

**PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR REE & ASSOCIATED
MINERALIZATION IN VELLATURU AREA (AREA: 96.30 SQ KM)**

DISTRICT- NTR & ELURU, ANDHRA PRADESH

COMMODITY: REE & ASSOCIATED MINERALIZATION

MINERAL EXPLORATION AND CONSULTANCY LIMITED

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SEMINARY HILLS

PLACE: NAGPUR

DATE: JULY, 2026

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

GENERAL INFORMATION ABOUT THE BLOCK

	Features	Details
	Block ID	Vellaturu Area
	Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
	Commodity	REE
	Mineral Belt	Eastern Ghat Mobile Belt (EGMB), Peninsular Gneissic Complex (PGC-II) and Gondwana Supergroup (Pranhita Godavari Valley)
	Completion Period with entire Time schedule to complete the project & Estimated Cost	10 months with about 190.15 Lakhs rupees.
	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 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 identify the REE enriched soil horizon, 05 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 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. 5 scout boreholes will be carried out to further establish the depth continuity of the mineralization. vi. To establish the reconnaissance resources for REE bearing minerals as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015. vii. 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	Three nos. of Geoscientist (2 Field + 1 HQ)
	Expected Field days (Geology) Geological Party Days	Geologist Party Days: 150 Days (Field) Geologist Party Days: 60 Days (HQ)
1	Location	
	The coordinates of corner points of proposed Vellaturu Area are as follows:	

	Points	Latitude	Longitude
	A	16° 44' 8.68" N	80° 38' 50.95" E
	B	16° 44' 7.73" N	80° 45' 47.48" E
	C	16° 39' 56.21" N	80° 45' 46.28" E
	D	16° 39' 53.31" N	80° 38' 48.32" E
	Villages	Reddigudem, Vellaturu, Koduru, Bhimavarappadu	
	Tehsil/ Taluk	Mylavaram, G.Konduru, Vijayawada (Rural) Tehsils of NTR District. Agiripalle district of Eluru District.	
	District	Tiruvu (NTR) & Nuzvid (Eluru)	
	State	Andhra Pradesh	
2	Area (hectares/ square kilometers)		
	Block Area	96.30 sq km	
	Forest Area	The proposed area is free from Eco sensitive Zone and Wildlife Sanctuary (Source: pmgatihakti.gov.in).	
	Government Land Area	Data Not Available	
	Private Land Area	Data Not Available	
3	Accessibility		
	Nearest Rail Head	Cheruvu Madhavaram (14 km west of the block)	

	Road	The area is 26 km away from Vijayawada. The area has a good network of roads connecting major towns like Nuzvidu in the north eastern part and Tiruvur in the northern part. Besides this, the villages are well connected within the area by motorable roads.
	Airport	Vijayawada International Airport (40 km SE of the block)
4	Hydrography	
	Local Surface Drainage Pattern (Channels)	The regional slope of the area towards south of south-east direction. Higher order stream flows towards this direction. Several small order streams flow towards south-east. Drainage pattern in the area is dendritic.
	Rivers/ Streams	
5	Climate	
	Mean Annual Rainfall	The Southwest monsoon brings plenty of rainfall from June to September. Maximum Rainfall: About 900 mm
	Temperatures (December) (Minimum) Temperatures (June) (Maximum)	Maximum Temperature: 40°C (May) Minimum Temperature: 13°C (January) Maximum Rainfall: 900 mm (July to September)
6	Topography	
	Toposheet Number	65D10 & 65D14
	Physiography of the Area	Physio-graphically, the area shows relatively flat topography. The study area consists of isolated hillocks which primarily made up of sediments of

		Upper Gondwana and Quaternary age. The area comprises several elevated longitudinal ridges. These hills are primarily composed of Khondelite of Eastern Ghats and some may contain PGC rocks. These rocks trend north-easterly.
7	Availability of baseline geosciences data	
	Geological Map (1:50K/ 25K)	1:50000 (NGDR)
	Geochemical Map	Stream sediment sample results from NGCM by GSI (NGDR portal) for TS 65D10 & 65D14 have been used to compute LREE, HREE & Total REE geochemical anomaly maps presented as plates in the proposal.
	Geophysical Map	
8	Justification for taking up Reconnaissance Survey / Regional Exploration	i) 28 NGCM Stream Sediment Sample data points fall in the proposed Vellaturu 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 1785.64 ppm. A total of 15 sample out of 28 (54% samples>1000PPM) shows TREE+Sc+Y value more than 1000 PPM. The maximum total HREE value in proposed Vellaturu area is 105.41 ppm of which the major contributing element is Gadolinium (maximum 59.04 ppm). The maximum LREE value in Vellaturu Area is 1684.88 ppm and the major contributing element is Lanthanum (maximum 416.02 ppm). The NGCM (FS 2020 & FS 2021) stream sediment samples carried out by GSI show highly anomalous values for REE in toposheets 65D10 & 65D14, therefore the Vellaturu Area is proposed for reconnaissance survey for REE.

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)	30.00	0.000	416.016	219.852
	Cerium (Ce)	60.00	187.500	808.800	428.911
	Praseodymium (Pr)	8.20	22.658	116.500	54.838
	Neodymium (Nd)	28.00	80.673	451.900	189.276
	Samarium (Sm)	6.00	14.511	76.940	31.887
HREE	Europium (Eu)	1.20	1.877	4.435	2.375
	Gadolinium (Gd)	5.40	12.268	59.040	21.713
	Terbium (Tb)	0.90	1.522	5.703	2.344
	Dysprosium (Dy)	3.00	5.917	17.440	8.497
	Holmium (Ho)	1.20	0.895	2.407	1.277
	Erbium (Er)	2.80	2.066	7.834	3.539
	Thulium (Tm)	0.50	0.293	0.982	0.523
	Ytterbium (Yb)	3.40	1.983	6.700	3.450
	Lutetium (Lu)	0.50	0.241	0.865	0.524
	Scandium (Sc)	22.00	11.040	25.000	15.773
	Yttrium (Y)	23.00	20.000	52.260	33.644
Total LREE			404.47	1684.88	924.76
Total HREE			30.26	105.41	44.24
ΣREE+Sc+Y			501.43	1785.64	1018.42

	ii) Additionally, to the anomalous REE concentrations in the Stream Sediment Samples from this area, Specialized Thematic Mapping (FS 2024-25) also reveals the presence of REE as secondary concentrations above the Garnet-sillimanite gneiss of Khondalite group from EGMB. Five recorded Total Rare Earth Element (ΣREE) concentrations exceeding 700 ppm, with the highest concentration of 1055 ppm observed in a garnet-sillimanite gneiss sample. The highest Strontium (Sr) concentration, measured at 830 ppm, was identified in a garnet-sillimanite leptynite sample. iii) Geological Exploration of REE was successfully carried out by GSI (FS 2021-24) for secondary REE enrichment in the EGMB and Pranhita Godavari Valley which gave encouraging results. The enrichment of REE in the present area was first pointed out by high concentration of total REE values in the composite stream sediment samples during the NGCM works. It is further observed that the concentration of the REE bearing minerals is mainly high in stream sediments and less in soil. The REE mineralization in the study area occurs in the form of heavy minerals in stream sediments. The REE bearing mineral phases identified by SEM study are monazite, zircon and allanite. It was also inferred from the reconnaissance surveys by GSI (FS 2021-24 in AP and Telangana) that the REE mainly occurs as secondary enrichment of the REE bearing mineral phases in stream sediment derived from the weathering and erosion of heavy mineral rich layers of the garnet-sillimanite gneiss, quartzites of Eastern Ghat Belt and sandstones of Gondwana i.e. alluvial placer type deposit. GSI recommended studying these areas in details for REE mineralization. The new findings of alluvial placer type of REE enrichment may create huge potential area for secondary REE mineralization. This may considerably augment the REE resource in India particularly from the Garnet-sillimanite gneiss of EGMB and Gondwana rocks. It will be a potential game changer in terms of REE exploration in India and significantly help to mitigate the crucial REE demand. Litho units belonging to Khondalite group of rocks, Lower and Upper Gondwana is present in the present proposed area. Similar investigation in the proposed area might yield encouraging results of REE.
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Table for Various analytical results for REE in alluvial placer by GSI					
SN	Block	TS	FSP	State	Outcome
1	Kottapalle Area (G-4)	65G04 & 65H1	2022-23	Andhra Pradesh	TREE values: BRS- 293-596 PPM SSS- 450-2174 PPM PTS- 329-1540 PPM SS- 415-1854 PPM
2	Kamalapuram-Jagannadhapuram Area (G-4)	65C15	2021-22	Telangana	TREE values: BRS- 105.79-10216.57 PPM SSS- 0.248-3.118% Regolith- 126.88-13249.96 PPM Clay- 318.84-2602.19 PPM
3	Velagapadu Area (G-4)	65G04	2021-22	Andhra Pradesh	TREE values: BRS- 137-1508 PPM SSS-294-10673 PPM PTS- 294-4348 PPM SS- 232-4245 PPM
4	Mulagalampalli Area (G-4)	65G04	2023-24	Andhra Pradesh	TREE values: BRS- 105-1681 PPM SSS- 290-1797 PPM PTS- 227-16770 PPM SS- 284-3665 PPM
5	Annapureddipalli Area (G-4)	65C15	2023-24	Telangana	TREE values: SSS- 339.957-40428.642 PPM Regolith- 243.34-8780.12 PPM
6	Patrwarugudem Area (G-4)	65C15	2022-23	Telangana	TREE values: BRS- 161.51-2187 PPM SSS- 0.1-2.03% Regolith- 0.42-6.98% PPM Clay- 313.46-984.36 PPM
	Pata-Gangaram	65C15	2021-23	Telangana	Reconnaissance Resource (334) in :

							Soil/Alluvium- 2.57 million tonnes with 547 ppm TREE Stream Placers- 0.13 million tonnes with 4355 ppm TREE Inferred Mineral Resource (333): TREE- 8.15 million tonnes with 745.87 ppm TREE TREO- 12.38 million tonnes with 762.15 ppm REO
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**PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR REE IN
VELLATURU AREA, DISTRICT –NTR & ELURU, STATE -ANDHRA PRADESH (AREA
96.30 SQ. KM.)**

1.0.0 INTRODUCTION:

1.0.1 Rare earth elements are characterized by high density, high melting point, high conductivity and high thermal conductance with distinctive electrical, metallurgical, catalytic, nuclear, magnetic and luminescent properties make them indispensable for a variety of emerging high end and critical technology applications which are relevant to India's energy security i.e., clean energy, defense, civilian application, environment and economic areas. REE demand is expected to continue its growth, especially for their use in low carbon technology. The ever-increasing demand for these REE necessitates a concerted effort to augment the resource position of our country.

