



## तकनीकी पत्रिका विषय-सूची

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***Vol.2, No.6, June, 2018***

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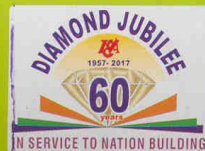
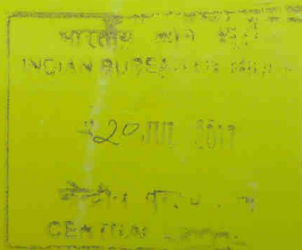
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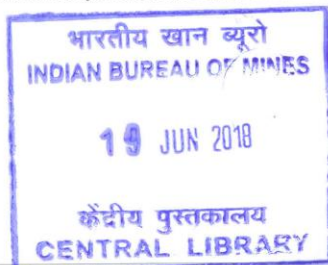
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*Stephen William Hawking (1942-2018)*

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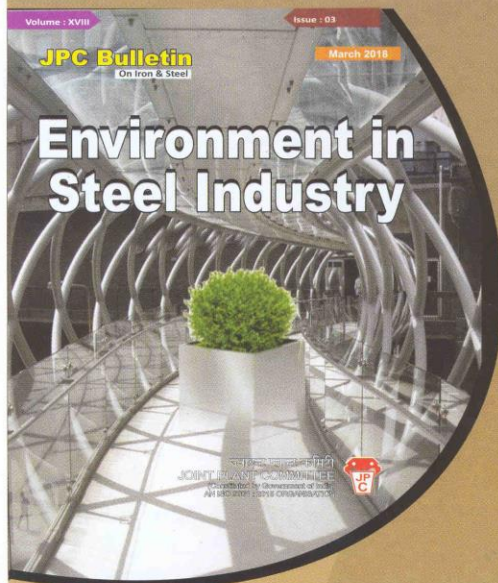
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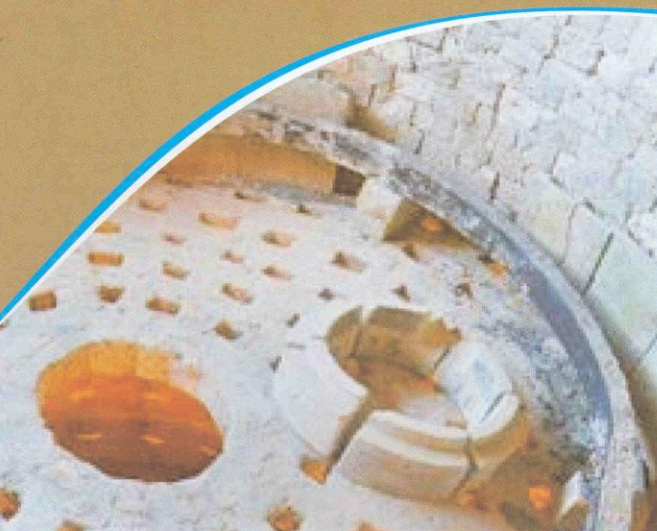
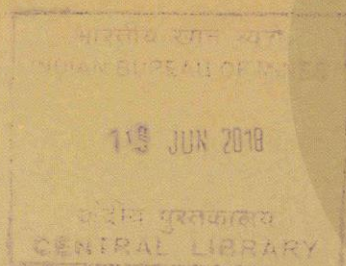
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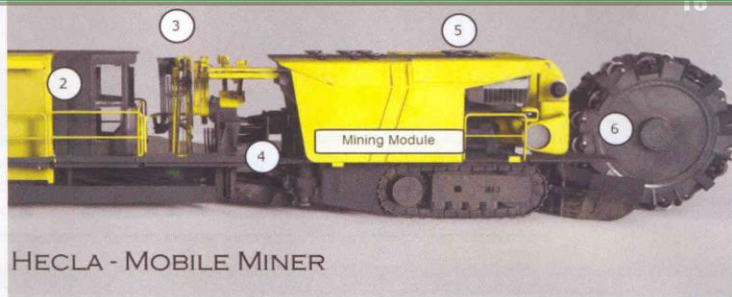




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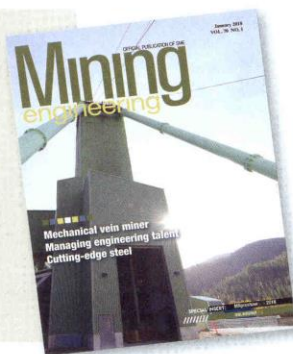
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[gleason@smenet.org](mailto:gleason@smenet.org)

