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CHILE MINING

2018



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Dear Reader,

The mining industry has only recently emerged from a difficult period. The consistent price decline of copper between 2013 and 2016 presented a whole set of challenges to red metal producers. Chile, as the world's copper powerhouse, was no exception. Nelson Pizarro, CEO of state-owned copper titan CODELCO, referred to this period of low mineral value and sustainability issues as a 'perfect storm' exacerbated by a lack of government funding. Miners worldwide embarked on aggressive cost reduction missions to boost productivity, eliminate bottlenecks, and think outside of the box to incorporate new technologies. In a joint effort with their providers, surviving mining companies managed to reduce production costs substantially across the board. It was a tough journey, but it paid off, as the industry has created much more efficient and resilient solutions to capitalize on the commodity cycle's most recent upswing.

While the cautious argue that we have not yet seen the light at the end of the tunnel, there are clear signs of recovery. The upward trend in the copper price, starting from the last quarter of 2016, continued throughout 2017. On the other hand, Chile's investment portfolio for the upcoming decade increased by 32%, according to COCHILCO, from the US\$49.2 billion portfolio in 2016 to an estimated US\$65 billion for the period from 2017 to 2027.

The mistakes of the last super-cycle remain fresh in everyone's minds, so both mining companies and providers must continue their strong partnership to develop cutting-edge technology and be at the forefront of innovation, efficiency, and safety.

With all of this in mind, Santiago is hosting the 15th edition of EXPOMIN. The event is the key meeting point for both national and international investors, mining executives, and technical experts with an interest in Chile's mining industry and its world-class pool of providers. EXPOMIN 2018 will look to strengthen the integration of the Latin American and global mining markets.

As part of this effort, FISA, the organizers of EXPOMIN, and Global Business Reports, a market-intelligence company with extensive experience in the production of industry reports worldwide, have partnered for the production of **Chile Mining 2018: EXPOMIN's Official Investment Guide**.

The publication offers a 360-degree overview of the state of Chile's mining industry, including its main producers and operating mines, exploration companies and their exciting upcoming projects, and the different providers across the whole value chain, from engineering to mining equipment and services.

Hoping that you have a great conference full of business and networking opportunities, we thank you for your participation in EXPOMIN, and we hope you enjoy reading **Chile Mining 2018**.

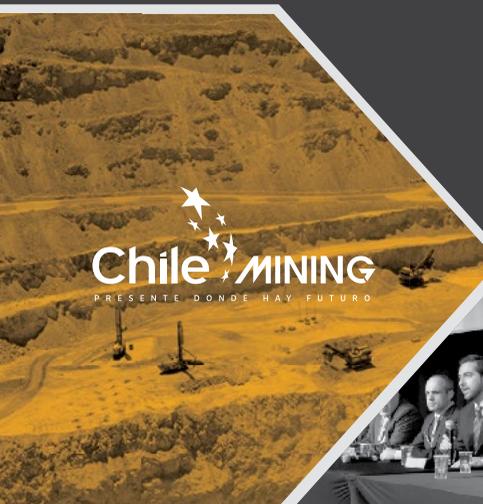
Best regards,



Carlos Parada
Executive Director
EXPOMIN



Alice Pascoletti
General Manager
Global Business Reports (GBR)



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An overview of Chile's main mining producers, latest M&A deals and upcoming operations

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Providers play a key role in optimizing operating costs and assuring sustainability

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EXPOMIN Official Investment Guide
Chile Mining 2018
EXPOMIN
Global Business Reports

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Chile

- International Boundary
- ★ National Capital
- City



0 100 200 300 Kilometers
0 100 200 300 Miles

Pacific Ocean

Atlantic Ocean





INTRODUCTION TO CHILEAN MINING



"The mining business is cyclical. We never know when there will be a period of low prices or how long it will last, so we are not banking on new copper super-cycles. We have to focus on being an efficient industry, capable of offsetting the decline in ore grades, the increased operational complexities and the growing environmental and social demands."

Carlos Ávila,
VP Planning and Technical,
BHP Minerals Americas

Mining in Chile

Reawakening the sleeping giant

It is no secret that the global downturn in commodity prices left mining jurisdictions across the world reeling since 2013. Chile, whose mining sector comprised 20% of its total GDP as recently as a decade ago, is no exception. As a country whose economy has historically depended on mining and whose national budget is pegged to the price of copper, Chile serves as a microcosmic representation of the mining industry at large. From 2015 to 2016, the world's top copper producer fell from 11th to 39th in the Fraser Institute's Survey of Mining Companies, the result of which, in this case, correlates directly with investment dollars. According to Sergio Hernández Núñez, executive vice president of the Chilean Copper Commission (COCHILCO): "Since 2013, the portfolio of mining investment projects in Chile has declined significantly, from approximately US\$110 billion to US\$65 billion." The purpose of this editorial, however, is not to examine the flotsam of a shipwrecked mining economy. Rather, it is quite an exciting time for the Chilean mining industry. Not only does Chile still produce 30% of the world's copper — Chile produced 5.55 million mt in 2016 — but it is also essential to recognize that US\$65 billion of investment is no paltry sum. Chile's total copper exports in 2016 accounted for \$26 billion in revenue, matching 2009's copper export revenue, which was the low point before the most recent mining boom. If history repeats itself, then the optimism stemming from a sustainable rise in the price of copper and

an imminent influx of foreign investment is warranted. "In my opinion, the price of copper already reached a floor," said Maritza Araneda, KPMG Chile's mining manager and resident copper expert. "A sustained increase is likely to be seen in 2018, with further upside in 2019." Fortunately for Chilean copper producers, global demand for copper has remained relatively steady. Anticipated infrastructure investments from the United States and China, as well as the looming transition from fossil fuels to electric batteries in the automotive industry, bode well for copper's inherent application value. *The Financial Times* reports that Chinese consumption of refined copper is expected to grow at 2% per year over next five years, and according to the Observatory of Economic Complexity, US\$13 billion worth of Chilean copper exports were destined for China in 2015. "China consumes approximately 45% of the world's copper," Araneda continued. "At the end of the day, whatever happens in China will heavily influence the price." In general, while total mining investment in Chile has taken a hit since 2013, production totals have remained relatively stable. While this is likely due to companies trying to maintain a certain revenue quota, the overarching message is that Chile's strongest mines were able to withstand the social darwinian test of an extended down cycle. Chile's mining health should serve as a positive sign of vitality for the global mining industry at large. —

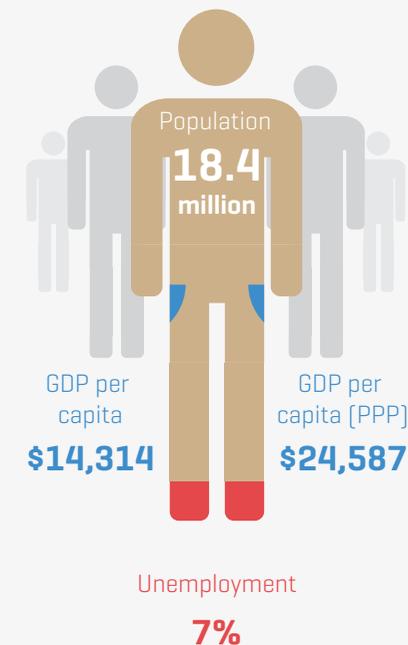
CHILE AT A GLANCE

Source: IMF

Capital: Santiago
GDP: \$263.2 billion
GDP Growth (2017): 1.4%
Inflation rate: 2.3%
Current account balance (% of GDP): -2.3%

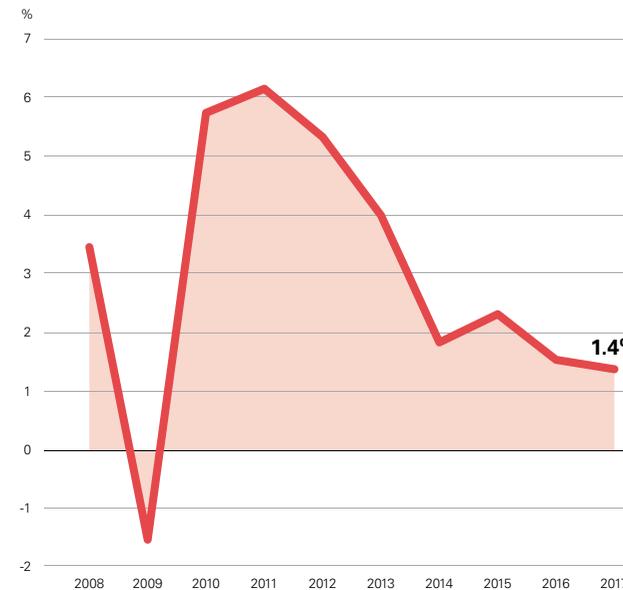
DEMOGRAPHIC DATA (2017)

Source: IMF



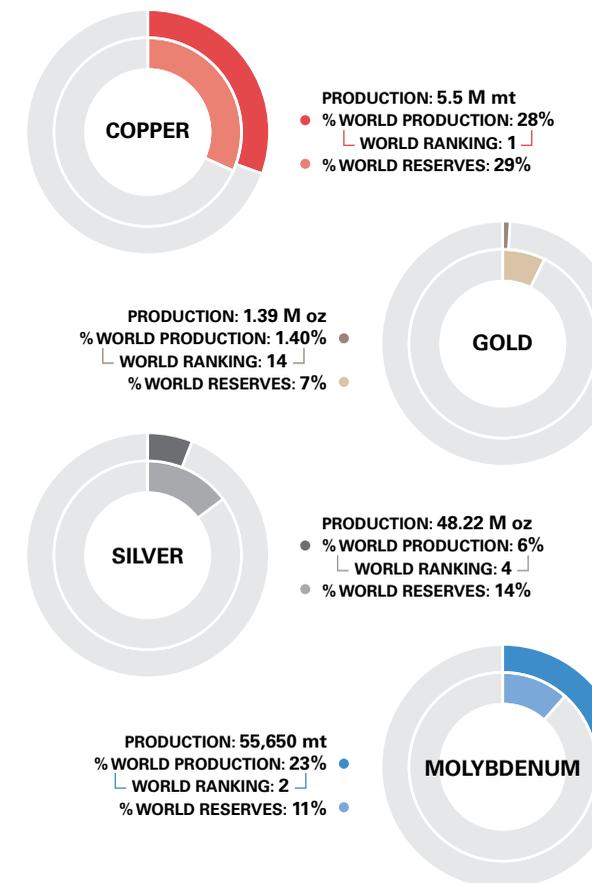
CHILE'S GDP GROWTH

Source: IMF



CHILE: MINING PRODUCTION AND RESERVES (2016)

Sources: Consejo Minero, USGS, Sernageomin, Cochilco



Caserones, a Permanent Challenge

SCM Minera Lumina Copper Chile

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Aurora Williams

10 — Minister of Mining*
GOVERNMENT OF CHILE

*Until March 2018

What have your major accomplishments been since taking over as minister?

One of our accomplishments was making the mining industry an integral development platform with more productivity, innovation, community involvement and environmental commitment. To do this, we have promoted multi-party dialogue and invited mining companies, suppliers, guild associations, nonprofit institutions, local communities, research centers and academy representatives to participate. As an example of the success of this model, the new Policy for Lithium and Governance of Salares gives us the ability to increase our lithium offer and diversify the national lithium industry. At the same time, we have created public-private entities, including the Mining Value Alliance and the National Mining Program High Law, which look for opportunities to create value with the introduction of new technologies. We also promoted the Mining Safety Regulation update to make regulations suitable to new operations in the industry, maximizing safety for the workers. Regarding public mining, we have capitalized Codelco, which secures the sustainability of the corporation and strengthens its productivity. By March 2018, we will double our support to small mining with over US\$100 million in resources within the next four years of government and create more focalized mechanisms for its sustainable development.

How can you reduce the relatively high costs of energy and water accessibility in Chile?

Considering new projects and expansions, it is projected that the industry will increase energy consumption to about 34% of total consumption over the next decade. As a result, the government has promoted new tenders that caused a decrease in the energy prices. Rates will become more competitive on an international level at between US\$50 and US\$100 per MW. Regarding water efficiency, we have promoted projects to expand the volume of preserved water, increase the reuse of treated waste water, and have more sea water desalination systems. According to Cochilco, total continental water consumption projected in 2027 will be 10.8 cubic meters per second, which represents a decrease of about 17% compared to consumption in 2016. Meanwhile, sea water use is expected to increase to 9.3 cubic meters per second in

2027. The copper mining industry is, in fact, increasing water efficiency.

How do you ensure a balance between productivity and environmental responsibility?

The government created the Presidential Advisory Commission, whose mission was to evaluate the current Environmental Impact Assessment (SEIA) and generate adjusted modification proposals to the new sociocultural and economic scenario. The goal is to have more expedited processes, but with high quality standards and in a context of legal certainty for the companies, the communities and the different public services that are part of the evaluation. This commission's work ended with 25 proposals, some of which became draft laws, regulatory modifications, and other management measures. Additionally, the creation of the National Sustainability Agency ensures that environmental standards are improved and fulfilled.

What steps are being taken to abate potential investors' concerns about strikes and labor unions?

Unionization is a fundamental right. It is recognized in every democratic country as a basic condition to establish fair and balanced relationships between employees and employers. Those who invest or wish to invest in Chile know that we are a nation that has very clear rules and great political, economic, and social stability. This is guaranteed by unrestricted respect to our laws and the international agreements we have.

What does the future hold for Chilean mining in terms of exploration and mine expansion?

Chile still has diverse geological potential. The country's exploration budget represented 6.4% of the global exploration budget in 2016 at US\$443 million. Most of the investment is related to copper at 66%, followed by gold at 31%. We also have plenty of silver, molybdenum, nitrates, lithium, iron, and rhenium reserves. In the future, we must increase that geological potential by expanding our mineral reserves, but also by exploring other elements that we know exist in our territory such as rare earths, titanium and cobalt. There are opportunities through Enami, which is looking for strategic partners to develop greenfield and brownfield projects. —



Diego Hernández

— President
SONAMI

Could you please give an introduction to Sonami?

Founded in 1883, Sonami is Chile's chamber of mines and our membership includes small, medium and large mining companies. The small mining companies belong to different regional associations and produce about 1% of Chilean copper. The large mining companies, with the exception of Antofagasta Minerals, are international and produce the full range of commodities that Chile has to offer. We belong to the Confederation of Production and Commerce, which is the top business association in Chile.

What are mining companies' major concerns at the moment?

In a short amount of time, mining companies had to transition from producing as much as possible while commodity prices were high to defending operating margins while commodity prices were low. There have been some positive effects, including lower operational costs. The devaluation of our currency has led to lower cash costs in terms of American dollars. Companies have also begun to make more decisions with the future in mind, including focusing on innovation and other long-term initiatives. In Q1 2017 we already saw an increase in tax payments from mining companies, indicating that the worst is behind us. We are also seeing an increase in pre-feasibility studies and brownfield exploration. Everyone wants to be prepared for when the price of copper reaches a certain level. Our expectation is that, as grades fall and some mines run out of ore, the demand for copper will continue to grow by around 2% annually for the next ten years.

What are the major innovation trends that you have observed in the industry?

Large mining companies tend to be conservative with technological investments because production is so capital intensive. Using unproven technology creates additional risks for these operations. Over the past few years, however, we have seen companies increasing the scale of their equipment and incorporating communications technology into their operations. We expect companies to increase their investments in automation. There has been quite

a bit of spending on this area, but we have yet to see its full use. At first, companies were hesitant to implement automation because introducing new technology could take time away from production efforts. However, as companies began to focus on operating margins, they are finding that they have no choice but to invest in this technology. A key benefit of automation is the increase in safety associated with having fewer employees on-site.

Do you expect the current legislation around land claims will change to attract more attention to greenfield activity?

We may see some changes to attract more greenfield investment, but land claim legislation will fundamentally remain the same. Guaranteed land claims is one of the biggest factors that attracted international investment to the Chilean mining industry in the first place. Ideally, we would like to have more medium-sized exploration companies enter Chile, but any changes must be done cautiously so as not to drive away existing investment. Chile's current project portfolio is competitive, and we anticipate more development in Chile during the next wave of mining investments. The government recently dropped foreign investment agreements that guarantee stability and certainty for international companies, and we believe these agreements should be brought back to attract more foreign investment.

What are the main advantages to investing in Chilean mining?

Chile is a mining country. We produce 30% of the world's copper, our mines are quite mature, and the mining industry is very well established. That said, there is still more room for production in Chile. Sonami has prepared some strategies to attract more foreign investment, which we plan to share with the new president. We need to find a way to make our regulations more similar to those of the world's most competitive mining jurisdictions, but without jeopardizing what the regulations were originally meant to protect. For example, an environmental permit that normally takes four years to obtain should only take two years. —

Sergio Hernández

Executive Vice President
CHILEAN COPPER COMMISSION (COCHILCO)



What have been the biggest developments in Chilean mining since 2013?

Since 2013, the portfolio of investment projects in Chile has declined significantly, from approximately US\$110 billion to US\$65 billion. The most important cause is the sharp decline in the price of copper. In fact, the demand for copper has been relatively steady. Before the downturn in the price of copper, the mining boom in Chile led to the development of and investment in many projects. Eventually, costs increased because these companies were hiring workers and consultants, and buying equipment and machinery. We are now seeing the opposite, and operational costs are lower. I believe the price of copper will hover around US\$3 per pound in the long-term.

How has the government helped boost or incentivize the mining sector during this time of low commodity prices?

The government of Chile provides information to the mining sector, including reliable statistics that we have access to thanks to our International Copper Study Group. They give us access to data pertaining to the evolution of the market, such as supply and demand. Besides that, we represent the country in the world copper market, we own the presidency of APEC's mining group, and we also supervise copper exports. We

have plenty of activities that always support mining companies, not only during difficult times. Cochilco is a very reliable institution that always thinks about the development of the sector.

How important is the use of data to Cochilco's operations?

We receive statistical information on production, costs, and supply and demand. This information is handled with absolute confidentiality and is delivered in generic terms, and it has evolved as a management tool for companies, universities and professional institutes. Our evaluations and investments of Codelco and Enami give us in-depth knowledge about the industry and supply needs. These figures give us confidence in the fact that Cochilco knows the mining sector from both a technical and economic perspective.

What are the main advantages of investing in Chile?

Chile is the biggest copper producer in the world. The country has developed unique technology, we have great professionals, and our institutions have 200 years of tradition and stability. Furthermore, Chile has a great deal of respect for international contracts, and investors can have legal certainty here. —



Carlos Parada

Executive Director
EXPOMIN
Commercial Manager
FISA



What is the objective of EXPOMIN?

EXPOMIN was created in the 1990s due to a change in Chilean law that opened up external capital, after having done the exact opposite in previous years by nationalizing the mining industry, which is when Codelco was created. This change in the law had to be done because the national investors were not capable of developing the mining industry according to its expected growth. EXPOMIN was an initiative by the American government to promote interaction with American dealers. Eventually, it became the predominant mining conference in Chile.

What were the highlights of EXPOMIN 2016, and what is the ideal outcome for 2018?

Every year, EXPOMIN represents what the industry is about and what is being done. We maintain a period of two years because many things happen in two years, particularly regarding technology. We created a committee that analyzes the interests of the industry and creates a theme based on their findings. The core of each conference does not change, but we alter the complementary activities related to the conference each time. For example, we have a congress called "Innovation for

Mining Development" that is related to the topics the mining industry is dealing with, like the use of sea water, mineral processing, sustainability, human resources, or new laws, for example. These conferences have one representative from the mining industry who is recognized as a leader in the field. This year, that representative is Iván Arriagada, CEO of Antofagasta Minerals. We also incorporate students to increase the interest in the industry and make it attractive as a profession.

In your opinion, how can the mining industry in Chile become more collaborative?

To face critical cycles, the Chilean mining industry must be more collaborative. EXPOMIN aims to be a platform for companies across all industries in Chile to share their views and experiences. EXPOMIN 2018 will be specifically focused on initiatives that incorporate innovation to solve problems in mining, and the development of Chilean technology companies.

How can Chile increase its competitiveness in the global mining industry?

Nowadays, the Chilean mining industry is going through a good period. The price of copper is projected to be very positive.

With certain commodities, Chile is still the leader in the world, and it will remain like that for a long time. Beyond that, the Chilean mining industry has to solve many infrastructure problems related to how mineral deposits are built, and there are technical challenges that affect productivity. On the other hand, we see other issues related to permitting, processing, and evaluation. All of these conditions have caused other jurisdictions in Latin America to become more attractive to foreign investors. I believe the Chilean mining industry is doing its job to solve these problems, however.

