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Correspondence Address

MEAI National Headquarters

Contact: **Secretary General,**
Mining Engineers' Association of India
F-608 & 609, Raghavaratna Towers, 'A' Block, VI Floor,
Chirag Ali Lane, Abids, Hyderabad - 500 001.
Ph.: 040-66339625, 23200510

E-mail : meai1957@gmail.com
website : www.meai.org

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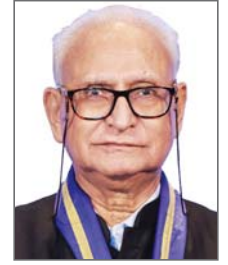
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President's Message.....

Dear members..

The month of February has seen two very successful national events held on Iron Ore mining & Beneficiation with stress on utilisation of low grade iron ores, organised by our Barajamada and Hyderabad Chapters and aptly supported by Iron & Steel giants Tata Steel and NMDC. Some innovative techniques were also presented. The national conference held at Hyderabad was followed by a panel discussion where in addition to the need for technological development, urgent need for improvement in logistics was also expressed. The secretary of Hyderabad Chapter offered to organise a special seminar in near future to deliberate on issues related to infrastructure development needs to meet the iron ore demand of almost doubling steel production capacity. Suggestions are welcome.

In the recently held national seminar at Hyderabad, I have suggested that some Chapters may take initiative and organise an event (Seminar or Workshop) exclusively by and for student members, at some convenient location and I take this opportunity to invite proposals from the interested Chapters before the next (third) Council meeting likely to be held in first week of April 2024.

In order to achieve a committed Net Zero emission target by 2070, the Ministry of Mines has constituted a Taskforce, wherein the MEAI President is a member, to study and recommend a roadmap, strategy and action plan to achieve low carbon emission transition in mining and mineral processing operations in the Country. A meeting of the Taskforce was conducted recently at New Delhi wherein TOR was discussed and it was decided to examine sources of emission, obtain baseline data on current level of emission and suggest mechanism for monitoring phase-wise emission reduction. Suggestions are invited from our members in this regard so that the same can be taken up in the next meeting of the Taskforce.

Later this month we shall be celebrating the great Indian festival of colourful Holi. I wish all members a colourful and joyous Holi.

S.N. Mathur
President



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EDITOR'S DESK



Dr. P.V. Rao
Editor, MEJ

Within the ever-changing landscape of the Global Resources Workforce, adaptation and innovation are not just desirable, they are essential for survival and success. As industries evolve and technology reshapes work, companies must respond, embracing change while fostering inclusivity and investing in their most valuable asset – their people.

Below are the specific views expressed by Chief Corporate Officer Shelley Robertson from Fortescue, in a webinar organized by AusIMM under the theme *Sustainable Mining – Shifting the Paradigm?*

On the ways Fortescue is embracing opportunities in a world that is rapidly changing: At the heart of Fortescue's strategic direction lies a commitment to versatility. It recognises the value of transferable skills and the diversity this brings to our workforce. She was drawn to Fortescue because it's a values-driven, future focused business. It embraces people with skills from various fields because this enriches the company and ensures a wide array of experience. It also has a history of embracing change. Its adoption of an Autonomous Haulage Solution for mining a few years ago is a clear example. The transition was carefully managed so that its people were able to re-skill into other roles through a coordinated plan in which every employee retained employment.

This proactive approach extends to the decarbonisation of their operations, a crucial step toward a sustainable future. For it, decarbonisation is not just an environmental necessity; it's a moral obligation. It is actively working to reduce its environmental footprint and contribute meaningfully to a greener tomorrow.

For it, its vision extends far beyond operational boundaries; it's about transforming lives and communities. For instance, it is committed to offering a pathway to a sustainable future, helping workers transition seamlessly into a future-focused workplace. It recognises that there will be people in other sectors who have great skills for companies like Fortescue and it welcomes playing a positive role in the just transition away from fossil fuels. Harnessing the power of new technology is essential in optimising their operations and through technology, it is not just reducing their impact, it is setting new industry standards.

Some of the ways Fortescue looks to invest in the future workforce: It understands that investing in the workforce is synonymous with investing in the company's future. Through in-house training, apprenticeship programs, and graduate pathways, it is cultivating the skills needed for tomorrow and its proactive approach ensures a seamless transition for workers, preparing them for a green economy.

It is putting itself in front of universities and high schools today, because it knows that these bright young people will be the future of our business. It works with the communities in which it operates to offer skills and employment programs to ensure they will all thrive in our future.

When it comes to the future, how do Fortescue go about embracing uncertainty: The future is inherently uncertain, but that doesn't deter them because they are predicting the unknown and making uncertain things certain by proactively preparing for challenges in both tactical and strategic ways. Identifying key roles and ensuring its trades remain relevant is pivotal. It is meticulous in managing new technologies, such as batteries in haul trucks, and staying ahead in the ever-evolving technological landscape. As a first-mover in decarbonising its operations, it hopes to show industry that it is possible to prepare for an uncertain future through upskilling and re-skilling its people so they are involved in the development of new technologies and solutions. Decarbonisation will drive opportunity across the business for its people and allow them to be at the heart of predicting what the future will look like.

Some of the things Fortescue is doing to make inclusivity and diversity a core focus for its team: It believes in creating a workplace where everyone feels valued and empowered, designing workplaces with diversity in mind. This includes the crèche facility at our Perth office, enabling working parents to balance family and work responsibilities and flexible work practices where it operationally allows. Inclusivity is not just a buzzword for us; it's a guiding principle that shapes our culture and makes us resilient in the face of change. It does this through empowering its leaders to care for their team members and give them the tools to make inclusive decisions in their day to day lives.

As a global business, it can provide opportunities for people to work in different jurisdictions and learn from different cultures, while always ensuring strong respect for and understanding of First Nations Peoples.

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EDITOR

Dr. P.V. Rao
Off. : +91 (040) 23200510
Cell: +91 96180 91039
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NEWS FROM THE MINERAL WORLD

➤ **Justice Katakey insists on strict adherence to mine closure plan**

Justice (retired) BP Katakey, who heads the single member committee constituted by the High Court of Meghalaya, has insisted on strict adherence to mine closure plan in the event of open-cast scientific mining in the state.

Disclosing that he had visited and seen the area where scientific mining has been proposed, Justice Katakey on Friday said he was given to understand that there will only be open-cast mining. "If it is open-cast mining, then the responsibilities of the authorities and the pollution control board will be much more given the experience of open-cast mining in Assam which is not very good," Justice Katakey said.

According to him, he had inquired about the open-cast mining in Assam being conducted by the Coal India Limited. "What I have seen is that there is no compliance with the mine closure plan. This should not be allowed in Meghalaya," he said, adding that open-cast mining has its advantages as well as disadvantages.

Meanwhile, Justice Katakey said the prospective licence applicants have been told that extraction of coal will start in another six months. "After getting the prospective licence, they must apply for environmental clearance. Before the government clearance is given, the state environment assessment authority has to carry out the verification and public hearing," he said. He said it is only then that the decision on whether or not to grant the licence will be taken.

Transportation of inventorised coal Justice Katakey said the transportation of the inventorised coal lying in the designated coal depots in West Khasi Hills, South Garo Hills and South West Khasi Hills, except for East Jaintia Hills, should be completed within four weeks. He said during a meeting on Friday, they concentrated on the transportation of the left-out inventorised coal in East Jaintia Hills. He said he will recommend the time limit for the transportation of the left-out coal.

According to him, 1.56 lakh tonnes of coal in East Jaintia Hills is yet to be transported. "Based on the order of the court, further action will be taken," Justice Katakey said. To a query, he said the state government had filed an affidavit in the Supreme Court declaring 32 lakh tonnes of assessed and inventorised coal. "But we found a little over 14 lakh MT. The (excess) coal declared was either missing, disappeared or non-existent," Justice Katakey said.

He said they had asked the state government to conduct a probe. "The inquiry is going on to find out the people responsible for this major lapse. Based on the report, we will take action," Justice Katakey said.

The Shillong times | February 3, 2024

➤ **India to leverage US-led Minerals Security Partnership to help PSUs secure critical mineral assets abroad**

PSUs such as Coal India Limited, NLC India Ltd, and NTPC Ltd, representatives of whom were present at the meeting, have expressed interest in securing lithium, cobalt, and graphite assets overseas.

The Union Mines Ministry has proposed to circulate critical mineral block proposals received by partner countries in the US-led Minerals Security Partnership (MSP) with central public sector undertakings or PSUs to allow them to acquire critical mineral assets abroad.

The ministry has also recommended that PSUs give a clear financial mandate to relevant subsidiaries to expedite the acquisition process in a meeting held on October 30, 2023. PSUs such as Coal India Limited, NLC India Ltd, and NTPC Ltd, representatives of whom were present at the meeting, have expressed interest in securing lithium, cobalt, and graphite assets overseas.

During the meeting, VL Kantha Rao, Secretary, Ministry of Mines, "assured to provide every possible help" to PSUs in the acquisition of critical mineral assets abroad, which includes circulating details of some block proposals received through the MSP, according to the minutes of the meeting accessed by The Indian Express through the RTI. India joined the MSP in June, 2023 during Prime Minister Narendra Modi's visit to the US.

The MSP is a US-led collaborative effort involving thirteen countries including the UK, Australia, France, and Germany, and the European Union, which aims to catalyse public and private investment in critical mineral supply chains globally. The collaboration is currently engaged in fostering a critical minerals and metals cooperation forum for the sharing of expertise, building a robust battery materials supply chain, and jointly developing a minerals processing facility in South America.

Kantha Rao also recommended the financial empowerment of relevant subsidiaries to "facilitate timely execution upon receipt of viable proposals". He

gave the example of ONGC Videsh Limited, which is a wholly-owned subsidiary and overseas arm of upstream petroleum major Oil and Natural Gas Corporation Limited (ONGC) tasked with exploring and developing oil and gas reserves overseas. He also referred to NTPC Mining Limited, a wholly-owned subsidiary of NTPC, which currently operates the thermal power utility's coal mining business in India.

In the meeting, M. Nagaraju, Additional Secretary, Ministry of Coal, which oversees Coal India Limited (CIL) and NLC India, informed that the two PSUs are interested in acquiring critical mineral blocks overseas and sought the ministry's and KABIL's assistance on the same. KABIL is a central public sector enterprise (CPSE) under the mines ministry, which on January 15 signed an agreement with a state-owned company in Argentina to explore and develop five lithium blocks in the South American country.

Asheesh Kumar, General Manager at CIL, added that the PSU is interested in securing lithium and cobalt blocks in Australia. In March 2023, two lithium and three cobalt blocks had been identified by the Union Minister of Coal and Mines and the Australian Minister for Resources for investment by KABIL, according to a report available on the mines ministry's website. Both CIL and KABIL did not respond to a query seeking clarification on the scope of their engagement with each other in exploring critical mineral projects in Australia.

Kumar also added that CIL will focus on Chile, Bolivia, and Argentina as well for securing critical mineral assets.

NTPC is looking at acquiring lithium, cobalt, graphite, and high-purity limestone assets abroad through its subsidiary NTPC Mining Limited. During the meeting, Steel Authority of India Limited (SAIL) representatives expressed interest in acquiring coking coal, limestone, and iron ore assets overseas for captive use. Since these minerals are not included in the list of thirty critical minerals identified by the mines ministry, Kantha Rao recommended SAIL to also explore the potential of investments in critical minerals abroad within the Steel Ministry, which owns the PSU. NTPC and SAIL did not respond to a query seeking comments on their critical mineral plans.

On January 18, CIL announced plans to enter the mining of critical minerals in India beginning with the exploration of a lithium block it expects to get from the central government. In 2023, CIL had also amended its Memorandum of Association (MoA) to include

non-ferrous and critical minerals, in line with the PSU's growing commitment towards critical minerals. Previously, NLC India had also expressed interest in participating in the ongoing auction of twenty critical mineral blocks launched by the mines ministry in November, 2023.

During the meeting in October, Kantha Rao also recommended ministries and PSUs interested in critical mineral assets overseas to engage international consultants to "conduct in-depth studies, compile comprehensive reports, and oversee due diligence procedures for prospective projects". He also added that PSUs should maintain a communication channel with Indian missions abroad as embassies can ensure the smooth acquisition of overseas projects.

Aggam Walia, Indian Express, New Delhi | Feb. 11, 2024

➤ **Large deposits of iron ore found in Rajasthan's Karauli**

According to preliminary indications, there are deposits of more than 840 million tonnes of iron ore in Khoda, Dadaroli, Todupura and Liloti near Hindon in Karauli

The Rajasthan Mines Department has started preparations for the auction for composite license of iron ore blocks in an area of about 1,888 hectares near Hindon in Karauli district after large deposits of iron ore were found there, officials said.



Mines secretary Anandi said that according to preliminary indications, there are deposits of more than 840 million tonnes of iron ore in Khoda, Dadaroli, Todupura and Liloti near Hindon in Karauli. She added that the new deposits of iron ore will also create new opportunities for industrial development and employment in the state.

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In the initial exploration done by the department, indications of both magnetite and hematite of iron ore

have been found. Iron ore deposits have been found in 462.3 hectares at Khoda of Karauli, 754.38 hectares at Dadaroli, 260.71 hectares at Todupura and 410.94 hectares at Liloti.

The exploration done by the department, magnetite of magnetic nature and hematite iron ore of normal nature is available here. Blocks have been prepared for auction.

HT Correspondent | Feb 12, 2024

➤ **Coal India to bid for 3 mines in critical minerals auctions in February**

Coal India's stockpiles and inventories held by power plants are currently at record highs, resulting in the miner lowering its annual production target for fiscal 2025 by 1.4% to 838 million tonnes.

State-run Coal India will bid for three blocks in critical minerals auctions conducted by the country's mines ministry in February, Chairman and Managing Director P M Prasad told analysts in a post-earnings conference call on Monday.

