PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR GLAUCONITE IN AMBARA-MARU BLOCK, DISTRICT- KACHCHH, GUJARAT
(AREA- 94.25 Sq. Km)

COMMODITY: GLAUCONITE

BY

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PLACE: NAGPUR
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SUMMARY OF THE BLOCK FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR GLAUCONITE IN AMBARA-MARU BLOCK, DISTRICT- KACHCHH, GUJARAT

Features	Details
Block ID	AMBARA-MARU BLOCK
Exploration Agency	Mineral Exploration and Consultancy Limited (MECL)
Commodity	Glauconite
Mineral Belt	The proposed exploration block falls in the northern part of Kachchh Basin. Kachchh Basin mainly consists of Pachcham, Chari, Katrol and Umia Formations. Presence of glauconitic sandstone is identified in the Umia (Bhuj) Formation and Katrol Formation. The block is predominantly occupied by lithounits of Katrol and Bhuj Formations of Late Jurassic - Early Cretaceous age and Early Cretaceous age. Katrol formation is present in the proposed block area. Katrol formation consists of Glauconitic Sand Stone, Oolitic Limestone, Shale, Conglomerate, Gypseous Shale, Calcareous Sanstone with Belemnites, Sandstone with Trigonia Fossils, Conglomerate, Fossiliferous Shale with Intercalated Limestone, Shale with Plant Fossils. Ambara-Maru Block is a part of Glauconitic sandstone Belt situated in the Kachchh District, Gujarat and falls in the Survey of India Toposheet no. 41 E/02 and 41E/03.
Completion period with entire Time schedule to complete the project	12 Months
Objectives	The exploration scheme of Ambara-Maru Block for Glauconite is formulated with the following objectives: • To carry out Geological & structural mapping on 1:12,500 scale for demarcation of Glauconitic bearing horizons with the structural features to identify the surface manifestations along with the lateral and vertical disposition of the mineralized zones. • To assess the quality of the glauconitic bearing horizons surficial by collecting surface samples (bedrock, channel and Trench) which will further shape up the future course of exploration. • To establish the surface continuity of the mineralisation i.e. concealed below the soil cover, pitting and trenching will be carried out. • Based on the outcomes of the above activities, drilling of boreholes will be carried out in a systematic grid pattern. The drilling program will establish the mineralisation vertically and laterally along with the qualitative and quantitative. • To estimate resources as per UNFC norms Minerals (Evidence of Mineral Contents) Amendment Rules 2021. • To upgrade the block to the higher level of exploration.
Whether the work will be carried out by the proposed agency or through outsourcing and details thereof. Components to be outsourced and name	Work will be carried out by the proposed agency.

of the outsource agency	
Number of Geoscientists	Nos. of Geoscientists: 2
Expected Field days(Geology, Geophysics, surveyor)	Geologist Party days: 150 (At field) & 60 at HQ
	Survey Party days: 0

1.	**Location**	
	Latitude - Longitude	**Cardinal Points** / **Latitude** / **Longitude** A: 23°35'16.66" / 69°05'25.56" B: 23°35'13.95" / 69°08'16.09" C: 23°33'00.19" / 69°09'25.38" D: 23°32'59.44" / 69°11'30.61" E: 23°29'04.03" / 69°11'36.02" F: 23°29'11.63" / 69°06'28.29" G: 23°30'45.97" / 69°05'35.28"
	Villages	Ambara, Maru, Ludbay, Deshalpur, Jinjay, Taraf Manjali (OG), Vigodi, and Ratadiya villages
	Tehsil/Taluk	Nakhatrana
	District	Kachchh
	State	Gujarat
2.	**Area (hectares/ square kilometres)**	
	Block Area	94.25 sq.km
	Forest Area	The block area is partially under Forest Area and partially Non-Forest area.
	Government Land Area	Data not available
	Charagaha	Data not available
	Private Land Area	Data not available
3.	**Accessibility**	
	Nearest Rail Head	Nearest railway station to the study area is Bhuj at about 65 km in south.
	Road	The area is well connected by all-weather metalled roads. National Highway-754K is approx. 01 km from the block area which connects via Deshalpar, Devpar, Nakhatarana, village to Moray village through metalled road. Nakhatrana Tehsil is about 21 kms (via Ugedi village) from the block.
	Airport	The nearest airport is Rudramata, Bhuj.
4.	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	The dendritic drainage.
	Rivers/ Streams	The area is drained by Gajansagar stream tributaries. Drainage in the study area is dendritic and trellis pattern.
5.	**Climate**	
	Mean Annual Rainfall	The average rainfall in the Kachchh area is 456mm.
	Temperatures	The average annual temperature ranges from approximately 42ºC during summer and approximately 10ºC during winter.
6.	**Topography**	

	Toposheet No.	41E/02 and 41E/03
	Morphology of the Area	The block area forms planar and gently undulating terrain.
7.	**Availability of baseline geoscience data**	Geological Map, is available at 1:50,000 scale in Bhukosh/NGDR.
	Geochemical Map	Available
	Geophysical Map	Not Available
8.	**Justification for taking up Reconnaissance Survey/ Regional Exploration**	1. Today most of the potash demand is met through bedded marine evaporite deposits such as sylvite, carnalite, kainite, polyhalite, surface and sub-surface potash-rich brines. India is fully dependable on import to meet the requirement of Potash. It is considered necessary to look for non-traditional source of potash such as glauconitic sandstone and potash rich shales. **Hence, potash recovery from glauconitic sandstone is essential.** 2. Glauconite comes in the category of critical minerals and Government of India is presently focusing and simultaneously carrying out the auctioning of potential Critical and Strategic Mineral blocks. So, the exploration of Glauconite prospects of the country is the need of the hour. 3. The present Reconnaissance survey in Ambara-Maru Block has been proposed in the SE of GSI's report titled "Detailed Investigation for Potash in Glauconite Bearing Shale and Sandstone around Guneri Village of Kachchh District, Gujarat. G-4 block (FSP 2014-15) for potash, where the glauconite bearing shale and sandstone of Katrol and Bhuj Formations of Kachchh basin is found to be present. 4. NGCM data suggests the presence of Glauconite in the proposed block. A total of 23 stream sediment samples of NGCM falls within the proposed block. Values of K2O is varying between 1.21% - 3.06%. Similar range of values is present in the adjacent north of the proposed block where GSI block for Glauconitic Sandstone is present. 5. Representative of MECL collected the 03 nos of samples from the block and the K2O values of the samples are 2.85%, 4.04% and 4.72% 6. Considering the consistency of glauconitic sandstone in the GSI block and sample analysis reports, the present exploration programme is planned to prove the continuity of the glauconitic sandstone in the SE extension part.