Do you have an overarching message for the delegates of EXPOMIN?

EXPOMIN is a high-profile event with a lot of exposure for those who participate, as potential investors will be coming from all over the world. It should be seen as a chance to share information and knowledge, as well as a window to show how advanced Chile is compared to other countries in South America. EXPOMIN should be considered as a key meeting for both the national and international mining industries. —



PRODUCTION & DEVELOPMENT



“The Bachelet administration started a commission of specialists to get an opinion on what should be done regarding lithium projects. The commission had some short-term recommendations, the main one being that the government should promote public-private developments in order to develop projects in Chile’s salars.”

- Patrick Cussen,
Director, Bearing Lithium

Chile's Copper Mines

Survival and growth

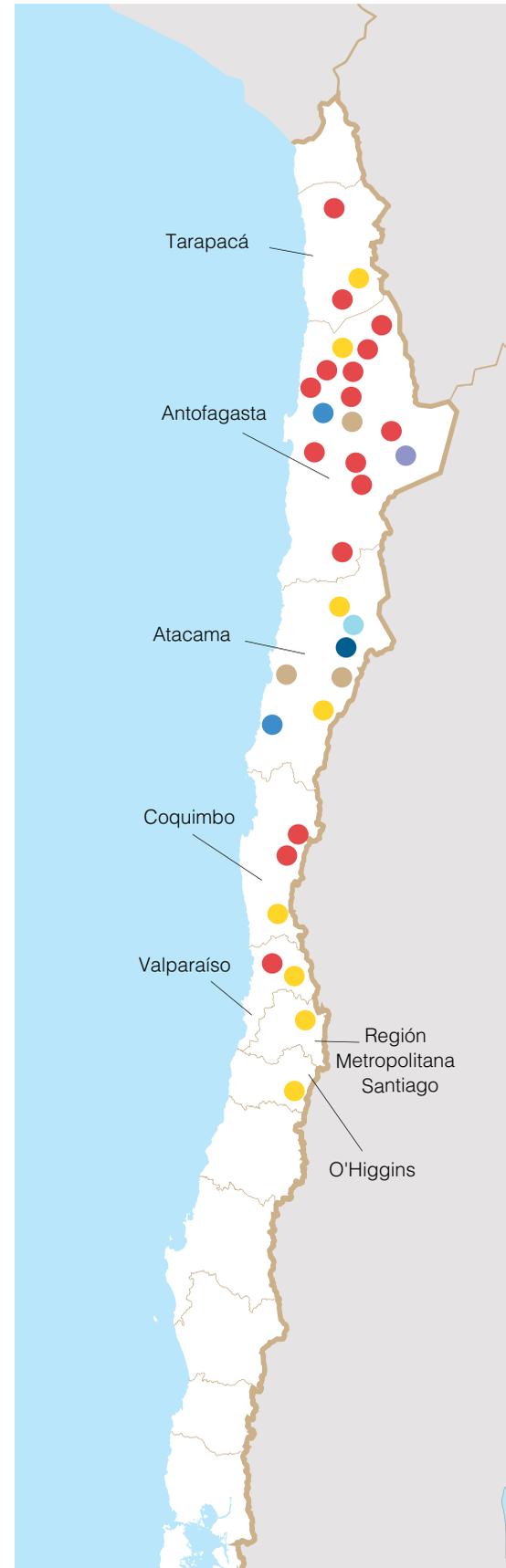
For many copper producers in Chile, production continued at a fairly consistent rate over the past several years despite a relative lack of return for their product. BHP Billiton's Escondida mine, the top-producing copper mine in the world, still produced over 1 million mt of copper in 2016, representing a modest 6.8% decrease in production from 2012. Anglo American and Glencore's Collahuasi mine, Chile's second-most productive copper mine in 2016, produced 506,000 mt, representing an 11.2% increase from the previous year.

The state-owned National Copper Corporation (Codelco)'s top-producing mine, El Teniente, has increased production every year since 2011. Codelco's total copper production in 2016 amounted to over 1.7 million mt, representing 31% of Chile's total production. BHP Billiton produced Chile's second-largest amount of copper in 2016 at 1.2 million mt. Mine production is volatile regardless of the state of the industry, but Chile's sustained level of production indicates an absence of any long-term economic health concerns.

Despite the current price of copper, Codelco appears to have its sights set on the future, investing in projects that aim to extend the company's current mine lives. In fact, in 2016, Codelco allocated over US\$2.7 billion toward development projects as part of an US\$18 billion investment plan that will last through 2020. The company's largest development project is at the Chuquicamata mine, where it is developing an underground mine structure that is projected to add 40 years to Chuquicamata's current mine life. The underground mine is expected to be in production in 2019. As Nelson Pizarro, CEO of Codelco, explained: "We realized that we needed to carry out a plan to replenish the production capacity that had been lost due to the decrease in the reserves, so we formed a portfolio of structural projects, such as the Chuquicamata new underground expansion, a new haulage level at El Teniente, a potential expansion for Andina, and others."

El Teniente, already the world's largest underground copper mine, is also a recipient of Codelco's investment funding, as the company is adding a seventh level to it that is projected to add 50 years to its mine life. Also in the El Teniente division, Codelco implemented the Dacita and Diablo Regimiento projects, which are expected to generate a respective 490,000 mt of refined copper over twelve years and 126,000 mt of refined copper over eight years.

Antofagasta Minerals (AMSA), the largest privately owned, Chile-based producer, brought their Antucoya mine into production. After having briefly been owned by Sociedad Química y Minera (SQM) and then reacquired by AMSA, Antucoya began producing in 2015 and is still ramping up its copper production totals. Meanwhile,



PRODUCTION MAP & DIRECTORY

Source: Consejo Minero

Region	Products	Company
Taraapacá Region		
Cerro Colorado	C	BHP Billiton
Collahuasi	C M	Anglo American/Glencore
Quebrada Blanca	C	Teck Resources
Antofagasta Region		
Antucoya	C	Antofagasta Minerals
El Abra	C	Freeport McMoRan/CODELCO
Radomiro Tomic	C	CODELCO
Chuquicamata	C M	CODELCO
Ministro Hales	C	CODELCO
Michilla	C	Antofagasta Minerals
Spence	C	BHP Billiton
Sierra Gorda	C G M	KGHM
Centinela	C G	Antofagasta Minerals
Gabriela Mistral	C	CODELCO
Salar de Atacama	L	SQM
Lomas Bayas	C	Glencore
Zaldívar	C	Antofagasta Minerals/Barrick Gold
Escondida	C	BHP Billiton
Franke	C	KGHM
Atacama Region		
Salvador	C M	CODELCO
NuevaUnion (development)	C G M	Teck Resources/Goldcorp
La Coipa	G S	Kinross
Maricunga	G	Kinross
Ojos del Salado	C G	Lundin Mining
Candelaria	C G	Lundin Mining
Caserones	C M	Lumina Copper
Coquimbo Region		
Carmen de Andacollo	C	Teck Resources
Altos de Punitaqui	C	Glencore
Los Pelambres	C M	Antofagasta Minerals
Valparaíso Region		
El Soldado	C	Anglo American
Andina	C M	CODELCO
Santiago Metropolitan Region		
Los Bronces	C M	Anglo American
O'Higgins Region		
El Teniente	C M	CODELCO

COMMODITY

- Copper
- Copper-Gold
- Copper - Molybdenum
- Copper - Gold - Molybdenum
- Gold
- Gold - Silver
- Lithium

- C = Copper
- M = Molybdenum
- L = Lithium
- S = Silver
- G = Gold

THE NEXT SUCCESS STORY FROM CHILE



MINERA TRES VALLES



The Tres Valles mining project is based off of two mines: Papomono (an underground mine) and Don Gabriel (an open pit mine), both of which are located in the Manquehua gorge in the Chalinga valley.

Its processing plant has a normal capacity of 5,400 tonnes per day (tpd) of ore, and consists of a copper leaching operation that has a crushing and agglomeration plant, heap leach pads and pools, and a SX-EW plant.

The facility is designed to produce up to 18,500 tonnes per annum (tpa) of thin copper cathodes.

+52 33 449 900 mineratresvalles.com



Image courtesy of Minera Tres Valles

16 ←

AMSA's Los Pelambres mine is consistently a top-five copper producer in the country, and the company's Centinela mine frequently falls within the top ten.

Apart from Antucoya, Codelco's Ministro Hales mine, KGHM's Sierra Gorda mine, and Lumina Copper's Caserones mine, also came into production during the height of the downturn, each of which have been able to sustain steady growth in spite of market conditions. "We are operating at 90% of our full concentrator plant production capacity, and we are working to close the remaining 10% gap as quickly as possible by identifying and mitigating bottlenecks," said Maciej Sciazko, CEO of Lumina Copper. "Hopefully, this project will serve as an example of how to bring an asset into production during difficult times."

The decline in commodity prices, however, did not come without some detrimental effects. Codelco's US\$18 billion plan is a toned down version of its original US\$25 billion plan. Despite a US\$600 million investment from the government earlier in 2016, Codelco has suspended its US\$5.4 billion Radomiro Tomic sulphide project until 2024, and the deadline to expand El Teniente was pushed from 2020 to 2023. "We expect to accelerate the remaining projects when the copper price is slightly above US\$3 per lb," said Nelson Pizarro. "We have decided not to increase the debt of the company and instead have been analyzing the profitability of each project and approving only the most profitable."

Even more concerning for the country, Codelco laid off over 4,300 employees in 2015, which created a ripple effect throughout the industry. "Mining in Chile has lost about 56,000 jobs, and two-thirds of that corresponds to mining providers," stated Pascual Veiga López, president of Aprimin, an organization that represents and promotes the development of mining suppliers. "We are not currently seeing the salaries, bonuses, and employment numbers we have seen in the past."

Despite their decrease in manpower, Codelco's production from 2015 to 2016 only decreased by a proportionately negligible 3.4%, which is emblematic of the rest of the industry in Chile. This is a direct result of increased operational efficiencies and investments in automation. "If you compare Chilean mining production in 2013 and 2016, however, you will only notice a small variation," continued Veiga. "Chile is obtaining good numbers but with 56,000 fewer workers, so that tells you that we are starting to overcome the challenge of maximizing productivity."

Nevertheless, as the market recovers, many miners may once again find work. Kinross, for example, is still carrying out aggressive exploration plans despite a temporary hold on gold production. "At the La Coipa mine, we continue to look for ways to restart the mine," explained José Tomás Letelier, vice president of external affairs at Kinross Chile. "We believe that the assets that we have in Chile have good potential and we would like to develop them further." —



Nelson Pizarro

—
CEO
CODELCO

“ We realized that we needed to replenish the production capacity that had been lost due to the decrease in the reserves, so we formed a portfolio of structural projects, such as the Chuquicamata new underground expansion, a new haulage level at El Teniente, a potential expansion for Andina and others. ”

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Could you please give us an overview of Codelco's position in the Chilean mining industry?

Codelco is Chile's largest producer of copper with more than 1.8 mt annually (including own and third party copper). We also produce gold and silver. Being a state-owned company, we have statutes and specific legal frameworks that allow us to compete in this market. Over the years, ore grades have been decreasing, while we have transitioned from mining on the secondary enrichment zone to primary sulfide (chalcopyrite).

What are the main challenges for today's mining industry?

Sustainable mining has a number of strategic pillars, including safety, the environment and local community relations. Minimizing environmental impact is a constant challenge. The environmental assessment process in Chile can take two to three years. The consequence of requiring hundreds of permits is that mining companies have been forced to develop advanced engineering work in order to evaluate the impact and its mitigation solutions. In Chile, communities have the right to be informed, but the regulations are not yet clear enough. Environmental control also limits the ability to use fossil fuels, which leads to the use of electricity and, therefore, a greater use of copper.

We have been suffering from drought for more than five years, and water scarcity is a big issue. Due to the resulting restrictions in the use of water, mining companies are now looking to use sea water for their operations. Obtaining sea water is not a problem, but pumping it up to high-altitude mines is very costly. Additionally, labor laws have also changed, imposing more regulations to the mining activity, with new work schedules. For instance, previously, mining settlements could be built as close as possible to the operation, but now they must be built below 3,000 meters above sea level. The Chilean mining industry, nowadays, is very challenging.

How has Codelco maintained its productivity despite the challenges of the mining downturn?

During the mining boom, mining companies produced the maximum possible

amount of copper due to the high price. In my opinion, this triggered an excess demand of engineering and construction services for new mines and the cost for critical supplies for the mining activities increased dramatically during that period. Additionally, the new generations of mining workers do not have the feeling of belonging to any company, and go to work wherever they are paid best while nobody is willing to work at the mine site. The industry has to shift from a business model focused on productivity and obtaining operational licenses to one focused on simultaneously satisfying workers expectations, controlling environmental effects, complying with law restrictions and, of course, creating value for investors. In summary, we need a new business model based on sustainability. Our challenge is to be able to monetize lower-grade ore deposits.

Does automation present a threat or an opportunity to mining workers?

Productivity is advancing as a result of automation, and it is now possible to achieve 16-18 hours of effective work per day versus 13 or 14, which equates to a lot of money. Robots do not get sick or tired. We have configured a way to scan equipment and optimize metallurgical recovery, and our goal is for plants to operate more than 95% on automatic pilot in the future.

What does the future hold for Codelco?

In 2014, the government committed to capitalize Codelco with up to US\$4 billion, including US\$1 billion through retained earnings and an additional US\$3 billion by way of direct capitalization within a period of four years. We realized that we needed to carry out a plan to replenish the production capacity that had been lost due to the decrease in the reserves, so we formed a portfolio of structural projects, such as the Chuquicamata new underground expansion, a new haulage level at El Teniente, a potential expansion for Andina and others. This aggressive portfolio of projects accounts for US\$25 billion of capital investment over five years. Unfortunately, the copper price dropped dramatically, so we had to prioritize the most critical projects, particularly Chuquicamata underground and the new level of El Teniente. —



Carlos Ávila

VP Planning and Technical
BHP MINERALS AMERICAS

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We have already started the Spence Growth Option (SGO) project, a US\$2.4 billion investment including a concentrator to process the hypogene mineral. This project will extend Spence's life by over 50 years, and we expect it to produce its first concentrate in the 2021-2022 Australian financial year.

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Could you please provide an overview of the most recent developments at Escondida and Spence?

2011-2017 was a very intense period as regards investment. Projects totalled over US\$10 billion, particularly at Escondida, where they included the new OGPI concentrator and the second desalination plant, with a capacity of 2,500 liters per second. The operation of the three concentrators will help us offset the decline in ore grades and maintain annual production stable at around 1.2 mt for a decade.

We have also started the Spence Growth Option (SGO) project, a US\$2.4 billion investment including a concentrator to process the hypogene mineral. This project will extend Spence's life by over 50 years, and we expect it to produce its first concentrate in the 2021-2022 Australian financial year. The 1,000-l/s seawater desalination plant to supply Spence, which will be built on the Mejillones Bay, will also be in operation by then.

What are BHP's short-term plans for Cerro Colorado?

At present, Cerro Colorado is working on its operational continuity, which will extend the mine's useful life through to 2023 and, a few months ago, we implemented a plant recovery plan in order to optimise and ensure the installations' integrity. In this way, we are ensuring the future of this mine, which started production in 1994 with an expected life until 2016 and is now on a sound footing to continue producing and contributing to the Tarapacá Region, with an option to do so beyond 2023.

What are BHP's plans for integrating autonomous mining into their operations?

We are going to be carrying out a study about integrated operations and mine automation for the operations of BHP Minerals Americas, with plans for implementation towards mid-2019. BHP has implemented automation projects in other parts of the world and the results have been very convincing. For example, in one of our Australian iron ore mines, Jimblebar, our autonomous truck fleet resulted in productivity gains that have helped to reduce transport costs by 20%. In parallel, we are giving priority to improving the planning and implementation of maintenance.

What is the nature of BHP's relationship with the local communities?

As a company, we have made a voluntary commitment to devote 1% of our pre-tax profits – calculated over the average of the previous three years – to social investment. In this way, we foster and support community development plans that give priority to improving people's quality of life. We are, for example, the private company that contributes most to culture and access to it. We work through long-term alliances with top-quality partners such as Chile's Teatro a Mil Foundation and its Museum of Pre-Columbian Art. We are also part of CREO Antofagasta, a public-private alliance to address the challenges of the city's growth. Capability development is another area in which we work and where a key initiative is the Industrial and Mining Training Centre (CEIM), which has now been in operation for over 15 years. Our contribution also includes the creation of high-quality jobs, procurement of local goods and services, supplier development and support for regional and national economies.

What steps is the company taking to maintain relations with its workforce?

We are strengthening the communication with our workers. We hold daily meetings so they can make known their views on different matters, particularly safety improvements. We insist on these relationship routines to listen to their concerns and resolve them, while also fostering informed opinions and explaining matters like remunerations and benefits in greater detail. Regardless of the price of copper, we must stay in the first quartile of costs and each of our workers contributes to this task. Since the last strike, we have achieved two important agreements: the exceptional working day with Union N° 1 and, in negotiations ahead of their due date, a new three-year collective contract with Union N° 2.

Do you have a final message for our readership?

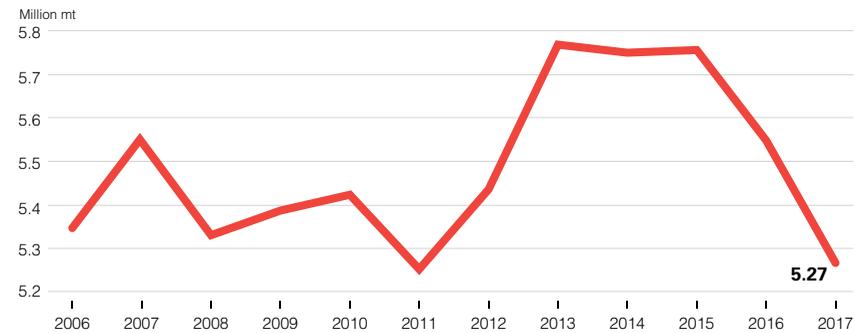
At BHP, we have a very positive view of the outlook for the copper market and have worked very responsibly, from a long-term standpoint, to ensure we are in a position to supply the world. Electric vehicles and solar energy will be the great drivers of demand, so we are convinced that copper is the mineral of the future. —

THE COPPER MARKET



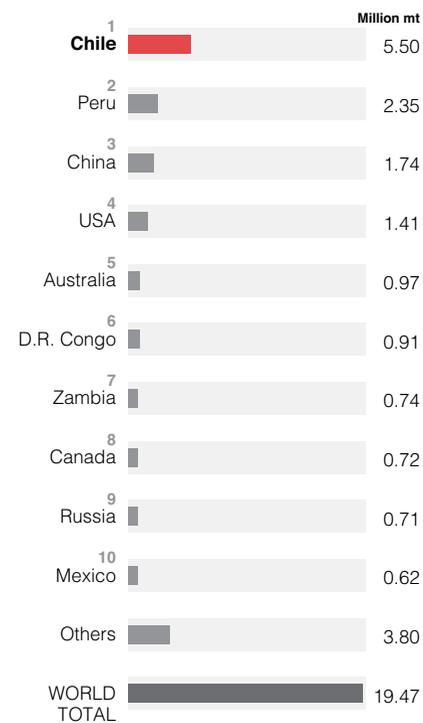
EVOLUTION OF COPPER PRODUCTION IN CHILE

Source: Cochilco



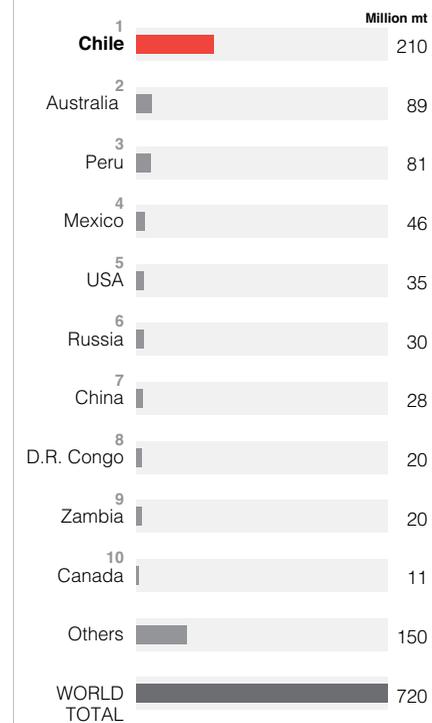
WORLD COPPER PRODUCTION (2016)

Sources: USGS / Cochilco / GBR



WORLD COPPER RESERVES (2016)

Sources: USGS / GBR



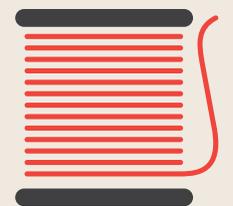
COPPER PRICE EVOLUTION 2017 - Official average price, LME, Cash Buyer

Sources: LME / GBR



SOME COPPER APPLICATIONS

Cables



Electric engines and equipment



Coins



Antibacterial gel





Maciej Sciazko

CEO
LUMINA COPPER

“

Chile has always been a stable country for doing business [...]. The country's environmental regulations are strict, but we have found that this is actually quite helpful to us in the long run.

