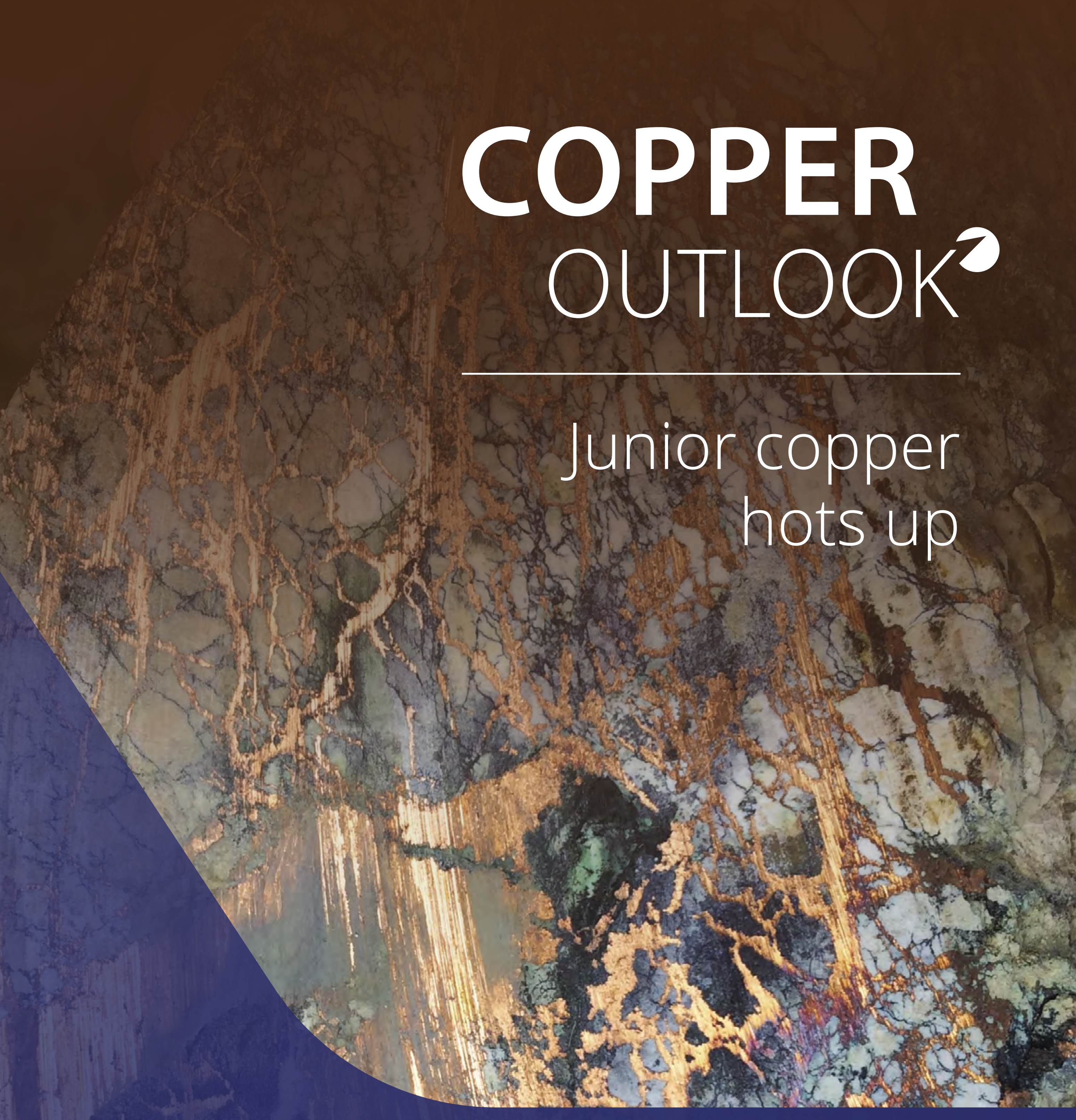

COPPER OUTLOOK

Junior copper hots up

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Mining Journal

In association with: McEWEN COPPER

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www.aspermont.com

Published by Aspermont Media, 1 Poultry, London, EC2R 8EJ, UK.
Printed by Stephens & George Magazines, Merthyr Tydfil, UK.
Subscription records are maintained at Aspermont Media Ltd, 21 Southampton Row, London, WC1B 5HA

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Copper booms on high prices

As the metal commonly viewed as most essential to the energy transition, it has been unsurprising to see investor interest in copper soar in recent years.

The time it takes to bring new copper mines online combined with a strong demand outlook means most market observers expect a significant supply shortfall in the medium to long term: Wood Mackenzie forecasts a gap of 5 million tonnes by 2030.

Some are even more bullish; investment bank Jefferies points to recent production misses by some of the world's largest copper miners as evidence they will under-deliver in future. The bank also believes the long-awaited tsunami of supply could fail to materialise.

"We expect copper production misses combined with rising demand to lead to higher prices," said Jefferies.

Such market conditions have proven irresistible for a host of junior copper miners, many of which have been busy dusting down assets that were unviable at sub US$3/lb copper. This report focuses on copper projects in the Americas and Australia, where the lion's share of the world's new projects are to be found.

Our Americas editor Paul Harris takes a deep dive first into the list of juniors with development-stage assets, then attempts to filter through the increasingly long list of companies at the exploration stage. What emerges is a story of declining grades and absence of new discoveries.

This is perhaps explained by the proportion of expenditure going into exploration: S&P Global Market Intelligence noted allocations to grassroots exploration for base metals hit an all-time low of 24% in 2020 while minesite allocations hit an all-time high of 41%.

"Buoyant market conditions have proven irresistible for a host of copper juniors"

Mining Journal, Paul Harris

The new wave of Americas-focused copper developers

Juniors with development stage copper projects can expect to see a very exciting 2022 given the dearth of red metals projects in the pipeline and a market forecast to enter into a prolonged supply shortage.

