Preliminary Exploration (G3) for the assessment of Aluminous Laterite / Bauxite and Gallium in Sandhan Block, Kachchh District, Gujarat

by

Geo Marine Solutions Pvt. Ltd., Mangalore

15-17-909/9, Leslie Haven, 5th Cross, Shivabagh

Mangalore-575005, Karnataka

November 2024

Preliminary Exploration (G3) for the assessment of Aluminous Laterite / Bauxite, and Gallium in Sandhan Bauxite Block, Kachchh District, Gujarat

By

Geo Marine Solutions Pvt. Ltd., Mangalore

15-17-909/9, Leslie Haven, 5th Cross, Shivabagh

Mangalore-575005, Karnataka

Mangalore

12 Nov 2024

Summary of the Proposal for UNFC G3 Level prospecting for Bauxite and Gallium in Sandhan Bauxite Block, Kachchh District, Gujarat.

	Features	**Details**
	Block ID	GUJ-Al-Ga-2
	Current Exploration Agency	Geo Marine Solutions Pvt. Ltd., Mangalore for Preliminary Mineral exploration G3 level
	Previous Exploration Agency	CGM, Gujarat
	G4 stage Geological Report	Based on the document published by Commissioner of Geology and Mining, Gujarat: "Gujarat's Mineral Wealth: A Responsible Exploration and Development Paradigm"
	Commodity	Bauxite and Gallium
	Mineral Belt	Bauxite and Gallium in weathered zone in Sandhan Bauxite Block, Kachchh District, Gujarat
	Completion Period with entire Time schedule to complete the project	**Mobilization:** two months from issue of work order/LOA. **Field work :** 8 months **Analysis :** 6 months (overlapping with Drilling) **Report :** 3 months
	Objectives	To understand the surficial distribution and downward continuity of Gallium - bearing Bauxite by drilling at 400m x 400m grid over an area of 9.85 sq.km, where there is a thick laterite /bauxite up to 10m below ground level.
	Whether the work will be carriedout by the proposed agency or through outsourcing and details thereof.	The NABET accredited exploration agency (Geo Marine Solutions Pvt Ltd., Mangalore) will be carrying out all the components of the proposed exploration. The chemical analysis will be done at NABL accredited lab.
	Name/Number of Geoscientists	2 Geologists plus 1 Surveyor plus 1 driller
	Expected Field Months (Geology)	8 months including mapping and drilling

1.	**Location**	Sandhan, Vanthali, Gujarat.
	Latitude	23°11'33.65"N
	Longitude	69°11'0.92"E
	Villages	Sandhan
	Tehsil/Taluk	Vanthali Taluk
	District	Kachchh District
	State	Gujarat.
2.	**Area (hectares/square kilometers)**	
	Block Area	9.85 Sq.km
	Forest Area	NIL
	Government Land Area	NIL
	Private Land Area	9.85 Sq.km
3.	**Accessibility**	
	Nearest Rail Head	Kothara Railway Station (8.3 Km)
	Road	Vinjhan-Sandhan Road
	Airport	Bhuj Airport (71.48 km)
4.	**Hydrology**	
	Local Surface Drainage Pattern (Channels)	Kanakavati river flows through the eastern side of the sandhan block
	Rivers/Streams	Kanakavati river.
5.	**Climate**	

	Mean Annual Rainfall	1257 mm in Kachchh District.
	Temperatures (December)(Minimum) Temperatures (June)(Maximum)	Min. temp. is 15.2°C and max. 27.7°C
6.	**Topography**	
	Toposheet Number	Toposheet No. 41E/04 & 41A/16
	Morphology of the area	The Kachchh district, forming the western most portion of the Indian sub-continent is situated between Gulf of Kachchh in south and Kori creek and vast stretches of Great Rann and Pakistan in North while to the east lies the little Rann and towards west Arabian sea. In Kachchh three district land forms can be readily identified viz. i) plains, ii) undulating landscape and iii) hills. Great and Little Rann, situated in the northern and eastern parts; the coastal plain in the south and south west from prominent plains while the plain of great and little Rann containing salt encrustations forms waste land, coastal plain supports, good vegetation. The area covered between northern and central hilly tracts of mainland presents on undulating landscape. Since the central part of Kachchh forms an up land are it gives rise to many important rivers like Rukmavati, Kankavati, Khari, Kharad, Makhadawali, Chari etc., which are ephemeral in nature and flow towards south or South West and confluence Gulf of Kachchh or Kori creek.