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Could you please give us an overview of Lumina Copper?

Lumina Copper is owned by JXTG Holdings Inc., Mitsui Mining & Smelting, and Mitsui Co., with 51.5%, 25.87%, and 22.63% ownership respectively. Caserones is a high-altitude operation with an average grade of 0.34% Cu, so maximizing production and maintaining cost is key for the company to remain in operation. Due to this, in mid-2016, the company entered a transformation period where we focused on increasing production output and cost optimization. For 2017, we set very aggressive goals and we achieved substantial progress in concentrator throughput – almost a one third increase compared to 2016. We also implemented a plant reliability process which significantly reduced the number of errors at our plant. Our cathodes production reached expected targets in the same year. In spite of recent improvements, we are still in a situation where we need to further maximize our operational and cost efficiencies.

What are the main factors that were considered in the cost optimization process?

Caserones was built during a time when commodity prices, and thus operational costs, were very high. When we began to transition from construction to production, the Chilean market was normalizing, so we renegotiated each of the contracts we had from 2012 and 2013. The contractors understood the situation and were quite cooperative in the renegotiation process. Recently, we have shifted focus towards addressing the need to improve productivity. Short term gains will be our initial priority before we focus on increasing our long run productivity performance.

How feasible have you found it to do business in Chile?

Chile has always been a stable country for doing business, and this has remained true in our experience. In general, Chile's stability has proven beneficial to our operations and we have been able to proceed without any major obstacles. The country's environmental regulations are strict, but we have found that this is quite helpful in the long run. For example, Caserones is located in an area where water is very scarce. We overcame this restriction by setting up

an efficient system that recycles more than 80% of the groundwater we use. This system was presented to Chilean authorities who assessed it thoroughly and approved it for our operations.

How would you characterize the qualified labor market in Chile?

In terms of labor, during the most recent mining boom, there were a lot of projects being developed and it was very difficult to find high-skilled labor in Chile. The situation eased in 2016 and 2017, but it will become more restrictive in the coming years as copper price remains above \$3/lb. We have strong relationships with the three different labor unions to which our employees belong and our transparency with them is key to this. We will leverage on these relationships this year and I am confident of a positive outcome for all parties involved.

How do you ensure the company has a win-win relationship with the local communities?

Caserones is a great example of how cohesive mining and agricultural communities can be. Since the very beginning of the mining process, we have prioritized establishing close relationships with local communities, including indigenous population. We employ from the local community and will further integrate as we set up social programs within the community. One of our aims is to make our workforce more robust.

What is Lumina Copper's long term vision in Chile?

Presently, we are completing the process of transitioning from a ramp up stage to a stable operation. For the long term, we are looking to create a mine that is sustainable throughout its whole life. Caserones has been a difficult asset to bring into production, but fortunately, thanks to everyone involved in the project, we recovered significantly in 2017. Hopefully, this project will serve as an example of how to bring a complex asset into production during difficult times. Usually companies relax when the price of copper picks up, but Caserones, as a low-grade producer, has no room or time to enjoy today's market situation. We need to stay focused on continuously improving our operation. —

Image courtesy of Minera Tres Valles



Major Asset Sales

A look at Chile's M&A activity

In 2015, Anglo American sold its Mantos Copper operations to London-based hedge fund Audley Capital for US\$300 million with an additional US\$200 million in contingency payments. The operation includes the Mantos Blancos and Mantoverde mines, which produce a collective annual total of 100,000 mt of copper. Having invested an additional US\$150 million in a concentrator de-bottlenecking project at Mantos Blancos and US\$782 million in a sulphide development project at Mantoverde, Audley is implementing a long-term strategy uncharacteristic of a typical hedge fund model. According to John MacKenzie, executive chairman of Mantos Copper: “There are two phases that we are implementing to get from high-cost, short-life to low-cost, long-life mines. The first phase is the capital-intensive process, in which we have been able to decrease our overall costs by developing a lean set of processes and systems. Secondly, we stay in touch with the most modern technologies that have already been tested and proven to work successfully. Overall, we will produce around 140,000 mt/y of copper.”

Additionally, in August 2017, Canada-based Spratt Resource Holdings acquired 70% of small producer Minera Tres Valles from the Vecchiola Group, a transaction that may provide hope to any major looking to sell an asset. Minera Tres Valles includes the Don Gabriel open pit mine

and the Papomono underground mine. Evidently, Spratt was attracted to the projects due to their potential capacity. “Right now, Don Gabriel produces 15,000 to 20,000 mt of ore per month with a strip ratio between 3.5 and 4. After the mine is fully ramped up, it will produce 78,000 mt per month,” said Luis Vega Muñoz, general manager of Minera Tres Valles. “We plan to eventually go public so that we can raise more capital to pursue additional drill targets.”

In 2016, AMSA sold its Michilla mine to Haldeman Mining for US\$52 million. In 2015, the mine's most recent year of production, Michilla produced 29,400 mt of copper. The mine has historically produced between 35,000 and 50,000 mt/yr of copper.

BHP Billiton has also been negotiating to sell its Cerro Colorado mine since April 2017. Having produced 74,000 mt of copper in 2016, the sale is expected to command approximately US\$800 million. Teck Resources, HudBay Minerals, and Lundin Mining, which operates the Candelaria mine in northern Chile, have all been speculated as potential buyers.

Glencore also ventured to sell its Lomas Bayas mine in 2015, but they have since taken the mine off the market. The mine produced over 80,000 mt of copper, but the speculated US\$500 million price tag was evidently too high for any prospective suitors. —



John MacKenzie

Executive Chairman
MANTOS COPPER

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The Mantoverde sulfide development project demonstrates very attractive capital efficiency at less than US\$10,000 per annual tonne of copper produced. It is relatively high-grade, and much of the necessary infrastructure is already in place, including our own desalination plant.

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How did Mantos Copper initially appear on Audley Capital's radar?

After nearly 25 years with Anglo American, I left the company in 2013 to set up a new mining company with the belief that the ideal time to do this was when the industry was heading into a downturn. I partnered with Audley Capital to seek suitable acquisition opportunities and identify co-investors. With Orion Mine Finance, our principal co-investor, we were successful in acquiring the Anglo Norte business of Anglo American, which includes the Mantos Blancos and Mantoverde copper mines, for US\$300 million plus an additional US\$200 million in contingent payments. Upon acquisition, the business was re-named Mantos Copper.

What is Orion's exit strategy for Mantos Copper?

Our investors, somewhat counter-intuitively, have a far more long-term approach to developing Mantos Copper than one may normally expect from a private equity fund. The Orion fund life of seven years provides good flexibility in terms of timing. Our strategy is to develop these two mines into long-life, low-cost operations, at which point, Orion would seek to realize its investment, most probably through a public market listing. Mantos Copper, in this case, would continue to grow and develop the business as a listed, mid-tier copper producer. Until the point of a listing, our private company status affords us significant flexibility to focus exclusively upon the implementation of our strategy, namely optimizing our operational efficiency and developing our key projects.

Could you elaborate on the de-bottlenecking project at Mantos Blancos and the sulfide development project at Mantoverde?

When we acquired Mantos Blancos, it had a projected mine life through 2021, at which point the oxide ore that currently accounts for 40% of the mine's copper production would be depleted. The mine would still have very significant sulfide resources with attractive copper grades, but we now intend to expand the existing copper concentrator in order to process 40% more sulfide ore per year. The US\$150 million concentrator de-bottlenecking project, which utilizes our current crushing capacity and simply adds additional grind-

ing and flotation capacity, maintains the production from Mantos Blancos at 50,000 mt of copper in concentrate per year. It is a very capital-efficient project and extends the life of Mantos Blancos to at least 2032. Mantoverde was built by Anglo American in 1994 and has a very successful history. It is currently a pure oxide operation that yields around 50,000 mt of copper cathode per year. When we acquired the mine, it had a projected mine life through 2019. Through an active drill program, we have already extended the life of the oxides to 2026. Beneath the oxide, there is a large, high-grade sulfide deposit that has a well drilled resource base with over 4 million mt of contained copper. The US\$782 million Mantoverde sulfide development project demonstrates very attractive capital efficiency at less than US\$10,000 per annual tonne of copper produced. It is relatively high-grade, and much of the necessary infrastructure is already in place, including our own desalination plant. This project is currently scheduled to commence production in 2021, at which point Mantoverde's overall production will increase to around 140,000 mt of copper per year.

How would you summarize the new investors' approach to operating Mantos Copper?

There are two key phases involved in converting these assets from being two high-cost, short-life mines to being two low-cost, long-life mines. The first phase was reducing our unit costs by implementing a lean operating model focused on efficiency and accountability, coupled with fit-for-purpose processes and systems. We are very proud of the fact that we currently have one of the lowest accident rates in the mining industry, and we are continually striving to achieve the target of zero harm. Our strategy is to stay in touch with what is happening in technological development and to implement technologies that have already been tested and proven to work successfully. The second phase of our strategy is more capital-intensive, specifically the development of the organic growth and life extension projects at each of our two operations. We also keep an eye open for value-accretive acquisition opportunities where we can leverage our existing skill set or asset base. —



Luis Vega

General Manager
MINERA TRES VALLES

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In August 2017, Sprott Resources acquired 70% of Minera Tres Valles [...] This new financial and technical partnership puts us in a strong position to ramp up our production, and it will play a significant role when we eventually go public.

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Could you please give us a brief history of Minera Tres Valles' presence in Chile?

Tres Valles is a relatively new project that was discovered by Vale in 2005. The Brazilian company developed the project and constructed the plant, investing a total of US\$242 million. The mine entered into production in 2011 and has important copper resources. At the end of 2013, the Vecchiola Group acquired the asset. Vecchiola is a contracting company with a long history and a very clear expertise in open pit mining and plant operations. Following the Vecchiola acquisition, we were able to cut costs by half over 18 months. For underground expertise, we rebuilt the technical team with relevant Vale experts by inviting them to stay on the project. Thanks to the strength of our team, we were able to survive the downturn. We now expect to continue reducing our cash costs by taking advantage of economies of scale.

What is changing with the arrival of Sprott?

In August 2017, Sprott Resources acquired 70% of Minera Tres Valles from Vecchiola, but we are still retaining our management and technical teams to keep the project moving forward. This new financial and technical partnership puts us in a strong position to ramp up our production, and it will play a significant role when we eventually go public. The project's production capacity is up to 18,500 mt of copper cathodes per year with a plant capacity of 5,500 mt per day. Our next step is to publish our reserves under 43-101 standards.

What cost optimization tactics did you employ in order to reduce costs so drastically?

Because of our relationship with Vecchiola, we were able to determine how our supplier contracts from the Vale days could be optimized and renegotiated. Additionally, we focused partly on the supply of third-party ore from our processing plant. Right

now, we are only operating at one-third of our total plant capacity, so third-party miners are a very important source of cash flow. These miners are also part of the local communities, so this is a good way for us to maintain a strong relationship with them.

What are the most recent updates on the Papomono and Don Gabriel mines?

Don Gabriel is our open pit mine, and Papomono is underground; we plan to ramp up production at Don Gabriel first. Right now, Don Gabriel produces 15,000 to 20,000 mt of ore per month with a strip ratio between 3.5 and 4.0. After the mine is fully ramped up, it will produce 78,000 mt per month.

Regarding Papomono, we are transitioning from a more selective extraction method to a massive exploitation method, so our unit costs are decreasing significantly. With the current known resources, we expect a mine life of nine to ten years, and once we secure the necessary funds to ramp up, it will take 12 to 15 months to reach full capacity. We will also still be focusing on the exploration of these properties, as the current reserves are only located in 10% of our 44,000 total hectares. We plan to eventually go public so that we can raise more capital to pursue additional drill targets.

What percentage of Minera Tres Valles' energy usage is renewable?

We have a contract with the KDM Group, which generates nearly 100% of our energy through a biomass project in Tilttil, Chile. We are also looking into implementing solar energy in the future, but this is still in the conceptual stage. Renewable energy helps reduce both our impact on the local communities and our cost margins. In addition to being respectful to the local communities in terms of our environmental footprint, it is important to mention that we have a foundation that promotes Minera Tres Valles-funded projects, that benefit the local towns. —



Javiera Contreras

Mining & Metals Manager
EY

How does EY help optimize its clients' expenditures?

After many of the mining companies implemented the obvious measures to optimize expenditures, not all of them continued to the next phase of understanding how to get the most productivity out of their assets nor did they focus on working capital. For example, some of our clients focused mainly on accounts payable and receivable, but they did not understand that they needed to also focus on their inventory to optimize their working capital. We shared insights on how reviewing your inventory as a powerful tool to improve your working capital.

How have you seen the capital raising environment change over the past few years?

Companies are always looking for new ideas to fund their projects, and they are getting more creative since banks are more reluctant to take risks in the mining industry. They are looking for different types of financing, including royalties, metal streaming, and minority partnerships. At EY, we have seen an increase in companies inquiring about how metal streaming could work in Chile. However, the regulatory environment in Chile is not ready for that, and it is not clear what the tax implications would be.

As the market has begun to recover, have you noticed an increase in consolidation?

The M&A deals we have seen have been very difficult to close because there is typically a mismatch in expectations. Some companies are willing to sell an asset for a lower price, but not as low as the buyers would like. It shows optimism within the industry that companies are not liquidating assets, but rather choosing to sit on them and wait as the market improves, and perhaps operate them themselves later on.

Do you think Chile's lack of tax exemptions deters foreign investment?

Chile is not as attractive to foreign investors as it was before the tax reforms of the last ten years. It has been getting increasingly expensive to do business in Chile, particularly for the mining industry. However, compared to other countries, mining companies pay similar taxes, and Chile is a relatively stable country.

If you were to design the new tax reform, what are the key points you would highlight?

After the reform, there will be two systems. One is the attributed system, in which companies pay 35% taxes whether they distribute profits to final shareholders or keep the fund within the company. I would take that away, as it creates a disincentive for companies to invest and spend within Chile. The second system is the semi-integrated system, in which companies get credit for corporate taxes paid against final taxes to shareholders only when profits are actually distributed to final shareholders. Companies used to get a 100% credit, but now, unless a foreign shareholder has a tax treaty with Chile, they can only credit 65%. I think that is very unfair to local shareholders (individuals) or foreign shareholders in jurisdictions without a tax treaty. Chile should go back to the previous system that allows a deferral of final taxes and also allows everyone to have that 100% credit, not only because it is fair, but also because it was a system that made companies want to invest within Chile.

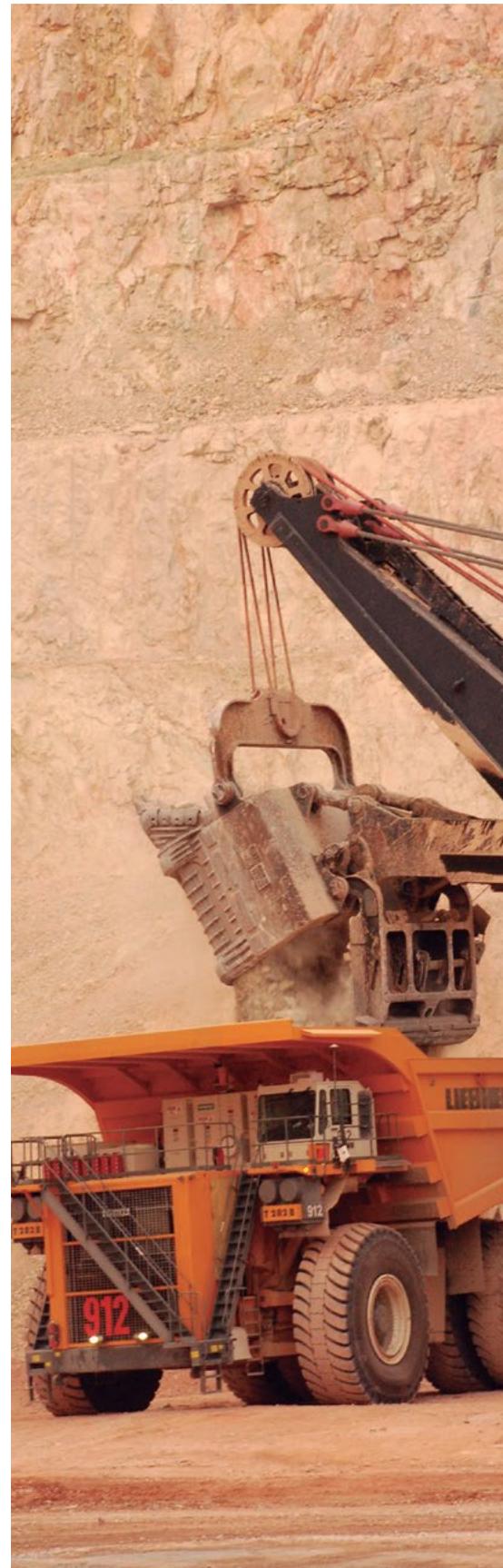
What are the key strengths of EY's Mining & Metals group?

EY's advisory team, which is a very strong pillar for our whole group, includes people from all service lines and is quite futuristic, meaning they are forward thinkers who have a lot of experience, particularly abroad. They are bringing ideas and solutions into Chile that are new to us, including the use of data analytics for predictive maintenance and remote mine operations. They also have systems to help large companies think about how they supply everything, as well as analyze what they buy and from which country.

What advice do you have for our investor readership?

Investors need to understand regulations to really understand how to invest better. For example, they should model out how they structure their investment, how are things going to work if they engage in a joint venture, or how they are going to take their profits out of the country, not just in two years, but in twenty years. —

Image courtesy of Liebherr



Chile's Varied Richness

Anticipating growth from the country's secondary commodities

Aside from copper, Chile is also the world's 14th largest gold producer, 4th largest silver producer, and 2nd largest molybdenum producer. Chile's gold and silver reserves comprise 7% and 14%, respectively, of the world's total reserves. Chile also accounted for 23% of the world's molybdenum production in 2016. Notable gold producers in Chile include Los Pelambres and Yamana Gold's El Peñón and Minera Florida mines, each of whom appear to be committed to Chile in the long-term. "We seek to achieve a long life for both of our assets in Chile," said Gerardo Fernández-Tobar, senior vice president of southern operations at Yamana Gold. "In general, Chile's geology, infrastructure, suppliers, and regulatory environment make the country a top priority for Yamana's continued presence in Latin America."

Chile is also one of the world's largest lithium sources, and the Salar de Atacama alone is responsible for 37% of the world's total lithium carbonate production. Though Chile's lithium market is considerably less mature than its copper and gold markets, the staggering volumes have not gone unnoticed. Codelco has already expressed an interest in lithium by establishing a lithium-focused subsidiary, Salar de Maricunga S.A., in April 2017, and BYD, a Chinese electric vehicle company, has shown interest in investing in Chile's lithium supply.

SQM's Salar de Atacama mine, the world's largest lithium brine mine, produced 44,000 mt of lithium carbonate in 2016, up from 33,000 mt in 2015, indicating the global demand for lithium is not slowing down to wait for the rest of the mining economy. The only other company that has permission from the government to produce lithium is Rockwell Lithium, which was acquired by Albemarle in 2016. In August 2017, Albemarle's lithium carbonate plant received permission from the government to nearly double production from 45,300 mt/y to 88,000 mt/y.