1.0.2 The Rare earth elements (REE) are a collection of 17 elements in the periodic table, namely scandium, yttrium and lanthanides (15 elements in the periodic table with atomic numbers 57 to 71 namely: 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). In spite of its low atomic weight Yttrium (atomic no. 39) has properties more similar to the heavy lanthanides and is included with this group. Scandium (atomic no. 21) is found in a number of minerals although it may also occur with other rare earth elements (REE).

1.0.3 Although these elements tend to occur together, the lanthanide elements are divided into two groups. The light rare earth elements (LREE) are those with atomic numbers 57 through 63 (La, Ce, Pr, Nd, Pm, Sm, Eu) and the heavy rare earth elements (HREE) are those with atomic numbers from 64 to 71 (Gd, Tb, Dy, Ho, Er, Tm, Yb and Lu). However, because of their geochemical properties, rare earth elements are typically dispersed and not often found concentrated as rare earth minerals in economically exploitable ore deposits.

1.0.4 Generally, the light rare earth elements (LREE) are more abundant in the earth's crust and easily extracted than heavy rare earth elements (HREE). It was the very scarcity of these minerals (previously called "earths") that led to the term "rare earth". The first such mineral discovered was gadolinite, a compound of cerium, yttrium, iron, silicon and other elements. This mineral was extracted from a mine in the village of Ytterby in Sweden; several of the rare earth elements bear names derived from this location.

1.0.5 Critical minerals are those minerals that are essential for economic development and national security. The lack of availability of these minerals or concentration of extraction or processing in a few

geographical locations may lead to supply chain vulnerabilities and even disruption of supplies. The future global economy will be underpinned by technologies that depend on minerals such as lithium, graphite, cobalt, titanium, and rare earth elements. These are essential for the advancement of many sectors, including high-tech electronics, telecommunications, transport, and defence. They are also vital to power the global transition to a low carbon emissions economy, and the renewable energy technologies that will be required to meet the 'Net Zero' commitments of an increasing number of countries around the world. Hence, it has become imperative to identify and develop value chains for the minerals which are critical to our country.

1.2.0 BACKGROUND

1.2.1 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.

1.2.2 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 and associated minerals in Vellaturu Area, Ntr & Eluru district, Andhra Pradesh.

1.2.3 MECL has prepared the proposal for G-4 level exploration for REE in Vellaturu Area, Ntr & Eluru district, Andhra Pradesh to put up for approval in the forthcoming meeting of Technical cum Cost Committee (TCC-I) of NMET.

1.3.0 LOCATION AND ACCESSIBILITY

1.3.1 The proposed Vellaturu Area comprises of 96.30 sq km area and lies Ntr & Eluru district (Toposheet No. 65D10 & 65D14), Andhra Pradesh. The major villages falling within the proposed block are Reddigudem and Vellaturu. 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 Nuzvid which is about 42 km south east of the proposed block. The nearest airport is at Vijayawada which is about 55 km south of the proposed block. The location map of the proposed block is provided as Plate No- I. The detailed location of the boundary points are given in Table 1.

Table 1: Coordinates of Corner Points of Proposed Vellaturu Area, Ntr & Eluru district, Andhra Pradesh

Points	Latitude	Longitude
A	16° 44' 8.68" N	80° 38' 50.95" E
B	16° 44' 7.73" N	80° 45' 47.48" E
C	16° 39' 56.21" N	80° 45' 46.28" E
D	16° 39' 53.31" N	80° 38' 48.32" E

1.4.0 PHYSIOGRAPHY

1.4.1 The topography is undulating, formed by residual hills standing out prominently in vast pediment-pediplain complex. In the area, minimum elevation is 48m and maximum elevation is 594m above MSL, with a general relief of 100 m. The terrain has thick fertile alluvial soil cover.

1.5.0 DRAINAGE

1.5.1 Munneru and Kattaleru rivers are the main source of water in this area. The area in TS No. 65 D/9 is drained by tributaries of Krishna River. In the areas with residual hills of charnockite and other high grade granulite rocks, radial drainage pattern is observed. The eastern part of the area is showing trellies type of drainage pattern.

1.6.0 CLIMATE

1.6.1 The area lies on 112m above sea level. The area experiences tropical climate. Winter season between November and February is pleasant. Temperature drops to 15° - 18°C during the night. Summer season between March and May is very hot and dry. Temperature goes upto 48°C during the day. Precipitation here is about 1019mm. 10 inches of precipitation between the driest and wettest months. The area receives its rainfall chiefly by southwest monsoon between June and September.

1.7.0 FLORA AND FAUNA

1.7.1 The terrain has thick fertile soil cover and alluvial cover which are extensively cultivated. Paddy, cotton and chilly are the main crops of the area. Mango plantation is common.

1.7.2 Deer (*Odocoileus virginianus*), wild boar (*sus scrofa*), Monkey (*Macaca fassicularis*), Peacock (*Pavo cristatus*) wild pig (*Sus cristatus*), Snakes constitute the main fauna of the area.

2.0.0 REGIONAL GEOLOGY

2.1.0 Litho ensemble belonging to three different tectonic, domains with contrasting structural styles and metamorphic imprints are exposed in this proposed area viz. Charnockite and Khondalite Group of Archaean age, Penninsular Gneissic Complex (PGC- II) of Archaean to Palaeo-Proterozoic age.

2.2.0 The general lithological sequence of the study area mainly comprises of garnet-sillimanite gneiss and Pyroxene granulites from Khondalite Group; Migmatites of Charnockite Group of Eastern Ghat Supergroup which is overlain by granite gneiss of PGC II. PGC II is mostly consists of grey hornblende granite and grey hornblende biotite granite gneiss.

2.3.0 Based upon the mode of occurrence and inter-relationship of various litho-units the following stratigraphic sequence is tentatively suggested by G. Lakshminarayana et. al., (1993) in this region.

Table No. 2.1: Stratigraphic succession After G. Lakshminarayana et. al. (1993)

SUPERGROUP	GROUP	FORMATION	LITHOLOGY	AGE
GONDWANA SUPER GROUP	Upper Gondwana	Soil cover		Recent
		Gangpur	Coarse grained white Sandstone, buff Siltstone & Claystone.	Early Permian to Lower Cretaceous
		-----Unconformity-----		
	Kota	Conglomeratic Sandstone, Clay, Siltstone and indurated red Claystone		
	Lower Gondwana	Kamthi	Conglomeratic Sandstone, Ferruginous Sandstone, Siltstone and indurated Claystone	
		-----Unconformity-----		
		Barakar	Gritty, felspathic Sandstone-siltstone- Carbonaceous shale and coal	
		-----Unconformity-----		
Talchir	Green Sandstone, olive green needle Shale and Siltstone			
-----Unconformity-----				
EASTERN GHAT SUPER GROUP	Khondalite Group		Garnet-sillimanite gneiss, Graphite	Archaean to Palaeo Proterozoic
			Calc-granulite / Calc silicate / Schist	
			Quartzites / Magnetite Quartzites	
PENNINSULAR GNEISSIC COMPLEX II	Intrusives		Quartz veins, Grey Hornblende-Biotite Granite Gneiss / Grey Hornblende-Granite Gneiss	Archaean
	Deformation.....			
	Basic intrusive		Amphibolite	Archaean
	Deformation, metamorphism and migmatitisation.....			
-----Unconformity-----				
	Basement	As yet undifferentiated from migmatitic complex.		

3.0.0 GEOLOGY OF THE BLOCK

3.1.0 The study area demonstrates majorly Khondalite and Charnockite Group of rocks of Neo-archaeon age from the Eastern Ghat Mobile Belt.

3.2.0 Garnetiferous sillimanite gneiss, Migmatites and Pyroxene granulites of EGMB is exposed majorly in the study area. Quartz reefs/vein occurs as intrusive bodies within the Khondalites. The stratigraphic succession of the area is given in Table 2.2.

Table- 2.2: The generalized stratigraphic succession of the proposed block (After GSI)

SUPERGROUP	GROUP	FORMATION	LITHOLOGY	AGE
			Soil	Quaternary
----- Unconformity -----				
EASTERN GHAT SUPERGROUP	Khondalite Group		Garnet- sillimanite gneiss, Quartzite, Migmatite, Pyroxene granulite	Archean To Paleo- proterozoic
----- Unconformity -----				
----- Deformation, metamorphism and migmatization -----				
Basement – as yet undifferentiated from migmatitic complex				

Description of the Litho units

The geological formations and a brief description of the lithology observed in the area are mostly belong to Khondalite Group of Eastern Ghat Supergroup and are described in details is as given below:

Eastern Ghat Supergroup

Quartzites

Quartzite occurs as linear bands of variable dimensions intimately associated with Garnet Sillimanite Gneiss and grey hornblende biotite granite gneiss. Quartzite constitutes the NS trending ridges. Quartzite in this area is off white to grey in colour, medium grained and foliated. It comprises mainly quartz with minor amount of feldspar.

Garnet sillimanite gneiss

The major part of the proposed area is covered by Garnet sillimanite gneiss. They are usually migmatitic in nature, which is formed as a result of mixing of granitic material with the original garnet sillimanite gneiss

rocks. The relatively younger quartzo feldspathic material is interbanded with the band rich in Khondalitic minerals e.g. sillimanite and garnet are observed in banded migmatites. The garnet-sillimanite gneiss comprises small specks of graphite. In addition to this quartz, feldspar and biotite are also present. The rock trends N-S with easterly dip of 55° to 65°. Leptynite occurs as small lensoidal body in association with Khondalite. They are observed near west of Reddigudem village.

