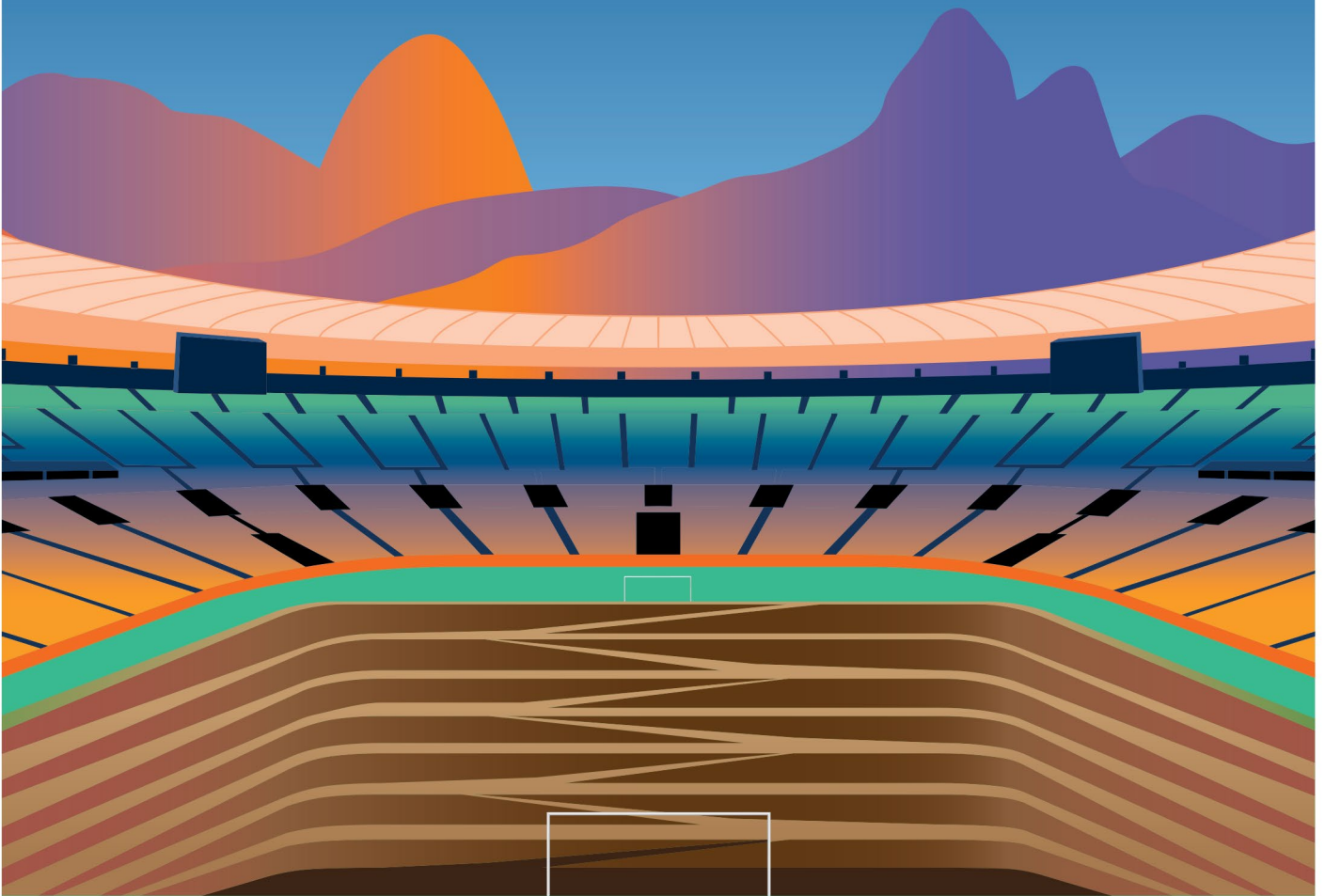


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## BRAZIL MINING 2023



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## Dear Reader,

Global Business Reports (GBR) is thrilled to present the 2023 edition of our *Brazil Mining* report. Brazil stands at the precipice of a transformative moment for the country's mining industry, with US\$50 billion in total capex projected for the sector in the 2023-2027 period. It is demonstrative of the global enthusiasm for mining in the country, which benefits from a stable government, strong services sector, and, most importantly, extremely diverse mineral wealth. Brazil is the world's largest producer of niobium and second largest producer of iron ore, magnesite, tantalum, and natural graphite, while ranking fourth for bauxite and fifth for lithium.

Global Business Reports conducted over 90 interviews with industry leaders in Brazil to gain a holistic understanding of the current trends and challenges defining the Brazilian mining industry today. As mining projects spring up across the country, they are taking a new and cutting-edge approach to sustainable operations. Brazil's environmental legislation is among the strictest in the world, and after the Brumadinho and Mariana disasters and resultant regulations banning tailings dams, the Brazilian mining industry has become a leader in environmentally-friendly mining. With a wealth in renewable energy sources and growing solar and wind sectors, Brazil has the potential for true, net-zero mining.

Recognizing the opportunity to become a leader in supplying the critical minerals that contribute to the global energy transition, the Brazilian government has taken several steps to increase production, including increasing public and private financing for mineral research and project support, while loosening licensing requirements for strategic minerals projects. In 2022, the Brazilian government released the National Fertilizer Plan to reduce the country's dependence on imports of fertilizers. Government support combined with strong international demand has created a perfect storm to boost Brazil's mining segment. The existing pipeline is strong, with new copper, lithium, polymetallic and potassium projects in exploration and development across the country.

The *Brazil Mining 2023* report, part of our GBR series, delves into these and other topics, providing a comprehensive annual guide to Brazil's mining value chain. It offers an update on regulatory and legislative activities, current operations and projects, and the latest industry trends in one of the world's most important and advanced mining jurisdictions. We are deeply grateful for the participation of our partners and interviewees. Thank you for choosing *Brazil Mining 2023* as your guide to the Brazilian mining industry.



**Alfonso Tejerina**  
Director and General Manager  
GBR



**BRAZIL MINING 2023**  
GBR SERIES  
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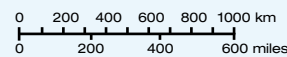
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# INTRODUCTION

"Brazil offers the technical conditions to develop a mine. We have the knowledge, the technology and the operational experience, with a trained workforce and availability of energy."

**Júlio Nery,**  
**Director of Sustainability**  
**and Regulatory Affairs,**  
**IBRAM**

**GBR SERIES • BRAZIL MINING 2023**

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# Brazilian Mining's New Frontier

## Mining at the heart of Brazil's 'Neo-Industrialization' drive

Image courtesy of ARMAC

Brazil is at the precipice of a transformative period for the mining industry, with US\$50 billion in total capex investment predicted for the 2023-2027 period, according to data from IBRAM. These investments are spread across the diverse minerals that make up Brazil's geological wealth. Greenfield projects in the country include a new polymetallic operation, lithium projects, and a major new phosphate project in development in the Amazon. In total, companies have announced over 100 projects in more than 85 municipalities across Brazil. Each of these projects creates lasting employment and wealth for their local regions and the country at large, with positive ramifications far beyond the (significant) tax contributions. Brazil's mining industry has the capacity to be a critical driver of the country's sustainable economic development.

According to the International Energy Agency, the demand for minerals used by the energy sector will increase considerably over the next two decades: 40% for copper and rare earth elements; 60-70% for nickel and cobalt; and about 90% for nickel. Brazil holds immense wealth in these high demand minerals but has yet to truly take advantage of them. "If you take a group of commodities that includes nickel, graphite, manganese, and rare earths, Brazil holds about one-fifth of the global resource base of each, but has less than 10% of the worldwide share of production and, in some cases, less than 1%," said Rohitesh Dhawan, CEO of the International Council on Mining and Metals (ICMM). "Production of these minerals is much less than the actual resources and reserves of the country, and that is before accounting for the fact that the amount of exploration in Brazil is insufficient relative to its potential."

As downstream consumers, such as car manufacturers, increasingly seek minerals produced in a sustainable manner, countries with the capacity to produce low-carbon metals are advantaged. With 77% of Brazil's energy produced from renewable sources, and a cheap cost of power at two cents per kilowatt hour compared to 30 cents per kilowatt elsewhere, the country has a competitive advantage in low-carbon production.

Geopolitically, Brazil is also in a favorable position to navigate the competition between East and West for critical minerals. 2023 has witnessed the continuation of a race to secure critical minerals supply in a moment of fragile geopolitics, with critical minerals widely viewed as vital to national security. "Brazil is one of the few countries with good relations between

the West and the East, allowing it to work with many different countries," Dhawan emphasized.

According to the World Bank, in 2021, foreign trade made up nearly 40% of Brazil's GDP, with China, the US, and the EU the country's largest trading partners. Brazil's position as an exporter is solid; the country has had a positive annual trade balance since 2014. Essential to Brazil's strength as an exporter is its powerhouse of a mining industry. The country's vast size and geological diversity demand that mineral exploration and production should be a driver of the sustainable development of the country at large. 75% of the mapping of the country is not at a scale that would allow for mineral exploration and development. To take advantage of the country's geological diversity, Brazilians need to know what is in the ground and where. Roberto Xavier, executive director of ADIMB, sees this situation improving: "The Geological Survey of Brazil is doing a superb job and every year more geological maps at scales more compatible with mineral exploration have been produced in important mineral provinces."

With such a significant area left unexplored, the country is ripe with opportunity. Recent years have seen a unified approach from industry leaders and government figures, including the creation of Invest Mining, which includes IBRAM, ADIMB, and the Brazilian Development Bank (BNDES), as members. Pedro Paulo Dias, director of market intelligence in the mining and transformative minerals division, said: "We created a network called Invest Mining, which brings together multiple actors to promote both direct financing mechanisms and regulatory improvements, including access to the Brazilian Stock Exchange, to ensure that mining has a greater insertion in the capital and financing market in Brazil."

Interviewees described Invest Mining as generating a new financing culture in Brazil, where financing for juniors has long been a problem. Increasing the diversity of companies is central to development of the sector, which is dominated by a few major players. "Brazil still has room to improve the domestic access to finance for high-risk, exploration projects," explained Adriano Drummond Trindade, mining partner at Mattos Filho Advogados. "The São Paulo Stock Exchange (B3) developed a 'venture exchange branch', but we lack the culture regarding investing in exploration and mining companies, as well as a robust ecosystem of mine analysts, economists, geologists, and specialized advisors in general that exists in more tradi-



**The goal is to discover new deposits and increase production, particularly for minerals utilized in the energy transition and input minerals for food security.**



## Vitor Saback

National Secretary of Geology, Mining, and Mineral Transformation  
**MINISTRY OF MINES AND ENERGY (MME)**

### What is the importance of mining for the Brazilian economy?

The Ministry of Mines and Energy (MME) sees the mineral sector, together with the agricultural and industrial sectors, as fundamental to boosting the Brazilian economy. Brazil is the world's largest producer of niobium and the second largest producer of iron ore, magnesite, tantalum and natural graphite. It is also the fourth largest global producer of bauxite and vanadium and ranks fifth for lithium and tin.

Tax collection, including the Financial Compensation for Mineral Exploration (CFEM), totaled R\$7.1 billion in 2022 and R\$3.41 billion in the first half of 2023. Revenue in the mineral sector for 2022 was R\$250 billion, and in the first half of 2023, R\$120 billion. The MME does not support increasing taxation and is against taxing exports.

### How is the government encouraging the production of critical minerals?

The global energy transition will be advantageous for Brazil due to Brazil's critical resources and the large volumes of minerals required for the transition to a low-carbon economy. The MME has worked to attract public and private investment and financing for mineral research in coordination and collaboration with private entities

operating in the sector. The goal is to discover new deposits and increase production, particularly for minerals utilized in the energy transition and input minerals for food security.

We have taken several steps to achieve these objectives. First, we have focused on expanding geological knowledge to attract investments in research into new reserves. Second, we have increased public and private financing for mineral research and support for projects both in the implementation and expansion stages. Third, the MME has worked to support technological development and innovation and the application of innovative technologies in mineral production chains. Fourth, we have supported sector regulation to reduce the time for obtaining mining rights. And last, the MME is combating illegal mining, thus improving the sustainability and operational safety of mining.

### What are the government's plans to develop infrastructure to support the mining sector?

The government announced an investment plan in transport infrastructure, railways, waterways, highways and ports. The plan is designed in a structured way that should enable access to new projects and facilitate the flow of

mining products. The MME maintains dialogue with the private sector and government institutions to support transport infrastructure projects close to mining projects in Brazil.

### How can Brazil balance environmental protection with mining development?

Brazilian environmental legislation is considered by many environmental experts to be one of the most complete in the world. In addition to addressing environmental preservation, our regulatory framework also includes preventative actions that aim to reduce the environmental impacts that many activities may cause.

Mineral licensing depends on environmental licensing. Mining activities, like other productive activities, are licensed and supervised by the competent environmental bodies. For the mineral sector, government actions for the next four years will be focused on strengthening government institutions in the mining sector, ensuring the safety of mining for society, and fostering the adoption of socially and environmentally responsible practices by companies in the sector. Additionally, the government will take measures to attract investment in mineral research and production, particularly for the energy transition and food security.

### What potential do you see in increasing exploration and development in the mining sector?

Brazil's mining industry is in a privileged position in terms of competitiveness due to our large territory, geological diversity and mineral wealth. In addition, our mining sector benefits from other aspects such as strong infrastructure, widely available clean energy, and legal security. We have a growing commitment to sustainable competitiveness.

To strengthen the mining sector, the National Mineral Policy Council (CNPM) underwent a readjustment, improving its advisory role to the President of the Republic when developing policies and guidelines to develop the Brazilian mining industry. Among the CNPM's responsibilities are the formulation of sustainable policies for the various segments that make up the mineral sector. These include policies for dam safety, the energy transition, and the integration of mining with the national mining strategy, among others. ■

tional jurisdictions for mining investment like Toronto, Perth or London.”

The Brazilian mining industry has an opportunity to strengthen the country’s industrial sector. With Brazil’s large workforce, excellent green energy matrix, and long mining experience, the country could be a powerhouse of industry with mining providing the essential spark. Rather than export commodities, Brazil could develop a local industrial sector that utilizes its green energy matrix to produce products derived from its metals and minerals cost-effectively and sustainably.

President Lula da Silva is pushing for “neo-industrialization”, a policy that involves using the digital and green energy transformations as a launching pad to increase the share that the productive sector makes up of the country’s economy. Flávio Moraes da Mota, head of the extractive and base industries department at the BNDES, said: “We seek to develop mining companies that respect the environment and society, with lower greenhouse gas emissions and higher technology.”

Compared to neighboring mining jurisdictions, the current Brazilian government is well-inclined towards the mining industry, encouraging the sector to support a larger industrialization push. According to Manuel Fernandes, energy and natural resources co-leader for Americas at KPMG: “The government is working towards industrial diversification and the objective of producing value-added products, such as batteries and electric vehicles, in the country, but a clear strategy for attracting investors, manufacturers and OEMs to Brazil is still required.”

**Tax reform generates buzz**

The only certainties in life may be death and taxes, but in Brazil, the future of the tax regime is by no means certain. On July 6, 2023, the Brazilian Chamber of Deputies approved a constitutional amendment bill with the basics of a tax reform policy that would impact federal, state and municipal indirect taxes. In 2022, the Brazilian mining sector paid R\$7 billion in royalties (CFEM) and R\$86.2 billion in total taxes, and the mining industry waits avidly for a clear sense of what the reform will mean for the sector.

The approved reform would put in place (a) a dual value added tax regime (VAT) that will replace the state VAT and the Municipal Tax on Services and (b) the Contribution on Goods and Services in place of the federal excise tax on manufactured products and the federal PIS/COFINS contributions.

The reform will not necessarily change the current tax burden for the mining industry, which is stable enough to enable investment, but is nonetheless burdensome when all relevant taxes are considered. “The mining industry already has high tax and royalty points, but the issue is not the federal tax or the reform, but rather the taxes imposed by the states and municipalities,” said Federico Bedran Oliveira, mining partner at Caputo, Bastos e Serra Advogados. “The Brazilian Mining Royalty (CFEM) was changed when the National Mining Agency was created in 2017, and has since been higher than what it was over the past 10 years. For example, in 2022, the total royalties were approximately R\$7 billion – but the major issue remains the taxes created by the states and municipalities.”

The current tax system is burdensome because it includes not only mining royalties – the CFEM – but additionally taxes levied on sales, such as ICMS, PIS and COFINS. Liliam Fernanda Yoshikawa, mining partner at Machado Meyer Advogados, said: “Right now, the main ongoing discussions regarding the Brazilian tax reform and its impacts on mining companies refer to the recent inclusion of a new rule that makes it possible for states to create a contribution on primary and semi-industrialized products that shall serve infrastructure construction works and housing in lieu of contributions to state funds. Should it be approved on a definitive basis, this will further increase the total tax burden for mining companies.”

Article 19, a last-minute addition to the reform that allows states to create their own charges on certain products, has generated concern from IBRAM and other associations. “If the article is not removed, it might represent a risk for many sectors, including mining,” said Drummond Trindade of Mattos Filho Advogados. “The amendment still needs Senate approval, and I anticipate there will be a lot of political discussion on this matter. It will be a challenge for states to retain Article 19 due to the industry’s scrutiny of these proceedings.”

Many industry figures are relatively unconcerned about the potential changes. The tax reform will be imposed at the point of consumption, rather than production, so the impact on the mining industry will be blunted. Some degree of change is certain, but investors should be able to continue to operate in Brazil without issue. William Freire, founding partner of William Freire Advogados, said: “Some specific taxes may increase, but I doubt it will change willingness to invest in the country.” ■



»» **The goal is to discover new deposits and increase production, particularly for minerals utilized in the energy transition and input minerals for food security.** ««

**Júlio Nery**

Director of Sustainability and Regulatory Affairs  
**BRAZILIAN MINING INSTITUTE (IBRAM)**

**Could you provide an update about IBRAM, its mandate and current initiatives?**

IBRAM is the main mining association in Brazil with 140 members across the whole supply chain. We represent over 85% of the Brazilian mineral production.

We work to influence regulations from the states and the National Mining Agency to keep them in line with what can be applied in the real world, as sometimes regulations exceed the companies’ capacity. We have an ESG agenda covering 12 main topics including energy consumption, water, tailings dams, safety and community relations. We also have a ‘Mining Hub’ where we work with innovation projects and start-ups to solve challenges in the mining sector. Finally, we organize the main event in Brazil’s mining industry: Expositram.

**Could you explain the recent regulatory initiatives to increase royalties and fees?**

There was a huge increase in royalties in 2017, and year by year we see attempts to increase them further. This said, what worries us is the charges over inspection fees (TFRM) by states and municipalities. The states of Pará,

Minas Gerais and Amapá started collecting these fees and our supreme court declared that these charges are legal. However, we are being charged double the real cost of the inspections, so we are engaging in the discussion about how much they should be charging. It is a big expense and TFRM could spread to the whole country.

**What is the potential of Brazil for battery metals and fertilizers?**

Our projection is that the total capex in the industry will be US\$50 billion for the period 2023-2027, up from US\$40.4 billion for 2022-2026. The pipeline of projects includes big investments in copper in Bahia, Mato Grosso and Pará, for a total of US\$4.47 billion, which is a 51% increase over the previous estimate. We also have a new polymetallic operation at Aripuanã by Nexa. For the future, we expect more investments in copper in the Carajás region, and there is also big potential for lithium. We have three lithium producers in Brazil and four companies doing exploration, with good potential in the north-east of Minas Gerais for pegmatite deposits.

Agribusiness plays a huge role in the country’s economy, but we import over half of the country’s needs for

phosphates. We have new phosphate projects, so what we really need is new potassium mines, as we only have one operation and it only covers 5% of Brazil’s demand. There is a new big project in the Amazon, but it will take a few years to start operations.

**What is the situation of tailings dams in Brazil?**

Following the accidents in past years, we work a lot on the sector’s self-regulation to improve standards, bringing in the ICMM’s new tailings standard, and also the Mining Association of Canada’s TSM – Toward Sustainable Mining initiative in Brazil.

The main challenge is the de-characterization of tailings dams, a concept created by the Brazilian legislation that is not very clear. It is similar to decommissioning, either disposing tailings within a pit, building infrastructure to safely dewater the dam, or making sure it will be able to contain all the rainfall. We have an enormous amount of work ahead, and capex is expected to be above US\$4 billion in this area in the next five years. Beyond cost, the issue here is the very tight deadline to decommission over 50 dams.

**What can be done to attract more exploration companies to Brazil?**

We have to improve our framework for investment in exploration. Most of the juniors look for capital in Canada or Australia. At IBRAM, we are working with other associations and BNDES to improve the financing opportunities for companies active in Brazil. In terms of regulations, last year there was a new resolution by the National Mining Agency to modernize the methodologies to report resources and reserves. Another aspect that should change is the system to obtain concessions for exploration. And finally, environmental licenses take too long in Brazil, and this could be improved.

**Could you give a final message to our readers?**

We have the knowledge, the technology and the operational experience, with a trained workforce and availability of energy. We need to invest in mapping and improving our geological knowledge, because we have enormous potential in many minerals. ■

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FM



PD

## Flávio Moraes da Mota and Pedro Paulo Dias

FM: Head of Extractive and Base Industries Department  
 PD: Manager of Market Intelligence of the Extractive and Base Industries Department  
**THE BRAZILIAN DEVELOPMENT BANK (BNDES)**

### Can you introduce the Brazilian Development Bank (BNDES)?

FM: The BNDES is the main long-term financing agent in the Brazilian market. We work to develop sustainable projects that promote economic growth, a fair transition to a low-carbon economy and job generation. The BNDES has a long history of supporting the mineral sector in Brazil, implementing new greenfield projects, capacity-building projects and acquisition of equipment. We also provide investment in the logistics infrastructure necessary for the mining sector. In the past, working together with private sector and state mineral research, we have supported investments in explorations bodies, promoting the development of important mineral regions in the county.

PD: We view mining as an essential driver of sustainable development, especially in the more isolated regions of the country. When mining arrives in regions that have difficulty attracting other investments due to a lack of infrastructure or qualified labor, it kick-starts the development of that region. Additionally, we see mining as an essential provider of inputs for various industries. Worldwide, there is an un-

derstanding that the growth of mining is essential both for the energy transition and food security. Food security is a particular issue in Brazil due to our dependence on imported fertilizers.

### Can you describe IBRAM's partnership with the BNDES?

FM: We built a partnership with the main entities representing the mining sector, focusing on structuring financing mechanisms that can fill existing gaps and support mining projects in Brazil. The goal is to support companies in the exploration or development phase of mines, which is in the phase of greater risk exposure and low access to investment capital. Access to credit for small and medium-sized companies is limited, and there is great interest in making these projects viable.

PD: We created a network called Invest Mining, which brings together multiple actors to promote both direct financing mechanisms and regulatory improvements, including access to the Brazilian Stock Exchange, to ensure that mining has a greater insertion in the capital and financing market in Brazil. Smaller projects provide the most significant potential to diversify Brazil-

ian mining production and expand our knowledge of our underground and mineral potential.

### Can you discuss the launch of a critical minerals financing fund?

FM: We intend to launch it preliminarily at the next COP and, finally, during the PDAC in 2024. The investment thesis is not yet confirmed, but the main target will be the development of critical minerals.

We aim to develop the value chain of the minerals, seeking partnerships and generating a value-added product within Brazil.

### What role does geopolitics play in investment?

PD: Global geopolitics today is a critical factor in the investment landscape. China plays a significant role in bringing competitiveness to the sector and leading certain movements within this highly competitive environment. Beyond financing for sustainable development, our biggest challenge is communicating to the world that Brazil is one of the best places to allocate capital for responsible, sustainable mining development.

The president calls Brazil's new industrial policy, which is currently being developed and launched, neo-industrialization. We seek to develop mining companies that respect the environment and society, with lower greenhouse gas emissions and higher technology. As a development bank, we must make it clear to the world that Brazil is prepared to receive investments and carry out processes in a responsible way. Security is essential for foreign capital, and Brazil provides the security that allows for the minimum desired return for investment.

### What is your strategy for the near future?

FM: Historically, the BNDES has a share of around 2% of Brazil's gross capital formation, and currently, we are disbursing around 0.7% of the Brazilian GDP. The main goal for the next two years is to triple the support of BNDES for investments in the mineral sector. We aim to support the investment forecast of US\$50 billion in the Brazilian mining sector.

The focus is on four main goals: supporting Brazil's iron ore operations, prioritizing the development of critical minerals projects, developing exploration bodies projects and diversifying the Brazilian mineral production. ■



## Rohitesh Dhawan

CEO  
**INTERNATIONAL COUNCIL ON MINING AND METALS (ICMM)**

### How can the Brazilian mining industry add value?

The way to think about value added from mining is that the industry transforms natural capital into social and economic capital. When done well, it can even increase the stock of natural capital through activities like reforestation and conservation. The supply of some metals and minerals will need to increase up to 20 times in the next 30 years if we are to successfully decarbonize the global economy while enabling social and economic development.

### Why is Brazil's mining industry poised for growth?

Three major trends are occurring, and Brazil is generally favorably positioned on all three. The first is a shortage of critical and strategic minerals. If you take a group of commodities that includes nickel, graphite, manganese, and rare earths, Brazil holds about one-fifth of the global resource base of each of these but has less than 10% of the worldwide share of production and, in some cases, less than 1%.

The second is sustainable production. Brazil has several advantages here. 77% of Brazil's energy is low carbon, and much of that supply is available to the industry.

The final trend is geopolitics and the desire from countries around the world to secure their supplies of critical minerals. Brazil is one of the few countries with good relations between the West and East, allowing it to work with many different countries.

### Could you provide an update on the ICMM's work in tailings management?

The tragedies at Mariana and Brumadinho catalyzed the industry to reset tailings dam management fundamentally. It led to the Global Industry Standard on Tailings Management (GISTM). ICMM members committed that for tailings dams with the highest consequence classifications, extreme or very high, they would disclose their levels of conformance by August of 2023. All members have done that, including our members who operate in Brazil. For all other dams, they will do so by August 2025. ■

### What is the background of Women in Mining Brasil?

The WIM Brasil emerged back in 2019. Our principal objective revolves around broadening and strengthen women's involvement in the mining sector. We must spotlight the need for greater gender equity and respect for women at all levels of an organization. While women currently participate, their roles have been predominantly confined to legal and communication sector, with limited representation in mining-related technical domains. It is vital that women are recognized as valuable reference and a source of technical expertise and operational excellence. Our goal is to foster a more responsible and sustainable industry, and to achieve this we must actively promote a more inclusive and diverse work environment.

### How do women contribute to the community?

Research has shown that women allocate over 50% of their income to the communities where they reside, whereas men typically allocate around 30%. This presents a significant issue of economic growth. To develop future talent, it is crucial to underscore the significance of STEM disciplines among women, making them aware of their potential contributions to the mining industry. A key aspect of our mission is to encourage women from diverse sectors to explore and join the mining field.

### What do you foresee for women's inclusion over the next few years?

The workforce of the future is essential, and we need to invest in women. While the mining industry is expanding, it has encountered reluctance among young people, primarily due to recent incidents and concerns about working in mining. However, our report indicates that women are already becoming increasingly involved and securing more leadership roles within the industry. Nonetheless, the high quitting rate among women underscores that there is still much work to be done. Women want to be part of the mining industry, but they often find the working environment unsupportive, which leads to women leaving the industry. ■



## Patrícia Procópio

President and Founding Member  
**WOMEN IN MINING BRASIL**



» **Brazil has the geology to be a leader in the future of critical minerals, but we do have some hurdles to overcome.** «

## Roberto Xavier

Executive Director  
**AGENCY FOR THE DEVELOPMENT AND INNOVATION OF THE BRAZILIAN MINING SECTOR (ADIMB)**

### What is ADIMB's mission?

The Agency for the Development and Innovation of the Brazilian Mining Sector – ADIMB – is a non-profit association of private companies, service suppliers, associations, and institutions related to the mining sector in Brazil. Within the government, our members include the Ministry of Mines and Energy, the National Mining Agency, and the Ministry of Science, Technology, and Innovation. We have approximately forty members, and our main role as one of the entities that represent the Brazilian mining sector is to provide a technical and scientific support to the upstream and midstream segments of a mineral project's lifecycle. We are involved in the improvement of the geological framework and mineral endowment of mineral provinces or districts in Brazil. This is essential to improve exploration targeting at lower risks.

We fulfill this mission by, first, forging collaborative research, development and innovation projects, partnering the mining companies with universities and government. Second, we provide human resources training and events at the national and international scale that translate into networking opportunities between industry, academia, and government. Collectively, these activities have the purpose of boosting the Brazilian mining sector.

### Can you elaborate on the collaborative research ADIMB supports?

The collaborative research projects are generally funded by the private sector of the mining industry. The first step in this model is to identify the company's demands in terms of geological knowledge and technological need. We then seek research groups at universities with skills and infrastructure to attend to these demands through a research project. Once the research has been approved in terms of budget, objectives, deliverables, confidentiality, schedule, and so on, ADIMB becomes the primary project manager. We currently have four ongoing collaborative projects on copper and rare earths. These projects are important for the identification of regional and deposit-scale footprints, which can lead to a better efficiency in the assessment of greenfield or brownfield exploration targets. These projects can also contribute to the development and testing of new, innovative methods applied to mineral exploration.

### What is your perspective on the lack of talented workforce?

The mining industry struggles from a lack of qualified professionals, and it has been continuously more challenging to recruit young talent. At the universities we have observed a decrease

in enrollments and graduation in earth science and geology programs, which affects recruitment for the mining industry.

There is no silver bullet for solving this issue. The government should also consider using mining royalties as subsidies for these research, development, and innovation programs.

### What challenges are the mining industry facing?

There was a recent study carried out by the Geological Survey of Brazil, showing a positive picture of the country's geological potential for critical metals. Nevertheless, this potential is still under-utilized and under-explored because the geological mapping of 75% of the Brazilian territory exists at scales (1:250.000 - 1:100.000) still incompatible for what is required for more efficient mineral exploration. At these scales, you see large geological units but not details that could lead to a better assessment of the potential for critical minerals in Brazil. The Geological Survey of Brazil is doing a superb job and every year more geological maps at scales more compatible with mineral exploration have been produced in important mineral provinces.

Another challenge is environmental licensing. The process is complex and time consuming. There is also a high tax burden, and a complex regulatory framework. Brazil has the geology to be a leader in the future of critical minerals, but we do have some hurdles to overcome.

### What major events does ADIMB have forthcoming?

One of the major networking events ADIMB organizes at the national scale is the biannual Brazilian Symposium on Mineral Exploration (SIMEXMIN). This event attracts around 1,300 professionals from the mining sector, and we are now at the 11th version of this event. It is designed to foster an environment of interaction between industry professionals, university researchers, and the government sectors.

At the international level, since 2004 we have been in charge of the organization of the Brazilian delegation and the Brazilian mining day seminar at the PDAC. We are in Toronto every year bringing the Brazilian delegation composed of core government personnel and CEOs from mineral exploration and mining companies that are currently in operation in Brazil. ■



» **The work of the Foundation is based on providing solutions to mining companies' scientific and technological problems.** «

## Cristovam Paes de Oliveira

President  
**GORCEIX FOUNDATION**

### What is the history of the Gorceix Foundation?

The Gorceix Foundation was created in 1960 when the Ouro Preto School of Mines was one of the academic units of the University of Brazil. The Ouro Preto School of Mines, due to its relevance, emancipated from the University of Brazil, and a group of former students felt the need to create a foundation that could support economically challenged students of the Ouro Preto School of Mines and contribute to the scientific and technological development of the mining sector.

We operate in the areas of social support, academic support, science and technology. The Foundation has nine departments, carrying out projects developed by professors and researchers of its own personnel as well as with personnel of the Federal University of Ouro Preto, to which the School of Mines belongs today, and of many other distinguished universities, research centers and production companies in Brazil. The Gorceix Foundation also manages project resources of researchers from the Federal University of Ouro Preto and of the Minas Gerais Federal Institute, providing the financial and activities reports to the funding agencies. In addition to helping economically challenged students at the Federal University of Ouro Preto

by giving scholarships, we offer academic and professional training and different types of assistance ranging from basic needs assistance grants to scientific initiation and academic merit scholarships. We offer short-term training courses for students at the School of Mines as well as courses in-company for the industry personnel.

### Can you describe the Gorceix Foundation's scientific activities?

On the scientific and technical side, we partner with the biggest companies in the mineral, metallurgical and O&G sectors, including contracts with Vale, Samarco, and Petrobras. The work of the Foundation is based on providing solutions to these companies' scientific and technological problems. We have developed innovative solutions for the processing of numerous different ores, as well as for the destination of residues, aiming to mitigate the environmental impact of the operations. In metallurgy, we helped develop solutions from pelletizing to energy efficiency, both in steelmaking and non-ferrous metals, for the most prominent Brazilian companies.

### How can mining improve its reputation?

The key is mitigating the issue of environmental impact. Environmental im-

pacts can be mitigated through proper technologies for safe processes and reduction of toxic elements. Improving the quality of waste generated by mining processes and determining how to use that waste in other activities to move towards a circular economy is a major challenge for the Brazilian mining sector.

The challenge of the Brazilian mining industry is to regain society's trust, and even recognition for its importance, by demonstrating that mining activities can be carried out safely and with enormous benefits to society. The Foundation actively seeks to support the industry in this area, developing innovative ideas for safe and reliable mining activities.

### Can you describe the strengths of the Brazilian mining industry?

In Brazil, we must have clear rules and legal stability. The government can contribute in creating this environment. Additionally, mining activities generate large volumes of materials and products, which must be transported from the point of extraction to processing and export areas. The Brazilian state must improve the country's infrastructure to support the transport of goods. Today, our transportation system is based on highways, but the most economical modes of transportation are by trains and ships. We feel that the government must continue to develop its railway transportation system, as well as the ports system, or the logistics costs will continue to be too high.