7	**Availability of baseline geoscience data**	
	Geological Map (1:50K/25K)	The proposal is based on the published literature mentioned in the reference. Geological inputs pertaining to the area falling in 41E/04 and 41A/16 are available and referred while preparing the write up.
	Geochemical Map	Geochemical inputs in soil regolith pertaining to the area falling in 41E/04 and 41A/16 are available and referred while preparing the write up.
	Geophysical Map (Aero-geophysical, Ground geophysical, Regional as well as local scale GP maps)	**N.A.**

8.	**Justification for taking up G3 level Mineral Exploration** Based on the Document released by Commissioner of Geology and Mining: "Gujarat's Mineral Wealth: A Responsible Exploration and Development Paradigm", published on 17 August 2024. Based on the report : Geology of parts of Abdasa, Nakhatrana and Mandvi Taluks, Kutchchh District, Gujarat state" by Kulkarni et al. (1964-65) NOC issued by CGM Gujarat to Geo Marine Solutions Private Limited for taking up the G3 level exploration in Sandhan Block Based on the paper titled "Chowdhury, A.N., Chakraborty, S.C., and Bose, B.B., 1965, Geochemistry of gallium in bauxite from India: Economic Geology, v. 60, p. 1052–1058". Based on the paper titled "Hui Qi, Neng Gong, ShengQiang Zhang, Jun Li, Guo-Li Yuan, Xue-Fei Liu (2023) Research progress on the enrichment of Gallium in Bauxite. Ore Geology reviews, ELSEVIER,Vol 160,Sept 2023, 105609". Based on the paper titled "Hua, Y., Zhang, Ta., Wang, L. (2024). A Review of the Extraction of Gallium from Bauxite Ores. In: Iloeje, C., et al. Energy Technology 2024. TMS 2024. The Minerals, Metals & Materials Series. Springer, Cham". A reconnaissance field work was conducted in Sandhan Block by Geo Marine Solutions Pvt Ltd in 30-31 October 2024. It can be seen from the map that the Clay and Marl of Sandhan Formation and Limestone of Miliolite Formation are present in the block area. The two formations have scanty or no outcrops except for few exposures near the river flowing in the eastern part of the block. The aluminous laterites of Matanomadh Formation is expected to continue below the Eocene carbonates Formations within the block area. Two grab samples were collected from the area turned out to be dolomitic limestone and Marl. It is pointed out that the NGCM (GSI) data for Soil Regolith near Sandhan (TS 41 E/04) shows Al2O3 value of 11-12 % Gallium value of 11-17 ppm.

Detailed description on the following titles to be made in the proposal.

1. Block Summary:

Physiography: Physiography of the state of Gujarat comprises three distinct zones; Alluvial plains, Coastal plain and Desert areas. This area is part of the Rann of Kutch, a salt marsh known for its distinctive landscape and seasonal salt flats. The region is primarily flat, with some elevated areas, and it experiences a semi-arid climate. The nearby Kutch desert contributes to its arid conditions, while the surrounding hills provide a contrast to the flat terrain.

Background Information:

CGM Gujarat explored this area by means of pitting, trenching, and drilling and the estimated resource for the region is 27.85 m.t. Chemical analysis data of the bauxite shows high Al2O3 (average 52.05%) with low SiO2 percentage (average 4.33%). The satellite imagery analysis of the area shows laterite/bauxite. Hence CGM Gujarat recommended Sandhan Bauxite block for G3 level of exploration.

A reconnaissance field work was conducted in Sandhan Block by Geo Marine Solutions Pvt Ltd in October 2024. It can be seen from the map that the Clay and Marl of Sandhan Formation and Limestone of Miliolite Formation are present in the block area. The two formations have scanty or no outcrops except for few exposures near the river flowing in the eastern part of the block. The aluminous laterites of Matanomadh Formation is expected to continue below the Eocene carbonates Formations within the block area. Two grab samples were collected from the area turned out to be dolomitic limestone and Marl.

It is also pointed out that the NGCM (GSI) data for Soil Regolith near Sandhan (TS 41 E/04) shows Al2O3 value of 11-12 % Gallium value of 11-17 ppm. Gallium has high strategic significance today, due to its requirement in semi-conductor chips used in electronic industry. Currently, Gallium is produced as a byproduct from Bauxite ore processing.

It is pertinent that the entire global supply chain of Gallium monopolized by China, which controls 96% of the global supply chain of Gallium. Due to its immense application in Semiconductors, LEDs, Photo-voltaics and medical imaging technologies, the projected global annual growth rate of Gallium market from 2024 to 2030 is pegged at 24.8%. Given this scenario, presently, 30 ppm of Gallium is considered as a recoverable quantity in laterite/ bauxite.