India launched the first part of its critical minerals auction – expected to raise an estimated 450 billion rupees (\$5.42 billion) overall – in November last year in a bid to drive its clean energy push, drawing interest from the likes of Ola Electric and Shree Cement.

Separately, a senior Coal India official confirmed that the company will be bidding for lithium and nickel mines in the auctions that will be held on Feb. 26. The world's largest miner has also visited lithium mines in Australia and is in preliminary talks about operating them, Prasad added.

The Kolkata-based Coal India is optimistic about reaching its production target of 780 million metric tons in the current fiscal year, Prasad said, but added that land- and environment clearance-related challenges at its South Eastern Coalfields unit could bring a shortfall of 8-9 million tonnes.

Coal India's stockpiles and inventories held by power plants are currently at record highs, resulting in the miner lowering its annual production target for fiscal 2025 by 1.4% to 838 million tonnes.

The record-high inventory took a toll on the company's e-auction premiums, which fell in the range of 36%-50% for January and February, according to Prasad, lower than the annual average of 80%. Coal India earns a premium from e-auctions, or spot auctions, held over and above its supply obligations when demand outstrips supply.

This also dragged the miner's revenue growth for the October-December quarter to nearly 3%, its slowest topline growth in eleven quarters, barring the April-June period in 2023.

Indications of sufficient availability of coal led shares to end 4% lower on Monday. The stock has surged more than twofold in the last 52 weeks ending Friday. Prasad said he expects global coal prices to stabilise at current levels over the next 1-2 years.

Prasad further added that Coal India, one of the largest employers in the country, expects employee costs to continue declining with costs falling an estimated 20 billion rupees in fiscal 2024 due to attrition.

REUTERS | FEBRUARY 19, 2024

➤ **CHART: China's Belt and Road mining investment hits record**

A new report from Griffith Asia Institute, a unit of Australia's Griffith University, shows 10 years after the launch of China's Belt & Road Initiative (BRI) cumulative engagement tops \$1 trillion with about \$634 billion in construction contracts and \$419 billion in non-financial investments.

The authors point out that 2023 was the first time that more than 50% of BRI engagement was through investments where Chinese investors take equity stakes as opposed to construction contracts, which are typically financed through loans provided by Chinese financial institutions or contractors, often accompanied by guarantees from the host country.

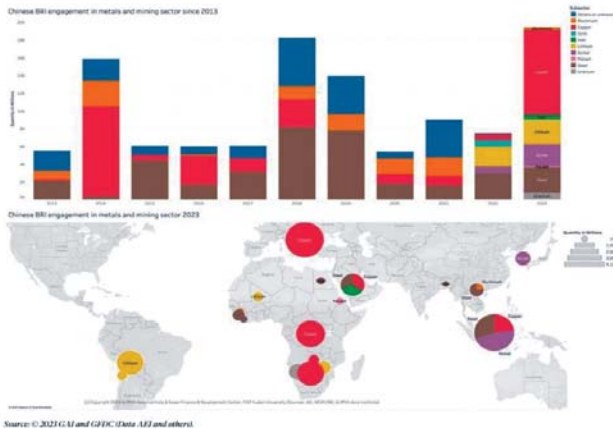
Last year Africa overtook the Middle East as the no. 1 target of BRI projects after a 114% jump in investments and a 47% jump in construction projects on the continent. Investments in Latin America and the Caribbean also doubled last year.

Minerals and metals investment focused on the green energy transition with copper making up the lion's share of new project announcements last year, followed by sizable lithium, nickel and uranium spending under the BRI.

China's BRI-related investment in metals and mining reached \$19.4 billion in 2023 according to the study, a 158% jump compared to 2022 and the highest on record.

Apart from a giant new copper processing facility in Saudi Arabia, mining investments were focused in Indonesia and various countries in Africa and South America.

China Belt and Road mining investment hits record



Source: Griffith Asia Institute

Examples include vertical integration investments by the world’s largest battery manufacturer CATL, which bought shares for a nickel mining concession in Indonesia from PT Aneka Tambang (Antam).

Lithium projects in Mali attracted investment from Chinese firms Jiangxi, Ganfeng and Hainan Mining (through the acquisition of Kodal Minerals) while Zhejiang Huayou Cobalt commissioned a lithium processing plant in Zimbabwe.

Downstream investment in battery and electric vehicle manufacturing also soared, reaching nearly \$10 billion, according to the report. The largest investors under the BRI last year were CATL, accounting for more than 15% of overall spending, followed by Zijin Mining at 11%.

Zhejiang Huayou Cobalt contributed nearly 9% of the total while CMOC (formerly China Molybdenum) and Minmetals each had a 5%-plus share of the \$92.4 billion total investments in 2023.

For 2024, the Griffith Asia Institute sees further growth of Chinese BRI engagement with a strong focus on country partnerships in renewable energy, resource-backed mining and related technologies including EV batteries.

Frik Els, Mining.Com | February 20, 2024

➤ **JSW Steel in talks with Whitehaven for coal mine stake**

India’s JSW Steel Ltd is in talks with Australian miner Whitehaven Coal for a stake in its Blackwater metallurgical coal mine, a source aware of the discussions said on Tuesday.

JSW Steel, India’s largest steel producer by capacity, is conducting due diligence and expects to get a coking coal sample from the mine this month to check specifications, the source said.

Whitehaven in January said it was exploring a potential sell-down of about 20% of Blackwater to global steel producers as strategic joint venture partners. The miner acquired the Blackwater and Daunia mines from BHP Group in a \$4.1 billion deal last October, and expects the acquisition to complete in early April.

JSW Steel could consider acquiring more than a 20% stake in Blackwater, the source said. JSW has held initial talks with Blackwater but has yet to see the specifications of the coking coal from the metallurgical coal mine in Australia, the source said. A spokesperson for Whitehaven declined to comment on any talks with JSW Steel but referenced mention of the joint venture sell-down in the company’s earlier statements.

A JSW Steel spokesperson declined comment.

JSW Steel has been scouting for coking coal assets overseas. The company currently imports coking coal from Canada, Australia, the United States, and some grades from Russia. Last year, JSW Steel was in talks with Canada’s Teck Resources for a stake in its coking coal unit but eventually a Glencore-led consortium agreed to buy it for \$9 billion.

Coking coal is emerging as a top option for companies to make a foray into, as it is used to make steel, an important component in large infrastructure and renewable projects.

India was planning to form a consortium of state-owned companies to facilitate coking coal imports to help domestic steel companies tide over shortages, *Reuters* reported last month. Indian steel companies consume around 70 million metric tons of coking coal annually, and imports constitute around 85% of the country’s total requirement.

Reuters | February 20, 2024

➤ **India gets 40 bids for commercial coal mines**

India has received a total of 40 bids for some of the 32 commercial coal mines that were made available for auctioning in December, the government said in a statement on Monday, adding the bids would be opened on Feb. 20.

The world’s second largest coal user, India began auctioning coal blocks to private companies in 2018, ending restrictions on the sale and use of the fuel, which was dominated by Coal India until then.

Output from mines auctioned to private companies is expected to boost production of coal by over 40% to 20 million metric tons in 2024/25, *Reuters* reported earlier this month.

“A total of 33 bids have been received ... where two or more bids have been received for eight coal mines and single bids have been received for 5 coal mines,” the statement said.

The remaining seven bids have been received for a second attempt to auction a tranche of three coal mines, it added.

Reuters | February 19, 2024

► **Vedanta’s parent sells \$209 million stake**

Vedanta Resources, the parent of Vedanta Ltd, has sold a stake worth more than 17.37 billion rupees (\$209 million) in the Indian miner, exchange data showed on Thursday. Finsider International, part of billionaire Anil Agarwal-led Vedanta Resources, sold more than 65.5 million Vedanta Ltd shares at 265.14 rupees each, the data showed.

That is a 5.2% discount to Vedanta Ltd’s closing price on Wednesday. The stock ended 4.2% lower at 267.95 rupees on Thursday. UK-based Vedanta Resources held a 63.72% stake in Vedanta Ltd through the six subsidiaries as of Dec. 31, 2023, per stock exchange data. Vedanta Resources was planning to sell a stake worth \$1 billion in Vedanta Ltd to investment firm GQG Partners, television channel ET Now reported on Wednesday.

It was not immediately clear to whom Finsider International sold the shares. Vedanta Ltd and Vedanta Resources did not respond to *Reuters*’ requests for comment. Saddled with \$6.4 billion in outstanding debt, including a \$4.5 billion payment due by fiscal 2025, Vedanta Resources has been attempting to shore up its finances, including through a recent debt restructuring.

Group chairman Agarwal has made several bids to trim debt, including through Vedanta Ltd. He made an unsuccessful attempt to take the company private in 2020 and his last stated plan was to split the company into six.

(\$1 = 83.0321 Indian rupees)

Reuters | February 15, 2024

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India launched the first part of its critical minerals auction – expected to raise an estimated 450 billion rupees (\$5.42 billion) overall – in November last year in a bid to drive its clean energy push, drawing interest from the likes of Ola Electric and Shree Cement. Separately, a senior Coal India official confirmed that the company will be bidding for lithium and nickel mines in the auctions that will be held on Feb. 26.

The world’s largest miner has also visited lithium mines in Australia and is in preliminary talks about operating them, Prasad added. The Kolkata-based Coal India is optimistic about reaching its production target of 780 million metric tons in the current fiscal year, Prasad said, but added that land- and environment clearance-related challenges at its South Eastern Coalfields unit could bring a shortfall of 8-9 million tonnes.

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(\$1 = 82.9980 Indian rupees)

Reuters | February 19, 2024

(Continued on Page 26)

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ASSESSMENT OF BLAST OUTCOMES THROUGH PRE-BLAST, IN-BLAST, POST-BLAST MONITORING AND EVALUATION - A DISCUSSION

M.O. SARATHY

Abstract

Blasting using commercial explosives and blast initiation systems is arguably the most efficient and economic method for excavations in large mining and civil projects. 'As desired' performance of explosives and initiation systems can have far reaching influence on final blast outcomes and consequently, efficiency of downstream operations and economics. Blast results are mostly affected by the properties, characteristics of explosive system, performance reliability, timing accuracy of blast initiation system, spatial distribution of explosive energy in the charged drillholes, mechanical properties and geologic structure of rock, ore or mineral in the block being blasted. Many parameters can be evaluated-monitored prior to blast (pre-blast), during the entire time-window of the blast while it is in progress (in-blast) and after the blast (post blast). This will help establish the actual performance of inputs and the outcome i.e., the final blast results in the geo-mining conditions under which the blast is being undertaken.

1. INTRODUCTION

Business Dictionary.com defines "monitoring" as 'supervising activities in progress to ensure they are on-course and on-schedule in meeting the objectives and performance targets'.

Monitoring is essential in blasting operations as a number of input parameters have to perform together for successful results. Material being blasted is an uncontrollable variable with varying properties and in-situ geological structures within the mass. The blasting engineer has access to a number of controllable inputs in the form of products, blast design and techniques, with whose judicious use, desired results can be achieved. Blast geometry and design are based on empirical relationships derived from drillhole diameter. Blast geometry parameters are burden, spacing, bench height, sub-grade drilling, drillhole depth and stemming length. Drill patterns are 'in-line' (drillholes placed one behind the other), 'staggered' (drillhole in the row behind placed between the two drillholes in front), 'square' (where spacing is equal to burden) and 'rectangular' (spacing greater than burden: normally 1.2-1.4 times). Initiation systems available for bench blasting include detonating cord, detonating relays, millisecond delay detonators (electric and non-electric) and electronic detonators. Explosive types include ANFO, Heavy ANFO, Slurry / emulsion explosives (packaged or bulk). Selection of appropriate initiation systems and explosives suitable for the prevalent geo-mining conditions is an important exercise that rests with the blasting engineer at site. Detonation stability, complete detonation of explosive column charged in drillholes and ability to remain unaffected in watery drillholes for a reasonable period of time are important requirements of explosives. Same with requirements of the initiation system in terms of functional reliability (no malfunction, misfire) and accuracy of delay

firing times. Monitoring and evaluation are very essential since:

- Evaluating characteristics of the material being blasted before blast is essential for selection of drill parameters and explosives commensurate to geo-mining conditions.
- It is required that actual performance of initiation systems and explosives during blasting is "as indicated" in the manufacturers' technical product data sheets. This is very essential since users mainly rely upon the data provided in the specifications for designing their blast in terms of explosives (density, velocity of detonation VOD, strength), initiation systems (mainly nominal delay firing timings) and sleeping time in charged drillholes.
- Monitoring helps in assessing if blast design parameters, drill patterns, initiation sequence, accuracy of initiation system delay timing and performance of explosive in use etc. are meeting the blast objectives in full.

Salmi and Sellers²⁶ have explained the need for monitoring and assessment very lucidly: Quote ... From the blaster's perspective, an outcomes approach to design is needed, firstly to identify desired fragmentation distribution and geotechnical parameters that will maximize the downstream value. The distribution will differ based on the blasting objective, for example: to maximize the fines in the 'Mine to Mill' concept; to minimize the fines for quarry blasting; to increase the lump to fines ratio in iron ores; to generate a maximum yield of large fragments for Armour and Riprap production; to remove overburden for strip mining, and to maximize the difference in fragmentation distributions between ore and waste in differential blasting. This may not be possible without significant blast changes ...Unquote

Life Member – MEAI, sarathymo@yahoo.com

2. EXPLOSIVE-ROCK RELATIONSHIPS and INTERACTIONS

The process of detonation of explosives is completed in a few milliseconds and depending on its size, a blast can take place for 2-3 seconds. The inter-relationships between rock

and explosives are complex. It is often said that mechanical and structural properties of the material being blasted has a more dominant effect on blast results than the explosive characteristics. Table-1 lists various rock-explosive characteristics which affect final blast results.