PROPOSAL FOR RECONNAISSANCE SURVEY (G-4 STAGE) FOR GLAUCONITE IN AMBARA-MARU BLOCK, DISTRICT- KACHCHH, GUJARAT

1. INTRODUCTION

1.1. Along with nitrogen and phosphorus, potassium is one of the most essential macronutrients and is required in agriculture in relatively large amounts for plant's healthy growth. After the growing recognition of potassium as one of the key nutrient in plant growth, subsequent development of potash industry was resulted. Reaching an estimated value of one million tonnes in 1921, production of potassium continues to increase consistently and reach to almost 34.6 million tonnes in 2013 (United State Geological Survey, 2013a, 2013b) expecting to raise 37.8 million tons in 2022 with the growth rate of about 2.9% annually (Rawashdeh et al., 2016).

1.2. Today most of the potash demand is met through bedded marine evaporite deposits such as sylvite, carnalite, kainite, polyhalite, surface and sub-surface potash-rich brines. These minerals are mixture of soluble salts, mainly potassium chloride or sulfates. More than 90% of these deposits are mainly concentrated in countries like Canada, Russia, Belarus, Brazil, China, Chile, Germany and USA (Anderson, 1985; The New York Times Editorial Board, 2013; Rawashdeh and Maxwell, 2014) on which rest of the world is dependent for supply of potash fertilizer.

1.3. In order to sustain crop production and to ensure self-sufficiency, exploration and investigation of alternative resource for potassium such as K-bearing silicates could be one of the options to meet the future demand (Manning, 2010; Manning, 2012; Ciceri et al., 2015).

1.4. In absence of mineable evaporite potash deposit in India, it was considered necessary to look for non-traditional source of potash such as glauconitic sandstone and potash rich shales. In many countries deficient in the conventional evaporite deposits insoluble potash used 'to be extracted out of silicate and non silicate minerals. Thus alunite in Bulla dealah in New castle, (Australia) containing 5% to 10%. K_2O was commercially exploited. Extraction of potassium from shales has also been discussed by Everest et al. (1964), similarly glauconite has been used in USSR as a source of potassium fertilizer's (GSI, CGPB report, 1978 p. 94).

1.5. Out of different non-conventional sources, glauconitic sandstones deposits are available in plenty and are considered as one of the indigenous resources for potassium in India. India has vast reserves of more than 3,000 million tonnes of glauconitic sandstone containing 4 to 8% K_2O occurring in States like Madhya Pradesh, Uttar Pradesh, Bihar. Chhattisgarh, Rajasthan and Gujrat (Kumar and Bakliwal, 2005).

2. BACKGROUND

2.1 Exploration for strategic, critical, precious, rare earth elements (REE), and platinum group elements (PGE) has been given top priority by the Government of India following the amendment of the MMDR Act, 2015, and its subsequent amendments up to 2023. Currently, the Government of India is conducting the auctioning of critical and strategic mineral blocks in various tranches, with MECL serving as the Nodal Agency.

From the 1st to the 4th tranche of critical mineral block auctions, a total of six glauconite blocks were offered on the auction platform, of which three were successfully auctioned. Considering that glauconite is categorized as a critical mineral, the present proposal has been prepared and is being submitted for a reconnaissance survey under NMET funding and execution.

3. LOCATION AND ACCESSABILITY

3.1 Ambara-Maru Block is located in Nakhatrana Taluka, Kachchh District, Gujarat, and falls under Survey of India toposheet numbers 41E/02 and 41E/03. The block is accessible from the district headquarters in Bhuj via Devpar, Nakhatrana, and Ugedi, through National Highway (NH)-754K. NH-754K connects directly to the block area.

Nakhatrana Tehsil is approximately 28 km from the block, while the district headquarters, Bhuj, is situated about 100 km to the southeast. The nearest railway station is Bhuj, located approximately 100 km southeast of the block. Bhuj railway station is classified as a Class-A station on the Western Railway network. The nearest airport to the block is Bhuj Airport, also located about 100 km southeast.

The corner points of the Ambara-Maru Block boundary are provided below:

Co-ordinates of Cardinal Point of Ambara-Maru Block (94.25 Sq Km) for Glauconite District: Kachchh, Gujarat

Cardinal Points	Northing (m)	Easting (m)	Latitude	Longitude
A	2608612.343	509227.1079	23°35'16.66"	69°05'25.56"
B	2608532.862	514060.4133	23°35'13.95"	69°08'16.09"
C	2604421.206	516028.891	23°33'00.19"	69°09'25.38"
D	2604402.679	519579.1981	23°32'59.44"	69°11'30.61"
E	2597163.564	519742.3847	23°29'04.03"	69°11'36.02"
F	2597388.087	511013.394	23°29'11.63"	69°06'28.29"
G	2600288.275	509508.0633	23°30'45.97"	69°05'35.28"

4. PHYSIOGRAPHY AND DRAINAGE

4.1. The block area exhibits gently undulating topography. The regional slope of the area is towards north and northeast. The highest elevation of the area is 146 m in the eastern part of the Block. The lowest elevation of the area is 49 m in the Northern part of the block.

4.2. The area is drained by Gajansagar stream tributaries. Drainage in the study area is dendritic and trellis pattern. Drainage in the study area is dendritic and trellis pattern.

5. CLIMATE

5.1. The climate is overall hot in the district. The season can be divided into three parts during the year

1. Hot and moist season from July to September.
2. Cool and dry season from October to February.
3. Hot and dry season from March to June.

5.2. Due to High Hills and Lack of Forest, the seasonal winds are not governed and the monsoon seasons last for a very short span only. In every ten years, Scarcity is faced for 2-3 years, 4-5 years are weak monsoon or semi-scarcity years, only 2-3 years are good monsoon years. There is almost no pre or post monsoon rains in the district. Average rainfall for the District During the year 2016, the maximum temperature recorded 45.60°C at Bhuj, whereas the minimum temperature recorded was 11.50 °C.