Background Geology (regional and geology of the block):

The geology of the area comprises of Sandhan Formation and Deccan trap. The bauxites were formed by the alteration of the pyroclastic facies of the Deccan lava flows. About two km west-northwest of the town of Lifri, a few minor laterite humps are seen. The laterite is light grey in color and forms a thin crust capping the pseudo-brecciated rocks and agglomerates. Thin sections of different varieties of bauxite when examined under the microscope reveal to be composed mainly of gibbsite with minor amounts of limonite, leucoxene, and rarely quartz and calcite. The entire sandhan block is soil covered except the river section which shows miliolituic limestone sections.

Mineral potentiality within the proposed block based on geology:

In GSI report titled "G*eology of parts of Abdasa, Nakhatrana and Mandvi Taluks, Kutchchh District, Gujarat state" by Kulkarni et al. (1964-65)* reported that the bauxite occurs in the form of pockets, capping the laterites of Supra-Trappean group. In situ lateritization and bauxitzation of Deccan Traps and associated pyroclastic materials have resulted in the formation of bauxite. Also, there are reworked bauxites which cap the in-situ bauxites. In the field, bauxite forms shinning fawn grey boulders which can be recognised very easily. Near Balachod, Sandhan and Nandra, extensive areas are strewn over with bauxite boulders. Shri Y.S. Sahasrabudhe has dealt with Kutch bauxites in some detail and conclude that Balachod Nana, Sandhan, Nangrecha, Nandra and Kotad-Jarjok deposits will give 97,000, 9,00,000, 3,70,000, 77,500 and 3,20,000 metric tons respectively of bauxite.

CGM, Gujarat explored this area by means of pitting, trenching, and drilling and the estimated resource for the region is 27.85 MT. Chemical analysis data of the bauxite shows high Al2O3 (average 52.05%) with low SiO2 percentage (average 4.33%). The satellite imagery analysis of the area shows laterite/bauxite.

Scope for proposed exploration:

The proposed work for G3 Exploration comprises detailed topographic and geologic mapping in 1: 4000 scale and drilling within the Sandhan Bauxite Block (about 10 m depth for each borehole) over an area of 9.85 sq km at 400 by 400m grid as per the MEMC guidelines for G3 level. 20 numbers of Pitting /trenching in the area is proposed and the locations shall be selected based on the drill core samples and geology observed in the drill core.

Recommendations of G4 Stage Mineral Prospecting Report: The available information in the GSI literature and the related published literature suggest to carry out exploratory and drilling to prove the quality and quantity in these area.

Objectives: The proposed G3 level mineral prospecting is planned for carrying out exploration of Aluminous Laterite / Bauxite with significant values of Ga extending below the Eocene carbonate rock formations.

2. Previous Work:

The document titled “Gujarat's Mineral Wealth: A Responsible Exploration and Development Paradigm,” published by the Commissioner of Geology and Mining, Gujarat, on August 17, 2024, mentions the exploration activities carried out by the CGM in this region. Samples are recovered through pitting, trenching, and drilling, and the estimated bauxite resource is 27.85 million tons in the entire region.

Chemical analysis of the bauxite indicates a high average aluminium oxide (Al2O3) content of 52.05%, accompanied by a low silicon dioxide (SiO2) percentage of 4.33%. Furthermore, satellite imagery analysis confirms the presence of laterite and bauxite in the region. Based on these findings, a G3 level of exploration is recommended to further assess and develop the bauxite resources.

3. a. Block description (Sandhan Block): Boundary Coordinates of Sandhan Block are given below.

Table-1. Boundary coordinates of Sandhan block, Karnataka

Sl no.	Longitude	Latitude
1	68.97707	23.02129
2	68.95949	23.04508
3	68.97053	23.05513
4	68.99324	23.0404
5	69.02032	23.03409

b. Coordinates of Proposed Pit /Trench and Borehole Locations: Geographical coordinates of the proposed pit/trench and borehole locations are given in the Annexure-1.

4. Planned Methodology:

a. **Geological and geomorphological Mapping in 1:4000 scale**: Reference points will be established within the mapping area by level transferring of SoI (Survey of India) benchmark point. The total area of 9.85 sq km will be mapped on 1:4000 scale using DGPS survey method to bring out different geological and geomorphological units

b. All the mapped units will be linked (geo-referenced) to the toposheet (41 E/04 & 41 A/16) pertaining to the area.

c. **Core Drilling for Sub surface mineral content**: the collection of sub-samples at 1.0 m interval in 63 borehole locations at 400 by 400m grid pattern within the area having laterite capping.

d. **Piiting and trenching**: 20 numbers of pits are proposed upto 2.0m below ground level. The pit location shall be selected based on the geology and mineralization in the area observed in the drill cores. Pitting shall be conducted concomitant to the drilling .

5. Feasibility Studies:

a. **Geology:** Geological mapping on 1:4000 scale and 63 borehole locations up to 10m depth at 400mx400m grid size in laterite capping areas and 20 number of pits will bring out the mineral potential of the area.

