PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR REE, Zr AND ASSOCIATED MINERALS IN MARAVNUR (AREA: 46.33 SQ KM) BLOCK DISTRICT- ARIYALUR, TAMIL NADU

COMMODITY: REE, Zr AND ASSOCIATED MINERALS

MINEREAL EXPLORATION AND CONSULTANCY LIMITED

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SEMINARY HILLS

PLACE: NAGPUR

DATE: 23 MARCH, 2026

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

GENERAL INFORMATION ABOUT THE BLOCK

	Features	**Details**
	Block ID	Maravnur Area
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	REE and Zr
	Mineral Belt	The study area occupied by Charnockite Group belonging to Southern Granulite complex of Archaean age and Peninsular Gneissic Complex-II of Archaean to Palaeo- Proterozoic age, sedimentary sequence belonging to Gondwana Super group and Upper Cretaceous formations. A few patches of Cuddalore Formation of Miocene age occur as outliers on the Upper Cretaceous sediments.
	Completion Period with entire Time schedule to complete the project & Estimated Cost	12 months with about 136.64 Lakhs rupees. (Maravnur)
	Objectives	Based on the evaluation of geological data available, the present exploration program has been formulated to fulfill the following objectives: i. To carry out Geological & Structural mapping on 1:12500 scale for identification of REE, Zr and associated mineral bearing formation with the structural features to identify the surface manifestation (if any) and lateral disposition of the mineralized zones. ii. To collect bedrock, stream sediment samples (from positive catchment area) for analyses of Zr and REEs. iii. To identify the Zr and REE enriched soil horizon, 10 nos. of orientation pitting will be carried out. Soil samples will be collected from all the soil horizon and bedrock separately by panning for heavy mineral separation.

		iv. To further determine the Zr & REE mineralised zone in the proposed block, auger drilling will be carried out and samples will be collected from targeted soil horizon established by orientation survey. v. To establish the reconnaissance resources for Zr & REE bearing minerals as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules-2015. vi. The outcome of this exploration will decide further exploration strategy for upgradation of block to Preliminary (G-3) Exploration.
	Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name of the outsource agency	Work will be carried out by the proposed agency.
	Name/ Number of Geoscientists	Two nos. of Geoscientist (1 Field + 1 HQ)
	Expected Field days (Geology) Geological Party Days	Geologist Party Days: 120 Days (Field) Geologist Party Days: 60 Days (HQ)
1	**Location**	
	The coordinates of corner points of proposed Maravanur Area are as follows:	

Corner Points of Proposed Maravnuur Block

Point	GCS (DMS)		UTM Zone-44N (m)	
	Latitude	Longitude	Northing	Easting
A	11° 07' 37.86" N	079° 00' 3.57" E	1230777.517	281673.4619
B	11° 07' 36.91" N	079° 02' 4.55" E	1230723.867	285345.0193
C	11° 06' 41.59" N	079° 02' 5.49" E	1229023.464	285362.3895
D	11° 06' 40.96" N	079° 03' 8.36" E	1228991.582	287270.3971
E	11° 05' 29.92" N	079° 03' 8.36" E	1226808.377	287256.1017
F	11° 05' 28.97" N	079° 05' 19.76" E	1226753.55	291244.1277
G	11° 04' 23.59" N	079° 05' 21.96" E	1224743.843	291298.0316
H	11° 04' 23.59" N	079° 01' 57.63" E	1224784.17	285095.8449
I	11° 03' 6.81" N	079° 01' 58.13" E	1222424.548	285095.2035
J	11° 03' 6.39" N	079° 00' 4.44" E	1222434.422	281644.08

	Villages	Maravnur
	Tehsil/ Taluk	Thimmur, Silakudi, Methal and Papanacheri
	District	Ariyalur
	State	Tamil Nadu
2.	**Area (hectares/ square kilometers)**	
	Block Area	46.33 sq km
	Forest Area	The proposed area is free from Eco sensitive Zone and Wildlife Sanctuary (Source: pmgatishakti.gov.in).
	Government Land Area	Data Not Available
	Private Land Area	Data Not Available
3	**Accessibility**	
	Nearest Rail Head	Ariyalur (18 km North East of the block)
	Road	The study area is well connected from state capital Chennai through national highways and railways. The study area is well connected by national highways (NH No.-45) with Trichy, Dindigul in the south-west and Ulundhurpet- Chennai in the north. Besides a nature of all-weather metaled roads, the area in well connected by state highways with Perambalur-Ariyalur-Chidambaram and Chidambaram-Ariyalur-Tiruchirapalli. The interior parts of the area are connected by both metalled and unmetalled roads.
	Airport	Tiruchirappalli International Airport (85km south-west of the block)
4	**Hydrography**	

	Local Surface Drainage Pattern (Channels)	The hill ranges exhibit sub-dendritic to dendritic drainage pattern is prevalent in the area whereas in the plains and isolated hillocks it shows sub-dendritic and sub-parallel drainage pattern.
	Rivers/ Streams	Nandalaar and Marudaiyar rivers are the main source of water in this area. In the areas with residual hills of charnockite and other high grade granulite rocks, radial drainage pattern is observed.
5	**Climate**	
	Mean Annual Rainfall	The Northeast monsoon brings plenty of rainfall from June to September. Maximum Rainfall: About 750-850 mm
	Temperatures (December) (Minimum) Temperatures (June) (Maximum)	Maximum Temperature: 40°C (May) Minimum Temperature: 24°C (December) Maximum Rainfall: 850 mm (July to October)
6	**Topography**	
	Toposheet Number	58M/04
	Physiography of the Area	The topography is generally flat terrain has thick fertile alluvial soil cover.
7	**Availability of baseline geosciences data**	
	Geological Map (1:50K/ 25K)	1:50000 (NGDR)& 1:25000 (Part) (NGDR)
	Geochemical Map	Stream sediment sample results from NGCM by GSI (NGDR portal) for TS 58I/16 & 58M/04 have been used to compute LREE, HREE & Total REE geochemical anomaly maps presented as plates in the proposal.

	Geophysical Map	Available
8.	**Justification for taking up Reconnaissance Survey / Regional Exploration**	i) 9 NGCM Stream Sediment Sample data points fall in the proposed Maravnur area. The total REE, LREE and HREE values have been calculated and the geochemical anomaly map for the same has been prepared. The proposed area has a maximum TREE+Sc+Y value of 2851.8 ppm with an average value of 1651.90 ppm. A total of 5 sample out of 9 (45% samples>1000PPM) shows TREE+Sc+Y value more than 1000 PPM. The maximum total HREE value in proposed Maravnurr area is 217.47 ppm of which the major contributing element is Gadolinium (maximum 53.294 ppm). The maximum LREE value in Maravnur Area is 2016.67 ppm and the major contributing element is Cerium (maximum 1260.3 ppm) followed by Lanthanum (maximum 617.63 ppm). The NGCM stream sediment samples carried out by GSI show highly anomalous values for REE in toposheets 58M/04, therefore the Maravanur Area is proposed for reconnaissance survey for REE, Zr and associated minerals.

