

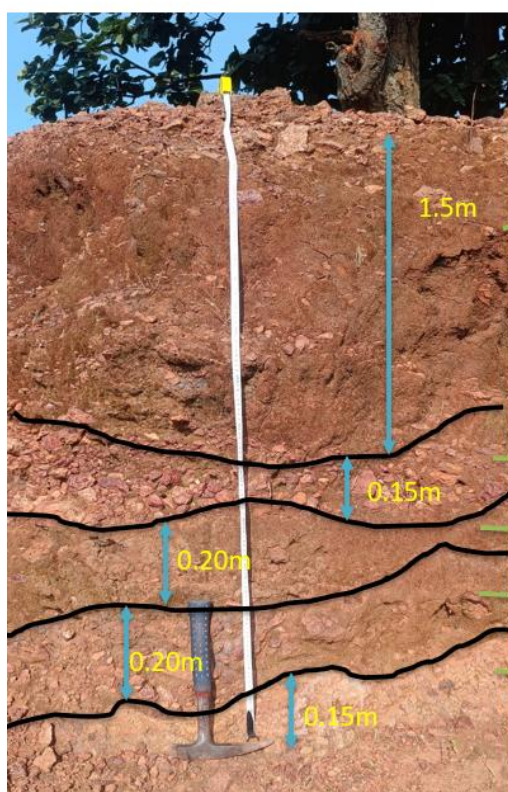
**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G-3)
FOR BAUXITE, TITANIUM AND ASSOCIATED MINERALS IN**

ANVARAPAT BLOCK

DISTRICT – LOHARDAGA, STATE – JHARKHAND

(Under NMEDT Programme)

(TEXT, ANNEXURES AND PLATES)



Location- 253398.82 m E 2607473.74 m N

Old quarry partialy backfilled face

Backfilled soil

Backfilled Waste (Lateritic and
Bauxitic boulder)

Soil

Aluminous Laterite

Pisolitic Bauxite(visible exposure)



MINERAL EXPLORATION AND CONSULTANCY LIMITED

(Formerly known as Mineral Exploration Corporation Limited)

A Government of India Enterprises
CORPORATE OFFICE, NAGPUR

NOVEMBER -2025

**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G3)
FOR BAUXITE, TITANIUM AND ASSOCIATED MINERALS IN
ANVARAPAT BLOCK,
DISTRICT - LOHARDAGA, STATE – JHARKHAND**

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**GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G-3) FOR BAUXITE, TITANIUM
AND ASSOCIATED MINERALS IN ANVARAPAT BLOCK,
DISTRICT - LOHARDAGA, STATE – JHARKHAND**

SALIENT FEATURES

1.	Name of the block	Anvarapat Block Tehsil- Kisko Sub division District – Lohardaga, State – Jharkhand
2.	Mineral	Bauxite/Laterite
3.	Total Area	1.00 sq.km.
4.	Area covered under present scheme	1.02 sq.km.
5.	Period of Exploration	January 2025 to June 2025.
6.	Meterage drilled by MECL	Total 519 m
7.	No. of Boreholes drilled by MECL	Total 18 Nos
8.	Thickness of Different Grade Bauxite	Average thickness of bauxite is 4.83m
9.	Cut-off grade	As per end use grade classification recommended by IBM. cutoff grade of 1. Bauxite: $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 \leq 7\%$ 2. Aluminous Laterite: $\text{Al}_2\text{O}_3 > 25\%$ and $< 30\%$ & SiO_2 is $> 7\%$ $< 12\%$ 3. Aluminous Clay: $\text{Al}_2\text{O}_3 > 20\%$ and $\text{SiO}_2 > 30\%$ 4. TiO₂ demarcation: $\text{TiO}_2 > 2\%$
10.	Resources	1. Bauxite: 13.64 MT with an average grade of Al_2O_3 34.86% and SiO_2 5.22%, Fe_2O_3 33.52% TiO_2 6.10%. 2. Aluminous Laterite: 7.62 MT with an average grade of Al_2O_3 31.46% and SiO_2 9.82%, Fe_2O_3 36.05% TiO_2 4.86%. 3. Assessment of TiO₂: 29.46 MT average grade of TiO_2 4.86%, Al_2O_3 32.98%, SiO_2 30.94%. 4. Aluminous Clay: 21.86 MT average grade of Al_2O_3 31.99% and silica 38.25%, TiO_2 1.93% *MT Million Tonnes
11.	Grade	Low Grade Bauxite / Ferruginous Bauxite
12.	UNFC Category	Inferred Category (333)
13.	Report Submission	November 2025

कार्यकारी सारांश

बॉक्साइट, टाइटेनियम और संबंधित खनिजों के लिए प्रारंभिक गवेषण (जी 3) पर भूवैज्ञानिक रिपोर्ट अनवरापाट ब्लॉक, जिला – लोहरदगा, राज्य – झारखंड

अध्याय-1 ए

कार्यकारी सारांश

- 1.1.1 बॉक्साइट (Bauxite) का अत्यधिक महत्व है क्योंकि यह एल्यूमिना (Al_2O_3) के उत्पादन का प्रमुख स्रोत है। एल्यूमिना का उपयोग घर्षक (Abrasives), अपचायक (Refractories), रसायन (Chemicals) तथा सीमेंट जैसे अनेक उद्योगों में किया जाता है। बॉक्साइट से प्राप्त एल्यूमिनियम अपने हल्के वजन, वातावरणीय क्षरण (Atmospheric Corrosion) के प्रति उत्कृष्ट प्रतिरोध तथा उच्च विद्युत चालकता के कारण अत्यधिक मूल्यवान है। इन विशिष्ट गुणों के कारण एल्यूमिनियम का उपयोग औद्योगिक उत्पादों से लेकर दैनिक घरेलू बर्तनों तक व्यापक रूप से किया जाता है, जिसके कारण इसे “गरीबों का सोना” भी कहा जाता है। इसके अतिरिक्त, एल्यूमिनियम दुर्लभ एवं महंगी अशुद्ध धातुओं जैसे तांबा (Copper) और जस्ता (Zinc) का एक सस्ता और प्रभावी विकल्प सिद्ध हुआ है, जिससे विश्व स्तर पर एल्यूमिनियम उद्योग के विकास को गति मिली है।
- 1.1.2 झारखंड के लोहरदगा ज़िले को अपने समृद्ध बॉक्साइट भंडारों के लिए देशभर में जाना जाता है, जो गुणवत्ता और स्थायित्व की दृष्टि से देश के सर्वोत्तम भंडारों में से एक हैं। ये लेटराइटिक बॉक्साइट निक्षेप पठारी और पर्वतीय शिखरों पर विकसित हुए हैं और एल्यूमिना (Al_2O_3) उत्पादन के लिए प्रमुख कच्चा माल प्रदान करते हैं। उच्च गुणवत्ता वाले अयस्क की विश्वसनीय आपूर्ति के माध्यम से लोहरदगा के बॉक्साइट भंडारों ने भारत के एल्यूमिनियम उद्योग को सुदृढ़ बनाए रखने और महंगी गैर-लौह धातुओं जैसे तांबा और जस्ता के विकल्प के रूप में इसकी स्थिति को मजबूत करने में महत्वपूर्ण भूमिका निभाई है।
- 1.1.3 खनिज और खनिज विकास (संशोधन) अधिनियम, 2015 (MMDR Amendment Act, 2015) तथा खनिज नीलामी नियम, 2015 के प्रावधानों के मद्देनज़र, झारखंड सरकार के खनिज निदेशालय (DMG) ने MECL के साथ लोहरदगा जिले में बॉक्साइट ब्लॉकों के अन्वेषण हेतु NMET निधि के माध्यम से कार्य करने पर चर्चा की। उक्त अधिनियमों और नियमों के अनुरूप इन ब्लॉकों का अन्वेषण राज्य सरकार को पहचाने गए बॉक्साइट ब्लॉकों की नीलामी करने में सक्षम बनाएगा।
- 1.1.4 अनवरापाट ब्लॉक क्षेत्र पाकर पठार के पश्चिमी किनारे पर स्थित है, जो लोहरदगा जिले के किस्को उपखंड के पाकर गाँव के पश्चिम में अवस्थित है। लोहरदगा नगर रांची हवाई अड्डे और राज्य की राजधानी रांची से सड़क मार्ग द्वारा जुड़ा है, जो ब्लॉक से लगभग 110 किमी दूर है। निकटतम रेलवे स्टेशन लोहरदगा है, जो पठार से लगभग 40 किमी की दूरी पर स्थित है।

- 1.1.5 क्षेत्रीय स्तर पर अध्ययन क्षेत्र की विभिन्न शैल इकाइयाँ छोटानागपुर ग्रेनाइट ग्राइसिक कॉम्प्लेक्स (Chhotanagpur Granite Gneissic Complex - CGC) की ग्रेनाइट ग्राइस चट्टानों से बनी हैं, जिनमें अनवर्गीकृत रूपांतरित शैलों के टुकड़े (enclaves) समाविष्ट हैं, जिन्हें पेगमेटाइट्स और मोटी क्वार्ट्ज नसों ने भेदा हुआ है। कुछ स्थानों पर दमोड़र सुपरग्रुप की चट्टानों के छोटे अनावृत भाग भी देखे जाते हैं।
- 1.1.6 बॉक्साइट धारक क्षेत्र छोटानागपुर पठार में स्थानीय रूप से “पट” के नाम से जाने जाते हैं। यहाँ की लेटराइट/बॉक्साइट परतें छोटानागपुर ग्राइसिक कॉम्प्लेक्स (CGC) की ग्राइसिक आधार शैल पर विकसित हुई हैं। क्षेत्र में पत्राभ (foliation) या सिस्टोसिटी (schistosity) की सामान्य दिशा उत्तर-पूर्व से दक्षिण-पश्चिम (NE-SW) है, जिसका झुकाव (dip) 20° से 60° तक दक्षिण-पूर्व की ओर है।
- 1.1.7 अनवरापाट ब्लॉक पाकर पठार के पश्चिमी भाग में स्थित है, जो एक वी-आकृति वाला छोटा पर्वत है। पठार का ढाल धीरे-धीरे उत्तर-पूर्व की ओर है, जबकि दक्षिण, पूर्व और पश्चिम दिशाओं में खड़ी ढलानें और चट्टानी दीवारें पाई जाती हैं। पठार का पश्चिमी विस्तार स्थानीय रूप से “बंगलापाट” के नाम से जाना जाता है। क्षेत्र का अधिकतम ऊँचाई स्तर समुद्र तल से लगभग 1066 मीटर है, जबकि न्यूनतम ऊँचाई उत्तर दिशा के घाटी भाग में लगभग 940 मीटर है। इस ब्लॉक में पुराने खदानों में बॉक्साइट और लेटराइट की परतें दिखाई देती हैं, जिन्हें MECL द्वारा मानचित्रित किया गया है।

अनवरापाट ब्लॉक क्षेत्र की स्थानीय स्तरीकरण अनुक्रम (Local Stratigraphic Succession):

काल	स्तर	मोटाई
हाल का	मिट्टी	—
तृतीयक से हाल का	लेटराइट मिट्टी	(0.1–2.0 मी.)
	लेटराइट और मुर्रम	(1.5–2.5 मी.)
	बॉक्साइट और एल्यूमिनस लेटराइट	(0.5–15.0 मी.)
	विविध रंगों वाली मिट्टी	(2–5 मी.)

- 1.1.8 पाखर पठार के बॉक्साइट निक्षेप एल्यूमिना-समृद्ध शैलों के सिलिका लीचिंग (Silica Leaching) प्रक्रिया के परिणामस्वरूप बने हैं और ये सपाट शिखरों वाले पठारी क्षेत्रों पर लेटराइट/बॉक्साइट की चादर के रूप में पाए जाते हैं। मुख्य बॉक्साइट खनिज गिब्ससाइट (Gibbsite) है, जबकि ब्यूमाइट (Boehmite) और डियास्पोर (Clachite) अल्प मात्रा में उपस्थित हैं।
- 1.1.9 वित्तीय वर्ष 2016–17 में, GSI ने “लोहरदगा, लातेहार, चतरा एवं रांची जिलों में टोपोशीट संख्या 73A/10 एवं 73A/14 (A1 क्वार्ट्ज)” में क्षेत्रीय भू-रासायनिक मानचित्रण (Regional Geochemical Mapping) का कार्य किया। यह कार्य भूवैज्ञानिक सुश्री पूनम नगर और सुश्री इंद्राणी कर्मकार द्वारा किया गया। कुल 808 वर्ग किमी क्षेत्र को तीन माध्यमों—धारा अवसाद (Stream Sediment), मिट्टी (Soil) और जल (Water)—के माध्यम से व्यवस्थित रूप से मानचित्रित किया गया। परिणामों से ज्ञात

हुआ कि मिट्टी के नमूनों में तत्वों का वितरण समान है। नमूनों में उच्च SiO_2 सांद्रता ग्रेनाइट ग्राइस के प्रभुत्व से नियंत्रित है, जबकि CGC पर लेटराइट की टोपी वाले क्षेत्रों में Al_2O_3 की मात्रा अधिक पाई गई। Fe_2O_3 के अधिक मान उन स्थानों पर पाए गए जहाँ लेटराइट प्रचुर मात्रा में है, विशेषकर पाखर आर.एफ. क्षेत्र के मध्य भाग में। पाखर क्षेत्र में हिंडाल्को इंडस्ट्रीज़ द्वारा बड़े पैमाने पर बॉक्साइट खनन कार्य सफलतापूर्वक किया जा रहा है।

- 1.1.10 वर्तमान अन्वेषण कार्यों में स्थलाकृतिक सर्वेक्षण (2 मी. कॉन्टूर अंतराल), भूवैज्ञानिक मानचित्रण (1:2000 स्केल) तथा अन्वेषणात्मक ड्रिलिंग शामिल है। अनुमोदित कार्य के अनुसार, कुल 519.00 मीटर ड्रिलिंग कार्य 18 बोरहोल्स में पूर्ण किया गया। सभी बोरहोल्स NW-SE दिशा में 200 मीटर अंतर पर और NE-SW दिशा में सामान्यतः 300 मीटर अंतर पर स्थित हैं। पठारी परिस्थितियों के कारण कुछ स्थानों पर यह अंतर परिवर्तित हुआ। संसाधन का आकलन बहुभुज (Polygon) पद्धति से किया गया। यह संसाधन खनिज साक्ष्य नियम, 2015 (संशोधित 14 दिसंबर 2021) के अनुसार "प्रारंभिक अन्वेषण (G3)" स्तर पर "अनुमानित खनिज संसाधन (332)" श्रेणी में रखा गया है।
- 1.1.11 बॉक्साइट का खनिजीकृत क्षेत्र दो रूपों में पाया जाता है—(i) विभिन्न मोटाई वाली अनियमित परतों के रूप में तथा (ii) बोल्टर प्रकार में। बॉक्साइट क्षेत्र को IBM कट-ऑफ $\text{Al}_2\text{O}_3 \geq 30\%$ और $\text{SiO}_2 \leq 7\%$ के आधार पर सीमांकित किया गया है।
- 1.1.12 इस ब्लॉक में 13.64 मिलियन टन बॉक्साइट संसाधन का अनुमान लगाया गया है, जिसकी औसत ग्रेड Al_2O_3 34.86%, SiO_2 5.22%, Fe_2O_3 33.52% और TiO_2 6.10% है। संसाधन का आकलन बहुभुज पद्धति से किया गया है।
- 1.1.13 एल्यूमिनस लेटराइट संसाधन 7.62 मिलियन टन का अनुमानित है, जिसकी औसत ग्रेड Al_2O_3 31.46%, SiO_2 9.82%, Fe_2O_3 36.05% और TiO_2 4.86% है। यह अनुमान $\text{Al}_2\text{O}_3 \geq 25\%$ से $< 30\%$ के कट-ऑफ पर आधारित है।
- 1.1.14 TiO_2 का आकलन: TiO_2 सभी शैल इकाइयों—बॉक्साइट, एल्यूमिनस लेटराइट और मिट्टी—में पाया गया है। औसत TiO_2 प्रतिशत विविध रंगों वाली मिट्टी में 1.93%, बॉक्साइट में 6.10% तथा एल्यूमिनस लेटराइट में 4.86% है। 2% कट-ऑफ पर कुल 29.46 मिलियन टन संसाधन का अनुमान किया गया है, जिसकी औसत ग्रेड 4.86% TiO_2 , 32.98% Al_2O_3 तथा 30.94% SiO_2 है।
- 1.1.15 एल्यूमिनस मिट्टी (Aluminous Clay) का संसाधन 21.86 मिलियन टन का है, जिसमें औसत ग्रेड Al_2O_3 31.99%, SiO_2 38.25% और TiO_2 1.93% पाया गया है। यह संसाधन $\text{Al}_2\text{O}_3 \geq 30\%$ और $\text{SiO}_2 > 30\%$ के कट-ऑफ पर बहुभुज पद्धति से अनुमानित किया गया है।
- 1.1.16 अनुसंधानित ब्लॉक में निम्न-ग्रेड बॉक्साइट (13.64 मिलियन टन) के साथ पर्याप्त मात्रा में TiO_2 संसाधन उपलब्ध हैं। इसलिए सिफारिश की जाती है कि अधिक सटीक टनेज और औसत ग्रेड के आकलन हेतु निकट दूरी पर विस्तृत अन्वेषण (Detailed Exploration) किया जाए। इसके

अतिरिक्त, बॉक्साइट/लेटराइट एवं मिट्टी से टाइटेनियम, वेनेडियम और गैलियम के निष्कर्षण की संभावना हेतु परिशोधन (Beneficiation) अध्ययन करने की भी अनुशंसा की जाती है।

- 1.1.17 अनवरापाट ब्लॉक में स्थापित बॉक्साइट संसाधन G-3 स्तर पर हैं। अतः यह ब्लॉक भारत सरकार द्वारा **संयुक्त लाइसेंस (Composite License)** के अंतर्गत नीलामी हेतु उपयुक्त है।

GEOLOGICAL REPORT ON PRELIMINARY EXPLORATION (G-3) FOR BAUXITE, TITANIUM AND ASSOCIATED MINERALS IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, STATE – JHARKHAND

CHAPTER-1B

EXECUTIVE SUMMARY

- 1.1.1 Bauxite holds prime importance as the primary source for producing alumina (Al_2O_3), which is further used in a range of industries such as abrasives, refractories, chemicals, and cement. Aluminium, derived from bauxite, is valued for its light weight, excellent resistance to atmospheric corrosion, and high electrical conductivity. These unique properties make it widely used in manufacturing—from industrial applications to everyday household utensils—earning it the name “*poor man’s gold*.” Moreover, aluminium serves as an efficient and economical substitute for scarce and expensive non-ferrous metals like copper and zinc, thereby driving the growth of the aluminium industry across the globe.
- 1.1.2 Lohardaga district of Jharkhand is widely recognized for its rich bauxite deposits, which are among the finest in the country in terms of grade and consistency. These lateritic bauxite occurrences, capping the plateau and hilltop regions, serve as the primary raw material for alumina (Al_2O_3) production. By providing a reliable source of high-quality ore, the bauxite deposits of Lohardaga have played a vital role in sustaining the aluminium industry in India and strengthening its position as a substitute for costlier non-ferrous metals like copper and zinc.
- 1.1.3 In view of the MMDR Amendment Act, 2015 and the Mineral Auction Rules, 2015 enacted by the Government of India, the Directorate of Mines and Geology (DMG), Government of Jharkhand, engaged in discussions with MECL to undertake exploration of bauxite blocks in Lohardaga district through NMET funding. The exploration of these blocks, in accordance with the provisions of the MMDR Amendment Act and the Mineral Auction Rules, 2015, will enable the State Government to auction the identified bauxite blocks.
- 1.1.4 Anvarapat block area is situated on western flank of Pakhar Plateau, which is located in the west of Pakhar village of Kisko sub division of Lohardaga district, Jharkhand. Lohardaga town is well connected to Ranchi Airport and Ranchi the state capital

which is about 110 km from the block. The nearest railway station is Lohardaga, located at a distance of 40km from the plateau.

- 1.1.5 Regionally the different lithounits in the study area consist of granite gneiss of Chhotanagpur Granite Gneissic Complex (CGC) with enclaves of unclassified metamorphics intruded by pegmatites and thick veins of quartz. Minor outcrops of Damodar Supergroup rocks are also exposed at few places.
- 1.1.6 Bauxite bearing areas are popularly known as “pat” in Chhotanagpur plateau, the laterite/bauxite are developed over the gneissic country rock belonging to Chhotanagpur Gneissic Complex (CGC). The general trend of foliation/schistosity in the area varies from NE-SW with 20° to 60° south easterly dip.
- 1.1.7 The Anavrapat block lies on the western flank of the Pakhar Plateau, which is a V-shaped hillock. The plateau slopes gradually towards the northeast, while steep gradients with cliff faces are characteristic of the southern, eastern, and western sides of the hillock. The western extension of the plateau is locally known as Banglapat. The highest elevation is about 1066.0 m above MSL, whereas the lowest point, towards the northern valley portion, is around 940.0 m above MSL. Within this block, exposures of bauxite and laterite are observed in old quarries, which have been mapped by MECL.

The Local Stratigraphic Succession of the Anvarapat block area

Recent	Soil
Tertiary to Recent	Laterite Soil (0.1 to 2.0m) Laterite and Morrum (1.5-2.5m) Bauxite and aluminous laterite (0.5 to 15.0m) Variegated Clay (6.0 to 27.0m) Lithomarge (2-5m)

- 1.1.8 The Bauxite deposits of Pakhar Plateau are the result of Silica leaching process of alumina rich rocks and it occurs on flat topped Plateau region as blanket of laterite/bauxite deposit. The major Bauxite mineral is gibbsite with minor amount of Boehmite and Cliachite minerals.
- 1.1.9 During the F.S: 2016-17, GSI undertook “Regional Geochemical Mapping in toposheet nos. 73A/10 and 73A/14 (A1 quadrant) in Lohardaga, Latehar, Chatra and Ranchi districts of Jharkhand” by Ms Poonam Nagar (Geologist) and Ms Indrani Karmakar (Geologist). A total 808 sq. km area was systematically mapped by three

different media; stream sediment, soil and water as per the NGCM guideline. Stream sediment samples were collected on 1km x 1km unit cell and composite samples 2km x 2km grid whereas water, soil, regolith 'R' and 'C' horizon were collected by 5'x5' grid pattern on 1:50,000 scale. Soil sample studies show uniform distribution of elements. Higher concentration of SiO_2 in samples is mostly governed by granite gneiss. Aluminium concentration is higher in samples where CGC is capped by laterite. Higher values of Fe_2O_3 are present where laterite is present. Al_2O_3 show higher values in south- western and central part of toposheet no.73A/10 and this is due to the presence of laterite in these areas. Fe_2O_3 values are higher in central part around Pakhar R.F. where laterite is the dominant lithology. HINDALCO INDUSTRIES are working extensively in the Pakhar area and successfully mining bauxite in the name of Pakhar Mines.

- 1.1.10 The present exploration work included Topographic survey (Contour interval 2m) and Geological mapping (1:2000 scale) followed by exploratory drilling work. As per the approved quantum of work, a total 519.00m drilling was completed in the approved 18 boreholes. All boreholes were drilled on 200 m spacing in NW-SE direction and in NE-SW directions general spacing is 300m. Owing to plateau conditions borehole spacing varies at places. However, all the boreholes are placed at 200m interval. Resources have been estimated by polygon method. The estimated resources in the block area may be placed under Inferred Mineral Resource (332) category as MEMC rule 5 clause b which state "The area under investigation falls under 333 category of resources under UNFC nomenclature. However as per the Minerals (Evidence of Mineral Contents) Rules, 2015, amended upto 14th Dec 2021, Rule 5 which states "At least Preliminary Exploration (G3) has been completed to establish Inferred Mineral Resource (333), which shall be considered akin to Indicated Mineral Resource (332), and a geological study report has been prepared conforming to Part IV of Schedule-I." **Hence resources are categorized under 332 category.**
- 1.1.11 The mineralized zones of Bauxite occur as i) irregular bedded with varying thickness and ii) boulder type. Bauxite zones are demarcated based on IBM cutoff The resource estimated at $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 \leq 7\%$ by Polygon method.
- 1.1.12 Bauxite resources of **13.64 MT has been estimated with an average grade of alumina 34.86% and SiO_2 5.22%, Fe_2O_3 33.52% TiO_2 6.10%.** The resource estimated at $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 \leq 7\%$ cut-off by Polygon method

- 1.1.13 Aluminous Laterite resources of **7.62 MT** has been estimated with an average grade of alumina **31.46%** and **SiO₂ 9.82%**, **Fe₂O₃ 36.05%** **TiO₂ 4.86%**. The resource estimated at $\text{Al}_2\text{O}_3 \geq 25$ to $\leq 30\%$ cut-off and by Polygon method
- 1.1.14 **Assessment of TiO₂:** TiO₂ has been recorded in all lithounits viz. bauxite, aluminous laterite and clay horizons. The average TiO₂% is 1.93 % in the variegated clay, 6.10 % in bauxite Zone and 4.86% in Aluminous Laterite zone. A resource of **29.46 MT** has been estimated for TiO₂% cutoff of 2%, with average grade of 4.86% in the Bauxite, Laterite and clay zone which has average alumina 32.98%, SiO₂ 30.94%.
- 1.1.15 **Aluminous Clay** resources of **21.86 MT** has been estimated with an average grade of alumina **31.99%** and silica **38.25%**, TiO₂ 1.93%. The resource estimated at $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 > 30\%$, by Polygon method.
- 1.1.16 The Explored block has low grade bauxite deposit with 13.64 MT and has good amount of TiO₂ resources, so it is recommended to carry out detailed exploration at closer space to increase the confidence level regarding tonnage and average grade. Further it is recommended for beneficiation studies on possibility of extraction of titanium, vanadium and Gallium from bauxite/laterite and clay.
- 1.1.17 Established resources for bauxite in Anvarapat block are at G-3 level. Hence the block may be auctioned in composite license by Central Government of India

CHAPTER-2

DETAILS OF THE QUALIFIED PERSON(S) / EXPLORATION AGENCY

MINERAL EXPLORATION AND CONSULTANCY LIMITED

(Formerly Mineral Exploration Corporation Limited)

(A Govt. of India Enterprise; A Miniratna-I PSE)

(Ministry of Mines, Govt. of India)

Dr. Babasaheb Ambedkar Bhawan, High Land Drive Road,
Seminary Hills, Nagpur-440006.