6. Nature, Quantum, and Target:

a. Mapping in 1:4,000 scale incorporating all geomorphological units, manmade structures, streams etc. falling within and around the area. (Total area of 9.85 sq km.)

Table 3: Nature, Quantum, and Targets

Sl. No.	Description of Work	Quantum (SqKm/ Number)	Time required
1			
	Geological & Geomorphological mapping in 1: 4000 scale with DGPS Survey (Total 9.85 sq km)	9.85 sq km	150 days
2	Pitting : 20 numbers	20 pits (upto 2 m depth)	
2	Bore hole up to 10m depth	63 BH	75days
3	XRF, ICP-MS analysis petrography	230 nos	180 days
4	Report Writing		90 days

7. Break-up of expenditure and Time schedule:

Attached as separate sheet: Attached as Excel

References:

1. *G.R. Kulkarni and G. Thothathiri, geology of parts of Abdasa, Nakhatrana and Mandvi Taluks, Kutchchh District, Gujarat state.*
2. *Document released by Commissioner of Geology and Mining: Gujarat's Mineral Wealth: A Responsible Exploration and Development Paradigm, published on 17 August 2024.*
3. *Chowdhury, A.N., Chakraborty, S.C., and Bose, B.B., 1965, Geochemistry of gallium in bauxite from India: Economic Geology, v. 60, p. 1052–1058.*
4. *Hui Qi, Neng Gong, ShengQiang Zhang, Jun Li, Guo-Li Yuan, Xue-Fei Liu(2023) Research progress on the enrichment of Gallium in Bauxite. Ore Geology reviews, ELSEVIER,Vol 160,Sept 2023, 105609.*
5. *Hua, Y., Zhang, Ta., Wang, L. (2024). A Review of the Extraction of Gallium from Bauxite Ores. In: Iloeje, C., et al. Energy Technology 2024. TMS 2024.*