Late 2021 saw a taster of what is to come when two copper deals closed: Lundin Mining offered C$625 million and a 29% premium for Josemaria Resources in Argentina; and Capstone Mining announced a C$4.2 billion merger with Mantos Copper in Chile. In 2021, investors also proved ready to hit the launch button on junior copper stocks that hit long intersections of decent grade, as Filo Mining (C$4 to C$12) and Solaris Resources (C$6 to $16) found. Large deposits are increasingly rare. The data shows juniors held just 10 projects with more than 10 billion pounds of contained copper-equivalent resources.Junior-held projects can be cut by four if you consider: that Yamana Gold is a major miner of gold, not copper; Lundin Mining's acquisition of Josemaria Resources; that SolGold counts both BHP and Newcrest as shareholders; and, that Trilogy Metals is in a joint venture with South32.

Filo Mining will almost certainly reach that 10 billion pounds-in-the-ground threshold at Filo del Sol and Regulus Resources has a chance to do so at Antakori if drilling at Anta Norte is successful. In terms of grade, only 10 have copper-equivalent grades of 0.5% or above, although this article purposefully does not include volcanic-massive-sulphide deposits, which tend to be high grade.

Cutting the data this way shows less major influence, with only SolGold in this group, suggesting that major miners may prioritise volume over grade so they can bring to bear the full benefit of economies of scale on what are likely to be multi-decade production assets. In addition to the positive macro trends, the past year or two has seen disruptions in the political and country risk outlook in the Americas, with projects in four districts - San Juan, Arizona, British Columbia and Ecuador - appearing increasingly attractive.

San Juan

Investors are rapidly warming to Argentina as an investment destination due to an increase in the perceived political friction in Chile and Peru, but also on the back of several

Company	Project	Resources CuEq Blb	CuEQ Grade
Yamana	MARA	38.3	**0.49**
SolGold	Alpala	31.4	**0.52**
Western	Casino	25.8	**0.3**
Los Andes	Vizcachitas	19.5	**0.43**
Ngex	Los Helados	17.6	**0.48**
Josemaria	Josemaria	15.7	**0.37**
Aldebaran	Altar	15.2	**0.5**
Copper fox	Schaft Creek	11.6	**0.3**
Trilogy Metals	Arctic	10.9	**4.57**
McEwen	Los Azules	10.2	**0.48**
Filo	Los Filos	8.3	**0.63**
Regulus	AnkaKori	7.9	**0.7**
World Copper	Escalones	3.45	**0.367**
Hot Chili	Productora	2.5	**0.52**
Surge	Ootsa	2.2	**0.44**
Northwest	Kwanika	2.0	**0.41**
Hot Chili	Cortadera	2.0	**0.49**
Solaris	Warintza	1.9	**0.7**
Arizona Sonoran	Cactus	1.6	**0.35**
Cordoba	Alacran	1.6	**0.64**
QC Copper	Opemiska	1.2	**0.88**
Marimaca	Marimaca	0.93	**0.6**
Copper Fox	Van Dyke	0.7	**0.33**
Northwest	Stardust	0.4	**2.0**

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Source: Company reports, MJ estimates. Please note, older resources may be global resources while more recent ones will be in-pit resources. There may also be differences in the copper equivalent calculation between companies and over time. Please email corrections.

transactions in the lithium space. In addition to the above factors, the country has the ability to provide metals for the energy transition. San Juan, in particular, is showing the potential to become an emerging hub for copper development. With the Argentina desperate for hard currency, the national and provincial governments are supporting sector growth with fiscal changes such as reducing export taxes.

A clear indicator of this intention should appear in the coming months when Josemaria Resources expects to complete the negotiation of a fiscal agreement for its Josemaria deposit.

"It's to do with a political shift and their desire to get mining going to make it a bigger part of their economy. The advancement of projects in the lithium sector, with big companies coming in to take over projects, is giving more comfort to foreign investors that the government is laying-out the welcome mat," McEwen Mining chair and chief owner Rob McEwen told Mining Journal. San Juan is becoming the hottest copper-exploration district in the world for juniors. The province is anticipating its biggest drilling season ever as Filo Mining, McEwen Copper, Josemaria Resources, Aldebaran Resources, Libero Copper and others advance.

Some 500,000m of drilling, using around 60 rigs, is planned in the San Juan this year, so getting drillers, drill rods and other inputs is now proving to be a challenge, according to companies there.

With five large copper-gold projects in San Juan, a service cluster might start to emerge with several companies

Continued on page 9

Solaris advances 'world-class' Warintza copper project

Solaris is targeting a 1 billion tonne resource at the Ecuadorian site.

Solaris Resources is close to showing the world-class credentials of its Warintza project in southeastern Ecuador, thanks to the completion of an updated mineral resource estimate for the Warintza Central deposit at the end of this quarter.

Exploration at Warintza has caught the market's attention due to discoveries at Warintza West, Warintza East and recently at Warintza South, in addition to long intercepts of mineralisation at Warintza Central, such as 1,067m grading 0.60% copper equivalent. And president and CEO Daniel Earle is keen to underpin the uniqueness of Warintza Central as the company is targeting a billion-tonne resource to cement its place within the top rank of undeveloped copper projects in the hands of a junior.

"The drilling for the forthcoming resource update is complete, with final assays being returned, and we expect to have a high-grade starter pit to really drive robust cash flows in the early years, capital payback, and a high internal rate of return," Earle said.

Adding to the project's world-class credentials is the existing nearby infrastructure, including a national highway that connects to Pacific ports, a hydroelectric power line for low-cost and clean grid power, abundant freshwater, low elevation and available labour.

Earle also includes a positive regulatory environment within this, which under the administration of President Guillermo Lasso, is becoming one of the most attractive jurisdictions in the hemisphere.

"The Lasso administration is continuing to streamline and improve the permitting and regulatory environment, as well as the fiscal regime that applies to the mining sector. We think this will make this project one of the most attractive acquisition opportunities on the board as we enter a new M&A cycle for copper, which has kicked off in the last few quarters," Earle said.

"While the Warintza Central deposit will underpin the valuation of Solaris in the near term, Earle thinks additional drilling will highlight huge growth potential beyond Central over the long term.