The reason why there are only two lithium producers in Chile is largely due to the government's classification of lithium as a strategic metal, which creates a barrier for lithium exploration companies who wish to eventually bring their projects into production. The main limitation is that lithium properties in Chile are not able to become concessions, and the general consensus is that the rules around lithium production are largely unclear. —



Gerardo Fernández-Tobar

Senior VP Southern Operations
YAMANA GOLD

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We defined a new production platform for El Peñón, reducing it from 220,000 to 140,000 oz Au. This was done to better fit the operation to the mineral resources and reserves, as well as the most recent results of exploration which point to narrower, higher-grade veins.

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Could you please give an overview of Yamana's presence in Chile?

Yamana Gold has two producing mines in Chile, El Peñón and Minera Florida, as well as a number of development projects, including the Atlas Titan joint venture exploration project, the Agua de la Falda joint venture project, and La Pepa. In 2017, we expect El Peñón and Minera Florida to produce a combined 245,000 ounces of gold and 4.48 million ounces of silver, with the majority of that coming from El Peñón. In addition, Chile is a significant portion of our exploration efforts with over 30% of our overall budget dedicated to Chilean exploration in 2017. At El Peñón alone, our 2017 exploration program was 86,000 meters at approximately US\$14 million.

Overall, exploration and production in Chile are very important to our portfolio. El Peñón, in particular, is a very important asset for us in terms of cash generation, and we continue to improve the operations and financial performance. Since Yamana acquired El Peñón in 2007, its production has been around 2.6 million ounces of gold and 81 million ounces of silver, and for most of that time, it has been the top producer in the company. Despite this, in 2017 we defined a new production platform for El Peñón, reducing it from over 220,000 ounces of gold to 140,000 ounces, while maintaining most of its cash generation capacity. This was done to better fit the operation to the mineral resources and reserves, as well as the most recent results of exploration which point to narrower, higher-grade veins. To achieve this transformation, we deployed an aggressive operations excellence program using a combination of lean tools and techniques and technology enhancements.

While Minera Florida is a more modest contributor to our portfolio, we are also focused on operations optimizations and developing the excellent exploration potential on the property. In 2016, we consolidated the land concessions surrounding the mine and discovered the Las Pataguas vein system. These systems are closer to the processing plant than the current mine workings, and their setting could allow the mine to improve the infrastructure, which would in turn improve efficiency and reduce costs. Minera Florida has been in

production since the mid-1980s, and we continue to see great opportunities to expand the resources and reserves and extend mine life.

How is Yamana leveraging technology in the production process?

We are in a great position to leverage recent developments in technology. We have created a true continuous improvement culture, where innovation and change can be better managed and implemented effectively. Also, the developments in advanced analytics, communications, and other disruptive technologies mean that more powerful tools are accessible and less costly than in the past.

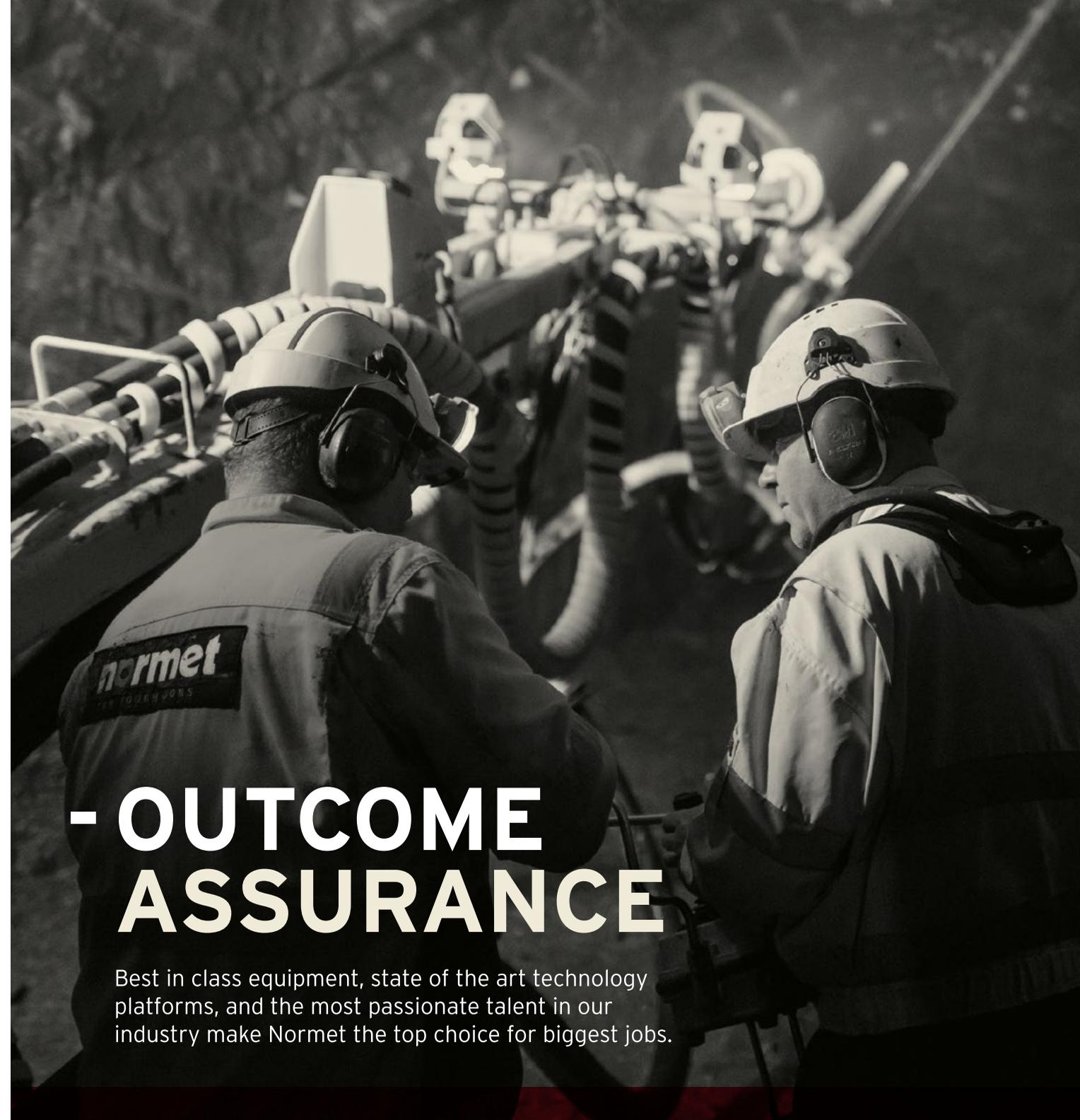
At the moment, we have three main technology initiatives. The first is shorter-term interval control for underground mines, including knowing exactly what each machine is doing, what workers are doing, and where they are against the plan so short term decisions can be made.

The second initiative is increasing the level of automation. Automatic control for processing is very common, but we are seeking to control more variables than before in order to get marginal gains in recovery, power, and reagents consumptions.

The third initiative, which is currently still in its testing phase, is to improve our predictive maintenance. Together with the equipment vendor, we collect and analyze data from the equipment in real-time and use it to extend the life of major components so that we can be more cost-efficient and minimize unplanned maintenance downtime.

What is Yamana's long-term vision for Chile?

Chile has been very good for Yamana. We seek to achieve a long life for both of our assets in Chile, which provide an excellent foundation as we advance exploration at our development opportunities in the country. Chile is stable in terms of geopolitical risk and is a world-class mining jurisdiction. There are some challenges, but in general, Chile's skilled workers, geology, infrastructure, suppliers, and regulatory environment make the country a top priority for Yamana's continued presence in Latin America. —



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GROUND WATER CONTROL & GROUND CONSOLIDATION	

Image courtesy of Chile Ministry of Mining

Chile's Next Top Mine

The country sees new project developments as prices improve

In addition to sustained production, Chile's development projects bode well for the future of the country's mining industry. In 2015, Teck and Goldcorp announced a 50/50 joint venture to consolidate their Relincho and El Morro projects into a single development project, NuevaUnión, which could become one of the largest mines in the world. The US\$3.5 billion copper-gold-molybdenum project could save the companies a combined total of US\$4.9 billion, as the Relincho project and El Morro project were expected to cost US\$4.5 billion and US\$3.9 billion, respectively. According to Jeff Hanman, vice president of corporate affairs at Teck: "This innovative partnership between Teck and Goldcorp combines two stand-alone projects, resulting in one project with a longer mine life at a lower cost and improved capital efficiency."

Teck is also investing in its Quebrada Blanca mine, implementing a development project that aims to extend the life of the mine by 30 years. Also, while the mine has produced fewer than 50,000 mt/y of copper in each of the past three years, Quebrada Blanca Phase 2 is expected to extend the mine's production capacity by 240,000

mt/y of copper and 6,000 mt/y of molybdenum, putting the mine's production total nearly on par with Chuquicamata.

In 2015, BHP Billiton began a development project focusing on expanding the life of its Spence mine by 50 years. The feasibility study process began at the end of 2015, but the company only approved the US\$2.46 billion required investment in August 2017. Spence has produced an average 173,000 mt/y of copper over the past three years.

In addition to its efforts at NuevaUnión, Goldcorp has also entered into a 50/50 partnership with Barrick Gold to develop the Cerro Casale project. Previously a 75/25 joint venture that featured Barrick as the majority partner and Kinross as the minority partner, Cerro Casale is known to be one of the world's largest undeveloped gold deposits. Like Goldcorp, this is not Barrick's only joint venture in Chile, as the company also owns part of the Zaldívar mine in a 50/50 partnership with AMSA. Large companies entering joint ventures as a means to hedge their bets may be a continuing trend as the market remains in a state of recovery. —

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AN IMPROVING EXPLORATION MARKET



“The world’s view of Chile is more positive than Chile’s view of itself right now. Chile is more resilient than what locals give it credit for, and I believe the future will be very positive.”

- Ignacio Salazar,
CEO, Orosur Mining

A New Wave of Exploration in Chile

Will optimism translate to development?

In addition to sustained levels of production and increased investment in development projects, Chile's mining sector also continues to show signs of vitality through exploration following a sluggish period from 2013 through 2016. According to EY, Chile's exploration budget in 2016 totaled US\$443.4 million, representing a 30% decrease from the previous year. The fact remains, however, that Chile has the highest concentration of world-class copper porphyry deposits, as well as more than half of the world's lithium carbonate reserves. As the value of Chile's exploration portfolio varies almost directly with the price of copper, the next years are positioned to be pivotal for Chilean exploration.

Copper and Gold Projects

If there is any indication that the majors have regained their interest in investing in new projects, it begins with Goldcorp's acquisition of Exeter Resource Corporation, which was completed in August 2017. Chilean Metals is also one of the early beneficiaries of the majors' attention, having sold its Copaquere project to Teck in exchange for a 3% NSR royalty. The company still has five properties, the priority being the Zulema copper-gold project, which they believe to be analogous to Lundin Mining's Candelaria mine. "We initiated a drill program starting in January 2017 and just completed it in April," said Patrick Cruickshank, CEO of Chilean Metals. "We proved that it is an IOCG-style system, and we will be implementing phase two of our drilling program." TriMetals Mining is expected to begin a 20,000m drilling program by mid-2018 on their Escalones copper project, for which they have already published a 43-101 resource. The company was waiting for a more favorable market to begin drilling, but the 2018 campaign is expected to bring the project to the pre-feasibility stage. "At the moment, Escalones, which is located near El Teniente, has 6.5 billion lbs of copper equivalent at a grade of 0.38%," said Felipe Malbran, TriMetals' vice president of exploration. "Our aim is to take the project through the development process, likely with an equity partner or as a joint venture, if it makes the most sense at the time."



Image courtesy of Maricunga

Hot Chili has already completed a pre-feasibility study on its Productora copper-gold project, and the company has spent a total of US\$100 million on the project's development. In May 2017, Hot Chili, along with joint venture partner Compañía Minera del Pacífico, a subsidiary of CAP Mining, began a drilling program with the aim of expanding the potential mine life before beginning a definitive feasibility study. "Productora is currently at a resource base of 1.5 million mt of contained copper and 1 million oz of contained gold," said Christian Easterday, managing director of Hot Chili. "The project will be a large-scale, open pit, sulfide and oxide operation producing approximately 70,000 mt/y of copper and possibly up to 30,000 oz/y of gold."

Atacama Pacific Gold is also nearing a feasibility study on its Cerro Maricunga gold project, and they expect the study to be completed by mid-2018. The company remains open to both joint venturing to take the project into production and building the mine themselves. "While Cerro Maricunga is the largest oxide gold discovery in the last 10 to 15 years, it will still be a relatively simple, straightforward project to bring into production," said Carl Hansen, CEO of Atacama Pacific Gold. "Assuming the feasibility study and permitting processes go according to plan, this project could be in production by late-2020."

Kingsgate Consolidated's Nueva Esperanza gold and silver project is currently one of the most advanced projects in Chile. As the definitive feasibility nears completion, the company plans to begin mine construction in the first half of 2018 and then be in production by 2020. According to Leonardo Hermosillo, Kingsgate's vice president of project development: "I am very sure that when the feasibility study is complete and the deal is approved, the value of the company is going to increase. At that point, we will have the option to go into production ourselves, find a joint venture, or sell the project, but right now we plan to take it into production."

Also nearing production are Altiplano Minerals's Farellón and Maria Luisa projects, which the company earned into via joint venture with Comet Exploration. While the joint venture was only announced in 2017, both projects are close to production because the artisanal miners who previously owned them had already completed a significant amount of permitting and drilling. According to Altiplano's CEO, John Williamson: "From the start, both mines will be smaller producers in the 50,000 to 60,000 tonne-per-year range with initial five-year mine lives, but we will be adding reserves and increasing the mine lives as we go along. Long-term, we expect the mines to last at least ten years, given the right commodity price."

Prospect Generators

Two copper-gold exploration companies in particular, Mirasol Resources and Revelo Resources, decided to take advantage of recent economic conditions by staking significant land claims in Chile at relatively inexpensive costs, following the prospect generator model. Mirasol currently has an active joint venture in Chile with Yamana Gold, known as the Gorbea joint venture, as well as a number of non-joint venture projects in northern Chile that are potential epithermal precious metal properties. Between the company's Gorbea joint venture and Ocean Gold joint venture in Argentina, Mirasol planned to have approximately 6,000 meters drilled by the end of 2017. According to Stephen Nano, CEO of Mirasol Resources: "In Chile, we are actively seeking joint venture partners for a number of our projects that include the Rubi

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ALTIPLANO MINERALS

Building Sustainable Growth

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John Williamson

President and CEO
ALTIPLANO MINERALS

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The key to maximizing productivity is using larger machinery with more sophisticated engineering designs and drilling and blasting techniques.

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— **Could you give us an overview of Altiplano's latest updates?**

In September 2017, we completed around 350 meters of exploration development, drilling about 30 holes along the length of the tunnel. In December, we began to remove copper, gold, and iron material from the vein, totaling approximately 2,000 mt to date. Our first bulk sample results came back at a grade of 2.36% copper. Our goal now is to remove 5,000 mt of material at a grade of greater than 2%. In February 2018, we are beginning a second surface drilling campaign with Maria Luisa. We hope to acquire more information before moving into the underground phase of Maria Luisa because it is a more complex, multiple-phase project. In December 2017, we made an offer to our joint venture partner, Comet Exploration, to buy out the remaining 50% of Farellon and Maria Luisa. When junior mining companies acquire projects, the market wants to know that you own 100% of the project, and it expects that you have the money to be the operator. The entire acquisition was predominantly covered by outstanding warrants, but we expect Farellon to be in production by mid-May 2018 and Maria Luisa by the end of 2018.

What is your strategy to reduce costs and maximize margins?

Our main strategy to reduce costs is to maximize productivity, and the key to accomplishing this has been to determine how to mine over the pre-existing local mining techniques. Specifically, we have larger machinery, as well as more sophisticated engineering designs and drilling and blasting techniques, which will help us not only increase productivity, but also operate more safely. The workforce at the mines are already very skilled, but we have also added technical support.

How does the Orogrande exploration project in Idaho fit into your portfolio?

Orogrande was our first project, and we still believe it has good potential. However, given the rate at which we are moving in Chile and the cost structure in Idaho, we thought it best to keep our focus in Chile for the time being. That said, the Chile projects allows us more freedom to take our time exploring Orogrande at our own

pace and perhaps look for a strong joint venture partner. Because we are prioritizing the Chile projects, we need to be more flexible in Idaho. At most, we will spend a couple hundred thousand dollars on an airborne survey and additional soil sampling.

How has the decrease in energy prices that was spurred by an increase in renewable energy usage affected your cost structure?

Given the stage we are in with both properties, we are not particularly affected by changes in energy costs. We generate all of our energy onsite. There are no government policy decisions that are hindering our efforts in Chile. Eventually, joining the Chilean power grid will cost us roughly \$40,000, and at that time we can reduce our usage of diesel fuel. It will be a worthwhile investment when the time comes, but we first need to prove our grades and determine at which point the investment can be made.

What is your main criteria for future investment in Chile?

Our main corporate strategy for acquiring new projects in general is to look for projects that would require a finite amount of capital to get back up and running, to drive them toward cash flow in the short-term to pay back our investment, and then focus on expanding them. In the future, when Altiplano has established a base on two to five cash flow positive assets, we would like to become more involved in greenfield exploration projects that have large deposit potential. We have already begun looking at about six additional projects in Chile, and we are willing to consider partnering with other stakeholders to advance projects.

What do you expect the new government regime to do to attract mining investment into the country?

When the new government takes over in March 2018, my expectation is that they will maintain the status quo for some time. Eventually, I would like to see more effort being made to open up land claims for small to mid-sized exploration companies like Altiplano. Right now, much of the unexplored land is held by large corporations who are not investing. —



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Chile Country Manager
GOLD FIELDS



Could you give us an introduction to the Salares Norte project?

Gold Fields started working on Salares Norte in 2009, and the first gold discovery was made in 2011. Since then, we have been progressively increasing our efforts, and we have thus far drilled about 100,000 meters. We have an average of 4.6 grams per tonne of gold, but there are areas where we have higher grades. Everything is indicating that it will be an open-pit operation, but we need to finish the study before we make a definite decision. We are completing the pre-feasibility study and continuing to drill to expand our resource base.

How is the permitting process in Chile compared to elsewhere in the world?

Permitting is difficult everywhere right now, and it is an evolving process. Chile changed its requirements in 2015, so its evaluation system is somewhat new. We believe that the approval time we saw with the first project is not reflective of what is happening now or will happen in the future. The amount of investment in the industry and the number

of active projects are variables that impact on approval times.

Do you think there is a lot of gold exploration potential in Chile?

While Chile is a copper country, I do believe there is a lot of potential for gold mining. Particularly in the region where we are, there is more gold than copper. That area was basically unexplored before we started there, and it appears our presence has sparked an interest among our peers.

What is your long-term plan for Chile?

Salares Norte appears to be just the beginning of a bigger exploration district. The area around the property is completely unexplored, and there is geological potential to expand there. Our strategy, at the moment, is to prioritize Salares Norte, and then we will look into expanding in the area. Should we decide to proceed with the project, our overall plan is to go into production in 2021. We have good support from the local communities and the authorities, and we have high expectations for Salares Norte. —

What attracted LiCo to Chile and, more specifically, the Purickuta lithium project?

TF: LiCo's business is specifically focused on energy metals. We were always looking to add additional assets in South America and we realized the best opportunity was in Chile. The political change happening here may be favorable to lithium exploration, and we thought the time was right to find a high-quality asset, start exploring, and hopefully get to the point where we can mine lithium for the benefit of our shareholders and the local community. We are looking at several different direct extraction technologies, including Tenova Bateman. With this technology we will be turning a historically low-tech business into a high-tech business.

What phase is the project in right now?