Plate-1: **Map showing the Satellite Image of Sandhan block**

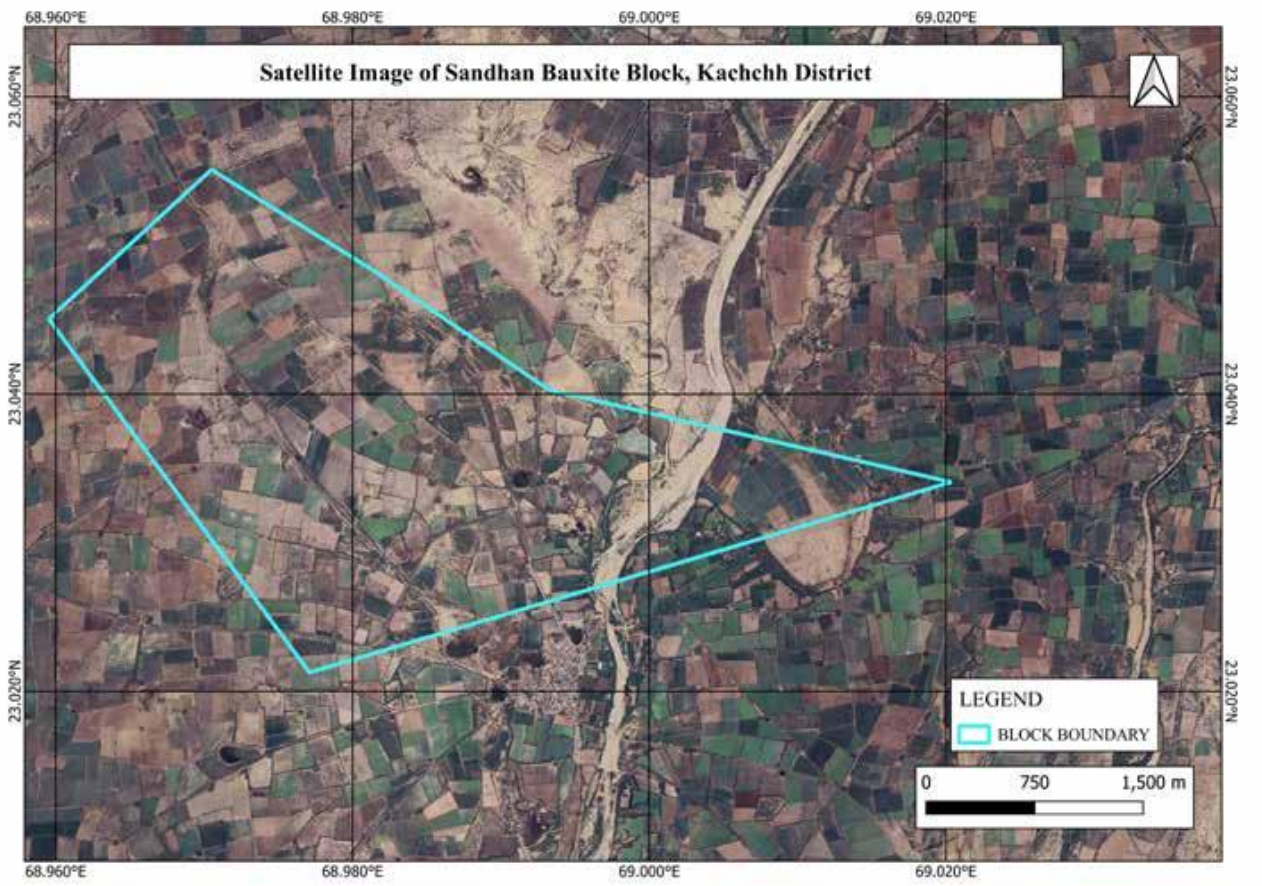


Plate-2: Block Boundary in 1:50K Map (source: GSI)