"We could take that inventory at Central and demonstrate to industry the potential to double or triple it with nearby discoveries. Last year, we made a discovery at Warintza West with the first ever hole drilled there, and we made a discovery with the first ever holes at Warintza East," Earle said. "This year, we just announced our fourth discovery at Warintza South, a target with two to three times the volume of Warintza Central. All these targets were defined by high conductivity, geophysical anomalies and coincident copper and molybdenum geochemical anomalies based on historical sampling – this is the low hanging fruit.

"Among these, South is a much larger target, with two to three times the volume of Central, and then the next target in line, Yawi, is twice the size of that." Once the Warintza Central resource update is published, the next task is to show its world-class potential by studying the preliminary economics. To that end, Solaris has already started the work to complete a preliminary economic assessment (PEA), such as metallurgical testing, geotechnical work and environmental work.

"The resource is the key input because from that you build your mine plan and have your pit shape for site layout, infrastructure studies and so on. All that work is all well underway," Earle said. Solaris also has a lot of drilling to follow-up and expand on the recent discoveries made at West and East, and potentially at Warintza South once initial results come back.

Solaris also has a lot of drilling to follow-up and expand on the recent discoveries made at West, East and South. However, with Warintza Central dominating the company's valuation, and likely to do so going forward, the Solaris management team is keen for shareholders to also obtain value from the other exploration assets held in Ecuador, Peru, Chile and Mexico, which it obtained through the original property package put together by legendary geologist David Lowell. While the mechanics have yet to be determined, the idea is to spin these assets out into a new company called Solaris Exploration, whose shares are likely to be distributed to Solaris Resources shareholders.

"We see tremendous value in these assets and we want to make sure we preserve that value for our shareholders down the line beyond the immediate opportunity we've been working on with Warintza. We think there's more value than we can reasonably expect to service in the market and in any kind of transaction for the company," Earle said.

"We have a market capitalisation of about C$1.4 billion today and the valuations the sell side analysts apply to the updated resource at Warintza Central range between C$3 billion to over C$4 billion at a long-term copper price of US$3.50 per pound.

"You can see how much value is still to be realised in the market for Warintza Central before you begin to approach fair value.

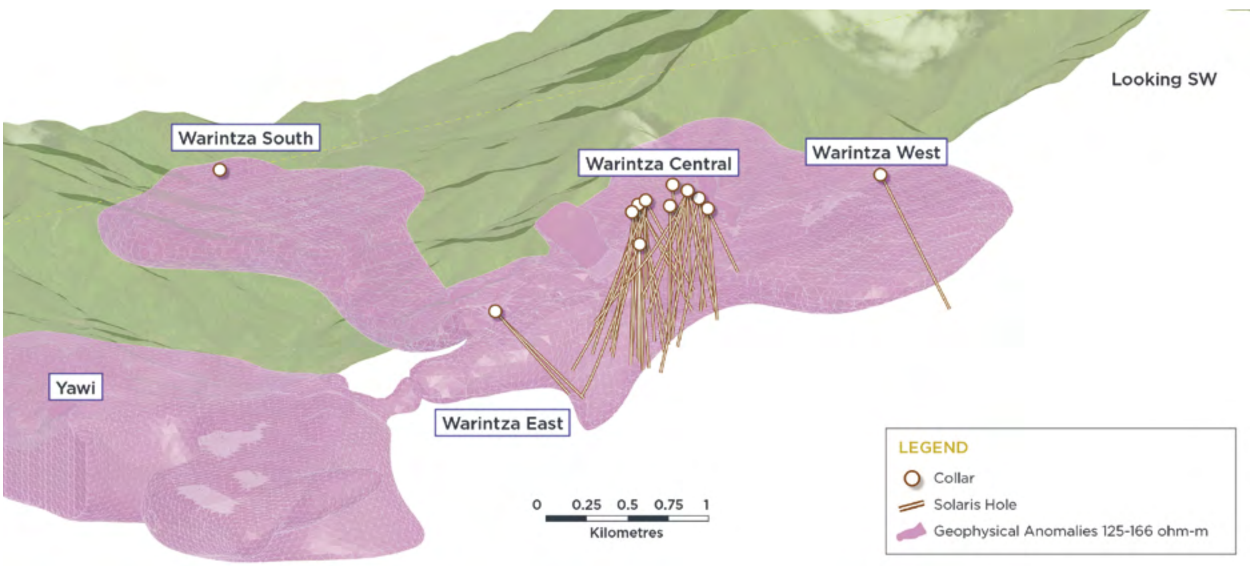
"This also doesn't provide any credit to the discoveries already made and future discovery potential of adjacent targets within the 7km-x-5km cluster of outcropping porphyries at Warintza.

"There is more work that needs to be done behind the scenes – in terms of the reorganisation of the company, its subsidiaries and the concessions themselves – before we're able to put a timeline and specifics to the spin out, and assess funding needs."

Creating Solaris Exploration is also a prudent step in the face of the possibility of the Warintza Central resource generating interest on the corporate front, such as a strategic partner or joint-venture interest – as well as an outright takeover.

"We try to be an open book with industry players, but it's not just about value. If you think about what the longer-term potential is for our shareholders, it's the larger opportunity within the land package we have in Ecuador," Earle said.

"Some portion of [of the land package] will end up in the spin out company, but there is also the greater potential in the rest of the Warintza belt."



"Ecuador is a very immature jurisdiction from an exploration standpoint and we think there are many world-class discoveries that are going to be made in the coming decade and beyond. "We certainly want to be there to participate in that and bring our shareholders along for that benefit.

"Warintza has the potential to deliver a massive win for Ecuador, in terms of establishing its credentials as a premier jurisdiction for new mining investment, particularly in copper. We want to make sure we do the best possible job, not just in respect of value, but within a broader set of values that are important to all our stakeholders and the country itself."

Solaris (and Ecuador) are poised to win big given the emerging copper cycle in which forecast supply deficits are increasing with each iteration.