Crustal abundance (ppm) of rare earth elements (After Mason and Moore 1982)			**Summary of Stream sediment sample data falling in Proposed Block (NGCM)**		
Group	Element	Crustal abundance (ppm)	Minimum (ppm)	Maximum (ppm)	Average (ppm)
LREE	Lanthanum (La)	30	175.19	617.63	359.78
	Cerium (Ce)	60	341.96	1260.30	721.86
	Praseodymium (Pr)	8.2	37.99	139.47	80.29
	Neodymium (Nd)	28	142.82	535.11	305.24
	Samarium (Sm)	6	21.20	79.95	44.89
HREE	Europium (Eu)	1.2	1.3344	1.9548	1.6265
	Gadolinium (Gd)	5.4	15.519	53.294	30.383

	Terbium (Tb)	0.9	1.8252	5.8614	3.3609
	Dysprosium (Dy)	3	7.4484	19.051	12.046
	Holmium (Ho)	1.2	1.2684	2.9834	1.9633
	Erbium (Er)	2.8	4.0747	10.037	6.4442
	Thulium (Tm)	0.5	0.6152	1.4253	0.9267
	Ytterbium (Yb)	3.4	4.2603	10.158	6.4563
	Lutetium (Lu)	0.5	0.6995	1.6606	1.0419
	Scandium (Sc)	22	35	79	52.75
	Yttrium (Y)	23	15	34	23
Total LREE			545.299	2016.67	1153.90
Total HREE			133.23	217.47	133.23
Total TREE			809.20	2851.80	1651.90
Zirconium (Zr)			**190**	**2025**	**5921**

ii) The highest ΣREE value recorded in these rocks' ranges from 809.20 ppm to 2851.80 with an average of 1651.90 ppm (Mottled Sandstone), LREE being the maximum contributing factor. Additionally, the highest Zirconium (Zr) value recorded in these rocks' ranges from 2025 ppm to 5921 ppm (Mottled Sandstone) with an average of 3340.44 ppm.

The mottled sandstone units exhibit distinctly elevated concentrations of rare earth elements (REEs), which is primarily attributed to the presence of abundant Fe-oxyhydroxide phases developed during subaerial weathering and early diagenetic alteration.

These ferruginous mottles, composed mainly of goethite, ferrihydrite and subordinate hematite, provide highly reactive surfaces enriched in hydroxyl functional groups capable of binding REE^{3+} ions through inner-sphere surface complexation reactions.

During the oscillating redox conditions associated with mottling, dissolved REE species in pore fluids are preferentially adsorbed onto negatively charged $Fe–O^{-}$ sites via ligand-exchange mechanisms, forming stable mono- and bidentate complexes that effectively immobilize REEs within the ferruginous matrix.

		This process is especially efficient for light REEs (La–Nd) and produces characteristic LREE-enriched signatures and Ce anomalies. Subsequent diagenetic transformation of amorphous Fe-oxyhydroxides to more crystalline hematite retains the adsorbed REEs, enhancing their concentration in mottled horizons relative to unaltered sandstone. **Thus, the high Total REE content of the mottled sandstone is interpreted as a geochemical fingerprint of Fe-driven adsorption and redox-controlled enrichment processes superimposed on a felsic provenance.** ii) Additionally, NGCM mapping (Acc No; SRO_15135 in Toposheet No. 58I/16 2005-06) in parts in parts of Perambalur and Thiruchirappali District fall in Toposheet 58I/16 which is adjacent to the proposed area in the west. Elements that showed values higher than the crustal abundance are SiO_2, Fe_2O_3, MgO, Ga, Sc, V, Th, Pb, Ni, Co, Sr, Y, Zr, Cr, Cu, Zn, Sb, Pd, F and Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Tm and Lu of REEs whereas less than crustal abundance are Al_2O_3, MnO, Na_2O, K_2O, TiO_2, P_2O_5, Be, Ge, Ba, Ru, Nb, Hf, Ta, U, Tb, Er, Yb, As, Bi, Se, Pt, Cs, Ag, Mo, Tn, W and Cd. The geochemical contour map shows the highest Th concentration of 70.1 ppm is recorded in the NE of Orattur village occurring over sandstone, clay and kankar. **The highest concentration of Zr (2516.2 ppm) that are thirteen times higher than the average crustal abundance) is located in the NW of Malvay Kannanur Village occurring over sandstone, shale and gypsum clay.** Subsequently, the entire study area shows concentration of Hf higher than the average crustal abundance. Maximum value for the **Hf (76.82 ppm)** is recorded in the SE part of the toposheet located in the **northwest of Malvay Kannanur village occurring over sandstone, shale and gypsum clay.** Hence it was recommended that a exploration programme may be carried out covering the nearby Toposheets to know the economic potentiality. Hence it was recommended that a exploration programme may be carried out covering the adjacent Toposheet no 58M/4 to know the economic potentiality.

PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR REE, Zr AND ASSOCIATED MINERALS IN MARAVNUR AREA, DISTRICT: ARIYALUR, TAMIL NADU (AREA 46.33 SQ.KM)

1.0.0 INTRODUCTION:

1.0.1 Rare earth elements are distinguished by their high density, elevated melting points, superior electrical conductivity, and excellent thermal conductivity. They exhibit unique electrical, metallurgical, catalytic, nuclear, magnetic, and luminescent properties, rendering them critical for a wide spectrum of advanced and strategic technologies essential to India’s energy security. Key application domains include clean and renewable energy systems, defense hardware, high-performance civilian technologies, environmental remediation, and other economically significant sectors.

1.0.2 Global and domestic demand for REEs is projected to rise steadily, driven particularly by their indispensable role in low-carbon and green energy technologies. This sustained growth underscores the urgent need for systematic exploration and resource augmentation to strengthen the national REE reserve base and ensure long-term supply security.

1.0.3 The rare earth elements comprise a coherent group of 17 chemically similar elements in the periodic table: scandium (Sc), yttrium (Y), and the 15 lanthanides with atomic numbers 57–71. The lanthanide series includes lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), and lutetium (Lu). Although yttrium has a lower atomic number (39), its ionic radius and geochemical behavior closely resemble those of the heavy lanthanides, warranting its inclusion in the REE group. Scandium (atomic number 21), while not a lanthanide, commonly occurs in a variety of minerals and is frequently associated with other REEs.

1.0.4 Lanthanide elements are conventionally subdivided into two geochemical categories:

Light Rare Earth Elements (LREE): Atomic numbers 57–63, comprising La, Ce, Pr, Nd, Pm, Sm, and Eu.

Heavy Rare Earth Elements (HREE): Atomic numbers 64–71, comprising Gd, Tb, Dy, Ho, Er, Tm, Yb, and Lu.

Despite their collective designation, REEs typically exhibit lithophile behavior and strong geochemical affinity for one another, leading to widespread but low-concentration distribution within the Earth's crust. Consequently, they rarely occur in highly enriched, economically mineable ore bodies, necessitating targeted exploration of specialized mineral systems such as carbonatites, ion-adsorption clays, and placer deposits for viable extraction.