CHAPTER-3

TITLE AND OWNERSHIP

3.1.0 DETAILS OF OWNERSHIP

S No	Title	Details
1	Title of the report	GEOLOGICAL REPORT ON “PRELIMINARY EXPLORATION (G3) FOR BAUXITE, TITANIUM AND ASSOCIATED MINERALS IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, STATE – JHARKHAND”.
2	Ownership	Government of Jharkhand
3	Name of the Prospector	MINERAL EXPLORATION AND CONSULTANCY LIMITED (Formerly Mineral Exploration Corporation Limited) (A Govt. of India Enterprise; A Miniratna-I PSE) (Ministry of Mines, Govt. of India)
4	Address of Prospector	Dr. Babasaheb Ambedkar Bhavan High Land Drive Road, Seminary Hills, Nagpur, Maharashtra, Pin- 440006
5	E-Mail of the prospector	cmd@mecl.gov.in , gm-exploration@mecl.gov.in
6	Telephone numbers of prospectors	0712-2510289, 0712-2511829

3.2.0 DETAILS OF PERIOD OF PROSPECTING

3.2.1 The G3 stage of exploratory work in the Anvarapat block commenced with geological mapping, along with exploratory drilling in borehole No. MAP-01 on 24.01.2025 and completed with the closure of borehole No. MAP-18 on 30.06.2025. The allied field-works including surveying, drilling and sampling etc. were completed simultaneously. The analytical/laboratory studies were carried out simultaneously in laboratories of MECL and other Govt. /NABL accredited laboratories.

3.3.0 DETAILS OF EXPLORATION AGENCY, QUALIFICATION, AND EXPERIENCE OF ASSOCIATED TECHNICAL PERSONS ENGAGED IN EXPLORATION

3.3.1 Exploration Agency (EA):

Mineral Exploration and Consultancy Limited
(Formerly Mineral Exploration Corporation Limited)
(A Govt. of India Enterprise-A Miniratna PSE)

3.3.2 Experience: Organization established in year 1972

Experience: Geologist have experience of more than 30 years

Qualification of Geologist: M.Sc./M.Sc. Tech (Geology/ Applied Geology / Geophysics)

Table no 3.1 List of Personnel with Experience

Sl.No.	Name of the Person	Designation	Qualification	Experience
1	Shri Shrikant Sharma	HOD (Exploration)	M.Sc., Geology	23 Years
2	Shri P. Ravindran	GM (Exploration) Rtd.	M.Sc., Geology	35 Years
3	Shri Naveen Kumar Pala	Sr. Manager (Geology)	M.Sc. (Tech.), Applied Geology	21 Years
4	Shri Arun Singh	Sr. Manager (Geology)	M.Sc. (Tech.), Applied Geology	19 Years
5	Shri Rohit Kumar Sharma	Manager (Chemical Lab)	M.Sc., Chemistry	15 Years
6	Shri Shubam Kumar	Geologist	M.Sc Geology	09 Years

CHAPTER-4

DETAILS OF THE AREA

4.1.0 LOCATION AND ACCESSIBILITY OF THE BLOCK

- 4.1.1 Anvarapat block area is situated on western flank of Pakhar Plateau, which is located in west of Pakhar village, of Kisko sub division, district Lohardaga, Jharkhand. Pakhar village is situated at about 25km away from sub-district headquarter i.e., Kisko (block office) and 22km away from district headquarter i.e., Lohardaga. Thus, the Siskari-Pat block is located at a distance of 25-40 kms from Kisko block office and Lohardaga town respectively. Lohardaga town is well connected to Ranchi Airport and Ranchi the state capital which is about 110 km from the block. The nearest railway station is Lohardaga, located at a distance of 40km from the plateau.
- 4.1.2 The block location is presented as **Plate-I** and **Text Figure-1**. The Siskari Pat Bauxite block falls in part of Survey of India Topo-sheet No.73 A/10 and is bounded by the following Co-ordinates.

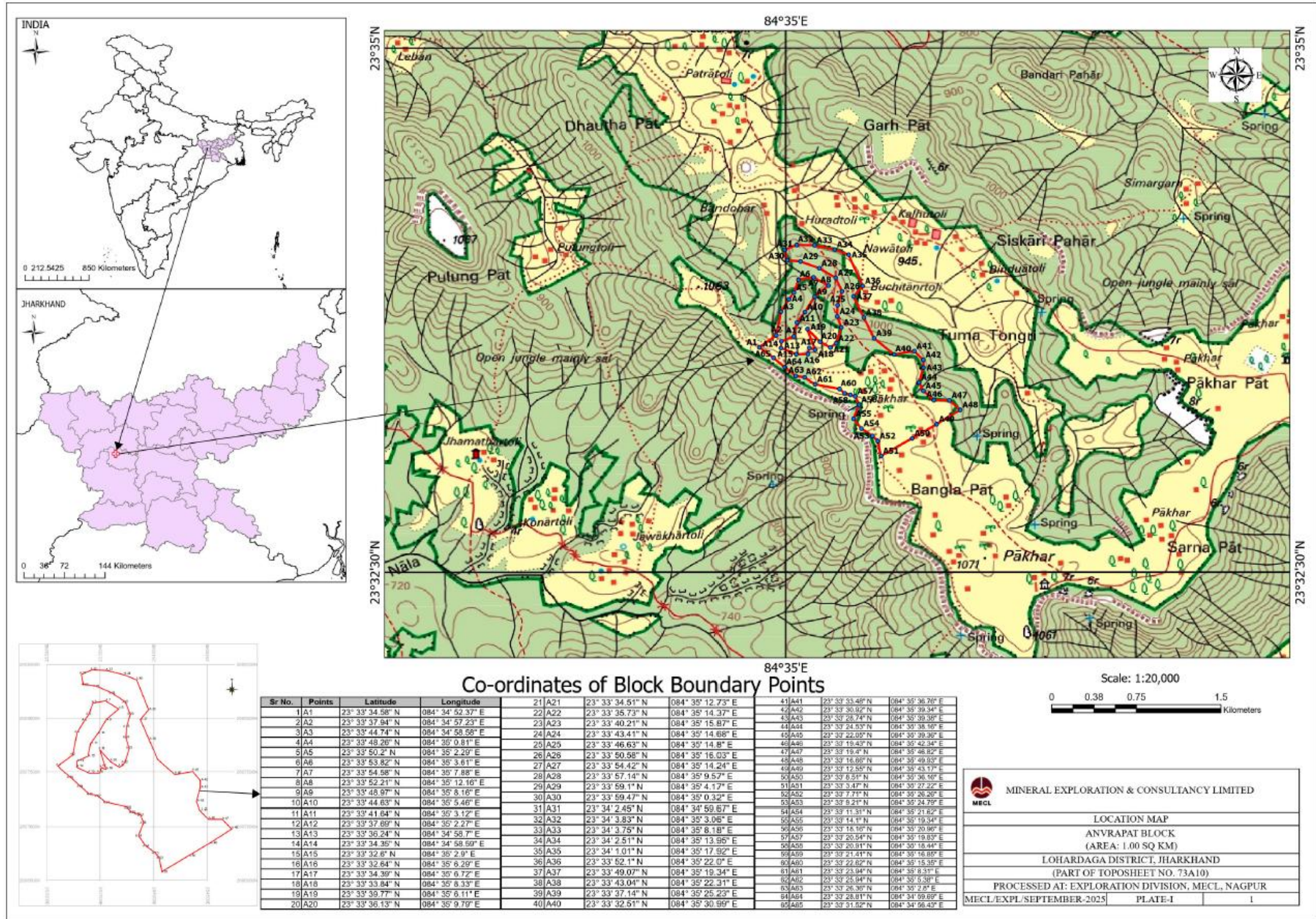
Table-4.1
Co-ordinates of the corner points of the block boundary of Anvarapat Block,
District: Lohardaga, Jharkhand

LABEL	UTM (WGS84) - ZONE 45 N		D M S		REDUCED LEVEL (M)
	EASTING (m)	NORTHING (m)	LATITUDE (N)	LONGITUDE (E)	
A 1	253102.396	2607554.106	23° 33' 34.583"	84° 34' 52.367"	1042.424
A 2	253242.052	2607655.072	23° 33' 37.939"	84° 34' 57.229"	1031.328
A 3	253284.080	2607863.649	23° 33' 44.739"	84° 34' 58.587"	1005.935
A 4	253349.041	2607970.945	23° 33' 48.261"	84° 35' 0.812"	1000.191
A 5	253391.994	2608029.951	23° 33' 50.201"	84° 35' 2.291"	998.395
A 6	253431.028	2608140.855	23° 33' 53.826"	84° 35' 3.601"	993.698
A 7	253552.660	2608162.108	23° 33' 54.583"	84° 35' 7.875"	988.443
A 8	253672.943	2608087.013	23° 33' 52.209"	84° 35' 12.159"	983.775
A 9	253557.851	2607989.288	23° 33' 48.971"	84° 35' 8.161"	990.534
A 10	253479.019	2607856.990	23° 33' 44.629"	84° 35' 5.461"	993.381
A 11	253410.996	2607766.010	23° 33' 41.636"	84° 35' 3.118"	996.918
A 12	253384.936	2607644.996	23° 33' 37.690"	84° 35' 2.271"	1002.982
A 13	253283.047	2607601.923	23° 33' 36.235"	84° 34' 58.706"	1033.165
A 14	253278.657	2607544.175	23° 33' 34.357"	84° 34' 58.585"	1038.871
A 15	253400.026	2607487.833	23° 33' 32.593"	84° 35' 2.896"	1043.081
A 16	253496.334	2607487.754	23° 33' 32.643"	84° 35' 6.291"	1042.508
A 17	253508.922	2607541.010	23° 33' 34.380"	84° 35' 6.703"	1034.006

LABEL	UTM (WGS84) - ZONE 45 N		D M S		REDUCED LEVEL (M)
	EASTING (m)	NORTHING (m)	LATITUDE (N)	LONGITUDE (E)	
A 18	253554.796	2607523.392	23° 33' 33.833"	84° 35' 8.330"	1039.719
A 19	253495.067	2607707.095	23° 33' 39.768"	84° 35' 6.116"	1013.288
A 20	253597.909	2607593.506	23° 33' 36.134"	84° 35' 9.808"	1034.553
A 21	253679.979	2607541.998	23° 33' 34.506"	84° 35' 12.731"	1038.376
A 22	253727.007	2607579.112	23° 33' 35.737"	84° 35' 14.366"	1037.709
A 23	253772.773	2607716.717	23° 33' 40.233"	84° 35' 15.898"	1018.248
A 24	253739.948	2607814.977	23° 33' 43.407"	84° 35' 14.682"	1016.544
A 25	253744.882	2607914.055	23° 33' 46.629"	84° 35' 14.797"	1004.044
A 26	253781.977	2608034.998	23° 33' 50.579"	84° 35' 16.033"	989.628
A 27	253733.264	2608154.170	23° 33' 54.424"	84° 35' 14.245"	991.938
A 28	253602.214	2608240.182	23° 33' 57.146"	84° 35' 9.575"	979.757
A 29	253450.276	2608303.245	23° 33' 59.112"	84° 35' 4.183"	954.291
A 30	253341.143	2608316.191	23° 33' 59.473"	84° 35' 0.329"	945.705
A 31	253324.065	2608408.020	23° 34' 2.447"	84° 34' 59.672"	963.310
A 32	253420.896	2608449.117	23° 34' 3.835"	84° 35' 3.060"	989.736
A 33	253566.022	2608443.930	23° 34' 3.746"	84° 35' 8.179"	947.462
A 34	253728.988	2608402.978	23° 34' 2.505"	84° 35' 13.947"	959.375
A 35	253840.893	2608354.959	23° 34' 1.006"	84° 35' 17.920"	934.973
A 36	253952.324	2608079.497	23° 33' 52.118"	84° 35' 22.011"	944.906
A 37	253875.335	2607986.866	23° 33' 49.066"	84° 35' 19.352"	955.942
A 38	253956.056	2607800.020	23° 33' 43.040"	84° 35' 22.308"	983.148
A 39	253956.056	2607800.020	23° 33' 43.040"	84° 35' 22.308"	983.148
A 40	254197.024	2607471.993	23° 33' 32.514"	84° 35' 30.995"	1057.540
A 41	254360.979	2607498.943	23° 33' 33.479"	84° 35' 36.757"	1050.909
A 42	254432.979	2607418.981	23° 33' 30.920"	84° 35' 39.342"	1045.560
A 43	254432.998	2607351.992	23° 33' 28.744"	84° 35' 39.383"	1044.956
A 44	254395.796	2607223.146	23° 33' 24.538"	84° 35' 38.148"	1052.733
A 45	254428.703	2607146.124	23° 33' 22.053"	84° 35' 39.353"	1051.538
A 46	254512.002	2607064.000	23° 33' 19.430"	84° 35' 42.337"	1053.241
A 47	254639.010	2607061.111	23° 33' 19.406"	84° 35' 46.815"	1051.781
A 48	254725.996	2606975.053	23° 33' 16.657"	84° 35' 49.932"	1047.931
A 49	254531.999	2606851.969	23° 33' 12.553"	84° 35' 43.168"	1061.587
A 50	254330.943	2606731.043	23° 33' 8.514"	84° 35' 36.153"	1059.691
A 51	254074.906	2606580.048	23° 33' 3.469"	84° 35' 27.220"	1060.502
A 52	254050.029	2606710.925	23° 33' 7.707"	84° 35' 26.265"	1046.853
A 53	254008.784	2606758.643	23° 33' 9.235"	84° 35' 24.784"	1044.367
A 54	253919.985	2606824.038	23° 33' 11.311"	84° 35' 21.615"	1055.558
A 55	253856.494	2606911.164	23° 33' 14.107"	84° 35' 19.326"	1059.695

LABEL	UTM (WGS84) - ZONE 45 N		D M S		REDUCED LEVEL (M)
	EASTING (m)	NORTHING (m)	LATITUDE (N)	LONGITUDE (E)	
A 56	253905.004	2607035.018	23° 33' 18.157"	84° 35' 20.962"	1056.598
A 57	253874.062	2607109.037	23° 33' 20.545"	84° 35' 19.828"	1060.839
A 58	253834.934	2607121.124	23° 33' 20.917"	84° 35' 18.442"	1060.883
A 59	253789.789	2607136.351	23° 33' 21.387"	84° 35' 16.842"	1051.599
A 60	253748.073	2607175.097	23° 33' 22.623"	84° 35' 15.348"	1060.871
A 61	253549.041	2607218.919	23° 33' 23.937"	84° 35' 8.308"	1053.763
A 62	253467.151	2607282.259	23° 33' 25.950"	84° 35' 5.384"	1049.590
A 63	253394.098	2607295.941	23° 33' 26.355"	84° 35' 2.801"	1052.672
A 64	253307.165	2607373.070	23° 33' 28.813"	84° 34' 59.692"	1040.861
A 65	253215.953	2607458.016	23° 33' 31.523"	84° 34' 56.427"	1048.962

TEXT FIGURE-1



4.2.0 DETAILS OF THE AREA WITH LAND USE

- 4.2.1 Generally, Anvarapat block area is table land which is part of Chhotanagpur plateau. Northern part of the block area is covered by pakhar forest land and area outside the block boundary is occupied by mining activities (now abandoned) and a few areas are used for agriculture activities by local villagers.

4.3.0 MINERAL(S) UNDER INVESTIGATION

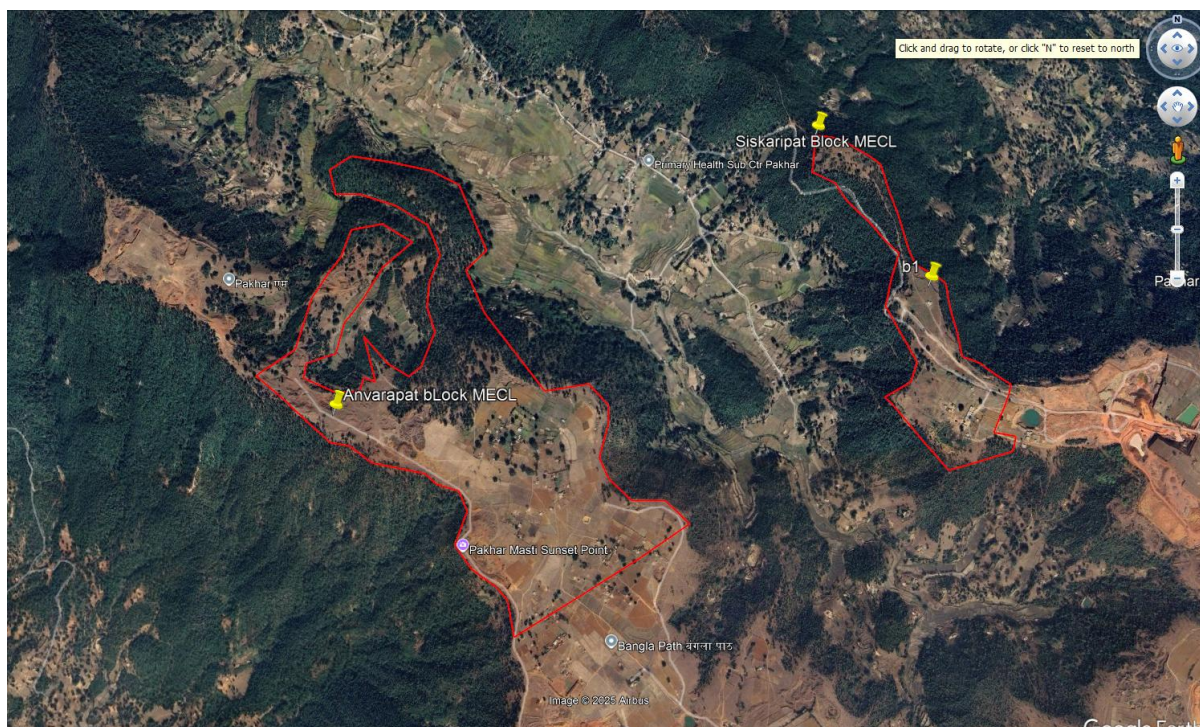
- 4.3.1 The block has been explored for Bauxite, Titanium and associated minerals at G-3 Stage exploration.

CHAPTER-5

PHYSIOGRAPHY AND ENVIRONMENT

5.1.0 RELIEF OF THE AREA WITH MINIMUM AND MAXIMUM ELEVATION, DRAINAGE PATTERN, NATURAL WATER COURSES, RESERVOIRS, ETC.

5.1.1 The bauxite bearing areas are popularly known as ‘Pat’ in Chhotanagpur plateau region, topographically the plateau comprises rolling plains, mounds, hillocks and low to moderately high isolated flat-topped hills rising at places to more than 1100m above Mean Sea Level (MSL) dissected by wide valleys. In the study area, the minimum elevation of the area (plain land) is about 720 meters. whereas in the Siskari pat block which is a flat-topped hill has the minimum elevation of 940MSL and the maximum elevation point of 1066 meters above M.S.L. The block location depicted on google satellite imagery is shown as **Text Figure No.2.**



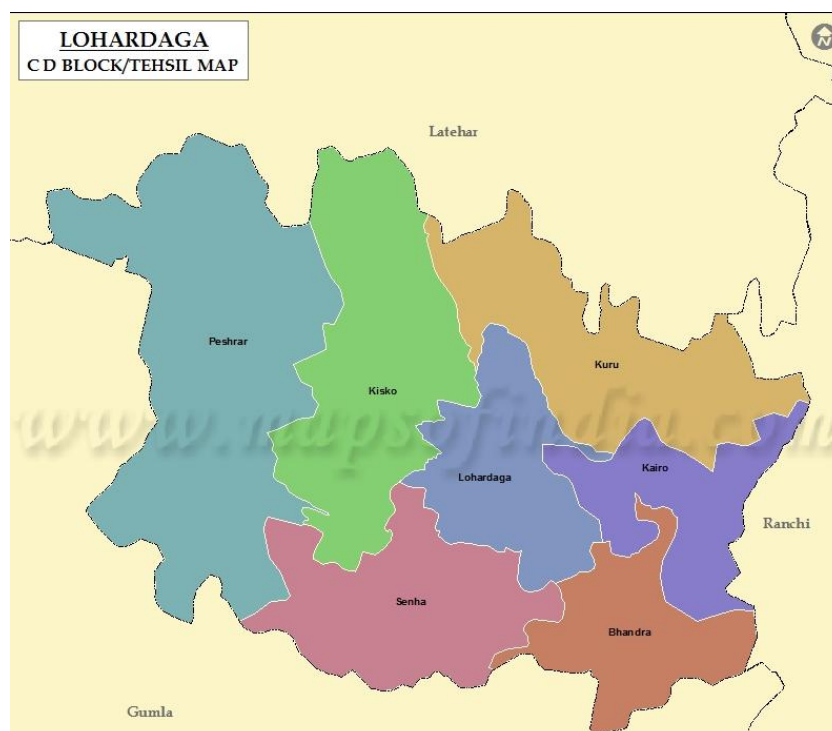
Text Figure No.2: Google-earth Imagery map with respect to Anvarapat block and Siskari Pat Block explored by MECL, District: Lohardaga, Jharkhand

5.2.0 ROADS, RAILWAY TRACK, ELECTRIC TRANSMISSION LINE, TELEPHONE LINE, ETC.

- 5.2.1 The block area is located west of Pakhar Village, Kisko Taluka and the nearest town is Lohardaga the district headquarters of Lohardaga district, Jharkhand.
- 5.2.2 Lohardaga railway station is the nearest railway station at a distance of about 25 km from where the plateau is approachable further in northwestern direction by unmetalled roads. From railway station the approach road is on Lohardaga-Latehar road Via Richugutu/Latehar/lohardaga.
- 5.2.3 Nearest airport is at Ranchi at a distance of 115km towards east and the nearest Port is Haldia which is at a distance of 500km towards east from the block area.
- 5.2.4 There is no major electric transmission line in the block

5.3.0 HOST POPULATION (LOCAL TRIBES), HUMAN SETTLEMENTS WITHIN AND NEARBY AREA

- 5.3.1 There is one Sub Division (Lohardaga) and Seven (7) blocks in Lohardaga district. These blocks are namely Bhandra, Kisko, Lohardaga, Kuru, Kairo, Peshrar and Senna. Lohardaga is one of the poorest districts of Jharkhand; it is predominantly rural area, with heavy dependency on agriculture and has low industrial investments. Around 50% of the households live on below poverty line in the district.
- 5.3.2 Siskari-Pat falls in Kisko block of lohardaga dist (Lohardaga Tehsil map is given below).



TEXT FIGURE-3

- 5.3.3 Kisko is the second poorest block of Lohardaga district. It is situated on the northwest part of Lohardaga district. The block is surrounded by Latehar district in the north, Kudu block in the east, and Lohardaga block towards south. The 52 villages of Kisko block are organized under 09 Gram Panchayats. Total population of the block was 54968, with 27,707 males and 27,261 females. The population in 0-6 age group was 9,194 (2011 Census of India)
- 5.3.4 **Population:** according to the 2011 Census of India, Kisko CD block had a total population of 54,959, all of which were rural. There were 27,692 (50%) males and 27,267 (50%) females. Population in the age range 0–6 years was 9,373. Scheduled Castes numbered 1,663 (3.03%) and Scheduled Tribes numbered 33,559 (61.06%).
- 5.3.5 **Literacy:** according to the 2011 census, the total number of literate persons in Kisko CD block was 29,422 (64.54% of the population over 6 years) out of which males numbered 17,212 (74.89% of the male population over 6 years) and females numbered 12,210 (54.02% of the female population over 6 years). The gender disparity (the difference between female and male literacy rates) was 20.87%. As of 2011 census, literacy in Lohardaga district was 78.62%. Literacy in Jharkhand was 67.63% in 2011. Literacy in India in 2011 was 74.04%.
- 5.4.0 SOCIO DEMOGRAPHIC PROFILE OF THE AREA AND NEARBY**
- 5.4.1 The Anvarapat block lies 3km west of Pakhar village which belongs to Kisko block of Lohardaga dist,
- 5.4.2 According to the 2011 Census of India, Pakhar village has a total population of 2,134, of which 1,117 (52%) were males and 1,017 (48%) were females. Population in the age group of 0–6 years was 501. The total number of literate persons in Pakhar was 552 (33.80% of the population over 6 years)
- 5.4.3 as per the 2011 census out of the total Kisko population, 36.35% of the population spoke Kurukh, 32.83% Sadri, 20.01% Urdu, 7.08% Hindi and 3.43% Mundari as their first language.
- 5.4.2 As per the 2011 census out of the total Kisko population, 54.68% of population followed Sarna Religion, 23.31% population followed Islam Religion, 16.79% population followed Hindu Religion, 5.01% population followed Christianity Religion and remaining 0.21% fall in other category.