6. REGIONAL GEOLOGY

6.1. Regionally, proposed block falls in the Northern part of Kachchh Basin and lithostratigraphically forms part of Katrol Formation belonging to Late Jurassic - Early Cretaceous age. The Rann of Kachchh and Kachchh Peninsula covered an area of 45612 sq km in north western parts of our country. Physiographically, Kachchh is divided mainly into hill ranges, gently sloping peripheral coastal tracts and dissected coastal erosional plains, and younger deltaic plains, tidal flats, spits and marginal accretionary zones.

6.2. Kachchh, peri-cratonic rift basin of western India, represents a complete sequence of strata ranging in age from Middle Jurassic to Holocene (Fig.5.1). The Mesozoic and Cenozoic rocks of Kachchh are separated by a period of non-deposition, followed by diastrophism, erosion and volcanism, during the close of Cretaceous period. The Mesozoic rocks consist of marine sediments from Bathonian to Tithonian (Portlandian) and non-marine sediments in Cretaceous. These sediments were deposited in a sheltered gulf in sub littoral to deltaic environments in two major cycles: Middle Jurassic transgressive cycle and Late Jurassic-Early Cretaceous regressive cycle (Biswas, 1981). These sediments were laid down on a Precambrian granitic basement which is exposed only in the Nagar Parkar Hills in Pakistan.

The Mesozoic sediments were uplifted, folded, intruded and covered by the Late Cretaceous-Early Palaeocene Deccan trap. The terrestrial volcano-clastic sediments represent the Palaeocene sediments while the Early Eocene transgression and subsequent Tertiary deposits filled the peripheral lows bordering the Mesozoic highs as well as the lows between them.

6.3. The Mesozoic sediments of Kachchh are represented by Pachchham, Chari, Katrol and Umia Formations (after Krishnan, 1982). Krishnan (1982) classified the Mesozoic succession of Kachchh as presented in the below table-

Regional Stratigraphic sequence of Litho units (after Krishnan, 1982)

Age	Unit	Sub-division	Lithology
Post-Aptian	UMIA (1000 m)	Bhuj beds (Umia Plant beds)	Sandstone and shale
Aptian		Ukra beds	Marine calcareous shale
Upper Neocomial		Umia beds	Barren sandstone and shale
Valanginian		Trigonia beds	Barren sandstone
Upper Tithonian		Umia ammonite beds	Shale and sandstone
Middle Tithonian	KATROL (300 m)	Upper Katrol Shales	Shale
Middle Tithonian		Gajansar beds	Shale
Lower Tithonian		Upper Katrol (Barren)	Sandstone
Middle Kimmeridgian		Middle Katrol	Red sandstone
Upper Oxfordian		Lower Katrol	Sandstone, shale, marl
Oxfordian	CHARI (360 m)	Dhosa Oolite	Green and brownoolitic limestone
U. Callovian		Athleta beds	Marl and gypseous shale
Middle Callovian		Anceps beds	Limestone and marl
Middle Callovian		Rehmani beds	Yellow limestone
Lower Callovian	PATCHAM (300 m)	Macrocephalus beds	Shales with calcareous bands and golden oolites
Lower Callovian		Coral bed	Shale and limestone
Lower Callovian to Bathonian		Patcham shell limestone Patcham basal beds (Kuar Bet beds)	Limestone, shale and marl

7. GEOLOGY OF THE STUDY AREA

7.1. The proposed block area consists of Cretaceous age to Jurassic age lithounits of Katrol and Bhuj Formations. Early Cretaceous age of Bhuj formation consists of Feldspathic Sandstone and Grit. Lithounits of Bhuj formation is exposed in the southern part of the block area.

7.2. Late Jurassic - Early Cretaceous age, Katrol formation covers maximum part of the study area and is characterised by the presence of Sandstone, Shale with Trigonia Fossils, Glauconitic Sand Stone, Oolitic Limestone, Conglomerate, Shale with Plant Fossils.

7.3. Regional strike of the bedding plane is NW-SE. Rock beds are horizontal to gently dipping (5^0 to 20^0) with general dip towards SW and exhibit gradational contact. The tentative stratigraphic sequence of litho units exposed in the Block area (After GSI) is given in below Table.

Stratigraphic sequence of the Ambara-Maru Block for Glauconite
District: Kachchh, Gujarat
(After GSI)

Age	Formation	Lithology
Early Cretaceous	Bhuj	Feldspathic Sandstone and Grit
Late Jurassic - Early Cretaceous	Katrol	Sandstone, Shale With Trigonia Fossils
		Glauconitic Sst Oolitic Lst. Shale, Conglomarate
		Sandstone, Shale With Plant Fossils

8. PREVIOUS WORK

8.1. Eminent workers of Geological Survey of India carried out diverse nature of studies in the area which are listed below.

8.2. Z.G.Ghevariya, carried out works and prepared a report on investigation for bentonite deposits in Kutch district Gujarat during FS 1978-80 in the Toposheet Nos- 41 R10, 11, 14 & 15.

8.3. Kulkarni and Desikan (1965-66), Kulkarni and Agarwal (1963-64), Vijaya Sarthi and Sable (1984-85), Ghevariya (1980-81) and Ghevariya and Srikarni (1990-91) have reported about the occurrence of glauconite from the Mesozoic and Tertiary rocks of Kachchh.

8.4. Jain, RL (1994-95) carried out investigation of 100 sq km area on 1:25,000 scale for potash in glauconite bearing shale and sandstone in Kachchh district, Gujarat and estimated 0.02 million tonnes reserve of glauconite with 5.33% K2O on the basis of a glauconite bearing band having cumulative thickness of 1.5m up to a depth of 2m and strike continuity of 3 to 4km.

8.5. Sarkar and Banerjee (2011) pointed out an authigenic origin of the glauconite of Naredi Formation. K-Ar dating of glauconite of Ukra member was carried out by Rathore, SS et.al (Proceedings of Indian academy of sciences, No.1, March 1999, pages 49 to 55) and 4 samples shows an age of 105.2± 1.3 Ma.