### What is your priority for the near future?

At the end of last year, the Gorceix Foundation finished its strategic planning looking forward to 2026. An opportunity arose to expand the foundation's activities through a partnership with the municipality of Ouro Preto. The partnership will create a technology park in an old, abandoned fabric factory. The Foundation wants to create a technology park focused on the mineral sector. Several companies have already announced their intention to open laboratories in this park with new facility to develop research aimed at high technological innovations in partnership with the Foundation. Over the next five years, we will dedicate ourselves to implementing this technology park, creating a legacy for future generations. We are just waiting for the agreement from City Hall. ■





# Sustainability

## Mining in the eye of the beholder

Image by Marcio Isensee e Sá at Adobe Stock

Hostility to the mining industry from the general public is the result of a long history of disregard for the environment and communities surrounding historic mining projects. In Brazil, the negative public opinion of the industry was crystallized by the Brumadinho and Mariana disasters. In order to maintain a license to operate, the mining industry needs a consistent and defined approach to community engagement and communities work. "The way to think about value added from mining is that the industry transforms natural capital into social and economic capital," said Rohitash Dhawan of the ICM. "By harvesting resources that exist underground, responsible mining transforms them into value for society both through the role mining plays in social and economic development and in producing vital products."

The industry seeks to convey both its recognition of culpability for past wrongs, and the positive benefits that

the mining industry offers to the public. At EXPOSIBRAM, a central theme was the need to break down the image of mining activity as enriching few, while impoverishing many. The industry seeks to communicate that rather than being environmentally unfriendly, mining is environmentally essential.

On a broader scale, the mining industry seeks to establish qualitative criteria for legislation aimed at regional development. In the state of Bahia, bidding processes include this type of classification, with companies required to establish the value of social investment policies. For example, 10% of royalties could go to social programs in the community. The key is to be able to communicate to the state and the public the value and potential the mining process brings to the region. Maria Albuquerque, CEO of Synergia Consultoria Socioambiental, said: "We are seeing a change in mentality among

mining companies. They no longer view ESG criteria solely as a prerequisite for obtaining mining licenses. They are now considered key corporate objectives."

### Community engagement

The shift towards more autonomous mining has benefits in terms of cost and risk-reduction, but it takes away one of the core value-adds a mine brings to a community: job creation. Indeed, when a mine seeks to enter an area, a core sell is that the mine will generate significant long-term employment for the community. As mines increasingly automate their processes, this value-add shrinks. The jobs that are created are often temporary, only generated for the duration of the major construction period of a development project. Lucas Sardinha, project director at the consultancy Herkenhoff & Prates, said: "Historically, job generation was the promise offered by mining projects.

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## Maria Albuquerque

CEO  
SYNERGIA CONSULTORIA  
SOCIOAMBIENTAL



**Brazil is one of the countries with the greatest social inequality. We therefore play an important role in promoting the economic development of local communities living in the areas where mining is carried out.**



### Can you introduce Synergia Consultoria Socioambiental?

Synergia Consultoria was founded eighteen years ago. We offer environmental services focused on the social component. Environmental and social aspects are interrelated; mining companies cannot address environmental issues without linking them to social variables.

There is an increasing demand for social communication and dialogue, environmental education, and resettlement services from mining companies. We also prepare socio-economic studies and patrimonial reports necessary for licensing processes. In addition, we support mining companies in the areas of emergency prevention to environmental and social rehabilitation. For rehabilitation, we provide technical advice to our clients to help communities rebuild their productive base or implement socio-economic projects.

It is also important for us to objectively measure the impact of the social investments of our clients, especially ESG investments. To this end, we use advanced data analysis tools and territorial studies using qualitative and quantitative methods. These analytical tools enable mining companies to have a strategic vision of how their social investments are related to the social projects' performance.

### What are the main demand trends in the Brazilian mining industry?

We noticed an increase in demand for our services following the dam accidents in Mariana and Brumadinho. To meet the growing demand, we divided our service offering into three phases: Prevention, Emergency Response, and Remediation. As remediation projects tend to be long-term, we are still working on projects related to incidents that occurred in 2022, and these represent a significant portion of our revenues in 2023. We are seeing a change in mentality among mining companies, they no longer view ESG criteria solely as a prerequisite for obtaining mining licenses, they are now considered key corporate objectives.

### Why is it important for mining companies to consider social return on investment?

Mining companies plan their social investments before the licensing phase, and it is very important for them to define the investments according to the reality and social dynamics of the local communities. In this sense, we work with mining companies considering the costs and the social return on investment.

Water and social carbon are two issues of increasing concern to the mining industry, and we are already working in these areas. Social carbon consists of quantifying the actions taken by companies to address social harm or to preserve a specific area or the culture of local communities. Social carbon, then, is a carbon credit that companies earn by helping indigenous communities preserve their culture. We recognized that it is possible to convert our culture preservation projects into social carbon credits, and now this is a solution we are offering to the mining industry.

### How does Synergia Consultoria Socioambiental use technology to predict contingencies and analyze the impact of socioenvironmental investments?

Over the years, we have developed SIS Pesquisa, an artificial intelligence system capable of integrating secondary databases with complex social and economic family registers, geographically referenced data, and other indicators about fieldwork which we collect in real-time with other systems. SIS Pesquisa helps us to design our solutions according to the specific needs of each client.

Our data collection and processing system, SIS Pesquisa, allows our multidisciplinary group of professionals to focus on the analytical aspects and work closely with our clients, instead of doing all the data collection manually.

### How has the environmental regulatory framework changed in recent years?

Environmental regulations in Brazil are increasingly focused on protecting the environment and preserving traditional communities and water sources. Most mining companies anticipated this tendency and are avoiding the use of tailings dams.

On the other hand, the discussion on the regulatory framework has been reignited due to the recent change of government. In this context, mining companies must adapt to the political situation and adopt a more comprehensive approach to the conservation and economic reparation of local communities and the environment.

### What are the main goals of Synergia Consultoria Socioambiental for the next two years?

We aim to continue working on the development and application of technological innovations to offer new solutions. Brazil is one of the countries with the greatest social inequality. We therefore play an important role in promoting the economic development of local communities living in the areas where mining is carried out. ■

Currently, the number of direct employment opportunities is declining, while indirect positions are increasingly being staffed by specialized professionals who work alongside service providers on construction sites across Brazil.”

Counteracting this challenge requires greater attention to the needs of the individual communities. As job creation becomes a lesser offering, mines need to increase the direct benefits they bring in other areas to ensure that local communities remain on board with the projects. Community development does not allow for a one size fits all approach, as each community has its own desires and needs.

Determining and fulfilling those needs is delicate work that requires attention and careful targeting. Herkenhoff & Prates, for example, carries out communities work for Samarco, which has a footprint that impacts more than twenty municipalities with over a hundred territorial units that have individual vulnerabilities and strengths. Cristina Margoto, executive director at Herkenhoff & Prates, explained: “Each of these units has its unique vulnerabilities and strengths, making community engagement highly complex, even within a single project by a single company.”

With relationships between mines and local communities strained, the presence of a third party is essential. The public in Brazil has a severe lack of trust in the mining sector, and to regain that trust and rebuild relationships requires investment. Mariana Nahas, CEO of NMC Sustentabilidade Integrativa, a company that develops social impact projects and connects mining companies with the communities in which they operate, has observed a real failure of effective communication: “It is important to have an intermediary who understands the local social dynamics to better manage the relationship between the company and the community. We have found that local people are more willing to communicate their needs to an impartial mediator.”

The mining companies interviewed for this report have supported not just local infrastructure, medical services and

» Maritime emissions are considered Scope 3 emissions for mining companies and account for approximately 90% of the mining industry's total emissions.



« **Bernardo Vettorazzi,**  
Business Development Manager, RightShip

educational facilities, but also engaged directly in facilitating the growth of the local economies. José Cláudio Nogueira Vieira, director of Clam Meio Ambiente, provided an example: “We were recently hired by an iron ore company to support a group of women to increase their income by enabling them to sell their products directly to the market rather than through an intermediary.”

**Green gets greener**

Brazil's energy matrix is famously green, dominated by renewable hydropower. That matrix is beginning to shift as wind and solar continue to rise, and the race to 100% carbon neutral energy production picks up pace.

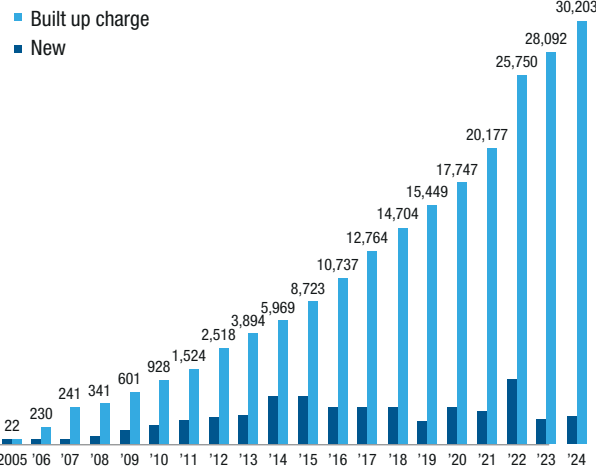
However, energy access across the country is uneven. A well-developed power grid is critical for connecting the rest of the country to the northeast, where the majority of Brazil's energy production is centered and where the dry and windy conditions facilitate a growth in wind power. In addition to the insufficient power grid, there is also a shortage of wind equipment manufacturers in Brazil, with demand for equipment outpacing supply.

In 2022, Vale began operations at one of the largest wind-farms in Latin America, Sol de Cerrado, which will supply 16% of all power consumed by Vale in Brazil when operating at full capacity. The land was previously unused, and now hosts a 776 MW windfarm, with the capacity to support of a city of 800,000 residents. For mining companies, wind energy is a positive due to its negligible social impact. In many cases, the local people have no land ownership, and the process of wind farm construction provides them with legitimate deeds. Importantly, agricultural activities can take place on the same land as wind energy generation.

The mining industry is also looking to supplement traditional renewable energy resources with green hydrogen and green ammonia. In September 2023, Vale announced the signature of an agreement with H2 Green Steel to study the construction of an HBI plant, which would run on green hydrogen for green steel production.

Brazil's existing renewable energy matrix, supported by investments in green energy along all parts of the mining chain, supports the existence of a truly green mining industry. From wind power to green steel production, the complete mining processes can be decarbonized, and Brazilian mining is leading the way. Eduardo Bartolomeo, CEO of Vale, explained the company's ambitious decarbonization targets: “We plan to invest up to US\$6 billion to reduce our Scope 1 and 2 emissions by 2030. We have also set a target of reducing our Scope 3 CO2 emissions by 15% by 2035 – equivalent to New Zealand's total emissions.” ■

**Evolution of Installed Wind Power Capacity in MW from 2005 to 2024**



Source: Brazilian Electricity Regulatory Agency (ANEEL), ABEEólica and Airswift.com



**Mariana Nahas**

CEO  
NMC SUSTENTABILIDADE INTEGRATIVA

**Can you introduce NMC Sustentabilidade Integrativa (NMC)?**

We connect mining companies with the communities in which they operate, working to minimize the negative environmental impacts of mining and promote community development.

**What are the main milestones achieved by NMC in the last two years?**

We have been supporting rehabilitation projects, mainly related to the disasters of the tailing dams in Brumadinho and Mariana. We work in the development of economic activities such as agriculture to support the economic self-sufficiency of the communities. We also perform studies that analyze relevant variables related to the dynamics of the territories to identify economic activities that can positively impact the long-term well-being of the population.

**What would you consider the biggest weakness of mining companies in dealing with local communities?**

Mining companies often fail to communicate properly with local communities. For this reason, it is important to have an intermediary who understands the local social dynamics. We have found that local people are more willing to communicate their needs to an impartial mediator like us.

We have also done a lot of work with our territorial analysis solutions to support mining companies in identifying the difficulties faced by local communities. ■



CM



LS

**Cristina Margoto and Lucas Sardinha**

Directors  
HERKENHOFF & PRATES (H&P)

**What is H&P's role within the mining industry?**

CM: H&P provides services in areas such as dam safety, socio-institutional relations, environmental management and territorial development.

LS: The value of our professionals and methods lies in our ability to foster dialogue and collaboration among various stakeholders, finding common ground and mediating differences.

**How has a mine's value-add changed over time?**

LS: As you see at Samarco and other companies, the volume of workers is decreasing as the operation goes through an automation process. Technology is replacing manual labor. The mining companies' most significant asset, job creation, is decreasing. Historically, job generation was the promise offered by mining projects. Currently, the number of direct employment opportunities is declining, while indirect positions are increasingly being staffed by specialized professionals who work alongside service providers on construction sites across Brazil. Managing this transient workforce poses a significant challenge for companies.

**How can the mining industry improve its community relations?**

LS: Transparency is key, as local communities often lack clarity on fund allocation. Improved communication from mining companies regarding their contributions and activities is essential. ■



**José Cláudio Nogueira Vieira**

Director  
CLAM MEIO AMBIENTE

**Can you introduce Clam Meio Ambiente?**

With about 550 people, including geologists, biologists, engineers, and psychologists, Clam Meio Ambiente is one of the largest environmental consulting firms in Brazil. We offer a wide range of services related to ESG, particularly regarding environmental issues. For example, monitoring the impact of mining on fauna and flora, measuring water quality, as well as geological and geotechnical services. In Brazil, we observe a high demand for licensing services. Regulations are becoming more stringent. We support our clients in complying with all environmental regulations while helping them to operate more efficiently and sustainably.

**How were 2022 and the first half of 2023 for Clam Meio Ambiente?**

Our revenue has grown approximately 20% per year and our team has also grown. We expect to continue to grow as local and federal regulations in the mining sector become more complex, and government agencies require detailed and increasingly specific and specialized environmental studies.

**What are Clam Meio Ambiente's objectives for the next two years?**

We hope to expand our activities abroad; in Latin America, we are interested in Colombia and Peru. In Africa, we have already started to support Vale with hydrogeological studies and we expect to have more projects there. ■



# Regulatory Framework

## A complex landscape in search of clarity

Image by iklila at Adobe Stock

Mining in Brazil is federally regulated, but with environmental matters, federal, state and municipal regulations can apply. Federal and environmental regulations do not always align, leading to inconsistencies in interpretation and enforcement of regulations at the permitting stage. Adriano Drummond Trindade, mining partner at Mattos Filho Advogados, explained: “This challenge is so prominent that the previous administration had to implement the “pro-strategic minerals policy” aimed at improving coordination among the various agencies, both at federal and state levels, that get involved in permitting a mining project.”

Brazil’s regulatory landscape is a maze, with mining companies required to navigate the municipal, state and federal governments. A variety of federal institutions are present in the mining industry, including the Ministry of Mines and Energy (MME), the National Mining Agency (ANM), and the Geological Service of Brazil (CPRM). This overlapping layer of institutions is supplemented by the multitude of other government players that regulate the industry’s labor, environmental and safety activities.

The National Mining Agency (ANM) was created in 2017 to take the place of the National Department of Mineral Production with the aim to modernize the industry’s regulatory framework. The ANM is also responsible for ensuring compliance with the mining regulatory standard, managing the mining registry and granting mining titles.

The creation of the ANM is viewed as a notable improvement on the previous regulatory landscape. In addition to offering greater streamlining and clarity, the agency has provided more transparent management of mining titles. The result has been a more collaborative approach to regulation. Bedran Oliveira elaborated: “The ANM is relatively new and there is still room for further development. However, the management of mining titles today is much more transparent. Today, there is social participation, where the private sector and law firms work together with the ANM to build the regulations.”

In order for investment to flow into Brazil, investors must have a clear regulatory and legal framework and strong institutions. The ANM supports the mining industry by creating a greater sense of stability and clarity. “In the regulatory and governance areas, the ANM is doing an excellent job,” said William Freire, founding partner of William Freire Advogados. “The national mining agency understands the necessity of mining for the country.”

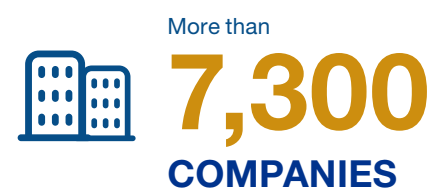
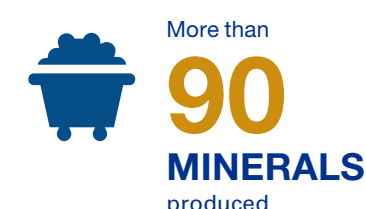
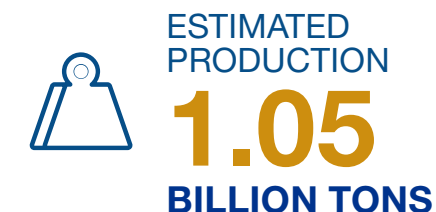
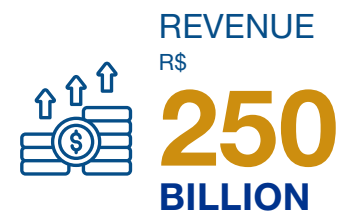
The mining agency has benefited from the digitization trend sweeping the globe, with electronic files introduced in 2015. The agency invested significantly in the digitization of processes, thus speeding up permitting. For example, applications for exploration permits are now handled electronically and take a little over 30 days. However, the digitization of operations has not sufficiently compensated for understaffing and limited resources at the agency. There are still over 100,000 applications awaiting approval by ANM. “There should be 2,000 employees nationwide, but the agency has only 600,” said Marcelo Mendo, partner and head of the mining practice at Cescon, Barriou, Flesch & Barreto Advogados. “Such limitations hinder the ability to implement new policies and regulations, but we expect the Federal Government to come to ANMs aid in the near future.”

Environmental licensing adds a layer of bureaucracy and complexity to the already complicated concessions and regulatory landscape. At the federal level, the Ministry of the Environment develops policy, and the National Council of Environment (CONAN), implements the directives of the NMA. Mining companies entering the Brazilian market must obtain licenses at three points during the development process: A preliminary environmental license, an installation license before construction begins, and an operational license before the projects initiate operations. This process can take as long as 12 years.

The industry is calling for a general simplification of environmental regulation. In particular, the industry seeks a federal law that regulates the allocation of licenses. “We still require a general law for environmental licensing, which has been in Congress for 19 years, passed by the Chamber of Deputies, but not by the Senate,” explained Alexandre Sion, founding partner at Sion Advogados. “This implies that procedures are guided by norms with a hierarchy below the law, resulting in conflicts over the validity, effectiveness, and applicability of norms.”

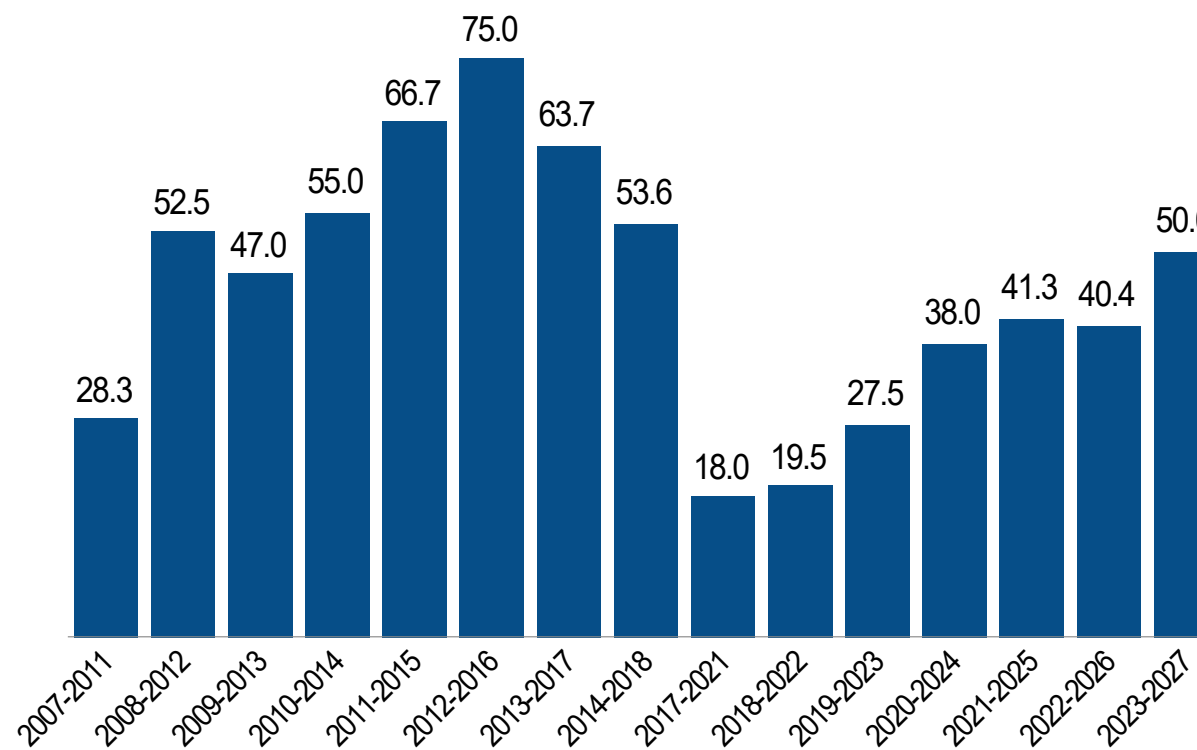
The regulatory landscape remains in flux. On December 29, 2022, Law No. 14,514 was approved, extending terms for mineral exploration licenses for up to four years, and allowing every mining right to be used as collateral in financing transactions. The latter provides junior companies with improved access to capital markets. However, the government’s decision to change the “first-come-first-serve” system for exploration leases to an auction system has been challenging for juniors due to their limited capital. It will, nonetheless, benefit the broader mining sector. ■

### Mining in Brazil



Source: KPMG, IBRAM, Instituto Brasileiro de Geografia e Estatística 2022, United Nations 2022, Banco Central 2023

### Mineral Sector Investment in Brazil (US\$ Billion)



Source: IBRAM



## Liliana Fernanda Yoshikawa and Pedro Henrique Jardim

Mining Partners  
**MACHADO MEYER  
ADVOGADOS**

### Can you introduce Machado Meyer?

PHJ: Machado Meyer is a 51-year-old law firm with about 700 lawyers and 105 partners offering a wide range of legal services. Our specialized departments can provide solutions to mining issues in the areas of labour, environment and taxation. In addition, we have a crisis management team that has been very active in the mining sector in recent years.

### After the tragedies of Brumadinho and Mariana, how has the industry adapted to the new regulations?

PHJ: I think companies recognize the importance of the regulations for tailings management. The private sector has begun to adapt to the new parameters and is increasingly using technical innovations to comply with stricter regulations. For example, it is common for companies to switch from liquid tailings to dry, paste and stacked tailings.

We have certainly made progress on the legal aspects that impact society, the state, and communities, but I still see some bottlenecks in regulations affecting companies, such as access to finance and land use. When businesses do well and have adequate access to funding, they can increase their positive impact on communities through infrastructure, employment opportunities, and so on.

### How are the discussions on the tax system to promote artisanal and small-scale mining progressing?

Right now, the main ongoing discussions regarding the Brazilian tax reform and its impacts to mining companies refer to the recent inclusion of a new rule that was approved in the last two rounds of voting sessions by the Chamber of Deputies and that makes it possible for states to create a contribution on primary and semi-industrialized products that shall serve infrastructure construction works and housing in lieu of contributions to state funds - should it be approved on a definitive basis, this will further increase the total tax burden to mining companies. ■



## Marcelo Mendo and João Raso

MM: Partner and Head of the Mining Practice  
JS: Senior Associate  
**CESCON, BARRIEU, FLESCH  
& BARRETO ADVOGADOS**

### What is the context for mergers and acquisitions in Brazil?

JR: We have seen many mergers and acquisitions in recent years, but the growing interest in strategic minerals, such as nickel, copper, lithium, rare earths, and cobalt, among others, has fuelled the M&A industry – both on the equity and the offtake sides.

These kinds of transactions are taking place in a context where automotive companies are looking for a constant supply of such minerals to produce electric vehicles, and the need of the global industry to clean its energy sources.

MS: We have been working with several Brazilian companies, as well as with foreign investors, in connection to copper, nickel, lithium, and rare earths projects.

### How can Brazil improve access to capital for junior companies to advance exploration?

JR: To facilitate access to the capital markets for junior companies a law was passed in December 2022 that authorized every mining right to be granted as collateral in financing transactions. There are still many other measures to be regulated by the National Mining Agency that could foster junior companies' access to capital markets, such as the registration of royalties and streaming agreements to the title.

### How has the regulatory framework for mining improved since the creation of the National Mining Agency?

JR: One important step was the digitization of the agency. For example, the process to apply for an exploration permit is now done electronically and takes about 34 days - a big step for the industry.

One of the obstacles, however, is the agency's limited resources that hinders the ability to implement new policies and regulations, but we expect the Federal Government to come to ANM's aid in the near future. ■

# Brazilian Mining's License to Operate



"The previous administration had to implement the 'pro-strategic minerals policy' aimed at improving coordination among various agencies, both at federal and state levels, that get involved in permitting a mining project. The difficulties arising from inconsistent interpretations and enforcement of regulations particularly impact companies during the permitting stage."

**Adriano Drummond Trindade, Mining Partner,  
Mattos Filho, Veiga Filho, Marrey Jr e Quiroga Advogados**

"The major challenge in Brazil is not only attaining a mining license from the federal government, but rather an environmental license which has to be issued by the federal government, the state, as well as the municipality. The ANM needs to develop more in terms of human resources and technology to process the approximately 100,000 applications that are awaiting approval."

**Frederico Bedran Oliveira, Mining Partner,  
Caputo, Bastos e Serra Advogados**



"Although the Constitution specifies that only the Union can legislate on mining – that is, federal law – many aspects related to mining, such as the environment, can be legislated by other bodies. As a result, constitutional controversies can also arise regarding the applicability of laws and norms in different areas."

**Alexandre Sion, Founding Partner, Sion Advogados**

"Mining in Brazil is considered a public utility activity, which is vital because it enables the mining companies to solve complex challenges. Brazil considers mining a public interest activity similar to roads, airports, and public hospitals."

**William Freire, Founding Partner, William Freire Advogados**



"Since 2020, a regulation was implemented which reinforces the prohibition of the use of upstream dams for tailings ponds. It has been extremely challenging to get licenses after the Mariana dam disaster in 2015 and the Brumadinho dam disaster in 2019 as these accidents have put significant pressure on the system."

**Manuel Fernandes, ENR Regional Co-Leader for Americas – KPMG**



"Financing is always available for good projects. In Brazil, several good rare earth projects have been discovered in recent years, so we do not see any issues with financing in the country"

**Tom Drivas,**  
CEO,  
Appia Rare Earts & Uranium Corp

# PRODUCTION AND EXPLORATION

GBR SERIES • BRAZIL MINING 2023

Image courtesy of Kinross



# Iron Ore

## Despite headwinds, Brazilian mining's engine continues roaring

Image courtesy of Tractebel

Iron ore prices suffered a 24.8% fall due to lower demand from China. As the dominant mineral produced in Brazil, comprising 61.4% of all minerals produced in the country according to IBRAM, any change in iron ore prices has a dramatic impact on the Brazilian mining industry. Indeed, in 2021 Brazil exported 358 million tons (t) of iron ore with a total value of US\$44.6 billion, while in 2022, the country exported 3.79% less iron ore, at 344.1 million t, but experienced a 35.2% drop in value, with iron ore exports of only US\$28.9 million. Lower ore prices are not, however, stymying expansion: Approximately US\$17 billion is expected to be invested in iron ore production in Brazil between 2023 and 2027.

Vale, which celebrated its 80th anniversary in 2022, continues to drive iron ore production in Brazil, with a recent US\$2.7 billion investment to expand iron ore production in the Amazon. "This is part of our strategy to expand operations in Northern Brazil, especially the S11D mine, where we have the best reserves of 65% iron content and most competitive in cost," said Vale CEO Eduardo Bartolomeo, noting the demand for richer ore: "The higher iron content in the ore extracted from underneath Carajás' rich topsoil helps reduce the amount of fossil fuels needed to make steel as the world strives to decarbonize."

3A Mining's project entered production in December 2022, and has the installed capacity to produce 1.5 million t/y of iron ore, although it is limited to 300,000 t/y until it receives its definitive license. Fabio Assumpção, the executive director of 3A, is hampered by the logistics costs of transporting iron ore to steel producers. He called for further investment in logistics for the transport of raw materials from blast furnaces in other regions to Minas Gerais and the ports, noting: "Today, most of our costs are logistical, and considering the current product prices (pig iron around \$400 on the international market), even with a very low production cost, it is not possible to generate good margins."

Although logistics costs are high, the industry is seeing targeted investment to expand logistics infrastructure, including a significant investment by Vale in the Carajás railway, and new port and railroad projects in Bahia by Bamin. Júlio Nery, Director of Sustainability and Regulatory Affairs at IBRAM said, "For iron ore, our logistics infrastructure is quite competitive, probably better than for other minerals. We have three different railways, two out of Minas Gerais and one out of Carajás, and very good ports for iron ore export."

There is significant interest in expansion to meet future demand. Assumpção stated: "I believe that the direct cargo to blast furnaces consumption in the region is around 10 to 15 million tons per year (considering the installed capacity) and due to that, and the current availability of products, more investments in logistics will be necessary."

Samarco, which ceased operations in 2015 after the Fundão dam failure, resumed operations in late 2020, and is currently operating at around 30% capacity. The company obtained approvals in June 2023 for a project that will more than double production by 2025, including the development of a new filtration facility. Rodrigo Vilela, CEO, noted:

**Fomento DO BRASIL**

**We help in the development of everyone's daily life.**

Fomento do Brasil is focused on the identification, transformation, and commercialization of mineral assets and its ability to promote robust and continuous development in the regions where it operates.

### Classification of Brazil's mineral production and reserves compared with the world's total

MINERAL	% OF WORLD PRODUCTION	RANKING POSITION	% OF WORLD RESERVES	RANKING POSITION
BAUXITE	8.2%	3	8.4%	4
COPPER	1.6%	14	1.3%	13
GOLD	2.6%	13	4.4%	6
IRON ORE	15%	2	17.6%	3
KAOLIN	2.7%	9	23%	2
MANGANESE	2%	9	18%	3
NIOBIUM	88%	1	94.1%	1
TANTALITE	22.3%	2	42.5%	2
TIN	7.3%	5	8.5%	5
ZINC	1.25%	12	1.2%	6

Source: Mineral Commodity Summaries 2022 - US Geological Survey and KPMG

"Despite operating at around 30% capacity, our production costs are competitive, and we have been able to achieve good results due to positive iron ore pellet prices."

Samarco is on track to continue increasing production, while simultaneously focusing on remediation efforts after the Fundão dam collapse in 2015. Carla Wilson, general manager of BHP Brasil, a shareholder in Samarco, described the forward-looking investment in the company: "We have recently approved R\$1.3 billion investment to restart a second concentrator, which will increase pellet production capacity to approximately 16 million t/y (100% basis)."

Cedro Mineração, founded only four years ago, initially produced 3 million t/y iron pellets from Extrativa Mineral, a mine in Belo Horizonte, and will increase production to 5 million t/y in 2023 with the start of operation at a new mine in Mariana. As an independent producer that sells directly to producers such as Vale, Cedro's capex is dependent on market conditions. José Carlos Martins, senior business advisor at Cedro, noted that Brazil's dominance in iron ore benefits companies of all size: "The infrastructure in the country is very well developed because the big mining companies own the infrastructure to operate, and other smaller companies can benefit as long as they have long-term contracts and commitments with the bigger producers."

However, excessive regulation and long delays in licensing have been a scourge to development across the industry. Martins said: "Since the tailings accidents in 2015 and 2019, it has become difficult to significantly increase iron ore production."

70% of Brazilian iron ore is exported to Asia, and particularly to China. China's outlook for iron ore has been challenging recently. Jayme Nicolato, CEO of Mineração Morro de Ipe & Porto Sudeste, explained: "China has an installed capacity of 1.2 billion t/y. Therefore, any challenges in the Chinese economy will impact everybody."

The iron ore industry is dominated by a handful of major players, but to dramatically increase development and generate further tax money and employment, encouraging the development of new juniors is essential. Fomento do Brasil, a junior iron-ore company that is part of Fomento Group, is advancing Ferro Potiguar, a project expecting to produce 1.5 million t/y of iron-ore pellet. Rodrigo Santos, the general manager, pointed out: "The Ferro Potiguar project will generate more than 2,000 jobs and allow the government to collect around R\$1.5 billion in taxes that can be used to build infrastructure and promote development in the municipalities." ■

**New Moment Samarco.**  
*Learning Together*  
to always evolve.

**SAMARCO**



»» **Vale is playing a key role in the global energy transition with its portfolio of high-quality iron ore products and solutions, essential for the decarbonization of the steel industry.**



## Eduardo Bartolomeo

President  
VALE

### Please provide an update on Vale's activities in Brazil over the past year?

Vale has been advancing in its ambition to become a leader in sustainable mining and in creating and sharing value with its shareholders, other stakeholders and society as a whole. The company is playing a key role in the global energy transition, with its portfolio of high-quality iron ore products and solutions, essential for the decarbonization of the steel industry, and as a producer of metals essential for the world's electrification.

We are also taking significant steps to contribute to Brazil's neo-industrialisation as we are working to leverage the production of green hydrogen by partnering with steel producer H2 Green Steel to jointly study the development of an industrial hub in Brazil. In this industrial complex, H2 Green Steel would produce low carbon products, such as green hydrogen and hot briquetted iron (HBI), using iron ore briquettes produced by Vale as input material and renewable electricity as the energy source for its hydrogen production.

We have also signed agreements with clients in the Middle East to create "mega hubs" focused on low-carbon products. We are promoting circular mining, which helps reduce our waste generation, and we have an arc of initiatives ranging from science to research,

including actions to encourage the bio-economy and forestry agenda.

The company also remains committed to promoting inclusion and diversity. At the end of 2022, women accounted for 22.1% of our workforce and our goal is to reach 26% by 2025. In terms of ethnic-racial equity, 32.1% of Vale's leadership positions in Brazil are held by black employees and we want to reach 40% by 2026.