Pyroxene Granulite

Pyroxene granulite occurs as lensoidal bodies of variable dimension within migmatite and khondalite. It is fine to medium grained, melanocratic, comprises pyroxene and plagioclase with occasional garnet and biotite.

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.

Structure

The rocks of Eastern ghat mobile belt, i.e., Garnet sillimanite gneiss are showing well developed gneissosity. The regional trend of gneissosity plane is NE-SW with steep dip of 55°-65° towards southeast. The gneissic rock is showing 2-sets of nearly perpendicular joints which are again emplaced by sillimanite bearing quartz veins and pegmatite veins comprising mainly quartz, feldspar and mica. The foliation is considered to have developed because of first phase of folding and uniformly shows parallelism with the primary layering (**Moitra, 1996**).

4.0.0 PREVIOUS WORK

4.0.1 The pioneering geological work was carried out by W.T Blanford (1870-1872) about one and a half century ago. The earliest account on the geology of the Chintalapudi sub-basin was given by him who stated that this part of the Gondwana basin contains Chintalapudi Sandstone (Kamthi Sandstone).

4.0.2 Huges (1877) and King (1881) are the two pioneer workers who carried out an extensive geological mapping of the entire Godavari Valley Coalfield. Raja Rao (1982) who carried out geological mapping of the Godavari coal field broadly agrees with the geological map of King and identified a small patch of the Talchir Formation near Chintalapudi. He divided the Pranahita-Godavari valley basin into four sub-basins namely (1) Godavari, (2) Kothagudem (3) Chintalpudi and (4) Krishna-Godavari coastal tracks. Exploratory drilling for Coal in Sattupalli and Chintalapudi and

Aswaraopeta areas was carried out by Ramanamurthy (1979) for sedimentary stratigraphic sequence and coal horizons. Raviverman et.al. (1985) also considered that the Chintalapudi sub-basin is represented by the 'Kamthi Group' of rocks of Lower Gondwana affinity.

4.0.3 As a part of geological mapping programme of the southern region of Geological Survey of India, the Chandrugonda-Mulakalapalli-Amaravarm area of the Chintalapudi sub-basin was systematically mapped by Lakshminarayana and Md. Burhanuddin (1986-88) and Lakshminarayana and Kutumba Rao (1989) who reported the occurrence of the Talchir, Barker, Kamthi (Lower Gondwana) and Kota and Gangapur Formation (Upper Gondwana) in the earlier considered Kamthi of Sattupalli-Chintalapudi-Dammmapeta area of the Chintalapudi sub-basin. The newly identified Barakar Formation was recommended for drilling to determine the presence of the coal seams.

4.0.4 Gaonkar et.al. (1989) carried out geophysical investigation for exploration of coal in Sattupalli-Ayyannapalem areas and studies to augment the geological data. Gravity lows are recorded to the north and south of this feature which indicate the existence of deep sub-basins located near Bugapadu in the north and Diddavaram in the south. Seismic surveys have indicated that the sediment thickness to be about 500 m near Gangavaram, 700 m near Sattupalli and more near Pakalagudem.

4.0.5 V. Singaraju and K.S. Bhaskara Rao (2001-2002) have taken regional traverses on 1:50,000 scale to understand the geological set up of the reported diamond occurrences. They have examined the diamond mines documented in the Mallavalli area by previous workers and demarcated their extensions. They have carried out Sedimentological, Geomorphological and heavy mineral studies around Mallavalli area to identify the target areas for diamond exploration. According to their study, both the terraces of Ramileru vagu consist of silty sand only. Study of heavy minerals from few stream sediment samples collected from streams draining the transition zone between EGMB and Dharwar craton, did not reveal the presence of any Kimberlite specific minerals.

4.0.6 A Specialised Thematic Mapping In Eastern Ghats Mobile Belt On The Southern Bank Of The Godavari River In Parts Of Krishna And Khammam Districts of Andhra Pradesh was under taken during FS-1997-98 by J. Srihari, S.M.J Bashes, D.N Charyulu, S.T Narahari. They identified a presence of three different liho-tectonic domains with contrasting structural and metamorphic imprint is exposed in the area. The domains include parts of Dharwar Craton, Khammam Schist Belt with associated biotite gneiss and Eastern Ghats Mobile Belt. Shear zones mark the domain boundaries. Litho assemblage representing the Dharwar Craton of the area includes granite with bands of amphibolite and younger dolerite dykes. Cratonic assemblage of the area shows evidences for one phase of deformation and shows imprints of chlorite or green schist facies of metamorphism. Khammam Schist Belt is represented

by meta-psammo-pelites, metamorphosed calcareous sediments and meta-igneous rocks. The litho types of KSB are intimately associated with and occur as conformable bands within deformed granitic gneiss. These, along with the associated granitic gneiss are successively emplaced by pink granite, anorthosite gabbro complex, meta- gabbro and younger dolerite/gabbro dykes. In association with biotite gneiss, they show evidences for two phases of deformation and upper amphibolite to granulite facies of metamorphism. While gneissic granite forms part of PGC of Dharwar Craton, KSB litho types along with the associated biotite gneiss may represent a more deformed segment of Dharwar Craton now in tectonic contact with PGC. Lithounits representing the EGMB include quartzite, khondalite, pyroxene granulite, charnockite and migmatite. Litho ensemble of EGMB shows evidences for two phases of deformation and granulite grade of metamorphism. Metamorphic transitions are not present across the different litho tectonic domains viz., Dharwar Craton, Khammam Schist Belt and Eastern Ghats Mobile Belt. Granitic gneiss east of Chimalpad area bears imprint of Eastern Ghats orogeny. The EGMB and KSB form basement for Gondwana Sediments. Basement-cover relationship is undisturbed. They also reported Brcciated iron ore and slag occurrence near Vellaturu and Ramanakkapeta; old workings for chromite occurrence near Dendukuru near Madhira. Ultramafite in the west of Shantinagar analysed anomalous values of Cr 1709 ppm, Ni 1206 ppm, Cu 8635 ppm and Ag 6.5 ppm.

4.0.7 A Specialised Thematic Mapping was carried out on northern extension of Kondapalli Mafic-Ultramafic-Anorthosite Layered Igneous Complex (KLIC) to elucidate its relation with Eastern Ghat Belt with special reference to chromite mineralization in Gampalagudem and Gangineni in parts of Khammam district of Telangana and Krishna District Of Andhra Pradesh by Swati Subhadarshini and Tapash Mahajan (FS 2023-24). Khondalite and graphite bearing khondalite represents granulite grade rock with the mineral assemblage of Qtz + Grt + Sill + Bt + Kfs + Opaque + Gr. Different generations garnet and sillimanite are studied from thin sections to decipher metamorphic evolution of EGMB with respect to deformation. Towards the eastern central part of study area, graphite is found to occur in khondalite which is manifested by small hillock. Graphite is black in colour, shiny, gives grey streak and occurs in between garnet grains. Towards extreme south east, an anorthosite body was mapped where an old working site was encountered. It is approx. 20 ft deep. Anorthosite shows layering with alternate gabbro layers. In the vicinity of this old working, chromite float ore were collected which has 22.46% Cr₂O₃. Other than this, in the mapped area, hardly any visible chromite band is found. North of the mapped area shows a quartz reef within foliated charnockite, which has huge books of biotite mica. Total REE content (TREE) in four samples (Garnetiferous alkali feldspar granite, pegmatite, garnetiferous quartzo-feldspathic gneiss) are higher than 1000 ppm (1001.66 – 1922.27 ppm). The chromite mineralization is not very significant due to very limited extent and sporadic occurrences. During petrography and EPMA study REE phases such as allanite, zirconetc. were identified in

garnetiferous alkali feldspar granite, graphite bearing khondalite and garnetiferous migmatitic gneiss. The highest Σ REE value recorded in these rocks ranges from 1002 ppm to 1923 ppm (Garnetiferous alkali feldspar granite), LREE being the maximum contributing factor. Garnetiferous alkali feldspar granite also shows presence of allanite, zircon, ilmenite during EPMA studies. It has a satisfactory areal coverage towards the northern part of the study than south, in terms of further explorational mapping work. Hence it was recommended that a preliminary exploration programme may be carried out over the garnetiferous alkali feldspar granite exposures covering the nearby Toposheets to know the economic potentiality.

4.0.8 Anamika C. and Reshma M. (2017-18) carried out Geochemical Mapping in Toposheet no. 65D10. During their course of investigation, a total of 207 composite samples were collected. TREE shows higher values over the Garnet Sillimanite Gneiss of Khondalite Group. It shows concentration upto 2000 ppm. Chromium shows a distinct anomalous area showing very high concentration upto 4485 ppm around Kondapalle and Gangineni area. These areas have serpentinized Pyroxenite rocks and abandoned mines are present. Ultrabasic gabbro anorthosite have also been reported in the area.

4.0.9 Sandhya Rani and Pallab Chatterjee (FS 2017-18) carried out Geochemical Mapping in Toposheet no. 65D14. During their course of investigation, a total of 558 Stream Sediment samples were collected. The total REE varies from 93.88 ppm to 1700 ppm. Total LREE value varies from 78.81 ppm to 1573.66 ppm and total HREE value varies from 8.88 ppm to 67.40 ppm. LREE : Lanthanum shows very strong positive correlation almost with all the LREE except for Sn and Be. Higher values above threshold occur in North western part of the area near Agripalli, Idara occupied by Garnet Sillimanite Gneiss, Quartzite of Khondalite Suite of Eastern Ghat Mobile Belt and in northern part near Gollapalle, Ravicherla occupied by Gollapalle sandstone of Gondwana Super group and Rajahmundry Sandstone of Mio-Pliocene age. Tb shows very strong positive correlation with Ho, Er, Dy, Tm, Yb and Lu. All the elements of HREE are strongly correlated with each other. Higher values above threshold occur in Western part of the area near Agripalli occupied by Garnet Sillimanite Gneiss, Quartzite of Khondalite suite and in Northern part near Gollapalle, Ravicherla, Mirzapuram occupied by Gollapalle and Rajahmundry Sandstone formations. The geochemical elemental distribution maps exhibit higher values for Pb, Zn and REE, V and Rb in the study area. Thus, it was recommended to study these elements in detail to know the potentiality of the area.