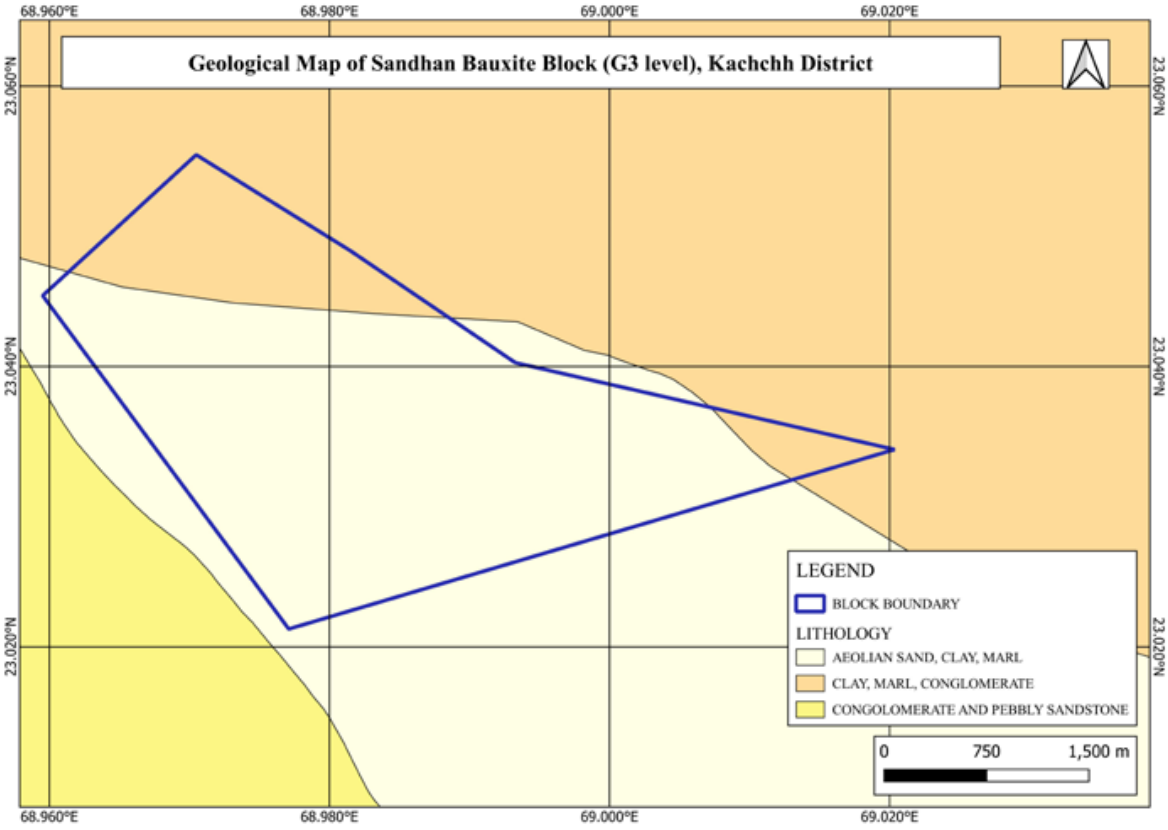


Plate-3: NGCM (GSI) data for Soil Regolith in Toposheet. No. 41 E/04

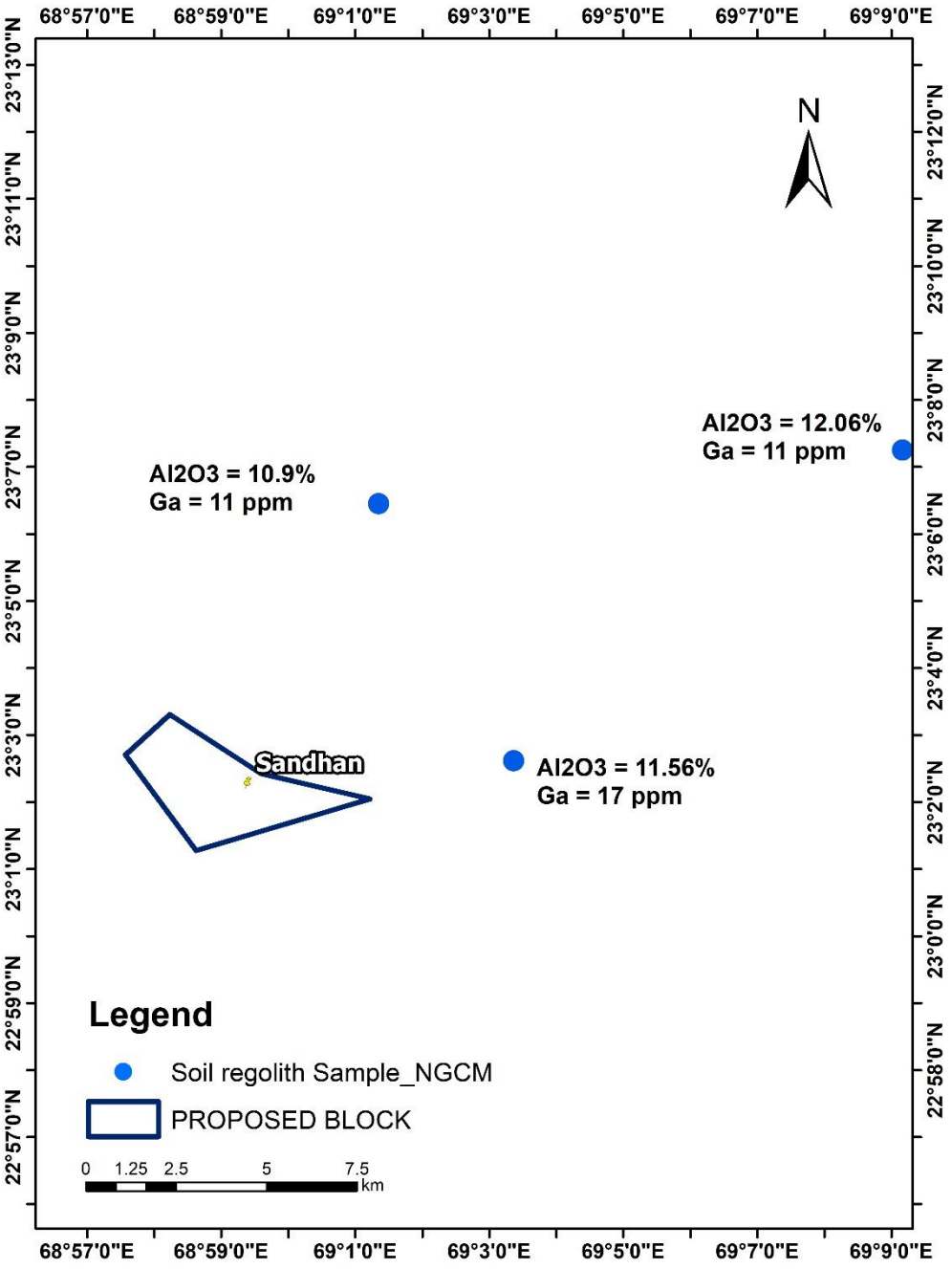


Plate-4: **Map showing Sample locations (400x400m grid) in Sandhan block in 9.85 sq.km.**