1.0.5 Light rare earth elements (LREE) are generally more abundant in the Earth's crust and are more readily extractable than heavy rare earth elements (HREE). The historical designation "rare earth" arose from the perceived scarcity of these minerals, originally termed "earths." The first REE-bearing mineral to be identified was *gadolinite*—a complex silicate containing cerium, yttrium, iron, and other elements—discovered in a mine near the village of Ytterby, Sweden. Several rare earth elements, including yttrium, ytterbium, terbium, and erbium, derive their names from this locality

1.0.6 Critical minerals are defined as those essential for economic development, technological progress, and national security, where potential supply disruption poses significant risk. Supply vulnerabilities often arise from limited geological availability or the geographic concentration of extraction and processing capacities. The future global economy will be driven by technologies that rely heavily on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements. These resources are indispensable for high-technology sectors, including advanced electronics, telecommunications, transportation, and defense systems.

1.0.7 Furthermore, they are fundamental to the global transition toward a low-carbon economy, underpinning renewable energy technologies vital for achieving international "Net Zero" emissions targets. Consequently, it is imperative to systematically identify, secure, and develop integrated value chains for minerals deemed critical to the nation's economic resilience and strategic autonomy.

1.1.0 BACKGROUND

1.1.1 On enactment of MMDR Amendment Act- 2015, Minerals (Evidence of Mineral Contents) Rule 2015 and Mineral Auction Rules 2015, Govt. of India directed State Government to speed up exploration work for different Mineral Commodities in the respective states. Accordingly, MECL has prepared the proposal for Reconnaissance

(G4) level involving identification of mineralized areas worthy of further investigation towards deposit identification.

1.1.2 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 Reconnaissance Survey (G-4) for REEs, Zr and associated minerals in Maravanur block of Ariyalur district, Tamil Nadu State.

1.1.3 MECL has prepared the proposal for G-4 level exploration for REE, Zr and associated minerals in Ariyalur district, Tamil Nadu State to put up for approval in the forthcoming meeting of Technical cum Cost Committee (TCC-II) of NMEDT.

2.1.0 LOCATION AND ACCESSIBILITY

2.1.1 The proposed Maravnur block over an extent of 45.43sq.km and it is north of Kumbakonam block of Thanjavur district. The study area is well connected from state capital Chennai through national highways and railways. The study area is well connected by national highways (NH No.-45) with Trichy, Dindigul in the south-west and Ulundhurpet- Chennai in the north. Besides a nature of all-weather metaled roads, the area in well connected by state highways with Perambalur-Ariyalur-Chidambaram and Chidambaram-Ariyalur-Tiruchirapalli. The interior parts of the area are connected by both metalled and unmetalled roads.

2.1.2 All the villages in the area are well connected to each other and to the highways by motorable roads and tracks. The nearest railway station is at Ariyalur which is about 18 km north-east of the proposed block. The nearest airport is at Tiruchirapalli International which is about 87 km south-west of the proposed block. The location map of the proposed block is provided as Plate No- I. The detailed location of the boundary points were given in Table 1.

Table 1: Coordinates of Corner Points of Proposed Maravnanur Block, Ariyalur district, Tamil Nadu State.

Point	GCS (DMS)		UTM Zone-44N (m)	
	Latitude	Longitude	Northing	Easting
A	11° 07' 37.86" N	079° 00' 3.57" E	1230777.517	281673.4619
B	11° 07' 36.91" N	079° 02' 4.55" E	1230723.867	285345.0193
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Point	GCS (DMS)		UTM Zone-44N (m)	
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H	11° 04' 23.59" N	079° 01' 57.63" E	1224784.17	285095.8449
I	11° 03' 6.81" N	079° 01' 58.13" E	1222424.548	285095.2035
J	11° 03' 6.39" N	079° 00' 4.44" E	1222434.422	281644.08

2.2.0 PHYSIOGRAPHY

2.2.1 The topography is moderately undulating, formed by residual hills standing out prominently in vast pediment-pediplain complex. In the area, minimum elevation is 60m and maximum elevation is 100m above MSL, with a gradient being 6 metres per kilometer. The terrain has thick fertile alluvial soil cover.

2.3.0 DRAINAGE

2.3.1 Nandalaar and Marudaiyar rivers are the main source of water in this area. In the areas with residual hills of charnockite and other high grade granulite rocks, radial drainage pattern is observed. These rivers are tributaries to Kollidam River in the south-south east.

2.4.0 CLIMATE

2.4.1 The study area forms a hot and dry climatic region. The rainfall is poor and mainly derived from the NE monsoon with an average precipitation of 84 cms. The hot weather begins early in March and the highest temperature is reached in April and May.

2.5.0 FLORA AND FAUNA

2.5.1 The area does not support any luxuriant vegetation owing to the generally arid nature and poor water supply. Agriculture is mostly of dry nature although pockets of rice and sugarcane cultivation are observed around some tanks and wells.

2.5.2 Monkey (Macaca fassicularis), Peacock (Pavo cristatus) wild pig (us cristatus), Snakes constitute the main fauna of the area.

3.1.0 REGIONAL GEOLOGY

3.1.1 Various lithounits exposed in the area falling in the Toposheet no. 58 I/16 belongs to Charnockite Group belonging to Southern Granulite complex of Archaean age and Peninsular Gneissic Complex-II of Archaean to Palaeo-Proterozoic age, sedimentary sequence belonging to Gondwana Super group and Upper Cretaceous formations.

3.1.2 The basement rocks comprise grey migmatite gneiss (biotie-hornblende gneiss) with concordant bands and lenses of amphibolite, pyroxene granulite, magnetite quartzite and quartz sillimanitic rock. Those are traversed by dolerite dykes.

3.1.3 The sedimentary rocks rest over the platform of charnockites and gneisses which are exposed along the western and southern, south-eastern and southern margins of the sedimentary basin. The western, south-eastern and southwestern contacts between the sedimentaries and crystallines are more or less in straight lines, but the southern contact is somewhat sinuous. The widths of the Uttattur and Trichinopoly sub-groups are maximum in the southern portion. North-eastwards their outcrop widths gradually narrow down, due to overlap by successive younger rocks.

The general stratigraphy of the area [after Sundaram et. Al. (2001)] is given below:

Age	Group	Formation	Member
Recent		Alluvium	
Miocene		Cuddalore sandstone	
Angular unconformity			
Danian		Niniyur	
Unconformity			
Maastrichtian	Ariyalur	Kallamedu	
Campanian		Kallankuri chchi	
Santonian		Sillakkudi	Kilapavalur
Unconformity			
Coniacin	Trichinopoly	Anaipady	
Turonian		Kulakkalanattam	
Unconformity			
Cenomanian	Uttattur	Karai	Kunnam
			Odiyam(Gypsifrous mudstone)
Albian		Dalmiapuram (Maruvattur)	Limestone
			Siliciclastics
Aptian		Terani	
Unconformity (based on well section)			
Archaean		Crystallines, Charnockites & Gneisses	

Reference:

Sundaram, R., Henderson, A., Ayyasami, K. and Stilwell, J.D., 2001, " a lithostratigrapic revision and palaeoenviromental assessment of the Cretaceous System exposed in the on shore Cauvery Basin, southern India", Calcareous Research (2001) 22, 743- 762.