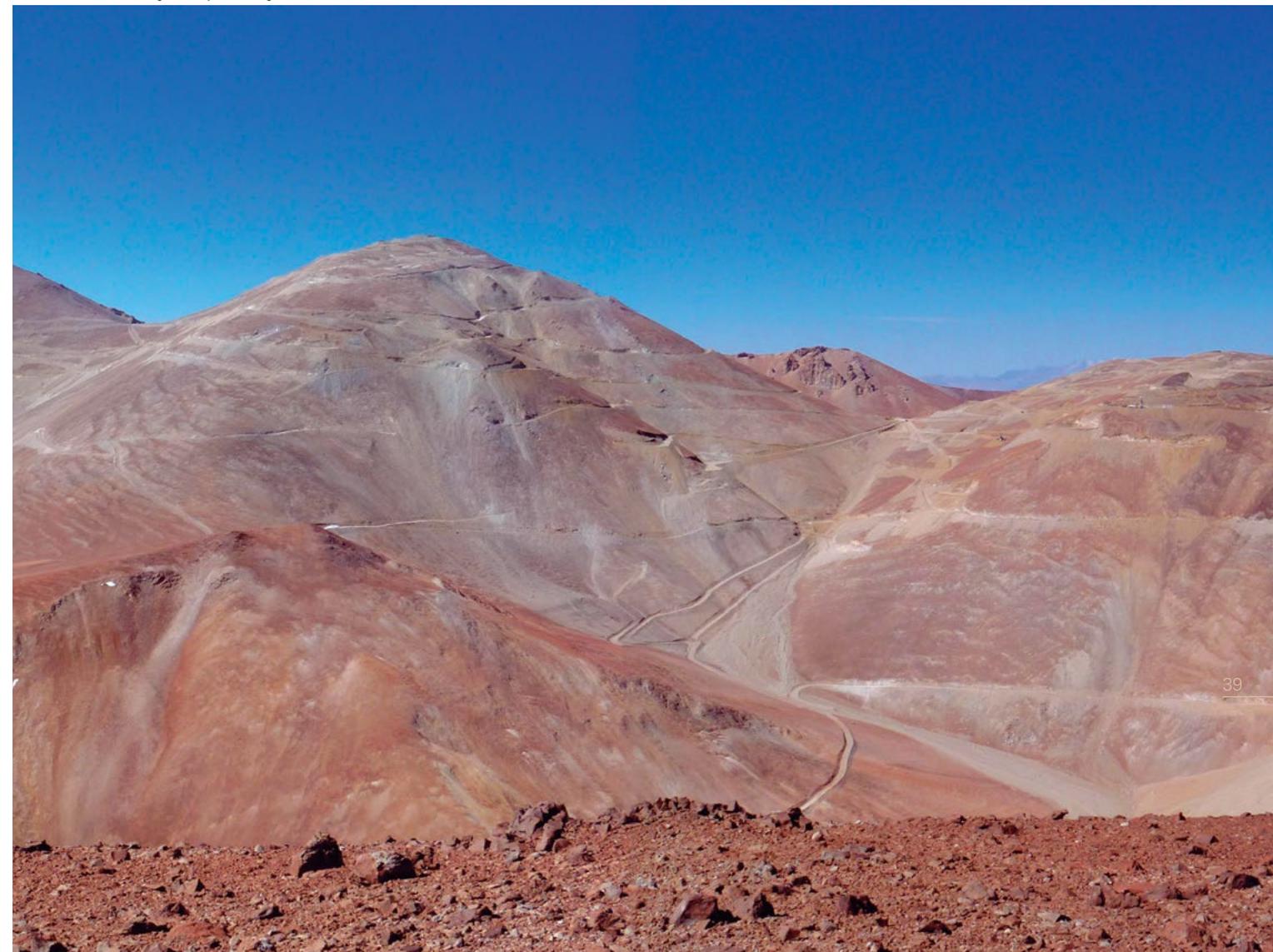
MB: We have completed a geophysical survey. The interpretation was that we have lithium brine from about 20 meters below surface to the depth of the survey, which is between 150 and 200 meters. Now, our task is to drill to a depth of 300 meters. What is unique about our plan is that we are looking

to implement direct extraction technology instead of the traditional evaporation pond model. Our hope is to see if the property can support about 4,000 mt of lithium carbonate per year using this technology. With a direct processing technology, we would not have to wait 18 months for the lithium to precipitate and evaporate. Not only is the speed of the process beneficial, it is also not invasive environmentally, as we would not be evaporating water into the air, but rather after the process takes the lithium out of the water, recirculating the water, and putting it back into the salar.

How would you characterize LiCo's relationship with the local community?

MB: LiCo has strived to create a good relationship with the local community. Many of the locals work for SQM, so they are open to the idea of mining, but their main concern is the water, and they like the fact that LiCo is not building an evaporation pond. We also believe that, with our technology, we can produce some agricultural water for the local community, which is a big benefit for them. —

Image courtesy of Maricunga



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and Odin copper projects. Both of these projects are very prospective and are receiving strong interest from copper producers.”

Similarly, Revelo Resources has recently signed agreement letters with two precious metals producers. In June 2017, the company signed a letter agreement with Hochschild for the option and eventual sale of 100% of their Loro property, and in July 2017, they signed a letter agreement to sell two projects, San Guillermo and Reprado, to Austral Gold. Revelo's complete portfolio includes 26 projects totaling 300,000 hectares and 40 drill targets. “Our Montezuma copper-gold project is probably our flagship project, but we are also particularly excited about Loro, as it has all the characteristics of an epithermal precious metal vein prospect similar to Yamana Gold's El Peñón mine,” said Tim Beale, CEO of Revelo Resources. “Regarding other copper projects, we are very excited about Morros Blancos, which is very close to our San Guillermo project. Morros Blancos has two very large hydrothermal alteration zones with very strong characteristics of the upper parts of porphyry copper systems.”

International Majors

Another indication that Chile's exploration potential is alive and well is the presence of companies that are producers in other countries. Gold Fields, which has mines in Peru, Ghana, South Africa, and Australia, is in the process of completing the pre-feasibility study for their Salares Norte gold project. “Gold Fields started working on Salares Norte in 2009, and the first gold discovery was made in 2011. Since then, we have been progressively increasing our efforts, and we have thus far drilled about 100,000 meters,” said Max Combes, Gold Fields' country manager in Chile. “As of now, and should we proceed, our strategy is to take the project into production ourselves.”

Orosur Mining, the operator of the only producing mine in Uruguay, also acquired an early-stage gold asset, Anillo, through an earn-in agreement with Codelco. According to the terms of the deal, the company has until 2022 to complete a pre-feasibility study, and they are being funded by Asset Chile, which is cover-

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Tim Fernback & Malcolm Bell

TF: President and CEO
MB: VP Exploration
LICO ENERGY METALS



TF

ing most of the financing up to US\$3.5 million. “Asset Chile has until December to decide whether to move into phase two. They must get to the end of the second phase to consolidate an earning, which gives them a significant incentive to go onto the next phase,” said Ignacio Salazar, CEO of Orosur. “Our long-term goal is to eventually bring the asset into production, but if it makes more sense for somebody else to do so, then we are open to it.”

Lithium Projects

While it is understandable that Chile has been historically known as a “copper country,” it would be a mistake to not also consider Chile a “lithium country.” Chile is the world’s largest lithium producer, and the Salar de Atacama region alone contains 27% of the world’s total lithium reserves. SQM, however, is no longer the only company in on the secret. Lithium exploration company LiCo Energy Metals has recently completed a geophysical survey on the Purickuta project and plans to drill to a depth of 300m. “What is unique about our plan at Salar de Atacama is that we are looking to implement direct extraction technology instead of the traditional evaporation pond model,” said Malcolm Bell,

LiCo’s vice president of exploration. “Our hope is to see if the property can support about 4,000 mt/y of lithium carbonate using this technology.”

Wealth Minerals is also a new arrival to Salar de Atacama, having acquired a land position there of 46,000 hectares in 2016. In less than two years, Wealth Minerals has acquired five projects, including Salar de Atacama, Laguna Verde, Trinity, Five Salars, and most recently, Seven Salars, which includes Salar de la Isla and puts the company in a 50/50 partnership with Talison, which is operated by Albemarle. “This asset gives us bargaining power in any future consolidation discussions, particularly because it includes Salar de la Isla, which is very close to production because of the amount of work that has been done on it already,” said Tim McCutcheon, president of Wealth Minerals. “Salar de la Isla is on par with Salar de Maricunga in terms of size and grade.”

Salar de Maricunga, in fact, is home to the largest pre-production lithium project in Chile. Bearing Lithium, formerly known as Bearing Resources, signed an agreement to acquire Li3 Energy and its 17.7% stake in the Maricunga Lithium project in January 2017. The project, which is 50% owned by Lithium Power International and 32.3% owned by Minera Salar Blanco, has already had US\$30 million spent on its exploration over the past

five years, and the joint venture plans to complete a definitive feasibility study in 2018. “In the most recent resource update, the resource increased nearly four-fold from 600,000 mt to 2.2 million mt, while maintaining exceptionally high grades,” said Jeremy Poirier, CEO of Bearing Lithium. “It is the highest-grade undeveloped lithium brine project in the world.”

Other Metals

In addition to copper, gold, and lithium projects, there is a representation of companies exploring deposits of Chile’s less prevalent resources. Minera Aguila del Sur’s Quince iron project, for example, was discovered in 1997 by explorers searching for copper. The project now has a resource of 680 million mt of iron, as well as a significant vanadium reserve, and the company is expected to complete the pre-feasibility study within the next two years. “This is the largest iron source on the west coast of the Americas. Our location on the Pacific Ocean makes it easier to get to China to help them with supply, instead of them relying on some of the larger players in Brazil,” said David Cadwell, COO of Stillwater Resources, Quince’s geological consultancy. “At this point, the company is looking for a partner to shoulder some of the heavier expenses.”

In July 2016, Australia-based exploration company Golden Rim Resources acquired their Paguete zinc project, of which there are very few in Chile, and recently completed an updated resources estimate. According to Craig Mackay, Golden Rim’s managing director: “The results indicated 2.4 million mt at 8% zinc equivalent. Our long-term strategy is to take the project into production ourselves.”

Private Equity

Private equity is a less common path to funding in the mining industry than standard private placements, joint venturing, or an IPO. Given that risk mitigation is a priority in this type of business model, however, it should be no surprise that some private equity investments do exist in politically stable jurisdictions, such as Chile. International private equity firm Denham Capital, a nearly US\$9 billion fund, has invested in Santiago Metals, whose flagship project, Delirio, is a copper porphyry system that is currently going through the permitting process. “Santiago Metals has a pipeline of potential projects, but they all need to be run through Denham’s strict criteria,” said Waldo Cuadra, president of Santiago Metals. “We are also in the midst of a possible acquisition, which could be very exciting for us. We have received enough funding to make room for three total projects.”

Mandalay Resources has also followed the private equity model since it was set up by Plinian Capital in 2009. Mandalay’s Cerro Bayo mine in southern Chile was in care and maintenance when it was acquired in 2010, and Mandalay spent US\$23 million on its acquisition and reopening. The mine life was quickly extended from three years to ten, and Cerro Bayo was in production from 2010 until mid-2017, when one of the veins flooded and the proj-

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We are permitting for a water production well at Challacollo, a process that will take until mid-2018. At that point we will determine whether to sell the property or take it into production ourselves. Mandalay considers Challacollo a core asset because of its significant indicated resource, its feasibility-stage status once the water sourcing is resolved, and its exploration potential.

- Mark Sander,
President and CEO,
Mandalay Resources



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ect was put on temporary suspension. “None of the other veins were affected, but we need to ensure that none of the veins are susceptible to flooding before reopening any of them,” said Mark Sander, CEO of Mandalay Resources. “While the mine is shut down, we are still doing some surface drilling to confirm the mine pillar thickness in certain areas.” Cerro Bayo was effectively put on care and maintenance in September 2017.

Minería Activa, a local Chilean private equity firm, has taken a more domestic approach, focusing only on Chilean mining projects. The company’s first fund in 2008 was well known for its successful exit of the Dominga mine, which is now owned by Andes Iron. Minería Activa is currently on their third fund, which includes the Pampa Camarones copper project. The company purchased 90% the project in October 2016 for US\$18 million, and lately received the results of their most recent drilling campaign. “With mid-sized projects like Pampa Camarones you can increase reserves without significant expenditures,” said Minería Activa director Ignacio Del Río. “Through selective mining, we are able to mine with twice the grade while maintaining total cathode production.”

Looking Forward

As the copper price continues to surge and lithium remains in high demand, Chile’s exploration portfolio should receive the influx in investment capital required to move many of these projects forward. The quality of Chile’s deposits has already been proven by the more mature mines, so now is a good time to invest in what could be the next major mine in Chile. —



Lucy Pamboukdjian

Chief Commercial Officer
BOLSA DE SANTIAGO

What steps are you taking to become more internationally recognized?

Internationalization for us means both bringing international investors to trade in Chile and having more international assets and standards within Chile for local players to trade. In 2010, Bolsa de Santiago joined the Exchanges and Depositories of Colombia, Mexico, and Peru to create the Latin American Integrated Market (MILA). We also have agreements with the Brazilian Exchange B3, and the Canadian TSXV. Chile is gradually getting on other countries’ radars, which is exactly what we want.

Could you elaborate on your partnership with the Toronto Stock Exchange?

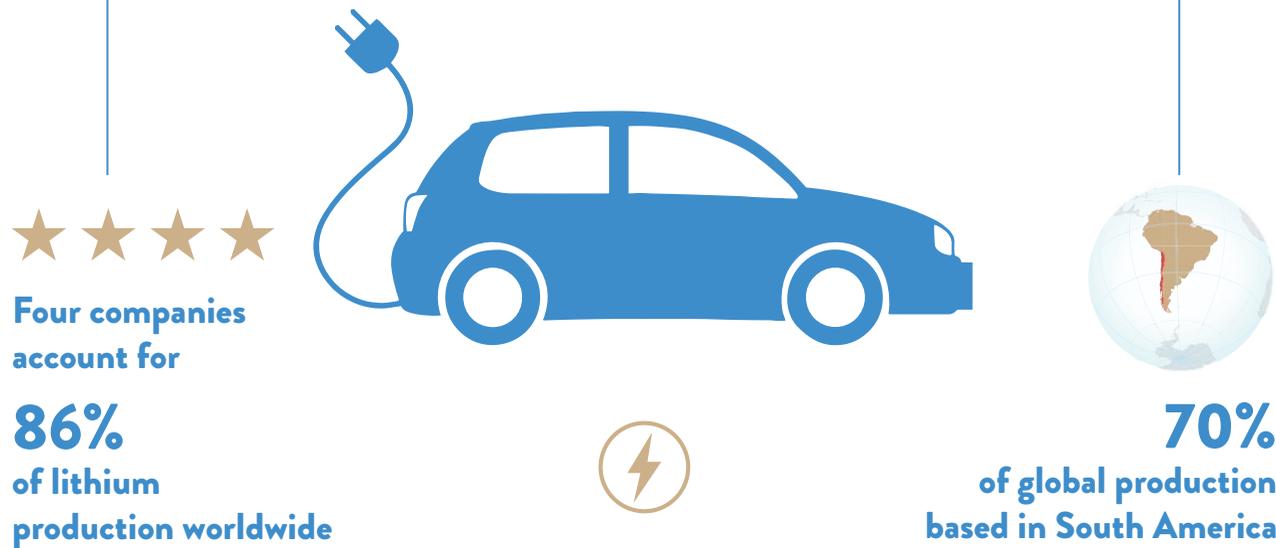
In 2013, Bolsa de Santiago signed an agreement with the Toronto Stock Exchange Venture (TSXV) to have a specific listing segment for mining companies. We discovered that most Chilean mining projects were listed in Canada, so the agreement stands for a dual listing initiative that grants any TSXV-listed company the right to dually list on the Chilean Exchange and have simultaneous access to investors in Canada, Chile and the other integrated MILA markets. There are no additional costs or listing requirements. We launched the initiative in 2015.

For mining companies, what are the main advantages of being listed on the Santiago Exchange?

Bolsa de Santiago is starting to develop a culture of investing in mining in Chile. We are making a conscious effort to work with new investors in the market. We are starting to see new buy-side demand in the mining industry. Our dual listing program with the TSXV and our MILA integration program should provide many opportunities for mining companies to increase their visibility in front of investors. In the long-term, we want to make Chile the top mining investment country. —

THE LITHIUM MARKET

Sources: Benchmark Mineral Intelligence, ABC Australia, Galaxy Resources, USGS



LITHIUM DEMAND GROWTH DRIVES PRICE UP

Source: Benchmark Mineral Intelligence

Lithium carbonate average prices (battery grade)

2015-2016
US\$9,000/mt

2017-2020
US\$13,000/mt

Lithium hydroxide average prices (battery grade)

2015-2016
US\$14,000/mt

2017-2020
US\$18,000/mt

Expected demand growth for battery market

2016
84,000 mt
lithium carbonate equivalent (LCE)

2020
164,000 mt
lithium carbonate equivalent (LCE)

Plans to phase out sales of internal combustion cars:

- Norway: 2025**
- India: 2030**
- UK / France: 2040**

Other countries with official targets for electric vehicle sales:

Austria, Denmark, Ireland, Japan, the Netherlands, Portugal, Korea, Spain

LITHIUM APPLICATIONS



**Lithium-Ion batteries
Glass and Ceramics
Lubricant Greases**

Other: pharmaceuticals, catalysts, air conditioning, welding electrodes, luminescent paints, rubber and aluminium production

LITHIUM PRODUCTION AND RESERVES PER COUNTRY (2016)

Source: USGS

	PRODUCTION (mt)	RESERVES (mt)
Australia	14,300	1,600,000
Chile	12,000	7,500,000
Argentina	5,700	2,000,000
China	2,000	3,200,000
Total	35,000	14,300,000

Jorge Maldonado

General Manager
SUPEREX



What is Superex's role within the Perfochile Group?

In 2008, my business partner and I founded Superex and became part of the Perfochile Group. Perfochile is a company that has existed for more than 33 years and that has some of the more powerful drills in Latin America. We currently have facilities in La Serena, Antofagasta, and Iquique. Perfochile is an expert in reverse circulation drilling and, by bringing in Superex's sonic drilling capabilities, Perfochile was able to round out their drilling portfolio.

What are Superex's main projects at the moment?

Many projects that have been on hold throughout the downturn are now starting to open back up. There is noticeably more activity from both majors and juniors. During the downturn, we were lucky enough to still be working with the few juniors who had exploration projects. We are a 15-drill company, and we were using two or three drills at a time during the downturn, but now we have as many as five drills being used. We are experts in greenfield exploration, but the majority of our business today is brownfield work, including for Glencore at the Lomas Bayas mine. Chile is still a great mining country. Investors still see a lot of potential and I hope the conditions will change in the near future.

What are Superex's main competitive advantages?

Our people give Superex its biggest competitive advantage. We are very aware that the mining business is cyclical, so we prepare financially to ensure that we never have to fire our employees. We prefer to hire people with no experience and train them. Despite the added cost, it is worth it because they learn everything our way. By keeping the employees we have trained, we are essentially creating another teacher who can help onboard additional employees. Despite being a small company, our clients see the value of our service.

Can you elaborate on Superex's water recycling system?

Superex is one of the only companies in Chile that has its own water recycling system. We have three or four of these, and our clients find this useful when presenting their plans to the Chilean government as they are able to give favorable water consumption estimates. Water is a very important part of drilling, especially diamond drilling, and when a water source is 200 kilometers from a drill site, you can only make three or four trips in a day. With our water recycling system, we could last two days between trips. Our

system can also be moved around quite easily, which is helpful at sites that have limited road access.

What are Superex's goals over the next two or three years?

We are expecting lithium exploration to increase, and the sonic drilling system is the best choice to get a good sample because it does not use air, additives or water. We call it dry drilling and it gets a perfect, uncontaminated sample. We have been thinking about expanding our business to Peru or Argentina, but for now, Chile is the country we want to be in. Mining is a long-term business and you cannot be narrow-minded because the small picture is not what you need to focus on. You must be open to learning and following new technological trends in order to adapt.



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Juan Luis Uberuaga

General Manager
FORACO CHILE



Could you give us a brief overview of Foraco's presence in Chile?

Foraco is a French company and the third largest drilling company in the world with activity in five continents. Foraco has strong technological tools and we provide a broad range of drilling services. Foraco entered Chile in 2000, but 2003 brought a drop in the market, so we decided to temporarily suspend operations. In 2010, Foraco bought Adviser Drilling and opened its offices in Chile for the second time. We currently have 150 employees in the country. At the moment, we are only managing one large project, but we are expecting new projects over the next year. In Chile, our strategy is to continue to work on small but well structured projects that generate consistent, organic growth.

What steps has Foraco taken toward innovation?

Foraco has a technical department dedicated to innovation. Most of our research and development occurs in France, Australia and Canada, and we are mainly focused on the reduction of water consumption, remote operations, routing, and drilling in deep wells. Water, in particular, is becoming a scarcer resource every day, which is why it is crucial for us to have water recycling and treatment systems. Today, all companies are looking to innovate, so it is likely to find similar developments elsewhere. That is why we put emphasis on providing a better service as a brand differentiator.