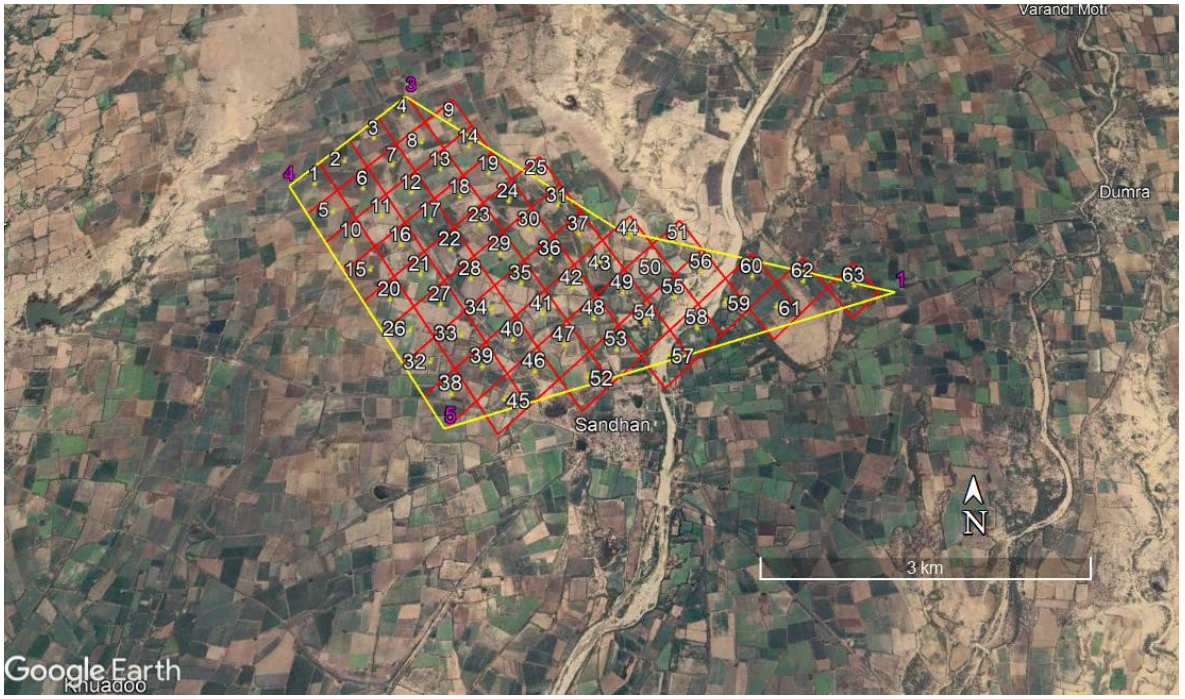
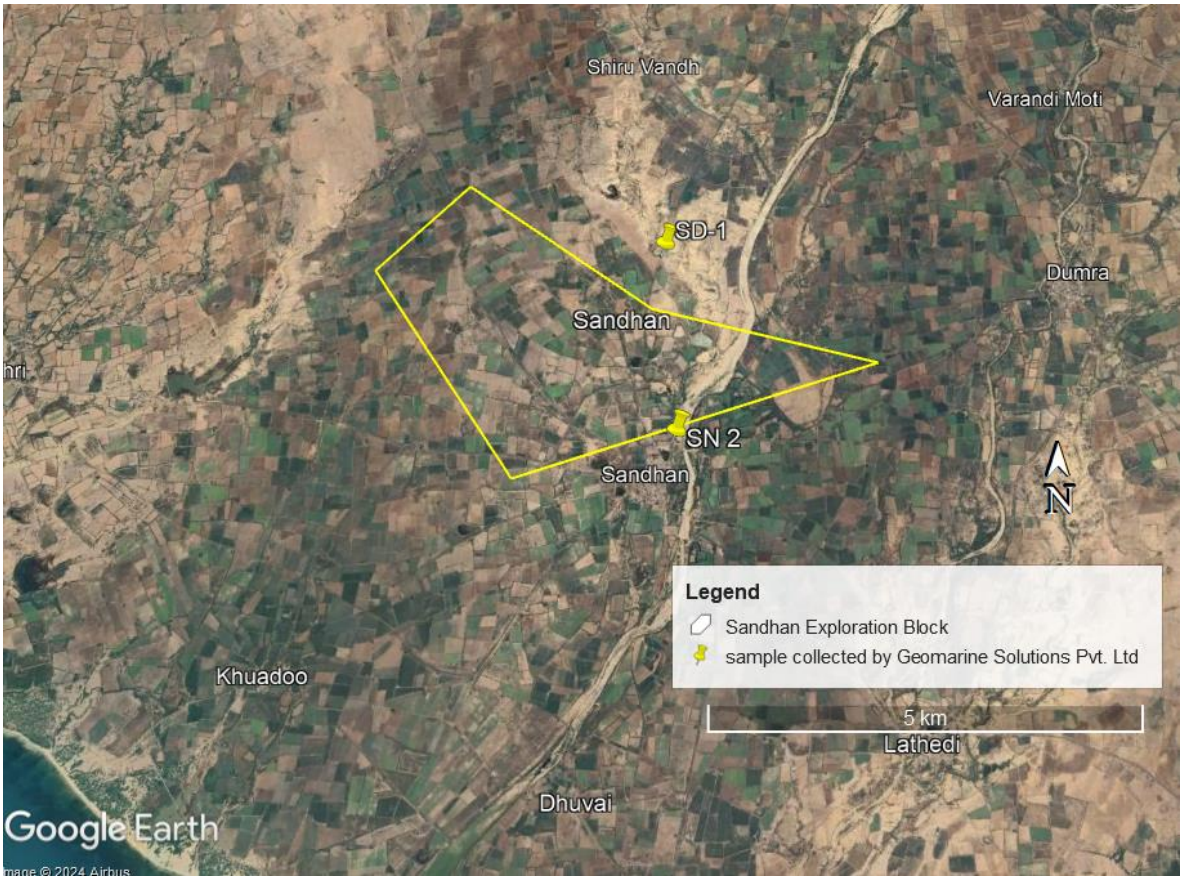