"Those deficits are growing as both a function of demand and the forecast supply. On the demand side, we've seen an incredible outperformance of the push towards decarbonisation to realise global climate goals," Earle said.

"There has been greater consumer adoption of electric vehicles than anyone has forecast. These trends are well-understood by investors, but are proceeding at a much more rapid pace. However, on the supply side, you've got a continued unwillingness of the sector to make the capital investments it really needs to make in order to have a hope of delivering the copper supply that's going to be required for this growth profile over the coming decade. There's still a collective hangover from the last boom, with investors demanding capital discipline as a consequence of overspending in the last cycle. That now leaves the pipeline looking very bare as we start the next bull cycle."

Country risk uncertainty is adding to the challenge of the copper sector to supply enough metal, due in part to political upheavals and community unrest in Chile and Peru – the world's number one and two producers, respectively.

"This has the impact of pushing out supply that was built into the models and bringing forward the supply deficits that have been forecast. The cycle has evolved more favourably from a pure price outlook perspective than anyone would have been forecasting a couple years ago," Earle said. And while various jurisdictions are increasing their government take – including Panama, Chile, Peru, the US and Zambia – Ecuador has bucked the trend with the government trying to kickstart and accelerate the build out of a major mining sector.

"This requires billions of dollars of investment and to encourage this they're going to continue making regulatory reforms to facilitate and expedite it, and improve the fiscal environment to make the country as attractive as possible for international investors," Earle said.


Dan Earle, President & CEO

As an example of this, in August 2021, President Lasso signed Decree 151 to improve investment protections. The decree included: a 5% reduction on income tax for all new investments under new agreements; exemption from the currency outflow/remittance tax for the import of goods needed for new investment; an exemption of all import duties and taxes for the import of goods needed for new investment; international arbitration for investments exceeding $1 million; and, a tax stability regime for mineral exploitation investments.

"This is really significant, concrete action to deliver on the administration's message to industry that Ecuador is welcoming large-scale mining development in the country, with all the attendant benefits to the country's finances, economy, tax base, employment and labour development, infrastructure and so on," Earle said.

Solaris – at a glance

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Email: info@solarisresources.com
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Directors
Richard Warke (chair), Daniel Earle, Greg Smith, Ron Walsh & Donald Taylor

Market Capitalisation
US1.23 billion

Quoted Shares on Issue
108.16 million

Major Shareholders
Equinox Gold, Richard Warke, Lukas Lundin, Ross Beaty

Continued from page 4

investing in training to develop the human resources and skills they need.

"The recognition at the provincial and national levels that mining can be an important part of the economy is huge," John Black, CEO of Aldebaran Resources told Mining Journal.

"As we enter the phase where we're going to see the major mining companies cashed up and motivated to acquire new projects, a lot of them will look pretty hard at Argentina. But, it takes the legislative and investment environment for companies to have the confidence to come and we're seeing that emerge in San Juan."

Grabbing headlines in late 2021, the Lundin Group is working to corner the Vicuña district. Three juniors from the company's stable are active there and they are joined by the eponymously-named copper producer Lundin Mining.

Lundin Mining's Candelaria mine is on the western extreme of the Vicuña district - NGex Mineral's Los Helados and Filo Mining's Los Filos are between the mine and Josemaria.

"The recognition at the provincial and national levels that mining can be an important part of the economy is huge."
— John Black, CEO of Aldebaran Resources

Filo and Josemaria were spawned from NGex, and if Lundin's M&A activity in the regioncontinues, the whole district could ultimately roll-up into Lundin Mining.

Josemaria is a porphyry copper-gold system about 1,500m-by-1,000m, and 600m to 700m vertically, within a larger alteration footprint of up to 4km-by-2km. It is expected to produce 130,000tpa copper, 225,000oz/y gold and 1Moz/y silver over a 19-year open-pit mine life.

Photo: Unsplash.com

"We needed to put a couple of holes on either side of [hole 41] north, south, east and west to try and understand the extent of that high-grade zone."
— Jamie Beck, President & CEO of Filo Mining

Filo del Sol has a 4.5km strike, runs at least 1.5km east-west and 1.5km to depth. An indicated resource of 425.1Mt grading 0.33% copper, 0.32g/t gold and 10.7g/t silver will be updated soon. It also has a January 2019 pre-feasibility study (PFS) that outlined annual production of 67,000t copper, 159,000oz gold and 8.6Moz silver for 14 years following a $1.27 billion initial capital cost.

In 2021 a high-grade feeder zone with an intercept of 858m grading 1.8% copper equivalent in hole 41 was discovered. This propelled the company's share price from C$4 to C$12 and significant resource growth is expected. In January, Filo returned another impressive hit of 64m grading 1,214g/t silver, 0.49g/t gold and 0.01% copper, or about 15.7g/t gold equivalent.

"We needed to put a couple of holes on either side of [hole 41] north, south, east and west to try and understand the extent of that high-grade zone. That is what the first few holes of the year were targeting with 50m step-outs. Hole 54, drilled to a depth of 1,370m is particularly anticipated," Filo Mining president and CEO Jamie Beck said.

Filo will also expand drilling with a focus on a 1 cu km area, where it sees grades upwards of 0.7% copper equivalent, and the tightening of the drill spacing to build a better geological model. In addition, 25-30% of the metres this season will be "swinging for the fences" on exploration targets on the property.

In the southwestern corner of San Juan, McEwen Mining is aiming for an IPO of its Los Azules deposit via McEwen Copper later this year. Los Azules has been something of an orphan in McEwen Mining's portfolio of predominantly gold projects, but with the copper price rising to over $4/lb it has become a very attractive asset.

Exploring and developing a porphyry copper deposit is expensive, which is why McEwen put it into McEwen Copper - in which it will initially retain 68% ownership and a 1.25% net smelter return royalty.

McEwen Copper will raise the funding it needs without stressing the parent company's balance sheet or detracting from its ability to invest in its gold development projects in Nevada and Ontario. Rob McEwen invested $40 million of his own money to launch McEwen Copper in 2021 and aims to close another $20-30 million soon.