We continue to make substantial progress in our operational performance and safety practices. We have a growth path based on a disciplined capital allocation process and on creating value for our company and for society.

### Vale recently announced a strategic partnership with Manara Minerals and Engine No. 1 to accelerate the growth of Vale Base Metals. Would you elaborate on this strategic partnership?

We signed an agreement with Manara Minerals, a joint venture between Ma'aden and Saudi Arabia's Public Investment Fund, under which Manara Minerals will invest in Vale Base Metals Limited (VBM), the holding entity for Vale's energy transition metals business, at an implied enterprise value of US\$ 26 billion. Concurrently, Vale and investment firm Engine No. 1 entered into an agreement pursuant to which

Engine No. 1 will make an equity investment in VBM under the same economic terms.

This strategic partnership will accelerate VBM's expected US\$25-30 billion capital program over the next decade and help drive a significant potential increase in production from about 350,000 t/y to 900,000 t/y in copper and from roughly 175,000 t/y to more than 300,000 t/y in nickel.

### What was the strategy behind Vale's US\$2.7 billion investment to expand iron ore production in the Amazon?

This is part of our strategy to expand operations in Northern Brazil, especially the S11D mine, where we have the best reserves of 65% iron content and most competitive in cost. The higher iron content in the ore extracted from underneath Carajas' rich topsoil helps reduce the amount of fossil fuels needed to make steel.

### What is the socioeconomic impact of Vale's mines on the surrounding areas?

Through Fundo Vale, we are supporting forest recovery and protection initiatives, as well as investing in research on biodiversity through the Vale Institute of Technology (ITV). From 2009 to 2022, Fundo Vale contributed R\$269 million to support 324 businesses with a positive socio-environmental impact, benefiting 18,500 rural producers and extractivists, mostly in the Amazon. On the social front, in 2021 our Executive Committee announced the bold target to help get half a million people out of extreme poverty by 2030. In 2022, we developed a roadmap with targeted actions.

Through the Vale Foundation, Vale is working to expand people's access to the rights to education, health, and social assistance, aiming to improve municipal indicators and expand access for those in situations of greater social vulnerability and exclusion.

### What are Vale's primary goals?

We are fundamental for the decarbonization as we supply high-grade, low-carbon iron products as well as essential metals for a green economy.

We also have made consistent progress in our journey to be a more sustainable, efficient and innovative company. We want to be a driving force of the transformation of society, in our relationship with people, communities and the environmental, social and cultural agendas. ■



»» **Our main focus in Brazil remains on ensuring full and fair reparation and compensation, and investing in the safe and sustainable restart of Samarco's operations.**



## Carla Wilson

General Manager  
BHP BRASIL

### Could you provide an overview of the main milestones achieved by BHP in Brazil in the last 24 months?

As a Samarco shareholder, since the Fundão dam failure in 2015, BHP Brasil has always been and remains fully committed to doing the right thing, the right way, in the reparation and compensation processes. That's why, since then, we've been actively focusing our efforts on the extensive remediation efforts being undertaken by Fundação Renova, as well as the safe and sustainable restart of Samarco's operations.

More than R\$31 billion has now been spent on financial compensation and reparation, with around R\$15 billion paid in compensation and emergency financial aid to approximately 427,000 people. The resettlements of the Bento Rodrigues and Paracatu communities are now moving towards their final stages, with 75% of resettlement cases now completed.

Samarco restarted operations in December 2020 and is operating safely and sustainably, without a tailings dam, at around 30% of its full capacity. Samarco's judicial reorganization plan was approved by the Brazilian Courts in early September, which allows Samarco to maintain operational and financial sustainability into the future, as well as guarantee the continuity of all the reparation efforts.

### What are the strategies to promote sustainability and safety in Samarco, including recent investments in new filtration systems?

Samarco currently operates without a tailings dam, instead using a filtration and dry stacking solution for tailings. As shareholders, we have recently approved R\$1.3 billion investment to restart a second concentrator, which will increase pellet production capacity to approximately 16 million t/y (100% basis) again through filtration and dry stacking, without a tailings dam. We expect to deliver first production in the March 2025 quarter, and once operating Samarco will reach 60% of its original production capacity.

Our social value goals are embedded in our corporate strategy, operational plans and capital allocation. An example is that BHP has advanced female employee representation to more than 35%. We are also on track to deliver our FY30 target to reduce operational GHG emissions by at least 30% from FY2020 levels, and we have a goal to achieve net zero GHG emissions by 2050. In FY2023, we decreased operational emissions by 11 per cent from FY2022, primarily through renewable electricity supplies, and zero scope 2 emissions were registered at Escondida and Spence (both in Chile). In addition, we are working on electrification to elimi-

nate diesel and are collaborating with OEMs and industry, and anticipate first deployment of battery electric trucks from 2028 and locomotives from 2029 at our Western Australian iron ore (WAIO) operations.

### What technological innovations has BHP implemented to increase production in the coming years?

Globally, we are building a strong portfolio that is key to the development of the modern world: Copper for electrification and the energy transition, post-ash for food security, nickel for batteries and iron ore for infrastructure. The modern world will need more of these resources and at BHP we are ready to provide them. This means that we are executing different innovations to increase production. As an example, in Chile we are using artificial intelligence to increase our copper recovery and we are using blockchain technologies to track our emissions.

### What are the main advantages and challenges of operating in Brazil in comparison to other mining jurisdictions?

Our main commitment in the country has been ensuring full and fair reparation and compensation following Samarco's dam failure, as well as the safe and sustainable restart of Samarco's operations.

More recently, following BHP Group (Australia)'s acquisition of OZ Minerals in May 2023, the Brazilian assets of OZ Minerals located in Carajás, Pará, became part of the BHP group's portfolio. Given that until now BHP has not operated in Brazil, we are undertaking a strategic review of the assets to understand the potential in terms of resources and opportunities in the region and learn more about operating in the country.

### What are BHP's strategic objectives to grow in Brazil for the next 24 months?

We have a global strategic approach: To provide the commodities the modern world needs, and Brazil is a very important country when it comes to strategic resources and critical minerals. Our main focus in Brazil remains on ensuring full and fair reparation and compensation, investing in the safe and sustainable restart of Samarco's operations, and reviewing OZ Minerals operations in the country, which we are expecting will last between 12 and 18 months. ■



»» **Our Ferro Potiguar project will use dry stacking systems and will probably be the first iron ore project in the country to use recycled water in its operations.** ««

## Rodrigo Santos

General Manager  
**FOMENTO DO BRASIL**

### Can you introduce Fomento do Brasil?

Fomento do Brasil, part of Group Fomento, was founded in 2013, when the company acquired more than 11 greenfield mineral rights in Rio Grande do Norte, a semi-arid region in north-eastern Brazil. The property consists of 22000 hectares and is located 80 kilometers from Natal Airport.

One of the main features of our company is our strong focus on sustainability. Our Ferro Potiguar project will use dry stacking systems and will probably be the first iron ore project in the country to use recycled water in its operations. Ferro Potiguar is a lean project; we expect to produce 1.5 million t/y of pellet feet. The pellet feet will be approximately 66.6% of iron ore green with low silica and alumina content of less than 8% and 1%, respectively. The mine has more than 180 million tons of iron ore resources and has an expected life cycle of 18 years. We are planning a CAPEX of US\$ 250 million.

### What have Fomento do Brasil's priorities been over the past year?

Last year, we completed our pre-feasibility study with internal resources. The company has also focused on advancing the social and governance aspects of the Ferro Potiguar project.

We have worked hard to build positive relationships with the surrounding communities, particularly the five municipalities where the project will be developed.

In 2022, we prioritized obtaining a preliminary environmental license and complete our Prefeasibility study. To this end, we have established public-private partnerships for the implementation of a water recycling system. As the region is semi-arid, water management is a key concern for the local population, so we must ensure optimal use of hydric resources.

### Can you elaborate on the environmental approach of Fomento do Brasil?

In terms of environmental protection, we will invest in a 100 km water pipeline to collect reuse water from the five surrounding municipalities to supply our operations and, after the end operations, the pipeline will be a legacy for the communities. We are also investing in dry stacking technologies so project does not involve any tailings dams, another sensitive issue in Brazil.

In terms of energy efficiency, we will introduce high-pressure grinding rolls. This technology will allow us to increase grinding efficiency and optimize energy use in the comminution

process. Another initiative in this regard is the installation of solar panels. Rio Grande do Norte hosts some of the largest solar plants in the country.

As for the social dimension, we have made efforts to achieve gender equality. More than 27% of our workforce are women, 10% higher than the mining industry average. We also promote local social development by recruiting local talent and providing training; 73% of our employees are from Rio Grande do Norte. Fomento do Brasil has launched the Construir e Fomentar program with local communities to support local people to develop projects according to their preferences, whether in the areas of culture, education, or sports. We have invested more than R\$ 280.000,00 to improve people's lives. Additionally, the Ferro Potiguar project will generate more than 2.000 jobs and allow the government to collect around R\$1,5 billion in taxes that can be used to build infrastructure and promote development in the municipalities. We want to show the communities that we can do things differently.

### What are the main obstacles and opportunities for the development of new iron ore projects?

The iron ore industry has introduced various technologies to minimize environmental impacts, increase human safety, and optimize productivity. However, the regulatory framework can still be a barrier. While it is crucial to ensure environmental compliance, the government also needs to streamline permitting procedures.

In terms of opportunities, Brazil is ahead of other Latin American countries in renewable energy generation capacity, as we have a high percentage of solar and hydropower. However, we still need to develop the logistical infrastructure. Brazil also has enormous reserves of very high-grade iron ore, as well as other critical minerals such as rare earths, copper, lithium, and others.

### What are the main objectives of Fomento do Brasil for the next year?

First, we want to obtain the installation license for our Ferro Potiguar project. We also expect to conclude our Feasibility studies, consolidate our public-private partnerships to advance our water reuse system and expand our mineral resources. ■



## Rodrigo Vilela

CEO  
**SAMARCO**

»» **Our focus has been on restoring production and repair, to compensate impacted communities and to remediate the environment.** ««

### Can you tell us about Samarco?

Samarco is a Brazilian company with 46 years of history, and we are a pioneer company to use flotation technology to process low-grade iron ore and introduced ore slurry pipelines for transportation. We re-started our operations with 7 million t/y of iron ore pellets and had been able to produce up to 30 million t/y before the Fundão dam failure in 2015.

In 2014, we were the second largest seaborne exporter of iron ore pellets in Brazil. After the dam failure, which marked our history and will never be forgotten, we suspended operations, but with the support of our shareholders and our commitment to repair the environment, we resumed in late 2020. Today, Samarco is a partnership between BHP and Vale, with a fully integrated operation from mining to export.

### Can you share Samarco's recent priorities?

Our focus has been on restoring production and repair and to compensate impacted communities and to remediate the environment. We've also worked on transforming our culture to emphasize inclusion, human rights, and sustainability. Despite operating at around 30% capacity, our production costs are competitive, and we have been able to achieve good results due to positive iron ore pellet prices. Notably, 2022 marked our safest year in 46 years, and we were recognized as the best company to work in the industry by the FIA-UOL Institute. These achievements have helped us to obtain approvals in June 2023 for a project to more than double our production by 2025.

### What investments are needed to double production?

We plan to invest around R\$1.5 billion in a new filtration facility, maintenance, and training. We will also increase our operational workforce by 40% to support these efforts. Additionally, R\$3 billion will be invested in the decommissioning of our existing tailing dams. One of the dam decommissioning project has been completed, and we are working on the second as planned.

### How does Samarco approach innovation?

Our innovation strategy focuses on three pillars: incremental, technological, and disruptive innovation. We use technology to improve productivity and reduce costs. As an example, we have lowered slurry generation by over 3% due to innovative solutions. Our main goal is to find ways to reduce and repurpose waste from our operations. We are receiving collaboration from global companies to find safe technologies for dry stacking and waste use. We are also exploring ways to reuse our residues in construction and metallurgy, like the micro-pellets as an example.

### What is Samarco's focus on sustainability?

Sustainability at Samarco rests on four pillars: Environment, Social Relations, Governance, and Remediation/Compensation. It's central to our strategy, guiding our actions. We are committed to improving water quality and reducing CO2 emissions. We have created an inventory, switched to 100% renewable energy, and are studying electrification and a better energy matrix in our production chain. Our clients are part of this commitment to global goals as well.

In terms of social responsibility, we are focused on the remediation actions from the Fundão dam failure, as we are collaborating with the Renova Foundation to repair damages. We have established a program to build relationships with the local community through transparency. Our job creation programs support employment and local growth. Many of our team members are from Mariana, which helps communication. As we double production, our Diversity and Inclusion program aims at hiring from underrepresented groups. We are dedicated to this.

### What are Samarco's goals for the future?

Our primary goal is to repair the damages from the Fundão dam failure. Afterward, we aim to double our production to 15 million t/y of iron ore pellets by 2025. We want to regain a significant position in the global market, prioritizing safety and responsibility. ■





## Jayme Nicolato

CEO  
MINERAÇÃO MORRO DE IPÊ & PORTO SUDESTE

### What is the history of Porto Sudeste and Mineração Morro de Ipê?

Porto Sudeste started operations in 2014, and it took some time to negotiate with clients to achieve nominal capacity. This year, we will handle 32 million tons of iron ore, and our capacity is 50 million t/y. We export 30% to Europe, but the majority is exported to China.

### Can you describe your coming priorities?

Currently, we are handling the old tailings dams. We are about to finalize the engineering study to recover and recharacterize the dams. All the new production will utilize dry tailings. We have massive filtering press facilities that will allow us to dry the tailings and have tailings storage facilities blended with waste.

In the future, we need to grow our ESG agenda, particularly by including the community in preparations for the dam decharacterization and showing them the importance of this project to the future. We are on track to reduce our CO2 emissions, improve the use of renewable energy, and achieve 100% recycling at the port and mine to minimize water consumption. ■



## José Carlos Martins

Senior Business Advisor  
CEDRO MINERAÇÃO

### Can you introduce Cedro Mineração?

Cedro Mineração is a young company, founded only four years ago. Initially, we produced about 3 million t/y iron ore from one mine, Extrativa Mineral in Nova Lima. This year we will increase our production to 5 million with the start of operations at our new mine in Mariana, located near Ouro Preto.

### What are the main opportunities and challenges for mining companies in the iron ore industry?

The infrastructure in the country is very well developed because the big mining companies own the infrastructure to operate, and other smaller companies can benefit as long as they have long-term contracts and commitments.

Companies are investing in technologies to increase production and cost efficiency, as well as to minimize environmental impacts; however, the long timelines for environmental permits can be a barrier, and it is also difficult to obtain environmental permits for new mines. In this context, I believe that medium and small companies have an advantage over large producers, as small operations have much less impact on the environment. ■



## Fabio Assumpção

Mining Operations, Logistics and Sales Director  
3A MINING

### Can you give an overview of the company's operations in Brazil?

3A Mining is headquartered in São Paulo, and operates an iron ore mine located in Corumbá, Mato Grosso do Sul. The overall project started in November 2021, with the mine coming into production in December 2022.

The plant has a current installed capacity allowing to produce 1.5 million t/y of premium iron ore, but today, we are still limited to producing 300,000 t/y until we receive a definitive license. We have also already started the procurement of an additional plant to expand capacity to 2.5 million t/y by mid-2024.

### What is 3A Mining's approach to sustainability and ESG initiatives?

We have divided our production process into two steps to increase efficiency, reduce costs, and eliminate the need for tailings dams. Putting the fines back into the ground after first separation and moving less waste from the mobile plant to the fixed plant also allows for fewer transport requirements. We are also planning to install solar panels to become self-sufficient in our energy needs. ■



## Gold

### Exploration and production continue to shine

Image by Daniel Mansur, courtesy of AngloGold Ashanti

In Brazil, all that glitters is indeed gold. According to data from IBRAM, gold production makes up 9.6% of Brazil's total metals production by value. Gold will receive nearly US\$3 billion in capex investments in the 2023-2027 period, approximately 6% of the total investments in the Brazilian mining industry during that period.

Kinross, which has been operating at the Morro de Ouro Mine in Paracatu, Minas Gerais, since 2005, produced 577,000 oz of gold in 2022, approximately 22% of the total national production. The company is investing in projects to improve production, explained Gilberto Azevedo, president and general manager. Speaking of the Gravity project, which will operate fully in the 2nd quarter of 2024, he said: "The project will involve the installation of concentrators in the circulating load of the grinding circuit, together with the implementation of an intensive leaching reactor. The investment is around US\$30 million, and we hope to produce 20,000 oz/y with this project."

In 2022, the company optimized the fleet of 793 off-road trucks and replaced two diesel engine loaders with electric models at Kinross Paracatu. In 2023, major projects include replacing combustion pumps with electric ones and replacing combustions lighting towers with solar systems. Azevedo said, "We believe that mining can be carried out in a responsible and sustainable way, contributing to Brazil's economic growth and the well-being of the communities where we operate."

Tristar Gold is currently developing Castelo de Sonhos, which has a resource estimate of up to 1.8 million oz of indicated and 700,000 oz inferred, and benefits from an excellent location outside of any indigenous or nature re-

serves and near a road, power line and labor force. Tristar has completed the pre-feasibility study and is currently awaiting its LP, the environmental permit. Nick Appleyard, president and CEO of Tristar Gold, praised Brazil's solid legal system and stable political landscape even with a major change of government at the federal level: "Countries come in and out of favor as an investment location, and right now, Brazil seems to be one of the best jurisdictions within Latin America to attract investment."

Cabral Gold, a junior exploration company advancing the Cuiú Cuiú project in the Tapajós region of the state of Pará, anticipates the completion of Cabral's PFS by the end of 2023, with hopes to enter production by the end of

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» We have had problems with illegal mining invasions in the recent past, and we often have to compete for ground with organizations that do not pay tax or respect the law and cause environmental and social damage.



**Miles Thompson,**  
President and CEO,  
Lara Exploration

# TRISTAR GOLD

## BRAZIL'S NEXT MAJOR GOLD MINE

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TriStar Gold is advancing Brazil's premier gold development project, its 100% owned flagship property Castelo de Sonhos, in mining-friendly Pará State.

TriStar has completed a pre-feasibility study and is now advancing permitting while evaluating optimization options.

info@tristargold.com  
tristargold.com



2024. The company is benefiting from the investment in infrastructure that has been transforming Brazil of late. In the Tapajós region, major new roads have been constructed, including the BR-163 highway, and G Mining has funded a 170-km high voltage power line. Alan Carter, president and CEO of Cabral, noted: "Over the past 20 years, massive improvements have been made in the region, creating opportunities for more discoveries to be made."

Altamira Gold is a junior with multiple projects covering 180,000 hectares, including Cajueiro, with a resource of 700,000 oz. Michael Bennett, president and CEO, expressed that the legal framework has improved since 2014. "Most of the processes are now handled online, and this improvement has simplified things on the mining side," he said.

However, Bennett has observed a shift in terms of areas coming up for bidding that is challenging for juniors. He explained: "Currently, these areas require a financial offer, which may pose a challenge for a company like Altamira to compete with the major players."

Equinox Gold was started with the purchase, building and commissioning of the Aurizona gold mine, and although it has expanded with assets in Mexico, the US and Canada, Brazil is the heart of the company's operations. In 2022, Equinox Gold brought the Santa Luz mine into production with the construction of a new processing system, the first resin-in-leach system in Brazil. The company is now producing around 600,000 oz/y Au, and plans to continue developing the portfolio to reach the goal of 1 million oz/y. Greg Smith, CEO of the company, said: "Equinox gold is extremely pleased to currently see increased production right across our asset portfolio in Brazil."

Gold prices have reached a notable high of over US\$2,000/oz. Mike Durose, president of Lavras Gold, which went public in 2022 with approximately 1 million oz of gold resources in at least 23 gold showings on the property, emphasized the strengths of the commodity: "In today's market where there are a lot of geopolitical risks, inflationary pressures, and economic risk, people should diversify their investment portfolios, and gold is the best asset to do so."

The number of new mines in development and the boom in exploration demonstrate that the global mining community is confident both in Brazil as an investment target and in gold as a commodity. Durose continued: "I remain positive on gold and think it is a commodity everybody should have some exposure to, primarily for diversification purposes because it is a negatively correlated asset class."

Inflation, however, is a significant challenge to the gold segment, as mining becomes more cost-intensive. "2022 was a challenging year for gold producers in terms of increased input costs – reagents, explosives, mill steel, labor, fuel, etc. increased dramatically throughout 2021 and 2022," said Smith of Equinox Gold. The CEO of the multi-asset gold company added: "We have seen that level off in 2023, but we have not seen the gold price match that increase in costs." ■



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**Brazil continues to be a promising region for Kinross and the mining industry as a whole.**  
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## Gilberto Azevedo

President and General Manager  
**KINROSS BRASIL**

### Could you provide an overview of Kinross Gold's recent key activities and milestones in Brazil and recent production results at Paracatu?

Kinross has been operating in Brazil at the Morro de Ouro mine in the municipality of Paracatu, Minas Gerais, since 2005. In 2022, we produced 577,000 oz of gold. This production represented 22% of the national production.

One of the ongoing projects that will positively impact our production is Gravity, which aims to increase global gold recovery in our process. The project will involve the installation of concentrators in the circulating load of the grinding circuit, together with the implementation of an intensive leaching reactor. The investment is around US\$30 million and we hope to produce 20,000 oz/y with this project. The new circuit is already in the implementation process and is scheduled to fully operate at the end of the second quarter of 2024.

### How does Kinross prioritize strong community relationships and support the local economy?

The Integrar Program, our main social investment platform, covers essential areas, such as culture, job and income generation, education and environ-

mental education. Over the last twelve years, we have invested around R\$30 million in this program, benefiting approximately 60 thousand people.

Tax Incentive Laws are an effective way of directing resources that would otherwise be allocated to income tax to support funds, programs and social projects. For 2023, we have more than 30 projects scheduled, totalling R\$11.1 million. Of these, R\$10.2 million will be allocated to Paracatu, with a direct impact on the areas of Education, Culture, Sports, Youth Protagonism, Tourism and Income Generation. The remainder will be directed to the municipalities of Caçu and Cachoeira Alta, where we have hydroelectric plants.

Furthermore, our direct contribution to the municipality in 2023 is substantial, with investments totalling around R\$13.6 million. This includes the recent renovation of the Gidalte School, whose contribution was R\$1.6 million, the renovation work on the Maria Trindade School, budgeted at around R\$2 million, which began recently, and the renovation of the Municipal Hospital, a work of extreme importance for the population of Paracatu, which will receive R\$10 million for essential improvements.

### Could you discuss Kinross' approach to technology and innovation in Brazil?

At Kinross, we are committed to constantly investing in innovative extraction technologies and improving our operational efficiency and safety. A concrete example is our mine dispatch system, which monitors approximately 100 pieces of equipment in real time, including drills, excavators, trucks and tractors. This guarantees efficient and safe production.

We recently took an important step by implementing autonomous operation of part of our fleet of Pit Viper 271 drilling rigs. The project began in 2021 and, currently, three drills operate independently, receiving data and parameters from technicians to carry out the work. This automation reduces operating intervals, resulting in a significant increase in the number of holes drilled in the same amount of time, which in turn has boosted productivity and safety in our operations.

### What is the company's approach to ESG in Brazil?

Kinross has set ambitious goals aligned with the objectives of the 2015 Paris Agreement. Our commitment includes reducing scope 1 and 2 emissions intensity by 30% by 2030, and carbon neutrality by 2050. In 2018 we acquired two hydroelectric plants, Caçu and Barra dos Coqueiros, located in Goiás, with capacities of 65 MW and 90 MW, respectively. These plants provide approximately 60% of the energy required for our Paracatu site, resulting in a significant 45% reduction in Scope 2 greenhouse gas emissions.

Furthermore, in 2022, at Kinross Paracatu, we adopted initiatives such as optimizing the fleet of 793 off-road trucks and replacing two loaders with diesel engines with electric models. With this, we avoided the emission of almost twelve thousand tons of CO<sub>2</sub>. In 2023, we will continue with our efforts, including replacing combustion pumps with electric ones and replacing combustion lighting towers with solar systems, projects that will help avoid the emission of 2,200 t of CO<sub>2</sub>.

We believe that mining can be carried out in a responsible and sustainable way, contributing to Brazil's economic growth and the well-being of the communities where we operate. ■



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**AngloGold Ashanti continues to work hard for results in its Brazilian operational units, focused on sustainable mining.**  
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## Othon Maia

Director of Sustainability and Corporate Affairs  
**ANGLOGOLD ASHANTI**

### Can you introduce AngloGold Ashanti?

AngloGold Ashanti is one of the largest gold producers operating in Brazil. In addition to gold production, the company is active in energy generation for internal operations, real estate management, and sulfuric acid production. AngloGold Ashanti has gold mines and metallurgical and processing plants in the states of Minas Gerais and Goiás. In 2022, AngloGold Ashanti produced 399,000 oz of gold.

### What are AngloGold Ashanti's ESG strategies?

We achieved two major milestones in 2022: First, we reached 100% dry waste disposal, and second, we achieved a 33% reduction in carbon emissions. The latter was originally scheduled for 2030, and was achieved significantly ahead of schedule. To reach this milestone, we have transitioned to 100% consumption of electrical energy from certified renewable sources. AngloGold Ashanti will continue this work by eliminating scope 1 and 2 carbon emissions by 2050.

AngloGold Ashanti has also invested in the automation of mine infrastructure equipment (pumping and ventilation) and our diesel generation plant. Additionally, we have implemented underground water recirculation systems, optimized refrigeration plants, replaced air compressors with more efficient models, and improved our

energy monitoring and management system.

In 2022, AngloGold Ashanti invested approximately R\$18 million in actions related to environmental management, and the company preserves 11,000 hectares of nature.

### Can you discuss AngloGold Ashanti's approach to tailings management?

All of our dams have received stability condition statements issued by an external auditor. The structures are also included in the Integrated Mining Dam Management System (SIGBM) of the National Mining Agency (ANM). Our dams are monitored daily by a specialized AngloGold Ashanti team that checks the condition of the structure and assesses the water level and the functioning of the drainage system, ensuring that no incident occurs.

### How does AngloGold Ashanti utilize advanced technology?

AngloGold Ashanti was the first to use underground telemetry, a remote equipment monitoring system that predicts the need for machine maintenance. We also have a People Tracking system which monitors people and equipment underground; remote detonation via Wi-Fi, autonomous drilling that reduces the need for underground labor; semi-autonomous loaders; intelligent ventilation systems; and 3D technologies, among other innovations.

### Can you describe AngloGold Ashanti's approach to safety?

In 2022, the company strengthened the Critical Risk Management (MHCS) procedures, evolving the controls and monitoring of management indicators, promoting actions and training aimed at raising awareness and individual accountability among employees.

Some of the measures taken to avoid accidents include the use of teleremote operated equipment in the mine; the implementation of an automatic fire fighting system, and the implementation of a people tracking system at the Cuiabá mine, which connects to more than 400 Wi-Fi points in the underground mine to locate people and equipment in real time. AngloGold Ashanti offers leadership training through the ABC Methodology (focus on behavior) which is applied to change safety-related behaviors. Additionally, we apply CCV (Critical Control Verification), an activity carried out in the field in which people who go to work check whether the critical risk assumptions are in compliance.

These measures have already shown positive results, as demonstrated by accident data which has fallen year after year. Compared to 2020, the accident rate in 2022 was reduced by 40.6%. In relation to 2021, the drop was 36.7%.

### What is your perspective on gold pricing?

The gold market has reached high price levels recently, compared to historic prices. It reached more than US\$2,000/oz. This rise is due to sustained and significant interest from investors, which has made the metal one of the most attractive assets on the planet.

### What are the strategic objectives of AngloGold Ashanti?

AngloGold Ashanti remains focused on business longevity, centering the best elements of its 189-year history and anchoring operations in current best practices to maintain a responsible gold management and ESG strategy.

In September 2023, the London Bullion Market (LBMA) endorsed gold refined by AngloGold Ashanti. The company's refinery is annually audited by the LBMA, which is the main independent authority for precious metals. LBMA's Responsible Gold Sourcing Program protects the integrity of the global supply chain.

AngloGold Ashanti continues to work hard for results in its Brazilian operational units, focused on sustainable mining. In total, more than R\$1 billion will be invested this year and more than 3,500 direct jobs created. ■



## Rodrigo Barbosa

CEO  
**AURA MINERALS**

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**Our commitment is to increase our resources and reserves by intensifying our exploration investments and to grow by new M&As.**  
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### Could you describe Aura Minerals' growth over the past years and its current portfolio?

Aura Minerals is a TSX-listed exploration and mining company. Aura started as listed company in TSX in 2006 by acquiring a few projects, but they did not perform well due to the financial crisis in 2009. In 2017, a new investor, the Yamana founder, bought over 50% of the company's shares, while the board invited me to join as CEO. After 3 years of several initiatives and hard work, we experienced positive results that led us to win #1 performance in TSX twice (2021 and 2022).

We went from producing 120,000 gold equivalent oz/y in 2017 to 250,000 oz/y in 2023. The development of the greenfield projects in our portfolio will take us to 450,000 oz/y by 2025. Currently, we are operating four mines: Aranzazu, an underground copper-gold mine located in Mexico; San Andrés, an open pit mine, located in Honduras; and two operations in Brazil, EPP mine in Mato Grosso and the Almas mine in Tocantins, which is about to commence commercial production. Finally, Aura has four additional greenfield projects: Borborema, which is set to commence construction soon; Matupá, which we aim to start building next year; Serra da Estrela in Brazil, which is in an intense exploration program; and Tolda Fira in Colombia, that is still on permitting and exploration investments.

### What are Aura Minerals' current priorities?

Our commitment is to increase our resources and reserves by intensifying our exploration investments and to grow by new M&As.

### What is Aura Minerals' exploration approach?

Aura has 650,000 hectares of mineral exploration rights. In 2020, we started investing significantly in our exploration programs with US\$20 million, and this year the budget is over US\$23 million. The main objective is to extend the lifespan of the mines, especially EPP and Aranzazu.

We are also investing in other targets to bring new production in the future. A few examples are the Serrinhas target in Matupa project where we already had interceptions of 81 meters 3.89 g/t Au and 59 m at 3.14 g/t Au potentially as an open pit. We just started drilling for copper in Serra da Estrela, Carajas, a world class region with IOCG deposits where Vale operates important iron ore and copper mines.

### How does Aura Minerals promote ESG criteria?

ESG is fundamental to the future of Aura Minerals. We have decentralized decision-making to give more autonomy to each mining operation, so people who are closer to the local communities and understand their needs and dynamics can implement better ESG strategies.

For us, safety, accountability and transparency for local communities are essential. We invite the local population to visit our operations when we disclose our operating and reclaiming plans together with our best standards on safety, geotechnical structures monitoring and plans to improve local conditions.

In Honduras, we have been working on projects to provide health services, education for children and infrastructure for transportation, while in Mexico we optimized the process to reduce water consumption, utilize renewable energy and have worked with local authorities in several initiatives to improve local infrastructure. In Brazil we have several partnerships with the government agencies to train and hire local talents. For example, Almas is a mine that just started to ramp up in March, and we already have over 80% of our local workforce from the region and over 20% woman.

On the environmental front, we have set a target to reduce carbon emissions by 5% over the next three years. To do so we are planning to develop renewable energy projects at our Borborema operation, where we are also working with the government to implement a greywater treatment program.

### What are Aura Minerals' main goals for the next two years, and would you like to give a final message?

Our first goal is to produce 450,000 oz/y. Secondly, we want to increase our resources and extend the life of our mines. As I mentioned, we are also actively looking for M&As opportunities in order to go beyond our 450,000. And we plan to do all of it with our highest ESG standards which we call Aura 360 culture. When a company increases its production in a sustainable way, its market value also increases. ■



**Greg Smith**

President and CEO  
**EQUINOX GOLD**



**Equinox Gold is a diversified gold company with seven producing mines in Brazil, Mexico and the US, and a mine under construction in Canada, but Brazil is really where the company started.**



**Can you introduce Equinox Gold?**

Equinox Gold was formed in late 2017 through the merger of three companies. Our flagship project at that time was the development-stage Aurizona gold mine in Maranhão, Brazil. Over the next few years we acquired a producing mine in the US, built a mine in the US and another mine in Brazil, and completed a merger that gave us four mines in Brazil and a mine in Mexico. With the scale achieved through those transactions we were able to acquire the project that we are currently building in Ontario, Canada, which will be our flagship asset when it is in production next year. Today, Equinox Gold is a diversified gold company with seven producing mines in Brazil, Mexico and the US, and a mine under construction in Canada, but Brazil is really where the company started.

**What are the recent updates at your Brazilian mines?**

In 2022, Equinox Gold brought our Santa Luz gold mine into commercial production, our newest mine in Bahia, Brazil. The mine had been a past producer, and we reengineered and rebuilt it with a new processing system – a resin-in-leach system, which is the first of its kind in Brazil. Santa Luz is close to our Fazenda gold mine, and we call these two our Bahia Gold Complex. Between these mines we are producing approximately 130,000 oz/y, and there is good upside to both. We will focus on this gold complex for the next few years as we believe there is a great opportunity to expand Fazenda, drill out some additional resources between the two projects, and turn these two mines together into a significant asset for Equinox Gold and Brazil.

We are also producing around 120,000 oz/y from our Aurizona gold mine, and also advancing the development of an underground expansion that would increase production and extend the Aurizona mine life. Our RDM gold mine in Minas Gerais is a smaller asset where we have had some challenges over the past couple years, and are now starting to increase production.

**What is your outlook for gold moving forward?**

Right now gold has many headwinds – with a strong US dollar and high-interest rates, which generally puts pressure on the gold price – but gold has actually performed remarkably well and in some currencies is hitting all-time highs, demonstrating that gold is a good hedge against inflation, a good store value, and has been making gains even in the context of more challenging economic environments.