Table-1: Properties / Characteristics and their effects

PROPERTY	EFFECT / RESULT / OUTCOME
Explosive's Properties / Characteristics	
Explosive's Density (g/cc)	Density defines whether explosives will sink in watery drillholes and assists in calculating loading density (kg/m) for a given drillhole diameter. An important parameter for calculating detonation pressure and explosive impedance.
Explosive's Velocity of Detonation VOD (m/s)	High VOD generates higher shock energy (brisance), useful in generating initial radial cracks and for breaking hard to very hard strata. Low VOD explosives react for longer time, generating lower brisance and more heaving effect.
Explosive's Gas Volume	Commercial explosives including AN-FO known to generate 800-900 liters of gas / kg (average) and this is responsible for throw / heave.
Explosive's Strength (Energy)	Expressed as weight strength (calories per gram, kilo calories per kg) and bulk or volume strength (calories per cm ³ , kilo calories per litre). Weight strength remaining constant, bulk strength increases or decreases with density, viz low-density explosives normally have low bulk strength and high-density explosives display higher bulk strength.
Explosive's Detonation pressure (kilo bar) 1 Bar = 14.7 PSI	A function of VOD and density viz explosives with higher VOD and density generate higher detonation pressure. Low density, low VOD explosive such as AN-FO has low detonation pressure, compared to higher density, higher VOD slurry or emulsion products. Higher detonation pressure generates higher borehole pressure, results in better fragmentation and increased heave / throw.
Water-proofness / compatibility	AN-FO has very poor resistance to moisture and not compatible for use in watery boreholes. Slurry and emulsion products have better resistance to water ingress, but definitely not totally 'water-proof' with extended sleeping times in watery drill holes. Refer manufacturer's product data sheet.
Material (rock, ore, mineral) Properties / Characteristics	
Density	High density rocks are usually dense, fine grained and hard, brittle. Lower density materials are softer and coarse grained
Compressive strength and Tensile strength	Normally, materials are stronger in compression and weak in tension. High density, fine grained and dense rocks have higher compressive strength. Tensile strength is normally 1/15 to 1/20 times that of compressive strength. Material breaks under reflected tensile waves.
Longitudinal wave velocity (Sonic Velocity)	High-density, fine-grained rocks have higher sonic velocities viz shock waves travel faster in this medium, compared to lower density, coarse grained materials in which the shock waves travel slower. This plays an important role while selecting delay intervals (ms/m) between drillholes along spacing and across the burden during a blast.

Geology (rock properties, structure), explosive (properties, its distribution within the rock mass in drillholes), blast design and its geometry, drillhole pattern and initiation sequence of drillholes have been identified as controlling factors for good blast results. In general terms, it has been well understood that high density, fine grained, hard rocks require explosives having high strength (high energy) and high velocity of detonation (VOD). Explosive with high VOD generates higher shock energy (brisance) which is desirable for creating the initial radial cracks in materials having high compressive strength. Coarse-grained, low-density, soft rocks absorb shock energy and hence explosives with high

VOD will not be suitable in soft strata. In such material, slower reacting explosives such as AN-FO (lower VOD) that generate large volumes of gases are more suitable. It is the gas (heave) energy which performs the task of breaking the mass. Table-2 lists properties of various explosive types, and Table-3 the rock properties.

Conventional slurry-emulsion products suitably modified to increase the heave by reducing the reaction rate and altering the shock-heave partition have been successfully used in blasting.

Table-2: Density and indicative VOD of few explosive types (in large diameter)

Product Type (In Large Charge Diameter)	Operating Density (g/cc)	Indicative VOD (m/s)	Detonation Pressure (kilobar)	Impedance Value
AN-FO	0.85 - 0.90	3500 - 4000	26 - 36	2.9 - 3.6
EMULSION-ANFO BLENDS*	1.05 - 1.18	3750 - 4500	37 - 59	3.9 - 5.3
SLURRY / WATERGEL	1.10 - 1.20	4000 - 4500	44 - 60	4.4 - 5.4
STRAIGHT EMULSION	1.10 - 1.20	4500 - 5500	55 - 90	5.0 - 6.6
TRI NITRO TOLUENE (TNT)	1.60 - 1.65	6800 - 6950	185 - 199	10.8 - 11.5

* Emulsion-ANFO blends (various ratios), example: Heavy AN-FO, Doped Emulsions.

Table-3: Density, Compressive Strength and Longitudinal Wave Velocity of few materials

ROCK / ORE TYPE	Density	UNIAXIAL COMPRESSIVE STRENGTH (UCS)		SONIC VELOCITY	IMPEDANCE
	g/cc	Kg/Sq cm	Mpa	m/s	
BASALT	2.7 - 3.3	2500-4000	245-392	5500-6600	14.8 – 21.8
GABBRO	2.93	-	-	5400-7000	15.8 – 20.5
GNEISS	2.6 - 3.0	1400-3000	137-294	4000-7600	10.4 – 22.8
GRANITE	2.5 - 2.8	2000-3600	196-353	4500-6200	11.3 – 17.4
LIMESTONE (Hard)	1.9 - 2.9	1300-2000	127-196	2800-7000	5.32 – 20.3
SANDSTONE	2.76	1600-2500	157-245	1400-4500	4.42 – 6.9
SHALE	2.81	-	-	2000-4100	5.62 – 11.5
QUARTZITE	2.5 - 2.7	1600-2200	157-216	5000-5500	12.5 - 14.9
HARD IRON ORE	4.9 - 5.3	-	-	6000 - 6280	29.4 – 33.3
AIR	1.2	-	-	1000	1.2
WATER	1	Incompressible		4600 - 4900	4.6 – 4.9

2.1 IMPEDANCE MATCHING

Rock Impedance (R_i) is obtained by multiplying its density and sonic velocity (longitudinal wave velocity). Explosive impedance (E_i) is obtained by multiplying its density with VOD. It is generally considered that better results can be expected when explosive impedance matches the rock impedance viz $E_i / R_i = 1$. It is also considered that maximum transfer of shock wave from detonation occurs in fully coupled drill holes viz explosive charge diameter equals drill hole diameter (as with bulk explosive). It can be seen from the Tables 2 and 3 that the maximum density of commercial explosive is 1.20 g/cc and VOD is 5500 m/s, while density of material being blasted can be as high as 3.0-3.3 g/cc and sonic velocities as high as 6500-7600 m/s. Highest density possible with commercial slurry and emulsion explosives is between 1.25-1.30 g/cc and needs to be specially formulated. This infers / implies that except in few soft strata, impedance cannot be matched and commercial explosives are suitable only for strata with low density and low wave velocities.

Bhandari³ observes that rock is never uniform and the variability within a given block causes all the problems. Rock fragmentation prediction does not take impedance into account. Thus, exact matching of impedance may not be fruitful. Zhengdong³⁴ says “good blasting effect can also be achieved under the condition of wave impedance mismatch. This in turn indicates that the traditionally emphasized theory of acoustic impedance is irrational. It is obvious that the acoustic impedance of explosives which have achieved a good blasting fragmentation effect is not necessarily equal to that of the rock. Meanwhile, it is also impossible to make acoustic impedance of explosive equal to that of rock in practical blasting”. Shoshun³¹ concluded that an impedance ratio of 0.75 or more is sufficient for effective rock blasting operations. However, when the impedance ratio is over 0.75, further increase of strain density is very small.

Ramulu et al²⁴ carried out blasts in sandstone overburden using AN-FO and bulk emulsion explosives. Fragmentation

analysis was carried out by image and sieve analysis. Average fragment size with AN-FO was 0.16 m and with emulsion explosive it was 0.23 m. Even though emulsion had a better impedance matching, AN-FO resulted in better fragmentation and the authors concluded that in rock formations such as sandstone, heave energy component of an explosive plays a major role in fragmentation, rather than shock energy.

2.2 BURDEN RESPONSE

A very practical, field-oriented technical monitoring method which uses high speed videography in bench blasting is to study the ‘burden response’(Chiappetta¹⁰). This method eliminates guess-work, individual’s subjectivity and accurately monitors the manner in which the burden reacts-responds at the free face after detonation of explosive in the drillhole. Explosive used could be anyone of the types described in Table-2 and the term ‘burden’ encompasses both burden distance and material properties contained in it. Burden response studies help in selecting optimum burden and delay interval for the particular drillhole diameter and explosive-rock combination in use at site. It is a very scientific method for studying how different explosives perform in the same geo-mining conditions. This method eliminates the lengthy process of ‘trial-and-error’ and helps optimize many parameters in just a few blasts.

2.3 BLAST DAMAGE MECHANISMS OF IN-SITU ROCK MASS

It is said that good blasting for wall control is a transition from well fragmented rock mass in front of the last row blasted, to an undamaged mass behind, in as short a distance as possible (Floyd¹³, ISEE¹⁵). In bench blasting, side break and back break occur due to wrong drillhole placement, improper blast design and initiation sequence-delay firing times. In below ground excavations also overbreak occurs due to the same reasons. Damage occurs due to excessive burdens, lack of free face for blasted rock to move into, such as blasting against a buffer or inadequate delay interval provided between rows in multi-row blasts. Damage to in-situ rock occurs due to geology - rock mass strength, structural integrity and high levels of stress-strain during blasting. This can cause pit-wall instability in open excavations resulting in slope failure rock slides and collapse of roof below ground. Blast damage mechanisms include:

2.3.1 Stress failure: Compressive, Tensile and Shear failure - Damage is caused when borehole pressure and blast induced stress exceeds the in-situ dynamic compressive strength of rock. Repeated blasting leads to reduction of shear strength and shear failure is controlled by shear strength of rock mass, duration of blast and blast vibration levels.

2.3.2 Gas driven crack extension and block heaving - In jointed medium, separation of layers occurs. Gas

driven crack extension behind the blast is a major cause of wall damage. High pressure gases wedge into structural anomalies and dilate / separate them. Damage is controlled by the joint strength and duration of pressure pulse. Block heaving occurs at the crest due to cratering effects caused by poor relief. Gas penetration dilation into blast generated fractures and natural joints 20-30 m behind blast have been recorded (McKenzie¹⁸).

2.3.3 Release of Load - In strata with discontinuities parallel to the last row of drillholes (back row), behavior of rock behind the blast is similar to a heavy steel plate falling on a stack of thick rubber sheets. The heavy plate progressively compresses the layers till its momentum is exhausted. The compressed rubber sheets then expand and lift the plate upwards and the layers also separate from each other. Similar phenomenon occurs in strata and is observed as tension fractures when large multi-row blasts are fired using an in-line pattern (row delay) where all the drillholes in the row fire simultaneously. Vertical parallel cracks upto 60 m behind newly created open pit bench face in large multi-row blasts have been observed (Hagan and Morris¹⁴).

2.3.4 Blast Vibrations (Peak Particle Velocity PPV) - Ground vibrations of high order are known to cause damage to in-situ rock. Damage criteria suggested by various investigators is given below (Singh³²):

Table-4: Peak Particle Velocity Vs Damage

Investigator	PPV in/s	PPV mm/s	Damage criteria
Calder	10	254	Safe - no cracks occur Minor tensile scabbing Strong tensile and radial cracking Break-up of rock mass
	10-25	254-635	
	25-100	635-2540	
	100	> 2540	
Langefors	12	305	Fall of rock in unlined tunnels Formation of new cracks
	24	610	
Oriard	> 25	> 635	Damage to rock

2.3.5 Monitoring of gas pressure behind blasts - this has been carried out by placing pressure transducers in dedicated drillholes of same depth as that of the blast and the drillholes are sealed. Negative pressures (in relation to atmospheric pressure) behind the blast are caused by forward burden movement which creates a huge void and gases take the path of least resistance (Kanchibotla¹⁶). 0 to -20 kPa at 3 burden distances, 0 to -36 kPa at 2-burden distances and -39 to -78 kPa at 1 burden distance have been recorded in blasts having good free face viz having good relief. Negative pressures are caused by volumetric increase of the air chamber (monitoring drillhole) due to opening up of new cracks and air gets sucked into these fractures. However, positive pressures have been recorded

when there is no free face, such as in crater blasts and in the range of 5 to 280 kPa at distances of 82 and 5 drillhole diameters respectively (Brent and Smith⁶). In confined crater tests in layered rock, high pressure gases were able to reach the monitoring drillholes and also likely to cause dilation of existing joints and cracks. Damage appeared to be stress induced as there was no evidence of high-pressure gases reaching the monitoring drillholes. Ouchterlony et al²² also observed negative pressures in the range of -0.21 to -0.62 bar and positive pressures +0.08 to +1.77 bar (1 bar = 100 kPa) and attributes it to swelling of rock by the shock waves amplified by the reflections which open up the fracture planes and fractures that get connected with the monitoring drillhole, increasing its effective volume and thus causes pressure to drop.

2.4 After-blast Fumes - Every blast generates fumes, but the toxic ones are of concern. Proper detonation of a well oxygen balanced explosive would not generate harmful fumes, mostly Carbon-di-oxide (CO₂), Nitrogen (N, N₂) and water vapour in case of slurry and emulsion explosives. Generation of various shades of orange-yellow fumes is an indication of sluggish or incomplete detonation due to (i) improper oxygen balance (ii) wet AN-FO (iii) under boosting (iv) contamination of explosive with drill cuttings (v) explosive that is defective or has become deteriorated due to water-slush / acidic mine water in sleeping drillholes (vi) charge separation due to borehole wall collapse or low density explosive floating in watery holes (vii) explosive in contact with pyritic ores (viii) static or dynamic pressures. AN in contact with sulphide ores reacts and generates heat altering the composition. Carbon Monoxide (CO), Nitrogen-di-oxide (NO₂) and Nitric Oxide (NO) [collectively known as NO_x] are released. Dynamic desensitization of explosive is known to occur in weakly consolidated, pre-fractured strata, wherein the front row drillholes detonate properly, while explosives charged in later delay firing drillholes (back rows) malfunction and generate toxic fumes (AEISG¹, Sarathy²⁷).