3.2.0 GEOLOGY OF THE BLOCK

3.2.1 The Cretaceous succession of Cauvery basin consists of a shallow marine sequence with a very rich faunal succession of Albian - Maastrichtian age. The Cauvery basin is considered to be a rift basin (Rangaraju et al. 1993), which developed by extension during the Mesozoic break up of the Gondwana land (Prabhakar and Zutshi, 1993). Blankford (1862) carried out detailed and systematic study on this succession and divided it into three major groups as Uttatur, Trichinopoly and Ariyalur on the basis of lithology. The Ariyalur group is more widely exposed than the other two groups. Sastry et al. (1972) divided the Ariyalur group into four formations, namely Sillakkudi, Kallankurichchi, Ottakkovil and Kallamedu in upward succession. The Ariyalur Group unconformably rests over the Trichinopoly Group (Table 1). The sediments of this basin are well exposed on the coastal plain of Tamil Nadu, along the Ariyalur, Virdhachalam and Pondicherry districts. Of these, the Ariyalur area provides the most complete representation of the Mesozoic succession and afforded many works on stratigraphy, palaeontology, paleoclimate and tectonic evolution of the succession (Banerji, 1979; Ramanathan, 1979; Sundaram and Rao, 1986; Ramasamy and Banerji, 1991; Ramasamy et al. 1995; Govindan et al. 1996; Madhavaraju and Ramasamy, 1999a, b; 2001; Madhavaraju et al. 2002; Ayyasami, 2006). All the formations constituting the Ariyalur Group, except Kallamedu Formation, were deposited in the marginal marine environments (Sundaram and Rao, 1986; Madhavaraju and Ramasamy, 1999b; Madhavaraju and Lee, 2009).

3.2.2 The Sillakkudi Formation at the base of the Ariyalur Group has been selected for this study (Fig.1). It overlies the Trichinopoly Group unconformably (Ayyasamy, 2006). This formation comprises of unfossiliferous calcareous sandstone, fossilifereous calcareous gritty sandstone, fossiliferous calcareous sandstone and interbedded arenaceous limestone with sandy clay. The basal unit of the Sillakkudi Formation consists of unfossiliferous calcareous sandstone, which is thin in the northern part of the study area, whereas it is well developed in the central and southern parts. A thick band of oolitic ironstone, sandwiched between the fossiliferous calcareous sandstone and arenaceous limestone has been reported from well sections (Madhavarju, 1996). Major part of this Sillakkudi Formation consists of sandstone and thus this study is concentrated on sandstones of this formation. The Kallankurichchi Formation unconformably overlies this Sillakkudi Formation. The Sillakkudi Formation (Fig.1) is well exposed in Mettol railway cutting (lat. 11°04'54.9''N and long. 79°02'3.1''E), Nochikkulam (lat. 11°07'55.8''N and long. 79°03'01''E), and Vayalpadi (lat. 11°20'2.5''N and long. 79°07'9.1''E)

3.2.3 The proposed area exposed by mottled sandstone in the south and east and argillaceous sandstone and sand in the west of the block of Khonadalite and Charnockite Group of rocks of silakudi formation belongs to campanion age.

3.2.4 Basal Archean rocks consist of biotitic and hornblendic gneisses intruded by pegmatites are seen outside of the block in the north west. Granites occur in the southern region, and the charnockites near the contacts are seen in the south and extended outside of the block in the south. There is a banded manganese quartzite exposed outside of the block in the east trending north-south to north-west direction have contact with chornockite in the east. At places, the charnockites are highly weathered and replaced by tuffaceous limestones.

3.2.1 The stratigraphic succession of the area is given in Table 2.2.

Table- 2.2:
The generalized stratigraphic succession of the proposed block (Lithostratigraphy of Ariyalur Group (modified after Sastryet.al 1972)

Group	Formation	Lithology	Age
	Niniyur		Danian
ARIYALUR	Kallamedu	Unfossiliferous fine to coarse grained sandstones interbedded with siltstone, sandy clay, ferruginous clay and marl	Maastrichtian
	Ottakovil	Fossiliferous calcareous sandstone interbedded with sandy clay	
	Kallankurichchi	Fossiliferous calcareous conglomeratic sandstone interbedded with sandy clay, sandy fossiliferous limesone, fossiliferous limestone and marl	
	Sillakkudi	Unfossiliferous calca-reous sandstone, Fossili-ferous calcareous gritty sandstone, Fossiliferous calcareous andstones interbedded with sandy clay and thin band of sandy limestone	Campanian
Trichi-nopoly			Late Turonian to Santonian

3.3.0 Description of the Litho-units: The geological formations/lithologies exposed in the area are mostly belong to Ariyalur Group of Silakudi Formation of un fossiliferous calcareous sandstone. Ariyalur Group of Silakudi formation and a brief description of are described in details is as given below:

3.3.1 Silakudi Formation

This comprises the Tertiary & Cretaceous sediments and Archaean basement. The oldest rock exposed have the biotite schist seen near Kiz Kavattankurichchi and in the well section near Viragallur (SRO_GSI_1167). Pale greenish, fine to medium grained, Calcareous sandstone, occasionally fossiliferous, gritstone and clay.

3.3.1.1 Mottled Sandstone

The sandstone is grey to greenish grey in colour occurring below the conglomerate bed. It consists mostly of quartz, feldspar and biotite at places. The sandstone is hard and compact with varying grain size and the cementing material is calcareous just below the conglomerate and turns non-calcareous towards bottom.

3.3.1.2 Chornockites

Charnockite exposed along the southern margin of the block, forms the basement over which the Gondwana and Cretaceous sediments were deposited. Charnockite is a dark coloured, granulitic rock varying in composition from acid to basic types Foliation (compositional) and cleavage planes are well developed in the rock. Acid variety is composed of quartz, sodic plagioclase, microcline, orthoclase, perthite, hypersthene, as essentials and hornblende, biotite, muscovite, apatite and magnetite as accessories. Basic varieties contain, calcic plagioclase, diopside, hypersthene hornblende, biotite and a very little of quartz (about 5%). Along with charnockite, graphic granite is also noticed £s lenses north-east of Asur. On the surface, the contact between the charnokite and the Gondwana /Cretaceous is unconformable except south of Uttattur and east of Terani where it is faulted.

3.3.1.3 Silakudi Sanstone

The Sillakkudi sandstones are classified as fe-sand, quartz arenite, litharenite, sub-arkose, arkose, wacke and sub-litharenite based on major element geochemistry. Lower concentrations of immobile trace elements like Cr, Co, V, and Sc suggest the felsic source rock provenance, which is also supported by the Th/Sc, Th/Co, Th/Cr, Cr/Th, and La/Sc ratios. Similarly, the La-Th-Sc ternary and La/Sc vs Th/Co plots also reveal the felsic character of the source rocks.