5.5.0 HISTORICAL SITES AND ARCHAEOLOGICAL MONUMENTS, PLACES OF WORSHIP, PUBLIC UTILITIES ETC.

- 5.5.1 Akhileshwar Dham is the religious place where thousands of people come to worship. The Shravani Mela of this place is very famous in the nearby areas. The geographical structure of this, the Lord Shiva temple is surrounded by a rock on one side and a huge pond on another side. Seeing this scene, the mind gets very relaxed. That is why it is one of Lohardaga's tourist spots. This site is located in the Bhandara block at 21 km from the district headquarter.
- 5.5.2 Prachin Shiv mandir, Khakparta is one of the most popular visitor spots in Lohardaga district. This temple is devoted to Lord Shiva. This is located atop a small hill in the Khakparta village of Lohardaga Sadar Block. It is famous for its scenic beauty and tranquil ambiance.
- 5.5.3 Lavapani Waterfall is one of the most important tourist places of Lohardaga District. This waterfall is situated at Madanpur village of Peshrar Block. Here water flows on the seven steps downwards, and located at a distance of 52 km from the district headquarter.
- 5.5.4 Public utilities like Banks (private/Public), Educational institutes, Medical Facilities, are available in Lohardaga town which is at distance of 25km from the study area

5.6.0 FORESTS, SANCTUARIES, NATIONAL PARK AND WILD LIFE SANCTUARIES ETC.

- 5.6.1 The Anvarapat block boundary was checked in DSS (Decision support system) portal of MoEF (Ministry of Environment and Forest) Govt. of India and it was found to be **In-Violate Zone** which means Go Zone area.
- 5.6.2 However a part of the area falls under Pakhar Reserve Forest area in the northern part of the block boundary. The hill slopes are under Pakhar Reserve Forest with Forest density of 0.2 Thick growth of sal and other trees are common in the area.

5.7.0 FLORA AND FAUNA WITHIN AND NEARBY

- 5.7.1 Trees like Sal (Shorea robusta), Mahua (Madhuca longifolia), Bamboo (Bambuseae), Pipal (Ficus religiosa), Neem (Azadirachta indica) etc. are common in the area. Important forest products are Sal leaves, Tendu leaves, etc.
- 5.7.2 Bear, jackal, deer, monkey, birds of different types and varieties of both poisonous and non-poisonous snakes are seen in valleys covered with thick forest but in the plateau part, the forest cover is relatively sparse.

5.7.3 Agricultural work: Rice is grown in the terraced lowlands called don. In the uplands called tanr, a coarse form of rice, millets, pulses and oil seeds are grown. Agriculture is mostly monsoon-dependent. “The wells, springs and ahars are the only traditional sources of irrigation.

5.8.0 WATER BODIES SUCH AS RIVER, NALA, STREAM, RESERVOIR, ETC

5.8.1 The plateau located on the top has availability of water at depth, during monsoon rainwater drains down the escarpments, the natural slope of the plateau acts as the drainage system, slope of the plateau is towards kisko nala which flows in NW-SE in the valley and lies at about 5km from the block.

5.9.0 CLIMATIC CONDITIONS

5.9.1 The district enjoy healthy, pleasant climate throughout the year. The annual average temperature is 23°C, the highest temperature goes to 36°C in summer and lowest of 10°C in winter. The district receives annual rainfall of 1000 to 1600 mm.

5.10.0 OTHER PHYSIOGRAPHIC, SOCIAL AND ENVIRONMENTAL FACTOR

5.10.1 Lohardaga district is listed as a backward region and receives financial support from the Backward Regions Grant Fund. The fund, created by the Government of India, is designed to redress regional imbalances in development. As of 2012, 272 districts across the country were listed under this scheme. The list includes 21 districts of Jharkhand.

5.10.2 Lohardaga district has large reserves of world class bauxite across Pakhar, Hisari, Rudhali Pat, Khamar Pat and the mining area also extends to neighboring districts. Hindalco Industries Ltd has 7 mining leases out of 9 active mines in Lohardaga district which supplies bauxite to Hindalco’s aluminum plants at Muri and Renukoot.

CHAPTER-6

INFRASTRUCTURE

6.1.0 LOCAL INFRASTRUCTURE, HOST POPULATION, HISTORICAL SITES, FORESTS, SANCTUARIES, NATIONAL PARK AND ENVIRONMENTAL SETTING OF THE AREA.

- 6.1.1 Lohardaga town the district head quarter of Lohardaga district, Jharkhand has the basic facilities like government primary hospital, private dispensaries, schools, banks, post office, bus stand and markets. As far as mining industry in the area is concerned, at present bauxite is being mined by Hindalco in the vicinity of the explored block.
- 6.1.2 The host population, historical sites, forests, sanctuaries, national park and environmental setting of the area have been described in Chapter 5.0.0 (Physiography and Environment).

CHAPTER-7

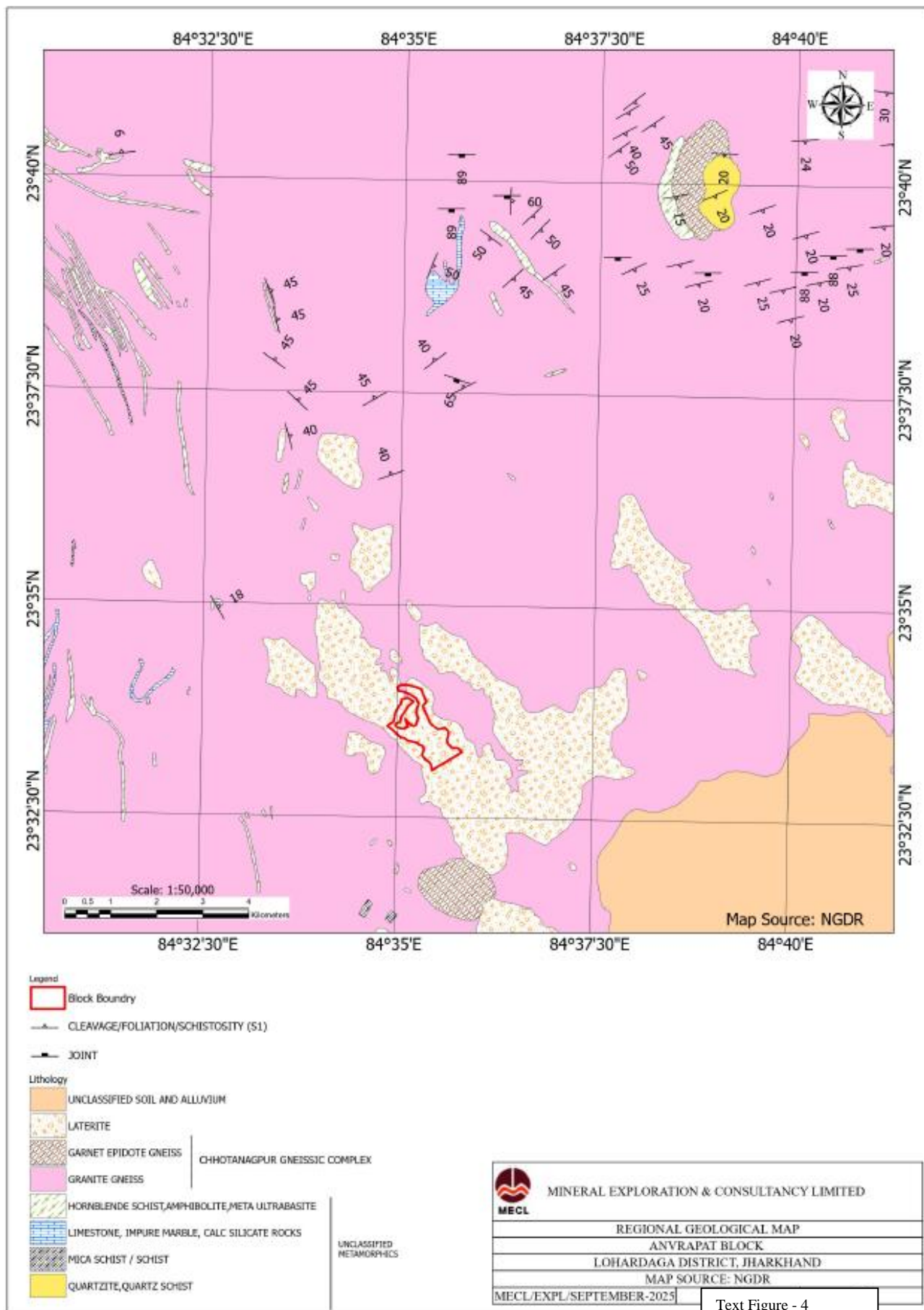
GEOLOGY

7.1.0 REGIONAL GEOLOGY AND STRUCTURE

- 7.1.1 Regionally the different lithounits in the study area consist of granite gneiss of Chhotanagpur Gneissic Complex (CGC) with enclaves of unclassified metamorphics intruded by pegmatites and thick veins of quartz. Minor outcrops of Damodar Supergroup rocks are also exposed at few places. Bauxite bearing areas are popularly known as “pat” in Chhotanagpur plateau, The laterite/bauxite are developed over the gneissic country rock belonging to Chhotanagpur Gneissic Complex (CGC).
- 7.1.2 Regional Geological Map is given as Text figure-4 and Regional Stratigraphy is given below.

Table-7.1
Geological Succession of the Lohardaga Dist, Part of Topo-sheet no 73A/10
(After GSI)

Age	Group/ Formation	Litho-units
Recent		Alluvium, conglomerate and carbonaceous shale
Tertiary to Recent		Laterite, Bauxite and lithomarge
Cretaceous	Lameta	Limestone and basalt ferruginous grit
Carboniferous to Jurassic	Damodar Super Group	Suprapanchet formation: Sandstone grit, clay Panchet formation: Red shale, sandstone, mudstone Raniganj Formation: Sandstone, shale with coal Barakar formation: Sandstone, siltstone, shale with coal Talchir formation: Shale, sandstone with conglomerate
Proterozoic		Quartz vein
Archean (?) - Proterozoic	Chhotanagpur Granite Gneissic complex	Diorite, granite, granite gneiss
Archean to Paleoproterozoic	Unclassified Metamorphics	Limestone, calc-silicate rock, Quartzite, phyllite, slate, mica schist, hornblende schist, amphibolite, talc schist



Text Figure - 4

7.1.3 **Unclassified metamorphics**

Unclassified Metamorphics which occur as enclaves within the Chhotanagpur Gneissic Complex are represented by slate, phyllite, mica-schist, quartzite, limestone, lime silicate rock epidiorite, hornblende, talc schist, amphibolites and quartz.

7.1.4 **Chhotanagpur Gneissic Complex (CGC)**

The CGC is characterized by an assemblage of gneissic rocks consisting of coarse-grained grey granite gneiss, garnetiferous grey granite gneiss, grey to medium grained granite gneiss and pink medium grained granite gneiss. Outcrops of Granite, granite-gneisses can be observed along the Auranga river section. A coarse-grained granite exposed consists of quartz, alkali feldspars, biotite with accessory minerals sphene, apatite, Fe- ore minerals etc. The granitic rocks weathered to kaolinite are found near Barnag village. Garnetiferous granite gneiss is also reported around Kharchapani.

7.1.5 **Pegmatite and vein quartz:** These occur as intrusive within the Chhotanagpur gneissic complex. The largest of the veins forming a ridge of about 1.5 km length and 0.5 km width occurs to the north of Rampur village. At Lawapani and Jobiyatoli village, pegmatite veins were found intruding the CGC.

7.1.6 **Sandstone:** Grey, mottled, medium to coarse-grained, often pebbly and conglomeratic and occasionally laminated sandstone and shale are found to occur on the surface mostly as isolated parallel to sub-parallel, arcuate bodies, north-east and north-west of Munger and south-west of Jalim. They are also exposed along the Auranga river and its tributaries like, Gowa nala etc. Feldspathic sandstone with thin beds of ferruginous sandstone are exposed along Auranga river.

7.1.7 **Laterite & bauxite:** In situ laterite capping occurs on the top of the plateau (high flat-topped hills), The lateritic capping is pisolitic in texture. The laterite/bauxite is developed over the gneissic country rock belonging to Chhotanagpur Gneissic Complex. Laterite/Bauxite outcrops are exposed in Maduapat, Siskaripat and Pakhar areas. In some areas laterite is directly in contact with granitic body, and the granite near the contact hardly shows any effect of lateralisation.

7.2.0 **REGIONAL STRUCTURE**

7.2.1 Structurally the area comprises of highly metamorphosed and deformed lithounits of Chhotanagpur Gneissic Complex. The foliation defined by flaky minerals is well preserved in granite gneiss; in porphyritic granite gneiss the foliation is defined by

the orientation of feldspar porphyroblasts. The general foliation of CGC rocks strikes NNE to NE and dips at high angle westerly. The hornblende schist and amphibolites enclaves and gabbro intrusions also occur parallel to the general foliation in gneisses.

7.3.0 GEOLOGY OF THE BLOCK

7.3.1 The Pakhar Plateau is V shaped hillock and it slopes gradually towards northeast. Steep gradients with cliff faces are characteristics of the south, east and western part of the hillocks.

7.3.2 In Anvarapat block, located in the western sector of the Pakhar Plateau within the Chotanagpur Gneissic Complex, the highest point is at 1066 mRL and lowest point towards the valley portion in north is about 940m above M.S.L. Geological mapping on 1:2000 scale delineates a central plateau—characterized by thick soil and lateritic soil cover—as the most elevated portion of the block. The northern part bears evidence of earlier mining activity, including well-developed quarries and rat-hole workings, some of which have been partially backfilled. Geological mapping has established a lithological succession comprising Bauxite, Aluminous Laterite, Massive Laterite, Laterite, and Saprolite zones. In the block area, exposures of bauxites, laterites in old quarries are observed and mapped by MECL. The stratigraphy sequence is given in **Table No. 7.2**. The Geological map of the block is presented as **Plate No.-III** and **Text Figure-5**.

Table No. 7.2: The Local Stratigraphic Succession of the Anvarapat block

Recent	Soil
Tertiary to Recent	Laterite Soil (0.1 to 2.0m)
	Laterite and Morrum (1.5-2.5m)
	Bauxite and aluminous laterite (0.5 to 15.0m)
	Variegated Clay (6.0 to 27.0m)
	Lithomarge (2-5m)

7.4.0 DESCRIPTION OF DIFFERENT LITHO UNITS IS GIVEN BELOW

The litho-units of the block consist of lateritic soil, laterite, bauxite, variegated clay and lithomarge. These litho-units were intersected in boreholes of varying thickness. Their colour, texture and chemical compositions vary widely the detailed petrography and description of rocks exposed/ intersected in the boreholes are given below.

1. **Soil:** The soil profile is well developed in most part of the block. At places Bauxite/laterite is exposed forming irregular out crop. The Soil is grey brown to deep red in colour.

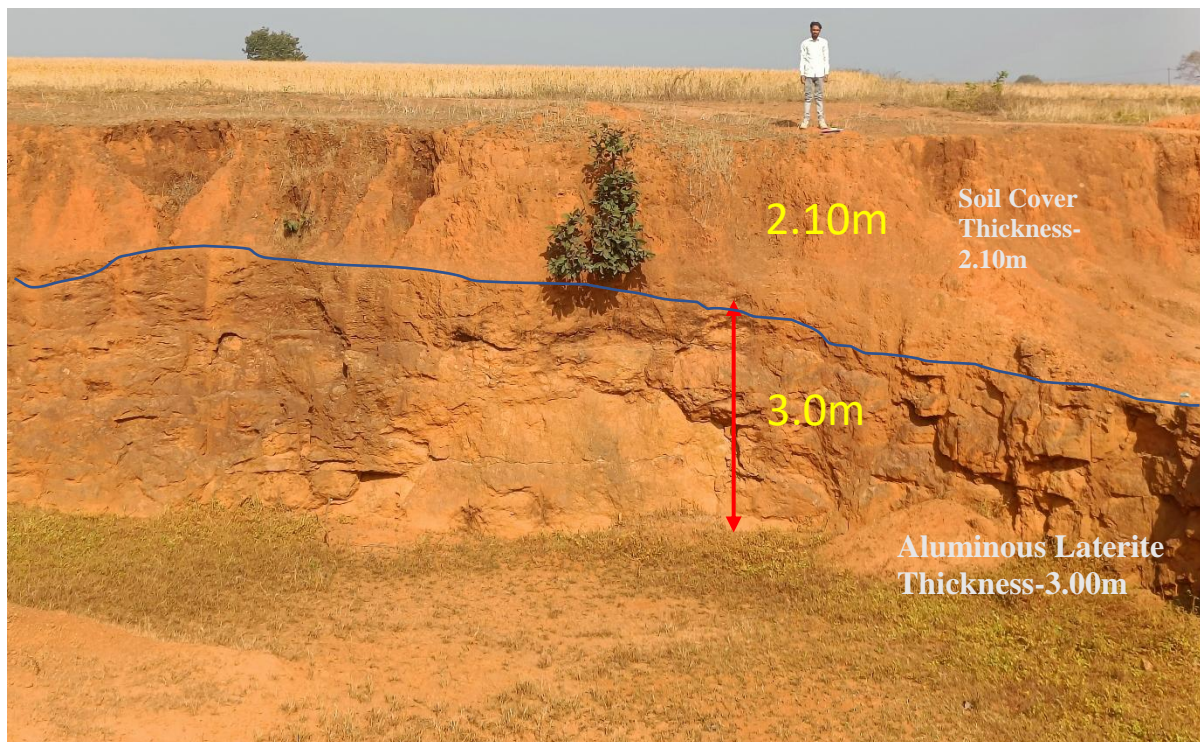


Photo 1: Lateritic Bauxite Soil horizon and Bauxite horizon are observed in the block

2. **Laterite/Aluminous laterite:** Laterite is seen as irregular body associated with morrum/lateritic morrum in the block and the thickness varies from 1.5 to 2.50 m. It overlies bauxite and underlies the lateritic soil at places. It is reddish in colour, hard, compact, and massive bodies with vesicular, scoriaceous, and ferruginous (murum) characteristics. These lateritic masses are sometimes aluminous, containing aluminous vesicles. Segregation of bauxite is commonly observed just beneath the pisolitic laterite (murum)
Hard, compact, deep-red lateritic pisolite horizons are exposed along escarpments and in some old quarry faces, representing intense lateritization. The associated murum (loose lateritic detritus) forms a discontinuous coating along escarpment edges, indicating differential weathering and erosional processes.

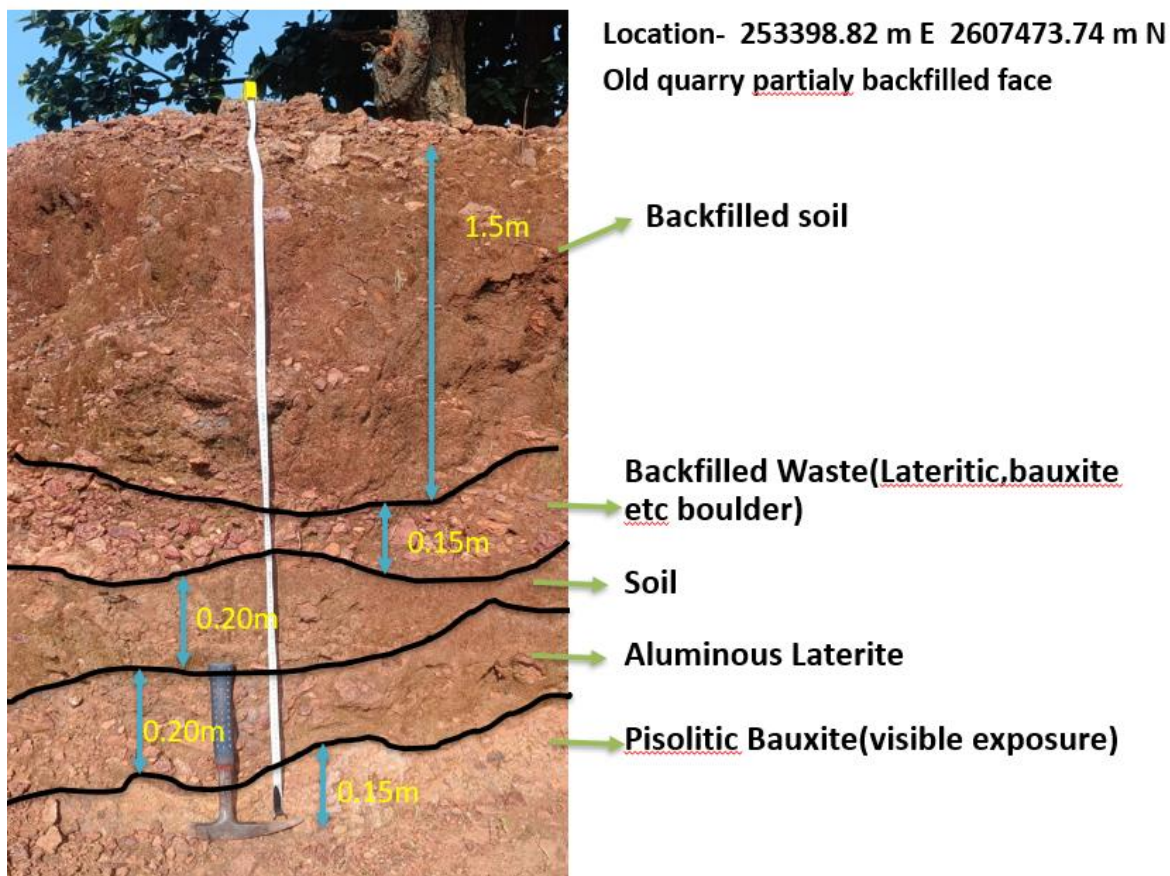


Photo 2: Profile at an old quarry as observed and mapped in the block

3. Bauxite:

The Anvarapat block in the western sector of the Pakhar Plateau overlies the Chhotanagpur Gneissic Complex, where the crystalline basement is composed predominantly of banded gneissic rocks that provide the protolith for the lateritic–bauxitic profile. The regolith exhibits a well-differentiated soil–laterite–bauxite sequence generated through intense tropical weathering, leaching, and supergene enrichment. Surface exposures comprise ferruginous soil and indurated laterite marked by pervasive hematitic/limonitic impregnation, light-pink bauxitic lenses, and abundant spherical iron-oxide nodules (murum)—all reliable indicators of subsurface bauxite mineralization. Aluminous laterite within the sequence typically appears light pink to grey coloured and contains small to large, rounded to ellipsoidal aluminous fillings disseminated through the matrix, further reflecting advanced aluminum enrichment.



Near edge of old work quarry

Location- 253212.00 m E 2607585.00 m N

Iron intrusion in Aluminous Laterite



Location- 253898.59 m E 2607072.73 m N

Light pink bauxite and spherical nodules of iron(murum)-Indication of Bauxite beneath.



Photo 3: Iron Intrusion in Aluminous laterite and spherical nodules of iron



Boulder in heaps

Location- 253629.66 m E 2607296.50 m N
Pisolitic Bauxite-Homogeneous
pisolitic structure

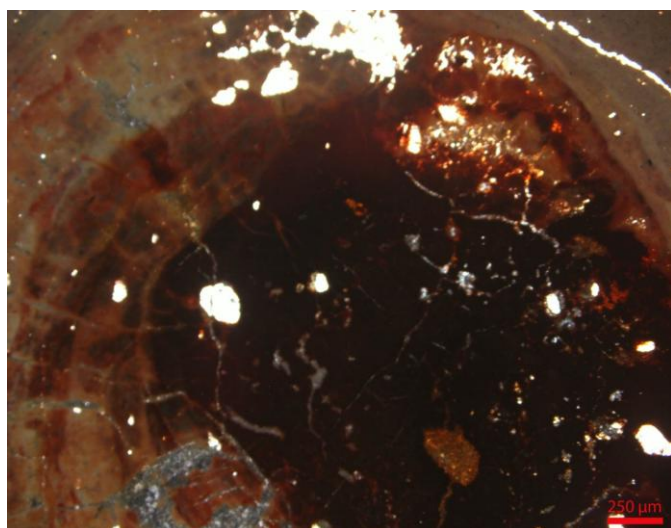


Location- 253645.88 m E 2607297.77 m N

Pisolitic Bauxite-Hetrogenous/Brecciated
pisolitic structure

Photo 4:
Pisolitic
bauxite in
the block

Bauxite in the block is identified as boehmite-type and exhibits as white to light pink to grey colour, hard and compact, with a distinctly developed pisolitic structure that is prominent at several localities. Petrographic examination confirms that the bauxite horizon is dominantly composed of fine- to coarse-grained cliachitic pisolites and patches, commonly displaying concentric banding and frequently replaced partially or wholly by very fine granular aggregates of gibbsite-boehmite. Gibbsite also forms thin cavity fillings of very fine to fine prismatic grains exhibiting a characteristic comb structure and occurs as disseminations intimately associated with boehmite. Opaque minerals, occurring as medium- to coarse-grained patches and irregular fillings, are typically embedded within reddish ferruginous aggregates and stains. Clay minerals appear as dirty to earthy patches, generally in association with cliachite and ferruginous matter

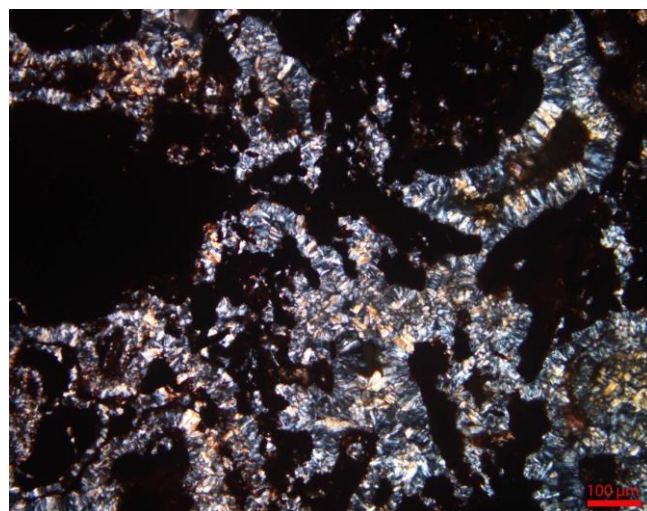


Pmg – 1:

Pmg – 1: Photomicrograph showing cliachitic pisolite with concentric rings and contraction cracks as seen under crossed nicols.

Specimen No. : MAP/P/01

Magnification : 40X



Pmg – 2:

Pmg – 2: Photomicrograph showing thin cavity fillings of gibbsite as seen under crossed nicols.