How is Foraco perceived in the market?

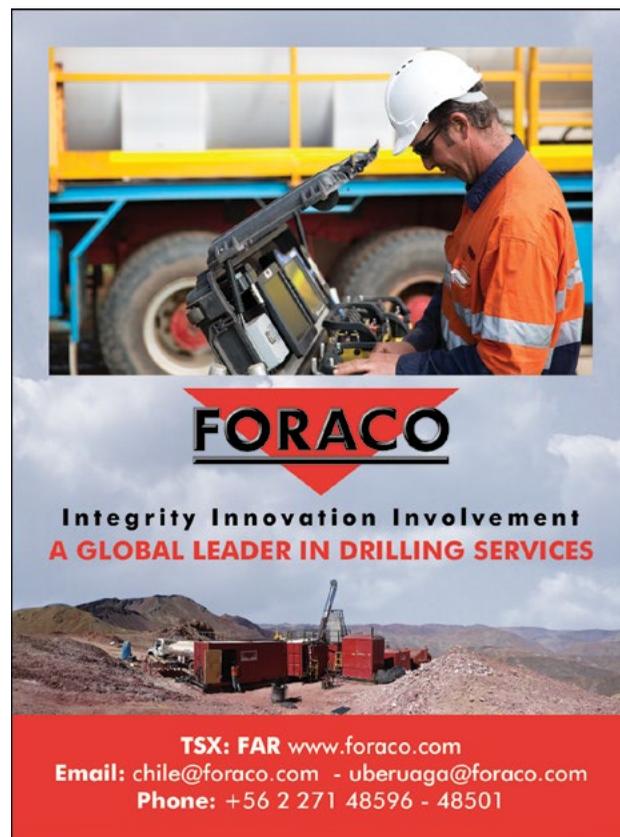
Foraco likes challenges and we deliver projects in difficult areas where traditional companies would not work: difficult countries, high mountain areas, low temperature conditions, and meteorological risks. We are also a public company, and thanks to this access to the markets, Foraco is always able to increase its working capital to take on new challenges. Since we entered the stock market, we have grown very quickly and acquired new companies in several countries. There are many people who trust us and who want to invest in us.

How does Foraco ensure safe practices on a mine site?

The Chilean market is very demanding in terms of safety and security, but we guide ourselves by safety regulations at a global level. Our company policy is such that we train our personnel, we apply high security standards, and we work every day to build a safer work environment.

As the price of copper recovers, what is your outlook on the mining industry in Chile?

The changes we made during the low copper cycle allowed us to reorganize ourselves in a way that best positions us for a market recovery. Our strategy over the next five years is to manage our costs better, and with a better staff structure. The recovery of the mining industry is occurring worldwide, not just in Chile. Therefore, it is important to apply these lessons globally. Foraco expects an intense level of activity over the next six to twelve months, so we are prepared for what is coming. —



The Onset of a Positive Market Sentiment



“For Hot Chili and any of the surviving companies listed on the ASX or TSX, there is quite a bit of optimism for future capital raising efforts. The copper price increase is being driven on the demand side by the very encouraging growth numbers in China and in the electric vehicle industry, as well as on the supply side by the union strikes in Chile and Indonesia.”

- Christian Easterday, Managing Director,
Hot Chili



“Our portfolio in Chile has essentially been built in the last three years. Because we had funds in the bank, we were able to continue exploring throughout the downturn. Within the last two years, we have started to turn our attention to copper projects, and the timing was right because most of the majors were hurting, commodity prices were low, and high-quality projects were becoming available.”

- Stephen Nano, CEO,
Mirasol Resources



“In 2014, we decided it was a good time to capitalize on the new projects becoming available that were previously held by distressed companies and establish a significant land position in Chile. Staking meaningful claims in Chile can be quite difficult because most of the prospective areas have already been staked by large mining companies who tend not to relinquish those claims.”

- Tim Beale, CEO,
Revelo Resources



“There is an appetite in the market for copper. Investors are allocating money toward copper projects, but oddly enough, they are not looking where the copper is. They are looking in Australia and Canada, but not in Chile. Chile produces over 30% of the world's copper. Australia and Canada each produce 5% or less.”

- Francisco Acuña, Business Manager,
Kura Minerals



“We are optimistic about exploration in Chile. In my opinion, exploration is always plausible and many projects that are seemingly at a dead end just need to be rethought. Most of the obvious mineralization in Chile has already been discovered, but there is plenty of potential if explorers get creative. Projects are not found, they are created.”

- Felipe Malbran, VP of Exploration,
TriMetals Mining



OVERCOMING CHALLENGES: THE ROLE OF PROVIDERS



“In the near future, most mining companies will have to recycle most of their water. They will also likely have more difficulty obtaining water permits and moving fresh water into the mountains. There is clearly plenty of water available in the sea, but engineering companies are still working on solutions to desalinate seawater and transport it to high altitudes.”

- Felipe Azócar,
General Manager, Tetra Tech Metálica

Investment Challenges

Looking for new opportunities in a mature market

Given Chile's extensive mining history and relative political stability, it should come as a surprise that, in 2016, junior mining companies were responsible for only 7.8% of the country's exploration, while major companies already residing in Chile

represented the lion's share of 80.9%. Chile has high-quality infrastructure, significant port accessibility by virtue of its geographical composition, legislative transparency and, according to Transparency International, very little discernible

government corruption. If this is the case, one would expect Chile to have garnered greater interest from exploration companies around the world.

Land Claims and Mining Licenses

The predominant explanation for an apparent lack of exploration activity in Chile is that land claims and mining licenses do not expire provided that the holders of the concessions pay annual taxes. For the major mining companies that hold the majority of Chile's explorable land, this is a negligible expense. "There is very little turnover of ground compared to other jurisdictions where licenses have limits," said Craig Mackay, managing director of Golden Rim Resources. "There are certain groups in Chile that hold very prospective licenses but are under no pressure to conduct meaningful exploration work. This keeps a lot of ground from the active exploration companies."

According to Cochilco, the top ten holders in 2015 accounted for 40% of Chile's total exploration concessions. While it has been reported that the government is considering changing the mining code to incentivize concession holders to explore or release land, such an outcome is unlikely because any type of legislative change may deter investment from foreign ma-

jors. The government is likely unwilling to trade major investment money for junior investment money. According to Diego Hernández, president of Sonami: "Guaranteed land claims is one of the biggest factors that attracted international investment to the Chilean mining industry in the first place. Ideally, we would like to have more medium-sized exploration companies enter Chile, but any changes that are made must be done cautiously so as not to drive away existing investment."

Water Scarcity

For mines entering the production or development phases, water scarcity continues to be the most pressing issue in Chile. While Chile evidently has plenty of access to water on its coast, transporting water to high-altitude mines has proven very costly in terms of the amount of energy it requires. Underground water is also becoming increasingly scarce and energy-consuming to extract, driving both producers and service providers to devise new water recycling tactics. "Kinross has taken measures to be more efficient with water usage and is using less water to produce the same amount of ore," said Jose Tomás Letelier, vice president of government affairs at Kinross. "We recycle a high percentage of the water we use, we have improved our piping and we have lowered evaporation rates, which is a common issue at such high altitudes."

As a result of the declining underground water supply, mining companies have been investing in desalination plants. Escondida, for example, recently constructed the largest desalination plant in Latin America, as well as one of the largest in the world. "The plant's capacity is 2,200 liters per second, and it has a 175-kilometer pipeline," said Mark Venning, business development director of Black & Veatch, the engineering firm tasked with building the plant. "The contract will enable us to build a 1,400-liter expansion. This will supply the water for Escondida and reduce or eliminate its consumption of groundwater."

In recent years, some companies have resorted to using sea water without desalination treatment for their operations, but they eventually learned that this solution can be incredibly corrosive and, consequently, expensive. "If you just use salt water, you reduce your recovery rate, and your plant lasts a fraction of the time," explained Venning. "When comparing the cost of using fresh water to the amount of increased capital that ends up being spent on a plant using salt water, it is easy to see which solution is more viable."

Employment and Regulations

Even if the land claims are secured and the water situation is resolved, it is still important for investors to understand how smoothly their operation will be able to continue. While government expropriation of private mining assets will likely never be an issue in Chile, as it is in Bolivia, Venezuela, and Thailand, for example, mining companies in Chile have had their fair share of hiccups.

In early-2017, Minera Escondida faced a 43-day, 2,500-employee strike, which was Chile's longest since 1973. As a result, Escondida's Q1 output dropped 63% compared to Q1 2016 output. Antofagasta Minerals also faced strike threats at their Centinela and Zaldívar mines in July 2017. Because of Chile's strong labor union presence, strikes do not simply end once the employees

Pascual Veiga



President APRIMIN

How did the low copper cycle affect the Chilean mining industry?

A lot has changed since 2012 because of the low price of copper. Mining in Chile has lost about 56,000 jobs, and two-thirds of that corresponds to mining providers. As a result, companies have had to maintain productivity at lower costs. If you compare Chilean mining production in 2013 and 2016, however, you will only notice a small variation. Chile is obtaining good numbers but with 56,000 fewer workers, so that tells you that we are starting to overcome the challenge of maximizing productivity. While production volume has dropped 2%, productivity is still increasing. We are still working hard to be competitive, but we are not currently seeing the salaries, bonuses, and employment numbers we have seen in the past.

How realistic is it that automation in mining becomes widely implemented?

Automation in mining is very realistic and can be implemented in almost every possible mining process. Providers support automation, and the main reason is the new labor reform in Chile. Instead of motivating more job opportunities, it motivated the automation of processes. Remote operations is also a very relevant option because it allows employees to operate the equipment in a secure and comfortable way. Codelco's Gabriela Mistral mine is already operating almost completely autonomously.

How do current environmental regulations affect suppliers and services?

Environmental regulations are affecting the industry more than we had initially expected, as the approval process is very bureaucratic. Unfortunately, in Chile, the environmental approval does not guarantee that you can go on with a project, and it is not always clear which entity grants the final approval. Chile has always been respectful of environmental laws, but the processes take too long: up to five years in some cases.

What are you most excited about for the mining industry in Chile?

Mining is very cyclical, but I am optimistic about the improvement of this cycle. Investment in the Chilean mining industry has been very strong, thanks to business transparency. Chile has a significant number of world-class professionals, from exploration to exportation. Over the course of the past 15 years APRIMIN has developed a strong platform of suppliers in Chile which covers the entire value chain of the mining industry, meaning investors can be confident that they will have a smooth transition into the country. —



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María Eugenia Parot

General Manager
GOLDER ASSOCIATES



What have been Golder's major developments in Chile over the past few years?

Golder has been consolidating a strong consulting and design team in Chile, providing integrated services to the mining industry in the areas of mine waste, water management, environmental impact assessment, permitting and sustainability, mine engineering and stability, and construction services. Our main goal has been to develop solid, well-rounded professionals through seamless collaboration of our experts working together on challenging projects.

What role does Golder play in finding water efficiency solutions?

Golder provides comprehensive water balance models that help clients to understand water consumption, recovery, and losses, as well as implement programs to minimize the overall consumption of freshwater. For example, we apply different technologies and conduct innovative investigations to maximize water recovery from tailings and optimize our designs to minimize water losses.

What are Golder's main advantages?

Golder has several competitive advantages when it comes to providing services to the mining industry, including technical excellence, which allows us to deliver tailored, state-of-the-art solutions to our clients. Our strong global footprint allows us to serve our mining clients worldwide and we have a deep understanding of the mining industry from early development stages to design, construction, operation, and closure. Finally, our model as an employee-owned company in which our senior owners lead the business is an advantage.

What are the key factors in establishing a successful relationship between a mining company and a local community?

Successful relationships are based on mutual benefit, respect, and trust. Early consultation with communities to find out what matters to them is key in developing successful relationships, as mining companies must be able to execute projects that respect and enhance elements that are important to local communities.

What are Golder's goals in the mining industry over the next several years?

By 2020, Golder aims to be the leading provider of integrated engineering and environmental services from the earliest stages of mine development throughout the entire life of the mine, as well as a global leader in providing niche services such as mine waste management, water management, geological resource engineering, mine closure, and environmental and social management.

What is your outlook on the future of mining in Chile?

We expect Chile to continue being a relevant player in the global mining industry. The country has the opportunity to become the global leader in innovation to solve key challenges related to productivity, water, ecosystems, and community relationships. —



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Esteban Hormazabal

General Manager
SRK CONSULTING



Could you please give us an overview of SRK's operations in Chile?

SRK's work in the Chilean mining industry pertains mostly to copper, gold, iron and some non-metallic commodities, including lithium and phosphates, among others. Our major clients include Codelco, Anglo American, AMSA, BHP Billiton, CAP, Barrick and Gold Fields, and we cover most of the disciplines in a mining project from exploration, planning and operation to mine closure. SRK currently has more than 115 employees in Santiago, and we are planning to grow. We also support the SRK teams in Argentina, Peru, Brazil and Russia from our Santiago office. SRK has been in Chile for 23 years, and we are the oldest SRK office in Latin America.

What steps does SRK take to create environmentally sustainable practices for its clients?

SRK has strong expertise in supporting environmental permitting processes, as well as mine closure and geochemistry. One of SRK's main value additions is the incorporation of environmentally friendly solutions in project designs. We are always innovating in productivity and improving our environmental standards and field equipment. Water recycling is also an important trend right now, and our hydrogeology department is doing water supply studies to optimize water use inside plants and proposing strong water management plans to avoid potential impacts to the environment.

How do you expect demand from your clients to evolve over the next few years?

During the last two years, SRK was involved in several mine closure projects and we are currently starting to receive more due diligence requests for early-stage operating projects and pre-existing mines. I believe we will face an increase in activity in the coming years. After the price of copper fell, the industry learned an important lesson. Also, mining projects in Chile are facing big challenges related to environmental and social issues. As a result, the mining industry will focus on more sustainable projects.

What is SRK's competitive advantage?

Our core competitive advantage is high-level consultancy, reflected in the excellent technical skills of SRK professionals. We have a solid group of employees and consultants that have been working together for a long time and can provide quick and practical solutions to challenging and world-class projects. We care about choosing our people, training them and preparing them for a long-term development process. SRK is a one-stop shop for its clients and a strategic ally with a worldwide network of experts. —



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Image courtesy of Chile Ministry of Mining

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go back to work. “Labor unions are more powerful now than they used to be, and recent strikes have had severe consequences,” said John Byrne, managing director at Boyden Executive Search. “In the case of Minera Escondida, both sides will need to meet again to negotiate.”

The verdict is still out regarding whether or not Chile’s regulatory environment is a substantive deterrent to investment. The general consensus is that the permitting process that was introduced by the government in 2014 is quite time-consuming. According to Pascual Veiga López, president of APRIMIN: “Environmental regulations are affecting more than we had initially expected. Unfortunately, in Chile getting environmental approval does not guarantee that you can go on with a project and it is not always clear which entity gets final approval of a project. Chile has always been respectful of environmental laws, but the processes take too long.”

The Chilean government, however, appears to understand how important a smooth permitting process is to stimulating the mining industry. According to EY, after considerable pressure from the private sector, the

government is working with the private sector to overhaul the existing environmental permitting process. “Chile needs to find a way to make regulations more similar to those of the world’s most competitive mining jurisdictions, but without jeopardizing what the regulations were originally meant to protect,” said Diego Hernández. “An environmental permit that normally takes four years to obtain should only take two years.”

Looking Forward

While efficiencies are being created to combat water scarcity issues, and a robust, albeit bureaucratic, regulatory process is necessary for a mining economy of Chile’s scale, land claim and mining license legislation appears likely unchangeable in the short-term. Because land availability is scarce compared to Chile’s actual exploration potential, junior companies wishing to enter Chile would be practically better off acquiring projects from or joint venturing with existing players in the country. —

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There is very little turnover of ground compared to other jurisdictions where licenses have limits. Certain groups hold very prospective licenses but are under no pressure to conduct meaningful exploration work. This keeps a lot of ground from the active exploration companies.

- Craig Mackay,
Managing Director,
Golden Rim Resources



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Roberto Durán & Javier Vaca

RD: President
JV: Regional Director
OHL CONSTRUCTION



JV

“

RD: We can provide support in underground mine engineering, the construction of vertical shafts, and mine access, and we can do this with our own machinery. Our experience in tunneling in the civil segment allows us to contribute to the increase in underground mining efforts.

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Could you please give an overview of OHL’s presence in Chile?

RD: OHL has been in Chile for over 35 years, and we have a wide history in this country. We have an important presence in the mining industry and, whether the market is up or down, we always make sure to have strong, experienced mining professionals.

JV: We currently have nine projects in Chile. Our only project directly related to mining is a dam that we are constructing in northern Chile. This is one of the largest copper projects in the country, and there have been several stages. We are currently in the eighth phase. The project began in November 2016, and we expect to finish it in two and a half years.

Which of OHL’s several divisions pertain to mining?

JV: We are reorganizing the company’s divisions and merging the industrial and construction divisions. We have synergies when it comes to mining projects because we are able to mix our capabilities with civil and industrial projects. The industrial division manufactures equipment, including conveyor belts, crushing plants, and others, and they are working on operations and maintenance with several projects in Chile. We are in the process of putting these divisions together, determining what the synergies are, and approaching Codelco and private mining companies to offer our services. It is a very positive development for us as we are transforming our service offering and making it more powerful.

How do construction companies compete for mining projects?

JV: Construction companies have always gone through the tender process in the public mining sector, but we have also moved to the private sector in recent years. In Chile, companies must comply with certain technical capabilities, financial requirements and safety standards. For each project, you have to pre-qualify with both the private and public sectors and then, if you qualify, you can participate in the tender.

RD: Chile is one of the main mining markets in the world and, as a result, it is very competitive and demanding. Companies that want to participate must meet the highest quality standards. Another point to consider is the environmental and social responsibility requirements, which also present very high standards. The environmental issue has only recently become a priority in the past decade, and environmental awareness has noticeably increased in the mining industry. As a result, companies have reconsidered their entire production chains. For example, OHL has focused on water recycling and carbon emission reduction.

As underground mining in Chile picks up, what additional services do you plan to offer?

RD: We can provide support in underground mine engineering, the construction of vertical shafts, and mine access, and we can do this with our own machinery. Our experience in tunneling in the civil segment allows us to contribute to the increase in underground mining efforts.

What are OHL’s main competitive advantages?

RD: In Chile, we have two main advantages. First, we have extensive market knowledge, worldwide experience, and the capacity to mobilize resources around. We also have our own crushing equipment, conveyor belts, and earthmoving equipment, so when entering a project, we design, build, and manufacture our own equipment, which is tailored specifically to each customer.

What are OHL’s goals over the next couple of years?

JV: The amount of mining activity in both Chile and Peru will increase, so our goal is to increase our market share in the industry. Also, through the merger of our industrial and construction divisions, we want our clients to understand our capabilities in both markets. Mining is a very important sector in Chile, and we believe OHL can contribute to clients directly as a partner, and not just as a contractor. —



Alejandro Buvinic

Director
PROCHILE

Can you please give us an overview of ProChile's role in mining?

ProChile is a government agency that has existed for more than 40 years, and we have been working with mining suppliers since the 1990s. Our goal is to promote suppliers and service companies abroad. We also train the companies that plan to operate abroad. International legalities can be very complex. Sometimes you need a permit, and sometimes you have to sign a joint venture with a local company. We also have to examine the tax system, particularly when there is a double taxation agreement.

What measures did ProChile take during the downturn to help suppliers survive?

With 6,000 mining suppliers in Chile, the downturn was a difficult problem to deal with. In the 1990s, Chile accounted for more than 17% of the global production of copper. By 2014 that percentage had gone up to 36%. The increase was due not just to the extraction of the mineral, but also to the development of the suppliers market. Chile has a large mining sector with significant projects and, as a result, our suppliers' businesses vary directly with the price of copper. When the price of copper decreases, mining suppliers suffer, particularly the small ones. Two years ago, we did a special report on exporting suppliers to miners. When commodity prices decreased, the suppliers had to look at other countries. This is where ProChile is most valuable. Every jurisdiction has different challenges. For example, in South Africa there is not just a language barrier, but also certain cultural differences. One company was training in South Africa and they kept running into issues with human resources. Occasionally we will take a Chilean company abroad, and other times that is not

allowed.

How are Chilean companies generally perceived abroad?