The real challenge the industry has faced recently been less about gold prices and more associated with inflation. 2022 was a challenging year for gold producers in terms of increased input costs – the cost of reagents, explosives, mill steel, labor, fuel, etc. increased dramatically throughout 2021 and 2022. We have seen those costs level off in 2023, but the gold price has not matched that increase in costs. If these elevated costs persist for a length of time, the gold price will have no choice but to react to the upside. Even if gold does not move on its own, the reality is, if you are not making a margin you are not going to produce as much gold, supply will drop and that will be bullish for the gold price. Gold has always gone up and will continue going up long term, but in this difficult economic environment we need to focus on what we can control: costs, efficiencies and maximizing our margin. Then, in those periods where gold really runs, we will have the opportunity to make significant money for our shareholders. I think as interest rates start to come down again and the US dollar comes off a bit, it is going to be extremely bullish for gold.

**What are Equinox Gold's strategies and goals for the next 24 months?**

Equinox Gold has the strategic vision of building a company that will safely and responsibly produce more than 1 million oz/y. We are currently producing approximately 600,000 oz/y. To reach our million-ounce goal we will keep developing our portfolio and potentially acquire additional assets to continue to grow the company. In Brazil, we are looking forward to getting underground at Aurizona and are very excited about the possibilities at Santa Luz and Fazenda, since we believe combining those two projects into one operating unit will enhance the production profile and longevity of our Brazil portfolio. ■



**Michael Durose**

President and CEO  
**LAVRAS GOLD**



**Our strategic goals are to define an economic gold mine at our LDS project, and to demonstrate the significant upside potential that we believe exists on the property.**



**Can you give an overview of Lavras Gold and its assets in Brazil?**

Amarillo Gold, our predecessor company, had two key assets - Mara Rosa, a shovel-ready open pit project of approximately 1 million oz in central Brazil, and the advanced exploration LDS project in southern Brazil. After Hochschild acquired Amarillo, Lavras Gold was spun off with the LDS project, US\$10 million in cash and a 2.0% royalty on certain exploration properties surrounding the Mara Rosa project, which should be in production by mid-2024.

Since Lavras Gold went public in April 2022, we have completed about 15,000 m of our 16,000-m drill program at LDS, prioritizing and testing several new targets that have never been drilled. We have recently upsized the drilling budget and will continue drilling. LDS is 29 claims on approximately 22,000 hectares of exploration ground around a favorable intrusive hosted gold system (Lavras do Sul Intrusive Complex) with a diameter of about 12 km. In addition to our 0.5 million oz at the Butiá gold deposit, we completed an NI 43-101 report on a second gold deposit, Cerrito, which added another 0.5 million oz to our resource, bringing us to approximately 1 million oz of NI 43-101 compliant gold resources in at least 23 known gold showings on our property. Importantly, Butia and Cerrito remain open to expansion. We have also announced several new discoveries at the Zeca Souza, Matilde, the Matilde Extension, Vila Marieta, Galvao, and Fazenda do Posto targets.

**Can you elaborate on Lavras' most recent discoveries at LDS?**

Our most recent discovery at Fazenda do Posto has gained attention because we drilled 340 m grading 1.09 g/t in bulk-tonnage style of mineralization. Fazenda do Posto also included some higher grade sub-intervals including 160 m grading 1.79 g/t including 27 m grading 2.07 g/t and 68 m grading 2.09 g/t. We have also drilled 21 holes into Zeca Souza, located on the west side of the intrusive complex about 1.2 km north of Butia and Fazenda do Posto. We encountered gold in all 21 holes, generally starting at or near the surface, but several holes bottomed in gold mineralization and require follow-up work. When we find visible gold – which has happened in 24% of the holes we have drilled, we typically find bonanza gold grades such as 43.6 g/t gold over 4.0 meters at a vertical distance of about 27 meters, and 3.0 meters grading 28.2 g/t gold at a vertical distance of about 100 meters vertical. This zone associated with visible gold at exceptional gold grades, together with long intervals of elevated gold values relatively close, suggests there is a robust gold system at Zeca Souza.

**What are the main challenges and opportunities for exploration companies in Brazil?**

Brazil has a strong legal system, although bureaucratic hurdles can be problematic. In addition, permitting can be time consuming, and the National Mining Agency has yet to improve its efficiency. Despite these challenges, there is immense potential for the mining industry to expand in the country as it remains largely unexplored. However, the mining industry must educate the population about the advantages of mining for the nation with objective information.

**What are Lavras' strategic goals for the next two years?**

Our strategic goals are to define an economic gold mine at our LDS project, and to demonstrate the significant upside potential that we believe exists on the property. In the near-term, we will focus on getting a better understanding of the scope and scale of our Fazenda do Posto discovery, as well as the relationship to Butiá. Moving forward, we will continue de-risking the project on both the geology and permitting sides, and converting some exploration concessions into mining concessions. We have several new targets to test and follow up on, and we will also focus on expanding gold resources at our most advanced project Butia. We also aim to continue to foster strong relationships with our stakeholders. Having an office in the town of Lavras do Sul is certainly helpful from a community relations perspective. We have also established the Rota do Ouro, or Gold Trail, which is a route that highlights the historical importance of gold mining to the development of the region. As one of the few mining companies in the region, Lavras Gold can demonstrate how to mine responsibly while bringing economic benefits to the area. ■



## Nick Appleyard

President and CEO  
TRISTAR GOLD



The cleanliness of the Castelo do Sonhos deposit helps on ESG management, and it fits into the Brazilian government's plan to have a modern clean mining industry.



### Can you introduce Tristar Gold?

Tristar Gold was formed from the sale of Brazauro to Eldorado with TriStar then acquiring the Castelo de Sonhos project. Tristar moved Castelo de Sonhos forward from 2008 to 2015. In 2015, some partners and I did a management takeover and injected more money and technical know-how into the company, and started moving it forward significantly faster.

In 2015, we had 280,000 oz of gold in resources. Within a few years, we had that up to 1.8 million oz of indicated, and 700,000 oz of inferred. We are still a single asset company, so our entire focus is on developing Castelo de Sonhos. We recognized that not only was the deposit excellent, but the location was very good as well. We are right next to a road and a power line, near to a labor force, and not in any indigenous or nature reserves. We have now completed our pre-feasibility study, and we are awaiting our LP, the main environmental permit, in the next few months.

### What are the strengths of the deposit?

Castelo do Sonhos is different because it is a paleoplacer deposit, which means it was a river fan 2 billion years ago, which is very old by the deposit standards of the earth. What is special about these projects is that they are generally very large, but because they've been weathered away already, they are very clean. There are no sulfides, there is no acid rock drainage, and no deleterious elements at all. It is comprised of quartzite (conglomeritic), silica, and then a few gold grains. The cleanliness of the deposit helps on ESG management, and it fits into the Brazilian government's plan to have a modern clean mining industry. This is probably the cleanest mine you could imagine in gold mining.

We have only developed a small portion of the project so far, and we have 1.4 million oz in reserves, right at the surface. If you see press releases for most companies, they are drilling 300 to 400 meter long drill holes to look for gold, and our drill holes are only 120 meters. We are just scratching to surface, there is so much more to explore.

### How does Tristar Gold prioritize sustainability?

We have a vice president of sustainability and an ESG committee at the board level. The company has done excellent work in this area since the beginning of our time at this project. We have our own nursery where we grow plants to revegetate drill sites, and after we replant our platforms, the remaining seedlings are distributed to the local community.

Our main focus though is on health and education. With the help of one of our investor companies, we assisted an important community near us in building a new school. Tristar always attempts to structure ESG projects so they are a strong partnership between us and the community.

### What do you see as the investment attitude towards Brazil?

Right now, Brazil seems to be one of the best jurisdictions within Latin America to attract investment. That wasn't the case for a few years, but the longer Brazil stays stable, the more favorable it will be as an investment target. Although at the federal level we have experienced a major change of government, the mining industry is still stable and still moving forward. The laws are solid and are enforced correctly. I think for most of us this is the most important, knowing where the goal posts are and not having them moving all the time.

### What are the main objectives for Tristar Gold over the next two years?

At Tristar Gold, our 100% focus is on Castelo de Sonhos and getting it permitted. Next is the final feasibility study, and finally, to enter the construction and production phases. It is just a matter of how we do that. We have hired a Chief Operating Officer who has hands on experience mining these types of deposits. As the project gets bigger, it might become beneficial to have a bigger partner, but the idea is to move the project into production as quickly as possible. ■



## Michael Bennett

President and CEO  
ALTAMIRA GOLD

### Can you provide a brief introduction to Altamira Gold and your current portfolio in Brazil?

Altamira Gold is a TSX-listed junior company chiefly concerned with exploration in our projects in Mato Grosso and Pará. Today, our primary projects include Cajueiro, which now boasts a resource of 700,000 oz; Apiacás, a historic gold-producing area with a footprint of one million oz; and Santa Helena, where we are not only exploring gold but also copper. In 2024, we plan to compile a resource on Maria Bonita, an area within Cajueiro that promises substantial returns.

### Could you expand on the main highlights at the Maria Bonita discovery?

One of the areas we identified through soil sampling was Maria Bonita, which displayed no signs of previous mining activity. After an unsuccessful attempt at trenching due to deep weathering, we decided to drill directly into a gold-in-soil anomaly. We were rewarded with a uniform distribution of gold running through an intrusive rock. In addition, we have discovered that the economics of this system are very significant, with more than 90% recovery using cyanide leach and VAT leach methods. Our next phase will involve a more in-depth exploration to determine the size and depth of Maria Bonita, and we plan to add a 43-101 resource here to our existing resources in 2024.

### What are the main updates on the Santa Helena project?

At Santa Helena we completed around 3,000 meters of drilling in early 2022, revealing high-grade veins of gold. We have also implemented soil sampling to identify anomalous copper in soils. Our recent geophysical study suggests that we have possibly identified an important crustal break where porphyries are likely to surface. Interestingly, we found that a circular magnetic low coincides with copper in soil anomalies. Moving forward, drilling this in 2023-24 and finding a copper porphyry could prove incredibly beneficial for Altamira Gold. ■

### Can you give an overview of the Cuiú Cuiú gold project in Brazil?

Cabral Gold (Cabral) is a junior gold exploration and soon-to-be development company. We have a 100% interest in the advanced Cuiú Cuiú gold project, located in the Tapajós Region, within the state of Pará. The Cuiú Cuiú gold project has approximately 1.2 million oz of 43-101 compliant resources, half of which is inferred, and half indicated. These resources are contained within two deposits, but the recent discovery of two new deposits that need further drilling suggests the resource base will grow.

Our focus for the next 12 to 18 months is to complete a PFS on the near-surface oxide portion of the gold deposits. We anticipate completion of the PFS on the oxide material by the end of 2023, which if positive, will lead to make a construction decision during Q1 2024, and be in production by the end of 2024.

### Can you expand on the reasoning behind Cabral's decision to enter into a Royalty Agreement with Osisko Gold Royalties?

Given current low share prices and the depressed market, it is very difficult to raise capital. Most companies are raising capital through private placements and suffering significant dilution as a result. Cabral weighed up all the options and decided that the best route was to raise money through the sale of a 1% NSR royalty, and we raised approximately US\$5 million, without having a huge amount of dilution to our capital structure.

This has given us a healthy cash balance of approximately C\$8 million. Over the next months, our focus will be the completion of the PFS, additional metallurgical tests work, mine plans, engineering studies, and further drilling. The project is fully permitted for a small mining operation and is licensed under trial mining licenses in Brazil. ■



## Alan Carter

President and CEO  
CABRAL GOLD

# Critical Minerals

## A value-add approach to critical minerals production

Image courtesy of AMG Brasil

In June 2023, Glencore, Stellantis and Volkswagen's battery unit PowerCo came together to back a US\$1 billion deal by ACG Acquisition Company to purchase two Brazilian mines; the Santa Rita nickel sulphide and the Serrote copper mine. The deal will turn ACG into ACG Electric Metals, focused on supplying critical metals for EV production in the West. The move was one of a number of major steps taken by global players to increase their presence in the Brazilian critical minerals area.

Brazil has lagged behind competitors like Chile and Argentina in terms of attracting direct attention from car companies and EV producers. Recently, however, vehicles manufacturers have started looking to Brazil. In June, the US automaker General Motors met with representatives of IBRAM to discuss critical minerals production in Brazil.

Brazil's government is committed to developing the critical minerals segment and plans to launch a critical minerals fund at the next COP in 2024. Flávio Moraes da Mota, head of extractive and base industries department at the BNDES, explained: "The fund will support the exploration and development of the production of essential minerals in Brazil along the complete value chain."

### Lithium

On May 9, 2023, Governor Romeu Zema of Minas Gerais rang the bell at the Nasdaq stock exchange in New York, launching the Lithium Valley Brazil initiative (Vale do Lítio). The initiative intends to develop the populations of the Northeast and North parts of the state around value-added lithium production. In 2022, the government also loosened the rules on lithium exports.

Sigma Lithium is one of the companies that has benefited from Brazil's lithium expansion, entering production and shipping its first batch of 5.5% grade lithium concentrate in July, 2023. Sigma has capacity to produce 36,700 t/y of lithium carbonate equivalent (LCE) at its Grota do Cirilo project.

In 2018, AMG Critical Minerals N.V. completed the construction of a US\$65 million lithium spodumene processing plant, and has since produced 90,000 t/y of lithium spodumene. AMG is seizing the momentum, and is currently expanding production to 130,000 t/y. With a further US\$250 million investment, AMG plans to convert concentrate to carbonate within Brazil. Fabiano Costa, CEO of AMG Brasil, explained: "In Brazil, we have a clean energy matrix due to our hydropower, and shipping all the concentrate to China to be processed produces as much CO<sub>2</sub> as we are saving."

Companhia Brasileira de Lítio has also significantly expanded since 2021, with the mining unit reaching 45,000 t/y and the chemical plant reaching 1,500 t/y of LCE. The company is conducting feasibility studies for an expansion program with the potential to begin next year.

Brazil is far from developing a complete battery supply chain, despite having the technology and natural resources for battery making. Vinicius Alvarenga, CEO of Companhia Brasileira de Lítio, identified the lack of demand as due to Brazil's successful ethanol program which has reduced the country's dependence on fossil fuels and incentives to purchase electric vehicles. Alvarenga stated: "I believe we should establish some type of incentive program for electric vehicle purchases, even if small, to avoid isolating our car industry in the future."

### Copper

6.1% of all Brazil's mineral production is comprised of copper, which can be found across the country, with production centered around the three states of Bahia, Mato Grosso and Pará. According to data from IBRAM, copper investment is expected to be over US\$4.5 billion over the 2023-2027 period.

Among the companies carrying out significant growth initiatives is Ero Copper, which controls the Caraíba operations in Bahia. In addition to constructing a new US\$300 million external shaft at the Caraíba project, the company began construction of its Tucumã project in April 2022. Production at Tucumã, an open pit mine, is expected to commence in the latter half of 2024, doubling Ero's consolidated copper production.

Vale, meanwhile, is advancing its US\$30 billion nickel and copper investment plan. In July, the company announced its intention to sell 13% of its base metals division, VBM, to Manara Minerals for US\$3.4 billion.

Copper juniors are equally enthused about developing in Brazil, but struggle with certain unfriendly policies. Lara Exploration is developing the Plenalto project, located near several copper deposits such as BHP's Pedra Branca, in a JV with Capstone Copper. Miles Thompson, president and CEO, said: "One of the most frustrating aspects of working in Brazil as a junior exploration company is the slow turnover of mineral rights. We now have a new licensing system in place where if there is more than one party interested in a piece of land, it goes to auction, which is great, but the process is slow and has now been interrupted for some time by the need to catch up on paperwork."

### Rare earths

In January 2023, the Serra Verde REE (rare earth elements) project received a capital injection of US\$150 million to advance the project, and it expects commercial production to begin by the end of 2023. The project is one of the few ionic-clay REE deposits outside of China, and like other ionic-clay deposits, can be mined easily without energy-intensive or environmentally risky procedures. The project, which at production will be the first scale operation to produce four critical magnetic REEs outside of Asia, is an excellent example of Brazil's REE potential.

This potential can only be advanced with significant investment, which is challenging to obtain. "The international financing environment has been difficult in recent months due to macroeconomic conditions, especially high interest rates," said Tom Drivas, CEO of Appia Rare Earths & Uranium Corp, a Canadian exploration company that recently acquired the Cachoeirinha project (PCH) in Goiás, Brazil.

Alvo Minerals, an exploration company advancing the polymetallic copper-zinc-lead-silver-gold VMS Palma project in Central Brazil, recently acquired the Bluebush REE project. Rob Smakman, CEO, identifies the country as ripe with opportunity: "Alvo will continue looking for other opportunities around Brazil, specifically around the Palma area, which we think is emerging as one of the more promising exploration and mining districts in Brazil."

Meteoric Resources acquired the Caldeira rare earths project in March 2023. Caldeira's average grade is three times higher than the second-best rare earth grade in the world, and since acquiring the project, Meteoric's market capitalization has increased from A\$20 million to A\$500 million. "Brazil can change the energy transition market dynamics," said Marcelo de Carvalho, Meteoric's Brazil country manager, noting that China sets rare earth prices and there are no ionic clay rare earths mines outside of China. "Once the first deposit in Brazil starts producing, the market will recognize the amazing rare earths potential of the country."

### Nickel

Nickel, which comprises 1.2% of all mineral production in Brazil, is poised to experience a demand surge, as numbers from the International Energy Agency signal that the production of electric vehicles is already outpacing predicted numbers for 2030. Unlike other critical minerals, there is currently no direct substitute for nickel, placing the mineral in a strong position to benefit from the electrification boom.

Centaurus Metals acquired the Jaguar nickel sulphide project from Vale in 2019, and recently finalized a deal to buy back the off-take rights that Vale held over Jaguar. The project is classified by the Federal Government as a critical project due to its nickel sulphide deposit, with an estimated resource nearing 1 million t with 70% of the resources less than 200 meters from the surface. "At Jaguar, we aim not just to extract nickel but also to produce nickel sulphate, a direct component used in batteries. This involves advanced processing, turning the mined nickel into nickel sulphate, and leveraging Brazil's abundant resources and affordable labor and power costs," said Bruno Scarpelli, executive director at Centaurus Metals.

However, the global market for nickel is competitive. Major mining jurisdictions worldwide are recognizing the need to lock down their position within the critical minerals segment, and Brazil is comparatively late to the game. Luis Azevedo, CEO of Bravo Mining, which is developing the PGM + Au + Ni Luanga project, emphasized the need to jump on the moment: "If we come late to the EV party, we will not get in – battery makers will already have a supply chain settled."

### Aluminum

During the pandemic, there was strong demand for aluminum, used both in packaging and in civil construction as people in lockdown renovated their homes. Globally, demand has decreased in 2023, due not just to the downturn in China, but to lower demand worldwide. "However, the Brazilian market is quite good," said Luciano Alves, CEO of CBA, which primarily provides aluminum to the domestic market. "There are some segments that are not doing as well, but some are doing very well. In Brazil, the transportation and consumer products markets are robust."

Guido Germani, CEO of Mineração Rio do Norte, explained that the larger aluminum landscape is challenging. Germani said: "We are seeing a lot of smelters closing in Europe because of high energy prices, and there are also a significant number of Chinese companies mining bauxite in Guinea that have brought about 80 million tons to the market in the last five years." ■

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**Luciano  
Alves**

CEO  
**COMPANHIA BRASILEIRA DE  
ALUMÍNIO (CBA)**



**For the company's entire history, we have done it all: producing our own bauxite, generating power, producing aluminum products and recycling.**



**Can you introduce CBA?**

CBA is a fully integrated aluminum producer, which is uncommon – usually, there are separate bauxite producers, alumina producers, smelters, and downstream businesses. For the company's entire history, we have done it all: producing our own bauxite (the primary ore of aluminum), generating power, producing aluminum products and recycling. This complete integration provides us with a significant competitive advantage.

We are focused on Brazil, selling 90% directly to the Brazilian market and exporting 10%. CBA will continue to grow, with significant investments across each step of our value chain and many investments flagged for the future modernization of the company, including decreasing emissions. One of these investments is the installation of press filters in one of our tailings dams to transition to dry-stacked tailings.

**How does CBA produce aluminum sustainably?**

Our aluminum production footprint is quite differentiated. We have a low-carbon production process due to the use of renewable power and established recycling operations. We expect to see higher demand for low-carbon products, particularly when there is a differentiation in pricing for low-carbon products, which has yet to be the case. When there is carbon taxation in the market, having low-carbon production will also be an advantage.

Recycling is a key investment for our future. Financially, it is a more stable, less volatile business than primary aluminum, which is a commodity business. Recycling also provides us a better risk-return profile to our portfolio and reduces our carbon footprint. Recycling will play a key role in lowering carbon intensity for aluminum producers. In Brazil, the collection network for scrap is relatively well-developed. There is a full spectrum of companies and people that depend on the recycling market. Moving more deeply into this segment, therefore, is essential to us also due to the social benefits it provides.

**What trends in demand have you observed recently?**

Worldwide, there is a change in the industry. Post-pandemic, there was significant consumption of aluminum on packaging, for instance, and investment by people in civil construction for renovations. There was strong demand in 2021 for those segments, but that demand has decreased this year. China is still growing, but the housing market is not as good as it once was. This is not only about China – demand worldwide is currently not as good as well. Ours is a commodity business and we are in a downturn, but we are used to this. However, the Brazilian market is quite good; the transportation and consumer products markets are robust.

**Can you discuss the importance of renewable energy for Brazil?**

One of the most important competitive advantages is that an aluminum producer can access renewable power. It significantly lowers costs. The aluminum emissions today are primarily driven by smelters and power generation, so companies that use coal-powered thermal power plants have very high emissions. To be a low-carbon aluminum producer, you need to produce less than 4 t of CO<sub>2</sub>e for each t of primary liquid aluminum produced. CBA is at 3 t, and the global industry average is 12.6 t, more than four times higher than our carbon footprint.

Some of our hydropower concessions will expire over the following decades, but we intend to continue to be fully integrated into renewable energy – probably reducing the percentage of hydro and increasing the share of wind and solar. As a country, Brazil has a lasting competitive advantage in the market due to our renewable energy footprint.

**What is your strategy for the coming years?**

CBA is developing and delivering big investments in 2023. The first is the press filter technology, which is key for us as we transition to dry-stacked tailings. That big investment reached an important milestone with the delivery of filter press equipment in the work in April, and electromechanical assembly, and will be completed at the beginning of next year. Second, we are investing in recycling, having commissioned a new scrap cleaning and processing plant in October 2023. This will increase our capacity for recycling and enable us to utilize lower-quality scrap. We also have significant future investments in our portfolio until 2027, to continue to grow and modernize the business. With these investments, our goal is to have a bigger, more competitive and sustainable business in the future. ■



**Vinicius  
Alvarenga**

CEO  
**COMPANHIA BRASILEIRA  
DE LÍTIO (CBL)**

**How has the expansion of the chemical plant in 2022 affected the overall capacity of CBL?**

In the past two years, CBL has seen significant growth in our operational capacities. Previously, our focus was predominantly on the domestic market, leading to underutilization of potential. In 2021, we decided to expand our two operational units located in Vale do Jequitinhonha. Our mining unit in Araçuaí Tinga and chemical plant unit in Divisa Alegre were both subject to this expansion. The mining unit's capacity increased from 11,000 t/y to a recent achievement of 45,000 t/y. Likewise, the chemical plant expanded from 14 t/y of Lithium Carbonate Equivalent (LCE) per year to 1,500 t/y. As a next step, we are conducting feasibility studies for another expansion program which, if feasible, will begin next year.

**Can you explain the hard-drove method extraction from pegmatites and the chemical process to produce lithium?**

Our unique approach involves underground mining of lithium pegmatite. Contrary to most other operations worldwide, this method reduces dilution and contaminants and generates almost no waste, providing significant environmental and cost advantages. In terms of processing, we use Dense Media Separation (DMS) to concentrate the pegmatite. The lithium content increases from approximately 1.3-1.5% to 5.5% through this process. Pegmatites from hard rock have less magnesium and boron content than those from brines, resulting in carbonate and hydroxide with lesser contaminants.

**How is Brazil positioned to develop a battery supply chain?**

Brazil is quite far from developing a full battery supply chain, despite having natural resources for battery making and the necessary technology. The main issue is the lack of demand due to Brazil's successful ethanol program which has been reducing the country's dependence on fossil fuels. Consequently, there is not much pressure in the market to incentivize electric vehicles. I believe we should establish some type of incentive program for electric vehicle purchases to avoid isolating our car industry in the future. ■

**What are AMG's planned development projects in Brazil?**

We are currently expanding production from 90,000 t/y to 130,000 t/y with an investment of US\$50 million. This expansion also allows us to increase our tantalum production. Tantalum is an essential component in keeping us cost competitive. Even if the lithium price drops, AMG will survive because of the diversity of our production. The expansion from spodumene will be finalized by the end of the year, and then we will have the operational ramp-up phase. I expect to operate in this new nominal capacity around the first quarter of next year.

Our significant step forward for AMG Brazil is to convert from concentrate to carbonate within Brazil. The investment for this project will be around US\$250 million, with a financial line from KfW, the German Development Bank. Our refinery will go from technical grade carbonate to battery grade hydroxide, which will be completed by the end of 2022. That is the vision of AMG Lithium.

**What are the positives of operating in Brazil?**

Unfortunately, Brazil is a country that has been labeled as corrupt, and we have been trying very hard to clean this image. Nowadays, the country is very secure from a legal perspective. For a big company like AMG, there is no risk in operating in Brazil. And for mining, in particular, the industry benefits because the country is mining-oriented.

AMG recently announced that we came to an agreement with a partner in Portugal. I have seen that building a mine in the heart of Europe faces significantly more hostility than constructing and opening a mine in Brazil. In Brazil, we have community support because communities usually see a mine as a potential for development. Additionally, from a legislation perspective, we have excellent legislation for mining, from environmental law to labor protection. I would dare to say that there is no better legislation in the world for mining. ■



**Fabiano  
Costa**

President and CEO  
**AMG BRASIL**



»» **Mineração Rio do Norte (MRN) was the first big bauxite mine in Brazil, and today, we are still the largest Brazilian producer and exporter of bauxite.** ««

## Guido Germani

CEO  
MINERAÇÃO RIO DO NORTE

### Can you give an overview of Mineração Rio do Norte and the company's footprint in Brazil?

Mineração Rio do Norte (MRN) was the first big bauxite mine in Brazil, and today, we are still the largest Brazilian producer and exporter of bauxite, with a production capacity of 18 million t/y, but currently producing 12.5 million t/y. Approximately 70% of our production remains in Brazil, primarily serving verticalized refineries, and the rest of the production is exported to countries in North America, Europe and Asia.

### Can you speak to MRN's performance in the last 24 months?

The past year has been challenging, as the market has run into difficulties. We are seeing a lot of smelters closing in Europe because of high energy prices, and there are also a significant number of Chinese companies mining bauxite in Guinea that have brought about 80 million tons to the market in the last five years. Fortunately, MRN has integrated shareholders in the aluminum business who are willing to take all our production. Since we essentially have our own markets, MRN is in a comfortable position.

Although we have an 18 million t/y production capacity, our resources at the East Zone will be depleted by 2027 or 2028. We have thus reduced production to 12.5 million t/y to extend the resource timeframe to make room for the licensing process on the West Zone mine expansion.

### What makes the state of Pará attractive as a mining jurisdiction?

The state of Pará is a thriving mineral province with a variety of deposits in early-stage exploration, including nickel, copper, bauxite, iron ore, gold, etc. Compared to Minas Gerais the landscape gradient is much flatter which is favorable for logistics, and there is a river way which is fantastic for logistics as well. However, there is still a significant investment to be made in infrastructure, and the state of Pará is in the process of attracting suppliers to establish themselves in the province.

### Can you expand on MRN's approach to tailings dam safety and ESG?

MRN's operation is located in flat geology, our tailings process is purely physical, meaning there are no chemicals involved, and the waste is a fine clay that dries up as hard as a brick.

These factors enhance the safety of our tailings dams.

We have also invested in a sustainable mining model which is focused on compliance with socio-environmental constraints. With our reforestation initiative we have rehabilitated around 7,500 hectares over the past 44 years. We are also studying reforestation initiatives in the communities to protect the Amazon and its flora and to create economic opportunities for them. Today, I can proudly say that MRN is an important vector of socio-environmental development in the Amazon region and is completely integrated into the environment. As our 2022 Sustainability Report clearly demonstrates, MRN belongs to the Amazon and, as such, we take care of this ecosystem with respect and responsibility.

Moreover, MRN has invested continuously and increasingly in the education and professional training of its employees and neighboring communities. As an example, we highlight the Basic Education Support Program (PAEB), which benefited a total of 125 quilombola children and young adults in 2022, with investments in scholarships, teaching and school materials, uniforms, food, transportation and after-school tutoring.

### What are the main strategies MRN has implemented to increase productivity and safety?

The company has been investing in automation in our plants, which significantly increases both the productivity and safety of our operations. This includes automated conveyor belts with monitoring systems to identify belt productivity and fatigue, remote-controlled dozers which can be operated from a safe space, internet coverage within the mine to be able to install collision avoidance technologies, and drones for surveying, measuring, and to be able to have an eye on the extensive area of operations.

### What are the main objectives of MRN for the next two years?

MRN's main objective is to license our new deposit before our resources are depleted at the East Zone, expected in 2027/2028. If everything goes well, we will be ramping up a new mine by the end of 2027, giving us an additional 15 years of operation. ■



## Marcelo de Carvalho

Brazil Country Manager  
METEORIC RESOURCES

### Can you summarize Meteoric Resources' main milestones?

In light of market trends and Brazil's geological potential, evidenced by significant recent discoveries of critical minerals, Meteoric Resources started searching for a rare earths project. We immediately recognized the value of the Caldeira project, and we completed the acquisition in March 2023. Six months after acquiring the project, our market capitalization has increased from A\$20 million to A\$500 million.

We are also observing a lot of support from the Brazilian government in developing critical minerals deposits, as they have realized that Brazil can lead the energy transition on a global scale. The country has immense rare earths reserves. There are already several companies exploring deposits, and Serra Verde is about to start production at its Ionic rare earths deposit in Brazil.

### What are the main exploration activities done in Caldeira?

We started diamond drilling in January 2023 and have taken some mineral samples for metallurgical testwork to the Australian Nuclear Science and Technology Organization. We expect our first results from them by early 2024. Other objectives of the drilling program are to understand the deposit's geology and test some areas that have not been drilled before. To this end, we imported an air core drill rig from Australia and hired a highly experienced driller.

### What factors make the Caldeira ionic rare earths project special?

There is nothing similar in the world in terms of grades. Our average grade is three times higher than the second-best rare earth grade in the world, partly because we are located within the largest alkaline caldera in the world. It has the potential to contain 5 or 10 billion tons of ore. Another remarkable feature is the yield. If you leach with a fertilizer at room temperature and a pH of 4.5, you can recover 70% of the ore. ■



## Rob Smakman

CEO  
ALVO MINERALS

### Can you introduce Alvo Minerals?

Alvo Minerals launched as a private entity in 2019 when we won an auction bid for the Palmeiropolis Volcanogenic Hosted Massive Sulphide (VMS) project. We raised financing on the ASX and consolidated the acquisition of interests in various surrounding exploration permits to establish an exploration tenure called the Palma project, a polymetallic copper-zinc-lead-silver-gold VMS project in Central Brazil.

### Can you elaborate on the phase two drilling results at the Palma project?

We have approximately 1,000 km<sup>2</sup> under tenure at the Palma project, and over the last six months, we have done significant regional exploration, trying to bring new prospects to a drill-ready stage.

Phase one was to ensure that the historical work was done to a level that is acceptable for JORC, and phase two was to establish how we can expand the project down-dip and along strike, potentially improving the confidence in the resource and move it from inferred into indicated.

We have been pleasantly surprised by the first few holes we have drilled on this target and hope to classify it as a resource soon.

### Can you expand on your expectations for Alvo's recently acquired Bluebush REE project?

We have the infrastructure and teams ready to explore, which makes Bluebush a low-risk project for exploration. We will utilize our auger rig, which is a much faster way of testing the project, and hopefully, we will be able to go significantly deeper than what is possible with a handheld auger. We expect to have six months of due diligence over the project, and if it turns out to be ionic, we are excited about the potential of Bluebush to be a new and emerging REE project in Brazil. ■





## Bruno Scarpelli

Executive Director  
CENTAURUS METALS

### Could you tell us about Centaurus Metals' history and business model?

Centaurus Metals is an international resource development company listed on the Australian Securities Exchange headquartered in Perth. However, our primary focus is Brazil. From 2008 to 2014, our attention was solely on the Jambreiro iron ore project, which remains a development-ready asset. In 2015, we diversified, and this led to our acquisition of the Jaguar nickel sulphide project from Vale in 2019.

### How are you planning to develop after the recent deal with Vale?

Last month, we finalized a significant deal with Vale, where we negotiated to buy back the off-take rights they originally held over the Jaguar project. This has significantly expanded our opportunities for strategic partnerships and alliances, especially with battery and car manufacturers.

### Can you shed light on the Jaguar project prospects?

The estimated resource is nearing 1 million t nickel. A few attributes make this project stand out: 70% of our resources are less than 200 m from the surface, ensuring an open-pit operation for about 20 years; the deposit has a high average grade in global terms; and its location offers easy access to infrastructure like power and roads. Most importantly, the project is anticipated to have one of the lowest carbon footprints in the world due to Brazil's renewable energy-driven power sector.

### Could you elaborate on the Jambreiro project?

We are currently renewing the licenses and gathering environmental data, with the aim of releasing an updated environmental impact statement soon. Our objective is to secure the construction license in 12 to 18 months.