Enrichment of Zr identified from Th/Sc versus Zr/Sc plot in fe-sands and sub-arkose types suggests the influence of sedimentary processes such as sediment recycling and sorting. However, the zircon geochemistry did not affect the REE distribution and its patterns in the Sillakkudi sandstones. The comparison of REE patterns and its Eu anomalies to the source rocks reveals that the Sillakkudi sandstones received a higher contribution of sediments from Dharwar Craton than Kerala Khondalite Belt. We conclude that the REE patterns and Eu anomalies are well preserved in the Sillakkudi sand stones and are highly reliable indicator of source rocks, even though the geochemical composition can be affected by processes such as hydraulic sorting during transportation. (*Geochemistry of Sandstones from Upper Cretaceous Silakudi Formation, Cauvery basin Southern India; Implication for Province by D Bakkyaraj, R. Nagendra, R Nagaraja and John S. Armstrong-Aldrin: Journal Geological Society of India vol. 76, November 2010 pp 453-467)*

3.3.1.4 **Soil and Alluvium**

A grey to reddish brown coloured soil is present in large part of the areas. The thickness of soil cover varies but generally 1 m – 2 m thick soil cover is common in area. The proposed area is mostly covered by thick soil.

3.4.0 STRUCTURE

The general strike of the sedimentary sequence is NE-SW in the northern part and NNE-SSW in the Southern part. The dips are at low angles of 4-l5° towards southeast; the more common range of dips is around 7°.

In the eastern part of the area close to the Ariyalur-Cuddalore contacts, the water table in the wells in Cuddalore sandstones is deep. The presence of fault breccia in a well located between Sirukambur ahd Unjini is indicative of a faulted contact between the Cretaceous and Cuddalore rocks.

4.0.0 PREVIOUS WORK

4.1.1 Jacob K, (1942) The Geology of the Ariyalur area (with a note on the occurrence of flints and cheats in Udaiyarpalayam taluk, Tiruchirapalli district) (Unpublished).

4.1.2 A Hydro-Geochemical Study for Potash Salt in Trichnopally District, Tamil Nadu (Field progress Report 1968-69 SRO_GSI_5525), By S. Sundara Raghavan, Geologist (Jr) Geological Survey of India Southern Region. The area, examined for potash salts lies in the Perambalur and Lalguid taluqs of Tiruchirapalli district, Tamil Nadu. It is bounded by longitudes 780 48' to 7906' and latitudes 100 57' to

110 20' and is covered by the Survey of India toposheets no. 58 I/16, 58 J/13, 58 M/4 and 58 M/3. The study of the distribution pattern of values of potassium which are very low and vary within limited range, shows that values of potassium cannot be used directly for finding any anomaly.

4.1.3 Report on the examination of the cretaceous Limestones in the area between Dalmiyapuram and Ottakoviul R.S. Tiruchirapalli District, Madras State (SRO_GSI_2414). By A.S. Narasimhan, Geologist, Geological Survey of India. The exact area of investigation as indicated by the State Geologist was a "8 Kms belt along the railway line between Dalmiapuram and Ottakkovil R.S." Accordingly, this area of about 216 Sq. Kms lying in topo-sheets Nos. 58 M/4, I/16 and J/13, was investigated for any limestone deposits, with negative results. In an area of about 216 Sq. Kms between Dalmiapuram and Ottakkovil R.S, Tiruchirapalli district, no economic deposits of limestone could be located. But in the area east of Ariyalur, within a radius of 9 Kms, three deposits of Kankar and a deposit of limestone, extending over an area of about 8.2 Sq. Kms were found.

4.1.4 Geochemistry of Sandstones from Upper Cretaceous Silakudi Formation, Cauvery basin Southern India; Implication for Province by D Bakkyaraj, R. Nagendra, R Nagaraja and John S. Armstrong-Altrin: Journal Geological Society of India vol. 76, November 2010 pp 453-467)

4.1.5 Additionally, NGCM mapping (Acc No; SRO_15135 in Toposheet No. 58I/16 2005-06) in parts in parts of Perambalur and Thiruchirappali District fall in Toposheet 58I/16 which is adjacent to the proposed area in the west.

Elements that showed values higher than the crustal abundance are SiO_2, Fe_2O_3, MgO, Ga, Sc, V, Th, Pb, Ni, Co, Sr, Y, Zr, Cr, Cu, Zn, Sb, Pd, F and Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Tm and Lu of REEs whereas less than crustal abundance are Al_2O_3, MnO, Na_2O, K_2O, TiO_2, P_2O_5, Be, Ge, Ba, Ru, Nb, Hf, Ta, U, Tb, Er, Yb, As, Bi, Se, Pt, Cs, Ag, Mo, Tn, W and Cd.

The geochemical contour map shows the highest Th concentration of 70.1 ppm is recorded in the NE of Orattur village occurring over sandstone, clay and kankar. **The highest concentration of Zr (2516.2 ppm) that are thirteen times higher than the average crustal abundance) is located in the NW of Malvay Kannanur Village occurring over sandstone, shale and gypsum clay.** Subsequently, the entire study area shows concentration of Hf higher than the average crustal abundance. Maximum value for the **Hf (76.82 ppm)** is recorded in the SE part of the toposheet located in the **northwest of Malvay Kannanur village occurring over sandstone, shale and gypsum clay.**

4.1.6 The NGCM data of the toposheet 58M/04 which is adjacent to 58I/16 shows, the highest ΣREE value recorded in these rocks' ranges from 809.20 ppm to 2851.80 with an average of 1651.90 ppm (Mottled Sandstone), LREE being the maximum contributing factor. Additionally, the highest Zirconium (Zr) value recorded in these rocks' ranges from 2025 ppm to 5921 ppm (Mottled Sandstone) with an average of 3340.44 ppm.

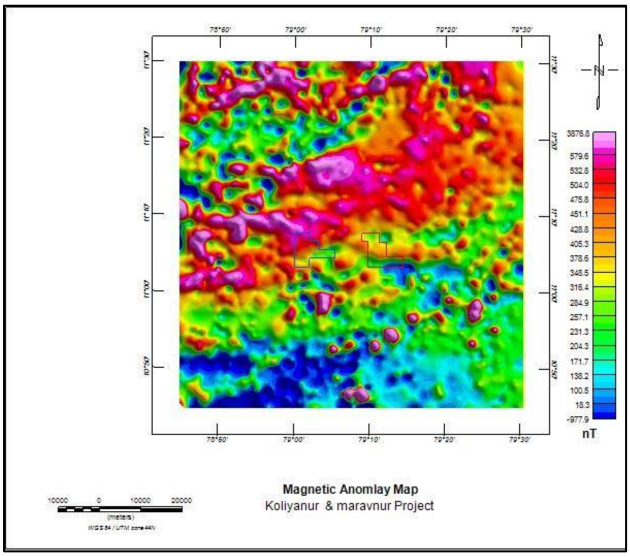
4.1.1.1 Geochemical highlights show multiple metal anomalies: **Zircon: 5921 ppm Vanadium:** Up to **558 ppm, Thorium:** Up to **465.12 ppm** in

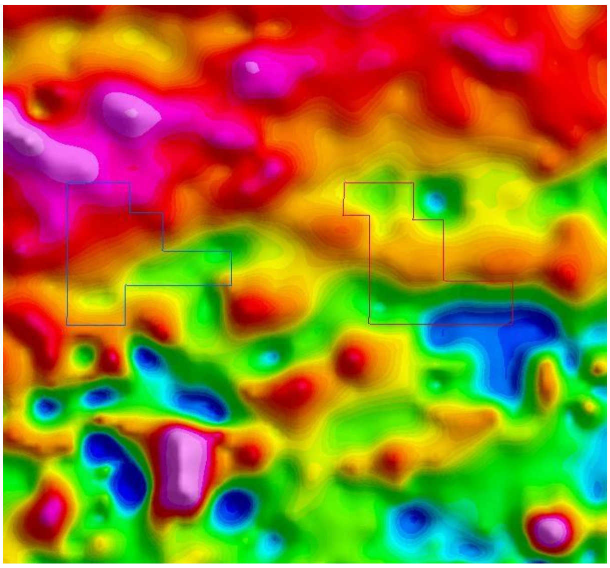
4.1.1.2 Rare earth element results are particularly significant for exploration therefore it is recommended for detailed study in the area so as to delineate the extension of these anomaly zones if any.