## Senior Editor

Georgene Renner  
[renner@smenet.org](mailto:renner@smenet.org)

## Technical Editor

Chee Theng  
[theng@smenet.org](mailto:theng@smenet.org)

## Production Graphic Artist

Ted Robertson  
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## Business Staff

### Media Manager/Advertising

Ken Goering  
[goering@smenet.org](mailto:goering@smenet.org)

Phone: 1-800-763-3132

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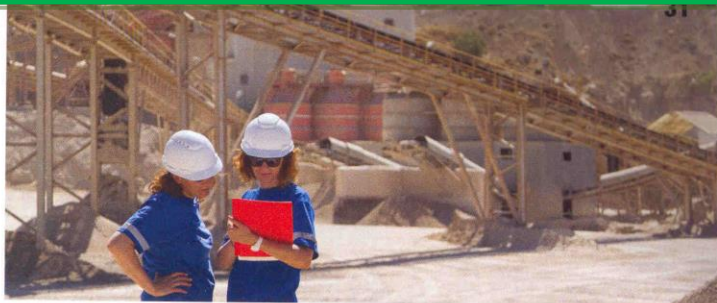


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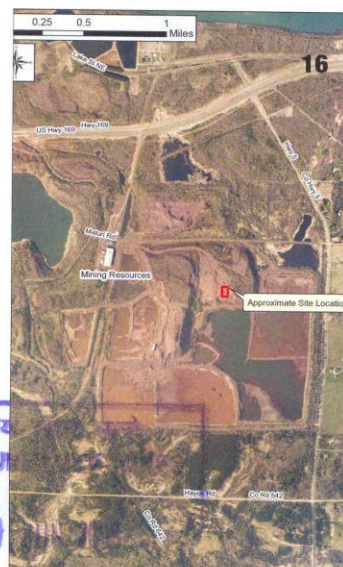
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Mining is an important part of Namibia's economy. In 2016, the country's 22 active mining operations contributed 11.1 percent to its gross domestic product. Fluorspar production in Namibia is about 45 kt/a (50,000 stpy). Gecko Namibia operates the Okorusu fluorspar mine. The company is currently investigating taking the openpit mine underground. Mine design details are examined on page 24. Minnesota has robust reclamation standards for the state's taconite industry. However, new scam mining technologies are producing fine and coarse tailings that have not been encountered nor reclaimed in northern Minnesota. Details on research into reclaiming these tailings begin page 16. Cover photo courtesy of Gecko Namibia.

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### Editor

Steve Kral  
[kral@smenet.org](mailto:kral@smenet.org)

### Senior Editor

William M. Gleason  
[gleason@smenet.org](mailto:gleason@smenet.org)

### Senior Editor

Georgene Renner  
[renner@smenet.org](mailto:renner@smenet.org)

### Technical Editor

Chee Theng  
[theng@smenet.org](mailto:theng@smenet.org)

### Production Graphic Artist

Ted Robertson  
[robertson@smenet.org](mailto:robertson@smenet.org)

### Business Staff

Media Manager/Advertising  
Ken Goering  
[goering@smenet.org](mailto:goering@smenet.org)

Phone: 1-800-763-3132

Fax: 1-303-973-3845

Email: [goering@smenet.org](mailto:goering@smenet.org)

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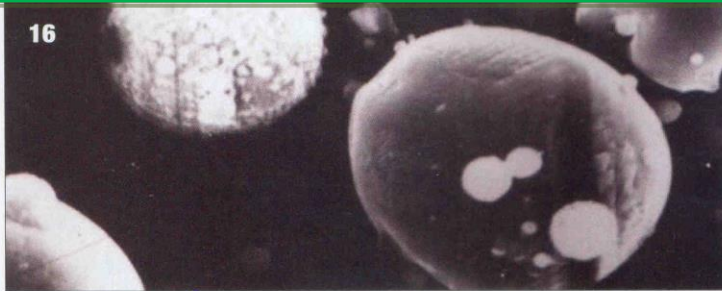