### What are Centaurus Metals' objectives for the near and distant future?

Our immediate goal is to complete the DFS for the Jaguar project by the end of the 2023. The construction phase is estimated to take around two years, with production forecast for the start of 2027. ■



## Luis Azevedo

CEO  
BRAVO MINING

### What is the history of Bravo Mining?

Luanga is a project found by Vale in the 2000s, with the discovery of a platinum occurrence. That escalated to a total exploration investment of about US\$50 million for 50 km of diamond drilling, generating a unique at surface PGM+Au+Ni deposit with 8.1 km of strike. Luanga was deemed not attractive enough at the time and was kept in their portfolio of assets.

In 2021, we completed the deal with Vale and off we went to form and engage the best team we could have.

Last year, there were only two IPOs in the TSX group, we were one of them. Our market cap increased from US\$175 million from IPO last July to approximately US\$500 million in just one year.

### Could you provide an overview of your Phase I and Phase II results?

We have drilled over 40,000 m, with Phase I focused on infill drilling and confirmation drilling from the previous owner's results. During Phase I, we re-assayed historic drill core that confirmed multiple mineralization horizons, completed 25,500 m of infill drilling and discovered new nickel-rich zones as well as high grade PGMs with exceptional rhodium values. With Phase II drilling we started to test deeper targets, and results thus far have come back prospective. We found Luanga to have very wide intersections with grades getting better down deep. Our initial thought was that this deposit could be an open pit mine, but we have now realized that an underground mine could also be a possibility.

We have 2.5 times the value of copper, and we also have PGM very rich in Palladium and Rhodium. Having such a rich portfolio of valuable and sought after commodities provides us with protection during market downturns and great leverage at peak periods over the cycles. ■



# Potassium and Phosphates

## Fertilizers flourish with National Fertilizer Plan

Image courtesy of Mosaic Fertilizantes

Phosphates make up 1.3% of Brazil's total mineral production. The agribusiness contributes approximately 30% to the country's GDP, but the country imports approximately 85% of all fertilizers. The Russia-Ukraine conflict caused a peak in macronutrient prices, providing fertilizer companies with higher profit margins. The crisis also highlighted Brazil's vulnerability in terms of supply. The strong internal market, government support and resource potential have placed the fertilizers segment in third place for investment, after iron ore and socioenvironmental projects, with a predicted 2023-2027 capex investment of over US\$5 billion.

The Potássio do Brasil potash project in Amazonas is one of the projects that is benefiting from the rush in investment. The project has a reserve of 2.2 million t/y for and LOM of 23 years, with the potential for growth. The company, which requested its installation license in August of 2023 with intention to break ground in early autumn 2023, is essential to the government's plans to increase domestic potash production, with the capacity to produce 20% of Brazil's total demand. Adriano Espe-schit, CEO of Potássio do Brasil, said: "The project is essential not just for Amazonas and Brazil, but also for the world because of the five meals that the world consumes, one comes from Brazil. For example, 75% of the orange juice in the world comes from Brazil."

For Mosaic, Brazil's largest fertilizer company, Latin America is a growth engine. The company is prioritizing investments in Brazil, including at the Taquari-Vassouras mine in the state of Tocantis and at the Fospar port in Paraná, to enable larger shipments. Corrine Ricard, president of Mosaic,

explained that a major barrier to fertilizer self-sufficiency is the difference in tax treatment between imports and domestic production: "The current tax regime disincentivizes domestic production, making it more efficient to import fertilizer. Secondly, infrastructure deficiencies make it difficult and costly to transport products from mineral concessions to agricultural areas. Also, there are inconsistencies in federal and local regulations that make the permitting process for developing projects lengthy and complex."

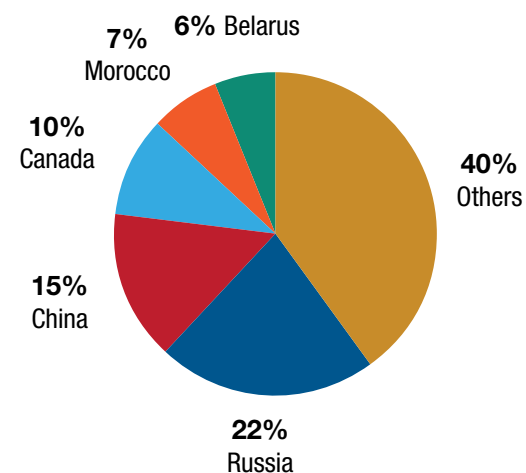
Nevertheless, Ricard identified Brazil's National Fertilizer Plan as a positive step to improving the situation. In 2022, the federal government enacted the 2022-2050 National Fertilizer Plan with the intention of reducing Brazil's

dependency on imported fertilizers. The plan targets an increase of domestically produced fertilizers to 55 % of national consumption in 2050 from 15% as of 2022. The decree established a National Council on Fertilizers and Plant Nutrition (CONFERT), which will coordinate and set PNF initiatives and facilitate public-private cooperation.

Itafos, a producer and explorer, has three projects in Brazil: Arraias, a producer, and Araxá and Santana, which are juniors. "The National Fertilizer Plan is an important kick-off which in this first moment seeks a reduction of fertilizer imports. However, the investments in the sector will rely on a clear and reliable environment from a legal, regulatory, and political standpoint," said Felipe Coutas, country manager at Itafos.

### Fertilizer Suppliers

**Brazil has almost a third of its imports coming from nations under conflict.**



Source: Brazil Ministry of Economy and Bloomberg

Itafos broke financial results records in 2022, with revenues of \$593.3 million and adjusted EBITDA of \$224.8. The company attributed those numbers both to strong production and improved market fundamentals for the agricultural sector. Factors such as the Russia-Ukraine conflict caused a peak in macronutrient prices, which contributed to a higher profit margin on the company's products.

The company is actively investing to strengthen their operations in Brazil, including technology to reduce the need for tailings dams. The company's new SCADA system, meanwhile, will allow them to completely connect the complete mining facilities. In Brazil, they aim to continue developing the Santana project and restart SSP production and sales at Arraias.

The mining sector has the opportunity to use the critical nature of fertilizer production to push for a stronger position for the industry politically. Luis Vessani, president of EDEM Projetos, identified the imbalance between the agribusiness and mining sectors as a key challenge to Brazil's push for fertilizer self-sufficiency: "Agribusiness has a stronger political presence, overshadowing the mining sector."

Agua Resources found the Lucena deposit in northeast Brazil, and has begun working on developing the Três Estradas phosphate discovery. The Três Estradas project will be the first phosphate mine in the southern region of Brazil, estimated to produce 300,000 t/y, 10% of the existing demand within a 300 km radius of the site. The benefits of producing local phosphate will include a lower cost due to reduced logistics costs. Indeed, having access to cheaper phosphate

will enable the agricultural producers in Brazil to increase their profit margins.

The major priority for the country when specifically focusing on fertilizers must be increasing the country's current ability to mine potassium. Júlio Nery, director of sustainability and regulatory affairs at IBRAM, stated: "Agribusiness plays a huge role in the country's economy, but we import over half the country's needs for phosphates. We have new phosphate projects, so what we really need is new potassium mines, as we only have one operation and it only covers 5% of Brazil's demand."

Indeed, the ability to produce fertilizers domestically is a matter of self-sufficiency and stability. Currently, many of the primary global fertilizer producers are in states of conflict or, for various reasons, geopolitically challenging. Flávio Moraes da Mota, head of the extractive and base industries department at the BNDES, the Brazilian development bank, stated: "Food security is a particular issue in Brazil due to our dependence on imported fertilizers."

Increasing domestic fertilizer production is a national priority and demonstrates the essential contributions the mining industry offers to the Brazilian nation and people. The government, aware of how essential the fertilizer segment is, is all in on fertilizer projects. Phosphate mining projects benefit from strong government support, both in terms of permitting and capital access. Agua, for example, secured 50% of the capital costs for the construction of their phosphate mine with the local development bank. ■



Potássio do Brasil's seedling nursery in Autazes, Amazonas



The city of Autazes, Amazonas



3D Layout - Beneficiation plant

Brazil Potash's subsidiary in Brazil "Potássio do Brasil" proudly presents its efficient and sustainable contribution to food security in Brazil and the rest of the world, called **Autazes Potash Project**, in the Brazilian state of Amazonas. Staying fully committed to sustainable development, the company's actions were guided by the ESG strategy (Environment, Social and Governance). Through the production of potash fertilizer, Potássio do Brasil can contribute to Brazil's agribusiness, which helps feed the world by complying with the United Nation's Sustainable Development Goal (SDG) number 2 - eradicating world hunger. In addition to all that, total production will account for 20% of Brazil's potash fertilizer supply.

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## Adriano Espescht

President  
**POTÁSSIO DO BRASIL**



**Brazil currently imports 98% of potash, and our project will be able to produce 20% of Brazil's demand.**



### Can you update us on Potássio do Brasil?

Potássio do Brasil's potash project is located in Autazes municipality, 120 km from Manaus, the capital of Amazonas state. It is an underground potash mine with a beneficiation plant. Brazil currently imports 98% of potash, and our project will be able to produce 20% of Brazil's demand.

We just requested our installation license last week (August 2023), and we hope to break ground in the next two months.

### What are the benefits of the project?

In the Autazes project we drilled holes in 43 rows, each with more than 1,000 meters, and it defined the reserve. We have a reserve for 23 years, producing 2.2 million t/y. Because we have the potential to grow, we believe we can double it in the second phase or triple it in the third phase.

We studied the impacts the mine will have on the town, intending to minimize or eliminate the negative ones and maximize the positive ones. We have committed to drawing 80% of our workforce from the region, training locals to gain the capacity to work for us.

### Why is Potássio do Brasil essential for Brazilian self-sufficiency?

The agribusiness in Brazil is enormous, making up around 28 to 30% of our GDP. We need fertilizers to continue growing the business - not just potash. We import about 85% of all fertilizers, including nitrogen and phosphates. The National Fertilizer Plan is a tool that can bring together all the actions that the government and the private sector must do to achieve a better result. For example, there is a goal to have a minimum of 2 million t/y of potash produced in Brazil by 2030. The only way to achieve this is with Potássio do Brasil's Autazes project. There is no other project that will be able to achieve this goal in that time. We are essential to the government's plans, and we have support from the local municipality government, the state government, and also from the federal government. This project is essential not only for Amazonas and Brazil, but also for the world, which will have 10 billion people by 2050, and we will need more food.

### How can Brazil grow its mining industry?

Brazil is a massive country with immense opportunities, but we need more exploration to improve our knowledge of our geological situation. As I mentioned, we have the second biggest river basin the world, and we still do not know how big it is. It is at least 400 kilometers, but we must carry out significant drilling to understand the basin in terms of the quality, the amount, and whether it is economical to produce. This is in reference to potash, but it is valid for all commodities. For example, in lithium, Sigma only started three years ago, and it is already a huge company.

### How is the project aligned with ESG goals?

We have a robust ESG approach because we are building in a place that is not a jungle. The area where the mine is was deforested and used for cattle before our arrival. Additionally, since the beginning, our project will be underground. Mining underground minimizes the impact on the surface. With an open pit, you have a vast area with significant waste. We will not produce any permanent waste because our waste will be salt, and then we will stockpile it until we have space underground to backfill. There will be zero tailings on the surface. The closure plan is stringent, intending to move 100% of the plant, leaving only the roads, which benefit the community, and the port, which can also help the community.

### What is your strategy for financing the construction?

We expect to carry out the project on time and budget. Our strategy for funding construction is divided between equity and financing. The BNDS is keen to finance our project, and we are talking with the development banks of several countries where we have suppliers. We will be financing around 70% and 30% equity, which is a substantial number for a project as large as ours. Our company is listed on the NYSE, closed capital. The company profile is about 35% UK, 23% Australian, 15% Canadian, and 13% Brazilian. ■



»» **Brazil is the fourth largest fertilizer consumer in the world, yet it is the most dependent country on fertilizer imports; 85% of the fertilizer consumed in 2021 was imported.** ««

## Corrine Ricard

President  
MOSAIC FERTILIZANTES BRASIL

### Can you introduce Mosaic Fertilizantes?

Mosaic began operating in Brazil 19 years ago as a distributor of fertilizers that the company had mined and manufactured in Canada and the US. In 2018, we acquired Vale's potash and phosphate mines and are now the largest fertilizer company in the country.

After acquiring Vale's assets, we focused on improving efficiency.

The fertilizer business is subject to wide price and margin fluctuations. To reduce our vulnerability, we have adopted a cost-minimization strategy that allowed Mosaic to exceed our initial savings targets by approximately US\$200 million, and we are now on the verge of achieving a new target of US\$500 million.

Investments in automation have been another important step in optimizing productivity and improving safety in our operations. The recent investment at Taquari-Vassouras was our first major investment to extend the life of the mine. Originally, the mine was expected to be depleted in 2024. Therefore, we began drilling to evaluate the possibility of extending the resource, and we also committed to purchasing new mining equipment. These strategies have allowed us to guarantee the operation of the plant until at least 2030 and to increase production from 300,00 t/y to 450,000 t/y.

### What are the main challenges for Brazil to achieve self-sufficiency in fertilizers?

Brazil is the fourth largest fertilizer consumer in the world, yet it is the most dependent country on fertilizer imports; 85% of the fertilizer consumed in 2021 was imported. One of the barriers to fertilizer self-sufficiency is the difference in tax treatment between imports and domestic production. The current tax regime disincentivizes domestic production, making it more efficient to import fertilizer. Second, infrastructure deficiencies make it difficult and costly to transport products from mineral concessions to agricultural areas. Third, there are inconsistencies in federal and local regulations that make the permitting process for developing projects lengthy and complex.

The National Fertilizer Plan is a positive initiative to address the barriers to fertilizer self-sufficiency. It will facilitate coordination between the different levels of government, which we believe will lead to better development of the mining and food industry in the country.

### How is Mosaic innovating to boost productivity?

The extraction of phosphates mostly requires surface mining that requires either dragline mining or blasting truck

and shovel mining. Therefore, we are experimenting with autonomous and electric trucks for transporting materials over long distances to increase efficiency. We are also testing various autonomous systems for mineral mining, milling, and fertilizer production. In the case of potash mining, which is usually underground, we are focusing on introducing remote control systems to keep people safe during the mining process. This technology is also advantageous in cases where mines are located in remote or difficult-to-access areas.

### What are the main demand trends in the fertilizer market?

There is a lot of conversation about soil health and regenerative agriculture, especially in Brazil, where agriculture accounts for 22% of GDP. Second, sustainability and healthy crop production are also very important issues. Agriculture must be intensive and sustainable.

Fertilizers are no longer just about nitrogen, phosphate, and potassium, but also about regenerating the organic matter in the soil to ensure it does not run out of nutrients and maintains biodiversity. Biological products aim to improve nutrient uptake in the plant; some of them make phosphorus more efficient, while others ensure that the microbiome in the soil is healthy. We are also developing products that make the carbon sequestration process more efficient, meaning we fertilize pastures and help them sequester carbon in their roots, just like trees.

### Can you expand on Mosaic approach to ESG criteria?

We created the Mosaic Institute in 2008 to promote social development in local communities. Through the Institute, we invest in four pillars: food, education, water, and local development. We have several projects, one of the most interesting is the Village Project, which consists of identifying rural farms that need help in developing their programs so that they can grow sustainable crops.

What are the main priorities of Mosaic for the next two years?

Latin America is a growth engine for Mosaic, so we consider the opportunities in Brazil as a priority. We have made investments in our port of Fospa in Paraná to accommodate larger shipments. We have also announced investments in the Taquari-Vassouras mine and another investment in the state of Tocantins. ■



## Luiz Vessani

President  
EDEM PROJETOS

### Can you elaborate on EDEM Projetos' business model?

EDEM is a partnership of geologists and consultants, evolving from a service-based entity to a mining projects development entity. Our core business approach is risk investment in exploration and project development. We initiate projects, nurturing them with our resources and exploration services until they hold evident value. Post this realization, we can either continue to invest with our resources or seek partnerships, the last one being our main strategy. Our current portfolio encompasses mineral exploration, development and production projects.

### What are the current main priorities for EDEM Projetos?

Our plan of expansion, especially in Bonito and Montes Claros de Goiás phosphate and potassium deposits respectively, is underway. Our primary attention is on the Mundo Novo project in Goiás, targeting a carbonatite complex. The goal is to evolve this to pilot production by 2024. Another noteworthy project is our recent partnership with a TSX listed entity for the exploration of rare earths in Nova Roma, Goiás. Though we have other projects focused on rare earths, they are in the early exploratory phase. We plan to unveil some of these projects to the market during this year, with potential new projects suitable for partnerships in rare earths next year.

### What is the biggest challenge for Brazil to achieve fertilizer self-sufficiency?

The primary challenge is to find a balance between the agribusiness and mining sectors. Agribusiness has a stronger political presence, overshadowing the mining sector. The Ukraine crisis highlighted Brazil's vulnerability in potassium and phosphate supply, most of which imported. A strategic planning opportunity arises here, particularly regarding the taxation differences between imported and domestically produced fertilizers. We are addressing this politically, with organizations like IBRAM and ABPM. ■



## Felipe Coutas

Country Manager  
ITAFOS

### Can you introduce your current portfolio in Brazil?

Itafos entered Brazil in 2008 when the world experienced a fertilizer crisis. We saw the gap in the market and created a company to explore for and produce phosphate to address the fertilizer challenge. The first asset we developed was Arraias, in Tocantins, Brazil, which has a production capacity of approximately 500,000 t/y of single superphosphate (SSP). We then developed the Santana project, a vertically integrated high-grade phosphate mine and fertilizer plant project located in Pará, Brazil, and then acquired the Araxá project, in Minas Gerais, Brazil, where we not only have phosphate but also niobium and rare earth elements.

### How has Itafos performed over the past year?

Itafos broke safety performance and financial records in 2022, with revenues of US\$593.3 million and adjusted EBITDA of US\$224.8 million. This performance is credited to strong production performance at our Conda facility, and supported in Brazil with our Arraias operations starting to sell sulfuric acid and Direct Application Phosphate Rock ("DAPR") as well as due to improved market fundamentals for the agricultural sector, the company being much more disciplined in terms of cost control, and our operational excellence.

### What are the main updates on Itafos' Araxá and Santana projects?

Araxá hosts one of the most interesting rare earth deposits globally, let alone in Brazil, with 5% TREO + niobium. Araxá project is under development, and we are updating the environmental and social studies and the feasibility study to go ahead with the permitting process. We are also in discussion with a university in Brazil to develop super magnets with a wide range industrial application.

As for the Santana project, we submitted a final drilling report to the Brazilian National Mining Agency (ANM) which is under analysis and will be approved soon so that the project can proceed with the permitting process. ■



"Mining today must be viewed from a different perspective. New technologies are available nowadays, and how they are used matters. Our challenge for incorporating technology is to look at the process rather than piece by piece."

**Leonardo Pena,**  
Managing Director,  
Ausenco

# ENGINEERING, CONSULTANCIES AND CONSTRUCTION

GBR SERIES • BRAZIL MINING 2023

Image courtesy of Kinross



# Engineering and consultancies

## Towards a sustainable industry by design

Image courtesy of Equinox Gold

As a result of recent tragedies, the Brazilian mining ecosystem is rapidly adapting to the stricter environmental protection measures adopted by the Brazilian government and the global mining industry. However, finding the balance between promoting greenfield and brownfield projects and ensuring the highest environmental and social standards for sustainable mining remains a challenge for the mining industry, which seeks to restore the Brazilian public's confidence.

The regulatory framework is becoming increasingly complex, and mining companies require partners in the engineering and consulting areas that have a thorough understanding of Brazilian institutions. Lucila Telles, WSP's country manager in Brazil, explained: "Companies are increasingly requesting for our support from the conceptual phase of the project in order to avoid future environmental risks and conflicts with surrounding communities and thus facilitate the permitting process."

WSP saw growth of 25% to 30% in 2023 due to stricter global standards for tailings management and changes to local and federal environmental regulations to protect the country's biodiversity.

There has been a noticeable shift following the Mariana disaster, as mining companies now prioritize safety and environmental issues. SRK has collaborated with the Renova Foundation, the entity in charge of the Mariana rehabilitation programs, providing technical studies, advice and support. Thiago Toussaint, managing director at SRK in Brazil, described the strategic shift in approach for engineering companies: "Following the Mariana incident, the mining industry focused on the importance of geotechnical safety. Thus, we decided to concentrate on enhancing our geoenvironmental and geotechnics business unit in Brazil."

The company has experienced increased demand for services related to geotechnical safety, including dewatered tailings stacking and site-wide water balance. Additionally, engineering firms are seeing significant demand for mine closure planning. SRK, for example, focuses on 'designing for closure' to ensure that when the time comes, the mine will be ready. "For Brazil, mine closure is relatively new compared to other mining countries," said Toussaint. "Mining projects are closer to closure, and challenges are knocking at the door."

In 2021, the National Mining Agency released a resolution with clear indicators for the requirements for mine closure. This was an essential step forward, providing much needed clarity. However, there are still certain areas of mine closure

procedures that must be addressed, including the geochemical characterization for tailings facilities.

A more sustainable industry is not just about engineering safer tailings dams, but about looking at all the inputs of the industry to find ways to become greener. For companies such as AFRY, green steel production is an area of opportunity. AFRY's Brazil operations take advantage of the company's technology hubs in Finland and Sweden, applying lessons learned in the Nordic states to Brazil. In our conversation with Tiago Affonso Ferreira Nunes, the head of mining and metals at AFRY, he emphasized that the future of mining will be intertwined with sustainability. The company foresees more investment flowing in updating existing operations to be more sustainable than in establishing entirely new operations.

Maria de Lourdes Bahia, vice president of mining and metals at AtkinsRéalis, emphasized the industry's interest in minimizing the negative environmental impact of its operations. The company has significant expertise in tailings and filtration projects, completing five filtration plant projects for Vale. At Nexa Resources' Aripuanã project, AtkinsRéalis implemented a water recovery solution during mineral processing. "In Brazil, we mainly support our clients in reducing their dependence on tailings," said de Lourdes Bahia. "That is why we are looking for alternative solutions to tailings dams and other technologies for more sustainable projects."

Insufficient renewable power infrastructure is a challenge for the industry's ambitious decarbonization goals, and there is a rise in interest from major mines in building renewable power plants. Vinicius Ambrogi, head of marketing and environment at EBP Brasil, said: "In some locations, there is still a lack of proper infrastructure to supply mining facilities with the large amount of energy they need to operate. Engineering companies will continue to play a relevant role in developing technologies to meet the growing demand for clean energy sources in the mining sector."

Green hydrogen represents a major opportunity for Brazil. According to Standard & Poors Global, the country could potentially export green hydrogen to the US and Europe to produce low-carbon steel. The H2 study, a partnership between the German Society for International Cooperation and Brazil's Ministry of Mines and Energy, demonstrated that as of May 2023, there have been at least 42 green hydrogen production projects in Brazil, involving more than 800 companies and institutions. These green hydrogen projects, and the larger push for more sustainable operations, requires a forward-thinking approach to engineering and consulting.

### Energy transition raw materials

The boom in critical minerals provides a unique opportunity for engineering and consulting companies. For example, more than 80% of the projects Ausenco is currently working on are projects to support the energy transition. Buoyed by demand in this area, Ausenco expects to grow by 30% in 2023. "I see this as the future of Brazil in terms of metals," said Leonardo Pena, vice president of the company in Brazil. "A few years ago, when speaking about mining in Brazil, it was all about iron ore. Now, projects in different commodities we discussed years ago have become feasible and viable and will support the world in the energy transition and decarbonization."

AtkinsRéalis, which started work on a project in the lithium valley in Minas Gerais in 2023, has experienced a notable growth in business from critical minerals. The company has developed new technologies for processing these metals. For companies working with critical minerals producers, it is full speed ahead. "As a country, we have advantages in terms of economic and political stability compared to other countries with large lithium deposits, such as Argentina," said de Lourdes Bahia.

GE21, a mining consultancy that works with various metals, has seen more demand in the green energy transition commodities concentrated in high-value areas. One of the company's clients, a Canadian junior, has started three exploration projects in Brazil, which the company is supporting with MRMR capabilities. "There has also been a boom in

lithium projects, particularly in the pegmatite zone here in Minas Gerais, known as Lithium Valley," stated Bernardo Viana, a partner at GE21. "Graphite projects are growing too, making up about 50% of our current projects. Phosphate is also significant, as it is strategic for Brazil."

For exploration companies to take advantage of Brazil's wealth of mineral resources, the country needs regulatory clarity and systems. Viana explained that a lack of public information in Brazil limits the ability of junior companies to present viable opportunities, and noted that the rules of engagement for juniors are often unclear, making it challenging for them to define targets and attract investment. However, there is still plenty of light ahead. Viana stated: "These challenges also create opportunities for companies like GE21, especially as we witness positive advances in regulations, such as the new resolution by the National Mining Agency to modernize methodologies for reporting Mineral Resources and Mineral Reserves."

The diversity of the country's geological environment and the scale of untapped potential provides Brazil with the possibility of a wealth of greenfield projects. The key question is if the mining industry's growth in production of critical minerals can drive a broader growth in industrialization. Manuel Fernandes, energy and natural resources co-leader for Americas at KPMG, said: "Over the next year, I hope to see a clear industrialization strategy from the Brazilian government, attracting investment to the country for the production of value-added products." ■





# Thiago Toussaint

Managing Director  
SRK BRASIL



**Following the Mariana incident, the mining industry focused on the importance of ESG and geotechnical safety. Thus, we decided to concentrate on enhancing our geoenvironmental and geotechnics business unit in Brazil.**



### Could you elaborate on the history of SRK in Brazil?

SRK entered the Brazilian market in 2005, providing engineering and geological services to the mining sector, such as reserves and resources certifications, an area where SRK is a leading player. Over time, we have broadened our services to include geotechnical and environmental business lines.

Following the Mariana incident, the mining industry focused on the importance of ESG and geotechnical safety. Thus, we decided to concentrate on enhancing our geoenvironmental and geotechnics business unit in Brazil, which began working with the Renova Foundation, the entity leading the Samarco remediation programs, in 2017. Our work with Renova is very extensive. We help them develop technical studies, act as peer review specialists, and provide technical advice to support their technical team.

### How has SRK Brazil performed in the last few years?

SRK Brazil experienced remarkable growth since 2016. In 2020, SRK reinvisioned our business strategies and focus, leading us to the best year in SRK Brazil's history in 2021. We expect 2023 to surpass SRK's performance in 2021.

### Which SRK services are most in demand?

Very often we are contacted by our clients seeking mineral resources and reserves certification, audits, and due diligence. After GISTM in 2020, the National Mining Agency (ANM) published a resolution in 2022 that brought important updates to the geotechnical safety area. We have observed increasing demand for services such as dewatered tailings stacking and site-wide water balance.

The second most important area is ESG. We have seen that clients are increasingly prioritizing ESG issues, including mine closure. For Brazil, mine closure is relatively new compared to other mining countries. Therefore, our experience with implemented and long-term monitored closure projects deepens our understanding of the challenges that we will be facing. Communities, consultancies, mining companies and regulators must work together in the coming period. The Brazilian Mining Institute (IBRAM) has recently initiated a discussion on this topic, which will certainly help increase the Brazilian mining sector's awareness of the subject, which ultimately seeks engineering, social and environmental safety.

In 2021, ANM published a new resolution with more clear indications on minimum requirements for closure. It is a good advance, but there are still various challenges to be addressed, such as the geochemical characterization for tailings facilities. At SRK, we believe in a "designing for closure" concept. Thinking of closure in the early stages of the project can help companies with related costs as well as facilitate management and minimizing future liabilities by increasing the level of understanding of the impacts caused through the life of mine.

Finally, there is growing interest in critical mineral deposits in Brazil, including lithium, copper, nickel, rare earths, and other minerals. We have been conducting due diligence to assist our clients in making investment decisions. In this context, we observe that the Bahia State (the northeastern Brazilian state of Bahia, with its capital in Salvador) has been targeted by numerous investors as a spot for strategic minerals, such as copper, nickel and gold.

### How can SRK support mining companies in improving their tailings management systems?

Since 2020, our clients have been asking SRK to conduct studies to improve the safety of their tailings facilities. We have been working extensively in collaboration with our colleagues from various countries including our South and North American practices and Australia, who have expertise in dry stack technologies.

Our team has experienced professionals able to provide geotechnical solutions while addressing hydrological uncertainty and the potential effects of climate change to assess the impacts and risks of tailings facilities for mining projects and their social and environmental surroundings.

### What are SRK's main objectives for the coming years?

We aim to achieve organic growth, maintaining our high level of technical expertise when serving our clients. To accomplish this goal, we plan to expand our team by 2024, consolidating a solid group of mining experts focused on providing advice and site-specific solutions, taking advantage of SRK's global expertise applied locally.

We also expect to continue operating our four business units of mining engineering and reserves, resource geology, geotechnics and geoenvironmental engineering. However, we aim to enhance our technical capabilities by investing in disciplines like rock mechanics, water resources and mine closure. ■



# Lucila Telles

General Manager  
WSP BRASIL

### Can you introduce WSP?

Currently, we employ around 500 people and have three operations in Brazil: one in São Paulo, where we mainly serve the industrial sector; then we have a business in Belo Horizonte, where we primarily serve the mining sector; and one in Rio de Janeiro, where we primarily serve the energy sector.

WSP's solutions include engineering services for the mining sector, such as waste and water management systems and mine closure planning.

### How was the last year for WSP in Brazil?

In the mining segment, we observed several factors last year that are driving demand for our services. First, the energy transition is attracting a large amount of foreign investment in nickel, lithium, copper, and other critical metals projects. Second, stricter global standards for tailings management and constant changes in federal and local regulations. Finally, companies are increasingly concerned about ESG issues related not only to environmental and water protection but also to community and indigenous development and human rights. The current government is very concerned about strengthening the social pillar of ESG criteria and ensuring the protection of the country's biodiversity.

### Could you elaborate on the WSP Future Ready program and your approach to digitalization?

WSP is currently going through a strategic plan focused on promoting ESG criteria and sustainability advisory services. Future Ready is an innovation initiative designed to discuss, analyze, and provide new solutions to our clients. The program not only addresses climate and environmental issues, but also covers a wide range of topics, such as potential societal changes, variations in market dynamics, and much more. One of the main features of the program is its focus on upcoming changes. Under this program, solutions are being developed not only to address issues facing the world today but also to address future scenarios. ■

### What is Ausenco's footprint in Brazil?

Today, we have a team of close to 300 people, with approximately 30 projects in execution. Ausenco entered Brazil in 2004; since then, we have purchased companies such as PSI, a pipeline engineering company, Sandwell, a transport and logistics company, and Vector, a geotechnical company. Today, we provide solutions from pit to port across different project phases. We work together with junior companies providing robust studies that are the base to find investors.

### Can you elaborate on Ausenco's offerings?

We have focused on finding a better way in all terms. Our plants fit for purpose, therefore use less resources and energy, utilize less steel and concrete, and demonstrate the extent to which we reduce the use of resources. Our pipeline group provides opportunities to monitor and safely maintain pipelines as well as well new complex pipeline projects. We also work on transportation and logistics, focusing on ports, railways, and all areas linked to material handling.

### How is the energy transition changing demand?

This year, we plan to grow by 30%. The main lever for that is the new commodities required for batteries. A few years ago, when speaking about mining in Brazil, it was all about iron ore. Now, projects in different commodities we discussed years ago have become feasible and viable and will support the world in the energy transition and decarbonization.

### What are your expectations for Ausenco in Brazil in the coming years?

There will be US\$50 billion in investments in Brazilian mining in the next five years. The challenge for Ausenco is determining how we will support our clients and meet their needs. The demand and the market are here. Brazil can become one of the primary providers of rare earths. We expect to grow while maintaining the same quality and providing consistent value to our clients. Adding value, our clients will grow, strengthening the partnership. These partnerships are a win-win for our clients, Ausenco, and the world, which benefits from our sustainable solutions. ■



# Leonardo Pena

Vice President  
AUSENCO BRASIL



## Maria de Lourdes Bahia

M&M LATAM  
ATKINSRÉALIS



Many junior companies are entering the country, and Vale is starting to invest significantly in base metals.



### How big is AtkinsRéalis' footprint in Latin America?

AtkinsRéalis has more than 100 years of market presence that has grown through acquisitions. The group entered the Brazilian market in 2007 after acquiring a local company that had been operating in the Brazilian mining and metallurgy sector since 1990.

AtkinsRéalis has a strong presence in the South American region, with offices in Peru and Brazil. In Brazil, we have three offices: The main office in Belo Horizonte with about 800 employees, another in Vitória with about 100 employees, and one in Parauapebas in northern Brazil. We employ around 1,500 people in Latin America, of which 1,100 are in Brazil and 400 in Peru.

In Brazil, we have experienced considerable growth in recent years. In 2015, we were only around 150 employees. This growth also reflects the growing importance of mining in Brazil and the region. In 2022, Latin America was responsible for 48% of the group's revenues. We currently have 50 projects in Peru and around 80 in Brazil with major companies such as Anglo American, Vale, Marcobre and Antapaccay. We offer services for the entire life cycle of a mining project, from feasibility study to execution, which is why we say we are present from mine to port.

### For what type of commodities do you see the greatest demand for your services in the Brazilian market?

Brazil is the second largest producer of iron ore in the world, with very high-quality iron ore, so we will continue to see more expansions and new projects for its exploitation. In addition, we will also see more nickel, copper and lithium projects due to increasing concerns about decarbonization. As a result, we have developed new technologies for processing these metals. This year, in 2023, we started a project in the Jequitinhonha Valley in Minas Gerais, an area promoted as lithium valley. We are also involved in a nickel project with Brazilian Nickel at Piauí, in the northeast of Brazil. As a country we have advantages in terms of economic and political stability compared to other countries with large lithium deposits, such as Argentina.

### How do you support your clients in reducing the risks associated with mine tailings and how do you approach ESG criteria?

In Brazil, we mainly support our clients in reducing their dependence on tailings. We have worked on several projects for dry processing of tailings and filtration plants. AtkinsRéalis has already completed five filtration plant projects for Vale, and for Anglo American we are investigating technologies to recover ore from tailings.