Typical Appearance



Level 0: No fumes



Level 1: Fumes



Level 2: Orange Yellow Fumes



Level 3: Significant Orange Fumes



Level 4: Orange Fumes



Level 5: Red/Purple Fumes

(To be continued in Next Issue)



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E- Mail ID- riom@skmepl.co, phone No: +91-6364516834.

Corporate Office:

M/s.SRI KUMARASWAMY MINERAL EXPORTS PVT.LTD.
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Banglore-560052
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E-mail : admin@skmepl.co



UNCOVERING CRITICAL MINERALS: ENHANCING EXPLORATION WITH DRONE-BASED GEOPHYSICAL TOOLS (MAGARROW, GPR) AND GROUND-BASED VERY LOW FREQUENCY TECHNOLOGY

Cyriac Joseph, Satya Prakash Balooni, Darshana Kumare

Abstract

This article delves into the promising potential of combining MagArrow, a drone-based magnetometer, with Ground Penetrating Radar (GPR) for mineral prospecting and exploration. The geophysical investigations conducted through this innovative approach offer a multitude of benefits, including the capacity to operate in challenging terrains, inaccessible regions, and environmentally sensitive areas. This minimizes disruptions to ecosystems and reduces risks to human exposure.

The introduction of this technology enables precise targeting of drilling sites, effectively curbing unnecessary drilling in unproductive areas and significantly shortening project timelines. Geophysical surveys conducted via drones have the capability to expedite projects that previously took 3-4 years, now accomplishing the same within a mere 5-6 months, with enhanced efficiency and precision.

The primary focus of this study is to meticulously evaluate the accuracy, efficiency, and cost-effectiveness of the MagArrow and GPR approach when compared to conventional surveying methods in geophysical exploration. Drone-based magnetometers have garnered acclaim for their proficiency in identifying and delineating various minerals, including Gold, Copper, Lithium, Lead, Zinc, Nickel, Manganese, Iron ore, and other Rare Earth Elements (REE). The integration of drone-based magnetometers with electromagnetic (EM) and magnetic resonance methods further empowers the identification and capture of deep-seated mineral deposits and aquifers.

The utilization of drone-enabled magnetometers in mineral exploration presents a myriad of advantages. It enables prospecting in rugged and otherwise inaccessible areas, including dense forests, while minimizing disruptions to the environment. Furthermore, it proves effective even in densely populated regions, reducing potential conflicts with local communities. This technology streamlines the rapid surveying of small parcels, eliminating the need for time-consuming road construction. By capturing a high volume of measurements in a condensed timeframe, drone-based surveys simplify complex tasks that were previously challenging when relying on traditional methods involving piloted aircraft or ground-based instruments.

Furthermore, this research extends its scope to encompass the study of ground-based Very Low Frequency (VLF) technology as a complementary geophysical tool. Ground-based VLF surveys, when conducted in conjunction with drone-based magnetometers and GPR, enhance the comprehensiveness of mineral exploration efforts. VLF surveys can identify conductive minerals, map geological structures, and detect potential anomalies in the Earth's electromagnetic field, providing critical data for refining mineralization target.

1.0 INTRODUCTION

The purpose of this article is to explore the potential of using a drone-based Magnetometer – MagArrow for the exploration of mineral deposits through drone-based geophysical exploration. This study will focus on evaluating this method's accuracy, effectiveness, and cost-effectiveness of this technology. Squadron Infra and Mining Private Limited carried geophysical studies out using a drone-based

magnetometer (MagArrow) at a known test site for Critical Mineral deposits. In every case, drone magnetometers have many scientific benefits in the basket. The advanced technology of the cesium vapor helps in identifying the magnetic intensity of the earth's magnetic field, which also helps in omitting the unwanted areas for drilling or mineral exploration.

Squadron Infra and Mining Private Limited
 cyriacjosh@squadron.co.in, satya@squadron.co.in, darshana@squadron.co.in

- Accurate survey lines (using RTK precision)
- Fast data collection over all terrains
- Smooth data collection without sudden sensor movements (due to uneven ground)
- Surveys over water and boggy terrain (unsuitable for cart)
- Surveys over dangerous land areas (minefields)
- Surveys over slopes and precarious land features (safety perspective)
- New technology enables comparable results to cart-based systems

2.0 GEOPHYSICAL SURVEY USING DRONE-BASED GROUND PENETRATING RADAR (GPR)

Prospecting using drone-based ground penetrating radar (GPR) is a geophysical method that transmits electromagnetic waves underground and measures the reflected signal to identify subsurface features, including non-ferrous minerals. Drone-based GPR works by sending high-frequency electrical signals to the ground using a transmitting antenna. The pulse travels on the ground and interacts with the underground data, returning to where it was detected by the antenna. The reflected signal is then processed to create an image of the underground. The minerals have dielectric properties that differ from the surrounding rocks and soil, which can cause them to reflect electromagnetic (EM) waves differently and create a unique signature. This signature can be used to identify the presence of non-ferrous minerals.

GPR is a non-destructive method that can provide detailed information about subsurface features, including their depth and dimensions. It can be used in many places, especially in rocky terrain and green areas. It is also fast and cost-effective compared to traditional drilling and sampling methods. The transmitted EM signal is also attenuated or scattered by certain ground materials such as clay or water. Additionally, GPR surveys require trained personnel and specialized equipment, increasing research value. GPR has shown great results as a mineral exploration tool, especially when combined with other geophysical methods such as magnetic and electromagnetic surveys. This article aims to contribute to the growing research on drone-based technologies for mineral exploration by using drone-based Magnetometer and drone-based Ground Penetrating Radar.

3.0 GEOPHYSICAL SURVEY USING GROUND-BASED VERY LOW FREQUENCY (VLF)

In the realm of geophysics and Earth sciences, the study of electromagnetic waves has unlocked a treasure trove of insights into our planet’s hidden secrets. Among these waves, Very Low Frequency (VLF) technology stands as a remarkable and versatile tool, offering a window into the Earth’s subsurface and beyond.

VLF waves, with frequencies ranging from 3 kHz to 30 kHz, occupy the lower end of the electromagnetic spectrum. These waves are neither radio waves nor microwaves but a distinct and powerful force in their own right. They are generated by a fascinating interplay of terrestrial and cosmic phenomena, making them invaluable for a wide array of scientific and practical applications.

VLF instruments are indispensable tools in the world of mineral exploration. Their ability to detect electromagnetic signals from beneath the Earth’s surface allows prospectors to unlock the Earth’s hidden treasures efficiently and cost-effectively. As technology advances and our understanding of Earth’s subsurface deepens, the scope for VLF instruments in mineral exploration will only continue to grow, opening up new possibilities for uncovering valuable mineral resources and contributing to the sustainable development of our planet’s natural wealth.

4.0 METHODOLOGY OF DRONE-BASED GEOPHYSICAL SURVEY USING MAGARROW FOR MINERAL EXPLORATION



Figure 1 - Drone-based Magnetometer – MagArrow

Drone-based geophysical surveys using magnetometers are becoming increasingly popular for mineral exploration, and environmental and archaeological research.

Nonferrous metal minerals such as copper, gold, silver, and zinc often have strong magnetic fields due to the presence of iron-bearing minerals in their geological setting. By measuring the magnetic gradient, the MagArrow can pinpoint the location of minerals.

MagArrow is based on a Cesium vapor magnetometer, which is highly sensitive, stable, and has the ability to measure both the magnitude and direction of the magnetic field. Flight routes should cover the entire target area with sufficient overlap between adjacent flight routes. The drone must maintain altitude and speed at all times, and magnetometers must be calibrated before each flight. Make sure the areas your drone can fly in are safe and legal.

The collected data are processed with special software to remove background noise and extract magnetic anomalies caused by minerals. The resulting data can be displayed as contour plots or 3D models to visualize the distribution and intensity of mineral deposits. Interpretation of the processed data to identify areas of potential mineralization and prioritize further exploration. Additional geological and geophysical data can be combined for better interpretation. Drone-based geophysical surveys using magnetometers are just one tool in mineral exploration, and results should be confirmed by surface surveys and other exploration methods. An in-depth understanding of the geological setting and expected pattern of mineralization of the area is essential to ensure the effective development and execution of exploration programs.

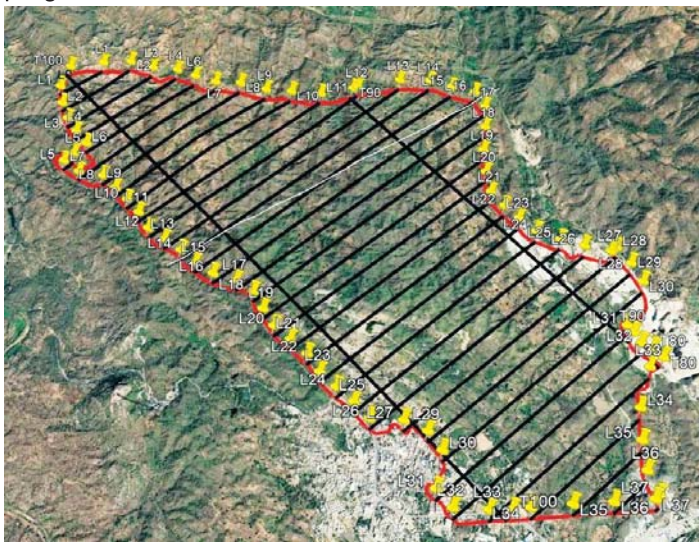


Figure 2 – Illustration of Flight Path

4.1 OUTPUT OF DRONE-BASED MAG DATA

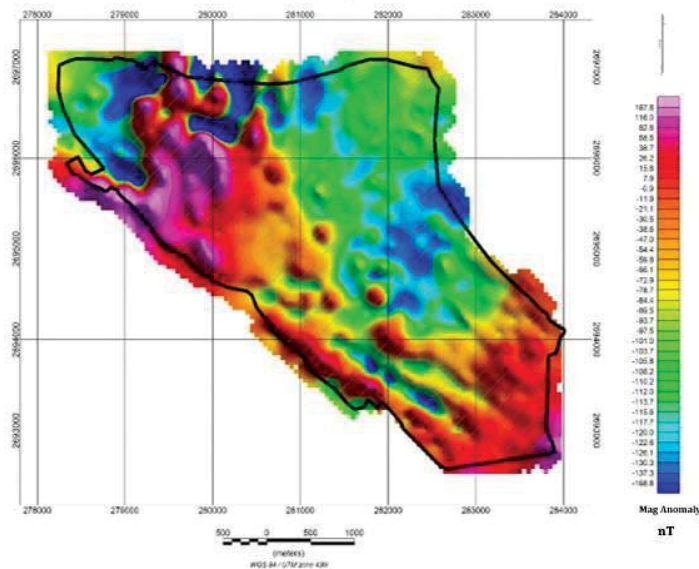


Figure 3 - Drone-based Magnetic Anomaly Map

4.2 Advantages of Drone-Based Magnetometer

- Efficient in Critical Mineral prospecting of severe terrain, harsh Deserts, and inaccessible areas.
- Mineral Prospecting in thick forests without disturbing the ecology
- Mineral Prospecting in densely populated areas-villages, towns, without entering the area.
- Very high-resolution outputs with LOW-flying height.
- No approach roads required
- Precision flying in harsh terrain Excellent for highly detailed magnetic survey, water detection, boreholes, well detection Centimeters data sampling intervals
- Fully autonomous flight Magnetic sampling at 1000samples a second
- Precisely identify and demarcate mineralised areas of Au, Cu, Li, Ni & and Fe-ores prospecting large prospect areas.

5.0 METHODOLOGY OF DRONE BASED GEOPHYSICAL SURVEY USING GROUND PENETRATING RADAR (GPR) FOR MINERAL EXPLORATION

Drone-based geophysical exploration using ground-penetrating radar (GPR) for mineral exploration can provide valuable data for identifying underground mineral deposits.

Ground Penetrating Radar (GPR) is a non-invasive geophysical method used to image and detect objects or subsurface features by sending electromagnetic pulses into the ground and analyzing the reflections that bounce back. It's commonly used for mineral exploration, archaeological, geological, environmental, and engineering applications.

GPR system consists of a transmitter and a receiver antenna. The transmitter emits short bursts of electromagnetic waves, typically in the microwave frequency range. Electromagnetic waves travel through the ground and encounter different materials with varying electrical properties, such as soil, rocks, water, and buried objects, they behave differently.

Drones equipped with GPR can cover a wide area quickly and efficiently. This is particularly useful for large-scale surveys or areas that are difficult to access on foot or by vehicle. Aerial GPR can provide high-resolution imaging of the subsurface due to the ability to maintain a consistent height above the ground and cover the survey area systematically.

Drone-based GPR systems offer real-time data analysis, allowing operators to make informed decisions during the survey itself. Combining drone-based GPR with other technologies such as LiDAR (Light Detection and Ranging) can create accurate 3D maps and visualizations of subsurface features, enhancing the understanding of the surveyed area.