4.2.0 Interpretation of Gravity and Magnetic data of Maravnur Blocks

4.2.1 Rare Earth Elements (REEs) are known to exhibit moderate to strong magnetic properties and moderate to high gravity responses. Based on the available geophysical data, an interpretation has been made to identify potential REE-bearing zones within the proposed Maravnur blocks.

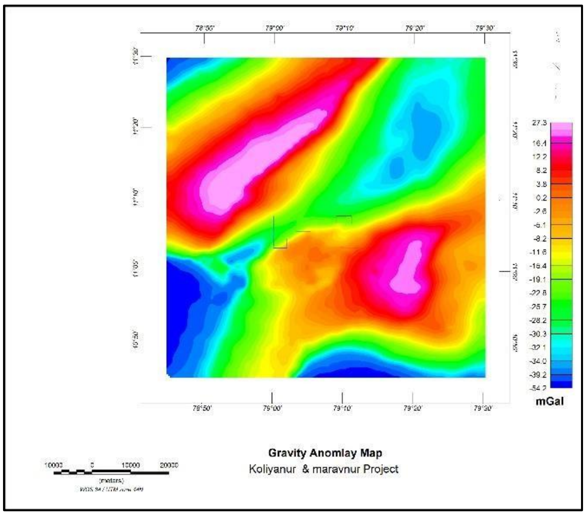
4.2.2 Magnetic surveying is generally considered one of the most effective geophysical methods for detecting carbonatitic-alkalic host intrusions, which typically produce intense circular to sub-circular positive magnetic anomalies.

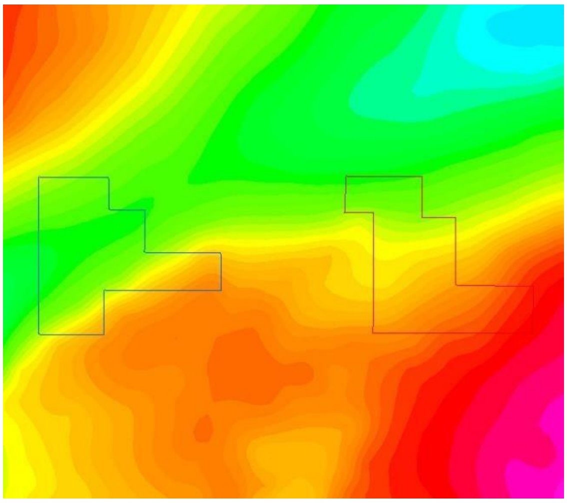




Magnetic Anomlay Map

Magentic map within block boundaries





Gravity Anomaly Map

Gravity anomaly map within the block

In the central to southeastern part of the Maravnur block , moderate to high magnetic values trending in a SE-NW direction were observed. A geological lineament was clearly observed in the SE direction at the southern part of the block. The similar Moderate high gravity high in SE – NW direction was observed which is well corroborated with Magnetic data.

Additionally, tectonic lineament has been observed through Magnetic as well as Bouguer gravity anomalies, which exhibit moderate to high values. Based on these observations, the central portion of the area can be considered for possible formation of REE mineralization Further detailed exploration is recommended to assess the economic viability of these targets.

4.3.0 MECL utilized National Geochemical Mapping (NGCM) data from NGDR portal, GSI of Toposheet No. 58M/04. Analysis of stream sediment samples within proposed blocks indicates **a maximum total REE concentration of 2851.80 ppm.** On the basis of anomalous stream sediment values in NGCM data the block is proposed for Reconnaissance Survey or REE

.

Table-4:
Data showing NGCM Stream Sediment results for Proposed Maravanur Area (9 numbers of samples) (Source: NGDR portal GSI)

Crustal abundance (ppm) of rare earth elements (After Mason and Moore 1982) Group	Element	Crustal abundance (ppm)	Summary of Stream sediment sample data falling in Proposed Block (NGCM)		
			Minimum (ppm)	Maximum (ppm)	Average (ppm)
LREE	Lanthanum (La)	30	175.19	617.63	359.78
	Cerium (Ce)	60	341.96	1260.30	721.86
	Praseodymium (Pr)	8.2	37.99	139.47	80.29
	Neodymium (Nd)	28	142.82	535.11	305.24
	Samarium (Sm)	6	21.20	79.95	44.89
HREE	Europium (Eu)	1.2	1.3344	1.9548	1.6265
	Gadolinium (Gd)	5.4	15.519	53.294	30.383
	Terbium (Tb)	0.9	1.8252	5.8614	3.3609
	Dysprosium (Dy)	3	7.4484	19.051	12.046
	Holmium (Ho)	1.2	1.2684	2.9834	1.9633
	Erbium (Er)	2.8	4.0747	10.037	6.4442
	Thulium (Tm)	0.5	0.6152	1.4253	0.9267
	Ytterbium (Yb)	3.4	4.2603	10.158	6.4563
	Lutetium (Lu)	0.5	0.6995	1.6606	1.0419
	Scandium (Sc)	22	35	79	52.75
	Yttrium (Y)	23	15	34	23
Total LREE			545.299	2016.67	1153.90
Total HREE			133.23	217.47	133.23
TREE+Sc+Y			809.20	2851.80	1651.90
	Zirconium (Zr)	**190**	**2025**	**5921**	3340.44

5.0.0 PLANNED METHODOLOGY

5.1.0 Based on the evaluation of geological data available, the present exploration program has been formulated to fulfill the following objectives:

i. To carry out Geological & Structural mapping on 1:12500 scale for identification of REE mineral bearing formation with the structural features to identify the surface manifestation (if any) and lateral disposition of the mineralized zones.

ii. To collect bedrock, stream sediment samples (from positive catchment area) for analyses of REEs.

iii. To further determine the REE mineralized zone in the proposed block, auger drilling will be carried out and samples will be collected from targeted soil horizon established by orientation survey.

iv. To establish the reconnaissance resources for REE bearing minerals as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

v. The outcome of this exploration will decide further exploration strategy for upgradation of block to Preliminary (G-3) Exploration.

The details of different activities to be carried out are presented in subsequent paragraphs.

5.2.0 GEOLOGICAL MAPPING

5.2.1 Geological mapping will be carried out in the entire 46.33sq.km area on 1:12,500 scale. Rock types, their contact, structural features will be mapped. Surface manifestations of the mineralization (REE) if available along with their surface disposition will be marked on map.

5.2.2 A sum of 50 nos. of bedrock samples will be collected from the various lithounits present in the area, to identify the host REE bearing formation. Bedrock samples will be collected from the fresh part of the rock by making chips. 34 element ICPMS studies will be carried out for the 50 bedrock samples collected from various lithounits, 10% of primary samples i.e. 5 external check samples will be sent to NABL External Labs for analysis.