8.6. Ajaya Kumar Sahu, Dhananjai Verma, et al. carried out the Reconnaissance survey for lateritic bauxite and lithomargic clay around Umarsar and Guneri areas (Toposheet nos- 41A/13), Western Kachchh, Gujarat (G4) during FS 2016-17 and estimated the total reconnaissance mineral resource of bauxite at 30% Al2O3 cut-off grade is 3042417 tonnes (3.04 MT) with average grade 38.40% Al2O3 and average of 18.42% SiO2. The total reconnaissance mineral resource for lithomargic clay is 101840.92 tonnes with average grade of 36.62 % Al2O3. 2 nos of glauconite samples (LB/2016-17/K1) and analysed K2O ranging from 5.07% to 7.27% in the explored block.

8.7. Basheer, H. K. and Kumar, A, (2014-15), carried out the detailed investigation for potash in glauconite bearing shale & sandstone around Guneri village of Kachchh district, Gujarat during FS 2014-15 and estimated a total of 852.84 metric tons of glauconite is estimated in the study area with K2O ranging from < 2%. A total of 1244.002 metric tons of glauconite is estimated in the study area with K2O ranging from 2 to 4%. A total of 3339.195 metric tons of glauconite is estimated in the study area with > 4% K2O. Based on the exploration results, block is in auction platform.

8.8. The present Reconnaissance survey in Ambara-Maru Block for Glauconite has been proposed in the SE extension of GSI's explored Guneri Block (FSP 2014-15) for Glauconite, where the Glauconite bearing sandstone and shale of Katrol formation is found to be present. As per the GSI findings, Bhuj Formation consists of Ferruginous sandstone, glauconitic sandstone (Hard and compact, intercalated and sandy to clayey) and feldspathic sandstone. It suggests that the area is very much suitable for the exploration of fertilizer minerals.

8.9. NGCM INVESTIGATIONS

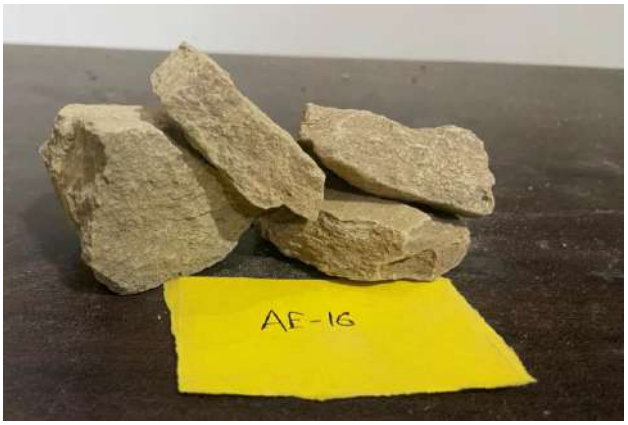
8.9.1. Geological Survey of India under National Geochemical Mapping program systematic stream sediment sampling was carried out in the study area in 2 km X 2 km interval in grid pattern.

8.9.2. NGCM data suggests the presence of Glauconite in the proposed block. A total of 23 stream sediment samples of NGCM falls within the proposed block. Values of K2O is varying between 1.21% - 3.06%. Similar range of values is present in the adjacent north of the proposed block where GSI block for Glauconitic Sandstone is present.

8.10 FIELD VALIDATION

8.10.1 Representative of MECL collected the 03 nos of samples from the block and the K2O values along-with the location of the samples are below mentioned-

Sample ID	Lat	Long	K_2O%	Lithological Description
AE-05	23.545676°	69.105942°	4.04	Greenish to Light Yellow Coloured Clayey Glauconite
AE-06	23.544980°	69.106206°	4.72	Grey to Greenish Coloured Sandy Glauconite.
AE-16	23.553812°	69.132796°	2.85	Brownish coloured Clayey Glauconite



9. PROPOSED SCHEME OF EXPLORATION

9.1. **Geological mapping:** Geological & structural mapping on 1:12,500 scale will be carried out in the proposed block for demarcation of Glauconite bearing horizons with the structural features to identify the surface manifestations and lateral and vertical disposition of the mineralized zones.

9.2. **Survey:** DGPS survey will be done for determining co-ordinate and reduced level (RL) of all the borehole locations.

9.3. **Surface Geochemical sampling (Bed Rock/Channel/Chip Sample):** During the course of Geochemical Sampling, around 285 nos. of bed rock /Channel/Chip samples shall be collected from the suitable surface locale. A total of 285 nos. of primary and 29 nos. of external check surface samples will be analysed for 8 radicals (K_2O, SiO_2, MgO, CaO, Na_2O, P_2O5, Al_2O_3 & Fe_2O_3). 10% of Primary samples (29 Nos) will be sent to NABL External Labs as External Check Samples.

9.4. **Exploratory Mining (Trenching/Pitting):** Trenching (Excavation) shall be carried out in the potential zones identified based on the results of geological mapping and geochemical sampling. A provision of trenching/pitting of 250 cubic meter has been planned. Trenching work will be carried out by excavating trenches of 1m width and up to 2m depth in the area to expose the source rock and mineralization. Locations of pits/trenches on ground will be decided by field geologist based on field observations. Trenches will be geologically mapped thoroughly by the field geologist. Around 125 nos. of trench/pit samples shall be collected. A total of 125 no of primary and 13 no of external check trench samples will be analysed for 8 radicals (K_2O, SiO_2, MgO, CaO, Na_2O, P_2O5, Al_2O_3 & Fe_2O_3). 10% of Primary samples will be sent to NABL External Labs as External Check Samples.

9.5. **Drilling:** If phase-I exploration data will give anomalous values, 20 Nos. boreholes on 1600m grid spacing will be drilled. The boreholes will be planned judicially after the completion of phase-I exploration and will be presented for review before the TCC for final approval.

9.6. **Drill core logging:** Geological core logging will be carried out systematically by recording carefully the minute details and physical/lithological characters of the rock formations including colour, core recovery, grain size, weathered zone, texture, banding, mineralogical composition, micro-structural/structural details, lithological variations along with visual estimate in respect of Potash content encountered in boreholes. As per the requirement the

Rock quality designation (RQD) shall also be carried out, while logging drill cores. On the basis of these parameters, grade of glauconite can be broadly assessed and it will also be helpful in sampling/demarcating the mineralised zones.