Specimen No. : MAP/P/05

Magnification : 100X

The bauxite exhibits multiple pisolitic facies: (i) elongated aluminous pisolites with localized goethitic/hematitic infill, (ii) ferruginous pisolitic bauxite with lustrous iron-oxide coatings on fine pisolites, (iii) massive homogeneous pisolitic

bauxite with well-sorted spheroidal concretions, and (iv) heterogeneous to brecciated pisolitic bauxite reflecting syn- and post-depositional deformation and episodic re-cementation during lateritization. Aluminous laterite shows advanced limonitization, brecciation, and brittle fracture fabrics, indicative of cyclic Fe-mobilization, silica depletion, and fluctuating redox conditions.



**Aluminous(Grey)
compact Pisolitic
Bauxite**

**Aluminous Rich
Friable Pisolitic
Bauxite**

**Fine pisolitic
bauxite**

**Heterogenous
Pisolitic Bauxite**

Laterite

Location- 253619.13 m E 2607277.22 m N



Location- 254043.10 m E
2607499.52 m N
Aluminous Laterite- seen
like brecciation brittle
behaviour.

**Aluminous Laterite with
laterite Capping.**



Biopedological observations, notably the juxtaposition of normal and stunted *Shorea robusta* (Sal) growth within single micro-catchments, reflect sharp lateral variations in regolith thickness, porosity–permeability, and nutrient availability—all controlled by the underlying gneissic bedrock, mineralogical heterogeneity (cliachite, gibbsite, boehmite, opaques, and clay minerals), and the intensity of chemical weathering that transformed the parent Chotanagpur gneiss into a bauxite-rich laterite.



Normal growth and stunted growth of sal tree at same photo frame

Location:
253816.59 m
E 2607477.03
m N



Indication of Bauxite beneath stunted growth of sal tree

LOCATION : 253661.64 m E 2607429.22 m N



Location : 253371.21 m E 2607851.17 m N

Generally, bauxite underlies the soil in western, south western and north western parts of the block. The bauxite is mostly hard, dense, compact with thickness ranges between 0.5 to 15m.

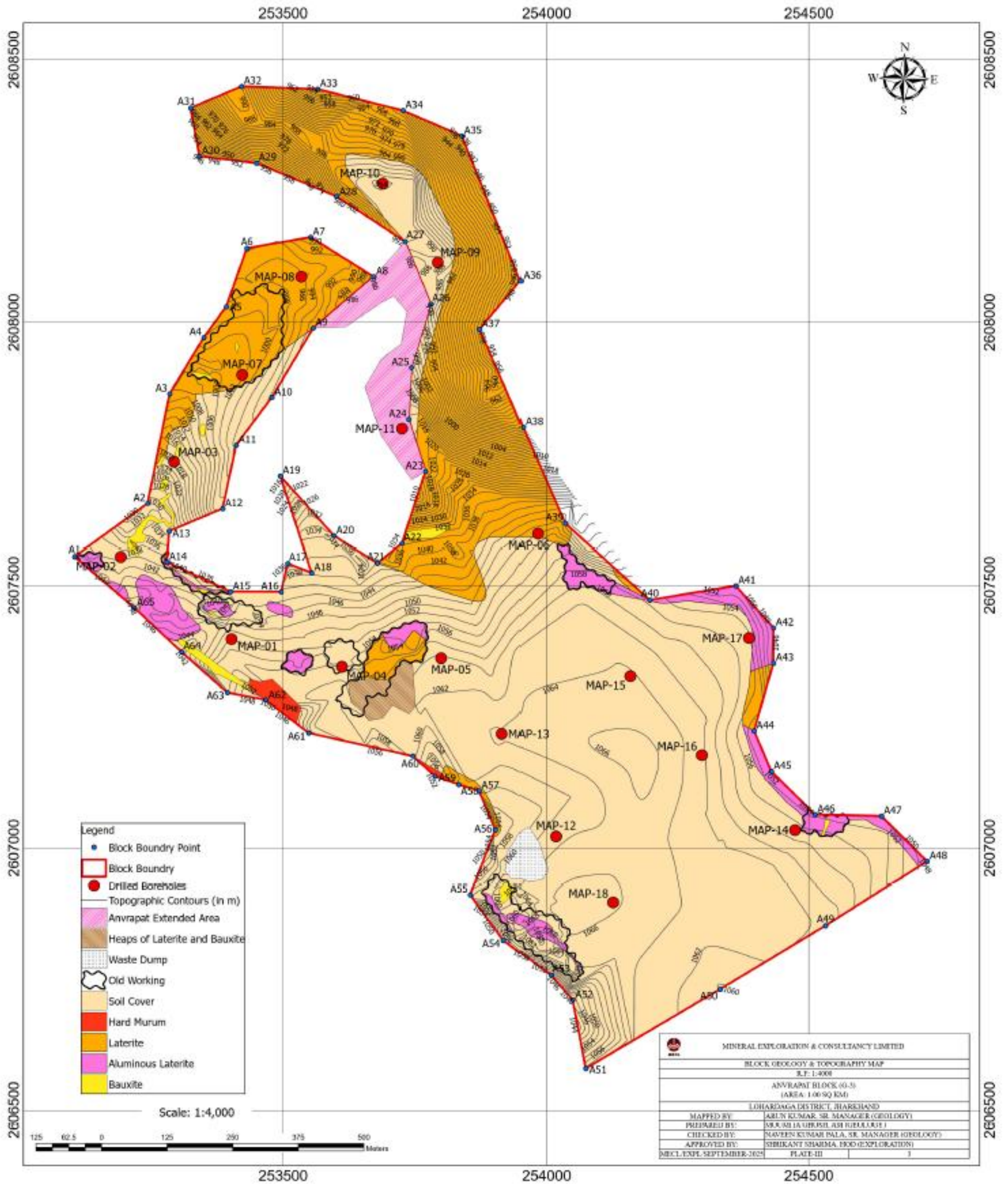
- (a) Average thickness of bauxite is intercepted in the 18 no boreholes drilled by MECL is 4.83m, with Min thickness of 0.60m (MAP-01) and maximum 15.00 m (MAP-14). Depth of intersection of these zones is min 0.50m (MAP-14) and max of 25.00m (MAP-13).
- (b) In the zones demarcated, Al_2O_3 varies from Min 31.14% (MAP-04) and Max 42.77% (MAP-01) and SiO_2 varies from Min 2.38% (MAP-17) and Max 6.91% (MAP-04)

4. **Clay/Variegated:** this litho-unit is observed in all the boreholes which varies in colour from reddish/pinkish brown/greyish brown to khaki brown **and the thickness of this litho unit as intercepted in boreholes varies from 1.5m (BH MAP-16) to 27.00m (BH MAP-03).**



**Photograph No.7: Core Photograph of MAP-11 showing
Clay intercepted between 6.00 to 10.00m**

5. **Lithomarge-** All the boreholes were closed in lithomarge after intercepting about 2 to 5m. Lithomarge as observed is white to pinkish white, light cream, yellow coloured as well as also showing other light colours.
6. **Granite gneiss:** Basement is not intercepted in the drilled boreholes. However, in one boreholes MAP-13, weathered granite gneiss is intercepted at depth from 49.00 to 50.00 and after which the borehole was closed.



TEXT FIGURE- 5

7.5.0 STRUCTURE OF THE BLOCK

7.5.1 Primary structure: Bauxite and lateritic bauxite show some clear distinguishable pisolites of diameter 0.10-0.40 mm. These pisolites vary in shapes and sizes filled with grey colour clay at places.

7.5.2 **Secondary structure:** Solution cavities observed in lateritic bauxite that were filled by drusy quartz at places. Laterite occurs in concretionary and vesicular form with nodules of Fe fragments.

7.6.0 MINERALISATION

7.6.1 Pakhar plateau is one of the main topographic unit in the area with altitudes between 940m to 1066m MSL. laterite/bauxite is developed over the gneissic country rock belonging to Chotanagpur Gneissic Complex (CGC).

The Anvarapat Block exhibits supergene bauxite mineralization developed over the gneissic basement of the Chotanagpur Gneissic Complex through prolonged tropical weathering and lateritization. Mineralization occurs as a capping of bauxite-rich laterite characterized by pocket- to blanket-type deposits localized along the western sector of the Pakhar Plateau. The ore zone comprises a spectrum of pisolitic bauxites—homogeneous, heterogeneous/brecciated, and ferruginous—reflecting multiple phases of chemical leaching, residual enrichment, and post-depositional reworking. Petrography reveals that cliachite forms the primary pisolitic matrix, frequently replaced by very fine granular aggregates of gibbsite and boehmite, which constitute the principal aluminum-bearing minerals. Gibbsite occurs both as thin cavity fillings of prismatic comb-structured grains and as fine disseminations, while boehmite is closely associated within these aggregates. Iron oxides and hydroxides (goethite/hematite) form opaques and ferruginous patches, locally infilling pisolitic cavities and creating limonitic zones that impart a deep-red coloration and contribute to the high ferruginous content of the ore. Clay minerals occur as minor phases, forming dirty to earthy patches intergrown with ferruginous matter. The mineral assemblage—dominated by gibbsite with subordinate boehmite, cliachite, opaques, and ferruginous clays—indicates a mature lateritic bauxite deposit with high alumina potential and variable iron enrichment, controlled by intense weathering of the underlying gneissic bedrock and fluctuating redox conditions.

7.7.0 MODE OF OCCURRENCE

7.7.1 The lateritic bauxite profile comprises four horizons and rests on the parent rock which provides the source material for bauxitisation

a) Residual soil horizon:

This is the topmost part of the profile, comprises of mechanical and chemical weathering products of the underlying horizon. The important character of this zone is that it contains plant remnants, humus and vegetation grow over it. Colour of this horizon depends on the nature of parent material and varies from brown to reddish brown to red colour. In most of the boreholes drilled in this area, soil horizon had been intersected from 0.3 to 5.0 m thick.

b) Duricrust horizon:

This is the upper portion of the accumulation zone. This part forms from the selective leaching of silica, silicate minerals and alkalis, enrichment and recrystallization of iron minerals. This is the hardest part with colour variation from black-red, red-brown to yellowish brown showing vesicular, colloform, nodular, concretionary to botryoidal texture.

c) Bauxite horizon:

Below duricrust the bauxite zone occurs. It is the lower portion of lateritic part which is rich in alumina minerals and is less hard. The horizon is homogeneous at places or has varying structure, texture composition and colour. The colour of the bauxite horizon is highly variable ranging from almost white to greyish, grey-brown, pinkish, reddish brown to brown in colour. Thickness of the bauxite horizon ($\text{Al}_2\text{O}_3 \geq 30\%$, $\text{SiO}_2 \leq 7\%$) varies from 1.00 m (borehole MAP-12) to 15.00 m (borehole MAP-14).

d) Saprolite horizon:

This horizon is the zone of leaching and composed of weathering products of the aluminium sheet silicates present in the parent rock, mainly clay mineral kaolinite. This zone also known as lithomarge. Colour of the saprolite zone varies widely from red, yellow, grey, brown, black, white, pink and variegated. It is often mottled soft earthy and porous. The upper portion is devoid of any relict texture or structure but the lower part preserve the texture or structure like foliation, grain size variation small folds etc. those were present in parent rock. The lower most part contains fragmented bedrock.

7.8.0 MINERAGRAPHIC AND PETROGRAPHIC STUDIES OF MINERALISED CORE SAMPLES

7.8.1 A total of 5nos. of XRD samples were collected from different bauxite/laterite zones and sent for mineralogical studies in Chemical lab of MECL. Nagpur. Results are awaited. A total 10 no of samples were subjected to Petrographical studies which confirmed the samples as bauxite/aluminous laterite. The sample wise details of the petrographic studies are presented as Annexure-VII and the photomicrographs of the polished sections are given as pmg-1.

7.8.2 Available Alumina and Reactive Silica: A total of 35 samples (MAPC-01 to MAPC-35) were analysed for: **THA-40⁰C, MHA-240⁰C and Reactive Silica** (critical for evaluating suitability for metallurgical, refractory or cement applications)

THA-40⁰C ranges between 14.03 to 35.19% and MHA-240⁰C ranges between 0.05 to 7.28% and Reactive Silica ranges between 1.55 to 13.32%

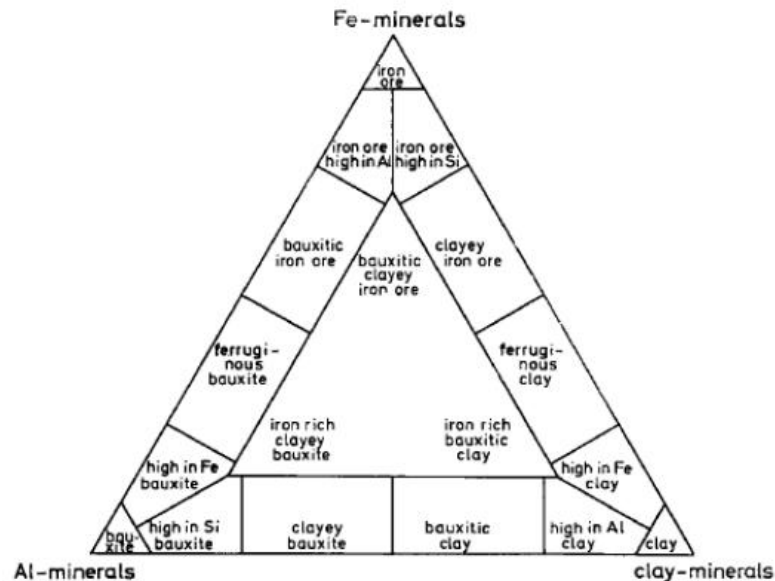
The analysis reveals a heterogeneous deposit with distinct high-quality and low-quality pockets. While several samples exhibit favourable THA and low silica, reactive silica remains the primary constraint. Approximately 20–25% of samples qualify as high-grade material. Targeted selective mining and geological mapping of low-silica zones are recommended to maximize resource value

Details of analysis are submitted as annexure-XI.

7.9.0 GEOCHEMISTRY OF BAUXITE

7.9.1 The classification proposed by Valetton (1972), modified from Bardossy (1963), is based primarily on genesis (mode of formation) and parent rock type, reflecting the geological and geochemical processes involved in bauxite formation.

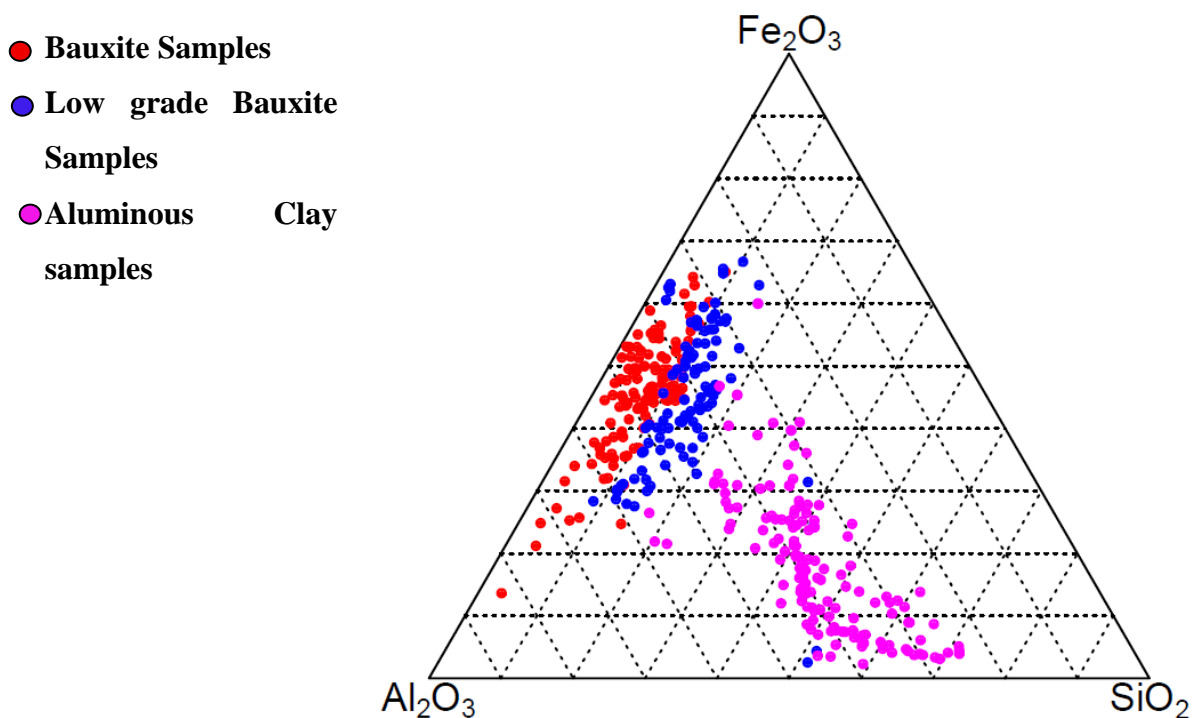
Classification scheme proposed by Valeton, modified from BARDOSSY(1963) is shown below,



TEXT FIGURE- 6

7.9.2 All the sample data of bauxite, low grade bauxite and clay are plotted on Ternary diagram and based on the Al_2O_3 – Fe_2O_3 – SiO_2 ternary diagram, bauxites along with its transition varieties from Ferruginous bauxite to Bauxitic iron ore, Clay form bauxitic clay (Fig. 7).

TEXT FIGURE- 7 – Al_2O_3 – Fe_2O_3 – SiO_2 ternary diagram of Samples analysed in Anvarapat block.



- 7.9.3 **Ferruginous Bauxite:** Ferruginous bauxite forms through intense lateritic weathering of alumina-rich parent rocks such as granite, gneiss, under tropical to subtropical humid climatic conditions. During prolonged chemical weathering, silica (SiO_2) is leached out, while alumina (Al_2O_3) and iron oxides (Fe_2O_3) become concentrated in the residual layer. When the process favors aluminium enrichment with partial retention of iron, ferruginous bauxite develops. It typically occurs as blanket-like caps over plateaus and hilltops, representing the upper zones of lateritic profiles, where alternating wet and dry periods promote oxidation and iron accumulation.
- 7.9.4 During bauxitization, Fe remains relatively immobile, while silica is leached out under tropical weathering. Hence, Fe accumulates residually along with Al, leading to ferruginous or high Fe_2O_3 bauxite.
- 7.9.5 Both ferruginous bauxite and bauxitic iron ore are products of the same lateritic weathering cycle, differing only in the relative dominance of aluminium or iron during the process of leaching, concentration, and secondary enrichment.

CHAPTER-8

PREVIOUS WORK

8.1.0 DETAILS OF PREVIOUS EXPLORATION CARRIED OUT BY OTHER AGENCIES/PARTIES

- 8.1.1. F.S: 2016-17, “Regional Geochemical Mapping in toposheet nos. 73A/10 and 73A/14 (A1 quadrant) in lohardaga, latehar, chatra and ranchi districts of Jharkhand” was carried out by Ms Poonam Nagar (Geologist) and Ms Indrani Karmakar (Geologist) GSI.
- 8.1.1.2 A total 808 sq. km area was systematically mapped by three different media; stream sediment, soil and water as per the NGCM guideline. Stream sediment samples were collected on 1km x 1km unit cell and composite samples 2km x 2km grid whereas water, soil, regolith ‘R’ and ‘C’ horizon were collected by 5’x5’ grid pattern of the 1:50,000 scale.
- 8.1.1.3 A total of 808 nos. of unit cell samples (202 composite samples), 10 nos of soil C samples, 10nos of regolith samples, 10 nos. of water samples and 10 nos of duplicate samples were collected and processed. Along with these 10 nos of XRD samples, 10 nos. Samples of heavy mineral and 04 nos. of rock samples for petrographic studies were also collected from both toposheet’s.
- 8.1.1.4 Soil sample studies show uniform distribution of elements. Higher concentration of SiO₂ in samples is mostly governed by granite gneiss. Aluminium concentration is higher in samples where CGC is capped by laterite. Higher values of Fe₂O₃ are present where laterite is present. Al₂O₃ show higher values in south- western and central part of toposheet no.73A/10 and this is due to the presence of laterite in these areas. Fe₂O₃ values are higher in central part around Pakhar R.F. where laterite is the dominant lithology.
- 8.1.1.5 LREE enrichment is present in the soil samples with min value of 116.81 and maximum of 693.56 PPM, TREE content is a min of 140.62 to max 781.84 ppm. These high REE’s values are observed over granite.
- 8.1.1.6 MECL has carried out exploration in Siskaripat block which is located 500m away in eastern direction from the current explored block. In this block MECL has established Bauxite resources of 2.99 MT with an average grade of alumina 35.57%, silica 4.96% and Aluminous Laterite resources of 4.02 MT with an average grade of

alumina 32.57%, silica 14.20%, Currently this block is under auction platform by Central govt of India.

- 8.1.2 HINDALCO INDUSTRIES group is working extensively in the Pakhar area and successfully mining bauxite in the name of Pakhar Mines.

CHAPTER-9

DETAILS OF AERIAL, GROUND GEOPHYSICAL AND GEOCHEMICAL SURVEY

9.1.0 DETAILS OF AERIAL, GROUND GEOPHYSICAL AND GEOCHEMICAL SURVEY TAKEN UP AND THEIR RESULTS.

- 9.1.1. During the current exploration program no Aerial/Geophysical surveys were carried out.

CHAPTER-10

EXPLORATION UNDERTAKEN DURING CURRENT INVESTIGATION

10.1.0 INTRODUCTION

- 10.1.1 The importance of bauxite is well known in the production of Aluminium metal and also in other industries viz. abrasives, refractory, chemical and cement. The properties like lightness of metal aluminium, its high resistance to atmospheric corrosion and good electrical conductivity makes it a popular metal and is being used for making household utensils and therefore known as ‘poor man’s gold’. The aluminium metal being a good substitute for nonferrous metals like copper, zinc which are scarce and costly metals has further necessitated the development of aluminium industry throughout the world.
- 10.1.2 Resources of bauxite in the country as on 01.04.2020 as per Indian Mineral Year book 2022 are placed at 4,958 million tonnes. These resources include 646 million tonnes reserves and remaining 4,311 million tonnes remaining resources. By grades, about 79% resources are of Metallurgical grade (I, II & Mixed). The resources of Refractory and Chemical grades are limited and together account for about 4 %. States, Odisha alone accounts for 41% of country's resources of bauxite followed by Chhattisgarh 20%, Andhra Pradesh (12%), Gujarat (8%), Jharkhand (6%), Maharashtra (5%) and Madhya Pradesh (4%). Major bauxite resources are concentrated in the East Coast bauxite deposits in Odisha and Andhra Pradesh
- 10.1.3 The production of bauxite is 22,494 thousand tonnes in 2021-22 increased by 10% as compared to previous year. There are 126 reporting mines in 2021-22 as against to 134 in the previous year. Ten principal producers having 41 mines contributed 91.40% of total production. NALCO is the leading producer and contributed 33% of the total production.
- 10.1.4 In view of the enactment of the MMDR Amendment Act-2015 and Mineral Auction Rule- 2015 by the Govt. of India, DMG, Government of Jharkhand had discussed with MECL to take up exploration work for Bauxite blocks in Lohardaga district of Jharkhand for upgradation of these areas as per the MMDR Amendment Act and Mineral Auction Rule, 2015 which shall enable the state government for auctioning of the Bauxite blocks.

- 10.1.5 Based on the mineral potentiality of the prospect and previous work carried out by GSI and MECL in the area, MECL formulated G-3 stage Exploration proposal and presented in the 68st TCC meeting of NMEDT held on 28th 29th and 31st August 2024. The Technical Cost committee has technically evaluated and recommended the exploration proposal for approval Executive Committee (EC) of NMET.
- 10.1.6 Consequently, the project was approved by 37th EC, NMET held on 23rd September 2024 and the same was intimated to MECL by Ministry of Mines vide letter number F.No.23/500/2024-NMET/445, New Delhi dated 23rd October 2024. Project was approved with the title “Preliminary Exploration (G-3 level) for Bauxite, Titanium and Associated minerals in Anvarapat block, District-Lohardaga, Jharkhand”, with estimated cost of Rs 175.63 Lakhs including GST in time schedule of 08 months for carrying out the proposed work (Annexure IX) and submission of report.
- 10.1.7 The present exploration drilling work in Anvarapat block commenced with geological mapping and exploratory drilling in Borehole No. MAP-01 on 24.01.2025 and completed with the closure of Borehole No. MAP-18 on 30.06.2025. As per approved quantum of work, a total 519.00 drilling was completed in approved 18 no of boreholes. The allied field-works including Borehole survey, topographical survey, sampling and analytical work were completed simultaneously. The laboratory studies including chemical analysis and physical analysis i.e. petrographic and bulk density studies were carried out simultaneously in laboratories of MECL and other Govt. / NABL accredited laboratories.
- 10.1.8 The details of the nature and quantum of work proposed Vs actual achievement is given in **Table-10.1**.

Table – 10.1
Approved Quantum of Work vs. Achievement by MECL in Anvarapat block, District: Lohardaga, State: Jharkhand

S. No	Item details	Unit	Quantum of work approved	
			Approved	Achieved
1.	Topographic Survey (Contour interval 2m) & Geological Mapping (1:2000 scale)	Sq. Km.	1.00	1.02
2.	Bore Hole Fixation and determination of co-ordinates & Reduced Level (RL) of the boreholes and demarcation of lease hold boundary points by DGPS	Nos.	83	83

S. No	Item details	Unit	Quantum of work approved	
			Approved	Achieved
3.	Core drilling 18 boreholes. Out of 18 BHs, 15 BHs of 30m depth to be drilled lithomarge and 03 borehole are proposed to be drilled upto 50m or basement (whichever is earlier)	M	600	519
4.	Pitting for determination of Bulk density (1mX1mX1m) – 3 Nos.	Cu.m	3	3
5.	Sampling & Chemical Analysis			
A)	Primary samples to be analyzed for 7 radicals viz. Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 , LOI, Ga & V.			
i.	Borehole Core samples	Nos.	540	487
ii.	Check samples (10% external)	Nos.	54	49
6.	Physical Studies			
a)	ICP-AES/ICPMS (sequential technique) for 34 elements i.e. 16 other elements viz. Li, Ga, In, Be, Ge, Mo, Ni, Cr, Ta, W, Ba, Co, Rb, Sr, Zr, Nb ; 16 REE viz. La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Sc, Y; 02 Actinides viz. U, Th.	Nos.	36	35
b)	X-RD studies	Nos.	05	05
c)	Combined determination of THA, MHA and Reactive Silica	Nos	36	35
7.	Petrographic Studies	Nos.	10	10
8.	Preparation of Polished Section & Thin Section.	Nos.	10	10
09.	In situ bulk density determination	Nos.	03	03
10	Geological Report Preparation {As per Mineral (Evidence of mineral contents) Rule-2015}	Nos.	01	01

10.2.0 OBJECTIVES OF INVESTIGATION

10.2.1. The objectives of present exploration programme at G-3 stage are as follows.

1. Preparation of Geological map on 1:2,000 Scale.
2. To carry out topographical survey on 1:2000 scale at 2m contour interval.
3. To prove the continuation of Bauxite zone(s) which are present in the adjacent Pakhar Bauxite Mine. Also to confirm the Bauxite occurrence up to the vertical depth of 30m below ground level.