4.0.10 Geological Exploration of REE was successfully carried out by GSI (2021-24) for REE in the alluvial placer which gave encouraging results. GSI recommended studying those areas in details for REE mineralization. The findings of those Geological Reports area summarized below.

Table-3: Table for Various analytical results for REE in alluvial placer by GSI

Sr no	Block	TS	FSP	State	Outcome
1	Kottapalle Area (G-4)	65G04 & 65H1	2022-23	Andhra Pradesh	TREE values: BRS- 293-596 PPM SSS- 450-2174 PPM PTS- 329-1540 PPM SS- 415-1854 PPM
2	Kamalapuram-Jagannadhapuram Area (G-4)	65C15	2021-22	Telangana	TREE values: BRS- 105.79-10216.57 PPM SSS- 0.248-3.118% Regolith- 126.88-13249.96 PPM Clay- 318.84-2602.19 PPM
3	Velagapadu Area (G-4)	65G04	2021-22	Andhra Pradesh	TREE values: BRS- 137-1508 PPM SSS-294-10673 PPM PTS- 294-4348 PPM SS- 232-4245 PPM
4	Mulagalampalli Area (G-4)	65G04	2023-24	Andhra Pradesh	TREE values: BRS- 105-1681 PPM SSS- 290-1797 PPM PTS- 227-16770 PPM SS- 284-3665 PPM
5	Annapureddipalli Area (G-4)	65C15	2023-24	Telangana	TREE values: SSS- 339.957-40428.642 PPM Regolith- 243.34-8780.12 PPM
6	Patrwarugudem Area (G-4)	65C15	2022-23	Telangana	TREE values: BRS- 161.51-2187 PPM SSS- 0.1-2.03% Regolith- 0.42-6.98% PPM Clay- 313.46-984.36 PPM
7	Pata-Gangaram	65C15	2021-23	Telangana	Reconnaissance Resource (334) in : Soil/Alluvium- 2.57 million tonnes with 547 ppm TREE Stream Placers- 0.13 million tonnes with 4355 ppm TREE Inferred Mineral Resource (333): TREE- 8.15 million tonnes with 745.87 ppm TREE TREO- 12.38 million tonnes with 762.15 ppm REO

4.0.11 MECL used the NGCM data from NGDR portal, GSI of Toposheet No. 65D09 & 65D13. The total REE, LREE, HREE values in stream sediments falling in the proposed block was calculated

and it was observed that the maximum total REE value in the proposed block is 1785.64 ppm. The maximum and minimum range for each element is given in below table. On the basis of anomalous stream sediment values in NGCM data the block is proposed for Reconnaissance Survey for REE.

Table-4: Data showing NGCM Stream Sediment results for Proposed Vellaturu Area (24 numbers of samples) (Source: NGDR portal GSI)

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	Maximum	Average (ppm)
			(ppm)	(ppm)	
LREE	Lanthanum (La)	30.00	0.000	416.016	219.852
	Cerium (Ce)	60.00	187.500	808.800	428.911
	Praseodymium (Pr)	8.20	22.658	116.500	54.838
	Neodymium (Nd)	28.00	80.673	451.900	189.276
	Samarium (Sm)	6.00	14.511	76.940	31.887
HREE	Europium (Eu)	1.20	1.877	4.435	2.375
	Gadolinium (Gd)	5.40	12.268	59.040	21.713
	Terbium (Tb)	0.90	1.522	5.703	2.344
	Dysprosium (Dy)	3.00	5.917	17.440	8.497
	Holmium (Ho)	1.20	0.895	2.407	1.277
	Erbium (Er)	2.80	2.066	7.834	3.539
	Thulium (Tm)	0.50	0.293	0.982	0.523
	Ytterbium (Yb)	3.40	1.983	6.700	3.450
	Lutetium (Lu)	0.50	0.241	0.865	0.524
	Scandium (Sc)	22.00	11.040	25.000	15.773
	Yttrium (Y)	23.00	20.000	52.260	33.644
Total LREE			404.47	1684.88	924.76
Total HREE			30.26	105.41	44.24
ΣREE+Sc+Y			501.43	1785.64	1018.42

5.0.0 PLANNED METHODOLOGY

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 identify the REE enriched soil horizon, 05 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 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. 5 scout boreholes will be carried out to further establish the depth continuity of the mineralization.
- vi. To establish the reconnaissance resources for REE bearing minerals as per UNFC norms & Minerals (Evidence of Mineral Contents) Rules- 2015.

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.

5.1.0 GEOLOGICAL MAPPING

5.1.1 Geological mapping will be carried out in the entire 96.30sq.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.

5.1.2 80 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 75 bedrock samples collected from various lithounits, 10% of primary samples i.e. 8 external check samples will be sent to NABL External Labs for analysis.

5.1.4 10 nos. of surface samples from various lithounits will be studied for petrography and minerography.

5.2.0 GEOCHEMICAL SAMPLING (Stream Sediment Sampling)

5.2.1 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.

5.2.2 Total 50 stream sediment samples will be collected from the proposed area. The final samples collected will be powdered and sent to laboratory for 34 element ICPMS analysis of REE. 05 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.

5.3.0 EXPLORATORY MINING (Pitting):

5.3.1 Orientation pitting will be carried out in positive catchment area identified on the basis of total REE NGCM values of GSI, BRS and stream sediment samples collected during proposed exploration. A provision of 05 nos of pitting on the identified anomalous zone (1.0 m wide X 1.0 m deep) with 5 cubic meters is kept. Pitting will be carried from surface up to a depth of 1 m. Locations of pits will be decided by field geologist based on field observations.

5.3.2 15 orientation soil samples will be collected from 05 pits where separate samples would 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.

5.3.3 10% of Primary Samples will be sent for external check in NABL External Labs by ICPMS method.

5.4.0 EXPLORATORY DRILLING

5.4.1 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.

5.4.2 Total 50 numbers of auger drilling boreholes have been proposed in the block each having a depth of 3 m. The total auger drilling carried out in the block will be 150 m. Based on the result of orientation pitting, samples from auger drilling will be collected from targeted soil horizon and bedrock.

5.4.3 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.

5.4.4 Subject to the analytical result of the augers, 5 scout boreholes will be planned in the last phase to establish the depth continuity and control of the mineralization. 5 nos of bulk density study will be done from borehole core samples.

5.6.0 WHOLE ROCK ANALYSIS

5.6.1 10 Nos of samples shall be subjected to determination of major oxides by XRF.

5.7.0 PETROLOGICAL & MINERAGRAPHIC STUDIES:

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

5.8.0 XRD & EPMA STUDY

5.8.1 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.

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

6.0.0 PROPOSED QUANTUM OF WORK

6.1.1 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	96.30
2	Geochemical Sampling		
i	Bedrock samples for REE (34 elemental analysis By ICPMS includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li& REE)	Nos	75
ii	Stream Sediment samples for REE (34 elemental analysis by ICPMS includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li & REE)	Nos	50
3	Exploratory Mining		
i	Orientation Pitting (5 pits) (1m*1m*1m)	Cu.m	5
ii	Pit samples for 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li & REE	Nos	15
4	Drilling for REE		
i	Auger Drilling in 50 boreholes (3m/BH)	m	150
ii	Auger Drilling samples for 34 elemental analysis includes Nb, Sr, Ta, W, Mo, Sn, Rb, Be, Cs, Li & REE	Nos	150
iii	Core Drilling	m	500
iv	Core Drilling samples	Nos	50
5	Laboratory Studies		
	i) Orientation Pit samples for REE in raw faction	Nos	15
	ii) Orientation Pit samples for REE in heavy mineral faction	Nos	15
	iii) Bedrock samples for REE	Nos	75
	iv) Stream sediment samples for REE	Nos	50
	v) Auger Drilling Samples for REE	Nos	150
	vi) Core Drilling samples	Nos	50
	vii) 10% external check samples for REE	Nos	36
6	Whole Rock Analysis for Major Oxides by XRF technique	Nos	10
7	Petrological Samples (Surface Samples)	Nos	10
8	Mineragraphic Studies (Surface Samples)	Nos	10
9	XRD Mineral phase analysis	Nos	10

Sl. No.	Item of Work	Unit	Target
10	EPMA studies 5 Samples (Heavies collected from REE samples)	Hrs	10
11	Density studies	Nos	5
12	Report Preparation (5 Hard copies with a soft copy)	Nos	1
13	Preparation of Exploration Proposal (5 Hard copies with a soft copy)	Nos	1

7.0.0 BREAK-UP OF EXPENDITURE

7.0.1 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. The total estimated cost is **Rs. 190.15 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 Vellaturu Area, District- Ntr & Eluru, Andhra Pradesh

Sl. No.	Item	Total Estimated Cost (Rs.)
1	Geological Mapping (LSM), Other Geological Work	50,87,340
2	Trenching	33,310
3	Drilling	67,29,680
4	Laboratory Studies	31,83,400
	Sub Total (1 to 4)	1,50,33,730
5	Exploration Report Preparation	7,50,000
6	Proposal Preparation	3,00,675
7	Peer review charges	30,000
8	Sub Total (1 to 7)	1,61,14,405
9	GST 18%	29,00,593
10	Total:	1,90,14,997
	Say Rs. In Lakh	190.15

8.0.0 TIMELINE

8.0.1 The entire project is planned tentatively for 10 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 Time schedule / Action plan

Estimated timeline for Reconnaissance Survey (G-4) for REE in Vellaturu Area, District- Ntr & Eluru, Andhra Pradesh [Block area- 96.30 sq. km; Schedule timeline- 10 months]															
S. No.	Particulars	Months/ Days	1	2	3	4	5	Review	6	7	8	Review	9	10	
1	Camp Setting	months													
2	Geological Mapping & sampling	months													
3	Pitting	cu.m													
4	Auger Drilling	m													
5	Drilling	m													
5	Geologist days	days													
6	Sampling days	days													
8	Camp winding	months													
9	Laboratory Studies	months													
10	Geologist days, HQ	days													
11	Report Writing with Peer Review	months													

9.0.0 JUSTIFICATION

- i) 28 NGCM Stream Sediment Sample data points fall in the proposed Vellaturu 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 1785.64 ppm. A total of 15 sample out of 28 (54% samples>1000PPM) shows TREE+Sc+Y value more than 1000 PPM. The maximum total HREE value in proposed Vellaturu area is 105.41 ppm of which the major contributing element is Gadolinium (maximum 59.04 ppm). The maximum LREE value in Vellaturu Area is 1684.88 ppm and the major contributing element is Lanthanum (maximum 416.02 ppm). The NGCM (FS 2020 & FS 2021) stream sediment samples carried out by GSI show highly anomalous values for REE in toposheets 65D10 & 65D14, therefore the Vellaturu Area is proposed for reconnaissance survey for REE.

