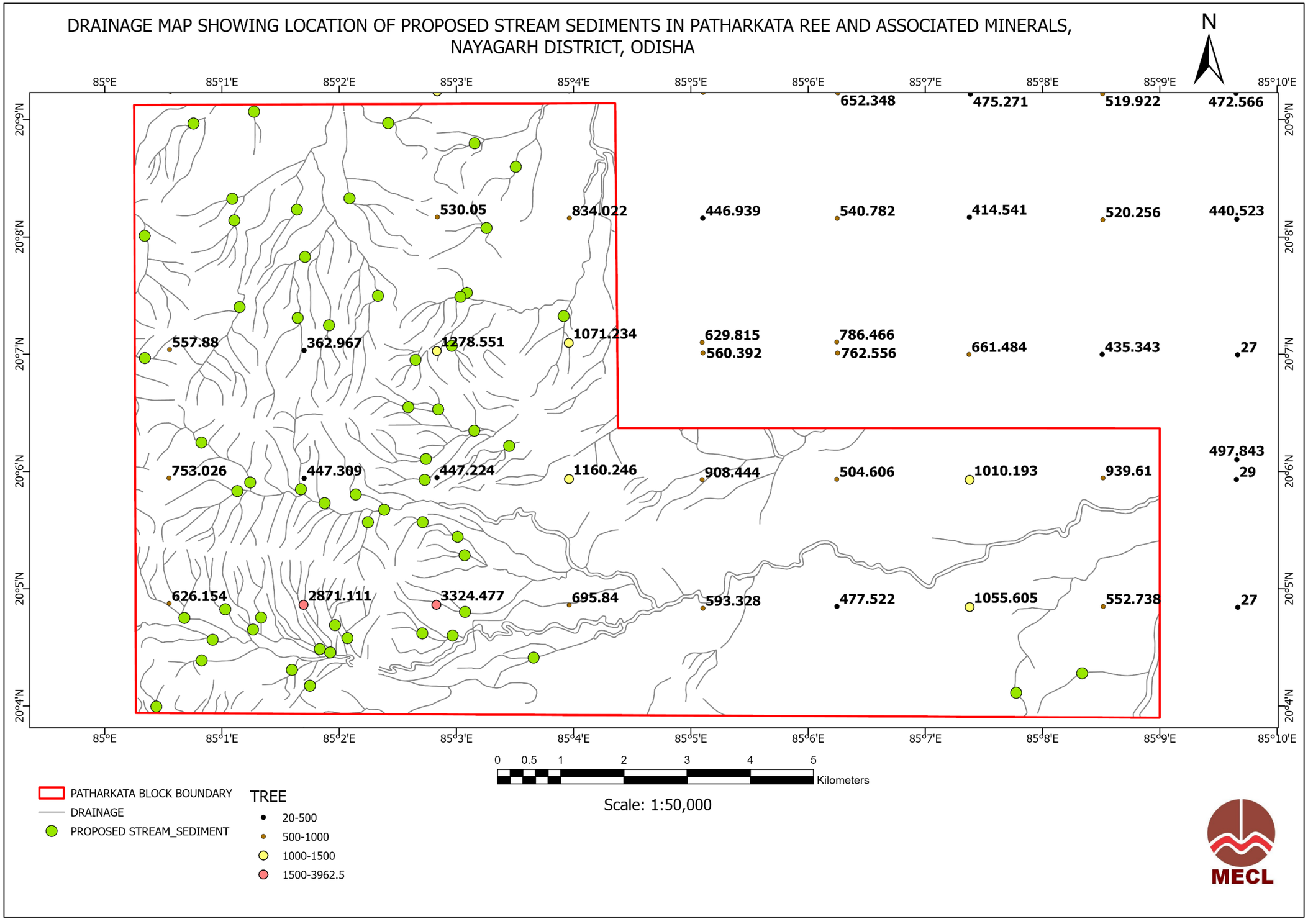


PLATE VIII

Geological Map Showing Proposed Auger Location of Patharkata Block (Area-105.364 sq.km.) Nayagarh District, Odisha