9.7. **Drill core sampling:** For preparation of samples, the borehole core will be splitted into two equal halves by using core splitter. One half will be powdered to 100 mesh size and the other half will be kept for future studies. The powdered material will be mixed thoroughly and about 100 gram of samples will be taken for chemical analysis by successive coning and quartering as primary samples and rest of the material (-100 mesh size) will be kept as duplicate half for future reference. It will generate about 400 Nos of **primary samples** and 40 Nos of **External Check samples** (10% of Primary samples). External Check samples will be sent to NABL Lab for analysis. **Composite samples** will be prepared borehole wise based on the analytical results of primary sample at every 8m interval (8m bench height). Composite samples shall be prepared from the entire borehole in which glauconite bearing horizon bands will be intersected. This will generate about 50 nos. of composite samples. Each sample should be marked at every 1m length in case of continuance of similar mineralogical composition down the borehole. The sample length towards the floor marked by non-ore zone needs also to be adjusted as per variations of the litho-units. Even if the floor is distinctly differentiated by the presence of non-mineralized zone, at least two nos. samples after the Glauconite zone need to be drawn to mark the floor of the Glauconite zone decisively.

9.8. **Chemical Analysis:** All the primary samples and 10% of the Primary samples as External check samples will be analyzed for 8 radicals (K_2O, SiO_2, MgO, CaO, Na_2O, P_2O5, Al_2O_3 & Fe_2O_3). About 10% of primary samples will be sent to NABL external laboratory as External check samples for analysis of 8 radicals (K_2O, SiO_2, MgO, CaO, Na_2O, P_2O5, Al_2O_3 & Fe_2O_3).

9.9. **Petrological and Mineragraphic Studies:** Thin and polished section studies on drill cores samples would be done for ascertaining the petrographic and mineragraphic characteristics. These samples would be drawn from ore zones and host rocks. A provision of 10 specimens for petrographic and 10 specimens for mineragraphic studies has been proposed in the block.

9.10. **XRD Study:** To know the different mineral phases, for recovery of potash, XRD study will be performed in 5 samples of glauconitic sandstone.

9.11. **Determination of Bulk density:** To calculate the resource, volume of the ore body need to be multiplied with a density factor. Hence, 5 nos. of samples will be drawn from the glauconitic sandstone for determination of Bulk density.

10. QUANTUM OF WORK

10.1 The following quantum of work have been proposed for Reconnaissance Survey (G-4 stage) for glauconite bearing formations in Ambara-Maru Block:

Sl. No.	Item of Work	Unit	Target
1	Geological Mapping (1:12500 scale)	Sq. Km	94.25
2	Surface Geochemical sampling (Bed Rock/Channel/Chip Sample)	Nos.	285
3	Exploratory Mining (Trenching/Pitting)	Cu M.	250
4	DGPS Survey for Borehole fixation	Nos	20
5	Drilling (Core)	m.	800
6	Sample Preparation & Chemical Analysis		
A.	Surface samples (Bedrock/Channel/Chip/Pit/BH Samples)		
	i) Primary samples for 8 radicals (K_2O, SiO_2, MgO, CaO, Na_2O, P_2O5, Al_2O_3 & Fe_2O_3)	Nos.	1010 (285 + 125+ 600) (Surface+Trench+BH)
	ii) 10% External check samples for 8 radicals (K_2O, SiO_2, MgO, CaO, Na_2O, P_2O5, Al_2O_3 & Fe_2O_3)	Nos.	101
	iii) Trace Element (34 element)	Nos.	101
7	Petrological Studies (10 samples)	Nos	10
8	Mineragraphic Studies (10 samples)	Nos	10
9	XRD Study	Nos.	5
10	Determination of Bulk Density	Nos.	5
11	Geological Report preparation	Nos.	1

11. TIME SCHEDULE AND ESTIMATED COST

11.1. The proposed exploration programme envisages geological mapping, Surface sampling, Trenching, core drilling, sample preparation and laboratory studies, which will be completed within 12 months, geological report preparation and peer review.

Therefore, a total of 12 months is planned for completion of the entire proposed programme.

Timeline Reconnaissance survey (G4) in Ambara-Maru Block for Glauconite, District: Kachchh, Gujarat [Block area- 94.25 sq. km; Schedule timeline- 12 months]															
S. No.	Particulars	Months/ Days	1	2	3	4	5		6	7	8	9	10	11	12
1	Camp Setting	months													
2	Geological Mapping	months													
3	Survey days	days													
4	Trenching/Pitting	cu.m													
5	Drilling (1 rig)	m													
6	Geologist days	days													
7	Sampling days	days													
8	Camp winding	months													
9	Laboratory Studies	months													
10	Geologist days, HQ	days													
11	Report Writing with Peer Review	months													

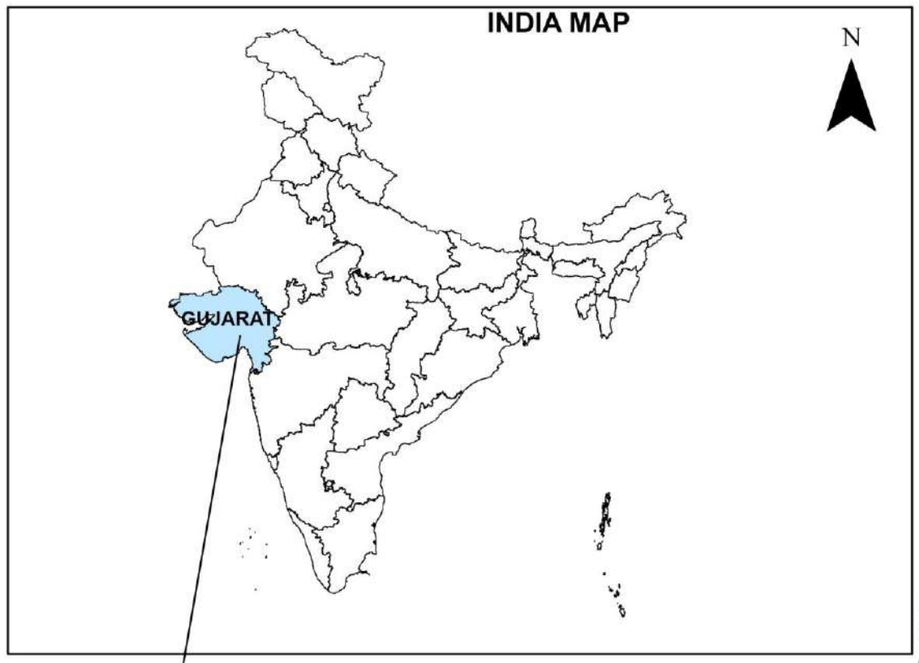
11.2. Cost has been estimated based on actual schedule of rates mandated in the circular OM No. 61/1/2018/NMET dated 31st March 2020 for NMET funded Projects. The total estimated cost is Rs. 228.49 Lakhs. The summary of cost estimates for this reconnaissance survey (G4) is given below:

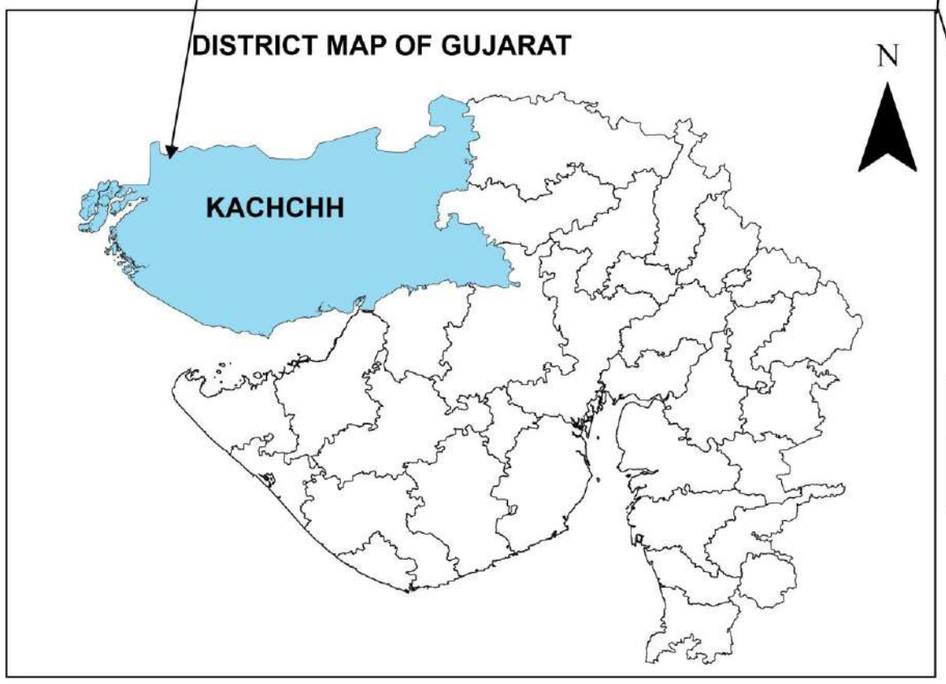
Sl. No.	Item	Total
1	Geological Work	32,54,085
2	Pitting & Trenching	8,32,500
3	Drilling	84,28,400
4	Laboratory Studies	55,53,381
	Sub total	**1,80,68,366**
5	Report	9,03,418
6	Peer Review	30,000
7	Proposal Prepration	3,61,367.32
	Total	**1,93,63,152**
8	GST (18%)	34,85,367.29
Total cost including 18% GST		**2,28,48,519**
SAY, in Lakhs		**228.49**

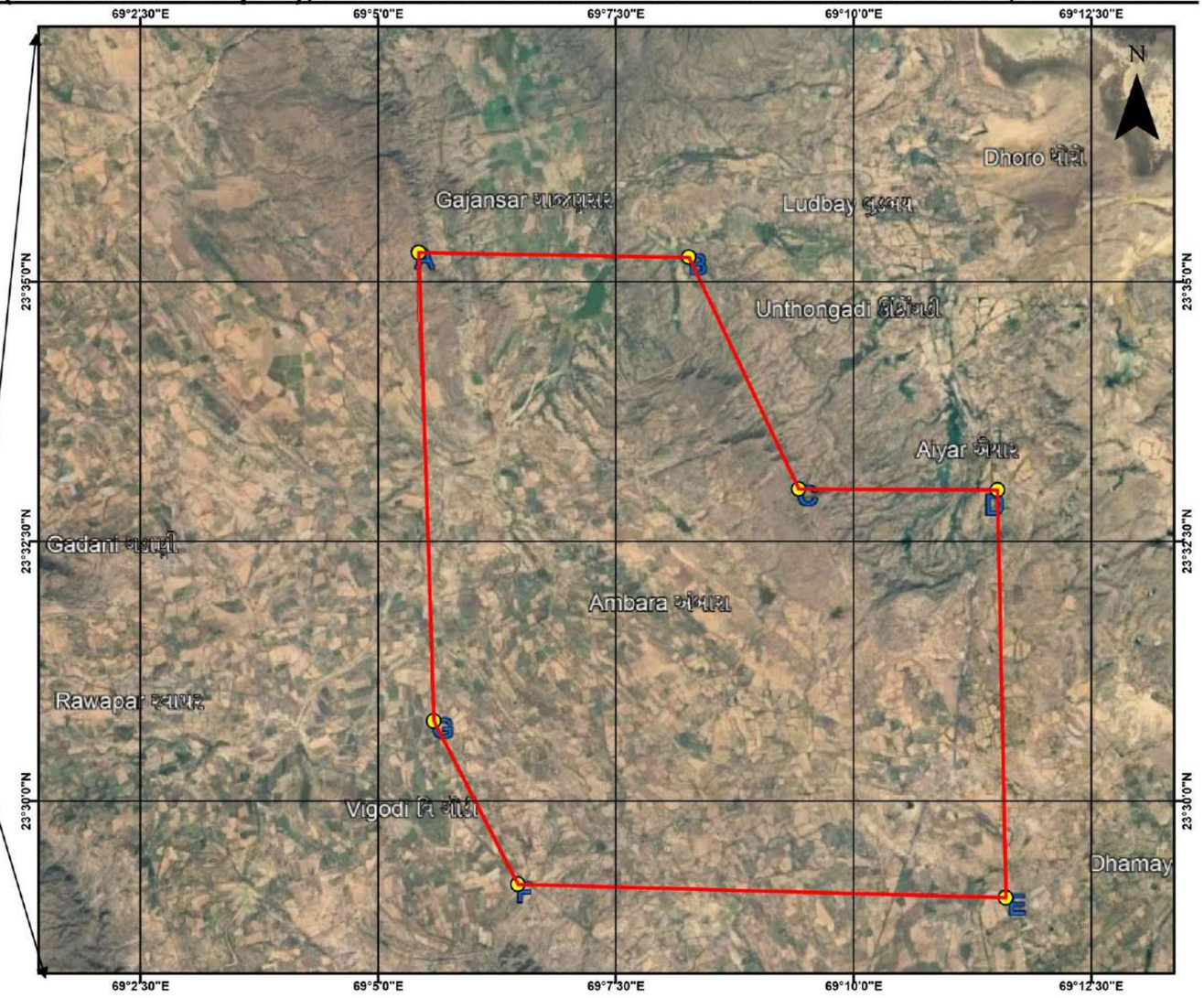
List of Plates:

1. Plate-I: Location Map of the Proposed Ambara-Maru Block, Nakhatrana Taluka, Kachchh District, Gujarat
2. Plate-II: Geological Map with Proposed Ambara-Maru Block, Nakhatrana Taluka, Kachchh District, Gujarat.
3. Plate-III: K2O Anomaly Map with Proposed Ambara-Maru Block, Nakhatrana Taluka, Kachchh District, Gujarat.

LOCATION MAP OF PROPOSED AMBARA MARU BLOCK (AREA:94.25 Sqkm),TEHSIL: NAKHATRANA DISTRICT:KACHCHH, GUJARAT







NOT TO SCALE

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- Ambara Maru Block_Boundary
- Cardinal Points of Ambara Maru Block Boundary

Cardinal Points	Northing (m)	Easting (m)	Latitude	Longitude
A	2608612.343	509227.1079	23°35'16.66"	69°05'25.56"
B	2608532.862	514060.4133	23°35'13.95"	69°08'16.09"
C	2604421.206	516028.891	23°33'00.19"	69°09'25.38"
D	2604402.679	519579.1981	23°32'59.44"	69°11'30.61"
E	2597163.564	519742.3847	23°29'04.03"	69°11'36.02"
F	2597388.087	511013.394	23°29'11.63"	69°06'28.29"
G	2600288.275	509508.0633	23°30'45.97"	69°05'35.28"

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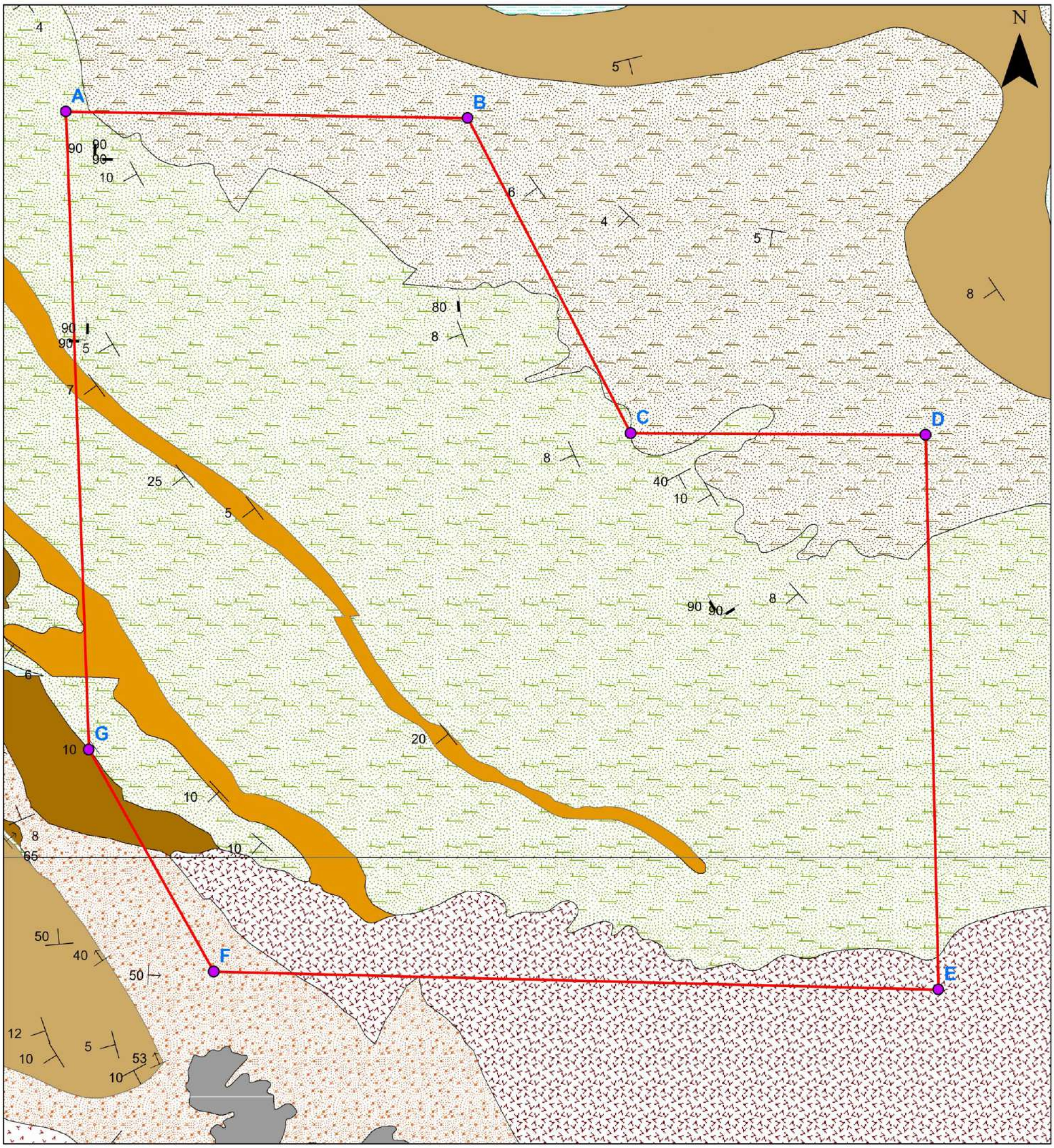
GEOLOGICAL MAP OF AMBARA MARU BLOCK (PART OF TOPOSHEET NO: (41E/02 & 41E/03), AREA ; 94.25 Sq.km, DISTRICT: KACHCHH, GUJARAT