Figure 4 - Drone-based Ground Penetrating Radar (GPR)

5.1 GROUND PENETRATING RADAR (GPR) OUTPUT

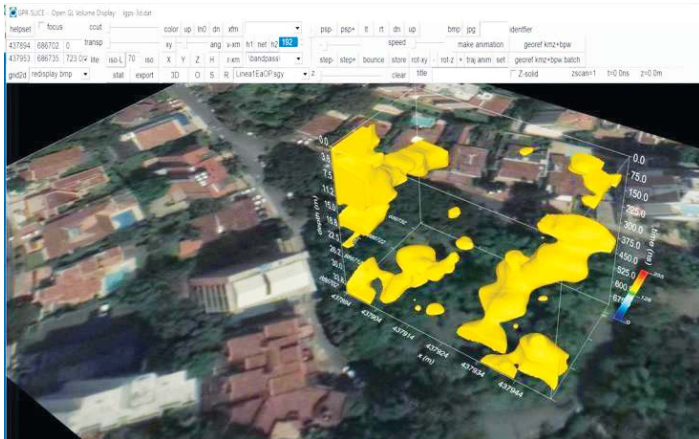


Figure 5 (a) - Isosurfaces in 3D highlighting anomalies in software GPR Slice

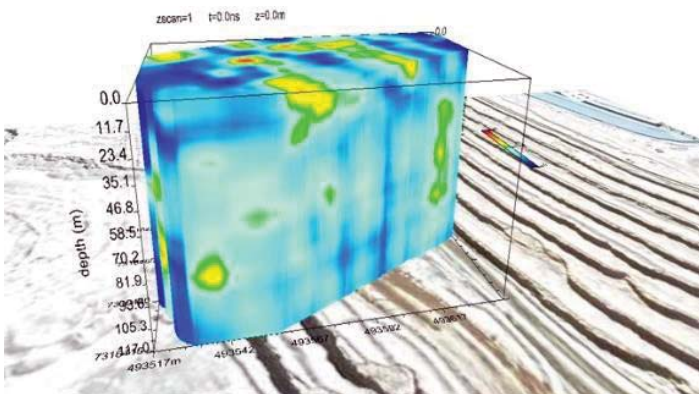


Figure 5 (b) - Isosurfaces in 3D highlighting anomalies along with depth in software GPR Slice

5.2 Advantages Drone-based Ground Penetrating Radar (GPR)

- Tailing dam in mines ((Strength & Leakage analysis))
- Cavity – land//underground monitoring
- Mineral prospecting.
- Detection of Underground tunnels, Structures, and pipe leakages.
- Stability Analysis and Subsidence Evaluation

- Lithological Characterization and Stratigraphic Modelling
- Aquifers Allocation and Evaluation & Archeologically Findings

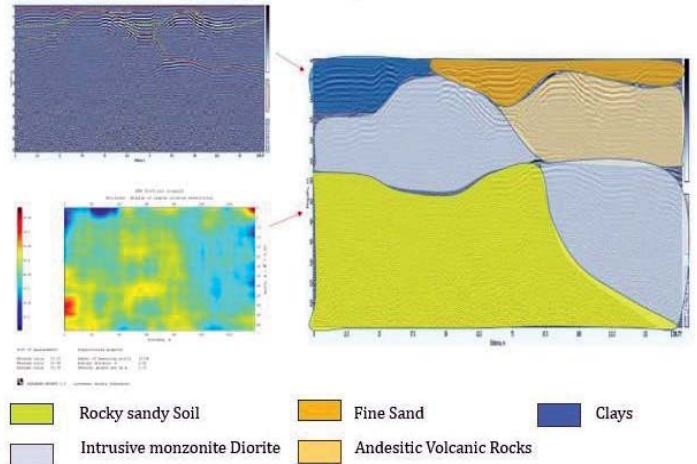


Figure 5 (c) The output from the GPR data captured shows the different lithological values of permittivity

6.0 METHODOLOGY OF GEOPHYSICAL SURVEY USING GROUND-BASED VERY LOW FREQUENCY (VLF)

The unassuming Very Low Frequency (VLF) instrument, with its remarkable capability to detect electromagnetic signals, has transformed the landscape of mineral exploration, providing invaluable insights into the Earth's wealth. VLF instruments operate within the frequency range of 3 kHz to 30 kHz, enabling them to discern subtle electromagnetic signals emanating from the Earth's crust and the surrounding geological formations. These instruments harness the inherent electromagnetic phenomena occurring deep beneath our feet.

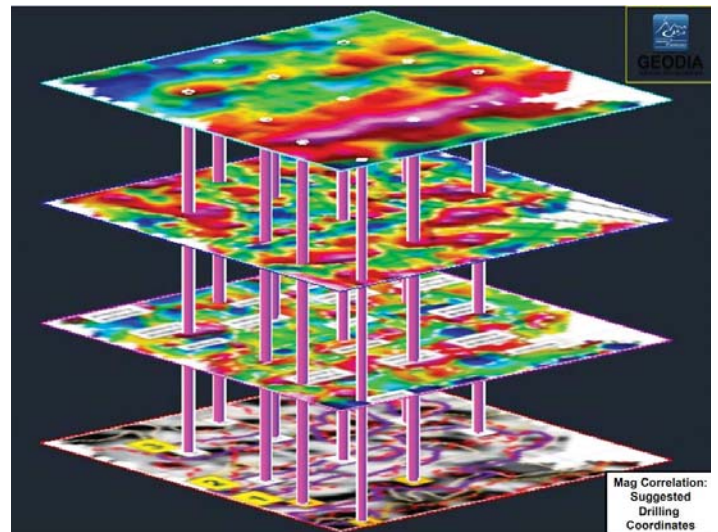


Figure 6. Mag correlation: suggested drilling coordinates

The practical implementation of VLF instruments encompasses both handheld and vehicle-mounted setups for ground surveys within target areas. These surveys entail the measurement of electromagnetic field variations, with recorded data subjected to rigorous analysis. Additionally, VLF instruments are adapted for aerial surveys, with deployment on aircraft or UAVs. These aerial surveys offer a panoramic view, allowing exploration teams to identify potential targets across extensive regions, enhancing the breadth of their search.

6.1 Advantages of Ground-based Very Low Frequency (VLF)

- Mineral Exploration
- Mapping Geological Structures
- Groundwater Detection
- Archaeological Investigations
- Hydrogeological Studies
- Detection of Seismic Activity
- Geotechnical Engineering

7.0 CONCLUSION

This paper delved into the potential of two drone-based methods, the Magnetometer (MagArrow) and Ground Penetrating Radar (GPR), for Geophysical surveys for mineral exploration. By evaluating their methodologies, accuracies, and applicability, we gain valuable insights into their contributions to the field of geophysics and mineral prospecting.

Drone-based Magnetometers have emerged as a promising tool for mineral exploration, leveraging advanced cesium vapor technology to detect magnetic anomalies and identify potential mineral deposits. These magnetometers, combined with drones, offer advantages such as accurate survey lines, swift data collection, and the ability to access challenging terrains. The integration of magnetometer data with other geophysical and geological information enhances the precision of mineralization predictions.

Ground Penetrating Radar (GPR), deployed through drones, showcases its ability in non-invasive subsurface imaging. By emitting electromagnetic waves and analyzing reflections, GPR unveils the potential presence of non-ferrous minerals. The efficiency, cost-effectiveness, and non-destructive nature of GPR make it a valuable tool for mineral exploration, especially when integrated with complementary methods like magnetic and electromagnetic surveys.²

In conclusion, the synergy between technological innovation and geological insight serves as the driving force behind the evolution of mineral exploration. The future holds the promise of further advancements, where the boundaries of geophysical research are pushed, and new horizons of discovery are unveiled. As the world's mineral

demands continue to rise, the integration of drone-based Magnetometers and GPR becomes not just a possibility, but also a necessity, as we navigate the complex subterranean realm in our quest for valuable resources.

In the world of geophysics and subsurface exploration, the fusion of GPR, magnetic surveys, and VLF surveys creates a powerful synergy. This multidisciplinary approach enhances our ability to understand and interpret the complex subsurface environment, whether we are searching for minerals, assessing environmental impact, or solving archaeological mysteries. By combining these techniques, we unlock a more comprehensive and accurate understanding of the Earth's hidden layers, paving the way for smarter resource management and more informed decision-making in various fields.

The technology facilitates rapid surveys of small parcels, eliminating the need for time-consuming road construction. By capturing a high volume of measurements in a short period, drone-based surveys, in tandem with ground-based VLF technology, simplify complex surveys that are otherwise challenging using traditional methods involving piloted aircraft or ground-based instruments. This multidisciplinary approach promises to reshape the landscape of mineral exploration, offering unprecedented accuracy and efficiency in uncovering Earth's hidden treasures.

8.0 REFERENCES

1. Daniels, J. *Ground Penetrating Radar Fundamentals*; Ohio State University: Columbus, OH, USA, 2000.
2. Katerina, Z.; Tomas, C. *Application of ground penetrating radar methods in soil studies: A review*. *Geoderma* 2019
3. Isles, D.J.; Rankin, L.R. *Geological Interpretation of Aeromagnetic Data*; Society of Exploration Geophysicists and Australian Society of Exploration: Tulsa, OK, USA, 2013
4. Malehmir, A.; Dynesius, L.; Paulusson, K.; Paulusson, A.; Johansson, H.; Bastani, M.; Wedmark, M.; Marsden, P. *The potential of rotary-wing UAV-based magnetic surveys for mineral exploration: A case study from central Sweden*. *Lead. Edge* 2017
5. Le Roux C, Macnae J (2007) SQUID sensors for EM systems. In: *Exploration in the new millennium, Proceedings of the fifth decennial international conference on mineral exploration* (pp. 417–423). <https://doi.org/http://www.dmec.ca/ex07-dvd/E07/Authors2.html#M>. Accessed 01 Dec 2021
6. Lee, T.H.; McKeever, S.; Courtney, J. *Flying Free: A Research Overview of Deep Learning in Drone Navigation Autonomy*. *Drones* 2021
7. Ristić, A.; Govedarica, M.; Pajewski, L.; Vrtunski, M.; Bugarinović, Ž. *Using Ground Penetrating Radar to Reveal Hidden Archaeology: The Case Study of the Württemberg-Stambol Gate in Belgrade (Serbia)*. *Sensors*. 2020
8. <http://www.industriasingeodina.com/about-us.html>
9. <https://www.squadrone.co.in/>

(Continued from Page 13)

➤ **Canada to accelerate critical mineral mining – energy minister**

Canada's Natural Resources and Energy Minister Jonathan Wilkinson says more funding for critical minerals projects is on its way. Credit: Government of Canada

Canada plans to boost its energy security by slashing the time it takes to develop new critical mineral mines by nearly a decade with improved permitting processes, energy minister Jonathan Wilkinson told *Reuters* on Tuesday.

Ottawa is focused on six critical minerals key to making electric vehicles and wind turbines: lithium, graphite, nickel, cobalt, copper, and so-called rare earth elements. Wilkinson said the mining and processing of critical minerals was currently too dominated by China.

"(We're) looking at how do we optimize the regulatory and permanent processes so you can take what is a 12 to 15-year process and bring it down to maybe five," he said. "There are ways you can just do things smarter ... There's no reason that you can't do permitting of different things between federal and provincial governments at the same time, instead of doing them sequentially."

Canada plans to reduce the time to approve mining permits by better funding the regulatory agency to get rid of paperwork backlogs and running permitting and environmental assessment processes at the same time. The country will have to continue importing cobalt, Wilkinson said, due to its limited resources of the metal. China controls most of the world's refined cobalt and rare earths supplies.

To cover costs, Canada is putting in place investment tax credits to pay for a "significant chunk" of the capital associated with new mining and mineral processing projects, Wilkinson said. Funds are also ready to be made available for infrastructure like transmission lines and roads that will help accelerate the development of new minerals, he added.

The government is also investing billions of dollars in several companies' battery factory projects in Canada, including Swedish battery producer Northvolt and German car manufacturer Volkswagen. A loan guarantee programme is being put in place as well to provide access for indigenous communities to low-cost

debt for investing as equity participants in existing and future projects, Wilkinson said.

In July, a group of five First Nation communities protested against mining plans in the so-called "Ring of Fire", a region in the remote James Bay Lowlands of northern Ontario that is seen as the next frontier for mining metals such as copper, cobalt and nickel. Wilkinson said streamlining permitting and environmental assessments would not lead to corner-cutting. "I think the environmental community also recognizes that there is no energy transition without significantly enhanced volumes of critical minerals," he said.

Reuters | February 13, 2024

➤ **Deep-sea mining may be inevitable, says UN regulator**

Deep-sea mining is likely just a matter of time, according to the head of the International Seabed Authority (ISA).

"Clearly now, we are reaching a very high level of interest so I would say that yes it seems to be inevitable," said Michael Lodge, the secretary-general of the ISA, in an interview with *CNBC*. "One of the main drivers of industrial interest is the potential to produce larger quantities of minerals at equivalent or lower cost to what can be produced on land," Lodge added.

His comments come as the ISA prepares to recommence talks on deep-sea mining in Kingston, Jamaica, next month. Recently, Norway's parliament greenlit seabed mining exploration in the country's territorial waters. The determination on January 9 made Norway the first country to formally authorize seabed mining activities in its waters.

Minerals and metals such as cobalt, nickel, copper and manganese can be found in potato-sized nodules on the ocean floor. Reserves are estimated to be worth anywhere from \$8 trillion to more than \$16 trillion. According to a study published in the *Journal of Cleaner Production*, producing battery metals from nodules could reduce emissions of CO² by 70-75%, cut land use by 94% and eliminate 100% of solid waste.

Meanwhile, scientists have warned that the full environmental impacts of deep-sea mining are hard to predict, and environmental campaign groups say the practice can lead to ecosystem destruction and species extinction. "It hasn't been done yet, so it is very hard to say conclusively that it would be as destructive as some people claim that it would be," said Lodge.

Staff Writer, Mining.Com | February 19, 2024

MEAI NEWS

MEAI HEADQUARTERS

1. First Aid Training (Batch – 4)

First Aid Training program (4th Batch) was conducted at MEAI HQs from 6-4-2023 to 16-4-2024. 32 candidates attended the training program, mainly mining engineering students from Mallareddy Engineering College, JBIT Engineering College, and others.

Dr Naveen, Training Officer, and Shri V Siddi Ramulu, Instructor imparted the training. On 17-2-2024, examination was conducted and the successful candidates were awarded certificates.