"McEwen Mining didn't have the treasury to fund the advancement of the project. We felt there was some confusion in the market as we have gold and silver production and then this giant copper deposit that's going to consume a lot of capital," McEwen said.

McEwen Copper is ramping-up towards 10 drills by mid-February to execute a 53,000m programme.

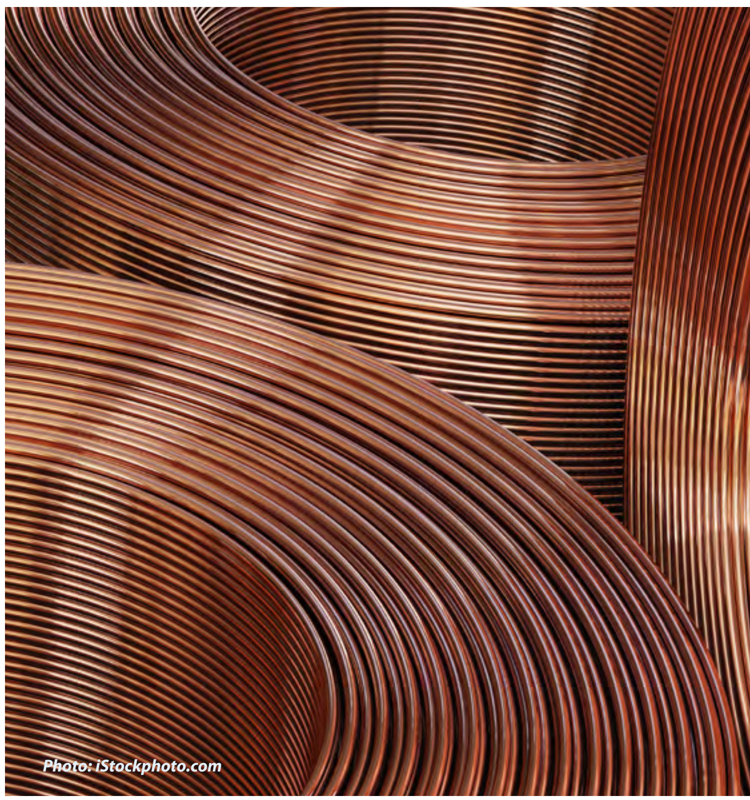


Photo: iStockphoto.com

"About 44,000m of that will be for upgrading the inferred resources to an indicated resource and about 9,000m for technical drilling, including geotechnical and hydrology," COO Peter Mah said.

Los Azules currently has a resource of 32.9Blbs copper equivalent (29.5Blb copper, 5.5Moz gold, 191Moz silver and molybdenum). In the September quarter, the company intends to publish an updated PEA. Once a northern access route has been completed to provide year-round access, McEwen will continue into a PFS.

Whittle Consulting believes the potential is greater than the 2017 PEA, which outlined average production of 415Mlb copper for the first 10 years and a 36-year mine following an initial capital cost of $2.63 billion.

"We are working on the updated PEA to reflect the work Whittle has done and the drilling we will have completed by mid-year. There's a chance Los Azules could be in the top-20 development projects in the world when built," said McEwen.

Also set to come out of the shade is Aldebaran Resources' Altair porphyry deposit, managed by the Antares Resources team that sold Haquira in Peru to First Quantum Minerals during the last copper cycle. At around the same time, Altar changed hands from junior Peregrine Metals to Stillwater Mining for $487 million.

Altar hosts a measured and indicated resource of 1.2Bt grading 0.43% copper, 0.09g/t gold and 1g/t silver, which does not include the Radio deposit, which has returned intercepts of 111m grading 1.4% copper equivalent within 333m grading 0.86%.

"Altar was never a good fit within Stillwater and the project stalled. They continued to invest in the project but it didn't move anywhere," said Black.

"Our group specialises in identifying large copper deposits that have the potential to be larger, or of interest to a major mining company. When we identified this mismatch, we approached Stillwater to see if we could acquire the project.

"It didn't work until Sibanye acquired Stillwater and determined Altair was a non-core asset, and we struck a deal to acquire up to an 80% interest at a fraction of the cost of the investment already put in. We see potential for it to be an even larger deposit and with some higher-grade zones which could be economically attractive starter pits."

Aldebaran has spent about two years working to understand Altar better, and recently began its first drilling programme. This will add to the 100,000m of drilling in the Central and East bodies. However, the key target is the Radio zone farther west, where there is insufficient drilling to define a resource.

"With the work we did to better understand the district, we're in a position to drill these new zones we identify, as well as the main known zones that are still open for expansion," said Black.

The company has cut in a new road that will extend the exploration season, with Aldebaran looking to drill 25,000m, subject to additional funding.

Black and his team are looking to repeat the success they had with Antares and the sale of Haquira.

"We've learned that what's important is demonstrating it can become a mine and all the de-risking associated with it:

Continued on page 15

McEwen ready to spin out Los Azules to copper-hungry market

The camp at McEwen's Los Azules

The Argentinian project is one the largest resources that is not owned by a major miner

McEwen Mining is planning to undertake an initial public offering of McEwen Copper and the Los Azules copper project, in San Juan, Argentina, later this year after completing an updated preliminary economic assessment (PEA), additional resource drilling and the construction of a road to provide year-round access. Los Azules porphyry copper-gold deposit is one of the world's largest undeveloped copper projects not owned by a major mining company. The project currently has a total resource of 32.9 billion pounds copper equivalent (29.5Blb copper, 5.5 million ounces gold and 191Moz silver).

Investors are warming to Argentina as an investment destination on the back of several significant transactions in the lithium space, as well as in the copper space. The country is showing the ability to provide metals for the energy transition, and San Juan province has the potential to become a hub for copper development through the advancement of projects such as Los Azules.

"There is a long history of mining in San Juan. Majors active in the province include Barrick Gold, Shandong Gold, Glencore, Fortescue Metals and the Lundin Mining group of companies," said McEwen Mining chair and chief owner Rob McEwen. "And we are aware that Anglo American and Vale have been looking at development opportunities in the province.