4. Fifteen bore holes will be drilled upto the 30m depth and three borehole upto 50m i.e. (till basement or whichever is earlier)
5. To assess the quality and the thickness of Bauxite horizons to estimate the Bauxite resources at G-3 (333) level in the block both quantitatively and qualitatively.
6. Along with Bauxite, resources of Titanium and associated Minerals also be reported if encouraging values are encountered.
7. To carry out exploration as per Minerals (Evidence of Mineral Contents) Rules, 2015, Mineral Auction Rule – 2015 and MMDR Act – 2015 to facilitate the Department of Mines & Geology (DMG), Government of Jharkhand for auctioning of the Bauxite block.

10.3.0 DETAILS OF PITTING, TRENCHING, DRILLING, ETC.

- 10.3.1 The approved scheme of Preliminary Exploration (G-3) work in Anvarapat Block includes geological mapping, Survey, drilling, core logging, Pitting, core sampling and associated laboratory studies
- 10.3.2 Trenching activities was not done in the block area, as this is not part of the scope of work. However, Pitting was carried out to calculate bulk density.
- 10.3.3 **Exploratory Drilling:** During the present exploration program, total 18 no of vertical boreholes on 200 to 300m spacing as given in para no 10.4.1, involving a total of 519.00 m of drilling was carried out in the block to check the strike and depth continuity of Bauxite bearing ore zones in the block area. All borehole cores were logged and mineralized zones were identified and samples were prepared from the mineralized zones and analysed for five oxides viz. Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI and Elements Vanadium and gallium. Lithomarge/saprolite samples were analysed for Total Rare Earth Elements at MECL Chemical Laboratory, Nagpur.
- 10.3.4 Summarised borehole details are given in Table No. 10.2. The details are given in Annexure No. IA.

Table-10.2
Details of Boreholes drilled by MECL in Anvarapat block, District: Lohardaga,
State: Jharkhand

Sl.No.	BH.No.	Northing (m)	Easting (m)	RL (m)	Date of Commencement	Date of Closure	Total Depth (m)
1	MAP-01	253401.652	2607397.974	1052.096	24.01.25	05.02.25	30.50
2	MAP-02	253190.471	2607553.713	1039.160	07.02.25	17.02.25	30.50
3	MAP-03	253291.800	2607734.582	1019.267	20.02.25	01.03.25	30.00

Sl.No.	BH.No.	Northing (m)	Easting (m)	RL (m)	Date of Commencement	Date of Closure	Total Depth (m)
4	MAP-04	253612.222	2607345.275	1056.197	05.03.25	19.03.25	30.00
5	MAP-05	253801.550	2607361.516	1060.575	20.03.25	29.03.25	30.00
6	MAP-06	253983.745	2607597.386	1050.154	31.03.25	08.04.25	28.00
7	MAP-07	253422.007	2607900.068	1002.495	09.04.25	13.04.25	15.00
8	MAP-08	253534.659	2608087.311	996.831	15.04.25	21.04.25	23.00
9	MAP-09	253794.856	2608114.150	989.366	22.04.25	26.04.25	15.00
10	MAP-10	253690.164	2608264.556	995.398	27.04.25	30.04.25	16.00
11	MAP-11	253726.954	2607797.624	1014.676	02.05.25	06.05.25	19.00
12	MAP-12	254018.171	2607022.519	1062.859	07.05.25	15.05.25	30.00
13	MAP-13	253916.696	2607217.504	1064.354	13.05.25	02.06.25	50.00
14	MAP-14	254473.790	2607034.468	1056.860	16.05.25	26.05.25	30.00
15	MAP-15	254159.828	2607327.537	1064.364	28.05.25	08.06.25	30.00
16	MAP-16	254296.159	2607177.011	1062.522	05.06.25	30.06.25	39.00
17	MAP-17	254385.922	2607400.125	1056.874	11.06.25	29.06.25	30.00
18	MAP-18	254126.859	2606896.683	1066.326	04.07.25	24.07.25	43.00
Total:							519.00

10.4.0 DATA SPACING FOR REPORTING OF EXPLORATION RESULTS

10.4.1 Most of the boreholes are drilled on 200 m spacing in NW-SE direction and in NE-SW directions general spacing is 300m. Owing to plateau conditions borehole spacing varies at places. However, all the boreholes were drilled at 200m interval.

10.4.2 Extract of MEMC Part III is as below

Exploration Norms for different types of deposits for I. Bedded Stratiform and tabular deposits of regular and irregular habit:

For limestone, bauxite, potash and salt beds the grid spacing of bore holes may be 800m or closer for deposits of regular habit and 400m or closer for irregular habit; for others the spacing may be 400m or closer for regular and 200m or closer for irregular habit.

Or

Provided that for deposits specified in Schedule II, 3 bore holes drilled so as to form a polygon in blocks of less than 100 hectares and 5 bore holes in blocks of more than 100 hectares may be sufficient. The lateral influence beyond the bore hole spacing may be limited to a maximum of 50 per cent. of the spacing depending on the results of surface geological mapping.

10.4.2 As per MEMC rules stated above. Resources have been estimated by polygon method. The estimated resources in the block area may be placed under Inferred Mineral Resource (333) category as per UNFC code. However as per the Minerals (Evidence of Mineral Contents) Rules, 2015, amended upto 14th Dec 2021, Rule 5 which states “At least Preliminary Exploration (G3) has been completed to establish Inferred Mineral Resource (333), which shall be considered akin to Indicated Mineral Resource (332), and a geological study report has been prepared conforming to Part IV of Schedule-I.” **Hence resources are categorized under 332 category.**

CHAPTER-11

LOCATION OF DATA POINTS

11.1.0 ACCURACY AND QUALITY OF SURVEY USED TO LOCATE DRILL HOLES

11.1.1 The surveyed block area is located near Pakhar village, lies in the Lohardaga District. Anvarapat block covers an area of 1.02 sq.km, and falls in part of Survey of India Toposheet No.73A/10. Survey site is located 13km northwest from Kisko village (block of Lohardaga dist) and approximately 25 km from Lohardaga, District headquarters, Jharkhand.

Table no 11.1

Block Boundary coordinates of corner points for Anvarapt block, District - Lohardaga, Jharkhand as per DGPS Survey

LABEL	UTM (WGS84) - ZONE 45 N		D M S		REDUCED LEVEL (M)
	EASTING (m)	NORTHING (m)	LATITUDE (N)	LONGITUDE (E)	
A 1	253102.396	2607554.106	23° 33' 34.583"	84° 34' 52.367"	1042.424
A 2	253242.052	2607655.072	23° 33' 37.939"	84° 34' 57.229"	1031.328
A 3	253284.080	2607863.649	23° 33' 44.739"	84° 34' 58.587"	1005.935
A 4	253349.041	2607970.945	23° 33' 48.261"	84° 35' 0.812"	1000.191
A 5	253391.994	2608029.951	23° 33' 50.201"	84° 35' 2.291"	998.395
A 6	253431.028	2608140.855	23° 33' 53.826"	84° 35' 3.601"	993.698
A 7	253552.660	2608162.108	23° 33' 54.583"	84° 35' 7.875"	988.443
A 8	253672.943	2608087.013	23° 33' 52.209"	84° 35' 12.159"	983.775
A 9	253557.851	2607989.288	23° 33' 48.971"	84° 35' 8.161"	990.534
A 10	253479.019	2607856.990	23° 33' 44.629"	84° 35' 5.461"	993.381
A 11	253410.996	2607766.010	23° 33' 41.636"	84° 35' 3.118"	996.918
A 12	253384.936	2607644.996	23° 33' 37.690"	84° 35' 2.271"	1002.982
A 13	253283.047	2607601.923	23° 33' 36.235"	84° 34' 58.706"	1033.165
A 14	253278.657	2607544.175	23° 33' 34.357"	84° 34' 58.585"	1038.871
A 15	253400.026	2607487.833	23° 33' 32.593"	84° 35' 2.896"	1043.081
A 16	253496.334	2607487.754	23° 33' 32.643"	84° 35' 6.291"	1042.508
A 17	253508.922	2607541.010	23° 33' 34.380"	84° 35' 6.703"	1034.006
A 18	253554.796	2607523.392	23° 33' 33.833"	84° 35' 8.330"	1039.719
A 19	253495.067	2607707.095	23° 33' 39.768"	84° 35' 6.116"	1013.288
A 20	253597.909	2607593.506	23° 33' 36.134"	84° 35' 9.808"	1034.553
A 21	253679.979	2607541.998	23° 33' 34.506"	84° 35' 12.731"	1038.376
A 22	253727.007	2607579.112	23° 33' 35.737"	84° 35' 14.366"	1037.709
A 23	253772.773	2607716.717	23° 33' 40.233"	84° 35' 15.898"	1018.248

LABEL	UTM (WGS84) - ZONE 45 N		D M S		REDUCED LEVEL (M)
	EASTING (m)	NORTHING (m)	LATITUDE (N)	LONGITUDE (E)	
A 24	253739.948	2607814.977	23° 33' 43.407"	84° 35' 14.682"	1016.544
A 25	253744.882	2607914.055	23° 33' 46.629"	84° 35' 14.797"	1004.044
A 26	253781.977	2608034.998	23° 33' 50.579"	84° 35' 16.033"	989.628
A 27	253733.264	2608154.170	23° 33' 54.424"	84° 35' 14.245"	991.938
A 28	253602.214	2608240.182	23° 33' 57.146"	84° 35' 9.575"	979.757
A 29	253450.276	2608303.245	23° 33' 59.112"	84° 35' 4.183"	954.291
A 30	253341.143	2608316.191	23° 33' 59.473"	84° 35' 0.329"	945.705
A 31	253324.065	2608408.020	23° 34' 2.447"	84° 34' 59.672"	963.310
A 32	253420.896	2608449.117	23° 34' 3.835"	84° 35' 3.060"	989.736
A 33	253566.022	2608443.930	23° 34' 3.746"	84° 35' 8.179"	947.462
A 34	253728.988	2608402.978	23° 34' 2.505"	84° 35' 13.947"	959.375
A 35	253840.893	2608354.959	23° 34' 1.006"	84° 35' 17.920"	934.973
A 36	253952.324	2608079.497	23° 33' 52.118"	84° 35' 22.011"	944.906
A 37	253875.335	2607986.866	23° 33' 49.066"	84° 35' 19.352"	955.942
A 38	253956.056	2607800.020	23° 33' 43.040"	84° 35' 22.308"	983.148
A 39	253956.056	2607800.020	23° 33' 43.040"	84° 35' 22.308"	983.148
A 40	254197.024	2607471.993	23° 33' 32.514"	84° 35' 30.995"	1057.540
A 41	254360.979	2607498.943	23° 33' 33.479"	84° 35' 36.757"	1050.909
A 42	254432.979	2607418.981	23° 33' 30.920"	84° 35' 39.342"	1045.560
A 43	254432.998	2607351.992	23° 33' 28.744"	84° 35' 39.383"	1044.956
A 44	254395.796	2607223.146	23° 33' 24.538"	84° 35' 38.148"	1052.733
A 45	254428.703	2607146.124	23° 33' 22.053"	84° 35' 39.353"	1051.538
A 46	254512.002	2607064.000	23° 33' 19.430"	84° 35' 42.337"	1053.241
A 47	254639.010	2607061.111	23° 33' 19.406"	84° 35' 46.815"	1051.781
A 48	254725.996	2606975.053	23° 33' 16.657"	84° 35' 49.932"	1047.931
A 49	254531.999	2606851.969	23° 33' 12.553"	84° 35' 43.168"	1061.587
A 50	254330.943	2606731.043	23° 33' 8.514"	84° 35' 36.153"	1059.691
A 51	254074.906	2606580.048	23° 33' 3.469"	84° 35' 27.220"	1060.502
A 52	254050.029	2606710.925	23° 33' 7.707"	84° 35' 26.265"	1046.853
A 53	254008.784	2606758.643	23° 33' 9.235"	84° 35' 24.784"	1044.367
A 54	253919.985	2606824.038	23° 33' 11.311"	84° 35' 21.615"	1055.558
A 55	253856.494	2606911.164	23° 33' 14.107"	84° 35' 19.326"	1059.695
A 56	253905.004	2607035.018	23° 33' 18.157"	84° 35' 20.962"	1056.598
A 57	253874.062	2607109.037	23° 33' 20.545"	84° 35' 19.828"	1060.839
A 58	253834.934	2607121.124	23° 33' 20.917"	84° 35' 18.442"	1060.883
A 59	253789.789	2607136.351	23° 33' 21.387"	84° 35' 16.842"	1051.599
A 60	253748.073	2607175.097	23° 33' 22.623"	84° 35' 15.348"	1060.871
A 61	253549.041	2607218.919	23° 33' 23.937"	84° 35' 8.308"	1053.763
A 62	253467.151	2607282.259	23° 33' 25.950"	84° 35' 5.384"	1049.590
A 63	253394.098	2607295.941	23° 33' 26.355"	84° 35' 2.801"	1052.672

LABEL	UTM (WGS84) - ZONE 45 N		D M S		REDUCED LEVEL (M)
	EASTING (m)	NORTHING (m)	LATITUDE (N)	LONGITUDE (E)	
A 64	253307.165	2607373.070	23° 33' 28.813"	84° 34' 59.692"	1040.861
A 65	253215.953	2607458.016	23° 33' 31.523"	84° 34' 56.427"	1048.962

11.1.2 All the Borehole Drilled in Anvarapat block were surveyed in respect of their location with the help of DGPS Instrument for surveying.

11.1.2.1 TECHNICAL SPECIFICATION OF DGPS

MAKE	TRIMBLE DGPS
MODEL	R8-S
YEAR OF PURCHASE	2017

11.1.2.2 MEASUREMENT ACCURACY:

- PPK Mode (Static)
- Horizontal – 3 mm +0.1 ppm or better.
- Vertical – 3.5 mm +0.4 ppm or better.

11.1.3 The survey work was carried out with the help of DGPS (Make-Trimble GNSS System, Model-R8s) and Electronic Total Station (M3). The DGPS Base Station BST-1 was established in the central part of the siskaripat block which MECL explored and two numbers of Station ST1 to ST2 were also established by DGPS in this block as a survey Control station for Survey work. Particulars of DGPS report are given as **Annexure No: I-C** and base station and control points given in **Table No.11.2**

Table-11.2

The R.L & Coordinate of Base and control Stations were determined by DGPS in WGS-84 Datum. (UTM Zone 45Q)

ID	Easting	Northing	RL	REMARKS
B-1	255645.779	2607838.318	1061.843	BASE
ST1	255368.310	2608352.908	1060.917	CONTROL STATION
ST2	255656.671	2607395.181	1059.845	CONTROL STATION

11.1.4 During the survey, surface features i.e., roads, village area, habitation, etc. have been picked up and the same have been depicted on topographical map of the block given

as **Plate-III and Text Figure-3**. Topographical survey with 2m Contouring interval was carried out on 1:2000 scale in the block.

- 11.1.5 Total 18 boreholes were drilled by MECL i.e. MAP-01 to MAP-18 and all the boreholes were fixed by DGPS survey instrument. Borehole location co-ordinates & Reduced level (RL) of the borehole along with boundary pillar in Anvarapat block area were surveyed by DGPS survey instrument. The borehole location and block boundary corner points are given in **table no 11.1 and as Plate-III**.

11.2.0 QUALITY AND ADEQUACY OF TOPOGRAPHIC CONTROL

- 11.2.1 The survey work has been carried out with the help of DGPS (Make-Trimble GNSS System, Model-R8s) and Electronic Total Station (M3) for higher level measurement accuracy. In order to have control on survey work, one base station B-1 and total two number of control stations ST1 to ST2 were established in the block. Survey work carried out by the experienced qualified surveyor as per the prevailing standard procedures.

CHAPTER-12

SAMPLING TECHNIQUE

12.1.0 NATURE AND QUALITY OF SAMPLING AND MEASURES TAKEN TO ENSURE SAMPLE REPRESENTATIVITY

- 12.1.1 The sampling and analysis were carried out for entire laterite/Bauxite zones intersected in the boreholes drilled. Borehole cuttings, the material which was obtained by dry drilling, was dried in sun and sampled for a uniform length of 1.00 m to 50cm keeping in view irregular and discontinuous nature of the deposit, the sampling was carried out according to lithological changes. Each sample thus obtained, was crushed to (-) 120 mesh size and its quantity further reduced to 500 grams by progressive coning and quartering. The material was further crushed to (-) 200 mesh size. Two representative samples weighing about 100 grams each was taken from this, one of which was sent for primary analysis for five oxides Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI, Elements Vanadium (V) and Galium (Ga) at Chemical Laboratory of MECL, Nagpur. The remaining 300 gms sample was used for preparation of composite samples for analysis of spectroscopic, XRD, and reactive silica etc for future reference.
- 12.1.2 During the present exploration, a total of 487 nos. of primary core samples were been generated and analysed for Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI, Elements Vanadium (V) and Galium (Ga). In addition to this, total 35 nos. of primary core samples collected from Saprolite/lithomarge were analyzed for TREE by ICP-OES method. The details of analysis of primary core samples for Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI and TREE, Elements Vanadium (V) and Galium (Ga) are given in Annexure III-B.
- 12.1.3 In order to check analytical bias if any, external (10%) check analysis have been carried out at external NABL accredited laboratories. Total 49 nos. of external check samples analyzed for Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI. The details of External check analysis are submitted as annexure IV.

CHAPTER-13

DRILLING TECHNIQUES AND DRILL SAMPLING EMPLOYED

13.1.0 DRILLING TYPES AND DETAILS

- 13.1.1 During the present investigation, MECL drilled total 18 no of boreholes with 519 m and the details of boreholes drilled by MECL are given in **Annexure-IB** and summary of borehole is given in **Table-10.2**.
- 13.1.2 All boreholes were laid on 200m spacing as given in para no 10.4.1 and all boreholes are vertically drilled. Drilling operations were carried out by conventional wireline drill rig RD-60. Drilling by dry coring method was the main tool for sub surface exploration. The length of individual run was generally kept as one meter or a fraction of one meter depending on lithological variations.
- 13.1.3 Drilling was carried out by dry coring method using RD-60 drill with NX and BX size of TC casing and TC shoe bit. The length of individual run was generally less than one meter and was essentially 20 to 50cm, depending on lithological variations. The core recovery was around 98 to 100%.
- 13.1.4 The core recovery in the mineralized zones is about 98-99% which is satisfactory. After closure, all the boreholes were properly plugged and sealed with cement pillars.



Photograph No.8: RD60 drill Rig used for drilling operations



Photograph No.9 to 11: Pillars constructed on boreholes drilled in Anvarapat block by MECL.

13.2.0 WHETHER CORE AND CHIP SAMPLE RECOVERIES HAVE BEEN PROPERLY RECORDED AND RESULTS ASSAYED

13.2.1 The material obtained by way of dry drilling (vacuum suction) was stored in polythene bags. The admixture of cuttings and powder was carefully examined and the details like colour, physical nature, and mineral constituents were recorded. The details of run wise log thus generated were consolidated and are presented in **Annexure- II A**.



13.2.2 The material obtained by way of dry core drilling was stored in GI made core boxes. The core was carefully examined and the details like colour, physical nature, mineral constituents were recorded. The details of run wise log thus generated were consolidated and are presented in Annexure-IIA.

13.3.0 MEASURES TAKEN TO MAXIMIZE SAMPLE RECOVERY AND ENSURE REPRESENTATIVE NATURE OF THE SAMPLES.

13.3.1 The short runs were made during drilling for optimum core recovery.

13.4.0 WHETHER THE RELATIONSHIP EXISTS BETWEEN SAMPLE RECOVERY AND GRADE

13.4.1 The core recovery is about 98-99% approximately. The entire bauxite/laterite mineralized zones / length were recorded during the geological logging on visual basis. Since, the recovery percentage in the mineralized zones is high there is no any negative effect from the core recovery.

13.5.0 CORE LOGGING

13.5.1 Sub surface drilling reveals presence of lateritic soil, laterite, bauxite, red clay, variegated clay and unconsolidated sand in the order of stratigraphic sequence. Lateritic soil is distributed unevenly over the plateau.

13.5.2 The logging was carried out run-wise for boreholes and the variation of lithounits i.e., Soil, Laterite, Bauxite and Saprolite/lithomarge were marked meticulously and detailed litholog is submitted as annexure IIA

CHAPTER-14

SUB SAMPLING TECHNIQUES AND SAMPLE PREPARATION

14.1.0 WHETHER CUT OR DRAWN AND WHETHER QUARTER, HALF OR ALL CORE TAKEN

14.1.1 The details of sampling procedure are described in Para 12.1.0. Borehole cuttings, the material which was obtained by dry drilling, was dried in sun and sampled for a uniform length of 1.00 m to 50cm keeping in view irregular and discontinuous nature of the deposit, the sampling was carried out according to lithological changes. Each sample thus obtained, was crushed to (-) 120 mesh size and its quantity further reduced to 500 grams by progressive coning and quartering. The material was further crushed to (-) 200 mesh size. Two representative samples weighing about 100 grams each was taken from this, one of which was sent for primary analysis for five oxides Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI, Elements Vanadium (V) and Galium (Ga) at Chemical Laboratory of MECL, Nagpur.

14.2.0 NATURE, QUALITY AND APPROPRIATENESS OF THE SAMPLE PREPARATION TECHNIQUE

14.2.1 The sampling and analysis have been carried out for entire laterite/Bauxite zones intersected in the boreholes drilled on visual basis. The primary samples have been marked in the mineralized zones intersected in the borehole based on type and concentration of bauxite zone and in general the sample length has been kept as 1.0 m which varied in some instances because of variation in lithology and type and concentration of mineralisation.

14.3.0 QUALITY CONTROL PROCEDURES ADOPTED

14.3.1 Standard sampling procedure in supervision of qualified sampling technician has been adopted and the samples have been prepared at project sampling unit. Total 487 nos. of primary samples have been prepared and analysed for Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI at Chemical Laboratory of MECL, Nagpur. In order to check the sampling and analytical bias if any, a total of 49 numbers of external checks submitted to NABL accredited lab i.e., JNARDDC in Nagpur.

14.4.0 MEASURES TAKEN TO ENSURE THAT THE SAMPLING IS REPRESENTATIVE OF THE INSITU MATERIAL COLLECTED

14.4.1 All the primary samples have been marked and prepared from Bauxite/laterite mineralised cores. During the preparation of primary samples, the mineralised cores have been studied meticulously and samples have been marked properly. The proper marking of primary samples from drilled cores and following standard procedure for primary and composite sample preparation shows the representative samples have been collected from the in-situ materials.

14.5.0 WHETHER SAMPLE SIZES ARE APPROPRIATE TO THE GRAIN

14.5.1 The primary samples have been prepared in (–) 200 mesh size. As per the previous studies in and surrounding the area, the (–) 200 mesh size is appropriate for the liberation of mineral grains and analysis for Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI and associated elements in the block area.

CHAPTER-15

QUALITY OF ASSAY DATA AND LABORATORY TESTS

15.1.0 THE NATURE, QUALITY AND APPROPRIATENESS OF THE ASSAYING AND LABORATORY PROCEDURES

15.1.1 The chemical analysis of primary samples for bauxite was carried out under WD-XRF method with Primus-IV model machine and details are given below.

Make: Rigaku

Model: Primus-IV (WD-XRF)

Analytical range: Wavelength Dispersive X-ray Fluorescence spectrometer (WD-XRF) is capable of analyzing major, minor and trace elements in rocks/ores/minerals and geological materials as solid samples (pressed pallets and fusion beads) in % to ppm range

Accuracy and precision (standard deviation) for major oxides is excellent (<1%). For testing of the samples, pressed pallets of the powdered samples were made using hydraulic press. The XRF instrument was calibrated using suitable matrix matching CRMs. After calibration of the instrument the samples were analyzed and the values of the SiO₂, Al₂O₃, Fe₂O₃, TiO₂ were obtained. The Loss on Ignition was determined by calculating the loss in weight of the sample after igniting the sample taken in a Pt crucible at 1000°C in a muffle furnace.

The following **Precautions** were followed in the laboratory while doing chemical analysis.

- (a) PPEs were used to avoid any contamination to the samples.
- (b) Label all containers to identify their contents.
- (c) Avoid touching hot objects. Be careful when using hot objects. Use suitable tongs to remove hot containers from the furnace.
- (d) Properly dispose of waste chemicals.

15.2.0 NATURE OF QUALITY CONTROL PROCEDURES ADOPTED

15.2.1 The standard procedure for chemical analysis as per provision made in the proposal for QA/QC has been followed. All the primary samples have been analyzed in the Chemical Laboratory of MECL, Nagpur. In order to assess the bias and inaccuracies in analytical determination,

- (i) Analysis of Certified reference materials/measurement standards (BCS CRM-395, GBAP-14, GBAP-16, NCSHC-28811)
- (ii) Analysis of blind samples
- (iii) Use of QC samples and control charts
- (iv) Analysis in duplicates & Internal Check standards.