ProChile has been developing the industry for a long time, and we have found that Chile is a very reputable country abroad. People know that when they are doing business with a Chilean company they are not vulnerable to fraud or scams, which is very important to our reputation. Chile has been developing a very high standard of innovation and carrying out studies that can be applied across many different technical industries. This is particularly true for the mining sector since there has been so much investment into it. If a company has a contract with Codelco or any of the other major mining companies present in Chile, the standard is already very high. As a result of this, many service companies are highly certified.

Which countries are most of your member companies investing in?

Over 80% of our membership goes to other Latin American countries. 45% go to Peru, which has recently become very popular; 20% go to Brazil, and about 15% are split between Argentina and Mexico. Other popular markets include the United States, Canada, Australia, China, Spain, Germany, Hong Kong, Mozambique and South Africa.

What is your outlook on the industry over the next few years?

Chile is a resilient country. We are a country of problem-solvers and it is important for us to remain positive and optimistic. The next step is to advance our capacity, knowledge and experience around the world. That is ProChile's goal in supporting its suppliers and service companies. —

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Chile is a very reputable country abroad. People know that when they are doing business with a Chilean company they are not vulnerable to fraud or scams.

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Post-Downturn Transformations



“Industry 4.0, or connected automation, is a growing trend. In the next years, it will be much more common in Chile. Right now, most equipment has run on the same technology for the past 60 years. New mobile and stationary equipment will come with a combination of hydraulics, sensors and controllers, which will allow for better production results with a direct impact on cost-per-tonne.”

- Marcelo Celis, General Manager, Bosch Rexroth



“There is a lot of optimism as a result of the recent uptick in the copper price. However, there are other factors that play into our optimism for the future. We believe we will soon be seeing companies replacing their fleets of equipment, as even well-maintained equipment have limits and will eventually cost more to repair than to replace.”

- Juan Luis Simunovic, General Manager, Fluitek



“Although historically it has been a challenge for renewable technologies to compete against depreciated coal and gas power plants, companies have recently begun to recognize the true value of renewable energy sources, which goes beyond just price. Mining companies are beginning to recognize that they will have better relationships with local communities if they reduce their emissions. The transition from conventional to renewable energy is unstoppable.”

- José Ignacio Escobar, General Manager, Acciona Energy



“The nature of desalination plants in Chile has really changed. Ten years ago, mining companies would insist on owning the water production assets and operating them. After the downturn, they have realized that it is best for someone to sell them the water, much like how a power plant operates.”

- Richard Dixon, Chile Country Manager, Stantec



“Mining is a volatile market, but volatility is the new stability. In order to help companies configure themselves to adapt to this, it is necessary to create ecosystems among suppliers and develop more collaborative relationships.”

- Philip Hopwood, Global Mining Leader, Deloitte



“We recognize that water supply is increasingly important to mining operations. We developed new technology for filtering tailings, and now we are testing those new equipment changes in some plants in Chile. We will soon be able to release the results of these new filters, which will be an incredible benefit to the industry.”

- Roberto Montiglio, Director of Sales South America, FLSmidth Minerals



INNOVATION



“The mining industry has tended to gloss over the technical depth of all of the information that has become available. I believe there will come a point in the near-future where legislation will mandate maximizing value of an asset while minimizing the environmental impact. This will give way for more innovators to drive these initiatives forward.”

- Matthew Dorman,
Latin America Regional Director, Whittle Consulting

Innovation and the Future of Mining

Chile as a hotbed for technological development

Perhaps clouded by some of the challenges the country faces both internally and as a global player, Chile remains an exciting mining jurisdiction. If a silver lining could be drawn from the downturn in the price of copper, it would be that Chile has essentially been forced to become a global

nucleus for technological innovation and engineering expertise. As mining companies focus on cutting costs while maintaining their levels of production, engineers have been tasked with developing efficiencies and fabricating creative solutions. While this

is the case in mining jurisdictions around the world, Chilean mining engineers have a particularly high reputation and are considered on par with those in Canada and Australia. “The Chilean engineer is well recognized around the world in the mining industry,” explained Juan Pablo González Toledo, president of the Institute of Mining Engineers. “In general, the perception of Chilean engineers is very strong in mining and in other industries.”

The Rise of Autonomous Mining

Chile’s mining expertise and the industry’s call for creating efficiencies have coalesced into a perfect storm of innovation. There is a general consensus around the mining industry that autonomous mining is the most exciting of these innovations due to its positive financial, environmental and security implications. “One of the positive things about automation is that it is steady, which reduces variability and saves millions of dollars,” said Felipe Cabrera, general manager of Emerson Automation Solutions. “Automation also greatly reduces the risk of people working in the mines being injured.” Codelco’s Gabriela Mistral mine is thus far Chile’s most advanced mine in terms of automation, implementing autonomous haulage systems (AHS) supplied by Komatsu. Beginning in 2007, the mine’s automation was a response to a qualified

labor shortage throughout Chile. The mine can now be operated by lower-level workers, but without any apparent loss of productivity. “An example of this is SMART construction,” said Darko Louit Nevistic, executive vice president of Komatsu Cummins Chile. “This system is a combination of intelligent machines and operation planning methods that can significantly increase productivity in a construction operation. All of the more complex tasks of the operations are managed by the machine automatically.” While mining companies generally appear to be quite receptive to the idea of automated operations, labor unions are much more skeptical. Even if it is reasonable to conclude that autonomous mining will replace human workers with machines, this does not necessarily imply fewer jobs available in mining. On the contrary, many believe the new technology will, in fact, elicit new employment opportunities. As Pedro Damjanic, senior vice president of mining at Finning Chile, stated: “Some people are scared that autonomous mining will result in a loss of jobs, but what they forget is that it creates opportunities to open many other mines that are otherwise too expensive to pursue.” Accenture estimates that, from 2016 to 2025, autonomous operations will save the mining industry an aggregate US\$56 million, 395 million mt of carbon dioxide emissions, 10,000 injuries and 250 lives. There are a number of ways in which mi-

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LIEBHERR

Marcelo Anabalón

VP Latin America
NORMET



How has Normet's business evolved since the acquisition of Semmco?

Semmco started in Chile in 1993 as a spray concrete contractor equipment manufacturer. In 2008, when Normet took over Semmco, we had a 90% share in the concrete sprayers market between Mexico and Chile. Now as

Normet we have have offices in Mexico, Colombia, Brazil, and Peru, and sales agents in Guatemala and Argentina. Through acquisitions, we added new business lines, including construction chemicals and dynamic bolts for ground support. This gives us an end-to-end approach, and we are now the only supplier who can offer the equipment, support, and construction chemicals required for the spray concrete process.

How is the business going in Chile?

Despite the mining downturn, our business has been growing continuously. Our biggest projects are at Codelco's El Teniente and Chuquicamata underground development, and we currently have 110 employees in the country. Normet's most popular sprayers are the Alpha 20 and Alpha 30, and our most popular concrete transporters are the Tornado and Variomec. In the Chuquicamata underground project, we introduced our scaling machine, Scamec 2000S, and now Codelco pretty much incorporates a dedicated scaling machine for all new contracts.

What is your manufacturing capacity?

Normet has two factories, one in Finland and one in Chile, and they produce different

products. Chile's factory increased its capacity by 50% in 2016, and now we can produce 10 machines per month locally. Overall production tripled in 2017.

What is next in Normet's innovation pipeline?

Normet's R&D team has many ongoing innovation projects, including our first battery-powered machine. Over the last six years, we have also introduced simulators for spray concrete and scaling, to train operators correctly. Regarding automation, the explosive loading process is not yet mechanized in Chile. We are working with Chilean explosives companies to further develop this technology.

How does Normet mitigate the amount of wasted concrete?

The average amount of rebound in spray concrete application is around 30%, but it should be 10%. Through our training programs, we have been able to achieve an 8% to 10% rebound. Rebound depends on three main factors: operator quality, concrete quality, and compressed air availability.

Mitigating waste is a process. First, we assess the quality of the operators the customer has.

After that, we develop a training program, which takes three to six months. Then, we use the simulator to develop skills. A key aspect is to review the concrete mix design and make adjustments if needed. Finally, we assess the performance of the training program. There are also efficiency opportunities in other processes, such as explosive loading. It is still a challenge to control the precise number of explosives used for each blast, but we have the right equipment for the charging process, which puts exactly the correct amount of explosives into each drilling hole.

What are Normet's goals over the next several years?

Normet's main goal is to offer continuous improvement to our partners' processes for increased safety, productivity and profitability. In the Chilean mining market, we want to be more involved with Codelco's future projects. We know that we need to develop a wider use of the scaling machines. We also have a long way to go with the explosive machines in the mines. Normet's main advantage is that we are ready to support our customers throughout entire selected process, as opposed to just supplying machines or other products. —

How receptive has the Chilean mining industry been to automation?

At first, it took some visionary customers, like Codelco in Chile or Rio Tinto in Australia, to endorse the technology and push for its successful application. Many other players in the industry are evaluating this technology, but it has not been a priority for them so far. When you have several fleets running with good results for a long period of time, the industry generally accepts that this is a reliable technology; we are at that point right now. This results in a safer operation as it reduces the amount of people exposed to risks, but it also makes operating in remote, harsh locations easier. And this is becoming more relevant to the industry as new deposits are in increasingly remote locations, where reducing the operating footprint is critical.

What types of hybrid machines does Komatsu offer?

In Chile in particular, we have hybrid excavators operating in the forestry sector with good results in terms of fuel burn and emissions reductions. We also have an LHD loader with hybrid technology for hard rock underground operations. —

Dale Clayton

Managing Director
LIEBHERR



What role does Chile play in your global strategy?

Liebherr is a global company with over 130 individual companies. Liebherr Chile is very important, as it is a large mining country and has a good exposure to copper, lithium, and iron ore. We have put an emphasis on Australia, Indonesia, and South Africa for coal and iron ore, but we would also like to focus our business on Chile and Peru to get more commodity diversity. Liebherr has been in Chile since 2001. We have 44 trucks operating and 20 excavators. The trucks operating are T282B and C models, which are 363-tonne ultra-class trucks. We also have 996B 600-mt excavators and some smaller R9350 and R984C excavators. We currently have trucks at Radomiro Tomic, Chuquicamata and Collahuasi. We have excavators at Centinela, and contractors EPSA, ICV, and Excon operate some of our machines.

What steps is Liebherr taking toward innovation?

We have market-leading technologies. With our trucks and excavators, we have our Litronic management systems and use our own internal components and control systems. Through our sister companies, we build many of our own mechanical and electronic components that are specifically built for our equipment, as opposed to equipment produced by a third-party supplier. We feel that this really gives our equipment an advantage when it comes to fuel economy and performance, as we can control all the stages of machine development.

We also have a Global Mining Service Excellence Program. This is where we measure all Liebherr Mining companies to our defined standards and look for our global best practices. We believe this sets us apart from our competition, as it is not a dealership competing against dealership; it is the Liebherr company finding the global best practice in everything we do.

How important is training to Liebherr?

Personal development is key for any organization. For our technicians, we have a five-level training program that starts with our basic online courses that we developed for excavators and trucks. We also have classroom-based training, where many of the intermediate courses are held. Levels four and five are our technical specialists, and this training is completed in Chile or at our factories. There are three full-time trainers based in Chile, two for the mine services and one dedicated to the workshop. They train with the help of our T282C electrical simulator. Our factories also invest heavily in their training centers with full simulators, and we have factory-based technical experts available to train on our trucks, excavators, and components. We also believe that we need to develop our administrative, supervision, and management staff and have regular training sessions on our internal systems. Our supervisors and managers regularly attend internal and external seminars and workshops for planning and product support management, and we spend considerable time on management coaching. Finally, we also offer training for our clients, including operator and mechanical training.

Do you have any final remarks on what Liebherr Chile is looking forward to?

Liebherr realizes that South America is a large and extremely important market for our future. We like being in South America, and we see its great potential. Mining is cyclical, and prices go up and down. We have to journey through the bad times as best as we can while preparing for the future and eventual market recovery. We believe that all of the improvements we have made over the last four years will put us in a good position to capitalize and look forward to an exciting future. —

Darko Louit Nevistic

Executive VP
KOMATSU CUMMINS CHILE



What is Komatsu's presence in Chile?

In 1999, Komatsu and Cummins joined together to form KCC and, since then, the company has experienced significant growth both in market share and volume. We are the distributor for both Komatsu and Cummins in Chile, while we also have a rental

company with a fleet of over 600 machines, as well as remanufacturing and component repair shops. Overall, we have over 5,000 people across Chile, and the mining industry is our main market. Today, we have 20 mining contracts and we are present in most of the major mining sites. We have a very strong focus on training, considering that 70% of our workforce are technicians. A significant milestone for us has been our recent \$33 million investment in a new repair facility in Santiago.

How does the acquisition of Joy Global fit into Komatsu's overall strategy?

As a result of the Joy Global acquisition (now Komatsu Mining Corporation), we have an even wider range of equipment, including drills, rope shovels, large mining loaders, and a full line of underground equipment and conveyor systems. Komatsu's offer considered several products for mining, including hydraulic shovels, trucks, and a variety of earthmoving equipment. Joy Global, on the other hand, provided machines that Komatsu did not have. The possibility for synergy between the two companies is significant.

What steps has Komatsu taken toward automation?

Komatsu has been working for many years on automation, leading the development of autonomous haulage systems (AHS) for mining operations. We were pioneers in deploying autonomous trucks and, today, we have fleets running in Chile, Australia and Canada. Here in Chile, we have operated an AHS at Codelco's Gabriela Mistral mine since 2007.

Likewise, Komatsu has made great advancements in the application of operator assistance methods for construction machinery. An example of this is SMART Construction, which allows for complex machinery to be operated by people without intensive training or accumulated experience. This addresses the shortage of qualified labor, while improving productivity and quality. Finally, we are also working on ways to remove people from harm's way, via remote operation. We believe that a combination of automated and remotely operated equipment will provide the industry with a safer and more productive environment in the future.

Alberto Belmar



General Manager
FAST PACK

What is Fast Pack's positioning in the market?

We are leaders in the manufacturing, supplying, and distribution of integrated solutions to conduct fluids. We customize our solutions for each customer, and we have specialized in spools in special alloys, including piping, valves, coatings, and other services. We focus on participating throughout our customers' value chains and achieving operational continuity to keep every

piece functioning. Fast Pack is one of the few companies that has all of our services integrated, which helps our customers save significant costs while also assuring our products are held to a high standard. 52% of our business is in the mining industry.

What sets Fast Pack apart, in your opinion?

Fast Pack's main competitive advantage is its longevity in the mining industry (20 years). We also deliver products very quickly to reduce operational downtime. The fact that we are an integrated company means we can react quickly. We also have a flexible product portfolio that adjusts to our customers' needs, depending on the processes that are used. In 2017, we created a new section in our factory dedicated to the HDPE coating process.

What efforts is Fast Pack making to internationalize?

Because we prioritize quality over expansion, we are focused on bringing our Peru office up to full strength first. We also have representation in China to have a strategic

alliance with Chinese suppliers. The mining industry recently went through a tough time due to the downturn, and our clients are focused on minimizing costs. Our Chinese presence has become relevant because the materials are high-quality, and the prices are very competitive.

What are Fast Pack's main goals in Chile over the next few years?

We continue to optimize our own operations, improving productivity and incorporating automation. We believe that every day presents an opportunity to improve. For example, we recently introduced an upgrade in our current Smartsheet resource that increases traceability and project control, an online manufacturing cost system, new valves lines, and an internal calendar service. We will soon be incorporating machines to do shot blasting, which will be automated so that we can keep the same good quality but with increased efficiency. We expect the mining industry to pick up its pace, and we are investing in new products for that reason. —

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ning inherently involves a considerable level of risk and limiting human involvement in the more dangerous aspects of the mining process mitigates this concern. "In Chile, the explosive loading process is not yet mechanized," said Marcelo Anabalón, vice-president Latin America of Normet. "We are working with Chilean explosives companies to further develop this technology."

Autonomous mining addresses the fact that thousands of workers can be living on a mine site at one time, which is costly in terms of both accommodations and employee morale. Remote operations is an increasing popular technological focal point, as it would allow employees to telecommute to a mine from a control center at the company's headquarters. ABB, for example, has already developed this technology and uses it to monitor their operations at their clients' mine sites, as opposed to sending their employees back and forth. According to Jorge Abraham Canales, ABB's industry lead for mining: "The opportunity to work on mines remotely is going to be the next big demand trend, and that is something ABB is pushing for."

The use of data has also become more prevalent in the mining industry. Each rock in a mine and each machine part have various data points associated with them, resulting in a nearly incalculable quantity of data at any given mine site. Some equipment companies have begun to leverage data analytics to develop predictive capabilities that optimize production processes or limit operational downtime, which could potentially cost a mining company thousands of dollars for every hour a machine is down. "Data analytics, in particular, can help predict when a company may run out of supplies or when a machine will

need maintenance," said Esteban Rodríguez, executive director of natural resources at Accenture. "It is also now possible to simulate a business' production or predict how certain factors could increase or reduce production."

New Energy Sources

Mining operations and developments in northern Chile have long regarded high energy costs as one of the major detriments of operating in the country. In

2012, Consejo Minero predicted Chile to have the second-worst energy costs in the world, after the Democratic Republic of the Congo, from 2014 to 2020. Since then, however, the Chilean government has taken steps toward reducing the prices of electricity supply tenders and promoting renewable energy operations, resulting in a 34% decrease in the average marginal energy cost from 2013 to 2015.

The increased presence of renewable energy in the mining industry would be a significant step toward a further reduction in both cost and carbon emissions. "The key

Ramón Opazo



CEO
ANTIRION

What is Antirion's business?

Antirion provides risk management services through a web-based software platform. It deals mainly with the strategic and operational risk management of safety, occupational health, and environment. This translates into healthy workers returning to their homes and a more protected environment. Our company started as a consulting service and then transformed into a software company. We have 12 large mining clients and

at least 300 contractors who serve these mining clients. Almost 90% of our company is dedicated to the mining industry. We chose to work in mining because it is the most advanced industry in risk management in Chile and much of the world. We consider mining to be part of the DNA of Chile, and miners are constantly looking to improve in risk prevention.

How does your software specifically mitigate risk?

The software is a management tool that serves managers, supervisors, workers, and health and safety professionals. A supervisor, for example, must be in charge of hundreds of safety points, so it is important to see how the controls are administered and have regular verifications. The software helps supervisors stay focused on critical hazards, which are monitored by accurate performance indicators. In most cases, it would be impossible to manage such controls without the help of software like ours. In essence, Antirion is an information manager that helps people make better preventive decisions.

What explains your success in the mining industry?

We are a profitable and debt-free company from the first day we entered the market. We were not affected by the fall in commodity prices because our software is very affordable, and also because risk management is not something that companies can stop attending to from one day to the next. Also, being profitable gives one some freedom to innovate.

Do you think the use of data technology is going to be more prevalent in the future?

We believe cloud technologies are here to stay. When we entered the cloud in 2010, virtually no one in Chile used it. Today, more people understand the cloud and customers are requesting more services. We have had to hire more people to expand our capacity and to keep up with the pace of development demanded by the mining industry, which is certainly moving forward technologically, including in the mobile application space. —



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Image courtesy of Liebherr

Looking Forward

As the state of the mining industry has repeatedly flashed its hazard lights over the past several years, mining companies across the world have no choice but to consider the future. In the coming years, Chile will be an interesting investment destination for mining companies, service providers, and perhaps even technology companies that previously had little to do with mining. Whether it is a response to companies cutting costs or environmental challenges, Chile and its talented pool of engineers are prepared to lead the charge toward more efficient mining practices as commodity markets are poised to rebound. —

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the prefeasibility engineering for the Complex Concentrates and Leaching Project (PLCC), which was completed a year later. The project eliminates arsenic from copper concentrates and dispose it

as a stable residue for Codelco's North District," said Iván Valenzuela, general manager of Ecometales. "The US\$324 million project will have a capacity of 200,000 mt/y of concentrates."

Minera Valle Central operation has been in production since 1992 and produced 57 million pounds of copper in 2016. In addition to receiving new tailings from Codelco in exchange for a US\$0.50/lb royalty, Amerigo is also expanding its operations to a historical El Teniente tailings deposit called Cauquenes, which was in use from 1937 to 1977.