# Mining engineering

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MARCH 2018  
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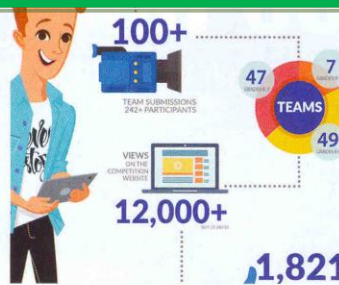
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## In This Issue

Barbara J. Arnold was installed as the 2018 SME president during the Society's Annual Conference and Expo in Minneapolis, MN last month. In her interview, beginning on page 13, Arnold explains what drove her to get into the mining industry, particularly coal. She also provides her take on the state the global mining industry, and then outlines her goals as SME president in the upcoming year. Coal is mainly composed of energy-producing elements carbon and hydrogen. But coal also contains other valuable elements such as iron, aluminum, silicon and rare-earth elements. The article beginning on page 16 examines how to recover the elements for coal byproducts. Minework fatigue remains an issue for mining companies. A review of what is known and future decisions on this challenge begins on page 33.

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[theng@smenet.org](mailto:theng@smenet.org)

## Production Graphic Artist

Ted Robertson  
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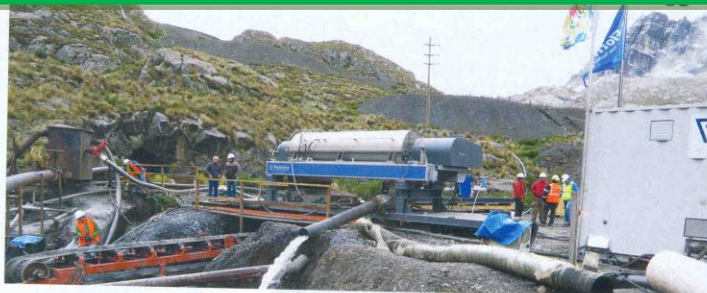


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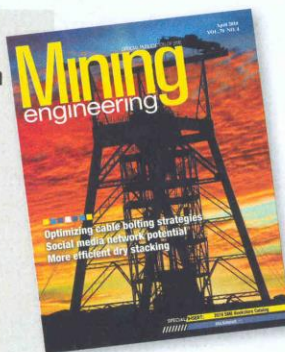
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### In This Issue

Ground support is a critical element in maintaining the stability of mining drives in deep and high stress mines. Mining operations must optimize ground support by selecting appropriate systems at the time of installation of each reinforcement element. The optimization of cable bolting strategies at a Canadian underground mine are examined on page 14. Information diffusion potential of a social media user affects how quickly information about a mineral project can diffuse through that user. The information diffusion potential of social media networks is investigated on page 28. Cover photo from Shutterstock.

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INDIAN BUREAU OF MINES

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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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# Mining Magazine, January/February, 2018

## Celebrating technology, innovation and the future

**W**elcome to a new year, and to the first of *Mining Magazine's* special themed issues of 2018. These issues, spaced evenly throughout the year, will focus on some of the key topics that are central to the modern mining industry and that keep coming up again and again in our interviews with industry figures and in our own research – IT and communications, the future of mining, energy, management and leadership, and mine optimisation.

As the mining industry gets more technologically advanced, IT and communications are playing an increasingly big role in operations. Turn to page 34 to read about how communications systems at underground mines are working faster, better and more comprehensively than ever before; or turn to page 42 to find out how mine engineers and planners are turning to digital and virtual solutions, informed by advances in big data and analytics, to achieve the safest, most productive operations possible. We have even included discussion on how the use of blockchain could transform mining supply chains, starting on page 47.

This is also the issue where we announce the winners of the annual *Mining Magazine* awards, which celebrate innovation and commitment to advancing the face of mining, not just technologically but also sustainably and in an environmentally respectful manner.

Each October, we invite our readers to nominate the best mines, teams and projects that they feel have demonstrated outstanding commitment to advancing the face of mining over the previous year – for example, this could be for the development of a new technology, or the innovative application of an existing one; for their involvement with a particular project that has seen amazing results, or for an initiative that has helped to change the industry's mind-set towards a certain challenge; for their research efforts into areas such as safety or energy efficiency, or for their approach to environmental stewardship. We then whittle the nominations down to a shortlist for our readers to vote upon.