That is why we are looking for alternative solutions to tailings dams and other technologies for more sustainable projects. For example, in the Aripuanã project (Nexa Resources), we implemented a water recovery solution during mineral processing.

AtkinsRéalis always tries to reduce its clients' carbon footprint and promote the use of renewable energy. We are also concerned about integrating local communities into our projects. Whenever possible, we hire and train local teams to work with us.

### What can you tell us about the growth potential of mining in Brazil?

There will be many more mining projects. IBRAM has projected US\$55 billion in investments over the next five years, and I anticipate that this figure will continue to grow. Many junior companies are entering the country, and Vale is starting to invest significantly in base metals.

However, one of the main challenges is attracting talent, due to the unattractiveness of the industry caused by misunderstandings about what mining is. Society must understand that it is a necessary activity for progress and the green energy transition. In terms of talent retention, companies must look for investment strategies to retain their workforce even in periods of low profits to minimize brain drain. Recently, we were recognized as one of the best companies to work for in the state of Minas Gerais, Brazil. AtkinsRéalis appeared within the Great Place to Work® (GTPW) Brazil rankings amongst similarly sized businesses in the 2023 GTPW Minas Gerais rankings. We are honored that our reputation as a global employer of choice is being recognized externally and internally by our employees.

### What are your main objectives for the coming year?

We want to increase our participation in the mining market. Our objective is to double or triple our activities in the mining industry. ■



RS



VA

## Rubens Spina and Vinicius Ambrogi

RS: CEO  
VA: Head of Marketing and Environmental Division  
EBP CONSULTORIA E ENGENHARIA AMBIENTAL

### Can you introduce EBP?

RS: We provide consulting and engineering services for environmental issues, mainly in environmental assessment, soil and groundwater remediation technologies. EBP is also active in energy transition; we convert organic waste into energy, biofuels, and biogas.

We have invested to gain market share in the mining sector. Therefore, we decided to open an office in Belem and another one in Minas Gerais to be close to our mining clients.

### What have been the main demand trends in the mining sector in recent years?

VA: Companies are looking for providers capable of integrating general environmental impact assessments and biodiversity services. Biodiversity is becoming increasingly important, as are carbon emissions and life cycle analysis.

### What are the most important technological innovations and methods you have introduced in recent years?

RS: In the field of AI we are currently developing some in-house tools for contaminated sites. We have been working for several years on mapping contamination plumes and understanding the behavior of organic and inorganic contaminants in different types of soils and aquifers. We recently decided to leverage our knowledge and experience to develop a tool capable of making predictions based on site-specific characteristics.

VA: The mining sector also requires the use of geostatistical methods for environmental monitoring. These methods help to produce information and patterns on the characteristics and spatial distribution of contaminants, facilitating the choice of the most appropriate strategies to mitigate risks.

### What are the biggest challenges for mining companies in decarbonizing their operations?

VA: The mining sector is interested in solutions that minimize the carbon footprint of operations, for example trucks. The biggest challenge with electric mobility is that trucks require large amounts of energy, and most batteries do not have that much capacity. I think green hydrogen is a very interesting possibility as an energy source for mining trucks. ■



## Bernardo Viana

Partner  
GE21 CONSULTORIA AMBIENTAL

### Could you introduce GE21 and discuss its footprint in Brazil, and the main services offered to the mining industry?

We are a consulting firm specializing in all mining cycles, from targeting and mineral exploration to mineral resources and mineral reserves, project local management, and have a team of around 130 people. We also develop specific programs for governments or large companies, such as infrastructure projects. Additionally, we have a technology team that works with geospatial technology, machine learning, artificial intelligence, and big data, providing consultancy services to clients not only in mining but also in logistics, farming, and industrial sectors.

In the past couple of years, we have seen a significant demand related to strategic minerals. One of our Canadian clients, has started three exploration projects in Brazil, which we are supporting with mineral exploration and MRMR capabilities. There has also been a boom in lithium projects, particularly in the pegmatite zone here in Minas Gerais, known as Lithium Valley. Graphite projects are growing too, making up about 50% of our current projects. Phosphate is also significant, as it is strategic for Brazil.

### Can you comment on the opportunities and challenges for mining exploration in Brazil?

One of the challenges we face in Brazil is the lack of public information, which limits the ability of junior companies to present viable opportunities. Additionally, the rules of engagement for these companies are often unclear, making it difficult for them to define their targets and attract investment. However, these challenges also create opportunities for GE21, especially as we witness positive advances in regulations, such as the new resolution by the National Mining Agency to modernize methodologies for reporting mineral resources and reserves. We have a complete team of QP/CP's running MRMR projects using CIM NI43-101, JORC Code and S-K 1300 best practice and rules. ■



# Water and Environment

## The future of tailings-free mining

Image courtesy of Equinox Gold

Mariana and Brumadinho were two of the most catastrophic industrial accidents in the history of Brazil. The Brumadinho disaster claimed 240 lives and left some 12 million cubic meters of waste material in water courses. For its part, the Mariana disaster claimed 19 lives and left approximately 60 million cubic meters of tailings in the Gualaxo do Norte, Carmo, and Doce rivers and in the Atlantic Ocean. The collapse of tailings piles can have a long-term negative impact on water quality and cause severe ecological damage and human health risks, as polluted particles can remain in the soil and water for years.

To date, the causes of the collapses are not fully understood. Some experts believe that it is very complicated to prevent dam collapse, and accidents involving dams are often

considered natural disasters. In the case of Mariana, the increase in volume of waste material in the dam was a factor that could have affected the safety of the facility. At Brumadinho, on the other hand, the expert panel of experts commissioned by Vale to investigate the catastrophe concluded that there was no evidence of distress prior to the collapse. However, the high-water level and improper drainage may have caused the dam to break down.

Brazil is a key global player in the mining world, and the ramifications of the accidents were global. The Mariana and Brumadinho collapses were directly responsible for the creation of Global Industry Standard on Tailings Management (GISTM), developed by the ICMM, the UNEP, and the Principles for Responsible Investment. Rohit Dhawan, president of the ICMM, celebrated the steps forward: "ICMM members committed that for tailings dams with the highest consequence classifications, extreme or very high, they would disclose their levels of conformance by August of 2023. All members have done that, including our members who operate in Brazil."

After the disasters, public debate focused on lax legislation on environmental, water and dams issues. In response, the government implemented a series of reforms and amendments to the National Dam Policy, the National Environment Fund Law, the National Water Resources Policy and the Mining Law to improve dams' safety. Among the most notable changes is Law 14.066, which passed in 2020 and took effect in February 2022. This law prohibits the construction of dams using upstream methods. It also requires all companies to develop a dam safety plan and an action and emergency plan, register structures in the System for Safety Management of Mining Dams (SIGBM), and prepare a regular report on dam safety. These requirements have created high demand for engineering and consulting services.

In terms of water management, some believe that Brazilian legislation still has weaknesses, especially when it comes to water management in the mining sector. Daniel Bertachini, executive director of MDGEO, explained: "Within the mining sector, there are specific issues in water resource management that deserve attention. At times, regulatory requirements can become cumbersome, leading to significant investments in studies that may not always yield practical risk mitigation insights."

Mining companies are considering more variables to ensure the safety of their tailings facilities and properly address en-

vironmental remediation in the event of spills. Mining companies not only focus on geotechnical factors, such as the stability of slopes and water levels to guarantee the safety of tailings facilities, but also consider other hydrogeological factors such as water quality, drainage and availability.

In this context, companies specializing in water management, geophysics and geoprocessing have seen an increasing demand for technologies such as data analytics and real-time monitoring to minimize the risk associated with tailings dams, as well as studies to ensure an alternative water supply in the event of a disaster.

It is vital that mines utilize tools such as dewatering technology to ensure that tailings dams are safe while maximizing their capacity. André Estêvão Silva, managing director of Huesker South America, a company that produces geomembranes, noted the importance of technology for tailings dam reduction: "When tailings dams reach their capacity, the common solution is to build a new tailings storage facility, but this creates environmental risks, increases capital outlay and has new permitting requirements."

Geomembranes are a vital tool not just to reduce water waste, but also to meet regulatory requirements by reducing the risk of contamination. Leandro Dhein, commercial director of AzulPack TechGround, which produces geomembranes for use in tailings dams, noted: "Reducing environmental impact means preventing soil and groundwater contamination."

Another important variable that mining companies are increasingly concerned about is chemical stability. To ensure chemical stability requires skilled analysis. Flávio Vasconcelos, CEO of Hidrogeo Engenharia, noted: "Chemical stability plays a critical role in the safety of tailings dams, as chemical compounds can alter the physical and mechanical properties of the tailings."

Technology is playing a critical role in addressing the environmental impacts of tailings dams. Eduardo Yassuda, president of Tetra Tech in South America, provided an example: "We developed a microseismic system, with microphones listening on a low frequency, that can determine if there is a change in the compo-

» Brumadinho and Mariana slowed the mining process because everybody sought to reduce risk. However, I think we have the technology, knowledge, and good practices to resume investment at full pace and move forward as an industry.

**Leandro Dhein,**  
Commercial and Marketing Director,  
AzulPack TechGround



sition of the dam. For example, if there is more water in the tailing dam, the velocity of sound propagation changes."

Tractebel is also applying new technologies to dealing with tailings dams' risks. One example is combined tailings disposal that reduces acid rock drainage, which poses a significant threat of freshwater pollution. Cláudio Maia, CEO of Tractebel Latin America, said: "Many mining companies are shifting from traditional tailings dams' structures in favor of alternative disposal methods such as combined disposal."

Eugenio Singer, general manager at Ramboll, cited the recent use of hyper saturated oxygenation technology in a hyperbaric chamber to restore aquatic life in a contaminated river in São Paulo as an example of technology usage in remediation processes. "We see a lot of growth potential in environmental studies with a focus on ESG, such as climate change adaptation and biodiversity conservation studies," explained Singer.

Progress on tailings dams' management has been made across the board, and companies are opting into standards even stricter than the regulations require. Indeed, it was Brumadinho and Mariana that inspired the ICMM to develop the Global Industry Standard on Tailings Management (GISTM), according to Dhawan of the ICMM, who affirmed that all ICMM members in Brazil have disclosed their conformance levels as of August of 2023.

This is part of a larger willingness within the industry to change how business is done, enthusiastically committing to improvements in operational practices and regulatory conformity. "The design, construction and operation investigation procedures are in the most advanced stage," explained Joaquim Pimenta de Ávila, CEO of Pimenta de Ávila Consultoria. "There are excellent structures for sharing knowledge about tailings dams." ■



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## Eduardo Yassuda

President South America  
**TETRA TECH**

### How does Tetra Tech serve the Brazilian market?

Tetra Tech has 27,000 employees in more than 100 countries, generating over USD\$4 billion in revenue. In South America, we started our operations in 2011 by acquiring three companies in Chile and Brazil. We have six offices in South America, with 450 employees across the continent. Our services are divided between environmental and social territorial studies, investigation, remediation, water resources, coastal engineering, mine planning, and geotechnologies. Tetra Tech has the expertise to support our clients in improving their environmental compliance. Our trademark is water resources. Regarding mining projects, we are mainly involved in improving water and energy management.

### Can you describe your community engagement work?

We have a strong team in resettlement. Involuntary resettlement projects require us to move residents from the areas that will be impacted by the mining activity to a new life. We have a trademark project with Anglo American in Minas Gerais where we relocated 50 families from the mining site to better places to develop their lives. Since then, we have carried out other projects where we help companies relocate and resettle to new areas with good social and economic conditions. There is a new understanding that companies are responsible not just for the resettlement but also for taking care of families and communities, and a perspective that they need to work with the communities, which enables us to get the communities on board and benefit from the project.

### What advanced technology do you offer for tailings dam monitoring?

We developed a microseismic system, with microphones listening on a low frequency, that can determine if there is a change in the composition of the dam. For example, if there is more water in the tailing dam, the velocity of sound propagation changes. ■



## Cláudio Maia

CEO  
**TRACTEBEL LATIN AMERICA**

### Can you introduce Tractebel in Brazil?

In Latin America, Tractebel operates in Brazil and Chile, where we employ around 1,000 people, 90% of them in Brazil. Our headquarters in Brazil are located in Minas Gerais.

### What were Tractebel's main activities in the past year?

In 2022, we restructured the company to expand our portfolio of services. We created three new divisions specializing in the environment, nuclear energy, and water treatment and supply.

In addition, we made progress in the development and application of innovative technologies, including digital tools for geotechnical engineering that allow us to create working models to better understand the behavior of structures for tailings and waste disposal, as well as dams.

Another recent innovation is the production of environmentally friendly hydrogen to power mining equipment. We have delivered a small-scale hydrogen supply unit to a mining company in Chile and are also working on the design of a similar project in Brazil.

### What is the predominant approach to ESG in the mining industry?

We observe that all our mining clients are very advanced and focused on ESG compared to other industries.

### What are the biggest challenges for Tractebel in the Brazilian mining sector?

One of the biggest challenges, especially for consulting companies dealing with complex mining structures, is the shortage of professionals with sound geological and geotechnical knowledge. Another challenge is the high competition in the engineering market; clients often do not understand the importance of quality over price, especially in the case of complex engineering work.

### What are the main goals of Tractebel for the next two years?

We aim to attract at least 100 more engineers and experts to support our growth. We intend to increase the size of the company by at least 30% within two years. ■



## Flávio Vasconcelos

CEO  
**HIDROGEO ENGENHARIA E GESTÃO DE PROJETOS**



**We expect the mining regulatory framework to improve in the short term since the current Brazilian solid waste characterization standards (ABNT-NBR 10.004) are inadequate for mining.**



### Can you introduce Hidrogeo Engenharia and the company's performance in the last two years?

Hidrogeo works in three main areas: Effluent management, mining waste management, and environmental impact assessments.

2022 was a good year for Hidrogeo, with revenue, employees, and projects increasing. For this year, we anticipate a growth of 20%. Our success is largely dependent on the commodities market, and both base metals and precious metals are currently showing promising prices, which usually leads to increased investment by mining companies. We are optimistic and expect 2023 to be another successful year for our company.

### What are the main demand trends in the Brazilian mining industry?

We saw a change in mentality among mining companies after the Mariana and Brumadinho disasters. They have increased their interest in analyzing the risks associated with their operations and have invested more in ESG aspects. Companies are primarily focusing on avoiding the use of tailings dams. The industry is turning to the use of filtration systems to dewater tailings. Another growth area in the industry is environmental and geotechnical studies on the physical stability of tailings dams to prevent collapses.

Moreover, in recent years we have observed that mining companies are paying attention to chemical stability, a service we provide. Chemical stability plays a critical role in the safety of tailings dams, as chemical compounds can alter the physical and mechanical properties of the tailings. In order to ensure chemical stability, we first analyze the waste material and then devise a chemical solution or reagent to reduce the impact of the pollutants.

Companies are increasingly requesting surface and underground water quality studies, as well as site impact assessments. However, in this area Brazil falls behind other mining jurisdictions, like Canada. We expect that the mining regulatory framework will improve in the short term since the current Brazilian solid waste characterization standards (ABNT-NBR 10.004) are inadequate for mining.

### What is the role of machine learning in water management services?

Part of our job is to identify whether the water is contaminated and, if it is, define where the polluting components are. We must also determine the water flow velocity and direction. Predicting environmental impact is a complex process that requires considering several important variables. However, with the help of advanced tools this data can be processed efficiently and accurately. While we utilize various tools to assist us, the key factor in effectively utilizing them is knowledge. This means having the ability to manipulate data in such a way that our models allow us to predict outcomes and determine the appropriate remediation actions to address our clients' issues.

### How has the water regulatory framework changed in recent years?

Since 2009, Brazil has established environmental laws regarding soil pollution and groundwater quality (CONAMA 420). This law complements others such as water effluent management (CONAMA 430), groundwater (CONAMA 396), and surface water (CONAMA 357). These regulations have been in effect for a while now, and recent revisions have aimed at reducing the maximum contamination levels. However, the government should prioritize requesting mining companies to conduct environmental and human health risk assessments using higher technical standards. At the end society would benefit with the results of this new type of relationship because the mining sector would be able to prove that all risk associated with it is under control and stakeholders would see this sector with a better understanding.

### What are your main objectives for the next 24 months?

Our objective is to enhance the usage of our AQUATEC platform, which streamlines the transmission of water quality data and information from mining locations straight from labs to us and we write the report to our clients. From the reports we can help our clients to evaluate the performance of their environmental control system among other demands. We are also seeking to extend our customer base in the mining sector. Currently, we have 10 clients in our portfolio, but we intend to raise that figure to 30 in the next two years.

Another important objective is to communicate our technical skills to develop studies in mining waste and effluent management, environmental risk assessment, water resources management and mine closure. We strongly believe that Hidrogeo Engenharia is one of the most complete and technical companies in the South American mining market. ■



## Eugenio Singer

General Manager  
**RAMBOLL BRASIL**

### What are Ramboll's main areas of activity?

We provide environmental services in several areas, including industry, infrastructure, sanitation, and urban planning. To illustrate, we are developing a new methodology for the design of port complexes and have already developed three master plans for InfraBrasil that prioritize sustainability and climate adaptation. As for the sanitation area, we have an environmental remediation division and conduct environmental impact studies.

Many of our renewable energy projects are developed for the mining industry. We are more than just a consulting company; we are strategic partners for our clients to achieve their sustainability goals and drive change in the global energy transition. In mining, we see a lot of growth potential in environmental studies with a focus on ESG, for example, climate change adaptation and biodiversity conservation studies. Other critical areas for the sector are tailings safety, water availability and efficiency.

### How important is mining for Ramboll?

The mining industry makes up about 50 percent of our market in the Impact Assessment Service Line, and renewable energy makes up the rest. In mining, we see a lot of growth potential in environmental studies with a focus on ESG, for example, climate change adaptation and biodiversity conservation studies. Other critical areas for the sector are tailings safety, water availability and efficiency.

### What are Ramboll's strategic objectives for the next 24 months?

We want to grow in the mining sector in geotechnical and social studies. To do this, we are focusing on organic growth and looking for partnerships with local companies specializing in social areas.

We also want to continue to be a reference in the country in disaster management issues through assessment studies and the implementation of mine site rehabilitation strategies. To this end, we also have a multidisciplinary team specialized in the social and human rights fields. ■



## Joaquim Pimenta de Ávila

CEO  
**PIMENTA DE ÁVILA CONSULTORIA**

### What services do you provide to the mining sector?

We carry out planning for tailings disposal, proposing planning for tailings disposal, and then work with tailings dams for years. Around 15 years ago we started to work with different technologies for tailings disposal. We also work on the safety of existing dams. We carry out safety evaluations using high-tech instrumentation. Pimenta de Ávila developed a software called Sysdam, which collects and processes the data and then reports on the dam's situation. It allows for continuous evaluation of the safety of the tailings dams.

### Can you discuss how regulations have changed around tailings dams?

Dam engineering practices have been continuously improving over the past 30 years, necessitated by the frequent rate of incidents in dams. New regulations and new regulatory procedures are the strictest in history. Now, all dams being constructed have precise restrictions around quality of the design, geotechnical investigation, construction control, and operations. However, we still have old dams that did not follow these advanced procedures at the time of their construction. All these existing dams require observation, monitoring, and safety procedures.

### Where do you see opportunities to grow?

We are always looking for business opportunities in both the mining and power generation sectors. In general, the events that are promoted by the ICMM, IBRAM, and ICOLD allow us to connect with potential clients. In Brazil, our primary interest is in the basic strategic miners like those who participate in IBRAM. The mining industry is receiving substantial investment to increase production of strategic minerals in Brazil and worldwide. We are determined to participate in these projects.

Another area of interest is using hydropower to replace thermal power. Brazil has significant potential in hydropower. We have several clients in the hydropower sector, serving as a consultant on the technology of constructing dams. ■



## Daniel Bertachini

Executive Director  
**MDGEO**

### What are MDGEO's main areas of expertise?

MDGEO is a pioneer in hydrogeological studies for mining projects, operations, and reclamation. Our history dates back to the late 1980s, marked by a wealth of experience and the development of hydrogeological methods by our founder, Antonio Bertachini, for dewatering the Águas Claras and Mutuca iron mines. These techniques have been continually refined and successfully applied in diverse environments, including significant mining projects across Brazil.

Subsequently, we embarked on a journey to expand our services, encompassing water supply, environmental studies, water monitoring, and customized solutions for mining companies. MDGEO's team specializes in conducting studies related to water quantity and quality, as well as assessments and modeling to evaluate and predict contaminant migration, dewatering, groundwater impacts, and water supply. Furthermore, we possess extensive expertise in hydrogeological studies for tailings dams, having pioneered the first hydrogeological studies for tailings dams in Brazil.

### What are the main trends you see in the market?

We have witnessed notable growth in the realm of hydrogeological studies for the remediation of tailings dams. Companies are now seeking studies of an unprecedented level of complexity in the field of tailings management. These studies not only address water level stability but also delve into water quality, availability, and various other hydrogeological considerations.

### Can you tell us how MDGEO applies innovative solutions?

In the realm of technology and innovation, our team has achieved significant advancements in automating water monitoring networks. We have pioneered customized methods for data collection and analysis, with specific case studies focused on evaluating water contribution basins for underground cavities in the Carajás mineral province. ■



## André Estêvão Silva

Managing Director  
**HUESKER SOUTH AMERICA**

### Can you give an overview of Huesker's operation and footprint in Brazil?

Huesker Brazil has grown significantly over the years and today, we are one of the manufacturing units of the group, producing certain product lines of the company's portfolio in our plant in São José dos Campos. Our local product production has significant synergies with the mining industry, which is one of the main markets we serve in the region. Huesker's geosynthetics have applications in areas such as infrastructure projects, materials handling, and waste management, and depending on the type of geosynthetic, it can be used for separation, drainage, filtration, protection, and reinforcement.

### How important is the mining industry to Huesker's overall business?

Today, the mining industry is one of our three main business areas in South America, especially Brazil.

### What solutions does Huesker offer for tailings dams?

Huesker's SoilTain dewatering technology, in conjunction with our reinforcement solutions, helps to reduce the required footprint areas of tailings dams which lead to lower required capital investment. Embankment and dike construction with SoilTain dewatering tubes allows the incremental raising of tailings dams.

### What are the challenges and opportunities of operating in Brazil?

The tax and labor laws in Brazil are complex, and it can be quite costly for companies to do business. On the other hand, once a company is established, these complex laws can act as a protective barrier in the sense that they control the amount of competition that enters the market. Huesker works in a specific and niche space, and Brazil offers a great market for our profile. The technical culture in Brazil is quite strong, and the market is promising.

Brazil is not as politically stable as one would like it to be, but on the other hand, the operational environment is extremely positive for Huesker as it is technical and oriented to niche products, offering great potential for growing demand. ■

# Construction and Contractors

## Increasing levels of automation

The Brazilian mining industry offers construction companies and contractors many growth opportunities. Sérgio Machado, CEO of U&M, believes that in a global landscape snarled with logistics challenges and geopolitical shocks, the more that can be done locally, the better.

The Brazilian mining industry is well-positioned to take a localized approach, with positive demographics and a strong industrial sector enabling mining and construction companies to source both goods and labor from the country. Compared to other South American countries, the Brazilian mining industry rests on a strong industrial footing. Fernando Aragão, CEO of the equipment rental company, Armac, said: "Brazil has a strong local supplier base, with local factories for all the main OEM equipment, a large population (+200 million), and a developed local financial market."

Despite being a well-structured and well-developed industry, in recent years the construction industry has remained weak. March 2023 saw a decline in activity for the fifth consecutive month. Some of this lessening in activity is believed to be related to extreme high inflation and high energy and construction material prices. High interest rates and lower demand have not helped the situation.

The National Confederation of Industry (CNI) together with the Brazilian Chamber of Construction Industry (CBIC) published a Construction Industry Survey in March 2023 that identified March as the fifth consecutive month in which the industry scored below 50. Any value that is less than 50 shows a decline in activity from the previous month. Infrastructure construction, in particular, has been soft – the segment scored 47.4 in March 2023, while building construction work scored 47.9.

These poor numbers have come with a drop in industry confidence. The country's business confidence indicators (ICEI) in the construction industry dropped in the first quarter of 2023, down to 50 in April 2023 from 51.1 in March. The average confidence score for January-April was 50.6 in 2023, while during the same period in 2022 that number was a much higher 55.8. The confidence score is divided in industry segments, and confidence in specialized services for construction deteriorated from 54.7 to 50.7 in that period, while confidence in infrastructure construction decreased from 53.8 to 51. A score above 50 indicates industry entrepreneurs are confident in the sector's growth prospects, while below 50 demonstrates a lack of confidence.

GlobalData predicts that Brazil's construction industry will grow by 2.7% in real terms in 2023, which is significantly less than 6.9% the previous year, and 10.0% in 2021. However, the industry will be bolstered by investment in housing, energy, and transport, in addition to strong development in the mining sector. In transport, for example, the government's 'Pro Trilhos' (Pro Rail) program has led to the authorization of significant rail projects, including the investment of 50 billion reais by the rail service TAV Brasil to enable the construction of the Rio-São Paulo railway line, with construction on the 380km project expected to be completed at the end of 2031.

The mining industry's construction needs provide a positive boost to the segment. Brazil's local construction and contracting industry is central to supporting both greenfield and brownfield projects. To meet the demand from mining companies for major construction projects to meet their production goals, the construction industry is investing continuously in technological development.

For example, U&M Mineração e Construção, a company specializing in rock and earth movement, has experienced significant growth in the mining segment, working in some of Brazil's largest mining operations. The company has benefited from this growth by acquiring new equipment with electrical and automated technologies. U&M carried out a project with Hexagon to transform conventional equipment to autonomous. Mauricio Casara, commercial director at U&M, stated: "There is a global trend toward electrification and automation, so we have been carrying out important projects in this direction since 2018."

Automation also provides a solution to a continued challenge: workforce supply. The construction industry, like the mining industry, has struggled with maintaining a sufficient supply of skilled labor. This has been particularly challenging when supplying construction labor for the mining industry. Mining construction projects require teams to spend extended periods living in rural areas, such as deep in the Amazon. Post-pandemic, priorities have changed, and many construction workers do not want to spend months on end away from their families, building mines or participating in development projects.

This is exacerbated by larger industry labor trends. The CNI's index of the evolution of the number of employees in the construction industry identified March 2023 as the fifth consecutive month of decline in the number of employees

in the construction industry. As of March 2023, the index of employees in construction dropped to 49.2 points, demonstrating a decline.

Autonomous construction is fairly new, but plays a vital role both in reducing labor needs and in improving safety. Construtora Barbosa Mello (CBM), has been carrying out autonomous projects since 2019, and is a leader in the area. In our conversation with CBM, they described their autonomous service as consisting of a high-precision scan of the area carried out by drones which send information to the cloud. That data can be used to generate 3D models of the projects, which are then transmitted to equipment through the Internet of Things. The benefit of this type of auto-

nous planning is that it allows operators based outside the construction site to integrate the data and use the information technology infrastructure combined with cameras to carry out remote-control of the vehicles.

Moving to autonomous operations does not, however, require disposing of existing equipment and replacing it entirely. Utilizing all new equipment is a major cost in terms of expense and carbon footprint. Adapting existing equipment allows construction companies to move forward without waste. CBM, for example, described sustainability as a priority addressed on multiple fronts. Those included renewing old equipment to integrate new technology for automation and electrification. ■

Image by Daniel Mansur, courtesy of AngloGold Ashanti

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## Fernando Aragão

CEO  
ARMAC



We have developed in-house training programs that help our customers safely introduce young talent into their operations, even in remote regions.



### Can you introduce us to Armac?

Armac was founded 30 years ago as a service provider and equipment rental company serving companies that rely on heavy machinery in their production processes, especially in industries where safety and reliability are essential, such as mining. Besides that, we also serve steel mills, fertilizer plants, agricultural companies, port terminals, and infrastructure projects. We are the largest company in our sector in Brazil, listed on the stock exchange, and have the scale to offer a reliable solution for even the largest and most complex projects.

Our team currently consists of more than 5,000 professionals, such as mechanics, truck drivers, and operators. All of them are intensively trained in-house and empowered to serve our customers with safety and reliability, considering the different characteristics of each project. In terms of fleet, we have 10,000 pieces of equipment, such as excavators, wheel loaders, dozers, trucks, and many others, ranging in size from 10 to 100 tons.

### What differentiates Armac from other similar companies?

We differentiate ourselves by our people-oriented approach, understanding that equipment is just the tip of the iceberg in mining and material handling. We have developed in-house training programs that help our customers safely introduce young talent into their operations, even in remote regions. This approach helps our clients in their mission to improve the lives of families living around their operations. Another differentiator is that we align our interests with the client by charging only for the volumes produced or operational hours; no spare hours or parts are charged. Everything is included in our fixed rates, which brings a high level of cost predictability and savings for customers.

The strong governance and balance sheet of a public company are also an advantage for customers looking for a dependable supplier they can trust to do the right thing and fulfill its commitments, even in tough times.

### How is Armac's model aligned with sustainability efforts?

We help our customers create good jobs for the communities surrounding their operations by avoiding importing labor from other regions whenever possible. We do that by attracting young talent to the mining industry and training them intensively so that they can perform at the required level. In addition, our business model is centered on extending the longevity of equipment and reducing idle time to a minimum, both factors have a very relevant impact on the total carbon footprint of the equipment industry. We have also invested in electric equipment for urban operations and are currently analyzing with one mining customer our first project with electric trucks and the electrification of our support fleet.

### What are the strengths of Brazil as a mining jurisdiction?

Besides the immense potential of natural resources, especially here in the state Pará, Brazil is a good and stable place to do business when compared to other emerging markets. Brazil has been a democracy for 35 years now, with both left and right governments during this period and independent executive, legislative, and judiciary powers. The business environment has been improving in the past decade, with important reforms recently approved, such as labor and social security reforms. These were signs of the growing maturity of our political system.

Brazil also has an independent central bank with a good track record of controlling inflation over the past decade. The large natural resource industries and our strength in agriculture also guarantee a currency account surplus, which helps stabilize the Real against the Dollar.

Brazil has a strong local supplier base, with local factories for all the main OEM equipment, a large population (+200 million), and a developed local financial market.

### What is your strategy for the next 24 months?

We will keep focused on our core business of serving mining customers with safe, reliable, and cost-effective operations. We also want to expand our presence in the north of Brazil, where we are opening branches in Parauapebas - PA, and Manaus-AM. ■



SM



MC

## Sérgio Machado and Mauricio Casara

SM: Acting CEO  
MC: Commercial Director  
**U&M MINERAÇÃO E CONSTRUÇÃO**

### How has U&M been performing in recent years?

SM: We have seen strong growth in the mining industry in recent years due to Brazil's favorable positioning in the global energy transition. As a company specializing in rock movements, we have participated in Vale's major projects and currently operate in eight of the largest mines in Brazil. Given this growth, we have been focusing on acquiring new fleets of equipment. We have around 800 machines, between heavy mining equipment and support equipment. Recently, we purchased 35 Komatsu HD 785-7 trucks, making U&M the largest fleet owner of this truck brand in Brazil.

Most of our work is in brownfield projects, and we have long-term contracts for mines that have been operating for fourteen to fifteen years. We expect greater demand in the next three years due to the growing dynamism of the Brazilian mining industry.

### How has U&M adapted to the growing demand?

MC: We always anticipate our customers' demands by regularly acquiring new equipment, which has allowed us to maintain significant growth. We are also focusing on restructuring the company, strengthening the board of directors, and expanding our portfolio of services.

There is a global trend towards electrification and automation, so we have been carrying out important projects in this direction since 2018. As part of our automation project, we have been working with Hexagon since 2020 to convert existing trucks into autonomous equipment. We expect to start commercial production of this automated equipment by early 2024.

### How do you ensure the safety of your employees?

SM: In July 2023, we reached 10 million working hours without accidents. Considering that we have more than 3,000 employees across eight mining operations and our equipment maintenance and renewal workshops, this achievement exemplifies our daily commitment to ensuring that everyone returns home safely. ■

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"Electrification, digitalization and automation are transforming the mining industry, moving towards increased sustainability, productivity and safety."

**Kamshat Galiyeva,**  
General Manager,  
Epiroc

# EQUIPMENT AND TECHNOLOGY

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Image courtesy of Vale



# The Future of Mining Equipment

## Electrification and automation driving technological innovation

Image courtesy of ARMAC

Global Data reports that the metals and mining sector contributes 4% to 7% of worldwide greenhouse gas emissions. Over 50% of these emissions are generated by the transportation and loading of minerals. If the mining industry is to be a central player in the global energy transition, and if it is to demonstrate that mining can be done sustainably to the general public, there must be a transformative approach to reducing the industry's carbon footprint.

Across Brazil, OEMs are innovating and bringing new machines to the market to meet the unique needs of the modern mining world. However, that innovation can and must speed up. Craig Milne, strategic advisor at Copperstone Technologies, believes that mining companies can support this by increasing their risk and investing in cutting-edge technology. "At the end of the day, the dollars are probably relatively small for mining companies to

invest in innovative technologies, but they must be willing to take bite-sized financial chunks and move quickly to see what works and what does not. If the industry intends to become more innovative, it must be able to evaluate technology on a different scale than they do their standard supply chain."

This is particularly true as the mining industry's significant critical minerals exploration begins to develop into new projects, with a healthy number of greenfield projects in development. And, in the long-term, changing requirements will impact OEM makers. Brazil is 90 to 95% open-pit mining. However, some OEM producers mentioned the potential for companies to start underground operations, particularly in Minas Gerais. In the future, some currently open pit mines will transition to underground, providing an opportunity for OEMs to fulfill their needs.

Mining companies are thus embracing technological advancements in their quest for productivity and sustainability. Equipment manufacturers are keeping pace by developing equipment utilizing alternative energy sources, automation systems and digitalization technologies.