Glimpses of the First Aid Training Program



Dr. Naveen, First Aid Training Officer and Shri. Siddiramulu, Training Instructor conducting First Aid classes



Feedback session with the participants on First Aid Training Program



Shri. M. Narsaiah, Secretary General, MEAI and Dr. Naveen, First Aid Training Officer with the candidates attending the First Aid Training Program

2. MEAI Tech Series – Feb 2024 (Mts–18): Daredevil Resq & Adventures

In continuation of the Technical Series, (MEAI TECH SERIES), without break since July 2022, MEAI conducted the EIGHTEENTH PRESENTATION (MTS-18) on 1st February 2024 at 06:30 pm on WebEx platform. The speaker was Mr Deepak Vidyarthi, a trained Rescuer and Council Member of MEAI.

Large number of professionals had joined and lauded the presentation that outlined grit, conviction and courage of a special class of thrill-seeking individuals, who consciously venture into hazardous situations risking their own life.

SPOT LIGHT was on

- CIVIL DISASTER- with Rescue of three construction workers suffocated under the debris of a high rise building that collapsed like a pack of cards. (1983)
- MISSION RANIGANJ- where 65 miners were rescued alive from a flooded mine (Mahabir Colliery) within four days in 1989
- RESCUE IN SAN JOSE MINE, CHILLE – Tale of rescue of 33 miners from a depth of 780 meters trapped in a twin collapse. (2010)
- SILKYARA HORROR & DEDICATED RATHOLE MINERS – Minute to minute account of the Rescue of 41 miners trapped in a tunnel under construction in Uttarakhand (India) by the dedicated endeavour of “Rat Hole Miners” (banned outfit in India); highlighting the failed machinery and Rescue by foreign experts! (November 2023)
- Lessons learnt from Silkyara Rescue

The interactive session concluded with a Vote of Thanks proposed by Mr T.R. Rajasekhar to the speaker for a wonderful presentation and to all the participants for their kind attention.

◡ Date	12-9-83
◡ Time	15:45 Hrs
◡ Persons Trapped	140
◡ Casualties	129
◡ Rescued Alive	11

CIVIL DISASTER

01.02.2024

MEAI TECH SERIES
MTS 18
MEAI TECH SERIES - MTS 18
DAREDEVIL RESQ & ADVENTURES
01.02.24
SILKYARA Tunnel Collapse
THE SYLKYARA HORROR

INTRODUCTION

DAREDEVIL RESQ & ADVENTURES
THE SYLKYARA HORROR: What Went Wrong ???
EXCERPTS
 The Chao Olman project, was supposed to widen roads in the region, keeping in mind sufficient slope...
 The size 12" x 24", portion of MEAIYARA Tunnel under construction collapsed at 07:30 pm, trapping 41 workers in a 60 metres stretch in Sylkyara side.
 SURE, SURE, Indian Air Force, ARMY, Border Road Organization, the Best American Machines breaking through Concrete, Best International Experts etc, Mine Tunnel Expert Chris Cooper were all involved at site but nothing seemed to be working.
 SURE, SURE, Indian Air Force, ARMY, Border Road Organization, the Best American Machines breaking through Concrete, Best International Experts etc, Mine Tunnel Expert Chris Cooper were all involved at site but nothing seemed to be working.
 When time was running out, when Hope was burning into despair,
 Unthinkably, this machine had done what "Indian Jugglers" was occasionally do!!!
 41 Trapped Workers 1 One Collapsed Tunnel !! All Machinery FAILED !!!
 And, they were all rescued out safely by the "KAT MINERS" !!!

MEAI TECH SERIES
MTS 18
Mahabir Colliery
WATER LOGGED NINGHAU SHAFT
WINDING SHAFT
MAHABIR COLLIERY
STEEL CAPSULE
J.S. GILL
J.S. GILL
MEAI TECH SERIES - MTS 18
DAREDEVIL RESQ & ADVENTURES
01.02.2024
Mahabir Colliery Rescue

At the end of the program, the participants were put to test for assessment of their learnings. Attendance and Assessment were mandatory for participants to be eligible for grant of MPDP Certificates.

MEAI PROFESSIONAL DEVELOPMENT PROGRAM (MPDP-IV)

EMINENT FACULTIES

04.02.2024

Sri K.MADHUSUDHANA
 Immediate Past President, MEAI

Sri G.DHANANJAY REDDY
 VICE PRESIDENT - II, MEAI

CHIEF GUEST
 Sri Vinay Kumar, DIRECTOR (TECHNICAL) NMDC

VALEDICTORY FUNCTION
MEAI PROFESSIONAL DEVELOPMENT PROGRAM - (MPDP-IV)

3. MPDP- IV

MEAI is pleased to announce the successful conclusion of MPDP- IV (MEAI PROFESSIONAL DEVELOPMENT PROGRAM) organised from 19th Jan, 2024 to 04th Feb, 2024.

Testimony to the popularity of the program is ever increasing number that touched 37 in Jan 2024 besides very effective and constructive feedback by the participants!

This would not have been possible without the guidance and cooperation of the members of the Training Development & Program Committee of MEAI, dedicated & devoted endeavour of the faculties and without the collaboration of sponsoring Organizations.

GLIMPSES of MPDP-IV Program

DAYS	07
Sessions:	24 (90 minutes per session)
Faculties:	15
Topics:	22

Participating Organizations

NMDC, MSPL, VEDANTA, HGML, TATA STEEL, JSW, ERM Group, VEDANTA, TRIVENI EARTH MOVERS, KSMCL, BKG MINING, IOD SANDUR.

VALEDICTORY FUNCTION - (MPDP-IV) - 04.02.2024
FEEDBACK BY FACULTIES

Sri A.R.VIJAY SINGH, FACULTY

Sri K.MADHUSUDHANA, FACULTY
 IMMEDIATE PAST PRESIDENT, MEAI

Sri T.R.RAJASEKHAR, FACULTY

Sri S.N.MATHUR
 PRESIDENT, MEAI

Sri DEEPAK VIDYARTHII, FACULTY
 CHAIRMAN, TDPC, MEAI

Sri M. NARSAIAH
 SECRETARY GENERAL MEAI

BARAJAMDA CHAPTER

International conference held at Jamshedpur

Tata Steel Limited organised a two-day International Conference on Mining and Beneficiation Technology (MBT'24) at Beldih Club (Jamshedpur, Jharkhand, India) on February 1-2, 2024, in collaboration with the Mining Engineers' Association of India (MEAI), Barajamda Chapter.

With over 200 participants from 50 global organisations, MBT'24 provided a unique platform for in-depth discussions, insightful deliberations, and valuable exchanges on cutting-edge topics such as Mining in the Digital Age,

Technological Interventions, De-carbonization, Mega Trends in Beneficiation, Smart Plant Operations, and Recovery of Critical Minerals.

The event was graced by Padma Bhushan Dr. V K Saraswat, Member of NITI Aayog, who highlighted the importance of technological advancements and sustainable practices in shaping the industry's future.



Dr. V K Saraswat, Member NITI Aayog being received by Shri D B Sundara Ramam, Vice President Raw Materials, Tata Steel and Shri P K Tripathy, Chief Raw Material Technology group.



Lighting of Lamp. (L-R): Shri Atul Bhatnagar, Shri D B Sundara Ramam, Shri P K Tripathy, Dr V K Saraswat and Shri Debashis Bhattacharya V P (R&D).



Chief guest Dr. V K Saraswat, Member NITI Aayog, Shri D B Sundara Ramam, Vice President Raw Materials & VP- I MEAI, Shri Debashis Bhattacharya V.P Technology R & D, Shri P K Tripathy, Chief General Manager, Raw Material Technology and Shri Atul Kumar Bhatnagar, General Manager (Ore Mines & Quarries) releasing the Conference Souvenir.



Shri D B Sundara Ramam addressing the delegates of the Conference MBT' 24. (L-R): Shri P K Tripathy, Shri Dr. V K Saraswat, Shri Debashis Bhattacharya and Shri Athul Batnagar, Chairman Barajamda Chapter.



Shri D B Sundara Ramam, VP-I MEAI and Shri M. Narsaiah, Secretary General MEAI with members of the Organizing team of the Conference Mining and Beneficiation Technology (MBT'24).

HYDERABAD CHAPTER

National seminar held at Hyderabad

A 2-Day National Seminar on 'Advanced Iron Ore Beneficiation & Sustainable Low Grade Iron Ore Utilization' was held at Hotel Taj Deccan on 16-17, February 2024 by the MEAI Hyderabad Chapter in association with NMDC. More than 150 delegates participated with active support coming from the mining and steel Making companies. Some of the significant aspects of the National seminar are:

A Souvenir that contained 13 full research articles, 8 abstracts, messages from Important personalities viz. Chhattisgarh CM Shri Vishnu Deo Sai, Ministry of Steel Shri Nagendra Nath Sinha, Additional Secretary, Ministry of Mines Shri Sanjay Lohia, CMD, NMDC Shri Amitava Mukherjee, MEAI President Shri S N Mathur, Chief Controller of Mines (I/C) IBM Shri P N Sharma, Director (Production) NMDC Shri Dilip Kumar Mohanty, Director (Technical) NMDC Shri Vinay Kumar and Director, Department of Mines & Geology, Telangana Shri B R V Susheel Kumar etc. was released on this occasion.

During the two-day conference, three technical sessions were held and 14 papers were presented. In the face of increasing global demand for steel production, NMDC, India's largest iron ore producer, has a pivotal role to play in supporting the economic growth of the country. However, reliance on high-grade iron ore is becoming unsustainable, prompting the need for advanced beneficiation technologies to extract value from the low-grade iron ores.

The transformative impacts of Advanced Iron Ore Beneficiation (AIOB) techniques on Mining Companies Environmental, Social, and Governance (ESG) scores were discussed.

- A paper from the University of Hyderabad discussed Laser Processing of Iron ore waste fines, which is an alternative reduction of Iron Ore with green tools such as laser beam, a controlled and clean process.
- Discussed on improving recovery of iron values from lean tailings of Donimalai Beneficiation and Pelletization

plant. The studies on the tailings with 40.6% Fe, have concluded that a concentrate of 59.03% Fe can be produced with an average process yield of 36.51% and 52.87% iron recovery.

- The experts stressed on investing in the R&D ecosystem to provide insights and opportunities for enhancing efficiency and sustainability. They include supporting research initiatives focused on improving beneficiation processes, waste management, utilization of low-grade and reduction of tailings.
- Experts discussed on Process flow sheet development for production of iron ore concentrate suitable for pelletisation from sub-grade iron ore
- Discussion also took place on iron ore tailings, which are finely ground and lean mineral waste products generated from mineral processing operations, usually disposed of in the form of a water-based slurry into tailing ponds/dams. Consequences of tailings disposal in the form of slurry results in loss of productive land, possible impact on surface and ground water, safety concerns on possible breach of dam. Consequently, tailings filtration for dewatering and paste thickening have emerged as viable alternatives for disposal of tailings in solid form.

The amenability of tailings filtration and paste thickening is often dependent on the chemical composition and size distribution of generated tailings. The tailings generated by filtration and paste thickening, their storage and handling (transportability) need to be addressed by studying the Rheology of paste and flowability of solids at expected moisture levels. With new technology, the filtered tailings can be transported by conveyor belt and stacked up to moisture content of 20% to 26%.

- Mining is a high-risk occupation and considered one of the oldest industries in the world. Mining accidents, hazards, and disasters have a number of similarities in terms of their significant impacts on the victims, mine owners, mine workers, governments policy-makers and local communities. Beautiful discussion took place on the journey towards zero Injury.
- Students also participated in the Seminar from PG Center Nandihalli, Sandur and presented their research work on beneficiation of lean-grade Iron Ore (Unlocking the Potential of a Vital Resource).
- A presentation on mathematical modelling on iron making from IIT Madras has been widely appreciated.
- Research Papers from the University of Hyderabad, IIT Kharagpur, IIT Madras, PG Centre Sandur, NMDC, AM/NS, TATA Steel, JSW, and MSPL have been discussed in the seminar.

Recommendations from the Two-Day National Seminar on "Advance Iron Ore Beneficiation & Sustainable Low-Grade Iron Ore Utilization"

- Mining & Steel PSU's should take up a leading role in both the construction and operation of beneficiation plants.
- The operational capacity of the beneficiation plant is currently hindered due to the non-availability of land for tailing storage. Government intervention is necessary to facilitate the allotment of land for tailing storage. This support is essential to enable the beneficiation plant to operate at its full potential.
- Incentives to encourage the utilization of low-grade iron ores through beneficiation and palletization processes are required. The government should subsidise the process cost using iron ore below 58% Fe to enhance competitiveness in beneficiation and pellet production by ensuring lower costs compared to lump ore.
- It is required to encourage the use of energy-efficient equipment in crushing, grinding, and beneficiation processes to reduce energy consumption and operational costs while minimizing environmental impact.
- The government should subsidize use of iron ores below 58% Fe. Cost of low- grade iron ore beneficiation is higher than directly purchasing high-grade ore. Tax exemptions on capital investment for beneficiation facility creation and land allotment for setting up beneficiation plants is required.
- It is required to provide infrastructure and logistical support for environmentally friendly transportation methods such as pipe conveyors and slurry pipelines for iron ore fines, lump, and slurry. Offer tax discounts on investments in cost-effective logistics to encourage the adoption of these eco-friendly transportation options - reducing carbon footprints.
- Encouragement to Homegrown Beneficiation Facilities: To address the technical challenges faced by the industry, it is recommended that homegrown beneficiation facilities be incentivized. This will not only provide technical solutions but also promote self-reliance in the sector.
- Government Intervention for Magnetite Ore Utilization: Vast resources of magnetite ore locked in the Western Ghats should be utilized for steelmaking. Government intervention is crucial to unlock these resources and meet the raw material requirements for the industry.
- Training and Development of Manpower: With the upcoming expansion of the mining sector, there is a pressing need for trained manpower. It is recommended that educational institutions, such as IITs and NITs take the lead in developing specialized programs to equip individuals with the necessary skills.