This year's winners heavily feature efficiency improvements and collaboration, as well as some individual innovators who have made huge contributions to their respective companies. Turn to page 13 for more information on the winners and the fantastic work they've been doing to advance the mining industry.

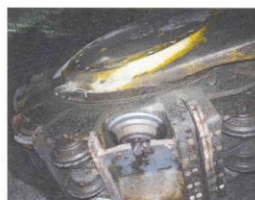
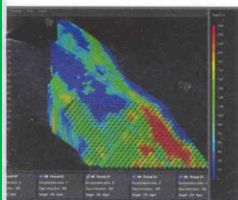
In other exciting news, we have been collaborating with our sister publication in Australia, *Australia's Mining Monthly*, to develop an exciting new event this upcoming May. The Future of Mining event, which will run from May 14th to 15th at the SMC Conference & Function Centre in Sydney, will feature expert speakers from leading companies across the global mining industry.

The event will address the key strategic and operational questions that matter, from project/operations level management through to the boardroom. It is also designed to step away from the traditional transactional conference model to provide a transformational experience, which should bring fresh new perspectives to the exciting topics under discussion while challenging conventional thinking. We would love to see some of you there!

**AILBHE GOODBODY, DEPUTY EDITOR**  
ailbhe.goodbody@miningmagazine.com  
Twitter: @MM\_DepEd\_Ailbhe



**"As the mining industry gets more technologically advanced, IT and communications are playing an increasingly big role in operations"**



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Tyres and wheels  
Surface engineering and infrastructure  
Upskilling workforces for digitisation  
Hard-rock cutting

### COVER

Strata brings the same digital connectivity used above ground to underground environments with its comprehensively designed Wi-Fi. Robust access points installed underground create 'hot spots' for digital voice calling, texting, tracking and even high-speed data access, all while using standard Wi-Fi-enabled devices. The cover image shows a Strata Access Point (A-Node) being installed at an underground mine. A-Nodes are installed along existing fibre-optic cables to provide untethered voice and data communications underground. In areas where fibre does not exist, A-Nodes are wirelessly connected along a wireless backbone of Strata B-Nodes.  
Underground Communications: see page 34



# Mining Magazine, March, 2018

## The rise of artisanal mining

**A**rtisanal mining has been back in the news recently as coloured-gems producer Gemfields is currently the target of a legal claim on behalf of 29 people local to the area around its Montepuez ruby mine in Mozambique.

The claim alleges that Gemfields and its subsidiary Montepuez Ruby Mining (MRM) are liable for human rights abuses including the deaths and mistreatment of artisanal miners and the seizure of land without due process. In many instances those acts are alleged to have involved the Mozambican police and/or other Mozambican government forces.

Gemfields has denied the claims, and stated: "We are working with our legal advisors in England and Mozambique to ensure that the claim, despite the limited details provided to date, is fully examined and also to defend robustly our hard-earned reputation as a leading supplier of responsibly sourced coloured gemstones."

Such clashes between artisanal miners and large-scale mining companies could become more common as artisanal mining is increasing rapidly. A report published in January by the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF) found that rising mineral prices and the struggle to earn a living from agriculture have led to explosive growth in artisanal and small-scale mining (ASM).

It reported that an estimated 40.5 million people were directly engaged in ASM in 2017, up from 30 million in 2014, 13 million in 1999 and 6 million in 1993. That compares with only 7 million people working in industrial mining in 2013. The study also approximated that around 150 million people across 80 countries in the global south currently depend on ASM for their livelihoods. Greg Radford, director of IGF, said: "For many people in the world's poorest countries, ASM is the only route out of poverty, or the sole way to boost meagre incomes when there are few job alternatives."

Despite its low productivity, ASM is an important source of minerals and metals and its share of global mineral production is rising. It accounts for about 20% of the global gold supply, 80% of the global sapphire supply and 20% of the global diamond supply. ASM is also a major producer of minerals indispensable for manufacturing popular electronic products, such as laptops and phones. For example, 26% of global tantalum production and 25% of tin comes from ASM.

However, as ASM relies on a mostly unskilled workforce using rudimentary tools and techniques, its environmental and health-and-safety practices tend to be very poor. For example, dust and fine particles resulting from drilling and blasting can cause respiratory illnesses. It also degrades crops and farmlands, resulting in lost food production. Streams and rivers often become polluted near ASM sites, making the water unsafe for drinking and it can also affect fish stocks previously relied upon for food.