Automation offers multiple benefits, including increased safety. Copperstone Technologies, for example, has developed a robot capable of autonomously traversing tailings dams, which is essential for supporting the data collection activities necessary for safe tailings management. Traditional tailings research is carried out from human-crewed equipment, including specialty trucks and boats. Reducing the presence of humans in high-risk

scenarios speeds up operations. Milne said: "When you put a human operator on tailings, there is always a high risk for the operator, and a lot of additional safety planning must go around the work."

Lowering the carbon footprint of a mine is as much a priority as improving the safety metrics, and OEMs are offering a variety of ways to reduce emissions. One effective option is to increase the efficiency and load capacity of the trucks.

Mercedes Benz is focusing on this aspect and recently launched the Arocs 8x4 on the Brazilian market. Among the most notable features of this truck is the increase in load capacity by almost 10 tons compared to the previous model. Another important feature of the Arocs 8x4 is the software adaptations that enable precise and efficient shifting. Marcos Andrade, marketing manager of Mercedes Benz in Brazil, explained: "We conducted rigorous testing with customers for two to three years before launching this platform, ensuring it emphasizes safety, efficiency and driver comfort while maximizing the load carrying capacity."

Mercedes Benz has also launched another version of the Arocs 4x8 designed to be compatible with biodiesel. However, Andrade pointed out that biodiesel currently accounts for only about 1% of the total Brazilian truck market. Innovating for a future beyond diesel is an essential challenge the equipment industry is facing head on, but equally important is the focus of OEMs on improving equipment life and efficiency to operate in a more sustainable manner.

Advanced technologies are central for a greener mining industry, and electrification is at the core of that push. For Epiroc, electrification, digitalization and automation are key to increasing sustainability, productivity and safety. Kamshat Galiyeva, general manager at Epiroc Brasil, explained: "The Brazilian mining industry and our customers are investing in automation, digitalization and electrification technologies, such as Kinross, which has acquired two of Epiroc's fully autonomous drill rigs, the Pit Viper 275, for their Paracatu mine. We are in the process of converting their existing fleet in this mine into an autonomous fleet."

Epiroc's Smart and Green series combines the benefits of zero-emission technology and automation and digitalization tools. Since one of the main constraints to implementing these technologies at scale is the lack of proper energy infrastructure and connectivity, Epiroc also works with its customers to find solutions to these inconveniences. "Our approach is not only to supply the mining equipment but also to support the customer in terms of consultation for the mine infrastructure and design to ensure that electrification projects can be successful," explained Kamshat Galiyeva.

Normet, an international OEM, is also highly cognizant of the significant infrastructural investment required by the transition to electric equipment. The company conducts studies to estimate the potential costs and requirements of key infrastructure such as charging station locations, and ensures that electric vehicles can operate according to the available supply and mine profile. According to Odilon Mendes, managing director of Normet Brasil, the benefits will rapidly surpass the costs of investment in this electri-

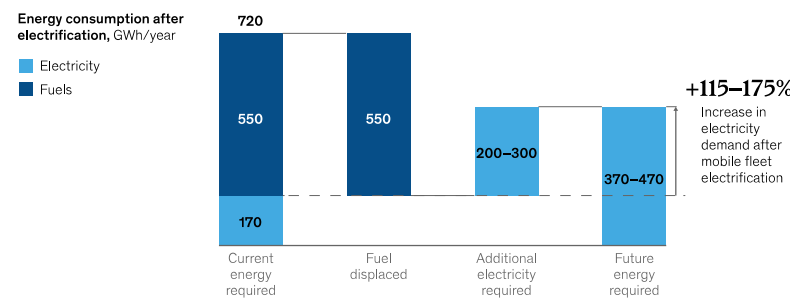
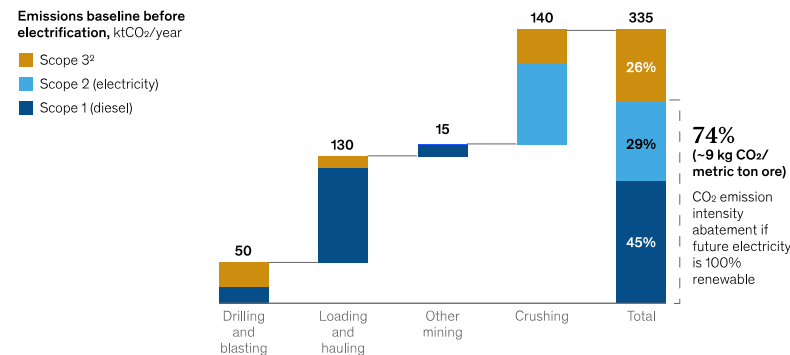
fication infrastructure. Mendes stated: "At this moment it's still challenging to imagine an all-electric fleet in underground mines but that will soon become a reality as the industry understands the benefit of this technology."

Normet has been highly active in the Brazilian market in recent years, and is launching a new line of electric equipment called Normet SmartDrive. "The use of electric equipment has significant safety benefits for workers, as it reduces carbon dioxide emissions in mines, which is particularly important in underground operations that have limited ventilation," said Odilon Mendes, managing director of Normet Brasil. "There is a remarkable shift towards electrification in the mining industry, and we are actively monitoring this trend."

The electrification of mining equipment will, however, require a significant increase in electricity demand. For the carbon emissions gains of electrification to be impactful, that additional electricity must come from a renewable source. A McKinsey study determined that electrifying the mobile fleet of the global iron ore industry would necessitate 20 to 30 terawatt-hours of electricity more than currently utilized, equivalent to 10 to 15% of Australia's annual electricity consumption. Brazil is unusually well poised to meet this demand due to its hydropower availability, but the industry at large must invest in diversified renewable energy sources to meet growing need for electricity as mining equipment transitions. ■

### The Electrification of a Sample Iron Ore Mine Could Cause Electricity Demand to More than Double

**Assumptions** **Open-pit iron ore mine**  
28 million metric tons per year of production of lumps and fines<sup>1</sup> (no beneficiation)



Source: McKinsey & Company

## DEFINING THE FUTURE UNDERGROUND

**ELECTRIFY YOUR ENTIRE SPRAYED CONCRETE PROCESS!**

Normet SmartDrive® product family provides high productivity with decreased operating costs.

Zero local emissions  
Cleaner air

More speed & higher performance

Increased safety  
Less noise

Improved energy efficiency  
Lower operating expenses



»» **Normet is focused on bringing battery electric vehicles to the Brazilian market, as we believe there will be a high demand for battery-powered equipment due to companies prioritizing decarbonization.** ««

## Odilon Mendes

Managing Director  
**NORMET BRASIL**

### How has Normet positioned itself in the Brazilian market in recent years?

Normet has been operating in Brazil since 2009 and currently has 25 employees in Brazil and supplies equipment, spare parts, services, rock reinforcement products and construction chemicals such as resins and polypropylene fibers to most of underground mining and some tunneling companies.

Normet specializes in underground mining, and we have experienced significant growth in the last years despite the challenges we faced. We expect the sales in Brazil to exceed our initial projections for the year.

### What have been Normet's key activities in the last 12 months?

Most of our businesses in the past 12 months are related to current customers, which are purchasing new equipment and other solutions, we have also acquired new customers among the different product lines – Equipment, Services and Construction Chemicals. While some companies are considering switching from open pit to underground mining, this is relatively uncommon yet as it can be a lengthy process.

A portion of our company's growth can be attributed to the supply agreements we have established with all our customers and the next step will be

opening new warehouses in Brazil to support our growth in the country.

Normet is launching its new line of battery electric equipment Normet SmartDrive® in the Brazilian market, and we will start conducting tests in the mines in the coming months. There is a remarkable shift towards electrification in the mining industry, and we are actively monitoring this trend. Additionally, automation is becoming increasingly popular in the market, and Normet is already working on developing technologies to meet this demand.

Normet has already implemented other technologies such as SmartScan, which is already being used with some Brazilian customers, and SmartSpray which will enable a completely automated concrete spraying process.

### What factors impact the demand for electrical equipment in Brazil?

Normet Group has been developing Normet SmartDrive®, a modular battery electric vehicle (BEV) architecture product line in the last two years and we are planning to introduce this equipment range to the Brazilian market at the end of 2023. The use of electric equipment has significant safety benefits for workers, as it reduces carbon dioxide emissions in mines, which is particularly important in under-

ground operations that have limited ventilation.

Using electric equipment in mines will demand investments in connectivity and electrical infrastructure but the benefits will surpass those investments in a short period of time. To ensure that electric vehicles can operate according to the available supply and mine profile, we conduct studies to estimate the potential cost reductions and requirements such as charging station locations. At this moment it is still challenging to imagine an all-electric fleet in underground mines but that will soon become a reality as the industry understands the benefit of this technology.

### What is your perspective on the development of underground mining in Brazil?

Typically, when we think of mining in Brazil, we think of open-pit mining, which accounts for about 90 to 95% of the country's mines. However, there is a potential for underground mining to grow in the future. We are currently in talks with companies that are starting underground operations in Minas Gerais and we believe some open pit mines will be transitioning to underground. We are optimistic about our future growth in Brazil.

One of the main advantages of underground mining is the widespread perception that it is a more sustainable way of mining, as it has less impact on the environment.

### What are Normet's top priorities for the coming months?

Our company is focused on bringing battery electric vehicles to the Brazilian market, as we believe there will be a high demand for battery-powered equipment due to companies prioritizing decarbonization. Additionally, we aim to expand our rental equipment fleet to meet the growing interest in this type of service. Furthermore, we will bring to Brazil our Variomec XS, which is an equipment for underground logistics, that will leverage the safety and comfort in the transportation of personnel and material in underground mines.

Regarding the construction chemicals product line, we are currently investing in the implementation of resin solutions that are already approved by some customers. Additionally, we have observed a rise in the demand for polypropylene macrofibres and we see a substantial potential to expand our market presence in Brazil within this area. ■



## Kamshat Galiyeva

General Manager  
**EPIROC BRASIL**

### Can you provide an overview of Epiroc in Brazil ?

Today we have approximately 300 employees across our headquarters in Barueri and our service branches in Belo Horizonte and Para State. We are currently investing in a new world-class workshop in Belo Horizonte, which we expect to inaugurate in 2024.

Epiroc has seen significant growth over the past three years. Approximately 70% of our 300 employees in Brazil serve the aftermarket division, and this division is also the largest revenue-wise.

### Can you expand on Epiroc's autonomous and Smart and Green solutions?

Epiroc partnered with Fortescue in Western Australia to test and evaluate the autonomous SmartROC D65 MKII and demonstrated that this autonomous surface rig outperforms manual rigs in terms of productivity and efficiency. We are seeing a trend where the Brazilian mining industry and our customers are investing in automation, digitalization, and electrification technologies, such as Kinross who has acquired two of Epiroc's fully autonomous drill rigs, the Pit Viper 275, for their Paracatu mine, and we are in the process of converting their existing fleet on this mine into an autonomous fleet.

Our Smart and Green series is the next step to highlight the benefits of zero-emission technology and automation and aligns with our strategy to provide equipment to mine metals and minerals in the most sustainable way possible.

### What are the main digital solutions Epiroc offers to the Brazilian mining industry?

Epiroc's strategy in terms of driving the digital transformation of mining is to create options for the future by making the right acquisitions. Over the past year, the company has acquired more than 26 companies, most of them operating in the technology, digitization, mine connectivity, and smart exploration areas. Also, in 2022, Epiroc created a Digital Solutions division that focuses on bringing solutions, expertise, and support to our customers on their transition journey, moving towards increased sustainability, safety, and productivity. ■



## Daniel Poll

Managing Director Sales & Customer Service  
**LIEBHERR BRASIL**

### What is the history of Liebherr in Brazil?

Liebherr Brasil, based in Guaratingueta (SP) since 1974, has almost five decades of continuous presence in the Brazilian market. In 2023, we will celebrate 50 years of Liebherr Brasil. We have put our trust in Brazil, and our customers have placed theirs in Liebherr. In Brazil, Liebherr started in the 1970s manufacturing ship cranes. Over the subsequent 50 years, Liebherr has brought other Liebherr group divisions to Brazil. Currently, we represent nine out of Liebherr Group's 11 divisions, with over 1,200 employees. Liebherr Brasil manufactures some products locally, with the only Liebherr plant in Latin America.

Some of our locally manufactured products are for earthmoving, such as wheel loaders and crawling excavators, while some are for construction such as truck mixers. We also manufacture large bearings for onshore wind power turbines in the north of Brazil.

### What milestones has Liebherr achieved in the Brazilian mining industry?

A recent highlight includes the sale of five new backhoe mining excavators for between 250 (R 9250)- 400 (R 9400) tons of operational weight, which are going to be delivered to two different customers in 2024.

We have also seen two R9250 Liebherr excavators reaching 70,000 SMU's. Projects for this kind of 250 t excavators is based on a lifetime of 45,000 SMUs. A third excavator is already well on the way to achieving similar metrics, with over 63,000 operations on the clock.

The longevity of these machines reflects Liebherr's high quality (components lifetime) and cutting-edge engineering. We provide know-how and assistance wherever the machine is in operation, providing our customers with the best support.

After the launch of the first L 586 XPower wheel loader at the end of the year, we successfully placed the machine with some mining customers. The machine has stand out performance facts, including a 25% reduced diesel consumption, as well as safety and comfort for the operators. ■



## Marcos Andrade

Senior Manager Product and Communication Marketing  
**MERCEDES BENZ BRASIL**

### Can you share the main demand in the past two years?

We experienced quite a significant milestone in the last couple of years, with the successful launch of a new 8x4 product, the Arocs, specially designed for the Brazilian mining sector. This new truck was developed to carry up to 58 t. In its first year, we sold around 200 trucks, and last year, we sold 450 units. Furthermore, we have recently launched the Euro 6 version of this truck, designed to be compatible with Brazil's biodiesel.

The 8x4 market has grown from 300 to 400 trucks to around 1,000 in recent years. With the world's focus shifting to electrification and new minerals, we see significant growth potential, especially in automation and autonomous driving, ensuring efficiency and safety in the mining sector.

### What are Mercedes-Benz's main strategic goals for the next two years?

Our primary strategic goal is the expansion of autonomous driving; we are investing significant resources into this area. Our aim is to improve efficiency and increase load capacity, which is a recurring challenge from our customers. We are looking for alternatives to enhance the load capacity of our trucks while maintaining the right balance between TCO and availability, and assuring always a high level of safety. ■



## Craig Milne

Strategic Advisor  
**COPPERSTONE TECHNOLOGIES**

### How important is the Brazilian market for you?

Vale was seeking the ability to do remote geotechnical investigation of tailings and selected Copperstone as the only company in that category. We did our final demonstration in a Vale mine in Canada and have maintained a strong relationship with them ever since.

### How are your HELIX robots different from other autonomous equipment?

Remote control boats only work well with clean, open water, and traditional remote wheeled or tracked vehicles get stuck in soft muds that are common in tailings. The four screws, or helical pontoons, on the robot allow the robot to float in water or soft mud and always stay buoyant. We can do all types of sampling, and the smaller robot often carries a sonar head, enabling us to offer bathymetric services.

### What are Copperstone's priorities for the coming year?

We are focused on scaling up the manufacturing of our robotic platform HELIX Neptune, a stable product line. We have built and sold several units worldwide and are confident in its performance. The mining industry is global, and although we started in Canada, there are many mines that we can service in Latin America, Brazil, Australia and elsewhere. ■



## Pablo Terres

Commercial Manager  
LATAM South  
**MAMMOET**

### Can you introduce Mammoet?

In recent years, we have consolidated our presence in the onshore wind market, especially in Brazil. Mammoet has been maintaining its position as a leader in the oil and gas market and industrial sector.

We offer a wide variety of equipment, including cranes, trailers, and so on.

### What is Mammoet's approach to innovation?

Mammoet has a global innovation team, and those scores are focused 24/7 on finding new ways to include more business. For example, Mammoet has already developed and is commercializing trailers powered by electricity. We are investing in the SK 600, a 6,000-ton electric-class crane. It is a massive piece of equipment, and it will be the first electric crane in this category.

### What is your strategy for the next year?

In the next 24 months, Mammoet will remain a leader in this segment, performing specific projects that deliver high value for the clients and maintain quality. Mammoet is a multi-cultural company, and I believe that the exchange of information we have between nations adds very important value both for the company and our customers. We bring our customers faster and more intelligent solutions for their challenges. ■



# Comminution and Material Handling

## The mining industry makes modern moves

Image courtesy of Tecnokor

In both material handling and comminution, advances in technology are improving efficiency and reducing downtime. Essential, however, is a recognition among the major Brazilian mining players that investment in material handling and comminution innovations will have a significant impact on their long-term profitability and sustainability goals.

Most mining operations use conveyor belts to transport ore, and these machines must have the capacity to transport massive quantities of material over long distances. Paulo Godoy, director of Almex in Brazil, a company that manufactures accessories for conveyor belts, explained that Almex supports mining companies with studies to find the best solution to extend the lifecycle of their conveyor belts. Almex offers a fault detection line based on sensors on the belt to monitor the performance of the main variables. "Conveyor belts are the most cost-effective way of transporting materials, but it is important to extend the life of the belt to maintain the efficiency of the transport, and this is what our products are aimed at," said Godoy.

A combination of an increase in sensors and investment in data management technology to utilize the information effectively enables mines to ensure operational efficiency. The ability to completely automate conveyor belt operations is increasingly desired. Marcelus Araújo, president of Tecnokor, a provider of complete material handling solutions, noted: "There is a notable demand for autonomous operation and more customers expect their equipment to work completely monitored with sensors as an interface."

Automation is only one way to increase efficiency. Another is increasing scale, although material handling solutions are reaching the point where increased scale does not necessarily equate with increased efficiency. There are, however, still gains being made. Tecnokor, for example, recently constructed the largest conveyor belt in terms of capacity in the country, with the ability to transport 30,000 t/y. The belt, which is a ship loading system built for Vale, also includes a silo of 760 m<sup>2</sup>. Maiari Ruckert, commercial director of Tecnokor, said: "The silo design and the size of the project made it particularly challenging to engineer."

Some companies are moving away from conveyor belts entirely. FLSmidth, for example, has developed a new solution for overland conveyors; a rail running conveyor. Rather than having rollers with rubber on top, the rail running conveyor moves along, carrying the rubber. This design has multiple

benefits: no restrictions for distance or capacity, a reduction of steel use in manufacturing, and a reduction of belt tension, meaning that the solution is lighter and less demanding for construction. "We are confident this solution will be a disruptive innovation in material handling," said Humberto Valladares, CEO of FLSmidth. "It will take some time to convince the industry to adopt it, but we are confident it will be transformative."

The crushing sector is equally in a process of innovation and reinvention. Technologies incorporated into comminution systems are designed with one goal in mind: optimization. Neuman & Esser, a German group that provides compressor and process solutions to the mining sector, is investing heavily in research and development to offer its customers greater equipment reliability, energy savings, higher mineral quality and throughput. Neuman & Esser's dry milling and classifying systems also address water consumption issues. "Our systems are focused on dry processing, removing water consumption in the process, and eliminating the need for effluent water to go to a tailings dam," explained Rafael Serpa, sales and applications general manager at Neuman & Esser.

For Neuman & Esser, digitalization is essential when it comes to comminution systems, and for any equipment maintenance. The company has a digital solutions team that focuses on improving current solutions and developing new technologies for the company's equipment. Serpa stated: "Digitalization and automation are important for the maintenance of equipment; if you want to increase the reliability of your process, you need to understand what is happening with the equipment, and through digitization and automation you can measure and record information that supports preventative and predictive maintenance.

» Sensor-based sorting is a mega trend in the mining sector, primarily due to its status as a dry processing technology, resulting in notable energy and water savings.



**Vinicius Souto,**  
Managing Director,  
**Steinert Latinoamericana**







Image courtesy of Equinox Gold

Valladares of FLSmidth sees growth opportunities in Brazil in critical minerals. FLSmidth recently acquired Thyssen-Krupp Mining. According to Valladares, the acquisition responds to the need to offer products that reduce waste and energy consumption. One of the most notable products is Thyssenkrupp's HPGR machine, which Valladares described as a standout in the market.

Steinert, a German company specializing in magnetic and sensor-based separation technology, is also join-

ing the lithium party. Vinícius Souto, managing director of Steinert Latino-americana, explained how Steinert technology works in lithium processing: "One key challenge is to separate the valuable mineral spodumene from its contaminant, schist, in the processing plant. Our technology helps by doing a pre-concentration sorting step, getting rid of most of the gangue material."

This means less material needs to be processed in the mill circuit, which translates into energy and time sav-

ings, as well as more material mined. In addition, Steinert is using sensor-based technology to recover minerals from tailings, a trend that has attracted the attention of major mining companies in recent years. "Leveraging our sensor-based technologies, mining operations can reprocess the materials, isolating and concentrating only the particles with higher mineral content," Souto explained.

Steinert sees Brazil as an excellent mining jurisdiction due to its resilient economy, the first to recover from the pandemic in Latin America, and crucial factors such as a skilled workforce, good infrastructure, and geological diversity. Compared to its neighbors, Brazil is particularly open to innovative technologies. For Steinert, Brazil is the place to be, and the company is actively investing in expanding its presence in the country in response to the opportunity the company sees. Souto explained, "This year, we inaugurated our new factory in the country to meet the increasing demand in Brazil and better serve the Latin American market. We intend to produce our technology locally to enhance competitiveness."

It is essential that both the Brazilian government and Brazilian mining companies continue investing in innovation in the comminution and material handling areas. As Brazil's mining sector grows to supply critical minerals for the electrification transition, the country's network of conveyor belts and material handling solutions will grow in tandem. The sector's development of sensor-based technology and automation will allow that growth to occur smoothly and without requiring an equal expansion of manpower. ■

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## Humberto Valladares

CEO  
FLSMIDTH BRASIL

### Can you provide us with an introduction to FLSmidth in Brazil?

We have operations across Brazil, with a warehouse in Sorocaba, a project management and sales office in Belo Horizonte, a service center in Santa Lucia, and another service center in Parauapebas in the north of Brazil. We offer complete equipment portfolio for copper and iron ore up to concentrate.

### What are the benefits of the acquisition of thyssenkrupp Mining?

FLSmidth recently acquired thyssenkrupp Mining a division of thyssenkrupp AG. The integration with thyssenkrupp is essential because it strengthens the flow-sheet of FLSmidth. There were some products offered by thyssenkrupp that were missing from our portfolio. For example, the HPGR machine offered by thyssenkrupp was a standalone in the market, as it brings significant energy savings in the comminution process.

Another additional strength are our service centers that can support the renewable energy industry.

### Can you describe your innovative material handling solution?

FLS has an innovative solution for Overland Conveyors. Instead of having rollers with rubber on top, the rail running conveyor moves along, carrying the rubber. This results in a reduction of steel used in manufacturing and a reduction of belt tension, meaning that the solution is lighter and less demanding for construction. There are no restrictions for distance and capacity. It will take some time to convince the industry to adopt it, but we are confident it will be transformative.

### What are some future goals?

Our projections are also represented in the growing investments that are being developed thanks to the exploitation of copper in the north of the country. We hope to accompany these projects with our sustainable solutions that contribute to greater productivity in operations. ■



MA



MR

## Marcelus Araújo and Maiari Ruckert

MA: President  
MR: Commercial Director  
**TECNOKOR**

### How does Tecnokor serve the Brazilian mining sector?

MA: In 2007, we acquired Koch do Brasil, which provides complete systems. We incorporated a pipe conveyor technology and we are the leading supplier for that technology in Brazil. Recently, we launched the Tecnokor brand. Currently, we are in the process of merging the two companies.

### What tendencies in demand have you observed?

MA: The equipment has to be durable and reliable. There is a notable demand for autonomous operation, and more and more customers expect their equipment to work completely monitored with sensors as an interface.

Another significant trend is the demand for reduced energy consumption.

Similarly, the production of green steel is an area of importance. These are technological paths that must be taken to meet the environmental need. And more and more all the suppliers are being asked to show actions to reduce their carbon footprint.

### What are the strengths of Brazil as a jurisdiction?

MR: Brazil has a strong base of industry and workforce. If you want to build a mining plant, you can produce it 100% in Brazil, without requiring imported items. We have a group of suppliers established in Brazil, both up and downstream. All products that are demanded in mining are available in the Brazilian market.

### What is your focus for the coming years?

MA: A core part of our strategy is obtaining greater penetration in the market of mobile machines, such as stackers, reclaimers, ship loaders and ship unloaders, car dumpers, to complement our existing line for mining market. We have been working together with Bardella, and we made a cooperation agreement with them to approach the market jointly in the coming years.

In addition, we are entering the agribusiness, which has equipment similar to our conveyor systems. We already supplied some equipment and we are aiming to increase our market share. ■



## Vinícius Souto

Managing Director  
**STEINERT  
LATINOAMERICANA**

### Can you introduce Steinert?

Steinert is a German provider of magnetic and sensor-based sorting technologies. Steinert's products and solutions are designed to help improve efficiency in materials recovery processes, reduce waste, and maximize the extraction of valuable resources from various waste streams. We have a range of sorting and separation equipment that uses advanced sensor technologies such as X-ray transmission, near-infrared (NIR), and magnetic separation to achieve precise material sorting, especially for mining applications. The company began operations in Brazil in 2007, but it was not until 2011 that Steinert installed its production facility. Today, we have a team of around 30 employees in Belo Horizonte serving the Latin American market and operating in three different segments: mining, metal recycling, and waste recycling.

### How can Steinert technologies be applied to reuse tailings?

Among the key challenges currently facing the mining sector, one prominent issue is the declining ore grades as existing deposits gradually deplete. Sensor-Based Sorting technology offers a compelling solution by extending its application to process marginal stockpile materials, extracting high-grade ores embedded within these stockpiles. ■



## Rafael Serpa

Sales and Applications General  
Manager  
**NEUMAN & ESSER**

### Can you introduce NEUMAN & ESSER (NEA) in Brazil?

Our Brazilian office is responsible for serving the complete Latin America. Minas Gerais is home to many international companies as it is centrally located and has the necessary infrastructure to reach customers in all parts of the region.

The NEA Group has four strategic business units - Compressor Solutions, which manufactures compressors for all kinds of industrial gases, pressures, and flows, and is used a lot in the mining sector; Sealing Solutions, which manufactures special sealing elements for rotating or reciprocating equipment; Process Solutions, which is specialized in mechanical processing, manufacturing dry milling and classifying systems; and Energy Solutions which specializes in green gases, mostly hydrogen, and biomethane.

### Can you elaborate on NEA's approach to decarbonization?

The lifespan of our equipment is significant, which reduces the carbon footprint of our solutions as the equipment does not have to be replaced regularly. We focus on sustainable applications, for example, we developed solutions for circular economy applications, such as tire recycling or special gases that are required for a circular economy. ■



## Paulo Godoy

Director  
**ALMEX GROUP BRASIL**

### Could you provide a brief overview of Almex?

In Brazil, Almex has been operating for two years as a subsidiary. Almex specializes in producing conveyor belt accessories and chemical products necessary for splicing conveyor belts. Our company also offers a fault detection line that utilizes sensors placed on the belt to measure variables affecting the belt's operation.

### What is your approach to technological development?

The future of the mining industry does not solely depend on the widespread adoption of automation and artificial intelligence systems. These technologies should be viewed as tools to assist employees in concentrating on tasks that require more analytical abilities, such as innovation. It is also essential to note that extensive installation of sophisticated equipment is not always imperative. Streamlining procedures can lead to more efficient outcomes.

### What are Almex's objectives for the upcoming year?

In addition to expanding our customer base, we strive to further advance technology and innovation. Technology should be accessible to everyone, including smaller businesses. This will enable them to improve the lifespan and reliability of their equipment. ■



## Technology and Innovation

### Remote monitoring is the new normal

Image courtesy of Hexagon

The Brazilian mining ecosystem is home to several technology development companies that are ready to help miners to take advantage of the country's impressive mineral wealth. CEMI, for example, is a Brazilian company that develops technologies to optimize industrial processes and uses different types of hardware, such as cameras and sensors, to collect data that is analyzed in real-time using mathematical models. These technologies help companies make better decisions based on the possible outcomes of different scenarios.

In the past year, CEMI has introduced new systems for a variety of applications throughout the mining cycle, including the tailings area. Marco Aurelio Soares, COO, highlighted the PC Model Base, an integration of multiple dynamic models and the SIM software: "It is a simulator that brings together numerous dynamic models, allowing us to simulate in real-time, slow motion, or 'accelerated' while the plant is in operation."

Following the Mariana and Brumadinho disasters, mining companies have increasingly demanded geotechnical monitoring technologies. GroundProbe, an Australian technology company owned by Orica, develops geotechnical movement monitoring solutions for mining structures and has gained significant traction in the Brazilian mining industry. "Our predictive technologies and software solutions allow our customers to monitor and detect wall movement, understand when it becomes a problem, and determine when a collapse is likely," said Antonio Rocha, head of group business development. "Our reactive technologies detect, track and alarm on moving geohazards in real-time, giving our customers and communities warning of a breach or collapse."

This recognition of the need for monitoring has led mining companies and associations to develop initiatives to meet that need. ALTAVE Intelligent Monitoring recently partnered with Mining Hub, an initiative supported by IBRAM. The company offers its customers a solutions oriented around safety that include hardware, such as cameras, radars and aerial sensors, as well as software to process and analyze the data. "If an employee is not wearing protective clothing or an accident occurs during operations, our solutions alert the operations manager," explained Ronny Madeira, former mining engineer and account executive of ALTAVE.

The use of digital tools, machine learning, and real-time data collection and analysis provide notable benefits in terms of safety, sustainability, productivity, energy efficiency and cost

savings. However, the effectiveness of these systems depends on connectivity and energy infrastructure. In light of this, telecommunications companies are becoming increasingly important in the mining industry. As technology advances, the need for reliable communications networks has become critical.

Technology, such as automation and remote-control systems, helps to use human capital more efficiently by re-allocating people from dangerous physical tasks to more specialized activities. This is particularly important for the mining industry when it is becoming increasingly difficult to attract young talent. Traditionally considered to be physically demanding and dangerous, work conditions for miners are changing and a new type of workforce will emerge. ■



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»» **The market for our safety solutions is strong. Brazil's major mining companies are our clients, and over 6,000 pieces of equipment use our collision avoidance technology.** ««

## Rodrigo Couto

President, Latin America  
**HEXAGON'S MINING DIVISION**

### Please provide an update on Hexagon's operations?

Hexagon offers integrated solutions for all mining areas, such as planning, operations, safety, monitoring, and smart centers. Hexagon's safety portfolio, which includes a collision avoidance system, fatigue and distraction monitoring, vehicle intervention, and tele-operation solutions, covers more than 85% of the market share worldwide. The market for our safety solutions is strong in Brazil. The major mining companies in Brazil are our clients, and over 6,000 pieces of equipment use our collision avoidance technology.

Hexagon recently acquired HARDLINE, a Canadian automation and remote-control technology company, which strengthens our life-of-mine technology stack providing the solutions that will support completely autonomous mine operations, complementing Hexagon's fleet management technology by allowing the tele-remote operation of heavy machinery. In terms of collision avoidance systems, our Vehicle Intervention System (VIS) offers level nine protection by stopping the vehicle if the operator doesn't take action in time to avoid a collision. This technology will be present in mines of two major Brazilian mining companies by the end of the year. Some mining services suppliers for tailings dams decommissioning are already using vehicle intervention and remote operations.

We collect data and have AI solutions to interpret it. We also offer the tools that operations need to handle high-level data, which improves mine safety by allowing them to take data-based approaches to implementing changes in their planning and operations.

In the journey from semi-autonomous to fully autonomous, we partnered with U&M, a major Brazilian contractor, to deploy an Autonomous Haulage System (AHS). By retrofitting their trucks with our drive-by-wire solutions, we are not only making the trucks autonomous, we are also enabling U&M to be more sustainable by using machinery that they already have and extending the life of the machines.

### What are the benefits of Hexagon's collision avoidance systems?

Our Collision Avoidance System (CAS) offers 360-degree operator awareness via a single, non-intrusive cabin display. This provides operators with a complete suite of sensors, software and hardware that generates seamless integrated data. As our CAS is OEM agnostic, our solutions can be installed on a mine's pre-existing equipment. Rather than having multiple computers, displays, antennas, and GNSS, we provide an integrated sensor ecosystem that optimizes data in a single platform. This minimizes the amount of maintenance needed and, therefore, the downtime.

Hexagon also offers a solution that helps combat fatigue and distraction. Our Operator Alertness System (OAS) empowers operators to maintain the level of attention necessary to stay safe during mining operations and allows intervention if necessary.

### How does Hexagon support tailings dam safety?

Hexagon offers geotechnical monitoring for tailings dams.

We are looking to expand our offerings in tailings management. Government requirements prohibit workers from entering risk areas, so increasing the autonomous equipment used in those areas is essential.

### How important is Brazil as a market for Hexagon?

Worldwide, Hexagon has experienced year-to-year growth of more than 35% in the last four years. Brazil is a key market in Hexagon's operations, making up 30% of our Latin American revenue, second only to Chile's 32%.

Brazil can be challenging in terms of Wi-Fi and network connectivity, so we partner directly with providers to offer an integrated SAS solution. For instance, our smart antenna can seamlessly adapt to different network suppliers such as Wi-Fi, LTE and peer to peer communication.

### What are your primary goals for the next 24 months?

We have two main market demands. The first is providing an integrated solution for safety, and the second is tailings dams decommissioning (TDD).

To address the first demand, we are going to integrate fatigue, fleet management, and collision avoidance systems in a single platform.

For the second, we are providing a unique solution which includes state of the art products such as teleoperate, 3D mapping, CAS, task management, fleet management, network coverage, and total monitoring for slope stability, as well as potential autonomous operations that will increase productivity through increased truck speed and autonomous dozer activity.

Our priority is developing our solutions and bringing our clients to a higher level of autonomy, which improves safety and productivity in their mines. We are focused on connecting the life-of-mine journey in Brazil, a country that is open to innovation. They appreciate the challenge, which is why Brazil's DNA and Hexagon's DNA match. We are dedicated to bringing effective solutions to both the companies and the country. ■



## Antonio Rocha

Head of Group Business Development  
**GROUNDPROBE**

### Can you introduce GroundProbe?

GroundProbe specializes in real-time solutions for measuring and monitoring geohazards. Our predictive technologies and software solutions monitor and detect wall movement, understand when it becomes a problem, and determine when a collapse is likely.