"Factors driving this interest are: one, the abrupt political shift to the left in Chile and Peru; two, the undeveloped geological potential of Argentina; three, the improved prices of metals; and four, the large foreign investments being made to develop Argentina's Lithium resources.

"All of these factors are giving greater comfort to foreign investors and the government is laying-out the welcome mat."

Los Azules has been something of an orphan in McEwen Mining's portfolio of predominantly gold projects, particularly through the bear market years where advancing it towards development seemed like a pipe dream. But with the copper price rising from a low of about US$2 per pound two years ago, to over $4 per pound today, and a supply deficit forecast, a deposit like Los Azules has become a very attractive asset and one that merits the investment to advance towards a production decision. Exploring and developing a porphyry copper deposit is an expensive business, which is why McEwen Mining is putting the asset into a new vehicle, McEwen Copper.

The parent company will initially retain 68% ownership McEwen Copper and a 1.25% net smelter return royalty, post the current US$80 million private placement. McEwen Copper will also hold the Elder Creek exploration property in Nevada, US.

The new company will thus be able to raise the funding it needs without stressing the balance sheet of the parent company or detracting from its ability to invest in its gold development projects around Gold Bar in Nevada, US, or the Fox complex near Timmins in Ontario, Canada. Rob McEwen had already invested US$165 million in McEwen Mining when he poured in another US$40 million of his own money to launch McEwen Copper in 2021. He aims to close on another $20 million-$30 million in the near future to provide its initial funds. The minimum investment is a quarter of a million dollars.

"The rationale for creating McEwen Copper is all about surfacing value for McEwen Mining and having a copper specific company that can raise funds to advance the development of Los Azules," McEwen said.

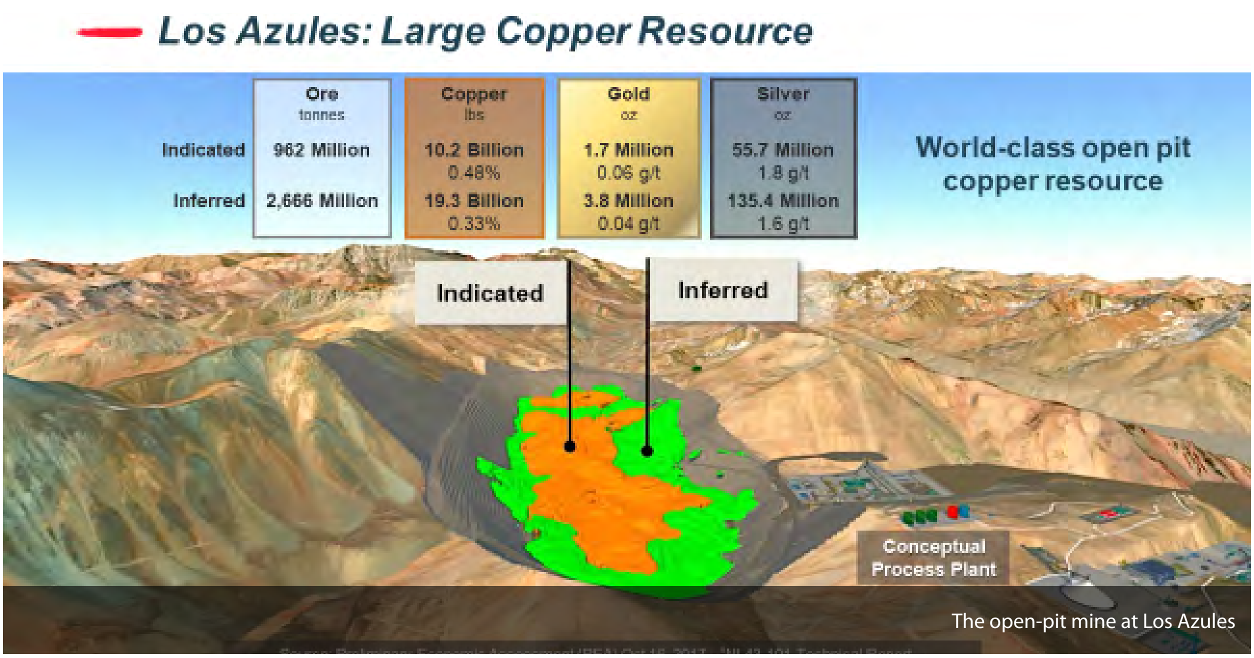
"Investors appear to have a preference for pure plays, such as a copper company or a precious metal company, but not a combination of the two. Especially when it's a small precious metal producer with a big copper project to fund, such as McEwen Mining."

Companies with large copper porphyry deposits tends to be valued at cents on the pounds of copper in the ground,

> "We expect that by the time we have completed the PFS (pre-feasibility study), the value of Los Azules should have increased to somewhere north of 3-5c/lb, based on the past sales of large copper projects."
> — Rob McEwen,
> Chairman and Chief Owner

which may not sound much, but given the billions of pounds of resource, those cents can quickly add up to some impressive figures.

With its initial funding round, management estimates the company has a valuation of around 0.6c/lb, and with the



The open-pit mine at Los Azules

derisking work to advance the project, it has a path to considerably raising that within the next couple of years.

"We expect that by the time we have completed the PFS (pre-feasibility study), the value of Los Azules should have increased to somewhere north of 3-5c/lb, based on the past sales of large copper projects," McEwen said. "Our current valuation of 0.6c/lb gives the project a value of $175 million; at 3c/lb, it would have a value of just under $1 billion and at 5c/lb, a value of over $1.6 billion. This represents a large increase in value for shareholders of both McEwen Copper and McEwen Mining.

"We see a potential upside of 4-6 times within three years. Furthermore, when you look at the sales of 12 large copper properties between 2010 to 2018, there may be considerably more upside given that of the 12 sales, there were only two projects at a PFS stage and those sold for over 13c/lb and 15c/lb.

"We have had several majors take a close look and express an interest in acquiring Los Azules. However, we believe it is much too early to sell, because the steps that we are taking should improve the project's value significantly and the outlook for copper is strong."