ASM is also the source of the largest releases of mercury, estimated by the Minamata Convention in 2011 at 1,400t/y – exposure to mercury can have serious health impacts, including irreversible brain damage, and is also difficult to contain and can be toxic at even very small doses.

In many parts of the world, ASM and large-scale mining operate in neighbouring, or even the same, concessions. However, their coexistence could open the potential for cooperation.

The IGF's recommendations for a more responsible and inclusive ASM sector include: building capacity through local institutional partnerships; encouraging miners to form cooperatives and associations; encouraging large-scale mining companies to support capacity building; using microcredits to lend to organised groups of miners and communities, supported by donors; and improving miners' access to efficient and cleaner technologies.

**AILBHE GOODBODY, DEPUTY EDITOR**

ailbhe.goodbody@miningmagazine.com Twitter: @MM\_DepEd\_Ailbhe

**"For many people in the world's poorest countries, ASM is the only route out of poverty, or the sole way to boost meagre incomes"**



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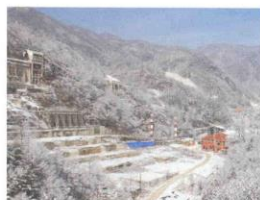
#### The Future of Mining issue

Artificial intelligence and automation  
Harnessing bacteria: biominer  
Gamification and virtual/augmented reality  
UAVs and drones  
Nanotechnology and robotics

### COVER

Digital twins will be used for simulations of sequential scenarios, for forecasts, and for quality management and control. Furthermore, digital twins will be the go-to tool for plant optimisation, training and services.

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# Mining Magazine, April, 2018

## Is the future of mining in space?

**T**here are so many new technologies and disruptive market forces that mining companies need to keep track of to identify the future trends in the industry. One of the topics that comes up again and again is deep space mining, perhaps because of how it captures the human imagination; the main commodity targets for mining from celestial bodies, including asteroids and Earth's own Moon, are water and metals such as iron, nickel, gold, platinum, copper, cobalt, iridium and rhenium.

According to Deloitte's 10th annual 'Tracking the trends' report, which was published in February and examines the top 10 trends that should be on mining companies' agenda in 2018, more than US\$13 billion has been invested in space-related businesses since 2000. These extend far beyond established industries such as satellites and launchers, and may ultimately support a commercial market of space-related businesses worth over US\$37 billion.

Deloitte mining head Philip Hopwood commented: "Although asteroid mining for rare metals still sounds like science fiction today, the market potential in the not-too-distant future could be astronomical. If mining companies want to get ahead of the trends, they need to delve deeply into emerging market disruptors."

The potential value of some of the near-Earth asteroids is considerable. A database owned by asteroid mining hopeful Planetary Resources, called Asterank, has collected, computed or inferred data on over 600,000 near-Earth asteroids to estimate the costs and rewards of mining them. These include value estimates that are based on the mass of a given asteroid and its spectral type, and profit and ROI calculations that are a combination of accessibility and value.

**"Although asteroid mining for rare metals still sounds like science fiction today, the market potential in the not-too-distant future could be astronomical"**

A NASA spacecraft called Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-Rex) is currently on its way to a near-Earth carbonaceous asteroid called 101955 Bennu to examine whether it could be a viable target for extracting water and minerals. Launched in September 2016, the spacecraft is scheduled to reach Bennu in December this year and return a sample to Earth in 2023.

Bennu comes very close to Earth every six years, and scientists estimate that asteroids of its type are made of about 10% iron and nickel. During its time at the asteroid, OSIRIS-Rex will analyse its shape and chemistry, sample its surface materials and collect data on its orbit so that scientists can determine the likelihood of it colliding with Earth in the future.

Asterank has estimated the value of Bennu to be US\$669.96 million and its estimated profit to be US\$185 million. It has also estimated the most valuable known asteroid to be worth US\$15 quintillion; Bloomberg notes that that represents the world's total gross domestic product (approximately US\$80 trillion) 192,283 times over. Of course this assumes current market valuations and that it would be possible to actually completely mine the asteroid.