### How has the demand for slope monitoring in Brazil evolved in recent years?

Our tailings monitoring services have grown in demand in Brazil, which has become one of the organization's most important markets and segments. However, we have recently observed that demand for slope monitoring systems for mines is experiencing a new upswing.

### What are the strategic objectives of GroundProbe for the next 12 months?

Our permanent objective is to develop new technologies based on the monitoring needs of our customers. We also want to continue to expand the commercialization of our various solutions, as we offer the most diverse range of monitoring solutions on the market. Finally, we want to continue to leverage the synergies with our parent company Orica and integrate the solutions of both companies to offer better technologies and opportunities to the mining industry. ■



## Alfredo Carballeira

Country Manager,  
**STOCKHOLM PRECISION TOOLS (SPT)**

### Can you discuss SPT's presence in Brazil?

In Brazil, SPT is based in Belo Horizonte, but our tools are utilized across Brazil, including Pará, Minas Gerais, Bahia, and all the key mining regions. SPT primarily works directly with the mines but also sometimes partners with contractors who utilize the tools on-site.

### What are the benefits of your star product?

The standout benefits of our star product, GyroMaster™, begin with its unparalleled accuracy in directional surveying, courtesy of next-gen solid-state sensors and the SPT proprietary Navibore algorithms. Unlike traditional magnetic sensors, which are susceptible to ferromagnetic interference, GyroMaster™ aligns itself to true north, ensuring pinpoint precision. It operates at a speed that's six times faster than its closest competitors, offering rapid data acquisition that revolutionizes real-time decision-making.

### How do you plan to grow SPT in Brazil?

We are significantly increasing both commercial and technical areas and increasing the number of teams we have that can be deployed across Brazil. ■



## Guillaume Barrault

CEO  
**DYNAMOX**

### Can you introduce Dynamox?

Dynamox is a hardware and software manufacturer, being one of the few companies in Latin America to produce wireless sensors. Dynamox's wireless sensors work by transmitting information through a gateway that uses telecommunications technology, including WIFI/Ethernet/4G/5G and Bluetooth. The company helps customers to increase the reliability of their equipment and reduce their asset downtime having many successful cases published.

One of the key milestones this year was the acquisition of Enging, a Portuguese company specializing in current and voltage measurement. The acquisition allows us to create a unified solution for the end users and added two critical variables to cover the whole universe of measurement to predictive systems and asset performance.

Another key milestone was the intelligent dashboard that provides a visual summary of the resultant of the automatic detection failure algorithms within the plant or site flow.

### What are the main objectives of Dynamox for the next two years?

Dynamox has the target to increase its activities in other markets worldwide. In Brazil, the company wants to consolidate its position as the leading asset monitoring company. ■



## Marco Aurelio Soares

COO  
CEMI

### What are the services CEMI offers to the mining industry?

We have advanced tools to diagnose, understand, simulate, and implement modifications in the process or better monitor and control industrial operations. The main advanced tools are stationary and dynamic simulators, Advanced Process Control (APC) systems, process management tools with IOT, PIMS, and BI solutions integrated with advanced and innovative instruments to complement process measurements, all integrated with dynamic models of the productive process, allowing full elucidation of the process and "mathematical explanation" of everything that happens. We also highlight advanced equipment specially developed for areas where equipment efficiency is highly necessary, such as dry and wet classifiers - dynamic classifiers, flotation concentrators - column and tank cell with 4th generation aerators, hyperbaric vertical filtration, fully automated mobile pilot plants, etc. Most of the software, advanced instruments, and equipment were entirely developed by CEMI, which, besides implementing all the advanced technologies in its projects, supplies its products to the entire market always providing training for a real transfer of technologies.

### What are the key trends in process optimization technology?

There is a global technological trend in online process sensors in its various stages and unitary processes. This is an unprecedented technological leap, especially when combined with process management tools and AI. It can be expected to extend the life of a mine by separating gangue from useful materials from ROM already in mine operations and material transport. Online analyzers that allow the analysis of conveyor belt contents, materials in the form of pulp, and foam at various stages of ore processing with up to 95% accuracy are a trend. With this technology, we can measure the properties of the processed material, such as moisture, metallic contents, coarse and ultra-fine granulometry. Many real-time measurements associated with dynamic physical models allow for a better understanding of the process state and more appropriate and precise control. This is a major revolution. ■



## Edson Luis Geraldini and Rafael Toledo

ELG: Sales Director  
RT: Key Account Manager  
**HOWDEN**

### What differentiates the company?

RT: Howden offers complete solutions, including everything involved in installation and engineering. We provide the equipment for ventilation, cooling systems, compressors, including the engineering, electrical packages, mechanics, and so on.

Howden has two areas in mining: underground mining and process mining. Howden has products to deliver complete packages both underground and in the processing plant. Within the production process, at the copper smelters, sinter plants and pellet iron ore plants, we have the equipment for environmental control such as bag filter and carbon capture systems to support customers in producing green metal.

### Can you describe the benefits of Howden's digital offerings?

ELG: VentSim DESIGN is specific to underground mining, and it is the leading software used globally for the simulation and design of mine ventilation. This equipment helps us offer a personalized service.

We then developed VentSim CONTROL, enabling on-demand ventilation for all mining operations. This results in a safer operation that will deliver the air for the operation with the desired quality and control to match the workers' activities and the moment-by-moment needs of the mine. VentSim CONTROL allows for significant energy savings because only the amount of air that is needed for the operation in a given moment is dimensioned.

### Where do you see an opportunity for growth?

RT: In Brazil, we already have the technology for carbon capture products and green hydrogen production and the capacity to meet this market demand.

### What do you see as the benefits of Brazil as a mining country?

ELG: 86% of Brazil's energy is hydroelectric, and we also have wind and solar power. Brazil is a nearly completely clean energy producer. Howden sees Brazil as a country with the potential for exciting development over the next twenty years. ■



## Ewerton Libanio

Managing Director  
**SATCOM DIRECT BRASIL**

### Could you provide an overview of Satcom Direct?

Satcom Direct (Satcom) is a provider of fully integrated, end-to-end, satellite communications solutions to the aviation, government, land mobile, marine, and infrastructure sectors. 11 years ago, Satcom established an office in São Paulo to support the Latin American region.

Mining is the second most important vertical for Satcom, after aviation. Brazil is our most important market in the region. After the Mariana Dam disaster, we saw significant demand for our remote operating technologies due to an increased awareness of safety. We can help our customers develop their operations to protect their employees. We have supported major mining companies such as Vale, providing innovative connectivity solutions for mining operations in remote locations.

### What is your perspective on Brazil's communication infrastructure for mining?

In terms of communication infrastructure, Brazil is ahead of other countries in Latin America. Increasingly more companies are adopting industry 4.0 technologies and becoming more automated and digitalized, resulting in communication infrastructures being further developed and upgraded. ■



## Ronny Madeira

Former Mining Engineer and Account Executive  
**ALTAVE INTELLIGENT MONITORING**

### What are the main solutions you offer to the mining industry?

Besides offering a complete monitoring solution, including hardware and software, we also provide on-time maintenance to guarantee the functionality of our solutions.

In terms of hardware, we can use devices such as high-resolution cameras, radars, and sensors, which can be installed in strategic locations using fixed platforms, drones, or even communication towers.

In addition to installing infrastructure and hardware, we offer our software, ALTAVE Harpia, which uses AI. We provide a complete monitoring solution, identify the problems with the hardware, and then create patterns to generate alerts using AI. These intelligent monitoring solutions also impact productivity, as clients can immediately identify problems in their operations and make better decisions in less time.

### What are the main goals of ALTAVE for the next 24 months?

Consolidating our solutions in the mining market by continuing to demonstrate to our customers the high value of our solutions to address the major challenges facing the industry today: safety and productivity. ■



## Airton Sena

General Manager  
**MODULAR MINING BRASIL**

### Can you describe your integrated solutions?

We offer a proven fleet optimization system, and are now constructing a new open platform. This platform will be an ecosystem of applications. Mines need more interoperability between solutions. No one company has the capacity to provide solutions for the complete mining processes, and the lack of communication between solutions has inhibited the mining industry. Our new platform will run our core solutions, but also allows the customer to use other solutions from their other partners, providing the client with a fully integrated platform.

### Where do you see opportunity for growth?

Digitalization and automation provide a major opportunity. Modular has the largest mining market share in digitalization, and we are continuously making our business more integrated and digital.

### What is your goal for the coming year?

Our strategy for the coming year is to implement new apps for the new platform. We developed a new program called EAP - Early Adopter Program, which has allowed our long-time customers to participate in the process of app's development in early stage. Our main target for the next year is to deploy the new open platform to newer players in our ecosystem. ■



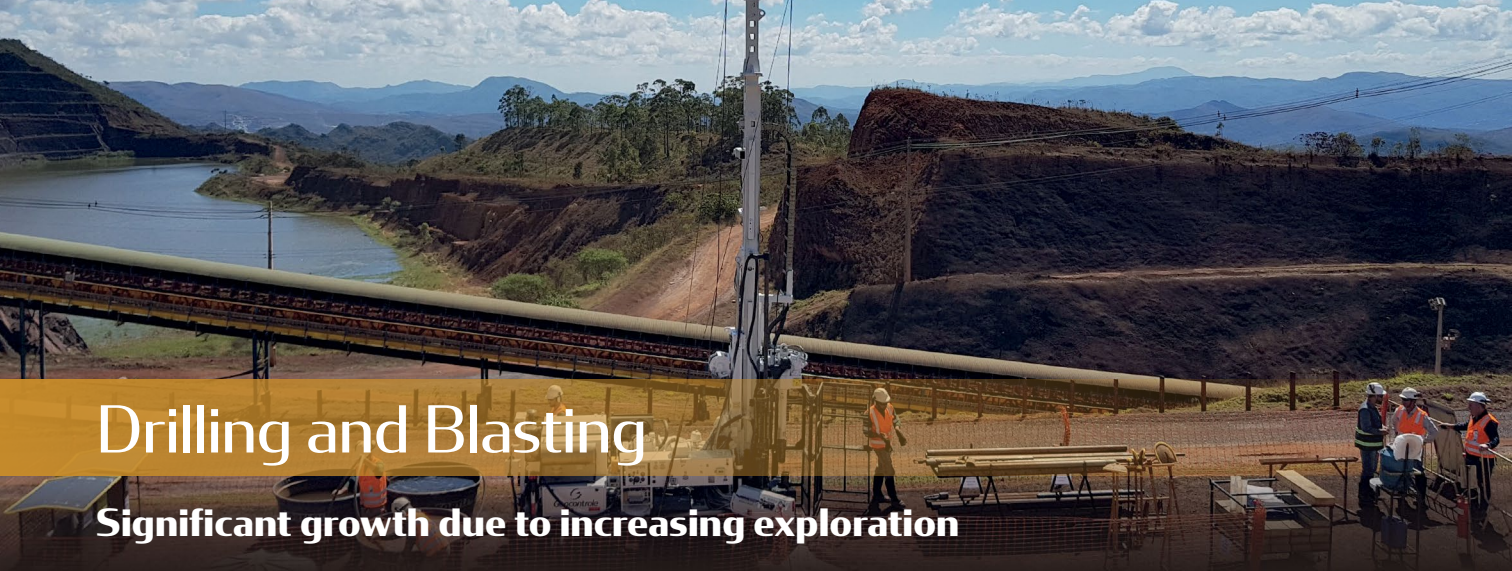
"There has been more mineral exploration activity, especially considering the energy transition. The main players in the market are either looking to increase capacity or expanding their asset portfolio with critical mineral resources."

**Nelson Beiró,**  
General Manager,  
Geocontrole

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Image courtesy of Core Case



# Drilling and Blasting

## Significant growth due to increasing exploration

Image courtesy of Geocontrole

The current Brazilian mining landscape offers many opportunities for drilling companies. As exploration increases in response to changing mineral demand, the demand for drilling and blasting services has boomed.

For Geocontrole, a company offering geotechnical investigations, drilling and laboratory services, the market has been phenomenal recently. The company experienced 25% growth of revenue in 2022 compared to 2021, and expects a 15% growth in revenue in 2023. Nelson Beiró, general manager of Geocontrole, stated: "High interest in critical mineral mining has had a positive impact on Geocontrole's business and we are seeing increased demand for our services."

DrillGeo has also experienced the same, particularly in the exploration area: "Demand for mineral exploration and research has increased significantly in the last ten years. Demand in 2022 was stable, and the expectation is that 2023 will show a growth trend that will continue for the next five years," noted Francisco Neto Sampaio, director.

In some part, this increase in demand has been driven by the green energy transition. As Brazil's diversity of mineral wealth has become more in demand, drilling and blasting services have benefited. Beiró stated: "There has been more activity in the mineral exploration space over the past few years, especially considering the green energy transition. The main players in the market are either looking to increase capacity or expanding their asset portfolio with critical mineral resources."

Indeed, it is a time of immense opportunity for Brazil, with the green energy transition driving demand for drilling activities. Neto Sampaio added: "With the advancement of decarbonization of the economy and the replacement of fossil fuels such with renewable energy sources like wind and solar energy, mining activities are expected to grow significantly, as the equipment used in these industries and components of electric cars consume many materials, such as copper, lithium, and nickel, which increases the demand for these and other minerals."

In addition to favorable market conditions, drillers operating in Brazil benefit from the climatic conditions. Unlike in Chile and other jurisdictions where operations can be subject to the extreme heat and cold of deserts or other hostile environmental situations, the climate in Brazil is relatively friendly for drilling. Neto Sampaio explained: "There is, despite the diversity of terrain, a favorable and stable climate. We do not have issues with earthquakes, blizzards, or hurricanes. Although the rainy and tropical climate can be a hindrance, the climate is nonetheless more predictable for operations."

The Brazilian exploration segment is not without challenges that impact players in the drilling and blasting area. Daniel Bortowski, director of Core Case, a producer of cases for the storage of drilling core samples, argued that the inability to properly identify meaningful targets and speculation has been a major challenge that has weakened the junior segment. Some juniors in past years tried to achieve quick results without putting in the time and expense to truly understand their resources. He stated: "Juniors focused primarily



<p><b>GEOTECHNICAL CONSTRUCTION WORKS</b></p>	<p><b>GEOTECHNICAL GROUND INVESTIGATION ONSHORE AND OFFSHORE</b></p>	<p><b>GEOTECHNICAL CONSULTANCY AND DESIGN</b></p>
<p><b>LABORATORY</b></p>	<p><b>MINERAL PROSPECTING</b></p>	<p><b>QUALITY CONTROL, GEOTECHNICAL INSTRUMENTATION AND MONITORING</b></p>
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»» Our demand for mineral exploration and research has increased significantly in the last ten years. Demand from 2017 to 2021 was very strong, 2022 was stable, and the expectation is that 2023 will show a growth trend that will continue for the next five years.



**Francisco Neto Sampaio,**  
Director,  
DrillGeo

»» Drilling rod manipulation is a high-risk endeavor, and the mining industry has suffered a multitude of accidents in that area. Today, we observe a strong need for options to reduce the risk levels of the activity.



**Ronald Ambler,**  
CEO,  
INNRA

on raising capital on the stock markets without seriously addressing geological analysis or engineering of potential deposits, so poor projects were quickly sold. This situation prevented a real opening of the industry."

Speculation remains a problem in the Brazilian mining industry. There is money flowing in, but it is often improperly directed. Bortowski said: "The government needs to create incentives not only to attract investment and capital but also to promote the development of new mines."

Efficient drilling is critical to reducing costs and accelerating the development of exploration programs, and automation is widely believed to be the solution. The use of automation in drilling has visible benefits: The first is safety, as it reduces the exposure of the drilling operators. Second, it reduces the human error rate, increasing precision and efficiency while reducing costs. Third, better, more precise drilling results in lower energy consumption. Automation is also a great response to the shortage of drilling operators, which has been a severe problem in the industry for years.

Geocontrole, for example, has a new drilling rig which can eliminate 99% of the man-to machine ratio. It will be deployed at one of Vale's operations, demonstrating the interest from major mines in transitioning to automated drilling. Nelson Beiró, Geocontrole's general manager, said: "We have showcased this automated drill rig to the market and are currently finishing the preparations to implement the rig in the field. This is the first geotechnical drill rig in the world that is equipped with automated systems that allow for easier and safer operations."

Advances in data science have enabled the development and introduction of these types of rigs. Geocontrole's rig provides a continuous evaluation of activities and metrics from the machine's telemetry systems. Rigs like these not only make mining safer, but also more inclusive, as the reduction in physical demands of drilling operations allows for a more diverse team of operators.

The move towards automation is representative of a transformation in the larger culture of the country's mining industry. "Today, Brazil is in the same position Chile was five years ago; amid a transition to a more intense focus on safety," said Ronald Ambler, CEO of INNRA. "Chile is further ahead on this journey, but Brazil is catching up rapidly and is already close to the same level in demand for advanced, safety-oriented technology."

DrillGeo is also active in the field of Automation. "Complete automation is more challenging for drilling companies than other parts of the mining industry, but continuing to move in this direction is a major priority," said Neto Sampaio. "We have been investing heavily in automated handling systems to reduce the presence of people in the process, working towards remote operations at a distance."

In August of 2023, the ministry of mines and energy announced a plan to invest 307 million reais (US\$63) million in mineral exploration through the PAC investment program. Out of the investments intended for exploration, the ministry intends to spend 281 million reais by 2026. The future for exploration is sustained investment on private and public levels. ■



DEVELOPING SUSTAINABILITY THROUGH QUALITY MINING











»» **The automated drill rig allows the highest levels of operational safety and quality of production, as there is continuous evaluation of metrics from telemetry systems.** ««

## Nelson Beiró

General Manager  
**GEOCONTROLE**

### How has Geocontrole evolved in the Brazilian market?

We entered the Brazilian market in 2013, and established an office in Belo Horizonte, Minas Gerais, as our only focus in the country was and remains the mining industry. Today, Geocontrole is structured with expert human resources who act in various fields of consultancy and geotechnical investigation, namely special foundations, observation and geotechnical instrumentation, quality control of materials, as well as soil, rock, and concrete mechanics laboratory testing, and we also provide drilling services to the main players in the mining industry.

Geocontrole's two main services today are geotechnical investigations and drilling, which each represent approximately 45% of the company's overall activity. The other 10% is represented by our laboratory services. We saw an exceptional 25% growth in revenue in 2022 compared to 2021, and we expect to continue on this path with a 15% growth in revenue in 2023.

### Can you elaborate on the main objectives of Geocontrole's partnership with INNRA?

INNRA offers solutions related to innovation, safety, and digitalization. Geocontrole saw it as a good opportunity to partner with them and bring them

to Brazil. We are proud to be the first company in the market to offer these kinds of solutions to clients and are already installing digitalized and automated equipment for some of our clients, which will improve the safety and efficiency of operations.

The safety of our workers is a key focus area for Geocontrole, and with the implementation of automated equipment we can take operators out of dangerous environments, making their work much safer and more comfortable than before. Increasing the safety and comfort of the work environment can also attract more people, such as the younger generation, women, or people with disabilities, to the field, which is extremely important at a time when there is a labor shortage in the market.

### What trends are you observing in drilling techniques?

With a focus on safety, Geocontrole is bringing an automated drill rig to our operations that can eliminate practically 99% man-to-machine machine ratio. It allows for operational safety as in just one maneuver, the employee-operator can perform his work, and it also provides the opportunity to create inclusive work environments in the drilling space since the physical demands of the drilling operation become practi-

cally non-existent. The automated drill rig allows the highest levels of operational safety and quality of production as there is continuous evaluation of activities and metrics from telemetry systems.

We have showcased this automated drill rig to the market and are currently finishing the preparations to implement the rig in the field. This is the first geotechnical drill rig in the world that is equipped with automated systems that allows for easier and safer operations. Our rig will be deployed at one of Vale's operations soon, and we expect that this will be the first such rigs to be deployed.

### How is Geocontrole involved in the tailings space?

Geocontrole is involved in several projects related to tailings dams, especially with the mining industry having an increased focus on tailings after the Samarco dam disaster. We are receiving significant demand for geotechnical investigations to improve the stability of tailings dams structures.

### What is your perspective on the current mineral exploration environment in Brazil?

Brazil is geologically well endowed and there are great opportunities related to the exploration and mining of critical resources that will be needed for the energy transition. Brazil has all the ingredients to be a leading player in the transition.

There has been more activity in the mineral exploration space over the past few years, especially considering the energy transition. The main players in the market are either looking to increase capacity or expanding their asset portfolio with critical mineral resources. High interest in critical mineral mining has had a positive impact on Geocontrole's business and we are seeing increased demand for our services.

### What are Geocontrole's strategic objectives for the next two years?

Geocontrole intends to continue its growth trajectory and be recognized as a major player in the geotechnical and drilling services market. We are currently building a new laboratory and offices in northern Brazil to be closer to the mining industry that is developing in that region. We will continue to offer new solutions, innovations, and technologies to the market to better serve our customers. ■



»» **We have developed a new business line, Core Case Tech, a tool that uses digital resources to analyze geological and drilling data.** ««

## Daniel Bortowski

Director  
**CORE CASE**

### Can you introduce Core Case?

Core Case was founded in 2010 to serve different industries that require drilling services, such as geotechnical, rock mechanics, and environmental companies. We produce cases for the storage of drilling core samples in 100% recycled plastic. Since our beginnings, Core Case has been focused on sustainability, safety, and the technical aspects of operational activities.

In recent months, we have worked on our expansion into other markets. We recently entered the Canadian market and have actively participated in trade shows, events, and media in Latin America. In addition, we have developed a new business line, Core Case Tech, a tool that uses digital resources to analyze geological and drilling data. Two of the largest mining companies in Brazil are already testing this technology.

### What are the advantages of Core Case products?

Our cases are designed with ergonomics, stability, and safety in mind. We ensure that our products are safe and easy to transport. We develop our products according to market needs. Gold, for example, is a very sensitive metal, so its transport must be carried out under very strict rules to avoid contamination. To solve this problem, we

have developed a system that allows water to be drained without risk of contamination.

Another common problem is the labeling of drilling information. Here in Brazil, it is common to lose drilling information during sample transportation, which is a problem because everything is measured very precisely. So we developed a product that keeps the sample information in place during the transportation of drilling samples.

### How does Core Case promote sustainability?

ESG criteria have become a priority in the Brazilian market, especially since the accidents with the tailings dams in Minas Gerais. The government has made significant efforts to promote compliance with safety and environmental standards, so mining companies are also looking for suppliers that prioritize sustainability.

Over the past twelve months, we have intensified our environmental activities. In partnership with the non-governmental organization Eco Local, we are working on a project to clean up beaches in several Brazilian coastal cities, particularly Santa Catarina, where our offices are located. It is a differentiated project, as we not only collect the garbage but also make sure that materials like plastic or aluminum are

recycled. At Core Case, we also use this waste to manufacture products in our portfolio, such as our eco-friendly drilling frame, which we named DH Collar Marker.

Due to our environmental initiatives, we recently received the Fritz Müller Award in the Social and Environmental Projects category, granted by the Environmental Institute of Santa Catarina. This is one of the most important awards in the state of Santa Catarina.

### What are the biggest challenges in developing new mines in Brazil?

A few years ago, many small junior companies became large companies by discovering significant deposits. However, many others tried to achieve quick results through short exploration campaigns without clearly defined targets. They focused primarily on raising capital on the stock markets without seriously addressing geological analysis or engineering of potential deposits, so poor projects were quickly sold. This situation prevented a real opening of the industry, and I believe that speculation is still a problem for the Brazilian mining industry. The government needs to create incentives not only to attract investment and capital but also to promote the development of new mines.

### Can you expand on your internationalization strategy?

We have a very clear internationalization strategy. We see a lack of innovation in Brazil because the country has traditionally been an exporter of raw materials. The government needs to create tax incentives, especially to reduce the high tax burden on workers. In this context, we recently entered the Canadian market because it is a country with a high level of development in the manufacture of high value-added products.

We are also interested in Latin America, one of the most important mining regions in the world. Specifically, we aim to expand our operations in Chile, Peru, Mexico, Ecuador, Argentina or Colombia.

### What are Core Case's strategic objectives?

First, to further develop our Core Case Tech software technology. Second, to maintain our growth in Brazil and Latin America. And finally, to position ourselves in the North American market through our company in Canada. ■



»» **Our focus has shifted towards incorporating greater intelligence into the ore extraction process.** ««

## Ravi Sahu

CEO  
STRAYOS

### What technological solutions has Strayos been working on?

Our focus has shifted towards incorporating greater intelligence into the ore extraction process. One area where significant costs are incurred is drilling and blasting, and many mining operations believe that they can optimize their resource through better dilution control. To address this challenge, we introduced our Ore Dilution Control solution in the form of a generative digital twin.

This solution utilizes existing data to model and analyze each 5 cm block, considering various blasting parameters. Accurately predicting the distribution of waste and ore empowers mining professionals to determine the optimal blasting parameters for reducing waste and maximizing ore recovery. This aligns with their production objectives and mitigates the common issue of dilution.

### How is the mining industry embracing new technologies, and what specific advancements are being adopted?

The industry is undergoing a significant transformation both in terms of evaluating new technologies and embracing them wholeheartedly. Technologies such as AI, autonomy and advanced sensor systems are being adopted, marking a departure from the previous resistance and hesitancy towards innovative solutions, and companies have

developed a culture of practice that did not exist a few years ago, shifting towards a more open approach of conducting pilot and experimentation projects to test these technologies.

The primary focus remains on achieving a quick return on investment. Companies are eager to see tangible results within a relatively short timeframe, typically ranging from six months to a year. Strayos' success lies in demonstrating that the implementation process is streamlined, and we have observed positive outcomes in the companies we engage with and where our technology is implemented.

### What are some common challenges or barriers that companies face when adopting AI models?

Many companies lack structured data storage practices and diligent data collection efforts necessary for building effective AI models. This becomes a significant barrier since the availability of the right data is crucial for generating meaningful outputs from AI platforms.

### Strayos recently partnered with Quantum Systems and Delta Drone. Could you delve into the company's strategy and how AI combined with drones prove to be powerful?

Our strategic goal for expanding into different markets is to partner with established companies in those regions with a deep understanding of the min-

ing industry's on-the-ground challenges, enabling us to deliver value to our customers more rapidly. By offering a comprehensive turnkey solution that covers hardware, sensors and software, we provide a seamless end-to-end solution, allowing them to adopt our offerings effortlessly and start benefiting from them immediately.

As data collection becomes more commonplace, combining drones and AI proves to be incredibly powerful. Drones excel at collecting vast amounts of data, but the key lies in automating the analysis process. With the abundance of imagery, videos and surveying data, automation becomes critical in efficient processing and extracting intelligence from this information.

### How are Strayos' AI solutions utilized?

Our platform is utilized in various areas, including drilling and blasting optimization, fragmentation optimization, and geotechnical operations. The operational focus revolves around two key themes; geotechnical analysis and improving ore dilution and fragmentation.

On the geotechnical side, mining companies are eager to leverage our tools to better understand their operations. They seek ways to optimize geotechnical processes and minimize ore dilution. By utilizing our platform, they can capture data before and after blasting, enabling them to generate a dilution factor through algorithms. This valuable information can then be fed back into the model, facilitating continuous improvement and decision-making.

### What are Strayos' goals for the upcoming months?

In 2023 and 2024, we aim to expand the implementation of our new Ore Dilution Control solution globally, with a particular focus on copper and gold mines, as they stand to gain substantial benefits from its utilization.

On the other hand, we have developed a cutting-edge machine vision solution, a 3D AI camera. This solution offers full autonomy, effortlessly collecting data and correlating it to specific material blocks. We enhance operational efficiency and decision-making by providing seamless data collection and analysis.

On the product front, we are also dedicated to expanding our solutions in hyperspectral sensing. We focus on leveraging imagery data and other sensor inputs to generate significant value. Hyperspectral imaging solutions are poised to play a vital role in the future of metal mines, enhancing their capabilities and extracting valuable insights. ■



## Laboratories and CRMs

### Leveraging the potential of laboratories through CRMs

Image by Alexander Rathsat Adobe Stock

High-quality, efficient laboratories can make all the difference to the success of an exploration program. With increased environmental regulations, laboratories also greatly assist mining companies in analyzing water and soil contamination.

One of the main problems for the industry is how long it can take to receive lab results, particularly for exploration programs that are on very tight time frames. Delays in laboratory services have been a significant challenge for the mining industry worldwide, with backlogs extremely long coming out of the pandemic. Braulio Pessoa, CEO of Itak, said: "After Covid, the market is more anxious. Client demands are urgent due to accelerated projects development. Many companies have reactivated old projects and are seeking immediate responses."

To accelerate the process, laboratories are turning to digital technologies. Fernando Quental, natural resources director at SGS, said: "Implementing digital tools to expedite analytical testing and information to the client is key as they always ask for speed."

As the Brazilian mining sector has begun to diversify in terms of mineral production, there has been greater demand for laboratory services from metals that were previously not major players. Like other companies providing services to exploration and mining companies, SGS has seen significant growth in Brazil in recent years due to increasing interest in exploiting critical minerals for the energy transition: "We have been experiencing double-digit growth for the last five years. Over the last year, SGS has been developing our services for lithium and nickel, pursuing the energy transition space with success, and adding new customers to our portfolio," continued Quental.

To increase precision and reliability, laboratories and mining companies are increasingly using certified refer-

ence materials (CRMs), which are control samples used to monitor chemical analysis. Itak is one such provider. Pessoa stated: "This product is used for checking whether a chemical analysis is correct and for chemical instruments calibration. Geologists use CRMs as blind samples to ensure the accuracy of their thousands of samples' analysis results."

At the core of developments in the laboratories and services sector is a demand that impacts nearly every element of the mining industry: the need for more information. That goes beyond sensors on machinery to a better and faster understanding of the mineral itself. Meeting that need in Brazil is a strong laboratories segment. ■

**ITAK** **CRMs AND PROFICIENCY TESTING**  
**All you need is here!**

- **CRMs (Standards):** Custom manufacturing and a wide range of standards in stock for prompt delivery.
- **Proficiency Testing:** A wide range of PTs (Round Robin) for Geochemical matrices.
- **Laboratory Consulting:** Technical consulting for geochemical laboratories.

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»» Implementing digital tools to expedite analytical testing and information to the client is key as they always ask for speed.



**Fernando Quental,**  
Natural Resources Director,  
SGS







# Braulio Pessoa

CEO  
ITAK



**Client demands are urgent due to accelerated projects development. Many companies have reactivated old projects and are seeking immediate responses.**



### Can you introduce ITAK?

After the 2008 global financial crisis, we decided to produce certified reference materials (CRMs). This product is used for checking whether a chemical analysis result is correct and for chemical instruments calibration. Each CRM is accompanied by a certificate, which allows the clients to compare their results with the certificate and ensure that their results are correct. Geologists use CRMs as blind samples to ensure the accuracy of their thousands of samples' analysis results.

We have a wide variety of CRMs available made from ores and rocks worldwide. It is important to choose a CRM made from a geochemical matrix similar to the samples analyzed. It is not recommended to use a CRM different from the samples. If we analyze samples of iron ore in a Brazilian mine, for example, the using of a CRM made from an Australian iron ore may affect the accuracy checking. ITAK can produce CRMs by demand, to geologists or labs, using their own materials such as rocks, ores or concentrates. We have produced a large stock of CRMs which allows us to sell products to geologists, chemical labs and for arbitration processes deciding materials and commodities prices, which reduces the risk of fraud.

ITAK also provides proficiency testing services in the mineral field, where labs analyze blind samples sent by ITAK (reference materials). After receiving the results, ITAK carries out a statistical treatment and issues a robust and detailed technical report, evaluating trueness and precision, informing if the participants analysis results are proficient or not through their analytical results.

ITAK also has its own chemical lab offering XRF analyses.

### What are the leading demand trends for your services?

Client demands are urgent due to accelerated projects development. Many companies have reactivated old projects and are seeking immediate responses. Our revenues doubled since 2022, and historically it has increased at least 30% yearly. I believe this market behavior shift is due to the pandemic.

### Have you seen changes in demand due to the boom in critical minerals?

We are always looking for new materials. In terms of chemical analysis, labs have been facing increasing difficulties due to low ore grades. These low grades require them to review and update methodologies, and for reliability checking, they need CRMs. The industry has more demand for new materials such as lithium and nickel. We decided to focus on a specific material by interacting and communicating with clients, ensuring that we meet their needs.

### How can mining companies manage slow turnaround times at labs?

There are less than five large lab company groups worldwide. I believe that there are insufficient companies to meet the demand. Launching or starting a company is challenging, especially in chemical analysis labs, because you need highly specialized people.

The best way to solve slow turnaround times for a mine that is currently producing is to develop an internal lab at its premises. With an internal lab that can deliver reliable results and is also able to analyze drilling samples and exploration inputs, the turnaround time problem for a mine can be solved. They also help the labs on the market to be able to deliver results promptly by lowering demand.

Additionally, I also recommend that junior companies develop a physical preparation lab. It could solve a logistical and the turnaround problem because they would send samples in pulps which would cut down the lengthy process at the chemical lab.

### What is your strategic focus for the coming years?

ITAK currently attends clients in more than 60 countries delivering products and services. We have some strategic objectives: The first is to serve more countries, developing a wider variety of products continually, not only in geology or in labs, but also producing more solutions for labs, such as CRM calibration kits. Another important goal is to be accredited with ISO 17034 as a CRM producer.

The most important factor of a CRM is the homogeneity and the reliability. ITAK offers a reliable process with a high level of homogenization. We combine proficiency tests and CRM production. In that sense, we have a database of information on the best and most reliable labs. By combining these solutions, having a large experience and updating the processes and the team interaction, I can see a prosperous future to ITAK and its stakeholders. ■

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