15.3.0 CHECK ANALYSIS FROM THIRD PARTY NABL ACCREDITED LABORATORY

- 15.3.1 The third-party external check samples analyses being carried out at JNARDDC, (NABL Accredited lab) Nagpur. Total of 49 numbers of external check samples for Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI, results are submitted as annexure IV.

15.4.0 SECURITY AND CHAIN OF CONTROL OF SAMPLES SHOULD BE CLEARLY MENTIONED

- 15.4.1 The samples were prepared at the project sampling unit with proper labelling and tag packed in sealed polythene bags sent to chemical laboratory in supervision of qualified sampling technician. At the sampling unit, standard procedure were followed and all the precautionary measures were taken to avoid the contamination. The sampling unit is a separate unit from the chemical laboratory, so there is no possibility of contamination.

CHAPTER-16

MOISTURE

16.1.0 All the analysis for oxides i.e., Al_2O_3 , SiO_2 , Fe_2O_3 , TiO_2 & LOI were carried out with natural moisture.

CHAPTER-17

BULK DENSITY

17.1.0 Bulk density calculation was carried out on samples collected from three pits. Three pits were made for bulk density measuring 50 cm x 50 cm x 100 cm. A gravimetric method used in which a known volume of undisturbed sample was dried and weighed. The result is the density for a volume of sample as it exists naturally including air space and organic matter.

17.1.1 Bulk density, or dry bulk density, is a property of soils and other masses of particulate material. It's the weight of the particles of the soil divided by the total volume. Thus, it should be noted that the unit of bulk density is the unit of weight over the unit of volume, for example kg/m³ for the metric system and lb/ft³ for the English system.

Bulk density can be given by following formula

$$\text{Bulk Density (g / Cm}^3\text{)} = M / V$$

Where M=Mass of excavated material

V= Volume of excavated pit

17.1.2 BULK DENSITY CALCATION: Bulk density = Mass/Volume

Where M= Weight of Bauxite Rock

And V= VOLUME OF PIT

PIT NO	WEIGHT (g)	VOLUME (cc)	Calculated Bulk Density (gm/cm ³)
1	1359540	631488	2.15
2	210400	103096	2.04
3	228850	112136.5	2.04
			2.08

17.1.2 Average Bulk density as calculated is 2.08 g/cm³, which is considered for calculation of ore resources.



Photograph showing the Pits excavated for calculation of Bulk density

CHAPTER-18

BENEFICIATION STUDIES

18.1.0 Beneficiation studies were not carried out as there is no scope of work in the present stage exploration.

CHAPTER-19

RESOURCE ESTIMATION TECHNIQUE

19.1.0 DISCUSSION ON DATA DENSITY TO ASSURE CONTINUITY OF MINERALISATION

19.1.1 Pakhar plateau is one of the main topographic unit in the area with altitudes rising from 760m to 1066m MSL. On plateau region laterite/bauxite is developed over the gneissic country rock belonging to Chhotanagpur Gneissic Complex (CGC).

19.1.2 Anvarapat block is over an area of 1.02 sq.km, The Anvarapat Block exhibits supergene bauxite mineralization developed over the gneissic basement of the Chotanagpur Gneissic Complex through prolonged tropical weathering and lateritization. Mineralization occurs as a capping of bauxite-rich laterite characterized by pocket- to blanket-type deposits localized along the western sector of the Pakhar Plateau.

19.1.2 As per MEMC rules 2015, and with approval of TCC, MECL has drilled 18 no of boreholes with 519 m of drilling in the block. Present exploration data of MECL has been considered for geological interpretation and correlation and resource estimation for Bauxite and associated minerals and bauxite resources are calculated at IBM cutoff grade of $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 \leq 7\%$

19.2.0 WHETHER PREVIOUS EXPLORATION DATA HAS BEEN USED

19.2.1 There is no previous data available on bauxite mineralization in the Anvarapat block, however nature and mineralization information in Siskaripat block and abandoned adjacent mines were considered for correlation purpose.

19.3.0 THE NATURE AND APPROPRIATENESS OF THE ESTIMATION TECHNIQUE(S) APPLIED AND KEY ASSUMPTIONS

19.3.1 All boreholes were drilled as per MEMC rules 2015, amended upto 14th December 2021. Extract of Part III of MEMC rules is given below

Exploration Norms for different types of deposits for I. Bedded Stratiform and tabular deposits of regular and irregular habit:

Provided that for deposits specified in Schedule II, 3 bore holes drilled so as to form a polygon in blocks of less than 100 hectares and 5 bore holes in blocks of

more than 100 hectares may be sufficient. The lateral influence beyond the bore hole spacing may be limited to a maximum of 50 per cent. of the spacing depending on the results of surface geological mapping.

- 19.3.2 Accordingly, Bauxite, Titanium Oxide and other associated mineral resources are estimated by “**Polygon Method**”.

19.4.0 THE BASIS FOR CLASSIFICATION OF THE MINERAL RESOURCES

- 19.4.1 As per MEMC rules 2015, amended upto 14th December 2021. Part III and given in para 19.3.1, the mineral resource in the block area is categorized as inferred Mineral Resource (333) code as per UNFC system.

19.5.0 THE ASSUMPTIONS MADE REGARDING RECOVERY OF BY PRODUCTS

- 19.5.1 During diagenesis, epigenesis and weathering processes leaching and dislocation of Si and Fe leads to continuous aluminium enrichment in lateritic bauxites and in bauxites formed over parent rock in duricrust and bauxite zones. The trace elements present in parent rock displaced several times during this process. In saprolite zone certain trace elements like Ti, Ni, Co, Ga, V and copper may become enriched to such an extent that they form deposits and are minable as by products. Elements like Cr and Zr become enriched in basal Saprolite horizon due to their association with weathering resistant chromites and zircon of parent rock, while Ni, Co and P concentrate via solution. Ga in particular precipitates in reducing environment and become enriched
- 19.5.2 Vanadium (V) and Gallium (Ga) anomalous zones were demarcated based on >500ppm V and >50ppm Ga, however samples below these anomalous values are also considered where zone is demarcated. Thus, from primary analytical data Vanadium (V) anomalous zones has thickness ranging between Max 20.20m in BH MAP-04 and Min 1.00 in MAP-07 and for Gallium (Ga) anomalous zones has thickness ranging between Max 22.30 m in BH MAP-12 and Min 2.50 in MAP-09.
- 19.5.3 About 35 no of samples from lithomarge have been submitted for analysed for REE elements by ICPMS method, Total REE in these samples range from Min 47.26 and Max 741.80 ppm, out of 35 no of samples only 2 samples analysed more than 500ppm. Details are submitted as annexure IIIB.

19.6.0 DETAILED DESCRIPTION OF THE METHOD USED AND THE ASSUMPTIONS MADE TO ESTIMATE TONNAGE AND GRADES

19.6.1 The Bauxite ore resource and grade have been estimated by “**Polygon Method**”, and estimated resources placed under inferred (333) category of UNFC considering the following parameters and assumptions.

1. **Cut-off Grade:** This is the most significant artificial boundary demarcating low grade mineralization and techno economically viable ore that can be exploited at a profit. Threshold Value as per IBM notification 25th May 2018 is (i) For Aluminous laterite: Al_2O_3 – 20% (Min.) (ii) For Bauxite: Al_2O_3 -30% (Min.) and SiO_2 (Total)-7% (Max.) (Gazette Notification dated 25th May 2018 for Threshold Value of Minerals, IBM). The cut off for metallurgical grade bauxite was considered to be $\text{Al}_2\text{O}_3 \geq 40\%$ and $\text{SiO}_2 \leq 4\%$ (Indian Minerals year book, Volume-III; Mineral reviews, 56th Edition Bauxite, Advance release, March 2018)
2. **By products:** TiO_2 , 2% is considered as a byproduct with bauxite/clay. Resource of Ga, V have been estimated at 50 and 500ppm cutoff criteria.
3. **Minimum Stopping Width and Maximum Parting:** For bulk minerals like bauxite minimum stopping thickness is considered as 2 m, but in this area bauxite thicknesses are considerably less so stopping thickness considered to be 1.5 m.
4. **Correlation of ore lodes:** Correlation of ore lodes were done along NS and EW section lines.
5. **Description of lodes:** The mineralised zones occur as i) irregular bedded and ii) boulder type with varying thickness.
6. **Preparation of LV sections:** Not Applicable
7. **Preparation of Level Plan:** Not Applicable
8. **Bulk Density:** as given in chapter 17, Average Bulk density i.e., 2.08 g/cm^3 , is considered for calculation of bauxite ore resources
9. An overall deduction of 10% is applied to the total gross tonnage to arrive at the net in-situ geological resource on account of geological reasons i.e., data gaps, core recovery, irregular nature of deposit and abrupt change in zone thickness.

10. All boreholes were laid on 150 to 500m spacing as given in para no 10.4.1 and all boreholes are vertically drilled. The area of influence is taken as 50% where adjacent boreholes are positive or bauxite occurs as outcrop or nala or cliff sections or local quarry is present. Area of influence is taken as 25% in case of corner bore holes and where adjacent boreholes are negative.

11. Intermediate bauxite zone with little more than 8% silica has been considered for resource estimation as it can be mined and blended with high grade bauxite present in this block.

19.6.2 **Exploration Data for Resource Estimation:** During the present investigation, Geological Map prepared on 1:2000 scale, a total of 519.0 m drilling in 18 Boreholes was taken into consideration for evaluation of resources in the block.

19.6.3 Analysis of total 487 no of samples indicated that

- (a) Average thickness of bauxite is intercepted in the 18 no boreholes drilled is 4.83m, with Min thickness of 0.60m (MAP-01) and maximum 12.70m (MAP-05). Depth of intersection of these zones varies from 0.50m (MAP-14) to 15.00m (MAP-13).
- (b) In the Bauxite zones demarcated, Al_2O_3 varies from Min 31.14% (MAP-04) and Max 42.77% (MAP-01) and SiO_2 varies from Min 2.38% (MAP-17) and Max 6.91% (MAP-04)
- (c) Average thickness of Aluminous Laterite is intercepted in the 18 no boreholes drilled by MECL is 3.17 m, with Min thickness of 0.50m (MAP-15) and maximum 6.00m (MAP-12). Depth of intersection of these zones varies from 0.50m (MAP-04,05,10) and max of 22.50m (MAP-12).
- (d) In the Aluminous Laterite zones demarcated, Al_2O_3 varies from Min 26.78% (MAP-17) and Max 40.85% (MSP-10) and SiO_2 varies from Min 1.72% (MAP-17) and Max 12.10% (MAP-08)
- (e) Aluminous clay intercepted in boreholes after bauxite zones which were marked based on $\text{SiO}_2 > 30\%$
- (f) TiO_2 is present in all the lithologies intercepted, hence 2% cut-off is considered for demarcating the zone
- (g) Details of Zone are given below.

Table-19.1:
Details Of Bauxite zones from exploratory boreholes drilled by MECL in Anvarapat
block, district - Lohardaga, Jharkhand
Zones demarcated based on $\text{Al}_2\text{O}_3 > 30\%$ and $\text{SiO}_2 < 7\%$

Borehole	From (m)	To (m)	Thickness (m)	Al_2O_3 %	Fe_2O_3 %	SiO_2 %	TiO_2 %	LOI %	Ga (ppm)	V (ppm)
MAP-01	1.50	2.10	0.60	35.57	32.74	6.26	5.88	18.82	76	1044
MAP-01	6.40	7.10	0.70	37.80	30.85	6.52	3.10	20.96	70	706
MAP-01	8.50	9.10	0.60	42.77	23.28	5.37	4.51	23.52	92	688
Cumulative			1.90	38.67	29.05	6.08	4.42	21.09	78.84	807.05
MAP-04	4.00	6.00	2.00	31.14	41.14	6.72	5.03	15.55	75.75	1182.00
MAP-04	7.50	15.00	7.50	32.72	34.01	6.91	6.45	19.27	63.80	796.07
MAP-04	17.00	20.40	3.40	32.28	34.66	6.57	5.32	20.29	75.41	644.06
Cumulative			12.90	32.36	35.29	6.79	5.93	18.96	68.71	815.84
MAP-05	1.00	3.00	2.00	37.35	31.85	6.64	5.72	17.76	100.75	2952.50
MAP-05	6.00	18.70	12.70	32.48	36.54	4.27	6.32	19.86	64.54	861.85
Cumulative			14.70	33.14	35.90	4.59	6.24	19.57	69.47	1146.29
MAP-06	5.80	14.00	8.20	32.84	34.40	6.39	5.66	20.05	65.54	764.60
MAP-10	1.50	4.50	3.00	40.67	22.95	5.61	6.70	22.25	65.00	685.50
MAP-12	12.50	22.50	10.00	32.39	35.51	6.86	6.31	18.41	63.00	788.75
MAP-13	22.50	25.00	2.50	35.07	34.70	6.32	4.03	19.38	49.40	657.00
MAP-14	0.50	15.50	15.00	36.57	32.83	4.81	5.77	19.45	65.31	895.83
MAP-15	2.50	5.00	2.50	35.20	33.31	3.11	8.11	19.69	100.20	1724.20
MAP-15	9.00	14.00	5.00	33.20	34.26	4.31	6.20	21.49	65.20	1112.10
MAP-15	16.50	19.50	3.00	37.87	27.51	4.89	7.62	21.48	66.17	1193.83
Cumulative			10.50	35.01	32.11	4.19	7.06	21.06	73.81	1281.19
MAP-16	13.50	19.50	6.00	38.70	29.56	4.25	5.97	21.01	68.00	707.67
MAP-17	6.50	9.00	2.50	31.99	38.69	4.78	5.44	18.42	60.20	852.20
MAP-17	12.00	14.75	2.75	40.12	29.56	2.38	5.43	21.96	51.91	852.09
Cumulative			5.25	36.25	33.90	3.52	5.44	20.27	55.86	852.14
MAP-18	4.50	7.50	3.00	39.45	27.80	6.67	6.41	19.16	100.50	1475.33
MAP-18	11.50	20.00	8.50	34.67	35.49	3.76	6.23	19.33	56.18	862.06
Cumulative			11.50	35.91	33.48	4.52	6.27	19.29	67.74	1022.04

Table-19.2:
Details of Aluminous Laterite zones from exploratory boreholes drilled by MECL in
Anvarapat block, district - Lohardaga, Jharkhand
(Zones demarcated based on Al_2O_3 >25% and <30% & SiO_2 is >7% <12%)

Borehole	From (m)	To (m)	Thickness (m)	Al_2O_3 %	Fe_2O_3 %	SiO_2 %	TiO_2 %	LOI %	Ga (ppm)	V (ppm)
MAP-01	1.30	1.50	0.20	38.71	26.43	9.03	5.39	19.62	72	830
MAP-01	2.10	6.40	4.30	35.80	30.01	9.42	4.63	19.25	78.21	884.98
MAP-01	7.10	8.50	1.40	37.68	29.35	8.19	3.28	20.74	65.64	705.71
cumulative			5.90	36.35	29.73	9.11	4.34	19.62	75.02	840.58
MAP-04	0.50	4.00	3.50	39.19	23.26	11.01	5.90	20.05	102.71	1031.00
MAP-04	6.00	7.50	1.50	30.76	35.65	11.56	4.91	16.61	57.67	792.33
MAP-04	15.00	17.00	2.00	33.99	29.81	9.99	5.68	19.61	60.00	706.00
cumulative			7.00	35.90	27.78	10.84	5.62	19.19	80.86	887.00
MAP-05	0.50	1.00	0.50	33.31	33.60	10.82	5.00	16.05	87	3901
MAP-05	3.00	6.00	3.00	32.98	31.25	11.81	4.75	18.77	84.67	1267.33
cumulative			3.50	33.03	31.58	11.67	4.78	18.38	85.00	1643.57
MAP-06	0.40	5.80	5.40	26.85	42.82	8.94	4.56	16.15	65.17	967.69
MAP-08	5.00	10.50	5.50	27.97	39.75	12.10	4.21	15.42	52.18	771.55
MAP-09	2.50	3.50	1.00	33.31	30.59	11.91	5.33	18.22	60.50	623.00
MAP-09	5.00	6.00	1.00	32.85	32.45	9.86	6.11	18.22	48.50	736.00
cumulative			2.00	33.08	31.52	10.88	5.72	18.22	54.50	679.50
MAP-10	0.50	1.50	1.00	39.23	22.05	10.82	6.33	20.69	73.50	662.50
MAP-10	4.50	6.00	1.50	40.85	20.83	8.40	7.34	21.95	77.00	653.67
cumulative			2.50	40.20	21.32	9.37	6.94	21.44	75.60	657.20
MAP-11	1.00	3.00	2.00	33.13	32.08	10.56	5.97	17.35	88.00	1119.00
MAP-12	6.50	12.50	6.00	37.21	29.58	9.77	5.21	17.71	94.08	1827.08
MAP-12	22.50	23.50	1.00	40.43	21.96	11.56	3.31	22.06	66	454
cumulative			7.00	37.67	28.49	10.03	4.94	18.33	90.07	1630.93
MAP-13	10.00	15.50	5.50	27.43	40.78	11.36	4.63	15.30	71.64	1018.45
MAP-13	20.00	22.50	2.50	34.60	28.88	10.17	6.53	19.31	65.40	713.60
cumulative			8.00	29.67	37.06	10.99	5.22	16.55	69.69	923.19
MAP-15	5.00	9.00	4.00	28.31	40.95	8.63	4.29	17.04	59.75	1401.13
MAP-15	15.00	15.50	0.50	39.35	19.71	10.39	6.71	22.99	64.00	915.00
cumulative			4.50	29.54	38.59	8.83	4.56	17.70	60.22	1347.11
MAP-16	7.50	13.50	6.00	29.93	39.39	9.40	4.69	15.87	84.17	1619.33
MAP-17	0.50	6.50	6.00	26.78	46.02	8.28	3.63	14.67	54.25	1206.08
MAP-17	9.00	11.50	2.50	27.34	47.70	1.72	4.19	18.29	42.80	1477.40
cumulative			8.50	26.95	46.51	6.35	3.79	15.73	50.88	1285.88
MAP-18	7.50	11.50	4.00	27.22	43.68	9.63	4.48	14.47	69.25	1239.50

Table-19.3:
Details of TiO₂ zones from exploratory boreholes drilled by MECL in Anvarapat
block, district - Lohardaga, Jharkhand
Zones demarcated based on Zones demarcated based on TiO₂ >2%

Borehole	From (m)	To (m)	Thickness (m)	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
MAP 01	0.20	13.00	12.80	34.73	27.85	14.55	3.97	18.13	68.66	738.81
MAP 02	2.10	8.00	5.90	32.48	21.38	24.05	4.22	16.54	62.97	635.49
	10.00	12.00	2.00	34.11	11.23	38.86	2.12	12.78	37.00	222.00
	14.80	16.00	1.20	26.59	9.87	51.43	2.47	8.47	29.00	244.00
	Cumulative		3.20	31.29	10.72	43.57	2.25	14.65	52.78	492.99
MAP 03	2.10	2.40	0.30	28.11	31.31	21.05	2.93	15.51	42.00	559.00
MAP 04	0.20	21.50	21.30	33.42	31.95	9.50	5.66	18.77	72.13	816.26
MAP 05	0.50	22.50	22.00	32.92	32.49	10.13	5.44	18.46	66.76	1103.85
MAP 06	0.40	15.00	14.60	30.55	36.59	8.95	5.06	18.19	64.20	811.45
MAP 07	0.30	12.00	11.70	30.43	18.48	30.89	4.07	15.20	57.11	425.21
MAP 08	1.40	17.50	16.10	30.53	24.85	26.18	3.48	14.00	51.26	544.38
MAP 09	1.00	11.00	10.00	31.80	22.89	25.96	3.59	15.11	44.75	461.10
MAP 10	0.50	16.00	15.50	35.23	18.08	25.52	4.32	16.23	49.48	461.77
MAP 11	0.40	5.00	4.60	32.56	31.07	13.72	4.41	17.26	73.39	878.26
MAP 12	3.50	26.50	23.00	33.37	31.19	12.50	5.15	17.26	72.50	1043.76
MAP 13	7.00	26.00	19.00	30.51	33.92	13.56	4.77	16.71	63.73	827.35
MAP 14	0.50	15.50	15.00	36.80	32.51	4.86	5.66	19.58	64.97	883.57
MAP 15	2.50	14.00	11.50	31.93	36.38	5.55	5.95	19.55	70.91	1345.70
	15.00	15.50	0.50	39.35	19.71	10.39	6.71	22.99	64.00	915.00
	16.50	19.50	0.50	37.87	27.51	4.89	7.62	21.48	66.17	1193.83
	Cumulative		12.50	32.47	35.36	5.72	6.05	19.76	70.45	1322.39
MAP 16	5.00	20.00	15.00	33.69	34.09	8.49	5.15	17.92	77.90	1216.17
MAP 17	5.00	20.00	15.00	31.19	38.19	8.59	4.22	17.20	51.48	1025.13
MAP 18	4.00	20.00	16.00	33.53	35.91	6.36	5.71	17.96	67.94	1067.38
	21.00	22.00	1.00	26.30	43.14	7.21	3.77	18.57	48.00	842.00
	24.50	27.00	2.50	31.74	18.11	32.97	2.57	14.21	37.40	349.00
	Cumulative		19.50	32.93	34.00	9.81	5.21	17.51	63.00	963.72

Table-19.4:
Details of aluminous Clay zones from exploratory boreholes drilled by MECL in
Anvarapat block, district - Lohardaga, Jharkhand
Zones demarcated based on Zones demarcated based on $\text{Al}_2\text{O}_3 > 20\%$ and $\text{SiO}_2 > 30\%$

Borehole	From (m)	To (m)	Thickness (m)	Al_2O_3 %	Fe_2O_3 %	SiO_2 %	TiO_2 %	LOI %	Ga (ppm)	V (ppm)
MAP 01	9.10	21.00	11.90	33.48	16.28	33.63	2.31	13.79	40.46	294.66
MAP 01	22.00	27.00	5.00	32.65	4.45	50.45	2.15	9.85	30.20	161.40
MAP 01	28.50	30.50	2.00	29.63	12.28	46.95	1.34	9.35	29.00	140.00
cumulative			18.90	32.85	12.72	39.49	2.17	12.28	36.53	243.04
MAP 02	4.50	30.50	26.00	27.08	9.83	48.62	1.28	9.74	43.30	164.74
MAP 03	3.00	30.00	27.00	30.28	5.01	50.65	0.44	8.71	42.56	15.04
MAP 04	20.40	30.00	9.60	34.16	12.40	38.07	1.92	12.82	34.75	207.14
MAP 05	18.70	30.00	11.30	33.00	16.42	34.29	2.27	13.31	34.36	336.41
MAP 06	14.00	25.50	11.50	31.46	18.04	35.71	1.79	12.55	32.04	236.52
MAP 06	26.20	28.00	1.80	33.76	8.25	39.09	0.54	16.75	61.00	24.67
cumulative			13.30	31.77	16.71	36.17	1.62	13.12	35.96	207.85
MAP 07	0.30	6.00	5.70	30.66	19.41	26.24	5.17	17.34	67.74	495.74
MAP 07	7.00	15.00	8.00	29.41	14.29	40.88	2.16	11.31	43.63	269.13
cumulative			13.70	29.93	16.42	34.79	3.41	13.82	53.66	363.41
MAP 08	0.50	5.00	4.50	28.22	20.13	32.94	3.36	12.95	53.00	487.49
MAP 08	10.50	23.00	12.50	29.56	10.47	45.45	2.00	10.14	40.25	242.79
cumulative			17.00	29.21	13.03	42.14	2.36	10.88	43.63	307.56
MAP 09	1.00	2.50	1.50	32.52	27.06	17.82	4.04	17.33	49.67	538.67
MAP 09	3.50	5.00	1.50	30.23	32.16	16.60	3.50	16.84	47.33	535.67
MAP 09	6.00	15.00	9.00	30.18	10.84	44.68	1.70	11.09	38.22	194.72
cumulative			12.00	30.48	15.53	37.82	2.22	12.59	40.79	280.33
MAP 10	6.00	16.00	10.00	32.36	15.81	35.53	2.61	13.13	38.30	345.80
MAP 11	3.00	19.00	16.00	32.45	8.37	44.31	0.82	12.75	47.00	128.94
MAP 12	0.60	6.50	5.90	30.75	27.39	23.71	3.12	14.04	72.12	796.51
MAP 12	23.50	30.00	6.50	31.92	17.50	34.46	1.94	13.72	39.38	296.54
cumulative			12.40	31.36	22.21	29.35	2.50	13.87	54.96	534.43
MAP 13	3.00	10.00	7.00	28.52	26.11	28.02	2.54	13.74	64.17	671.83
MAP 13	25.50	27.00	1.50	30.69	21.29	31.36	2.30	13.97	36.00	363.67
MAP 13	29.50	30.50	1.00	34.54	11.45	38.51	1.47	13.63	29.00	161.00
MAP 13	36.00	37.00	1.00	37.35	3.02	44.07	1.62	13.25	33.00	338.00
cumulative			10.50	30.24	21.82	31.03	2.32	13.71	53.83	547.37
MAP 14	16.00	26.50	10.50	34.67	11.86	38.25	1.60	13.23	31.71	217.57
MAP 15	22.00	29.50	7.50	38.00	2.02	43.46	1.69	14.47	33.75	83.75

Borehole	From (m)	To (m)	Thickness (m)	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
MAP 16	3.50	5.00	1.50	32.63	17.81	30.81	1.87	14.88	41.67	299.67
MAP 16	19.50	25.00	5.50	35.98	16.09	27.24	3.11	17.07	55.38	374.38
MAP 16	29.50	32.00	2.50	27.73	27.07	30.95	1.44	11.79	21.80	305.80
cumulative			9.50	33.28	19.25	28.78	2.47	15.33	44.38	344.53
MAP 17	17.00	26.00	9.00	32.04	15.71	37.55	1.80	12.42	30.06	361.47
MAP 18	24.50	27.00	2.50	31.74	18.11	32.97	2.57	14.21	37.40	349.00
MAP 18	30.00	30.50	0.50	33.32	15.51	35.72	2.18	12.80	42.00	309.00
MAP 18	37.50	38.00	0.50	35.29	6.53	41.66	2.08	13.78	35.00	313.00
cumulative			3.50	32.48	16.09	34.60	2.45	13.95	37.71	338.14