5.2.3 A sum of 10 nos. of surface samples from various lithounits will be studied for petrography and minerography.

5.3.0 GEOCHEMICAL SAMPLING (Stream Sediment Sampling)

5.3.1 During the course of Geological mapping stream sediment samples will be collected from 1st and 2nd order streams to identify the positive catchment area for REE mineralization. The stream sediment sample will be commenced from the positive catchment area identified by NGCM samples having total REE value greater than 1000 ppm. Stream sediment samples will be collected in two factions i.e. raw SSS and heavy mineral (HMS) concentrated samples from the same location. The raw samples will be collected directly by sieving (-120 mesh) of naturally homogenous material and the HMS will be collected in the same spot around 20-30 kg from suitable trap site.

5.3.2 Total 70 stream sediment samples and 70 HMS will be collected from the proposed area. The final samples (both raw and HM) collected will be powdered and sent to laboratory for 34 element ICPMS analysis of REE. 07 external check samples will be analyzed for assay of 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Ba, Cs, Li & REE.

5.4.0 **EXPLORATORY MINING (PITTING):**

5.4.1 Pitting will be carried out in positive catchment area identified on the basis of total REE NGCM values of GSI and analysis of stream sediment samples collected during proposed exploration. A provision of 20nos of pitting on the identified anomalous zone (1.0 m wide X 2.5 m deep) with 50 cubic meters is kept. Pitting will be carried from surface up to a depth of 2.50 m. Locations of pits will be decided by field geologist based on field observations.

5.4.2 A sum of 50 Bedrock soil samples samples will be collected from all the soil horizon (Soil Regolith and Soil C) and bedrock (if exposed) of each pit. The collected soil samples will be subjected to both heavy mineral separations by panning and by natural faction method. The orientation soil samples would help to decide the target soil horizon best suitable for REE mineralization. All samples (both raw and HM) generated would be powdered and analysed for 34 elemental analysis including Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li & REE by ICPMS method. 10% of Primary Samples will be sent for external check in NABL External Labs by ICPMS method.

5.5.0 EXPLORATORY DRILLING

5.5.1 Auger Drilling will be carried out in the REE anomaly area. The REE anomaly area will be redefined on the basis of geological mapping, bedrock sampling and stream sediment sampling carried out by MECL. Auger drilling will be carried out in a grid pattern of 1 km X 1 km.

5.5.2 Total 70 numbers of auger drilling boreholes have been proposed in the block each having a depth of 5 m. The total auger drilling carried out in the block will be 350 m. Based on the result of orientation pitting, samples from auger drilling will be collected from targeted soil horizon and bedrock.

5.5.3 Auger samples will be collected in two modes i.e raw soil faction and HM faction. A total 70 samples will be generated in raw faction and 70 will be collected for HM faction from the same locations. All the samples will be processed and submitted for analysis for REE by 34 element ICPMS method. 10% of Primary Samples will be sent for external check in NABL External Labs by ICPMS method.

5.6.0 **PETROLOGICAL & MINERAGRAPHIC STUDIES:**

5.6.1 During the course of Geological mapping and sampling 10 nos. of samples from outcrops of various litho-units will be collected to carry out Petrography and Minerography. These samples would be drawn from ore zones and host rocks.

5.7.0 XRD & EPMA STUDY

5.7.1 To know the different mineral phases which can possibly host REE, 10 samples will be studied by XRD method. The samples for XRD will be selected from the samples which will analyze anomalous values of REE in bedrock, stream sediment and auger drilling.

5.7.2 A provision of 10 hours of EPMA study is also kept.

6.0.0 PROPOSED QUANTUM OF WORK

6.0.1 Details of the particular, Quantum and the targets are tabulated in **Table No.-5.1.**

Table No- 5.1
Envisaged Quantum of proposed work

Sl. No.	Item of Work	Unit	Target
1	**Geological Mapping** (on 1:12,500 Scale)	Sq km	46.33
2	**Geochemical Sampling**		
i	Bedrock samples for REE (14 REE elements+9 radicals of trace element (U, Ta, Ga, Be, Hf, Sn, As, Rb, Th) by ICP-MS (Sequentional Technique))	Nos	20
ii	Stream Sediment samples for REE – 120 mesh fraction (14 REE elements+9 radicals of trace element (U, Ta, Ga, Be, Hf, Sn, As, Rb, Th) by ICP-MS (Sequentional Technique))	Nos	30
iii	Stream Sediment samples for REE heavy fraction NGCM Anomaly zones (14 REE elements+9 radicals of trace element (U, Ta, Ga, Be, Hf, Sn, As, Rb, Th) by ICP-MS (Sequentional Technique))	Nos	30
3	**Exploratory Mining**		
i	Pitting (20 pits) (1m*1m*2.5m)	Cu.m	50

ii	Pit samples for REE in raw fraction (14 REE elements+9 radicals of trace element (U, Ta, Ga, Be, Hf, Sn, As, Rb, Th) by ICP-MS (Sequentional Technique))	Nos	20
4	**Auger Drilling for REE (Outsource)**		

Sl. No.	Item of Work	Unit	Target
i	Auger Drilling in 50 boreholes (5m/BH)	m	250
ii	Auger drilling samples for REE heavy fraction (14 REE elements+9 radicals of trace element (U, Ta, Ga, Be, Hf, Sn, As, Rb, Th) by ICP-MS (Sequentional Technique))	Nos	50
5	**Laboratory Studies**		
	i) Pit samples for REE in raw faction	Nos	20
	ii) Bedrock samples for REE	Nos	20
	iii) Stream sediment samples for REE in raw faction	Nos	30
	iii) Stream sediment samples for REE in heavy mineral faction (NGCM anomaly zones)	Nos	30
	iv) Auger Drilling Samples for REE in heavy mineral faction	Nos	50
	v) Separation of heavy minerals from stream sediment samples of - 2mm size through gravity and magnetic separation	Nos	80
	vi) 10% external check samples for REE	Nos	7
6	Petrological Samples (Surface Samples)	Nos	10
7	Mineragraphic Studies (Surface Samples)	Nos	5
8	Density		
9	EPMA studies	Hrs	10
10	Report Preparation (5 Hard copies with a soft copy)	Nos.	1
11	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	Nos.	1

7.0.0 BREAK-UP OF EXPENDITURE

7.1.0 Tentative Cost has been estimated based on Schedule of Charges (SoC) of projects funded by National Mineral Exploration Trust (NMET) w.e.f. 15/12/2025. The total estimated cost is **Rs. 92.41 Lakhs.** The summary of cost estimates for Reconnaissance Survey (G-4 Level) is given in **Table No. - 5.2.** The detailed cost sheet is given as Annexure-I.

Table No. 5.2
Summary of cost estimates for Reconnaissance survey (G-4) in Maravanur Block, District- Ariyalur Districts of T.N.