- **Management of Waste Generated from Beneficiation:** The seminar highlighted the challenges posed by waste generated from the beneficiation of low-grade iron ore. It is recommended that sustainable waste management practices be developed and implemented to mitigate the environmental impacts.
- **Collaboration between Industry and Academia:** The seminar showcased the importance of collaboration between industry and academia. It is recommended that such partnerships be strengthened to foster innovation and address the technical challenges faced by the sector.
- **Publish the ASP of ROM:** IBM should publish the ASP of ROM also. Similarly, there is no ASP for slimes/tailings, due to which royalty is being levied at par with the fines grade rate, while tailings/slimes are being sold at a very low price than the fines. Hence, ASP for non-published grades of iron ore such as tailings/slimes, ROM, BHQ etc. should be published by amending the Rules and also included in the monthly returns (Form F1).
- **Royalty is calculated on the basis of ASP:** ASP is calculated on the basis of 'EMP', which is a weighted average of 'sale value', which includes royalty, DMF and NMET for each mine. Since the sale value already contains the royalty, DMF and NMET, the lessee pays royalty on royalty, DMF and NMET (or an amount that already includes royalty). Due to this, there is an additional charge levied on the miners on account of current methodology and Rules. This has a cascading impact for all mines in the country, granted before or after MMDR Amendment Act 2015 i.e 12.01.2015. It is proposed that the amended rules shall be uniformly applicable to all mines and that Rule 38 of MCR, 2016 should be amended in such a way that the royalty, DMF & NMET are excluded from sale value.



Shri D K Mohanty, Chief Guest in the inaugural function addressing the delegates



Shri Vinay Kumar Director (Technical) NMDC Ltd. & Chairman MEAI-Hyderabad Chapter addressing the delegates.



Shri M S S Sharma making a presentation



Releasing the souvenir by the Chief Guest Shri D K Mohanty Director products, NMDC Ltd. (L-R): Shri V S Rao, Shri S K Agrawal, Shri D K Mohanty Shri Vinay Kumar, Shri S N Mathur, Shri Dhananjay G. Reddy and Dr P V Rao.



Shri Jaipal Reddy, ED, NMDC, Shri Vibhuthi Roshan, DGM NMDC with the Speakers from Technical Session – 2



Prof. A K Shukla, Shri G R K Rao, Shri B Sahoo, Shri Sujit Mohanty, Shri Vibhuthi Roshan participating in a Panel Discussion.



A section of delegates participating in the Seminar.



Dr. V K Rao, conducting the technical sessions.



Shri P R Tripathi, Former CMD, NMDC Ltd. addressing the delegates



Shri Amitava Mukherjee, Chairman, NMDC & Chief Guest in Valedictory function addressing the delegates.



(L-R): S/Shri L Krishna, Pradeep Kumar, Vinay Kumar, P R Tripathi, Amitava Mukherjee, S N Mathur, M Narsaiah, Dr. S. K Sinha, Ramveer Singh, Balakoti Reddy.




Sri M. Gopalakrishna releasing the Inaugural issue of Mining Engineers' Journal (MEJ) from Hyderabad on August 15, 1999.

Courtesy: Shri M. Fasihuddin


(L-R): Sri C.L.V.R. Anjaneyulu, the then Secretary General MEAI & Publisher MEJ, Sri T.V. Chowdary, the then President MEAI, Sri M. Gopalakrishna, IAS (Retd.) and Dr K.K. Sharma, the then Editor, MEJ.

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NOMINATIONS FOR MEAI AWARDS 2024

The Mining Engineers' Association of India presents awards Instituted by the Industry/individuals during the Annual General Meeting in July - August every year. Nominations for the following Awards are invited in the prescribed form, so as to reach the Secretary General by **30th of April 2024**. Nomination can be submitted by a member for one award only.

1. MEAI - Sitaram Rungta Memorial Award for the best paper on Mining-related issues during the year 2023.

AWARD Bylaws:

- a. The award is known as MEAI – Sitaram Rungta Memorial Award, instituted by M/s Rungta Group of Mines.
- b. The award is presented to a Mining Engineer/ Geologist or any other qualified person involved with Mining Industry, who presented a paper on mining related issues during the previous calendar year/ financial year.
- c. The papers presented in any of the paper meetings, seminars or workshops organized by the Association/ Chapter during the calendar year are eligible for the award, provided
 1. *The paper was not published in any journal/ magazine in India or abroad other than the MEJ*
 2. *The author did not deliver lecture/ talk related to this paper on any other forum other than in the Seminars / Workshops etc., organised by MEAI.*

2. MEAI NMDC Award for significant contribution to Iron Ore Industry during the year 2023.

Award Bylaws:

- a. The award is known as MEAI-NMDC Award instituted by M/s NMDC Ltd.
- b. The award is presented to a Mining Engineer/ Geologist or any qualified person involved in Mining Industry for the meritorious services rendered by him/ her to the Iron ore Industry.

3. MEAI Simminds Award for significant contribution to the limestone industry during the year 2023.

Award Bylaws:

- a. The award is known as MEAI – SIMMINDS award instituted by M/s SOUTH INDIAN MINES AND MINERALS INDUSTRIES Ltd.,

- b. The award is presented to a Mining Engineer/ Geologist or any qualified person involved in Mining Industry for his/ her significant services rendered to the Limestone industry.

4. MEAI Smt. Bala Tandon Memorial Award in recognition of contribution to Mining Industry for improving ecology, environment and forestation during the year 2023.

Award Bylaws:

- a. The award is known as MEAI - Smt. Bala Tandon Memorial Award was instituted by Padma Bhushan G.L. Tandon in memory of his late wife.
- b. The award is presented to a Mining Engineer/ Geologist or any qualified person associated with the Mining Industry, in recognition of his/ her meritorious services for improving ecology, environment and afforestation in mining and mineral industries.

5. MEAI Abheraj Baldota Memorial Gold Medal Award (Mining Engineer of the year 2023) in recognition of significant contribution to Mining Industry by a Mining Engineer with 20 years of experience in the Industry.

Award Bylaws:

- a. The award is known as MEAI – Abheraj Baldota Memorial Gold Medal Award (Mining Engineer of the year) instituted by M/s MSPL Ltd., in memory of its founder late Abheraj Baldota.
- b. The award is presented to a Mining Engineer with a Degree or Diploma in Mining Engineering and Mine Manager's Certificate of Competency with 20 years of experience in mining and allied disciplines as on the date the nomination is forwarded and the nominee should have completed 45 years of age and contributed substantially to the mining and mineral industries in the areas of management performance, production, mining technology, human resource development, protection of environment, mineral conservation, beneficiation etc.

6. MEAI Abheraj Baldota Memorial Gold Medal Award (Young Mining Engineer of the year 2023) in recognition of significant service to Mining Industry by an Young Mining Engineer who has not completed 35 years of age as on 2023.

Award Bylaws:

- a. The award is known as MEAI – Abheraj Baldota Memorial Gold Medal Award (Young Mining Engineer of the Year) instituted by M/s MSPL Ltd., in memory of its founder late Abheraj Baldota.
- b. The award is presented to a Young Mining Engineer with a Degree or Diploma in Mining Engineering or a Manger's Certificate of Competency with five years' experience in mining industry and the nominee should not have completed 35 years of age as on the date of filing his nomination for the award.

7. MEAI-SRG Informational Technology Award for the year 2023, In recognition of significant contribution to Mining Industry adopting Information Technology during the year 2023.

Award Bylaws:

- a. The award is known as S.R.G. Award for Information Technology, instituted by M/s S.R.G. Consulting Mining Engineers (P) Ltd. in memory of late Sriram Srinivasan and late Pradeep Kumar Bhattacharya both founder directors who lost their lives in Train (Rajdhani Express) accident in the year 2002.
- b. The award is presented to a qualified Mining Engineer/ Geologist/ any qualified person for his significant contribution in Information Technology to Mining and Mineral Industries and the nominee should be a Life Member of the MEAI.

8. MEAI Master Tanay Chadha Memorial Geologist Award for the year 2023 in recognition of the significant contribution by a geologist in the field of Mineral Exploration, quality control, and production, mine planning, etc. during the year.

Award Bylaws:

- a. The award is known as MEAI – Master Tanay Chadha Memorial Geologist Award instituted by Shri G.L.Tandon (Padma Bhushan) in the name of his late grandson (S/o Smt. Sunita Chadha and Shri Sudhanshu Chadha). The award is presented to a geologist with a Master's Degree in Geology/ Applied Geology/ Geophysics with at least five years' experience in Mining and Mineral Industry who had contributed significantly in the areas of mineral exploration, quality control and production, mine planning, etc.

9. MEAI- Smt Veena Roonwal Memorial Award for the year 2023 to a Mining Engineer/Geologist/a qualified person involved with the Mining Industry with 10 years of experience for presenting a paper during the year in a seminar/ symposium workshop organized by MEAI on "Water Management in and around a working mine" or "Implementation of New/Latest Technology in Mining and allied subjects.

Award Bylaws:

- a. The Award is known as Smt. Veena Roonwal Memorial Award instituted by Prof. G.S. Roonwal in memory of his late wife and is presented to a qualified Mining Engineer/ Geologist/ any qualified person involved with Mining Industry with 10 years' experience, for presenting a paper during the year in a seminar/ symposium/ work shop/ technical paper meeting organized by MEAI/ MEAI Chapter on "Water Management in and around a working mine or implementation of New/ Latest Technology in mining.

10. MEAI- Smt Kiran Devi Singhal Memorial Award for the year 2023 only to a person (MEAI Member/Non-member-need not necessarily be from mining discipline) for his/her contribution in the field of "Development and Conversation of Minerals and Environment" in and around Metalliferous mines (excluding Coal and oil) during the year 2022.

Award Bylaws:

- a. The award is known as MEAI - Smt. Kiran Devi Singhal Memorial Award instituted by Dr. Suresh C. Singhal in memory of his late mother.
- b. The award is presented to a member or non-member of MEAI for his/ her outstanding contribution in the field of "Development and Conservation of Minerals and Environment in and around metalliferous mines.

11. MEAI Award to a best paper on Mining published in the Mining Engineers' Journal in the financial year 2022-23 Instituted by Dr. M.L. Jhanwar

Award Bylaws:

- a. *The Award will be known as Eco-friendly Mining Award.*
- b. *The award consists of a Plaque/ Medal and a Certificate. The cost of the Award will be met from the interest received on the donation of Rs. 1 lakh from Dr. M.L. Jhanwar.*
- c. *The Award will be given to a person for contributing the best paper on Eco-friendly Mining in Mining Engineers' Journal published by MEAI.*
- d. *The Award is presented to a member or non-member of MEAI.*

The paper should not have been published in any of the journals in Magazines India/ Abroad other than MEJ on Eco-friendly Mining.

12. MEAI-SCCL Coal Award for the year 2023 to a Mining Engineer, a Geologist, a Mechanical Engineer and a Foreman/ Over man for meritorious contribution to the Coal Industry.

Award Bylaws:

- The Awards are known as MEAI- SCCL Coal Awards instituted by M/s SCCL Ltd.
- The Awards are presented to a Mining Engineer, Geologist, Mechanical Engineer, Overman/ Foreman or any qualified person involved in Coal Mining Industry for the meritorious services rendered by him/ her to the coal industry or papers published.

❖ **For detailed guidelines please visit the website www.meai.org and the memorandum of association and rules and regulations (as on 26.08.2022)**

Applications and Guide Lines

The application shall be forwarded/sent to Secretary General MEAI NHQ in Prescribed Format (Copy Enclosed) at Hyderabad before **30th April 2024**. (MEAI NHQ Address: Mining Engineers' Association of India, F-608&609, VI Floor, Raghava Ratna Towers 'A' Block, Chirag Ali Lane, Abids, Hyderabad – 500001. Mob – 7780117320).

Applications are to be sent along with enclosed soft copies in PDF format with the subject.

MEAI Awards 2024 to email - meai1957@gmail.com

MEAI Award Format

- Name of the Award Applied for :
- Name of the Applicant :
- Date of Birth :
- Academic Qualification :
- Professional Qualification :
- Whether a Member/
Life Member of MEAI
- Specific details of the award applied for as per requirement of bylaws (Enclose relevant documents)

Date:

Certify that the information/details submitted for the above Award are true to the best of my knowledge

Name:

Signature:

Enclosed copies of documents on experience and achievements.

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FORM IV

Statement about ownership and other particulars about newspaper (**Mining Engineers' Journal**) to be published in the first issue every year after the last day of February.

- Place of publication: **Hyderabad**
- Periodicity of its publication: **Monthly**
- Printer's Name: **Deepu Printers**
Nationality: Indian
Address: Mining Engineers' Association of India
F- 608&609, VI Floor, Raghava Ratna Towers,
'A' Block, Chirag Ali Lane, Abids,
Hyderabad - 500001.
- Publisher's Name: **Mr. M. Narsaiah**
Nationality: Indian
Address: Mining Engineers' Association of India
F- 608&609, VI Floor, Raghava Ratna Towers,
'A' Block, Chirag Ali Lane,
Abids, Hyderabad – 500001.
- Editor's Name: **Dr. P. V. Rao**
Nationality: Indian
Address: Mining Engineers' Association of India
F- 608&609, VI Floor, Raghava Ratna Towers,
'A' Block, Chirag Ali Lane,
Abids, Hyderabad – 500001.
- Names and addresses of
Individuals who own the newspaper
and partners or shareholders **Not applicable**
holding More than
one per cent of the total capital.

I, **M. Narsaiah** hereby declare that the particulars given above are true to the best of my knowledge and belief.

