Proposal for Undertaking Geo-chemical Analysis of Mine Samples of Iron Ore and Limestone Mines

Through NMEDT Funding

Indian Bureau of Mines, Indira Bhavan, Civil Lines,

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January – 2026

Content

1. BACKGROUND

1.1 The Government of India has significantly enhanced its focus on the exploration, mining, and production of critical and strategic minerals that are essential for national development and modern technologies. Due to improved mining and processing methods and the exhaustion of rich ores, materials earlier treated as waste such as dumps and tailings are now valuable. These old and active mine wastes can act as secondary sources of important minerals.

1.2 Historically, mining operations focused primarily on the extraction of the main lease commodities, often ignoring companion or associated elements due to technological or economic limitations. Many of these elements, which were once unrecoverable, are now classified as strategic and critical minerals, crucial for sectors such as electronics, renewable energy, and defence. As a result, legacy extractive wastes, including mine dumps, tailings, and smelter slags, may represent untapped repositories of these high-value materials.

1.3 In this context, the Indian Bureau of Mines undertook a nationwide, first-of-its-kind geochemical assessment covering the entire mining-to-metal value chain across ten major mineral commodities i.e., Chromite, Lead & Zinc, Copper, Bauxite, Manganese, Fluorite, Gold, Tin, Baryte and Graphite. This comprehensive study encompassed systematic sampling and analysis from mine faces, tailings, waste dumps, beneficiation plants, smelters, and refineries,

1.4 For that, IBM had submitted a proposal to National Mineral Exploration and Development Trust (NMEDT) "Proposal for Undertaking Geo-chemical Analysis of Mine Samples" seeking financial assistance for taking up the study specifically for the outsourced geo-chemical analysis of the samples. The final report was submitted to NMEDT on 12th December, 2025. The study clearly demonstrated that residues such as tailings, slags, red mud, anode slimes, filter cakes, and metallurgical dusts host significant concentrations of nationally important elements including Ni, Co, Ga, Sc, In, Sb, Cd, Se, Te, Nb, Ta, REEs, PGEs, often at grades exceeding those of the primary ore.

1.5 The findings of the above study were also presented before the Hon'ble Minister of Mines on 02nd of December 2025, who appreciated the scientific outcomes and their relevance to national mineral security. During the deliberations, the Hon'ble Minister highlighted the importance of the potential of critical minerals from by-product and secondary sources.

During the discussion, he also enquired about the future action plan, to which IBM had proposed to take up the study of iron ore and limestone mines in the country.

1.6 Limestone and iron ore form the backbone of India's cement and steel industries, respectively, and together account for the highest tonnage of mineral production in the country. Iron ore deposits may host critical minerals such as vanadium, titanium, cobalt, and nickel, while limestone deposits particularly dolomitic, phosphatic, and impurity-rich varieties may contain strontium, phosphorus, rare earth elements, and other associated elements.

1.7 Moreover, Banded Iron Formation (BIF) hosted iron ore deposits are also known to be associated with gold mineralisation, particularly along structurally controlled zones such as shear zones, fractures, and altered horizons within or adjoining BIF sequences.

1.8 Given this association of key critical elements and large volumes of waste generated from iron ore and limestone mining and processing operations, systematic geochemical evaluation of these materials is proposed to assess their potential as secondary sources of critical minerals and to support improved resource utilisation and sustainable mining practices.

2. PROPOSAL

2.1 Recognizing this potential, the Indian Bureau of Mines (IBM) proposes to undertake a systematic programme of sampling and comprehensive geochemical analysis of mine samples from limestone and iron ore deposits across the country.

2.2 India has a total of 179 iron ore mines and 680 limestone mines in operation. Out of these, approximately **124 mines**, comprising **73 limestone mines and 51 iron ore mines**, distributed across different geological provinces and mineral belts of the country, are proposed to be covered under the study so as to ensure representative coverage of the major deposit types and ore characteristics.

2.3 The study will involve collection of representative samples exclusively from mining leases of limestone and iron ore. Sampling shall cover mine faces, run-of-mine material, waste dumps, sub-grade dumps, mineral stacks, and tailing ponds wherever present. All samples shall be collected by officers of IBM following established sampling protocols to ensure representativeness and data quality.

2.4 The total number of samples proposed to be collected and analysed is estimated to be around 1500 samples, including check samples. The geochemical analysis will be carried out for major elements, trace elements, critical and strategic minerals, gold and silver

similar to the methodology adopted in earlier national-level geochemical studies, with the objective of creating a baseline geochemical database for limestone and iron ore mines in India.

2.5 The completion timeline for the study is eight months. To ensure timely execution of the project, all samples were proposed to be collected by March 2026. Analysis of all the samples including data compilation, is proposed to be completed by July 2026, followed by final report preparation and submission by 31st August 2026.

2.6 IBM has its own in-house facilities for analytical testing at Mineral Processing Division (MPD). The major objective of IBM Mineral processing division is to undertake beneficiations studies of exploration and mine samples. As the laboratories of IBM are overburdened with huge number of beneficiations projects, it may not be possible to take up the analysis of the samples generated during the present study.

2.7 In view of this, it is proposed to engage services of other organizations under the Ministry of Mines to take up the chemical analysis of the mine samples through NMEDT funding.

2.8 Hence, out of the tentative 1500 samples generated, 100 samples will be analysed at the Mineral processing division of IBM and rest 1400 samples will be analysed at the outsourced laboratories i.e., Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC), Nagpur and Mineral Exploration and Consultancy Limited (MECL), Nagpur.

2.9 The proposal is limited to the outsourcing of samples for sub-sampling and geochemical analysis. The proposal does not include the cost of sample collection by the officers of IBM and the analysis of samples at IBM laboratories.