This reminded me of MIT's 'Mission 2016 – The Future of Strategic Natural Resources' review, which pointed out in 2016 that one 500m-wide platinum-rich asteroid could contain nearly 175 times the annual global platinum output, which is equivalent to 1.5 times the known world reserves of platinum group metals – this would likely tank the global platinum market.



However, Professor Dante Lauretta from the University of Arizona, who is working in conjunction with NASA and overseeing the OSIRIS-Rex mission, cautions that too little is known about Bennu's composition to understand its potential value accurately.

While mining in space may not be as financially disruptive as these calculations have estimated, this future branch of the industry is definitely one to watch.

**AILBHE GOODBODY, DEPUTY EDITOR**

ailbhe.goodbody@miningmagazine.com Twitter: @MM\_DepEd\_Ailbhe



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# Mining Magazine, May, 2018

## Can mining be responsible?

**T**he first Responsible Mining Index (RMI) was launched on April 11 in Geneva, Switzerland. It was published by the Responsible Mining Foundation (RMF), an organisation that supports responsible mining, but is concerned about the many urgent and compelling matters that impact societies and environments in producing countries.

The RMI supports the principle that minerals and metals mining should benefit the economies, improve the lives of people and respect the environments of producing countries, while also benefitting mining companies in a fair and viable way. With this in mind, the goal of RMI is to encourage continuous improvement in responsible mining across the industry by transparently assessing the policies and practices of large, geographically dispersed mining companies on a range of economic, environmental, social and governance (EESG) issues, with the emphasis on leading practice and learning.

This first Index covers 30 companies that are based in 16 countries. These companies operate more than 700 sites in over 40 producing countries, and the assessment covers most mined commodities, excluding oil and gas. It focuses largely on company-wide behaviour, but also has a special focus on site-level actions at 127 mine sites in order to provide a snapshot of information disaggregated to the level of individual mining operations.

It centres on six areas: economic development; business conduct; lifecycle management; community wellbeing; working conditions; and environmental responsibility. The eight key findings include:

- While individual companies still show considerable scope for improvement, the RMI-assessed companies have collectively proven that responsible mining is a realistic goal;
- There is a diversity of responsible practice, and performance does not necessarily depend on the company size or commodity focus, the home countries where they are registered, or the producing countries where they operate;
- While the vast majority of companies have made policy commitments, a few companies are yet to make commitments on such well-established international practice;
- The scale and persistence of adverse impacts greatly undermine progress made by companies towards more effective management of EESG issues;
- External requirements improve public disclosure;
- Stronger performing companies generally demonstrate company-wide approaches to managing EESG issues;
- Data is largely missing at the site level, making it more difficult for companies and local stakeholders to develop trust-based relationships or engage in constructive discourse on issues of shared interest; and,
- The concept of open data sharing is still evolving, and disclosure of public-interest data in an effective manner can help companies foster more informed engagement with their stakeholders.

Overall, 19 of the 30 companies investigated appear among 10 strongest performers for at least one thematic area – the higher performing companies have generally developed systematic, company-wide approaches to managing EESG issues. Anglo American was ranked as the best in the areas of economic development, lifecycle management and community wellbeing; Newmont Mining led the way in business conduct and environmental responsibility; while AngloGold Ashanti was judged to be on top in terms of working conditions.

RMI commended the thoughtful and innovative approaches to leading practice, and the efforts of many companies to address EESG governance issues; it also noted that although the individual company results indicate that much more can be achieved, the positive message is that responsible mining can be done.



**AILBHE GOODBODY, DEPUTY EDITOR**  
ailbhe.goodbody@miningmagazine.com Twitter: @MM\_DepEd\_Ailbhe



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#### The Energy Issue

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Comminution

Alternative energy sources

Working towards carbon neutrality

### COVER

Goldminds Geoservices Inc. (GMG) is a Canadian company based in Quebec City. Picture: GMG technical team member supervises sonic drilling project in serpentinite tailings at Alliance Magnesium's property in Danville, Quebec. Alliance Magnesium Inc is a privately owned Canadian company that has developed a patented electrolysis clean technology for the production of magnesium from serpentinite. GMG is a mining and exploration consulting group specialised in mineral resource modelling and estimation, preliminary economic assessments, prefeasibility studies with independent reporting capabilities of various commodities in NI43-101, JORC and Competent Person report form. [www.goldmindsgeoservices.com](http://www.goldmindsgeoservices.com)