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	Maximum	Average (ppm)
			(ppm)	(ppm)	
LREE	Lanthanum (La)	30.00	0.000	416.016	219.852
	Cerium (Ce)	60.00	187.500	808.800	428.911
	Praseodymium (Pr)	8.20	22.658	116.500	54.838
	Neodymium (Nd)	28.00	80.673	451.900	189.276
	Samarium (Sm)	6.00	14.511	76.940	31.887
HREE	Europium (Eu)	1.20	1.877	4.435	2.375
	Gadolinium (Gd)	5.40	12.268	59.040	21.713
	Terbium (Tb)	0.90	1.522	5.703	2.344
	Dysprosium (Dy)	3.00	5.917	17.440	8.497

	Holmium (Ho)	1.20	0.895	2.407	1.277
	Erbium (Er)	2.80	2.066	7.834	3.539
	Thulium (Tm)	0.50	0.293	0.982	0.523
	Ytterbium (Yb)	3.40	1.983	6.700	3.450
	Lutetium (Lu)	0.50	0.241	0.865	0.524
	Scandium (Sc)	22.00	11.040	25.000	15.773
	Yttrium (Y)	23.00	20.000	52.260	33.644
Total LREE			404.47	1684.88	924.76
Total HREE			30.26	105.41	44.24
ΣREE+Sc+Y			501.43	1785.64	1018.42

ii) Additionally, to the anomalous REE concentrations in the Stream Sediment Samples from this area, Specialized Thematic Mapping (FS 2024-25) also reveals the presence of REE as secondary concentrations above the Garnet-sillimanite gneiss of Khondalite group from EGMB. Five recorded Total Rare Earth Element (Σ REE) concentrations exceeding 700 ppm, with the highest concentration of 1055 ppm observed in a garnet-sillimanite gneiss sample. The highest Strontium (Sr) concentration, measured at 830 ppm, was identified in a garnet-sillimanite leptynite sample.

iii) Geological Exploration of REE was successfully carried out by GSI (FS 2021-24) for secondary REE enrichment in the EGMB and Pranhita Godavari Valley which gave encouraging results. The enrichment of REE in the present area was first pointed out by high concentration of total REE values in the composite stream sediment samples during the NGCM works. It is further observed that the concentration of the REE bearing minerals is mainly high in stream sediments and less in soil. The REE mineralization in the study area occurs in the form of heavy minerals in stream sediments. The REE bearing mineral phases identified by SEM study are monazite, zircon and allanite. It was also inferred from the reconnaissance surveys by GSI (FS 2021-24 in AP and Telangana) that **the REE mainly occurs as secondary enrichment of the REE bearing mineral phases in stream sediment derived from the weathering and erosion of heavy mineral rich layers of the garnet-sillimanite gneiss, quartzites of Eastern Ghat Belt and sandstones of Gondwana i.e. alluvial placer type deposit.** GSI recommended studying these areas in details for REE mineralization. The new findings of alluvial placer type of REE enrichment may create huge potential area for secondary REE mineralization. This may

considerably augment the REE resource in India particularly from the Garnet-sillimanite gneiss of EGMB and Gondwana rocks. It will be a potential game changer in terms of REE exploration in India and significantly help to mitigate the crucial REE demand. Litho units belonging to Khondalite group of rocks, Lower and Upper Gondwana is present in the present proposed area. Similar investigation in the proposed area might yield encouraging results of REE.

Table for Various analytical results for REE in alluvial placer by GSI

SN	Block	TS	FSP	State	Outcome
1	Kottapalle Area (G-4)	65G04 & 65H1	2022-23	Andhra Pradesh	TREE values: BRS- 293-596 PPM SSS- 450-2174 PPM PTS- 329-1540 PPM SS- 415-1854 PPM
2	Kamalapuram-Jagannadhapuram Area (G-4)	65C15	2021-22	Telangana	TREE values: BRS- 105.79-10216.57 PPM SSS- 0.248-3.118% Regolith- 126.88-13249.96 PPM Clay- 318.84-2602.19 PPM
3	Velagapadu Area (G-4)	65G04	2021-22	Andhra Pradesh	TREE values: BRS- 137-1508 PPM SSS-294-10673 PPM PTS- 294-4348 PPM SS- 232-4245 PPM
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5	Annapureddipalli Area (G-4)	65C15	2023-24	Telangana	TREE values: SSS- 339.957-40428.642 PPM Regolith- 243.34-8780.12 PPM
6	Patrwarugudem Area (G-4)	65C15	2022-23	Telangana	TREE values: BRS- 161.51-2187 PPM

						SSS- 0.1-2.03% Regolith- 0.42-6.98% PPM Clay- 313.46-984.36 PPM	
		Pata-Gangaram	65C15	2021-23	Telangana	Reconnaissance Resource (334) in : Soil/Alluvium- 2.57 million tonnes with 547 ppm TREE Stream Placers- 0.13 million tonnes with 4355 ppm TREE Inferred Mineral Resource (333): TREE- 8.15 million tonnes with 745.87 ppm TREE TREE- 12.38 million tonnes with 762.15 ppm REO	

List of Plates

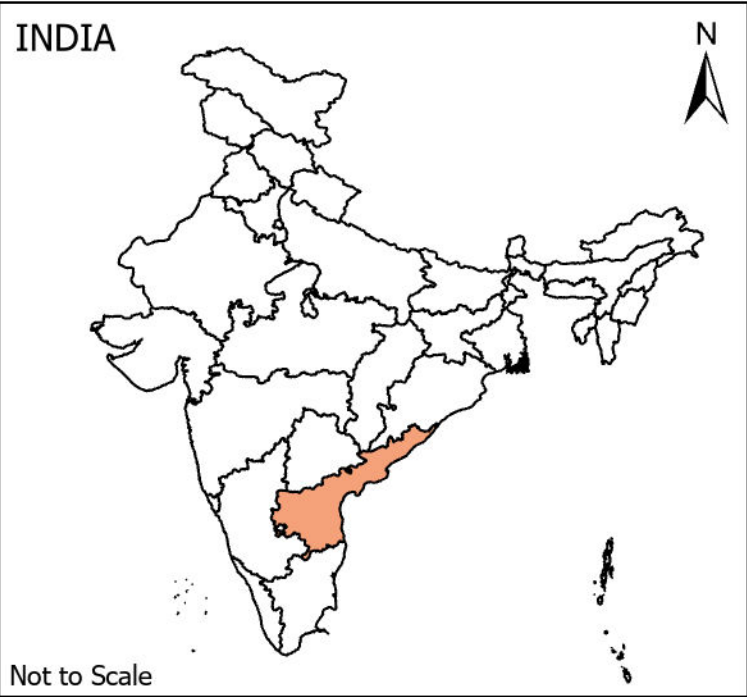
1. Plate –I: Location Map of Proposed Vellaturu Area (96.30 sq km), District: Ntr & Eluru, State: Andhra Pradesh.
2. Plate–II: Regional Geological Map showing Proposed Vellaturu Area (96.30 sq km), District: Ntr & Eluru, State: Andhra Pradesh.
3. Plate–IV: Anomaly Map with Total REE values in Proposed Vellaturu Area (96.30 sq km), District: Ntr & Eluru, State: Andhra Pradesh (Source: NGCM data).
4. Plate-V: Anomaly Map with LREE values in Proposed Vellaturu Area (96.30 sq km), District: Ntr & Eluru, State: Andhra Pradesh (Source: NGCM data).
5. Plate-VI: Anomaly Map with Total HREE values in Proposed Vellaturu Area (96.30 sq km), District: Ntr & Eluru, State: Andhra Pradesh (Source: NGCM data).
6. Plate-VII: Geology map showing Drainage and proposed stream sediment samples location points in Proposed Vellaturu Area (96.30 sq km), District: Ntr & Eluru, State: Andhra Pradesh.

7. Plate-VII: Geology map showing and proposed auger drilling location points in Proposed Vellaturu Area (96.30 sq km), District: Ntr & Eluru, State: Andhra Pradesh.