Sd/-

Date: 28-02-2022

Signature of Publisher



5th IN-PERSON PROFESSIONAL TRAINING PROGRAM ON IMIC ON 6-10, MAY 2024



**Venue: MEAI HQs, Raghavaratna Towers,
Abids, Hyderabad 500 001**

Mining Engineers' Association of India (MEAI), the trusted voice of the Indian Resources sector, is the leading Professional Organisation (PO) recognised by the National Committee for Reporting Mineral Resources and Reserves in India (NACRI) and the Committee for Mineral Reserves International Reporting Standards (CRIRSCO). MEAI accepts the obligation of offering Professional Development Programs to its members, registering Competent Persons (CP) and supervising their ethical conduct. NACRI is the National Reporting Organisation (NRO) of India recognised by CRIRSCO.

The earlier four training programs on Indian Mineral Industry Code (IMIC) approved by CRIRSCO were successfully finished by NACRI in January 2021, April 2021, April 2022, and April 2023 with the overwhelming participation of over 25 professionals in each program, representing all leading mining companies viz. NMDC Limited, Tata Steel, HZL, MSPL, MOIL, OMECL, NLC, JSW Steel, AMNS, Adani Enterprises, HGML, SCCL, APMDC, KSMC, ERM Group, Deccan Gold, Orient cements etc., consulting organisations viz. DMT, SRG, Geovale, Data Code, Capstone etc. and individual professionals from across the country and overseas. Most of the delegates have successfully passed the IMIC evaluation test and more than a third of them have registered as Competent Persons (RCP) with MEAI. The list of delegates that attended the previous IMIC training programs and subsequently registered/ renewed as CPs may be found in the MEAI website at www.meai.org.

About the Professional Development Program on IMIC

NACRI has formulated a 40-hour (5-day) in-person but non-residential training program on IMIC. This course, conducted by the domain experts from India and abroad, includes sharing of basic knowledge on all relevant aspects of IMIC and Code of ethics, mineral industry Best Practices, and general guidance to the prospective RCP. The course has been formulated in line with the JORC Code training program conducted by the AusIMM and imparted under six major modules viz. Why the IMIC standard? Context and Principles, Exploration Results and Targets reporting, How to properly inform Technical Studies to investors, Reporting of Mineral Resources, Reporting of Mineral Reserves, and The role of Regulatory Environment. The objectives of the training program would be to appraise the obligations and liabilities of the Competent Person under the IMIC, Role played by the IMIC in the Resources sector, Interpretation of the IMIC within the context of your working environment, Recognise and counter common misconceptions about the IMIC, Identify good and poor technical reporting, and Demonstrate the correct application of the IMIC.

Overseas domain experts from JORC (Australasia), PERC (Europe and UK), CBRR (Brazil), SME (USA) etc. may speak on Best practices and present practical examples on reporting of Exploration results, Mineral Resources and Mineral Reserves, wherever possible.

Prerequisites for the registration of a CP

RCP definition under Clause #9 of IMIC 2019 is as follows: *RCP is a mineral industry professional who is a member of a professional organisation headquartered in India and approved by NACRI or a member of a 'Recognised Professional Organisation' (RPO), as included in a list of similar bodies headquartered outside India available on the NACRI website. These organisations have enforceable disciplinary processes including the powers to suspend or expel a member. An RCP must have a minimum of ten years professional experience, which includes five years relevant experience in the style of mineralisation or type of deposit under consideration, and in the activity which that person is undertaking.*

In addition to the above, minimum professional experience required by the MEAI members for registration as RCP, the NACRI vide Article 2.2.ii further specifies that the potential RCP shall obtain at least 40 hours of mandatory professional development credits before making an application for registration and obtain at least 8-hour PD credits every year through participation in NACRI accredited seminars, conferences, workshops, training programs or webinars, for CP certificate renewal.

The initial CP registration fee as well as the yearly CP certificate renewal fee has been fixed at Rs 5,000 (Rupees five thousand only + GST @ 18%) and payable to MEAI. RCP certification shall be valid for a period of one year from the date of issue of the certificate and the same may be renewed thereafter.

IMIC training Venue

The 5th IMIC in-person training program will be held on 6-10 May 2024, in the state-of-the art Conference facilities available at MEAI Headquarters, Abids, Hyderabad. Working lunch on all 5 days, tea & snacks twice a day and a cocktail dinner on the inaugural evening are included in the course fee.

IMIC course fee payment details

The fee chargeable for attending the 5-day (40-hour) in-person but non-residential training program is Rs. 30,000 (Rupees thirty thousand only) plus applicable GST @ 18%) and payable online to:

Account Name: **MEAI-National Core Committee Fund**

Bank Name & Address: **UCO Bank, Abid circle, Hyderabad**

S/B Account No: **14410110037089**

IFSC: **UCBA0001441**

Contact person

Interested mineral industry professionals may please contact Mr M. Narsaiah, Secretary General, MEAI at meai1957@gmail.com/ Office T: 040-66339625/ 040-23200510/ Mob: 9177045204 for seeking any additional details on this program.

Dr PV Rao

Co-Chair NACRI

CONFERENCES, SEMINARS, WORKSHOPS ETC.

INDIA

2 Mar 2024: Technological advancement in mining & infrastructure. Organised by MEAI Bangalore Chapter in the Auditorium of Institution of Engineers (India), Ambedkar Veedhi, Bengaluru 560001. For details contact: Mr Sitaram Kemmannu, Secretary, MEAI Bangalore Chapter at meaibangaluruchapter@gmail.com

ABROAD

4-5 Mar 2024: Carbon Capture Summit 2024. Dubai 12345, United Arab Emirates. Web site: <https://www.middleeast.carbon-capture-conference.com/booking>

4-5 Mar 2024: International Conference on Mining Intelligence ICMI 2024. Rio de Janeiro, Brazil. Website URL: <https://waset.org/mining-intelligence-conference-in-march-2024-in-rio-de-janeiro>

4-8 Mar 2024: The 17th ACM International Conference on Web Search and Data Mining (WSDM). Event Location: Mérida, Yucatán. Contact wsdm-2024-general-chairs@googlegroups.com

10-13 Mar 2024: EnviroTech Lisbon, 2024 - cement conference. Hotel Cascai Miragem Health & Spa, Av. Marginal 8554, 2754-536 Cascais, Lisbon, Portugal. Contact details: 15 South Street, Farnham, Surrey, GU9 7QU, United Kingdom, Tel: +44 (0)1252 718 999, Email: enquiries@globalminingreview.com

11-12 Mar 2024: Australia Carbon Capture Summit 2024. Perth, Western Australia 6000. Website: <https://www.australia.carbon-capture-conference.com/booking>

17-18 Apr 2024: Deep Sea Mining Summit. London, UK, London, WC1 United Kingdom. Website: <https://www.deepsea-mining-summit.com/index>

22-23 Apr 2024: International Conference on Recent Developments in Mining Technologies ICRDMT 2024. London, United Kingdom. Website URL: <https://waset.org/recent-developments-in-mining-technologies-conference-in-april-2024-in-london>

23-25 Apr 2024: Exhibition Mining World Russia. 28th exhibition of machines and equipment for mining, processing and transportation of minerals. Moscow, Crocus Expo, pavilion For details contact: Ms. Natalia Medvedeva, Portfolio Director, ITE Group, Email: natalia.medvedeva@ite.group. Web link: <https://miningworld.ru/en/media/news/2023/august/17/equipment-for-mining-industry-in-russia>.

7-8 May 2024: International Mining Geology Conference 2024 (IMG 2024). Perth Convention and Exhibition Centre, Perth, Australia. For details contact conference@ausimm.com

17-18 May 2024: International Conference on Surface Mining and Land Reclamation ICSMLR 2024. Sydney, Australia. Website URL: <https://waset.org/surface-mining-and-land-reclamation-conference-in-may-2024-in-sydney>

21-23 May 2024: Discoveries 2024 Mining Conference. Mazatlan International Center, Av. del Delfin 6303, Marina Mazatlán, 82103 Mazatlán, Sinaloa, Mexico. Website <https://www.discoveriesconference.com/>

17-19 Jun 2024: Molten 2024. Brisbane, Australia and Online. Contact AusIMM. T: 1800 657 985 or +61 3 9658 6100 (if overseas)

17 Jun - 7 Oct 2024 (Online): JORC Reporting: Certification and Code Reporting Courses. 40 PD hours. Fee: Members A\$ 2644 – 2890 + GST; Non-members: A\$ 3454 + GST. Contact: AusIMM T: 1800 657 985 or +61 3 9658 6100 (if overseas). Po Box 660 Carlton, VIC 3053, Ground Floor, 204 Lygon St, Carlton VIC 3053.

18-19 Jun 2024: Direct Lithium Extraction Summit 2024. Denham Grove Hotel, Tilehouse Ln, Denham, Uxbridge, UB9 5DG United Kingdom. Website:<http://energy.apexevents.cn/>

22-23 Jul 2024: International Conference on Green Coal Mining Techniques and Waste Disposal ICGCMTWD 2024. Berlin, Germany. Website URL: <https://waset.org/green-coal-mining-techniques-and-waste-disposal-conference-in-july-2024-in-berlin>

11-15 Aug 2024: International Mine Ventilation Congress 2024. The heartbeat of mining, Sydney, Australia. For details contact conference@ausimm.com.

16-17 Aug 2024: International Conference on Mine Mechanization and Mining Policies ICMMMP 2024. Tokyo, Japan. Website URL: <https://waset.org/mine-mechanization-and-mining-policies-conference-in-august-2024-in-tokyo>

29-31 Aug 2024: International Conference on Graphene and 2D Materials. Valencia, Spain. Website: <https://www.pagesconferences.com/2024/graphene-materials>

2-4 Sep 2024: International Future Mining Conference 2024. #FutureMining2024, Sydney, Australia. 24 PD Hours. Contact: AusIMM T: 1800 657 985 or +61 3 9658 6100 (if overseas). Po Box 660 Carlton, VIC 3053, Ground Floor, 204 Lygon St, Carlton VIC 3053.

7-8 Oct 2024: International Conference on Design Methods in Underground Mining ICDMUM 2024. New York, United States. Website URL: <https://waset.org/design-methods-in-underground-mining-conference-in-october-2024-in-new-york>

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Corporate Office:

ERM HOUSE, #4006,
K R Road, BSK 2nd Stage,
Bengaluru - 560 070.

Email: mail@ermgroup.in
Tel: +91 80266 55930
+91 80690 13370



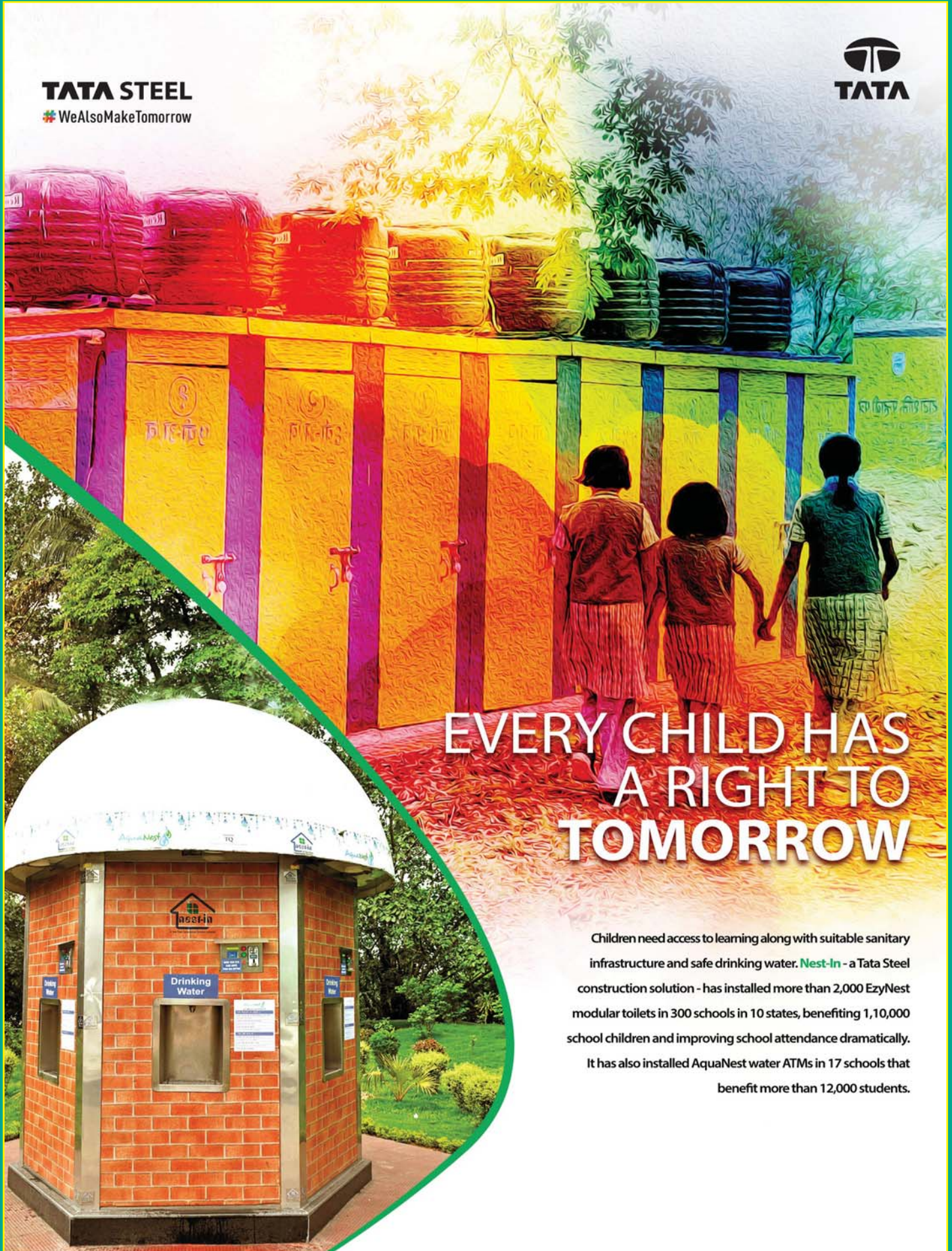
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