3. TARGET SITES FOR SAMPLING

S.No.	Target Sites (Mine Face, Dump, Mineral Reject, Screen Reject, Tailing Ponds, Tailing dump, Mineral stack etc.)	Mine/Processing plants	No. of samples to be generated
1	**Limestone Mines**	73	803
2	**Iron Ore Mines**	51	561
3	Check Samples (10%)		136
4	**Final number of samples**		1500

4. PARAMETER FOR ANALYSIS

4.1 Further inputs were also sought from the Mineral Processing Division (MPD), IBM regarding the selection of radicals to be analysed under the study. The MPD opined that the following radicals may be analysed for both iron ore and limestone mine samples.

4.2 The following table presents the details of the different elements proposed to be analysed for the mine samples, following standard operating procedures.

Set	Radicals / Elements
I	Si, Fe, Ca, Mg, Al, Mn, Cr, Na, S, Ba, Ti, K, P, LOI
II	REE (La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Ho, Er, Dy, Tm, Yb, Lu, Sc, Y), Sb, Be, Bi, Ga, Ge, Hf, In, Nb, Re, Se, Sr, Ta, Te, Sn, W, Cd, As, V, Mo, Zr
III	Cu, Co, Ni, Zn, Pb, Li
IV	Au, Ag

5. QUANTUM OF WORK

5.1 Under the proposed study, IBM will undertake comprehensive geochemical characterisation of limestone and iron ore mines to assess the occurrence, distribution, and enrichment behaviour of critical and strategic minerals at the mine stage. The study will focus on identifying potential enrichment in mine face, waste dumps, sub-grade material, and tailings that are presently unutilised.

5.2 Out of the total 1500 proposed samples, a total of 100 number of samples shall be analysed in IBM's in-house laboratories, while the remaining 1400 samples shall be outsourced to the above-mentioned agencies for sub sampling and detailed geochemical analysis on a nomination basis under NMEDT funding.

6. TIME SCHEDULE AND COST ESTIMATES

6.1 The proposed geochemical characterisation programme is structured such that all major activities including sample collection from mines, packaging and dispatch, laboratory processing comprising sample preparation and geochemical analysis, data compilation, and final report preparation will be completed within a period of eight months, i.e., by 31st August 2026.

Timelines for sampling and analysis									
S. No.	**Activities**	**2026**							
		Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**July**	**Aug**
1	Collection of samples from Mines and Plants								
2	Geochemical Analysis of the samples collected								
3	Data Compilation, Report preparation and Identification of potential areas for further study								

6.2 As the sample preparation charges per sample is not available in the Schedule of Charges (SoC) of NMET, the same is proposed to be worked out as per the formula given below.

Sample Preparation Charges per sample =

$$\frac{\text{Sampler party day charges* (1 sampler / Day) +Charges of Engaging Labour** (4Nos./Day)}}{\text{8 Nos. of Sample Per Day}}$$

*As per SoC of NMET

**As per rates prescribed by Central Labour Commission rates or respective State Govt. whichever is higher

6.3 The cost of the project involving outside agencies for analysis has been estimated based on actual schedule of rates mandated in the circular OM No. 6/2/2015-NMET/588 dated 4/12/2025 for NMET funded Projects. The total estimated cost is **INR 292.36 Lakhs**. The summary of cost estimates for this programme is given below.

Summary of Cost Estimates

S. No.	Item	Total Estimated Cost (Rs.)
1	Geologist man-days sampling & Sample preparations	19,56,444
2	Laboratory studies	2,28,20,000
3	Sub Total (1 to 2)	2,47,76,444
4	GST 18%	44,59,759.92
	Total:	**2,92,36,203.92**
	Say Rs. In Lakh	**292.36/-**

Enclosure: Detailed Cost Sheet

Appendix: Detailed Cost Sheet

ESTIMATED COST for Undertaking Geochemical Analysis of Mine Samples							
Sl. No.	**Item of Work**	**Unit**	**Rates as per NMET SoC December, 2025**		**Total Cost of the Project**		**Remarks**
			SoC-Item-S.No.	**Rates as per SoC**	**Qty./days**	**Total Amount (Rs)**	
1.0	**Sample Processing**						
1.1	Sampling man days for Sample processing work - Charges of one sampler per day (without Labour)	day	1.2.1b	7,850	175	13,73,750/-	1400 (total samples)/8 (no. of samples processed each day) = 175 days*
1.2	4 labours/sampler (Rs 832.42/day/labour) for sampling work	day	5.8	832.42	700	5,82,694/-	Charges of Engaging unskilled labour as per rates prescribed by Central Labour Commission rates or respective State Govt. whichever is higher
Sub-Total 1						**19,56,444/-**	
2.0	**Laboratory Studies**						
2.1	Complete analysis of limestone/iron ore samples	per sample	4.1.11	3,900	1400	54,60,000/-	
2.2	HR-ICP MS (REE & Trace)	per sample	4.1.16f	7,400	1400	1,03,60,000/-	
2.3	For Gold & Ag by Fire-assay	per sample	4.1.5a	5,000	1400	70,00,000/-	
Sub-Total 2						**2,28,20,000/-**	

Total Estimated Cost without GST		**2,47,76,444/-**	
Provision for GST (18%)	**CGST (@ 9%)**	**22,29,880/-**	GST will be reimburse as per actual and as per notified prescribed rate
	SGST (@9%)	**22,29,880/-**	
	IGST	–	
Total GST (CGST+SGST+IGST)		**44,59,759.92/-**	
Gross Value (Sub-Total 1 + Sub-Total 2)		2,47,76,444/-	
Total Tax Value		44,59,759.92/-	
Final Amount		**2,92,36,204/-**	
Amount in words	**Two Crore ninety-two lakhs thirty-six thousands two hundreds and four Only.**		