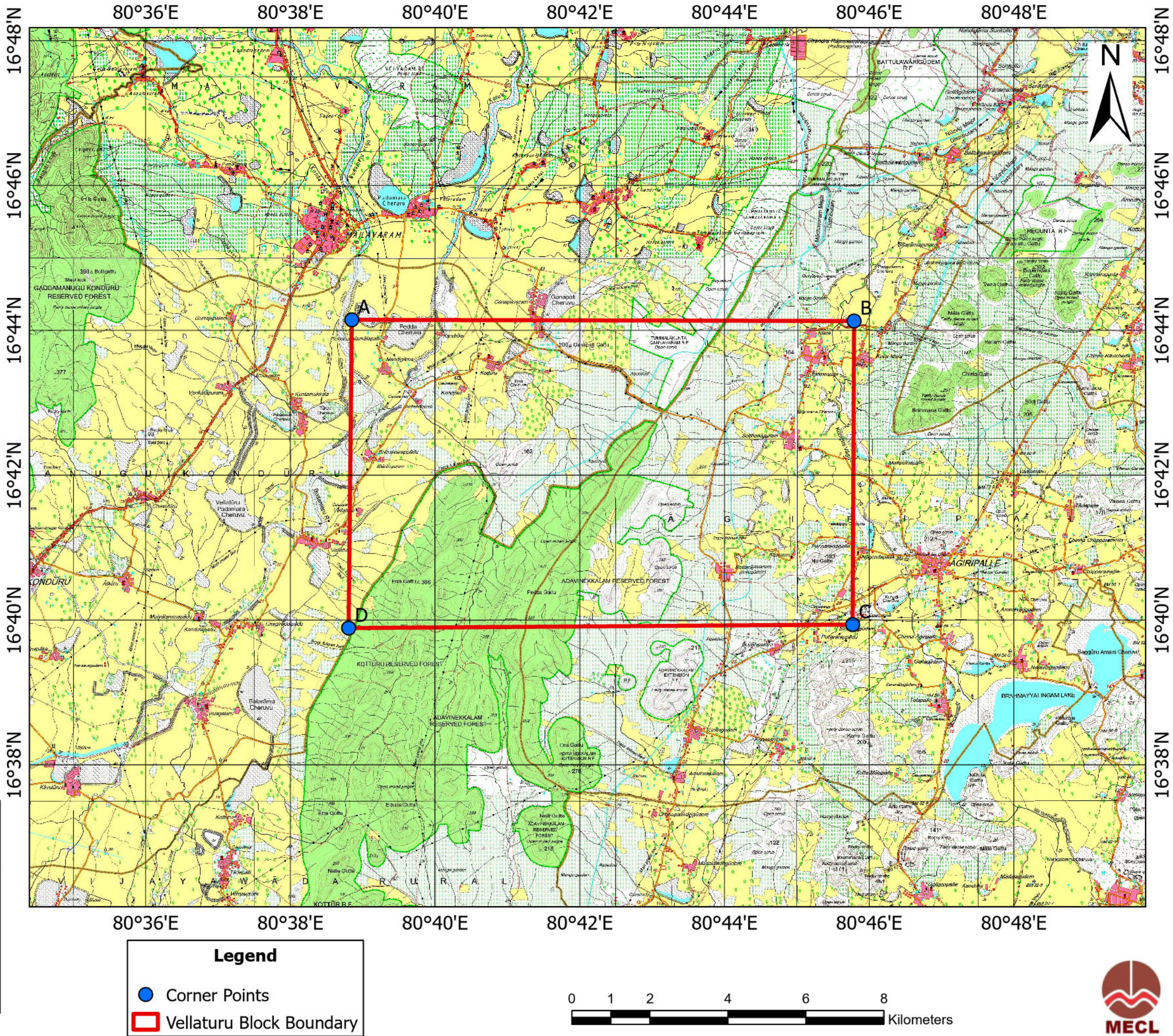
List of Annexure

- I. Detailed Cost sheet of Vellaturu Area, Ntr & Eluru, Andhra Pradesh.

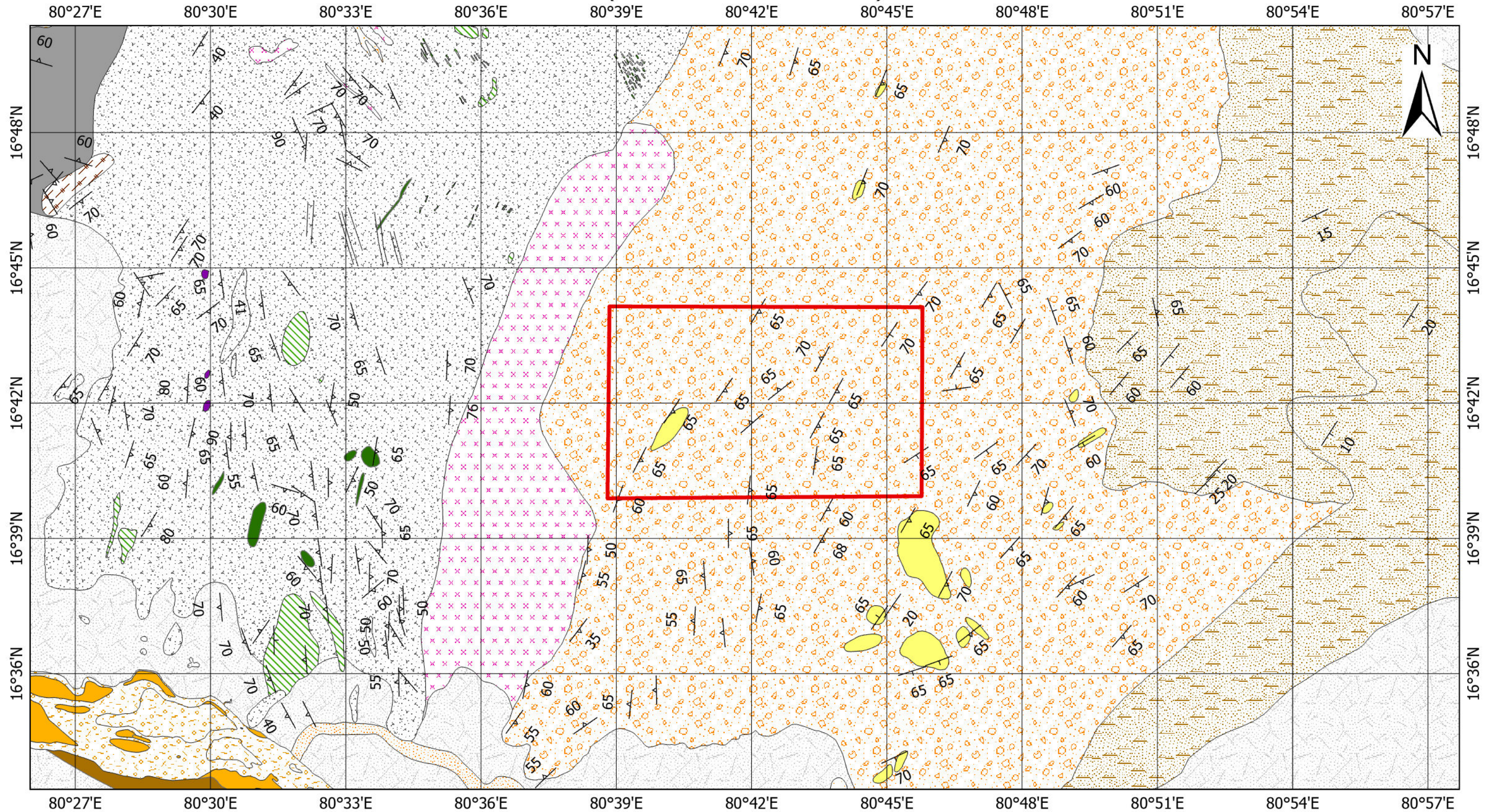
Location Map of Vellaturu Area (G-4) (Extent: 96.30 Sq. Km.) for REE and Associated Minerals, District : NTR and Eluru, State : Andhra Pradesh
(Parts of Toposheet No. - 65D/10 and 65D/14)



Co-ordinate Points in GCS (DMS)		
Points	Latitude	Longitude
A	16° 44' 8.68" N	80° 38' 50.95" E
B	16° 44' 7.73" N	80° 45' 47.48" E
C	16° 39' 56.21" N	80° 45' 46.28" E
D	16° 39' 53.31" N	80° 38' 48.32" E



Regional Geological Map of Vellaturu Area (G-4) (Extent 96.30 Sq. Km.) for REE and Associated Minerals, District : NTR and Eluru, State : Andhra Pradesh
(Source: NGDR Portal 1:50k)