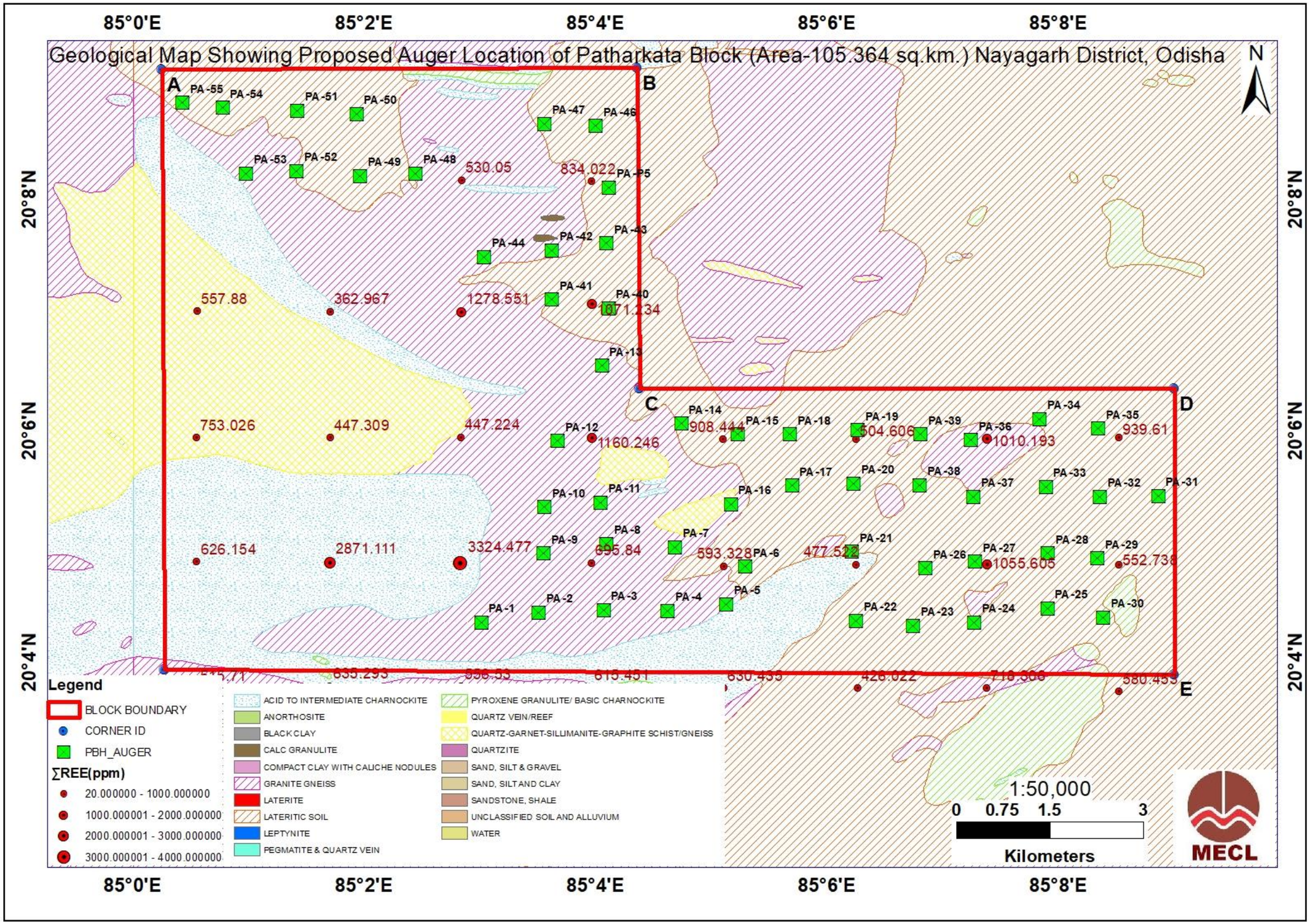


PLATE IX

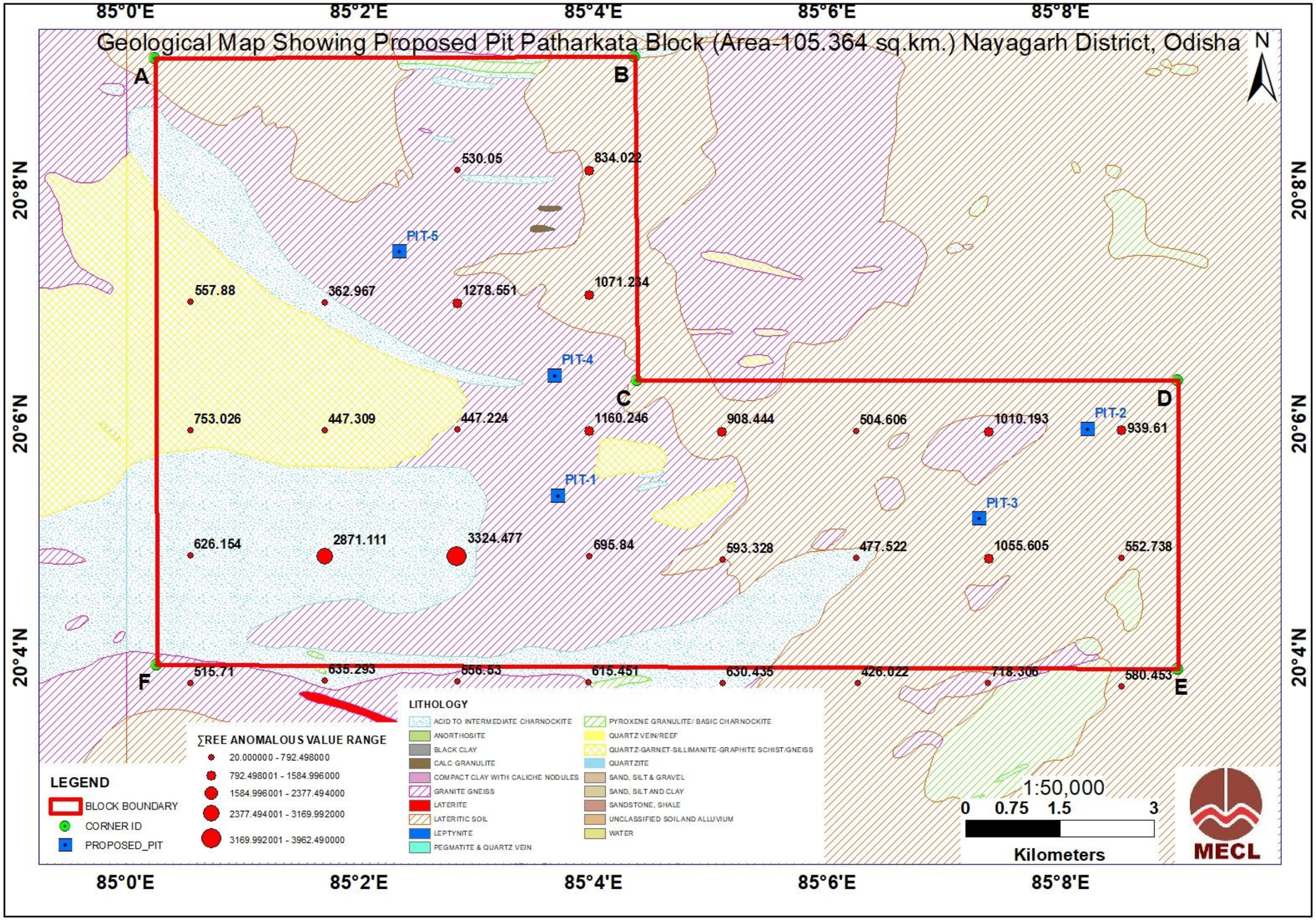

Geological Map Showing Proposed Pit Patharkata Block (Area-105.364 sq.km.) Nayagarh District, Odisha
N
85°0'E
85°2'E
85°4'E
85°6'E
85°8'E
20°8'N
20°6'N
20°4'N
A
B
C
D
E
F
PIT-1
PIT-2
PIT-3
PIT-4
PIT-5
530.05
834.022
557.88
362.967
1278.551
1071.234
753.026
447.309
447.224
1160.246
908.444
504.606
1010.193
939.61
626.154
2871.111
3324.477
695.84
593.328
477.522
1055.605
552.738
515.71
635.293
556.53
615.451
630.435
426.022
718.306
580.453
LITHOLOGY
ACID TO INTERMEDIATE CHARNOCKITE
ANORTHOSITE
BLACK CLAY
CALC GRANULITE
COMPACT CLAY WITH CALICHE NODULES
GRANITE GNEISS
LATERITE
LATERITIC SOIL
LEPTYNITE
PEGMATITE & QUARTZ VEIN
PYROXENE GRANULITE/ BASIC CHARNOCKITE
QUARTZ VEIN/REEF
QUARTZ-GARNET-SILLIMANITE-GRAPHITE SCHIST/GNEISS
QUARTZITE
SAND, SILT & GRAVEL
SAND, SILT AND CLAY
SANDSTONE, SHALE
UNCLASSIFIED SOIL AND ALLUVIUM
WATER
∑REE ANOMALOUS VALUE RANGE
20.000000 - 792.498000
792.498001 - 1584.996000
1584.996001 - 2377.494000
2377.494001 - 3169.992000
3169.992001 - 3962.490000
LEGEND
BLOCK BOUNDARY
CORNER ID
PROPOSED_PIT
1:50,000
0 0.75 1.5 3
Kilometers
MECL

PLATE X