19.7.0 METHODOLOGY ADOPTED IN POLYGON METHOD OF RESOURCE ESTIMATION

19.7.1 Following methodology has been adopted while computation of various grades of laterite/bauxite ore zones.

19.7.2 POLYGON METHOD:

The main objective of this method is to demarcate the area of influence of the laterite/bauxite intersected by a particular borehole. The influence area has been obtained by constructing polygons by drawing perpendicular bisector of triangles that connect the adjoining boreholes. The area of the influence of zones have been calculated by Auto-Cad software. In the polygon the cumulative thickness of bauxite horizons intercepted in the corresponding borehole. The entire block boundary is divided into 5 numbers of polygons of different areas. Borehole influence area (polygon map) of this block is presented as Text Fig. 8. The grade assigned to the polygon blocks is same as the weighted average grade of the corresponding boreholes. The formula of resource estimation is as follows:

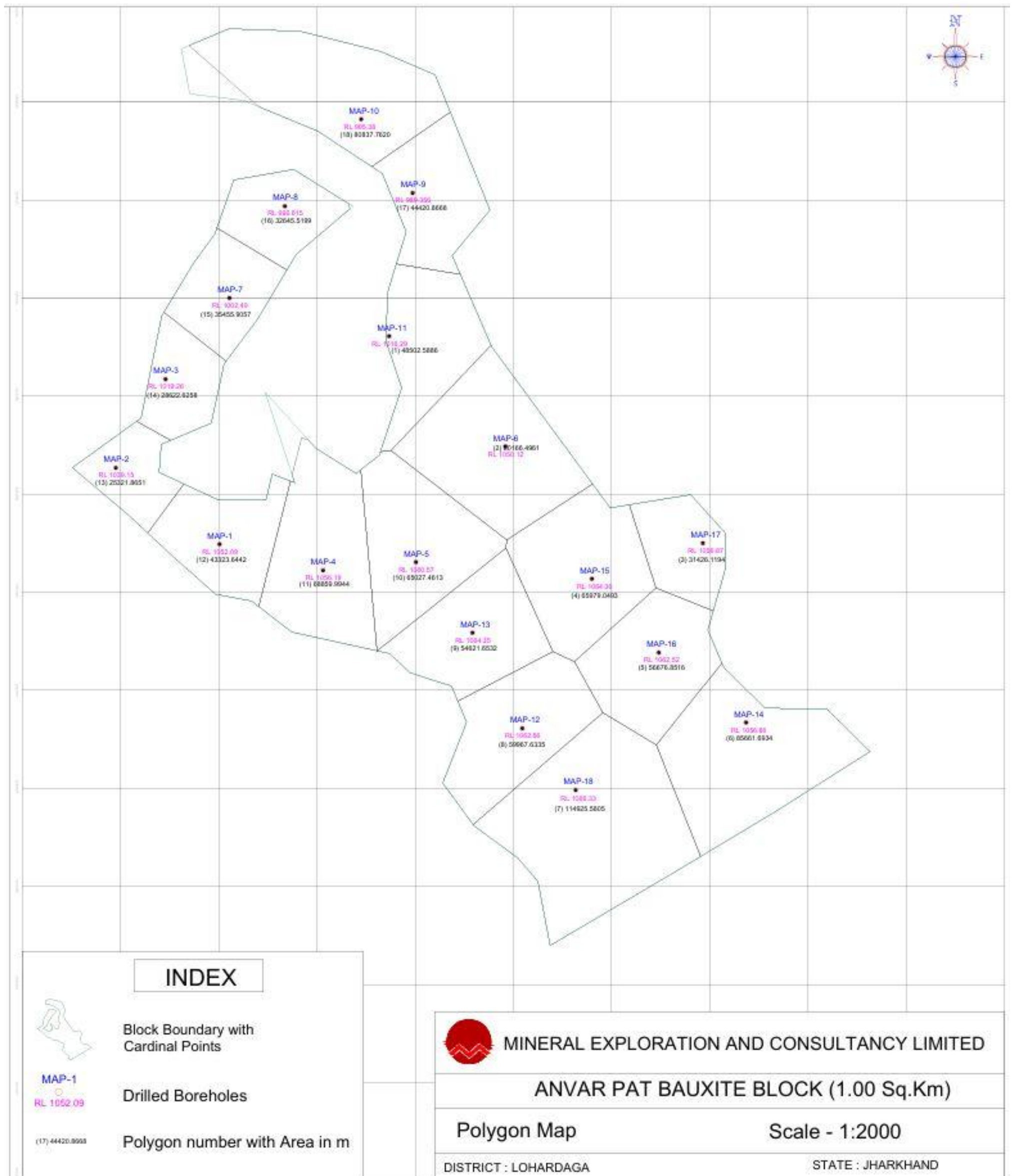
$$R = P_A \times Th \times \text{Bulk Density}$$

Where, P_A = Area of Polygon

R= Resource/ Tonnage

Th= Thickness of bauxite zone

TEXT FIGURE – 8
POLYGON MAP For Boreholes drilled in Anvarapat block, Dist: Lohardaga, Jharkhand.



19.8.0 DESCRIPTION OF THE GEOLOGICAL INTERPRETATION USED TO CONTROL THE RESOURCE ESTIMATES

- 19.8.1 The resource has been estimated by Polygon method as per MEMC Rules 2015. An overall deduction of 10% is applied to the total gross tonnage to arrive at the geological net in-situ resource of Various Bauxite ores to account for data gaps, irregular nature of deposit and abrupt change in zone thickness etc.

CHAPTER-20

REPORTING OF RESOURCES

20.1.0 RESOURCE AND GRADE

- 20.1.1 **Assessment of Bauxite:** The mineralized zones occur as i) irregular bedded with varying thickness and ii) boulder type. Details of mineralized zone thickness are summarized in the table- 19.1 to 19.2. The resource estimated at IBM cut-off of $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 \leq 7\%$ by Polygon method.
- 20.1.2 Bauxite resources of **13.64 MT is estimated with an average grade of alumina 34.86% and SiO_2 5.22%, Fe_2O_3 33.52% TiO_2 6.10%, (Table 20.1).** The resource estimated at $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 \leq 7\%$ cut-off.
- 20.1.3 Aluminous Laterite resources of **7.62 MT is estimated with an average grade of alumina 31.46% and SiO_2 9.82%, Fe_2O_3 36.05% TiO_2 4.86% (Table 20.2).** The resource estimated at $\text{Al}_2\text{O}_3 \geq 25$ to $\leq 30\%$ cut-off.
- 20.1.4 **Assessment of TiO_2 :** TiO_2 has been recorded in all lithounits viz. bauxite, aluminous laterite and clay horizons. The average $\text{TiO}_2\%$ is 1.93 % in the variegated clay, 6.10 % in bauxite Zone and 4.86% in Aluminous Laterite zone. A resource of **29.46 MT** has been estimated for $\text{TiO}_2\%$ cutoff of 2%, with average grade of 4.86% in the Bauxite, Laterite and clay zone which has average alumina 32.98%, SiO_2 30.94% (Table: 20.3).
- 20.1.5 **Aluminous Clay resources of 21.86 MT is estimated with an average grade of alumina 31.98% and silica 38.33%, TiO_2 1.93% (Table: 20.4).** The resource estimated at $\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 > 30\%$ cutoff.
- 20.1.6 **Gallium (Ga) resources of 25.88 MT is estimated with an average grade of Ga 69.70ppm, Vanadium 938.08ppm, alumina 33.77% and silica 31.81%, TiO_2 5.30% (Table: 20.5).** The resource estimated at $\text{Ga} \geq 50\text{ppm}$ cutoff.
- 20.1.7 **Vanadium (V) resources of 24.33 MT is estimated with an average grade of V 1003.03 ppm, Ga 68.73 ppm, alumina 33.08% and silica 33.93%, TiO_2 5.51% (Table: 20.6).** The resource estimated at $\text{V} \geq 500$ ppm cutoff.

Table No.20.1

**SUMMARY OF ESTIMATED POLYGON WISE, BOREHOLE WISE INFERRED CATEGORY OF RESOURCES (333) OF
BAUXITE (POLYGONAL METHOD) IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, JHARKHAND.
(at IBM cut off for bauxite >30% Al₂O₃% and <7% SiO₂%)**

Bulk density:2.08

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
4	MAP-04	68859.99	2.00	137719.99	286457.58	257811.82	31.14	41.14	6.72	5.03	15.55	75.75	1182.00
	MAP-04	68859.99	7.50	516449.96	1074215.91	966794.32	32.72	34.01	6.91	6.45	19.27	63.80	796.07
	MAP-04	68859.99	3.40	234123.98	486977.88	438280.09	32.28	34.66	6.57	5.32	20.29	75.41	644.06
5	MAP-05	65027.46	2.00	130054.92	270514.24	243462.82	37.35	31.85	6.64	5.72	17.76	100.75	2952.50
	MAP-05	65027.46	12.70	825848.76	1717765.42	1545988.88	32.48	36.54	4.27	6.32	19.86	64.54	861.85
6	MAP-06	80166.50	8.20	657365.27	1367319.76	1230587.78	32.84	34.40	6.39	5.66	20.05	65.54	764.60
10	MAP-10	80837.76	3.00	242513.29	504427.63	453984.87	40.67	22.95	5.61	6.70	22.25	65.00	685.50
12	MAP-12	59967.63	10.00	599676.34	1247326.78	1122594.10	32.39	35.51	6.86	6.31	18.41	63.00	788.75
13	MAP-13	54621.65	2.50	136554.13	284032.60	255629.34	35.07	34.70	6.32	4.03	19.38	49.40	657.00
14	MAP-14	85661.69	15.00	1284925.40	2672644.83	2405380.35	36.57	32.83	4.81	5.77	19.45	65.31	895.83
15	MAP-15	65979.05	2.50	164947.62	343091.06	308781.95	35.20	33.31	3.11	8.11	19.69	100.20	1724.20
	MAP-15	65979.05	5.00	329895.25	686182.11	617563.90	33.20	34.26	4.31	6.20	21.49	65.20	1112.10
	MAP-15	65979.05	3.00	197937.15	411709.27	370538.34	37.87	27.51	4.89	7.62	21.48	66.17	1193.83
16	MAP-16	56676.85	6.00	340061.11	707327.11	636594.40	38.70	29.56	4.25	5.97	21.01	68.00	707.67
17	MAP-17	31426.12	2.50	78565.30	163415.82	147074.24	31.99	38.69	4.78	5.44	18.42	60.20	852.20
	MAP-17	31426.12	2.75	86421.83	179757.40	161781.66	40.12	29.56	2.38	5.43	21.96	51.91	852.09
17	MAP-18	114925.58	3.00	344776.74	717135.62	645422.06	39.45	27.80	6.67	6.41	19.16	100.50	1475.33
	MAP-18	114925.58	8.50	976867.43	2031884.26	1828695.84	34.67	35.49	3.76	6.23	19.33	56.18	862.06

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
Total Geological resources of Bauxite with grade in tonnes					15152185.28	13636966.75	34.86	33.52	5.22	6.10	19.68	66.95	936.58
Total Geological resources for Bauxite with grade in million tonnes					15.15	13.64							

Table No.20.2

SUMMARY OF ESTIMATED POLYGON WISE, BOREHOLE WISE INFERRED CATEGORY OF RESOURCES (333) OF ALUMINOUS LATERITE (POLYGONAL METHOD) IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, JHARKHAND.

(at IBM cut off for Aluminous laterite >25% <30% Al₂O₃ and >7% & <12% SiO₂)

Bulk density:2.08

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
1	MAP-01	43323.64	4.30	186291.67	387486.67	348738.01	35.80	30.01	9.42	4.63	19.25	78.21	884.98
	MAP-01	43323.64	1.40	60653.10	126158.45	113542.61	37.68	29.35	8.19	3.28	20.74	65.64	705.71
4	MAP-04	68859.99	3.50	241009.98	501300.76	451170.68	39.19	23.26	11.01	5.90	20.05	102.71	1031.00
	MAP-04	68859.99	1.50	103289.99	214843.18	193358.86	30.76	35.65	11.56	4.91	16.61	57.67	792.33
	MAP-04	68859.99	2.00	137719.99	286457.58	257811.82	33.99	29.81	9.99	5.68	19.61	60.00	706.00
5	MAP-05	65027.46	3.00	195082.38	405771.36	365194.22	32.98	31.25	11.81	4.75	18.77	84.67	1267.33
6	MAP-06	80166.50	5.40	432899.08	900430.08	810387.08	26.85	42.82	8.94	4.56	16.15	65.17	967.69
8	MAP-08	32645.52	5.50	179550.36	373464.75	336118.27	27.97	39.75	12.10	4.21	15.42	52.18	771.55
9	MAP-09	44420.87	1.00	44420.87	92395.40	83155.86	33.31	30.59	11.91	5.33	18.22	60.50	623.00

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
	MAP-09	44420.87	1.00	44420.87	92395.40	83155.86	32.85	32.45	9.86	6.11	18.22	48.50	736.00
10	MAP-10	80837.76	1.00	80837.76	168142.54	151328.29	39.23	22.05	10.82	6.33	20.69	73.50	662.50
	MAP-10	80837.76	1.00	80837.76	168142.54	151328.29	40.85	20.83	8.40	7.34	21.95	77.00	653.67
11	MAP-11	48502.59	2.00	97005.18	201770.77	181593.69	33.13	32.08	10.56	5.97	17.35	88.00	1119.00
12	MAP-12	59967.63	6.00	359805.80	748396.07	673556.46	37.21	29.58	9.77	5.21	17.71	94.08	1827.08
	MAP-12	59967.63	1.00	59967.63	124732.68	112259.41	40.43	21.96	11.56	3.31	22.06	66.00	454.00
13	MAP-13	54621.65	5.50	300419.09	624871.71	562384.54	27.43	40.78	11.36	4.63	15.30	71.64	1018.45
	MAP-13	54621.65	2.50	136554.13	284032.60	255629.34	34.60	28.88	10.17	6.53	19.31	65.40	713.60
15	MAP-15	65979.05	4.00	263916.20	548945.69	494051.12	28.31	40.95	8.63	4.29	17.04	59.75	1401.13
16	MAP-16	56676.85	6.00	340061.11	707327.11	636594.40	29.93	39.39	9.40	4.69	15.87	84.17	1619.33
17	MAP-17	31426.12	6.00	188556.72	392197.97	352978.17	26.78	46.02	8.28	3.63	14.67	54.25	1206.08
	MAP-17	31426.12	2.50	78565.30	163415.82	147074.24	27.34	47.70	1.72	4.19	18.29	42.80	1477.40
18	MAP-18	114925.58	4.00	459702.32	956180.83	860562.75	27.22	43.68	9.63	4.48	14.47	69.25	1239.50
Total Geological resources of Aluminous Laterite with grade in tonnes					8468859.97	7621973.97	31.46	36.05	9.82	4.86	17.18	72.51	1138.87
Total Geological resources for Aluminous Laterite with grade in million tonnes					8.47	7.62							

Table No.20.3

**SUMMARY OF ESTIMATED POLYGON WISE, BOREHOLE WISE INFERRED CATEGORY OF RESOURCES (333) OF TiO₂
(POLYGONAL METHOD) IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, JHARKHAND.
(at IBM cut off TiO₂ >2%)**

Bulk density:2.08

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
1	MAP 01	43323.64	12.80	554542.65	1153448.70	1038103.83	34.73	27.85	14.55	3.97	18.13	68.66	738.81
2	MAP 02	25321.87	5.90	149399.00	310749.93	279674.94	32.48	21.38	24.05	4.22	16.54	62.97	635.49
		25321.87	2.00	50643.73	105338.96	94805.06	34.11	11.23	38.86	2.12	12.78	37.00	222.00
		25321.87	1.20	30386.24	63203.38	56883.04	26.59	9.87	51.43	2.47	8.47	29.00	244.00
4	MAP 04	68859.99	21.30	1466717.88	3050773.19	2745695.87	33.42	31.95	9.50	5.66	18.77	72.13	816.26
5	MAP 05	65027.46	22.00	1430604.15	2975656.63	2678090.97	32.92	32.49	10.13	5.44	18.46	66.76	1103.85
6	MAP 06	80166.50	14.60	1170430.84	2434496.15	2191046.54	30.55	36.59	8.95	5.06	18.19	64.20	811.45
7	MAP 07	35455.91	11.70	414834.10	862854.92	776569.43	30.43	18.48	30.89	4.07	15.20	57.11	425.21
8	MAP 08	32645.52	16.10	525592.87	1093233.17	983909.85	30.53	24.85	26.18	3.48	14.00	51.26	544.38
9	MAP 09	44420.87	10.00	444208.67	923954.03	831558.63	31.80	22.89	25.96	3.59	15.11	44.75	461.10
10	MAP 10	80837.76	15.50	1252985.31	2606209.45	2345588.50	35.23	18.08	25.52	4.32	16.23	49.48	461.77
11	MAP 11	48502.59	4.60	223111.91	464072.77	417665.49	32.56	31.07	13.72	4.41	17.26	73.39	878.26
12	MAP 12	59967.63	23.00	1379255.57	2868851.59	2581966.43	33.37	31.19	12.50	5.15	17.26	72.50	1043.76
13	MAP 13	54621.65	19.00	1037811.41	2158647.73	1942782.96	30.51	33.92	13.56	4.77	16.71	63.73	827.35
14	MAP 14	85661.69	15.00	1284925.40	2672644.83	2405380.35	36.80	32.51	4.86	5.66	19.58	64.97	883.57
15	MAP 15	65979.05	11.50	758759.07	1578218.86	1420396.97	31.93	36.38	5.55	5.95	19.55	70.91	1345.70
16	MAP 16	56676.85	15.00	850152.77	1768317.77	1591485.99	33.69	34.09	8.49	5.15	17.92	77.90	1216.17
17	MAP 17	31426.12	15.00	471391.79	980494.93	882445.43	31.19	38.19	8.59	4.22	17.20	51.48	1025.13
18	MAP 18	114925.58	16.00	1838809.29	3824723.32	3442250.99	33.53	35.91	6.36	5.71	17.96	67.94	1067.38

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
	MAP 18	114925.58	1.00	114925.58	239045.21	215140.69	26.30	43.14	7.21	3.77	18.57	48.00	842.00
	MAP 18	114925.58	2.50	287313.95	597613.02	537851.72	31.74	18.11	32.97	2.57	14.21	37.40	349.00
Total Geological resources of Titanium Oxide with grade in tonnes					32732548.53	29459293.68	32.98	30.94	12.85	4.98	17.60	64.22	878.38
Total Geological resources for Titanium Oxide with grade in million tonnes					32.73	29.46							

Table No.20.4

SUMMARY OF ESTIMATED POLYGON WISE, BOREHOLE WISE INFERRED CATEGORY OF RESOURCES (333) OF ALUMINOUS CLAY (POLYGONAL METHOD) IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, JHARKHAND.

Bulk density:2.08

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
1	MAP-01	43323.64	11.90	515551.37	1072346.84	965112.16	33.48	16.28	33.63	2.31	13.79	40.46	294.66
	MAP-01	43323.64	5.00	216618.22	450565.90	405509.31	32.65	4.45	50.45	2.15	9.85	30.20	161.40
	MAP-01	43323.64	2.00	86647.29	180226.36	162203.72	29.63	12.28	46.95	1.34	9.35	29.00	140.00
2	MAP-02	25321.87	26.00	658368.49	1369406.46	1232465.82	27.08	9.83	48.62	1.28	9.74	43.30	164.74
3	MAP-03	28622.63	27.00	772810.90	1607446.66	1446702.00	30.28	5.01	50.65	0.44	8.71	42.56	15.04
4	MAP-04	68859.99	9.60	661055.95	1374996.37	1237496.73	34.16	12.40	38.07	1.92	12.82	34.75	207.14
5	MAP-05	65027.46	11.30	734810.31	1528405.45	1375564.91	33.00	16.42	34.29	2.27	13.31	34.36	336.41
6	MAP-06	80166.50	11.50	921914.71	1917582.59	1725824.33	31.46	18.04	35.71	1.79	12.55	32.04	236.52
	MAP-06	80166.50	1.80	144299.69	300143.36	270129.03	33.76	8.25	39.09	0.54	16.75	61.00	24.67

Polygon No.	BH No.	Polygon Area (m ²)	Thickne ss (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
7	MAP-07	35455.91	5.70	202098.66	420365.22	378328.70	30.66	19.41	26.24	5.17	17.34	67.74	495.74
	MAP-07	35455.91	8.00	283647.25	589986.27	530987.64	29.41	14.29	40.88	2.16	11.31	43.63	269.13
8	MAP-08	32645.52	4.50	146904.84	305562.07	275005.86	28.22	20.13	32.94	3.36	12.95	53.00	487.49
	MAP-08	32645.52	12.50	408069.00	848783.52	763905.17	29.56	10.47	45.45	2.00	10.14	40.25	242.79
9	MAP-09	44420.87	1.50	66631.30	138593.10	124733.79	32.52	27.06	17.82	4.04	17.33	49.67	538.67
	MAP-09	44420.87	1.50	66631.30	138593.10	124733.79	30.23	32.16	16.60	3.50	16.84	47.33	535.67
	MAP-09	44420.87	9.00	399787.80	831558.63	748402.76	30.18	10.84	44.68	1.70	11.09	38.22	194.72
10	MAP-10	80837.76	10.00	808377.62	1681425.45	1513282.90	32.36	15.81	35.53	2.61	13.13	38.30	345.80
11	MAP-11	48502.59	16.00	776041.42	1614166.15	1452749.53	32.45	8.37	44.31	0.82	12.75	47.00	128.94
12	MAP-12	59967.63	5.90	353809.04	735922.80	662330.52	30.75	27.39	23.71	3.12	14.04	72.12	796.51
	MAP-12	59967.63	6.50	389789.62	810762.40	729686.16	31.92	17.50	34.46	1.94	13.72	39.38	296.54
13	MAP-13	54621.65	7.00	382351.57	795291.27	715762.14	28.52	26.11	28.02	2.54	13.74	64.17	671.83
	MAP-13	54621.65	1.50	81932.48	170419.56	153377.60	30.69	21.29	31.36	2.30	13.97	36.00	363.67
	MAP-13	54621.65	1.00	54621.65	113613.04	102251.73	34.54	11.45	38.51	1.47	13.63	29.00	161.00
	MAP-13	54621.65	1.00	54621.65	113613.04	102251.73	37.35	3.02	44.07	1.62	13.25	33.00	338.00
14	MAP-14	85661.69	10.50	899447.78	1870851.38	1683766.25	34.67	11.86	38.25	1.60	13.23	31.71	217.57
15	MAP-15	65979.05	7.50	494842.87	1029273.17	926345.85	38.00	2.02	43.46	1.69	14.47	33.75	83.75
16	MAP-16	56676.85	1.50	85015.28	176831.78	159148.60	32.63	17.81	30.81	1.87	14.88	41.67	299.67
	MAP-16	56676.85	5.50	311722.68	648383.18	583544.86	35.98	16.09	27.24	3.11	17.07	55.38	374.38
	MAP-16	56676.85	2.50	141692.13	294719.63	265247.67	27.73	27.07	30.95	1.44	11.79	21.80	305.80
17	MAP-17	31426.12	9.00	282835.07	588296.96	517701.32	32.04	15.71	37.55	1.80	12.42	30.06	361.47
18	MAP-18	114925.58	2.50	287313.95	597613.02	525899.46	31.74	18.11	32.97	2.57	14.21	37.40	349.00

Polygon No.	BH No.	Polygon Area (m ²)	Thickne ss (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
Total Geological resources of Aluminous Clay with grade in tonnes					24315744.73	21860452.05	31.99	13.88	38.25	1.93	12.70	40.85	268.30
Total Geological resources for Aluminous Clay with grade in million tonnes					24.32	21.86							

Table No.20,5

SUMMARY OF ESTIMATED POLYGON WISE, BOREHOLE WISE INFERRED CATEGORY OF RESOURCES (333) OF GALLIUM (Ga) (POLYGONAL METHOD) IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, JHARKHAND.