Since launching McEwen Copper, the company has been building its technical team and consultants to take the project forward – first, to complete an updated PEA and to construct a northern access route to provide year-round access. The updated PEA should be completed later this year in the fourth quarter. It will incorporate an optimised mine design. The next step after the PEA will be to advance to complete a PFS. The 2017 PEA outlined average production of 415m lb of copper for the first 10 years at an average C1 cash cost of $1.28/lb and an overall 36-year mine following an initial capital cost of $2.63 billion using price assumptions of $3/lb copper, $1,300/oz gold and $17/oz silver.

"While the Los Azules PEA projected a robust economics return at $3/lb copper. We brought in Whittle Consulting to look at optimising the mine plan. Their preliminary work suggests an even larger, more profitable mine may be possible at $3/lb. Under this scenario, there's a chance that Los Azules, when built, could become one of 20-largest copper mines in the world," McEwen said. "I want to emphasize that we are not planning to just have a large mine. We are committed and very excited to be designing a mine that will be the model for mines going forward when it comes to the usage of water, power,


Rob McEwen, Chairman and Chief Owner

the emission of carbon and reduced impact on the environment."

The company currently has two drills on site and is ramping-up towards 10 drills by mid-February. McEwen plans to execute a 53,000m programme.

"About 44,000m of that will be for upgrading the inferred resources to an indicated resource and about 9,000m for technical drilling, including geotechnical and hydrology," chief operating officer Peter Mah said.

McEwen Mining – at a glance

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Directors
Rob McEwen, Allen Ambrose, Michele Ashby, Richard Brissenden, Robin Dunbar, William Shaver, Michael Stein and Dr Donald Quick

Market Capitalisation
US$418 million

Quoted Shares on Issue
459 million

Major Shareholders
Rob McEwen, 18%; Van Eck Associates, 5%; State Street Corp, 3%

Continued from page 11

your social programmes to secure a social licence, demonstrating the metallurgy is good, what the costs are and where best to start," said Black.

"It's not simply a lot of copper tonnes. It's much more than that. We're in the process of demonstrating the higher-grade zones we think will improve project economics.We could apply a PEA now, but we want to make sure we know where the best parts are before we do that."

Libero Copper also plans 5,000m of drilling at its Esperanza project, in San Juan, where previous drilling showed a highlight of 387m grading 0.57% copper and 0.27g/t gold for 0.78% copper equivalent.

Further north, in December 2020, Yamana Gold completed the integration of the Agua Rica deposit, in Catamarca, with the 115,000tpd Alumbrera plant and infrastructure in what is now called MARA.

Agua Rica hosts reserves of about 11.8 billion pounds of copper and 7.4Moz gold, with silver and molybdenum in about 252,000tpa copper equivalent over the first 10 years

There appears to be high-grade ore beneath the existing pit design, which Yamana - which holds a controlling 56.25% interest (Glencore has 25% and Newmont 18.75%) - will seek to capture as it starts exploration drilling in that area in 2022 while it further optimises the project with the feasibility in progress. Yamana's executive chair Peter Marrone said the creation of MARA makes great business sense as well as being firmly rooted in the ESG zeitgeist.

"The starting point of any value creation is to take a footprint and reduce the scale of it. That is good from an ESG perspective, but also from an economic perspective," Marrone said.

"Across all measures, integration was the right thing to do as it reduced capex and the amount of risk, given that risk is mostly on the plant. [This] means Agua Rica will produce the same amount of copper, gold and molybdenum as other projects whose capex is double."

With a feasibility due before year's end, the company is working to button-down the metallurgy and see if recoveries can be inched upwards. Yamana plans to install a 36km-long conventional conveyor to move ore from Agua Rica to the Alumbrera plant, and is looking at electrification aspects to reduce its carbon footprint.

"The integration already significantly decreased the carbon footprint as there will be just one plant, not two. Alumbrera has an exhausted open pit that can be used for tailings storage and has eight years left in its tailings storage facility, which we can use," said Marrone.

MARA may also be able to benefit from some $220 million that was established by the Alumbrera partners for closure and reclamation, which given MARA's 28-year life is not going to happen anytime soon.

"Once the Mara permit is granted and development is in progress, my expectation is that those funds would be available for use on the development of the project as the closure obligations would be significantly reduced," said Marrone.

Arizona

For those for whom political and country risk in Latin America is still too hot, Arizona looks like it will vie with San Juan for development dollars. Rio Tinto and Hudbay have development-stage projects in the state, with juniors New World Resources, Copper Fox Metals and Arizona Sonoran Copper looking to get in on the action.

Arizona Sonoran Copper aims to the bring Cactus deposit into production in short order under George Ogilvie as

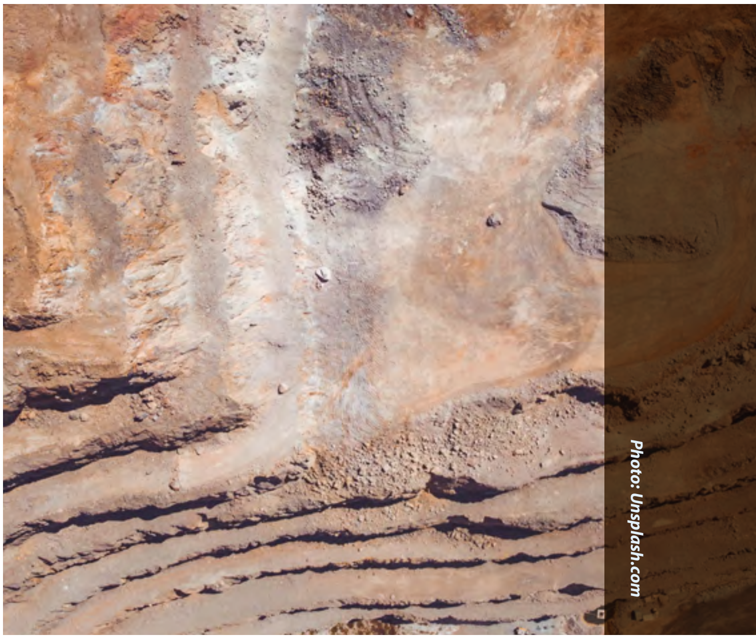

Photo: Unsplash.com

president and CEO. The recent TSX-V debutant is starting with an indicated resource of 1.6Blb of copper and recent drill results of 80.9m grading 1.43% copper. Cactus has a PEA for an 18-year mine life and a $124 million capex.