Sl. No.	Item	Total Estimated Cost (Rs.)
1	Geological Mapping (LSM), Pitting and Trenching, BRS and other Geological Work	33,46,791
2	Drilling	16,09,000
3	Laboratory Studies	24,47,400
	Sub Total (1 to 4)	74,03,191
4	Exploration Report Preparation	250,000
	Proposal Preparation	1,48,064
5	Peer review charges	30,000
	Sub Total (1 to 6)	78,31,255
6	GST 18%	14,09,625.87
	Total:	**92,40,880.69**
	Say Rs. In Lakh	**92.41**

8.0.0 TIMELINE

8.0.1 The entire project is planned tentatively for 12 months. Initially, geological mapping and surface bedrock sampling along with soil sampling shall be carried out followed by auger drilling provided positive results are obtained in the first phase of sampling.

Table No: 5.3 Tentative Action plan of Reconnaissance Survey (G-4) for REE, Zr and associated minerals in Maruvanur Block , Ariyalur District, Tamil Nadu
Total block area- 46.33 sq km; Completion Time- 12 Months

S.No.	Activities	MONTHS											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Camp setting	■				Review							
2	Geological mapping		■										
3	Sample preparation			■									
4	Analytical work			■									
5	Exploratory mining for pitting/trenching/BRS			■	■								
6	Sample preparation (Pit and Trench samples)				■								
7	Analytical work					■							
8	Auger Drilling						■						
9	Analytical work							■	■	■			
10	Geologist at HQ										■	■	
11	Report Writing with Peer Review											■	
12	FGR Submission												■
* Commencement of project will be reckoned from the day the exploration acreage is available along with all statutory clearances													
*Time loss on account of monsoon/agricultural activity/forest clearance/ local law & order problems will be addition to above time line.													

9.0.0 JUSTIFICATION

i) 9 NGCM Stream Sediment Sample data points fall in the proposed Maravnur area. The total REE, LREE and HREE values have been calculated and the geochemical anomaly map for the same has been prepared. The proposed area has a maximum TREE+Sc+Y value of 2851.8 ppm with an average value of 1651.90 ppm. A total of 5 sample out of 10 (45% samples>1000PPM) shows TREE+Sc+Y value more than 1000 PPM. The maximum total HREE value in proposed Maravnurr area is 217.47 ppm of which the major contributing element is Gadolinium (maximum 53.294 ppm). The maximum LREE value in Maravnur Area is 2016.67 ppm and the major contributing element is Cerium (maximum 1260.3 ppm) followed by Lanthanum (maximum 617.63 ppm). The NGCM stream sediment samples carried out by GSI show highly anomalous values for REE in toposheets 58M/04, therefore the Maravanur Area is proposed for reconnaissance survey for REE, Zr and associated minerals.

Crustal abundance (ppm) of rare earth elements (After Mason and Moore 1982) Group	Element	Crustal abundance (ppm)	Summary of Stream sediment sample data falling in Proposed Block (NGCM)		
			Minimum (ppm)	Maximum (ppm)	Average (ppm)
LREE	Lanthanum (La)	30	175.19	617.63	359.78
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	Terbium (Tb)	0.9	1.8252	5.8614	3.3609
	Dysprosium (Dy)	3	7.4484	19.051	12.046
	Holmium (Ho)	1.2	1.2684	2.9834	1.9633
	Erbium (Er)	2.8	4.0747	10.037	6.4442
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			Minimum (ppm)	**Maximum (ppm)**	**Average (ppm)**
HREE	Ytterbium (Yb)	3.4	4.2603	10.158	6.4563
	Lutetium (Lu)	0.5	0.6995	1.6606	1.0419
	Scandium (Sc)	22	35	79	52.75
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Total LREE			545.299	2016.67	1153.90
Total HREE			133.23	217.47	133.23
TREE+Sc+Y			809.20	2851.80	1651.90
	Zirconium (Zr)	**190**	**2025**	**5921**	3340.44

i. The integrated geological and geochemical datasets clearly demonstrate that the **Maravanur Block** hosts significant rare-earth element (REE) enrichment. National Geochemical Mapping (NGCM) data accessed from the GSI–NGDR portal (Toposheets 58m/04) show **total REE + Sc + Y values up to 2851.80 ppm**, far exceeding average crustal abundance. Light REE (ΣLREE) concentrations reach **2016 ppm** with consistently elevated cerium and lanthanum, while heavy REE (ΣHREE) peak at **~100 ppm**—indicating a robust geochemical anomaly across multiple samples.

ii. The REE pattern and Eu anomaly in the sedimentary rocks will provide important clues for the source rock characteristics (Taylor and McLennan, 1985). Higher LREE/ HREE ratios and negative Eu anomaly are generally found in felsic rocks, whereas the mafic rocks exhibit low LREE/ HREE ratio and low negative Eu anomaly (Cullers, 1994). The positive Eu anomaly was generally found in Proterozoic rocks (TTG), granodiorite and quartz diorite. The low positive Eu anomaly in TTG is resulted from hornblende melt equilibria (Cullers and Graf, 1984). In addition, the Sillakkudi sandstones show enriched LREE/ HREE ratio (4.30-13.66; 9.11±2.62; n = 20) ***and 8.66 in the proposed are***a, which suggests that these sandstones were mainly derived from the felsic source rocks (Taylor and McLennan, 1985).

iii. Enrichment of Zr identified from Th/Sc versus Zr/Sc plot in fe-sands and sub-arkose types suggests the influence of sedimentary processes such as sediment recycling and sorting. However, the zircon geochemistry did not affect the REE distribution and its patterns in the Sillakkudi sandstones. The comparison of REE patterns and its Eu anomalies to the source rocks reveals that the Sillakkudi sandstones received a higher contribution of sediments from Dharwar Craton than Kerala Khondalite Belt. We conclude that the REE patterns and Eu anomalies are well preserved in the Sillakkudi sand stones and are highly reliable indicator of source rocks, even though the geochemical composition can be affected by processes such as hydraulic sorting during transportation

iv. The REE, Zr, Th, V and Cr values are high against crustal abundance values. So far no exploration done in this formation for REE, Zr and associated mineralization. In view of importance of demand, it is suggested to begin with G-4 stage exploration.

v. Given India’s growing strategic need for REEs in clean-energy, high-technology, and defense applications, it is imperative to translate these geochemical indications into quantifiable resources. A **G-4 stage reconnaissance programme** will enable systematic geological mapping, heavy-mineral sampling, and baseline resource estimation in compliance with UNFC and Minerals (Evidence of Mineral Contents) Rules, 2015. Advancing this block to detailed exploration will directly support national objectives for securing critical mineral supply chains and reducing dependence on imported REE feedstock.

List of Plates

5. Plate-V: Anomaly Map with LREE values in Proposed Maravnur area (46.33 sq km), District: Ariyalur, of Tamil Nadu State (Source: NGCM data).
6. Plate-VI: Anomaly Map with Total HREE values in Proposed Maravnur area (46.33 sq km), District: Ariyalur, of Tamil Nadu State (Source: NGCM data).
7. Plate-VII: Drainage Map with lithology and proposed stream sediment samples and auger drilling location points in Proposed Maravnur area (46.33 sq km), District: Ariyalur, of Tamil Nadu State.

10. List of Annexure

a. Detailed Cost sheet of Maravnur Block, Ariyalur, District, Tamil Nadu.