Once the expansion is completed, the company's operation will have a production capacity of 90 million pounds per year at a cost between US\$1.40 to US\$1.60 per pound. As Rob Henderson, Amerigo's president and CEO, stated: "Minera Valle Central uses hydraulic extraction with high-pressure water to extract the tailings. The tailings at Cauquenes are very fine and have a granularity somewhere between powder and sand. The high-pressure water converts the solid tailings into a slurry of about 50% water and 50% solids, which are then pumped to our processing plant." Codelco has also taken its own innovative approach to copper recovery by stabilizing the arsenic in flue dust. Ecometales, a subsidiary of Codelco, has operations at the Chuquicamata and Ventanas smelters that are geared toward processing waste. This methodology is both economical and environmentally beneficial, as it removes arsenic from waste piles without emitting any toxic chemicals into the atmosphere. "In November 2013, we began developing

issue with mining companies was that they wanted to know if renewables could provide power 24 hours per day, seven days per week, and we have proven that renewables can do so," said Bart Doyle, general manager of Mainstream Renewable Power. Mainstream Renewable Power operates Cuel, a 33 MW wind project in Chile, and its joint venture, Aela Energía, began construction on two additional Chile-based wind projects that are due to begin operations in the second half of 2018.

Acciona Energy also hopes to one day provide renewable energy to the mining sector. Currently, the company operates the El Romero solar project, 30% of which is dedicated to supplying Google Chile. According to José Ignacio Escobar, general manager of Acciona Energy: "We are fairly confident that the renewable energy sector will be able to compete with the more conventional offerings. Some mining companies are now mandated to reduce their carbon emissions, so they have become more open to the renewable approach."

As the industry continues to search for efficiencies and ways to reduce costs, it is logical to conclude that mining operators would be receptive to alternative energy sources. Minera Tres Valles, for example, is working with the KDM Group, which generates nearly 100% of its energy through biomass. According to Luis Vega, general manager of Minera Tres Valles: "We are also looking into implementing solar energy in the future, but this is still in the conceptual stage. Renewable energy helps reduce both our impact on the local communities and our cost margins."

Alternative Production Methods

One smaller-scale producer, Vancouver-based Amerigo Resources, has innovated a way to produce copper solely from the tailings of El Teniente. Amerigo's

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Jorge Abraham

Industry Lead for Mining
ABB

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Robotics bring challenges, including union issues and people fearing losing jobs. ABB knows that mining is an industry that needs to be led by humans, but robotics has the potential to be a significant part of the safety aspect of mining. It will also allow people to work on mines remotely.

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Could you please give us a brief introduction to ABB?

ABB Chile first moved into the mining sector in 1996, and now mining represents about 60% of the company's business. We hope to have about 70% of the business in the mining sector by the end of 2018.

Could you talk about your robotics program as it relates to the mining sector?

In general, ABB has an advanced robotics program, and we have been promoting robotics in the mining sector for nearly ten years. There are some challenges in trying to implement robotics in mining, including union issues and people fearing losing jobs to robots. ABB knows that mining is an industry that needs to be led by humans, but we also believe that robotics has the potential to be a significant part of the safety aspect of mining. It will also allow people to work on mines remotely, and this is going to be the next big demand trend; ABB is pushing for it. In general, mining companies are aware that robotic technologies are going to be a part of the future of the industry.

What insights do you have about the availability of qualified laborers and engineers?

Chile has many high-quality engineers. Mine laborers receive a lot of training on-site; however, onsite training is different from learning at a university. I think education is very important, which is why we have a training center called ABB University. The program started out in a small room 15 years ago, but today it has a two-year

wait list. The program provides standard and specialty training to prepare people to be competitive.

What is ABB's competitive advantage?

ABB has very advanced technology, but our biggest advantage is our people. Our team truly believes in the company, and that opens many possibilities. ABB is very open to receiving suggestions and insight from the employees, which helps them feel as being part of the big picture. Another advantage is the onsite customer training we provide. When our customers know how to use the equipment correctly, they can get the most out of the product. Our customers are often very far away and need to solve issues on their own sometimes. Because of the onsite training program, they know what to do. The program also limits the need for us to send our engineers to fix equipment on-site.

What is your outlook on the mining industry in Chile?

Today's copper price today is good. The problem is not with the price, but with the production cost. ABB creates efficiencies for companies, and we believe that technology is the key to cutting down on production costs and reducing risk. Chile needs to be more open to new technology, and if even just one company takes a step toward the idea of new technology, many more will follow. Technology is going to be a significant part of the mining industry here in Chile, and ABB is looking forward to supporting mining companies as they incorporate new technology into their business. —



Bart Doyle

General Manager
MAINSTREAM RENEWABLE
POWER CHILE

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In the past, most mines were using renewables simply to be a green story. Mining companies wanted to know if renewables could provide power 24 hours per day, seven days per week, and we have proven that renewables can do so.

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How has the renewable energy landscape evolved over the past several years?

From 2008 to 2012, there was a very small market for renewable power, and the larger consumers did not really consider renewable energy as a serious option. That changed in 2014 with the first public distribution tender where renewables won a large portion. Since then, there has been a boom in renewable energy. Today, 13% of energy in Chile is provided by renewables, including 7% solar and 6% wind. It is phenomenal to go from nearly 2% to 13% in just two years. The next big jump is to have 25% of Chile's power provided by new renewables (excluding hydro) and I think that will likely happen within the next two to three years.

What are Mainstream's biggest projects right now?

The Cuel project, a 33 MW wind project, began operating in January 2014. Through Aela Energía, a joint venture by Mainstream (40%) and Actis (a U.K. fund, 60%), we won 300 MW of wind power in the October 2015 tender for Mainstream projects Aurora (170 MW) and Sarco (130 MW), now under construction. Finally, in the CNE distribution tender held in July 2016 Mainstream won 3,300 GWh of PPAs to be supplied by close to 1,000 MW of wind projects. Mainstream owns 100% of these PPAs and projects.

How receptive will Chile's mining industry be to moving toward renewables?

In the past, when renewables were at the same price as fossil fuels, most mines were using renewables simply to be a green story. Mining companies wanted to know if renewables could provide power 24 hours per day, seven days per week, and we have proven that renewables can do so.

What is the threshold, in terms of price per Mwh, for a wind or solar farm now, and what do you think it will be in the future?

The average PPA price in the last bid was US\$50 per Mwh. Mainstream won with an average price of \$US42/Mwh. One reason we were able to bid less since the tender in 2015 is because there has been a change

with the transmission cost. It used to be paid by the generator, but now it is paid by the customer. Starting in 2019, that is nearly a US\$9 swing in our favor. In addition to this, having different projects from Arica to Puerto Montt enables us to cover some of the trading risk, and having a 1,000-MW turbine order means we can obtain better deals on turbine prices at scale, as well.

From a foreign investment perspective, how do these prices compare to other countries?

The prices here compare quite favorably to other countries. Chile had been an extremely expensive place to buy power for many years because of lack of competition. In the next couple of years, we may see Chile jump ahead of other countries. The sector has yet to understand the impact of storage, and in Chile it is probably four or five years away. Distributed generation is something that should be big in Chile due to the excellent solar resource, but has not had a significant impact yet.

Could you elaborate on Mainstream's social responsibility program?

Historically, Chilean infrastructure projects have not been good at community engagement, including the mining sector. This has left a negative legacy between big businesses and local communities. Since Mainstream has been in Chile, we have invested in in-house community liaisons, who work with both indigenous and non-indigenous communities. Communities have a lot more power than they used to, and they are exercising that power. They want to be involved before projects are designed so they can influence how they are developed. In terms of jobs, the renewables sector is much larger now, and there are many more people working within the sector.

What is Mainstream's long-term vision in Chile?

I do not think new conventional plants are going to be built in Chile for at least the next five years. If these storage and distribution generations come into play at scale, then we may not see any new conventional plants built ever again in Chile. All future demand will be met by renewables. —

George Cariz



General Manager
DYNONOBEL

What is Dyno Nobel's presence in Chile?

Dyno Nobel is the second largest explosives company in the world. In 2009, Dyno Nobel became the first manufacturer of electronic detonators in Latin America, and we did this in Chile. Before that, they were imported from France, Canada and South Africa. Nowadays, Dyno Nobel has a plant in La Serena, where we manufacture non-electric and electronic detonators, and our goal is to introduce more products to the market.

How does Dyno Nobel leverage innovation?

Dyno Nobel is constantly trying to improve and innovate. One of our divisions is Dyno Consult, which specializes in software and terrain analysis. We have access to technicians who travel to Chile to help us decide where exactly to use certain explosives. Our engineers are constantly training to use our products and software and determining how to best use the data we have.

Dyno Nobel invented dynamite, the wick, the powder and the detonator, so we have always been at the forefront of technology. The company has about 200 years' worth of development, and we are leading the United States' explosives market. That is why we consider ourselves able to compete in the Chilean mining market.

What are the major pain points in the blasting sector?

In Chile there are two providers, Orica and Enaex, capturing about 85% of the market. It

is a duopoly, and it is very difficult for new companies to enter the business. Participating in a bid, for example, requires significant investment. When the price of copper was high, companies were used to operating without considering cost, so after the bidding process, typically only Orica and Enaex were left to win the contracts. It would be a good idea to split the bids into raw materials on one side and services on the other. Doing this will give more opportunities to companies that have world-class technology to enter the market, generating more competition.

What does Dyno Nobel do to assuage environmental concerns?

One of Dyno Nobel's top priorities is to ensure that our products are environmentally friendly. One of the biggest problems in the oil sector, for example, is that when the wells are loaded, some do not detonate, and the product stays in the land. To combat this, we have made our products biodegradable. —

Ricardo Estay



General Manager
EXSA CHILE

What is Exsa's plan for the Chilean market?

Exsa is in a phase of regional expansion, starting with Chile and very soon other countries within Latin America. Our market entry plan consists of three pillars, the first being the introduction of our differentiating technology, Quantex. The second pillar is generating productive platforms to be competitive from a logistics standpoint. The third is direct and personalized customer re-

lations to reduce their operational costs. We are starting the construction of our first production base in northern Chile, and we expect the plant to become operational in Q1 2018. Exsa has also invested US\$50 million in a plant in Peru for automated manufacturing of initiation systems.

What are the advantages of Quantex?

The Chilean industry has become extremely competitive. After the decline of copper prices, customers became more eager of finding technological alternatives to reduce costs. Quantex is a patented technology that offers more energy, less consumption of explosives, and increased versatility when working with different types of rock. Therefore, it performs better than any traditional blasting solution. It is based on fertilizer grade ammonium nitrate, which is more favorable than porous ammonium nitrate in terms of prices. Quantex is also more environmentally friendly, since it eliminates any toxic red fumes normally produced by blasts with traditional explosive mixes and at the same time has a lower carbon footprint. This technology gives us a clear com-

petitive edge, and it will make an important difference in the Chilean market.

What role does data play in your operations?

Data analytics is essential. In our case, the trick is to have the devices and systems in place to capture and process the data of every blast in real-time so that we can compare the real results with our models or the previously made diagnosis of the mining operation. Based on that, we can not only recommend improvements to our customers, but we can also customize any blasting solution to increase efficiency and reduce costs.

What are Exsa Chile's goals looking forward?

We have an ambitious but realistic goal to become an important player in the Chilean market. We are working to capture a relevant market share within the next five years, and we are very satisfied with the consistent and systematic support we have received from our Peruvian headquarters. We have a long-term business view, and we are in Chile to stay. —

Game-Changing Innovations



"Tenova is executing the design and supply of the main material handling system for Chuquicamata Underground, which is a US\$200 million project. This main conveyance system will be the largest in the world by far. We are using state-of-the-art technology that has never been implemented. Each conveyor we use is 20 MW, and the belt we are using could pull seven Boeing 747 aircrafts."

- Cristian Cavagnaro, General Manager, Tenova TAKRAF



"Rockwell Automation has a Distributed Control System solution called PlantPAX, which is part of our connected mine concept, where all of the information in a mine is available everywhere in real-time through a flexible, scalable, and easily maintainable platform."

- José Antonio Beas, Latin America Mining Industry Manager, Rockwell Automation



"Volvo has experience in direct mining operations in Europe involving fully electric and automated vehicles used to transport materials. We already have trucks being sold in Chile that involve the first stages of automation. These trucks can manage themselves, learn routes, and increase efficiency by consistently running the same route."

- José Olimpio, Managing Director, Volvo Group



"We have innovated a booster that is made entirely of non-explosive ingredients that cannot explode until mixed and detonated, which will have a significant impact on safety in mining operations. The sources of TNT are now very limited around the world, and this innovation is the answer to a future world without TNT."

- Alois Kwenda, General Manager, AEL Mining Services



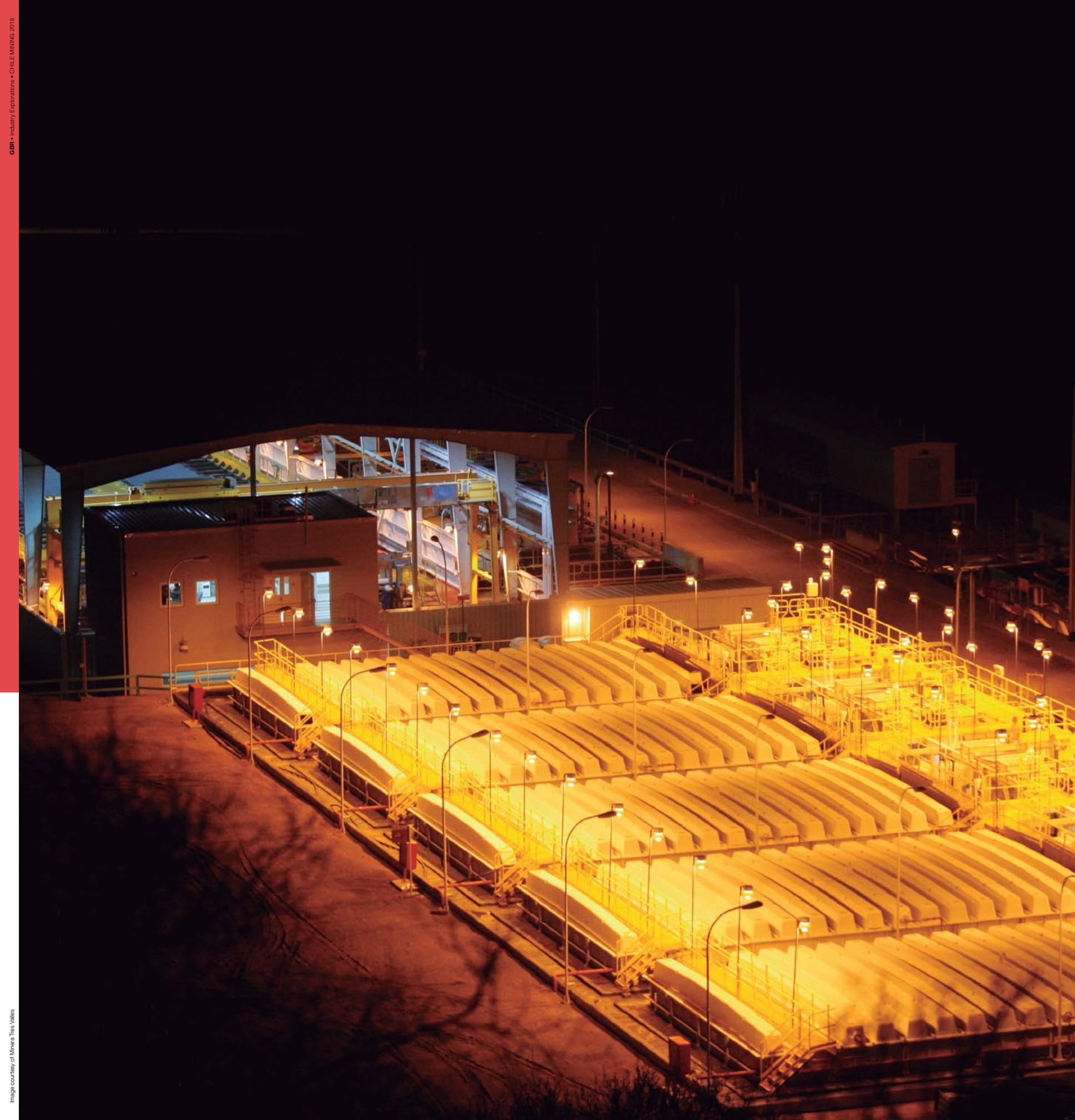
"Some people are scared that autonomous mining will result in a loss of jobs, but what they forget is that it creates opportunities to open many other mines that are otherwise too expensive to pursue. We are working very closely with clients and with Caterpillar to develop this technology and introduce it to the Chilean market."

- Pedro Damjanic, Senior VP Mining, Finning Chile



"Austin Engineering customizes each design client-by-client. We look at things like the density of the material, the angle of repose of the material, the angles of the ramps the trucks must climb, and many other aspects that define what the most suitable solution would be."

- Tim Mitchell, VP Business Development South America, Austin Engineering



CONCLUSION



“We were told repeatedly that 2014 was a bad time to enter the mining sector in Chile because of the copper price, but we actually came to realize it was a good opportunity, as many mining companies were looking for alternatives at this time.”

- Daisuke Otaki,
General Manager, Zamine

The Strength of the Leader

The world's copper powerhouse is not set to lose its dominant position soon

As commodity prices continue to recover, so will Chile's mining industry. The combination of expected infrastructure projects in the United States, China and India, and the world's transition from fossil fuels to electric vehicles and lithium ion batteries indicates that Chile's natural resources will play a more critical role than ever. Both the public and private sectors are confident Chile will remain an important player in the global mining industry, particularly in the event of a commodity deficit.

Mining is a cyclical business. Commodity prices over the past decade have become increasingly volatile and, as great as the mining boom was for most companies involved, the past few years were equally painful. Going forward, it is imperative for companies to examine the mistakes that were made at the onset of the downturn in order to avoid them when the next one inevitably comes. In the opinion of Nelson Pizarro, CEO of Codelco: "During the mining boom, mining companies produced the maximum possible amount of copper due to the high price. This triggered an excess demand of engineering and construction services for new mines, and the cost for critical supplies for the mining activities increased dramatically during that period."

Sustainability will be an important weapon in the fight against volatility, and cost-conscious productivity is a key element of a sustainable business model. Perhaps another boom would not be ideal for the health of the mining industry. According to Gonzalo Fanjul, director of corporate finance at Asset Chile: "When the copper price was up to US\$4 per pound, the average cost to produce was nearly US\$3 per pound. Mining companies are hoping for the price to recover slowly. They want a long-term, sustainable copper price. A stable and healthy industry is much better than the alternative."

As we look toward the future, the most comforting sense of optimism comes from the companies who have been in Chile through its highs and lows. Chile is indeed a proven mining jurisdiction, but the country's long-term players believe it could be much more. According to María Eugenia Parot, general manager of Golder Associates: "Chile has the opportunity to become global leaders in developing a mining industry that is innovative in the way it solves key challenges related to productivity, water, and community relationships." —

Final Thoughts



"Chile feels like a whole new country, and it seems the next generation agrees. Chile has the capacity to realize great achievements in the future, but we need projects and goals in order to have a clearer vision. We are facing a new cycle of development, and clean electricity and energy efficiency will be very important."

- Andrés Castro, General Manager,
Alumini Engineering



"The Strategic Investment Fund was launched in 2015 with the aim to stimulate productivity and growth and fill in specific gaps in the economy. Our mining roadmap's main goal is to have at least 250 providers who export a combined total of \$4 billion. We also aim to reduce the cost of production, while increasing copper production from 5 million to 7 million mt annually."

- Thierry de Saint Pierre, Executive Director,
Strategic Investment Fund, Chilean Ministry of Economy



"Underground mining is very relevant in Chile, but it is a young area. We are starting to work on innovation and development services to increase productivity for underground mining, such as hydraulic transport, new automatic control systems, and robotization."

- Iván Rayo, General Manager,
JRI Ingeniería



"We foresee about 60% of the mining process eventually being completed by artificial intelligence. Since most of the technology is already available, not much money needs to be invested. The only thing that needs to change is how the mining industry thinks. Right now is the best opportunity for the mining industry to take advantage of new technology."

- Esteban Rodríguez, Executive Director of Natural Resources,
Accenture



"Chile has a stable, transparent economy with low levels of corruption. We also have good infrastructure, including ports and roads in remote areas, and a significant number of high-level mining professionals. Knowing that we need to improve some things, we are confident that Chile is a very attractive country because of its experience and clear rules."

- Juan Francisco Bustos, Head of Mining Investment Office,
Chilean Ministry of Mining



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