Bulk density:2.08

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	SiO ₂ %	Fe ₂ O ₃ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
1	MAP-01	43323.64	10.20	441901.17	919154.44	827238.99	35.86	29.26	10.43	4.30	19.32	75.18	830.20
2	MAP-02	25321.87	4.90	124077.14	258080.45	232272.40	33.45	21.06	22.43	4.54	17.21	66.02	667.84
	MAP-02	25321.87	4.70	119012.77	247546.55	222791.90	33.27	6.53	47.49	0.46	9.82	58.43	19.36
3	MAP-03	28622.63	4.00	114490.50	238140.25	214326.22	33.11	5.96	47.01	0.39	11.51	57.75	10.00
4	MAP-04	68859.99	21.30	1466717.88	3050773.19	2745695.87	33.42	31.95	9.50	5.66	18.77	72.13	816.26
5	MAP-05	65027.46	18.20	1183499.80	2461679.57	2215511.62	33.12	35.07	5.95	5.96	19.34	72.46	1241.92
6	MAP-06	80166.50	13.60	1090264.35	2267749.84	2040974.86	30.46	37.74	7.40	5.22	18.50	65.39	845.24
	MAP-06	80166.50	1.80	144299.69	300143.36	270129.03	33.76	8.25	39.09	0.54	16.75	61.00	24.67
7	MAP-07	35455.91	5.70	202098.66	420365.22	378328.70	30.66	19.41	26.24	5.17	17.34	67.74	495.74
	MAP-07	35455.91	2.00	70911.81	147496.57	132746.91	32.52	13.44	35.15	3.44	14.74	56.00	238.50

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	SiO ₂ %	Fe ₂ O ₃ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
	MAP-07	35455.91	1.00	35455.91	73748.28	66373.46	29.01	20.39	34.98	3.54	11.35	50.00	540.00
8	MAP-08	32645.52	4.50	146904.84	305562.07	275005.86	29.97	34.15	15.14	4.85	15.05	69.04	893.64
	MAP-08	32645.52	2.00	65291.04	135805.36	122224.83	37.17	22.62	15.83	5.51	18.44	68.00	622.00
	MAP-08	32645.52	1.00	32645.52	67902.68	61112.41	32.60	16.28	35.03	2.70	12.49	52.00	358.00
9	MAP-09	44420.87	2.00	88841.73	184790.81	166311.73	31.72	30.94	15.10	4.41	17.10	58.50	610.50
	MAP-09	44420.87	0.50	22210.43	46197.70	41577.93	34.53	32.20	7.36	6.75	18.65	56.00	807.00
10	MAP-10	80837.76	5.50	444607.69	924784.00	832305.60	40.46	22.21	7.32	7.42	21.88	69.82	672.64
	MAP-10	80837.76	1.00	80837.76	168142.54	151328.29	34.27	8.96	40.08	3.18	12.86	50	325
	MAP-10	80837.76	1.00	80837.76	168142.54	151328.29	34.82	11.97	33.58	4.60	14.52	55	399
11	MAP-11	48502.59	4.60	223111.91	464072.77	417665.49	32.56	31.07	13.72	4.41	17.26	73.39	878.26
	MAP-11	48502.59	3.00	145507.77	302656.15	272390.54	35.54	6.44	42.42	0.56	13.75	51.67	46.67
12	MAP-12	59967.63	22.30	1337278.23	2781538.71	2503384.84	33.76	31.45	11.59	5.17	17.41	74.37	1065.49
13	MAP-13	54621.65	1.00	54621.65	113613.04	102251.73	28.98	20.67	34.80	1.46	12.62	50.00	339.00
	MAP-13	54621.65	19.00	1037811.41	2158647.73	1942782.96	30.49	33.48	14.22	4.65	16.58	63.84	812.92
14	MAP-14	85661.69	13.50	1156432.86	2405380.35	2164842.32	36.43	33.09	4.67	6.02	19.21	67.15	926.59
15	MAP-15	65979.05	11.50	758759.07	1578218.86	1420396.97	31.93	36.38	5.55	5.95	19.55	70.91	1345.70
	MAP-15	65979.05	0.50	32989.52	68618.21	61756.39	39.35	19.71	10.39	6.71	22.99	64.00	915.00
	MAP-15	65979.05	3.00	197937.15	411709.27	370538.34	37.87	27.51	4.89	7.62	21.48	66.17	1193.83
16	MAP-16	56676.85	15.00	850152.77	1768317.77	1591485.99	34.05	33.06	8.91	5.14	18.19	78.16	1165.34
	MAP-16	56676.85	0.50	28338.43	58943.93	53049.53	43.51	13.07	13.94	4.19	24.78	70	271
	MAP-16	56676.85	0.50	28338.43	58943.93	53049.53	35.30	22.29	16.32	5.66	19.70	94	535
17	MAP-17	31426.12	9.00	282835.07	588296.96	529467.26	28.26	44.08	6.95	4.18	15.87	55.72	1105.67

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	SiO ₂ %	Fe ₂ O ₃ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
	MAP-17	31426.12	2.25	70708.77	147074.24	132366.81	42.26	26.12	2.69	5.34	23.04	52.78	824.33
18	MAP-18	114925.58	11.00	1264181.39	2629497.28	2366547.55	33.89	38.76	8.21	5.63	17.72	78.24	1242.67
	MAP-18	114925.58	3.50	402239.53	836658.23	752992.40	43.17	35.51	4.68	7.88	24.73	67.00	921.83
Total Geological resources of Gallium grade in tonnes					28758392.85	25882553.56	33.77	31.81	11.03	5.30	18.31	69.70	938.08
Total Geological resources for Gallium grade in million tonnes					28.76	25.88							

Table No.20.6

SUMMARY OF ESTIMATED POLYGON WISE, BOREHOLE WISE INFERRED CATEGORY OF RESOURCES (333) OF VANADIUM (V) (POLYGONAL METHOD) IN ANVARAPAT BLOCK, DISTRICT - LOHARDAGA, JHARKHAND.

Bulk density:2.08

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	SiO ₂ %	Fe ₂ O ₃ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
1	MAP-01	43323.64	9.60	415906.98	865086.53	778577.87	35.93	30.06	9.37	4.37	19.41	76.25	857.02
2	MAP-02	25321.87	4.90	124077.14	258080.45	232272.40	33.45	21.06	22.43	4.54	17.21	66.02	667.84
3	MAP-03	28622.63	0.80	22898.10	47628.05	42865.24	26.99	31.73	25.16	1.80	13.32	37.00	563.38
4	MAP-04	68859.99	20.20	1390971.89	2893221.52	2603899.37	33.50	32.55	8.49	5.79	18.98	73.06	843.40
5	MAP-05	65027.46	20.00	1300549.23	2705142.39	2434628.15	33.12	33.63	7.96	5.74	18.99	69.74	1174.39
6	MAP-06	80166.50	13.60	1090264.35	2267749.84	2040974.86	30.46	37.74	7.40	5.22	18.50	65.39	845.24
7	MAP-07	35455.91	2.00	70911.81	147496.57	132746.91	30.53	22.69	24.38	4.57	16.70	67.60	553.60

Polygon No.	BH No.	Polygon Area (m ²)	Thickness (m)	Volume (m ³)	Gross Geological Resources (tonnes)	Net Geological Resources (tonnes)	Average Quality						
							Al ₂ O ₃ %	SiO ₂ %	Fe ₂ O ₃ %	TiO ₂ %	LOI %	Ga (ppm)	V (ppm)
	MAP-07	35455.91	0.50	17727.95	36874.14	33186.73	29.38	19.11	26.58	4.40	19.63	65.00	567.00
	MAP-07	35455.91	1.00	35455.91	73748.28	66373.46	29.01	20.39	34.98	3.54	11.35	50.00	540.00
8	MAP-08	32645.52	8.10	264428.71	550011.72	495010.55	29.51	34.91	14.66	4.50	15.79	59.72	767.51
9	MAP-09	44420.87	5.50	244314.77	508174.72	457357.24	31.93	29.89	16.23	4.27	17.00	49.27	594.27
10	MAP-10	80837.76	5.50	444607.69	924784.00	832305.60	40.46	22.21	7.32	7.42	21.88	69.82	672.64
11	MAP-11	48502.59	3.60	174609.32	363187.38	326868.65	31.77	32.73	12.85	4.92	16.79	77.67	988.33
12	MAP-12	59967.63	17.50	1049433.59	2182821.86	1964539.67	33.00	33.91	9.31	5.92	17.32	79.06	1242.77
13	MAP-13	54621.65	16.50	901257.28	1874615.14	1687153.62	29.70	34.81	13.74	4.90	16.30	65.18	867.70
14	MAP-14	85661.69	15.00	1284925.40	2672644.83	2405380.35	36.80	32.51	4.86	5.66	19.58	64.97	883.57
15	MAP-15	65979.05	11.50	758759.07	1578218.86	1420396.97	31.93	36.38	5.55	5.95	19.55	70.91	1345.70
	MAP-15	65979.05	0.50	32989.52	68618.21	61756.39	39.35	19.71	10.39	6.71	22.99	64.00	915.00
	MAP-15	65979.05	3.00	197937.15	411709.27	370538.34	37.87	27.51	4.89	7.62	21.48	66.17	1193.83
16	MAP-16	56676.85	13.00	736799.07	1532542.07	1379287.86	32.13	36.58	8.26	5.29	17.07	79.42	1331.77
	MAP-16	56676.85	0.50	28338.43	58943.93	53049.53	35.30	22.29	16.32	5.66	19.70	94.00	535.00
17	MAP-17	31426.12	11.00	345687.31	719029.61	647126.65	28.09	44.74	5.99	4.17	16.34	53.00	1187.32
	MAP-17	31426.12	2.50	78565.30	163415.82	147074.24	38.66	31.62	2.40	5.46	21.31	51.20	894.20
	MAP-17	31426.12	1.00	31426.12	65366.33	58829.70	21.00	39.58	29.29	0.87	8.73	19.50	888.00
18	MAP-18	114925.58	16.00	1838809.29	3824723.32	3442250.99	33.53	35.91	6.36	5.71	17.96	67.94	1067.38
	MAP-18	114925.58	1.00	114925.58	239045.21	215140.69	26.30	43.14	7.21	3.77	18.57	48.00	842.00
Total Geological resources of Va grade in tonnes					27032880.04	24329592.04	33.08	33.93	8.50	5.51	18.35	68.73	1003.03
Total Geological resources for Va grade in million tonnes					27.03	24.33							

20.2.0 COMPUTATION OF AVERAGE GRADE:

20.2.1 All calculations for grade estimation for bauxite zone are made by weighted average method. Since the sample interval was uniformly maintained along with different litho-units, the length of the sample was mostly maintained at 1.00m interval with the exception of litho-unit variations, and any structural implications. The, weighted average has been calculated by the following formula:

$$\text{Weighted average grade} = \frac{V_1 \times G_1 + V_2 \times G_2 + V_3 \times G_3 + \dots + V_n \times G_n}{V_1 + V_2 + V_3 + \dots + V_n}$$

Here 'V' = Volume of bauxite ore in individual borehole

'G' = Grade of the respective bauxite ore in the corresponding borehole

20.3.0 CATEGORY OF RESOURCE:

20.3.1 The bauxite in this area is relatively thin and do not get correlated with adjoining boreholes unequivocally in all the places, so the Total estimated resources in Anvarapat block having an extent area of 1.02 sqkm are placed under “Inferred Mineral Resource” (333) category of UNFC.

20.3.2 The area under investigation falls under 333 category of resources under UNFC nomenclature. However as per the Minerals (Evidence of Mineral Contents) Rules, 2015, amended upto 14th Dec 2021, Rule 5 which states “At least Preliminary Exploration (G3) has been completed to establish Inferred Mineral Resource (333), which shall be considered akin to Indicated Mineral Resource (332), and a geological study report has been prepared conforming to Part IV of Schedule-I.”

Hence resources are categorized under 332 category.

CHAPTER-21

SUMMARY AND RECOMMENDATIONS

21.1.0 DISCUSSION ON THE OUTCOME OF THE EXPLORATION WORK DETAILING THE NATURE OF THE DEPOSIT

- 21.1.1 Preliminary exploration was carried out in Anvarapat block which covers an area of 1.02 sq.km, lies in part of Survey of India Toposheet No.73A/10. The exploration site is located 13km northwest of Kisko village (block of Lohardaga dist) and approximately 25 km from Lohardaga, District headquarters, Jharkhand.
- 21.1.2 In view of the enactment of the MMDR Amendment Act-2015 and Mineral Auction Rule- 2015 by the Govt. of India, DMG, Government of Jharkhand had discussed with MECL to take up exploration work of Bauxite blocks in the Lohardaga district of Jharkhand for upgradation of the area as per the MMDR Amendment Act and Mineral Auction Rule, 2015 which shall enable the state government for auctioning of the Bauxite blocks.
- 21.1.3 Based on the mineral potentiality of the prospect and previous work carried out by GSI and MECL in the area, MECL formulated G-3 stage Exploration proposal and presented in the 68st TCC meeting of NMEDT held on 28th 29th and 31st August 2024. The Technical Cost committee has technically evaluated and recommended the exploration proposal for approval Executive Committee (EC) of NMET.
- 21.1.4 Consequently, the project was approved by 37th EC, NMET held on 23rd September 2024 and same was intimated to MECL by Ministry of Mines vide letter number F.No.23/500/2024-NMET/445, New Delhi dated 23rd October 2024. Project was approved with the title “Preliminary Exploration (G-3 level) for Bauxite, Titanium and Associated minerals in Anvarapat block, District-Lohardaga, Jharkhand”, with estimated cost of Rs 175.63 Lakhs including GST in time schedule of 08 months for carrying out the proposed work (Annexure IX) and submission of report.
- 21.1.5 The present exploration work in Anvarapat block commenced with geological mapping and exploratory drilling in Borehole No. MAP-01 on 24.01.2025 and was completed with the closure of Borehole No. MAP-18 on 30.06.2025. As per approved quantum of work, a total 519.00 m of drilling was completed in 18 no of boreholes. The allied field-works including Borehole survey, topographical survey, sampling and analytical work were completed simultaneously. The laboratory studies including chemical analysis and physical analysis i.e. petrographic and bulk

density studies were carried out simultaneously in laboratories of MECL and other Govt. / NABL accredited laboratories.

- 21.1.6 Regionally the different lithounits in the study area consist of granite gneiss of Chhotanagpur Granite Gneissic Complex (CGC) with enclaves of unclassified metamorphics intruded by pegmatites and thick veins of quartz. Minor outcrops of Damodar Supergroup rocks are also exposed at few places. Bauxite bearing areas are popularly known as “pat” in Chhotanagpur plateau, The laterite/bauxite are developed over the gneissic country rock belonging to Chhotanagpur Gneissic Complex (CGC).
- 21.1.7 Anvarapat block lies in the western part of Pakhar Plateau which is a V shaped hillock. The plateau slopes gradually toward northeast. Steep gradients with cliff faces are characteristics of south, east and west of the hillocks. The link of western plateau is known as Banglapat. The highest point is at 1066.0 mRL and lowest point towards the valley portion in north is about 940m above M.S.L. In this block, exposures of bauxites, laterites in old quarries are observed and mapped by MECL. Exposures were observed and mapped in the northern, NE. NNE, WNW and NE-NW boundary, also in the escarpment sections. Block stratigraphy sequence is given below

The Local Stratigraphic Succession of the Anvarapat Block area

Recent	Soil
Tertiary to Recent	Laterite Soil (0.1 to 2.0m) Laterite and Morrum (1.5-2.5m) Bauxite and aluminous laterite (0.5 to 15.0m) Variegated Clay (6.0 to 27.0m) Lithomarge (2-5m)

- 21.1.8 Bauxite deposits are the result of Silica leaching process of alumina rich rocks and it occurs on flat topped Plateau region as blanket of laterite/bauxite deposit. boulders of bauxite and lateritic bauxite present in deep nala sections and road cuttings which are signature of bauxite formation in this area. In the scarp sections the whole profile beginning from lateritic soil cover, laterite, lateritic bauxite, bauxite and underlying lithomarge clay are visible. The major Bauxite mineral is gibbsite with minor amount of Boehmite and other bauxite minerals
- 21.1.9 All boreholes were drilled vertically and as per MEMC rules 2015, amended upto 14th December 2021. Extract of Part III of MEMC rules is given below

Exploration Norms for different types of deposits for I. Bedded Stratiform and tabular deposits of regular and irregular habit:

Provided that for deposits specified in Schedule II, 3 bore holes drilled so as to form a polygon in blocks of less than 100 hectares and 5 bore holes in blocks of more than 100 hectares may be sufficient. The lateral influence beyond the bore hole spacing may be limited to a maximum of 50 per cent. of the spacing depending on the results of surface geological mapping.

- 21.1.10 Accordingly, The Bauxite, Titanium Oxide and other associated mineral resources are estimated by “Polygon Method”.
- 21.1.11 **Cut-off Grade:** Threshold Value as per IBM notification 25th May 2018 is (i) For Aluminous laterite: Al_2O_3 – 20% (Min.) (ii) For Bauxite: Al_2O_3 -30% (Min.) and SiO_2 (Total)-7% (Max.) (Gazette Notification dated 25th May 2018 for Threshold Value of Minerals, IBM). The cut off for metallurgical grade bauxite was considered to be $\text{Al}_2\text{O}_3 \geq 40\%$ and $\text{SiO}_2 \leq 04\%$ (Indian Minerals year book, Volume-III; Mineral reviews, 56th Edition Bauxite, Advance release, March 2018)
- 21.1.12 **Assessment of Bauxite:** The mineralized zones occur as i) irregularly bedded with varying thickness and ii) boulder type. Generally, bauxite underlies the soil in western, south western and north western part of the block area. The bauxite mostly is hard, dense, compact thickness ranges between 0.5 to 15m.
- 21.1.13 Average thickness of bauxite as intercepted in the 18 no boreholes drilled is 4.83m, with Min thickness of 0.60m (MAP-01) and maximum 15.00 m (MAP-14). Depth of intersection of these zones is min 0.50m (MAP-14) and max of 25.00m (MAP-13).
- 21.1.14 In the zones demarcated, Al_2O_3 varies from Min 31.14% (MAP-04) and Max 42.77% (MAP-01) and SiO_2 varies from Min 2.38% (MAP-17) and Max 6.91% (MAP-04)
- 21.1.15 Bauxite resources of **13.64 MT with an average grade of alumina 34.86% and SiO_2 5.22%, Fe_2O_3 33.52% TiO_2 6.10%**, The resource have been estimated ($\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 \leq 7\%$ cut-off) by Polygon method
- 20.1.3 Aluminous Laterite resources of **7.62 MT with an average grade of alumina 31.46% and SiO_2 9.82%, Fe_2O_3 36.05% TiO_2 4.86%**. have been estimated ($\text{Al}_2\text{O}_3 \geq 25$ to $\leq 30\%$ cut-off) by Polygon method
- 20.1.4 **Assessment of TiO_2 :** TiO_2 values have been recorded in all lithounits viz. bauxite, aluminous laterite and clay horizons. The $\text{TiO}_2\%$ average is 1.93 % in the variegated clay, 6.10 % in bauxite Zone and 4.86% in Aluminous Laterite zone. A resource of

29.46 MT has been estimated for $\text{TiO}_2\%$ cutoff of 2%, with average grade of 4.86% in the Bauxite, Laterite and clay zone which has average alumina 32.98%, SiO_2 30.94%.

- 20.1.5 **Aluminous Clay resources of 21.86 MT with an average grade of alumina 31.99% and silica 38.25%, TiO_2 1.93% have been estimated ($\text{Al}_2\text{O}_3 \geq 30\%$ and $\text{SiO}_2 > 30\%$) by Polygon method**

21.2.0 RECOMMENDATIONS

- 21.2.1** Explored block has low grade bauxite deposit with 13.64 MT and has good amount of TiO_2 resources, it is recommended to carry out detailed exploration at closer space drilling to increase the confidence level regarding tonnage and average grade. Further it is recommended for beneficiation studies on possibility of extraction of titanium, vanadium and Galium from bauxite/laterite and clay.
- 21.2.2 Established resources for bauxite in Anvarapat block are at G-3 level. Hence the block may be auctioned in composite license by Central Government of India.

CHAPTER-22
PLATES AND MAPS

Sl. No.	Plate No.	Title	R.F.
1	I	Location Map of Anvarapat block, District-Lohardaga, Jharkhand.	1:50000
2	II	Regional Geological Map of Toposheet no 76 A/10, Showing location of Anvarapat block, District-Lohardaga, Jharkhand.	1:50000
3	III	Topographical and Geological Map, Anvarapat block, District-Lohardaga, Jharkhand.	1:2000
4	IV-A	Polygon Map with borehole, area and Thickness of Bauxite, aluminous laterite & TiO_2 zone for boreholes drilled in Anvarapat block, District-Lohardaga, Jharkhand.	1:2000
6	V-A	Graphic litholog of drilled boreholes (MAP-01 To 18) showing bauxite zones ($Al_2O_3 > 30\%$ and $SiO_2 < 7\%$)	1:500
7	V-B	Graphic litholog of drilled boreholes (MAP-01 To 18) showing aluminous laterite zones ($Al_2O_3 > 25\%$ and $< 30\%$)	1:500
8	V-C	Graphic litholog of drilled boreholes (MAP-01 To 18) showing TiO_2 zones (at 2% cut-off)	1:500
9	VI	Fence Diagram for boreholes drilled in Anvarapat block, District-Lohardaga, Jharkhand.	

CHAPTER-23

ANNEXURE / ENCLOSURES TO THE REPORT

- 23.1.0 The report includes all the relevant annexure and maps/plans, sections photographs and photomicrographs etc.

CHAPTER-24

ANY OTHER INFORMATION

24.1.0 PEER REVIEW OF GEOLOGICAL REPORT

Peer Reviewer Comments and MECL Response of Anvarapat Block		
Sl.No.	Peer Reviewer Comments	MECL Response
1	Cover page: Correct the description as suggested.	Agreed
2	CONTENTS: 5.3.0, 5.7.0, 5.10.0 correct the sentence as suggested. In the description part (of the Contents) write the heading only, not the complete description.	Attended
3	Repetition of observations/points should be avoided as noted in the Content page 5.6.0 Vs 6.1.0 .	Attended
4	Annexures: Sl no 13 VI: Enclose the XRD analysis at the time of final submission of the report.	XRD analysis attached as Annexure -VI
5	Executive summary: Bauxite resource. The statement is incomplete, modify as suggested	Attended
6	Bulk density. Location of the 3 pits made in the block may be added in the text/plate.	Attended
7	Overall deduction of 20% is applied to the total gross tonnage to arrive the net insitu resource of bauxite. But the Table no 20.1 shows overall deduction of 10% only. correct the Net resource	Attended
8	Annexure II A: Make the corrections as suggested (particularly under Remarks column).	Attended

**CERTIFICATE FROM THE QUALIFIED PERSON WITH NAME, DATE
AND SIGNATURE**

This is to certify that the Preliminary Exploration (G3) for Bauxite, Titanium and Associated Minerals in the Anvarapat Block, District Lohardaga, State Jharkhand, has been carried out by Mineral Exploration & Consultancy Limited (MECL) in accordance with the prescribed technical standards, procedures, and guidelines laid down in: NMET/MECL-approved Exploration Methodology for G3 Stage

The exploration activities—including geological mapping, sampling, drilling, core logging, sample preparation, laboratory analysis, QA/QC validation and data processing—were executed under the supervision of qualified MECL geoscientists and technical personnel

NAME: SHRIKANT SHARMA

DESIGNATION: HoD (EXPLORATION)

DATE: 29-11-2025

**LIST OF PERSONNEL ASSOCIATED WITH EXPLORATION IN
ANVARAPAT BLOCK, DISTRICT: LOHARDAGA, JHARKHAND**

1	Overall guidance	Shri P. Ravindran, GM (Exploration) Shri Shrikant Sharma, HoD (Exploration)
2	Overall Planning, Co-ordination and Supervision	Shri Naveen Kumar Pala, Sr Manager (Geology)
3	Proposal Preparation	Shri Ashish Singh, Manager (Geology) Shri Arun Kumar Singh, Manager (Geology)
4	Project Management	Shri Ankit Goutam, Asst. Manager (Drilling)/ Project Manager Shri Arun Kumar Singh, Manager (Geology) / OIC
5	Physical Execution of work	
	a) Geology	Shri Arun Kumar Singh, Manager (Geology) Shri Shubam Kumar, Geologist
	b) Survey	Shri Pratap Singh Negi, Survey and Map Officer Shri Biswajit Pal, Tech. Asst. (S&D)
	c) Drilling	Shri Ankit Prabhakar, Asstt. Manager (Drilling) Shri Subrajit Pratihari, Jr. F.M. (Drilling)
6	Chemical Laboratory	Shri Shrikant Sharma, HoD (Exploration) Shri Rohit Sharma, Asstt. Manager (OIC, Labs) Dr. (Mrs.) Deepti. R. Rahangdale, Manager (Labs) Miss Shikha Priyadarshini, Sr. Chemist
7	Petrographic Studies	Shri Sayantan Pal, Asstt. Manager (Geology)
8	Documentation	Shri Naveen Kumar Pala, Sr Manager (Geology) Shri Arun Kumar Singh, Manager (Geology) Shri Peeyush Kalwani, Asst Manager (Geology) Smt. Moumita Ghosh, Sr Geologist
9	Non-Coal Geological Report Cell	Shri Jayanto Kumar Chowdhury, Sr. Manager (Systems) Shri N.C.S Reddy, Console Operator Shri Uday Ashok Patil, Sr. Computer Operator
10	Reprography and Printing	Shri Pratap Singh Negi, Survey and Map Officer

LOCALITY INDEX

Locality	Latitude	Longitude	Toposheet No.
Pakhar	23°33'21"	84°35'29"	73 A/10
Lohardaga	23°26'26.62"N	84°41'12.77"E	73 A/10
Lawapani	23°35'44"	84°32'55"	73 A/10
Jalim Khurd	23°19'50"	84°19'30"	73 A/10
Mungar	23°42'56"	84°32'40"	73 A/10
Kharchapani	23°39'31"	84°38'34"	73 A/10

REFERENCES

1. Interim Report on Regional Geochemical Mapping In Toposheet Nos. 73A/10 and 73A/14 (A1 quadrant) in Lohardaga, Latehar, Chatra
2. Lohardaga District website, govt of Jharkhand
3. Indian Bureau of Mines (IBM), gazette notification No. C-284/3/CMG/2017 for threshold value of minerals.
4. Indian Minerals year book 2017, IBM
5. Siskaripat Geological report, MECL

ABBREVIATIONS USED

SL. No.	Abbreviation	Full form
1	M / m	Meter
2	Cu m	Cubic Meter
4	RL	Reduced Level
5	mRL	Reduced Level in metre
6	M.S.L.	Mean sea level
7	IBM	Indian Bureau of Mines
8	GSI	Geological Survey of India
9	NMET	National Mineral Exploration Trust
10	TCC	Technical cum Cost Committee
11	EC	Executive Committee
12	MMDR	Mines and Minerals (Development and Regulation)
13	MEMC	Minerals (Evidence of Mineral Contents)
14	MECL	Mineral Exploration and Consultancy Limited
15	NABL	National Accreditation Board for Testing and Calibration Laboratories
16	QA/QC	Quality Assessment/ Quality Checks
17	WGS-84	World Geodetic System-84
18	DMS	Degree Minute Second
19	UTM	Universal Transverse Mercator
20	F.S.P.	Field Season Programme
21	DGPS	Differential Global Positioning System
22	XRF	X-ray Fluorescence
23	ICP-MS	Inductively Coupled Plasma Mass Spectrometry
24	BDL	Below Detection Limit
25	MT	Million Tonnes