Plate-5: Block Boundary and location of sample collected in Google earth imagery

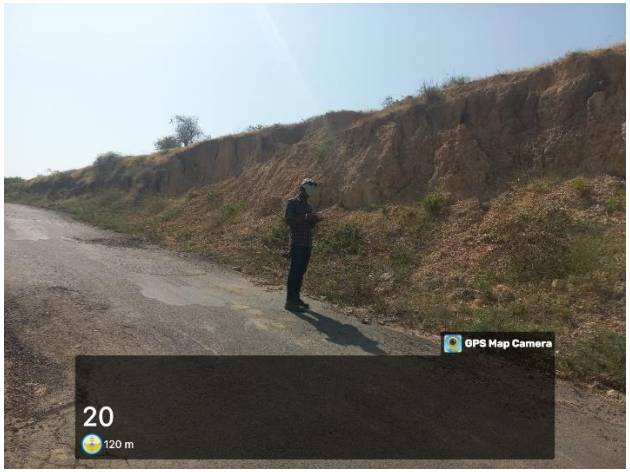


Annexure -1. Coordinates of Borehole point

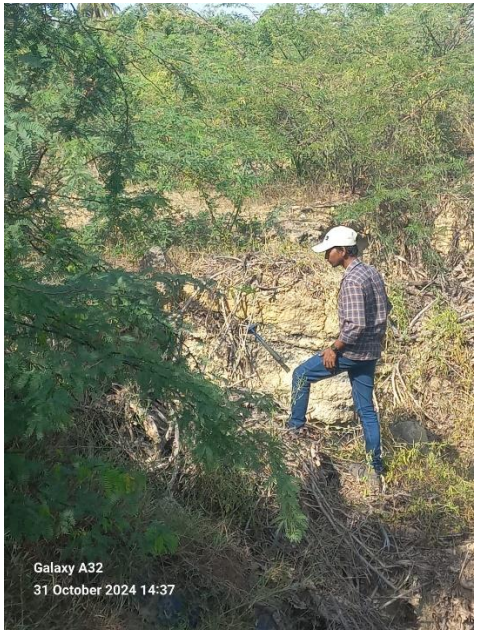
PointName	Longitude	Latitude
1	68.96198	23.04485
2	68.96476	23.04738
3	68.96754	23.04991
4	68.97033	23.05244
5	68.96419	23.04187
6	68.96696	23.0444
7	68.96974	23.04692
8	68.97253	23.04944
9	68.9753	23.05197
10	68.96639	23.03889
11	68.96917	23.04141
12	68.97195	23.04394
13	68.97473	23.04646
14	68.97751	23.04899
15	68.96859	23.03591
16	68.97137	23.03843
17	68.97415	23.04096
18	68.97693	23.04348
19	68.97971	23.046
20	68.97079	23.03293
21	68.97357	23.03545
22	68.97636	23.03798
23	68.97913	23.0405
24	68.98192	23.04302
25	68.9847	23.04555
26	68.973	23.02995
27	68.97578	23.03247
28	68.97855	23.03499
29	68.98134	23.03752
30	68.98412	23.04004
31	68.9869	23.04257
32	68.9752	23.02696

PointName	Longitude	Latitude
33	68.97798	23.02949
34	68.98076	23.03201
35	68.98354	23.03454
36	68.98632	23.03706
37	68.9891	23.03959
38	68.9774	23.02398
39	68.98019	23.02651
40	68.98296	23.02903
41	68.98574	23.03156
42	68.98853	23.03408
43	68.9913	23.0366
44	68.99408	23.03913
45	68.98238	23.02353
46	68.98517	23.02605
47	68.98795	23.02857
48	68.99072	23.0311
49	68.99351	23.03362
50	68.99628	23.03615
51	68.99906	23.03867
52	68.99015	23.02559
53	68.99293	23.02812
54	68.9957	23.03064
55	68.99849	23.03316
56	69.00127	23.03569
57	68.99791	23.02766
58	69.00069	23.03018
59	69.00347	23.03271
60	69.00625	23.03523
61	69.00845	23.03225
62	69.01123	23.03477
63	69.01621	23.03432

Field Photos by Geomarine Solutions from Sandhan Bauxite Block



Road section adjacent ot the Sandhan block exposing marl



River section within Sandhan block exposing miliolitic limestone