Legend

 VELLATURU BLOCK BOUNDARY

STRUCTURAL DATA

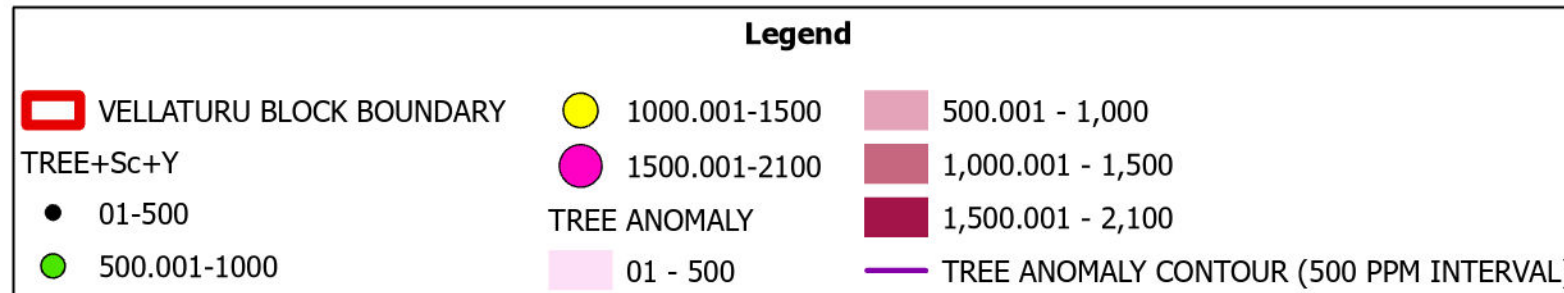
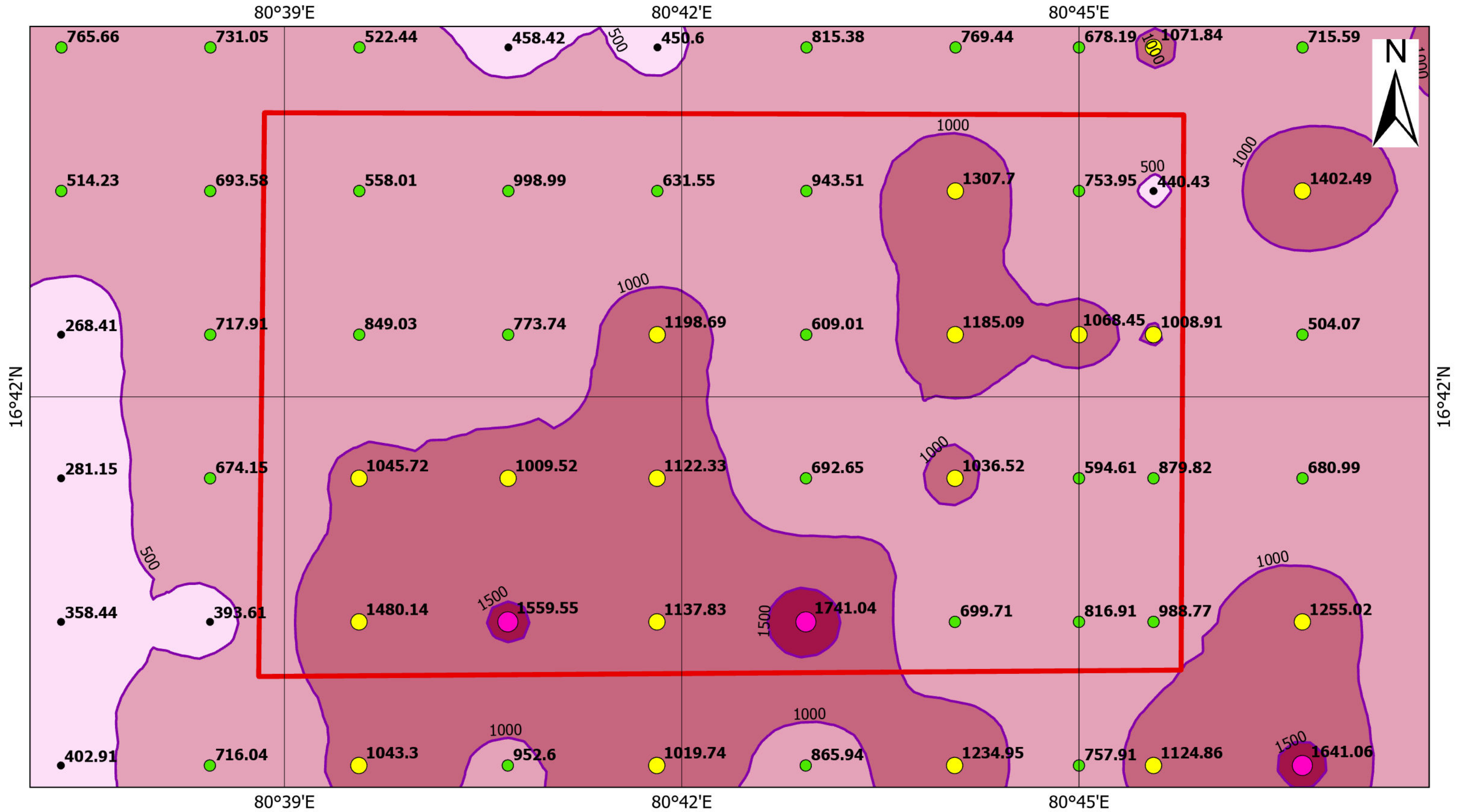
- BEDDING
- CLEAVAGE/FOLIATION/SCHISTOSITY (S1)

LITHOLOGY

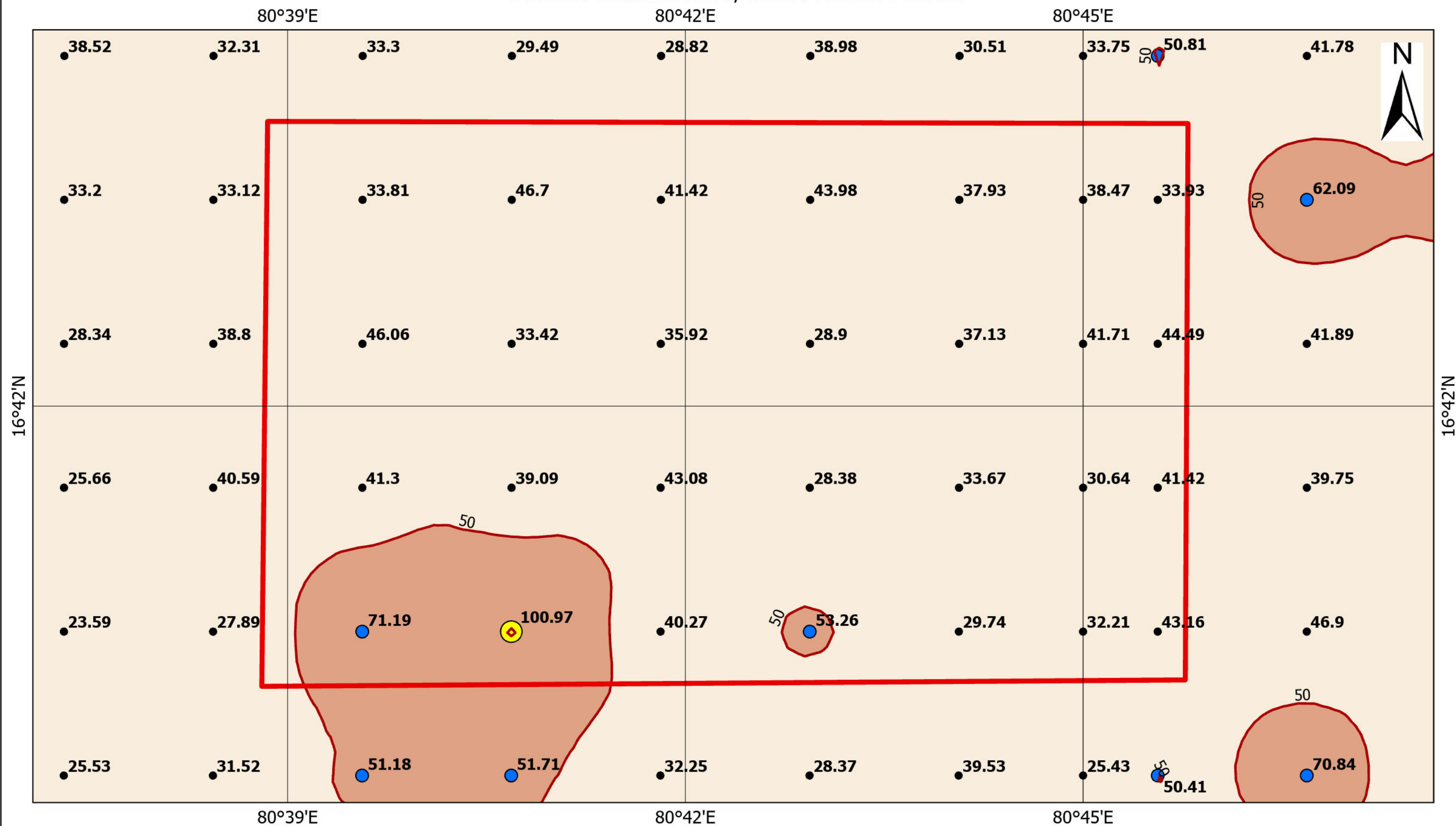
- BLACK SILTY CLAY (ACTIVE FLOOD PLAIN)
- BLACK CLAY UNDERLAIN BY COARSE SAND (PALAEO)
- BROWN SILT (ACTIVE LEVEE)
- SAND (CHANNEL BAR/ POINT BAR)
- COARSE SAND WITH ROCK FRAGMENTS (ACTIVE CHANNEL)
- SANDSTONE
- QUARTZITE
- PEGMATITE
- ACID TO INTERMEDIATE CHARNOKITE
- GABBROIC ANORTHOSITE
- GREY HORNBLENDE BIOTITE GRANITE
- PYROXENE GRANULITE
- GARNET-SILLIMANITE-GNEISS + GRAPHITE + CORDIERITE
- GREY HORNBLENDE BIOTITE GNEISS
- MIGMATITE GNEISS



**Total REE Anomaly Map Showing Stream Sediment Sample of Vellaturu Area (G-4) (Extent 96.30 Sq. Km.) for REE and Associated Minerals,
District : NTR and Eluru, State : Andhra Pradesh**



HREE Anomaly Map Showing Stream Sediment Sample of Vellaturu Area (G-4) (Extent 96.30 Sq. Km.) for REE and Associated Minerals, District : NTR and Eluru, State : Andhra Pradesh