Source:(NGDR Portal, Part of Toposheet 41E/02 & 41E/03, Kachchh district, Gujarat)

1:50,000
0 0.4750.95 1.9 2.85 3.8 Kilometers

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- Cardinal Points of Ambara Maru Block
- Ambara Maru Block Boundary
- BEDDING
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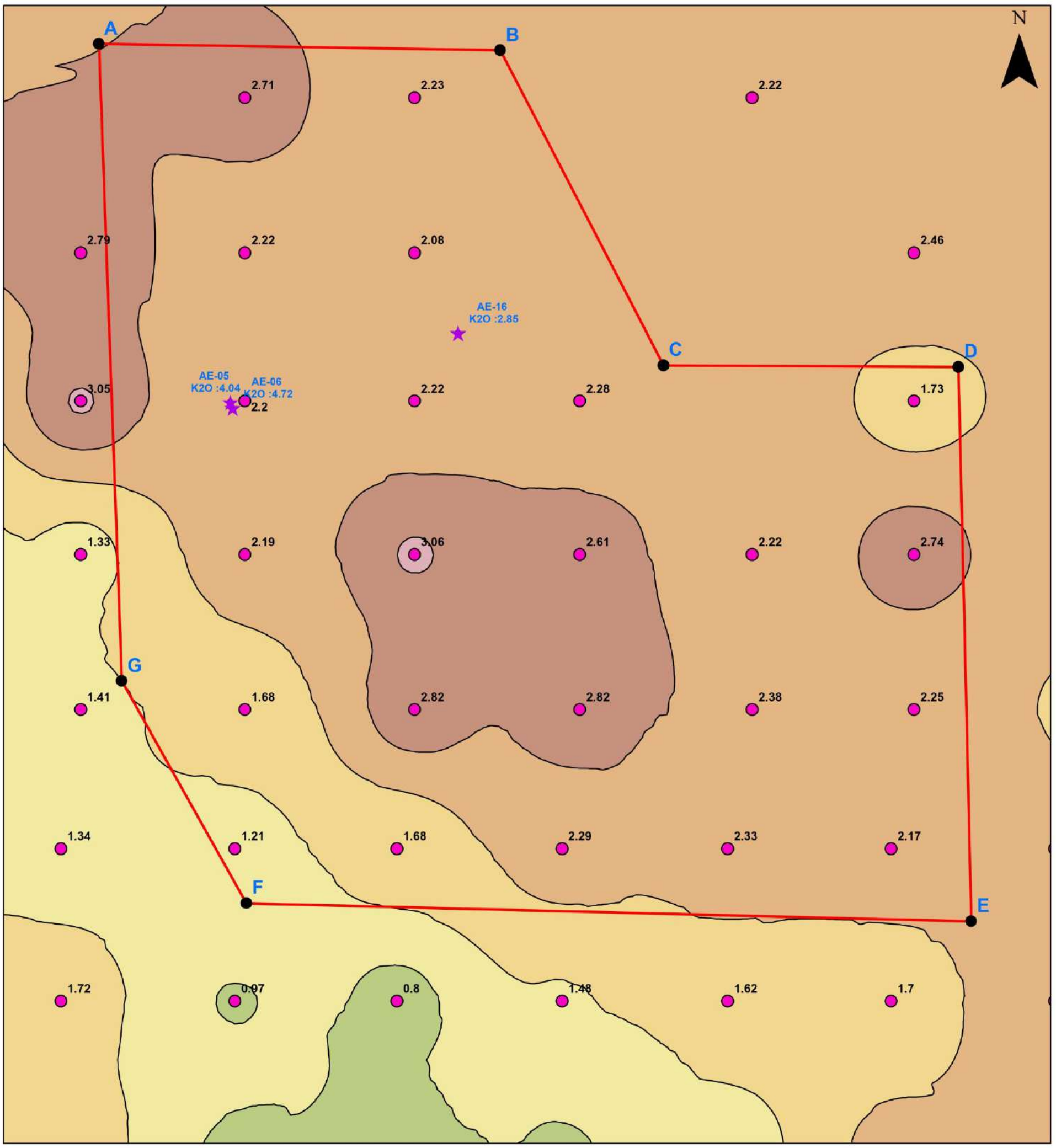
- AMYGDULAR BASALT
- FELDSPATHIC SANDSTONE AND GRIT
- FELDSPATHIC SANDSTONE, SHALE WITH AMMONITE FOSSILS
- FERRUGINOUS SANDSTONE AND GRIT
- FOSSILIFEROUS SHALE WITH INTERCALATED LIMESTONE
- GLAUCONITIC SST OOLITIC LST. SHALE, CONGLOMARATE
- SANDSTONE, SHALE WITH PLANT FOSSILS
- SANDSTONE, SHALE WITH TRIGONIA FOSSILS
- SANDSTONE, SHALE, CLAY, CONGLOMERATE
- SHALE WITH CALCAREOUS SANDSTONE

ANOMALY MAP FOR K2O% IN PROPOSED AMBARA MARU BLOCK (PART OF TOPOSHEET NO: (41E/02 & 41E/03), AREA ; 94.25 Sq.km, DISTRICT: KACHCHH, GUJARAT



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- Cardinal Points of Ambara Maru Block
- Ambara Maru Block Boundary
- Sample location Point along with K2O%
- Stream Sediments sample Location with K2O% value
- Contour of K2O%

Elemental Distribution of K2O%

- 0.310615063 - 0.5
- 0.5 - 1
- 1.000000001 - 1.5
- 1.500000001 - 2
- 2.000000001 - 2.5
- 2.500000001 - 3
- 3.000000001 - 3.5
- 3.500000001 - 4

1:50,000

0 0.4750.95 1.9 2.85 3.8 Kilometers

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