VELLATURU BLOCK BOUNDARY

100.001 - 150

100.001 - 150

HREE

100.001 - 150

HREE ANOMALY

01 - 50

01- 50

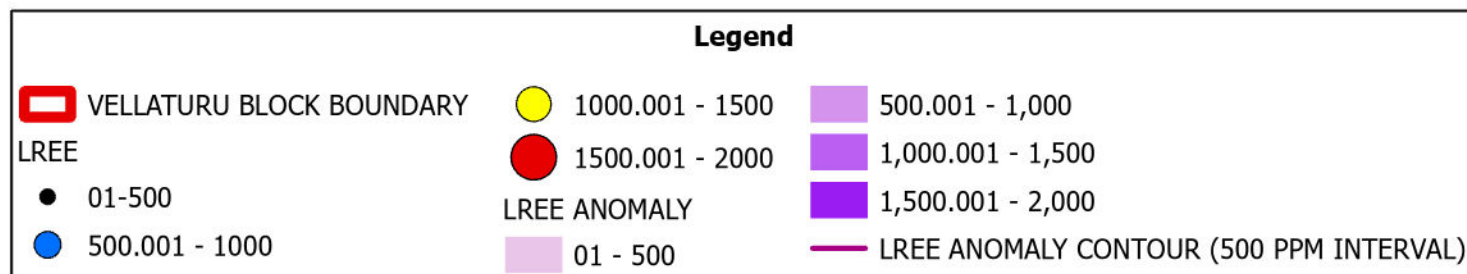
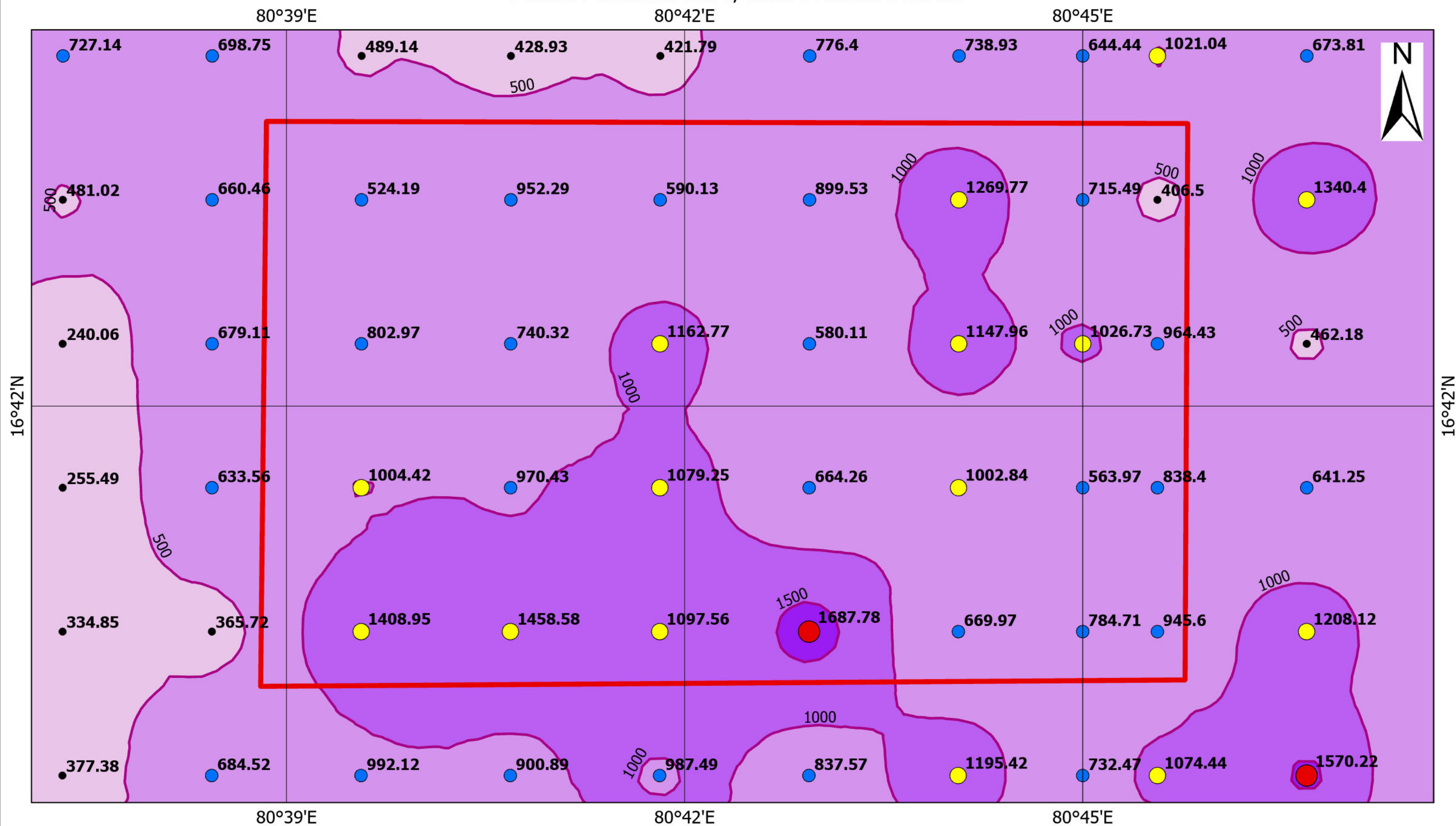
HREE ANOMALY CONTOUR (50 PPM INTERVAL)

50.001 - 100

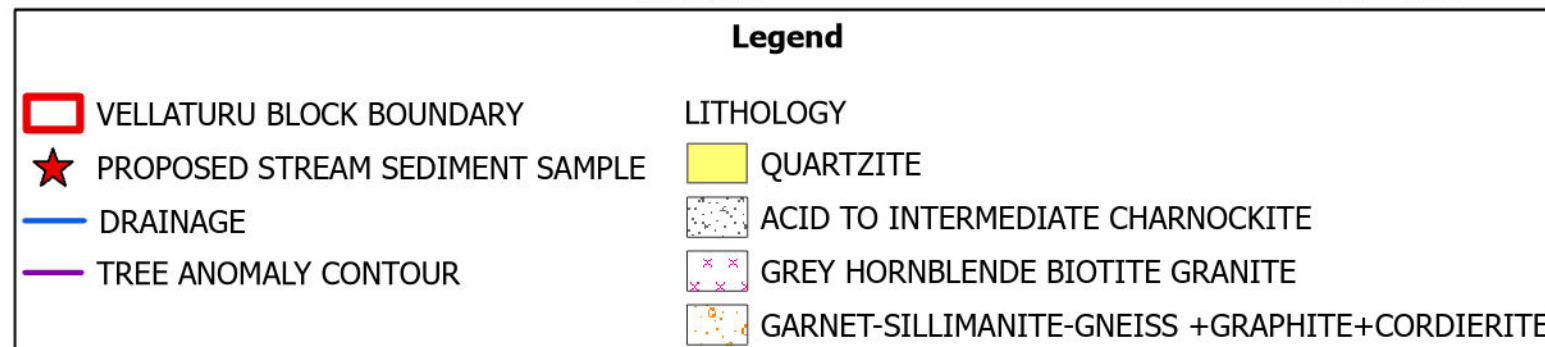
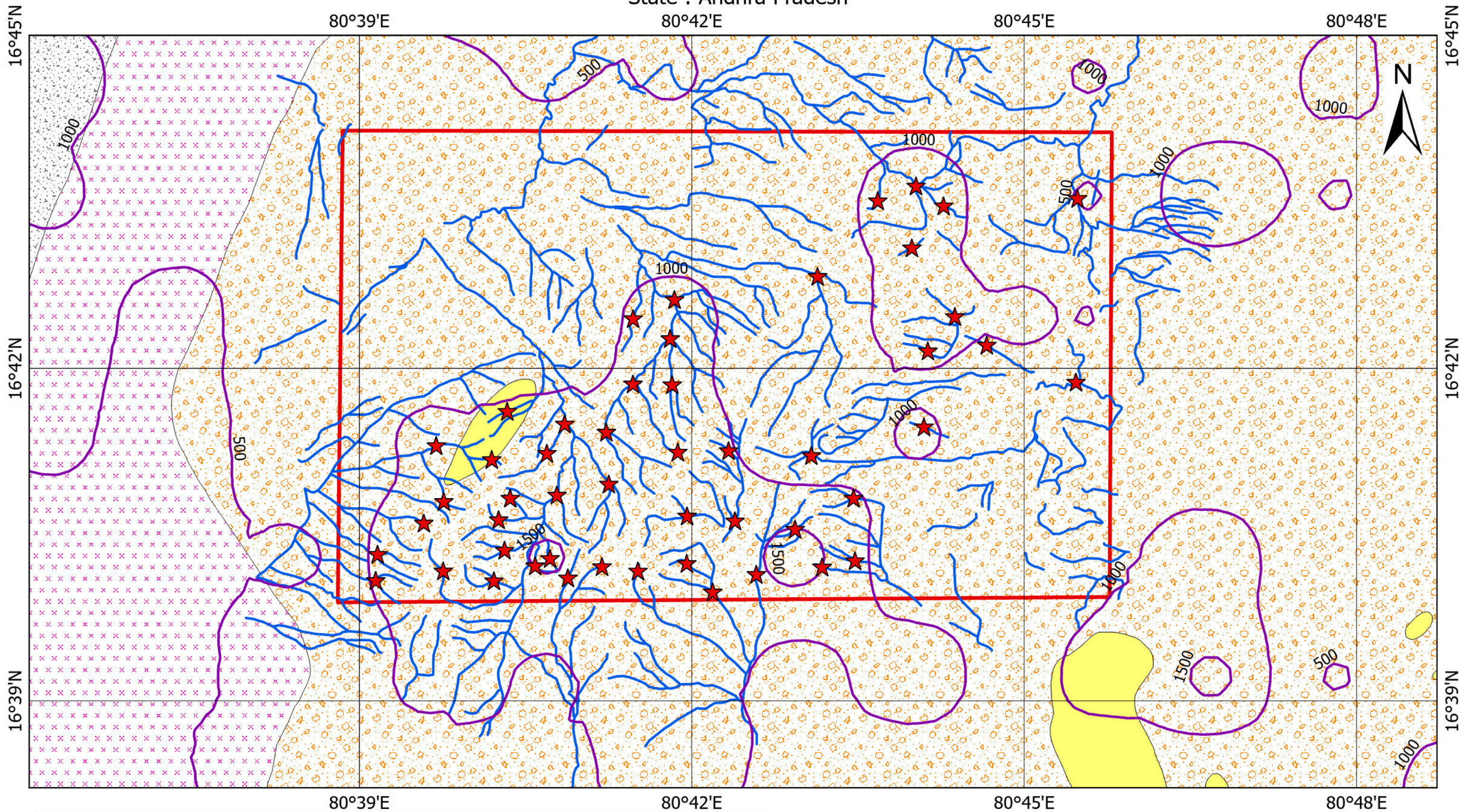
50.001 - 100



LREE Anomaly Map Showing Stream Sediment Sample of Vellaturu Area (G-4) (Extent 96.30 Sq. Km.) for REE and Associated Minerals,
District : NTR and Eluru, State : Andhra Pradesh



Map Showing Proposed Stream Sediment Sample of Vellaturu Area (G-4) (Extent 96.30 Sq. Km.) for REE and Associated Minerals, District : NTR and Eluru,
State : Andhra Pradesh



Map Showing Proposed Auger Drilling Location of Vellaturu Area (G-4) (Extent 96.30 Sq. Km.) for REE and Associated Minerals, District : NTR and Eluru, State : Andhra Pradesh