The project already has some key permits in place, including one to take water for the next 50 years at a rate of 3,700-acre feet per year, far above its maximum annual consumption of 1,200-acre feet. The project is on private land, which means only state and local municipal authorities are needed for permitting. Cactus will be a heap leach, SXEW mining operation, which in the next two and a half years will produce an average annual 28,000 short tons.

The current resource is over 3.5Blb, of which 2.5Blb is leachable material - principally oxide and supergene. Exploration upside comes via the Park Salyer target, which it plans to drill while progressing through PFS and feasibility this year.

"We've got a PFS and a feasibility study we'd like to get out with the aim of maintaining the robust returns and economics we're currently showing within our PEA," Arizona Sonoran Copper CEO George Ogilvie said. "Another key milestone will be the award of additional permits and we would anticipate that by the end of the calendar year, we should have those in hand, which ties-in nicely with the feasibility and project financing, so we can start breaking ground early in 2023."

Also in Arizona, Copper Fox Metals has the Van Dyke in-situ recovery (ISR) project, which has an indicated resource of 97.6Mt grading 0.33% copper to produce 29,000tpa of copper for 17 years, following an initial capital cost of $290 million. Arizona hosts two other ISR projects: Taseko Mine's Florence, and Excelsior Mining's Gunnison.

Copper Fox said the pre-application phase for the underground injection control permit and aquifer protection permit is estimated to take up to three years and would be followed by a two-year permitting process.

BC

The third junior cluster is in British Colombia, Canada, which has seen considerable M&A activity in the past year or so in copper and gold, with higher copper prices setting the scene for this to continue.

"Everybody's dismissed BC copper because they say BC porphyries are always the 0.3% copper, 0.3g/t gold kind of

Photo: Unsplash.com

porphyry, and people lift their noses up," Walter Coles, president and CEO of gold developer Skeena Resources, said.

"I wouldn't be surprised if copper goes to $10/lb, and in that case 0.3% BC porphyries are going to make a lot of money."

Juniors lining-up in British Colombia include Copper Fox Metals, Kutcho Copper, Northwest Copper and Surge Copper. Also in this corner of the world are Western Copper and Gold (Yukon) and Trilogy Metals (Alaska).

Surge Copper continues to expand its Ootsa porphyry project in the Huckleberry district, where a mill owned by Imperial Metals is on care and maintenance.

Drilling at the Seel breccia zone returned highlights of 46m grading 1.7% copper equivalent and 422m grading 0.5% copper equivalent in late 2021. Ootsa has a resource of 224Mt grading 0.44% copper equivalent across three deposits. In 2021, in partnership with Imperial, commissioned one of the world's largest Z-TEM geophysical surveys.

"The big value proposition for a district like this is the fact that you have a lot of infrastructure in place and its already well understood. … There is a mill at Huckleberry without a huge remaining reserve life means, so its future is to be determined," Surge CEO Leif Nielsen said.

"Surge did a study in 2016 that put detail and economics around what a combination of some of our ore bodies and that mill could look like, although we think it understated the overall size of the opportunity.

"We have to figure out how all the pieces could possibly fit together and a big part of that is drilling, improving resources and seeing what's out there."

While other major porphyry districts may have higher grade than BC, the province has advantages that level the playing field and might swing the pendulum of investor favour in its direction.

"We are in a world where, not too far into the future, companies and investors will not just be talking about carbon footprints, but actively pricing these things in. Deposits in BC are intrinsically well positioned for that future in terms of the energy efficiency of operations compared to the high Andes, where water is an issue and you need to build desalination plants and pump water 1,000s of metres up in elevation," Nielsen said.

"Those energy expenditure aspects of the projects are not a requirement in British Columbia. Furthermore, the power you are able to access, to the extent you can connect to the grid, is 98% hydro, so it's very decarbonised already. When you take those factors into consideration, 0.45% copper grades in BC could be equivalent to 0.55% or higher in other jurisdictions where there's more challenging costs."

Northwest Copper has the adjacent Kwanika and Stardust deposits, which is one of the highest-grade copper deposits in BC - it has five times the average reserve grade of current copper mines in the province. Recent drilling at Kwanika returned 235.45m grading 2% copper with some precious metals for a 2.92% copper equivalent, and 9.4m grading 33.6% copper equivalent, in one of the best holes ever drilled in the province.

The company was created through a merger in 2021 of Sun metals and Serengeti to join the deposits. This potentially allows for a high-grade start-up project of about 8Mt grading 2% copper equivalent at Stardust, and then later

Continued on page 21

Ero Copper touts green focus and shareholder returns

MCSA employee holding a sample with high-grade copper content from the Vermelhos underground mine

After a record year in 2021, red-metal producer plans to double output in the next 5 years

In a relatively short time, Ero Copper has emerged as a returns-oriented, eco-friendly Brazilian copper producer with a funded growth trajectory to firmly establish itself as a mid-tier company.

Ero posted record copper production in 2021 from its Mineração Caraíba SA (MCSA) complex in Bahia, Brazil, of 45,111 tonne of copper in concentrate, which surpassed guidance. The MCSA complex comprises the Pilar and Vermelhos underground mines, the Surubim open pit and a conventional flotation mill, producing a clean copper concentrate.

The rapid advance of Ero Copper stems from company founders, executive chair Christopher Dunn and CEO David Strang, who formed the company in May 2016, and who between them have extensive experience in structuring, financing and transacting copper companies.

Dunn has 25 years' experience in the investment-banking industry, including stints with Goldman Sachs, Bear Stearns and JP Morgan where he led their respective investment banking practices in mining and metals. Strang has a long history in the copper space, which includes successfully growing and selling several companies. Prior to Ero, Strang served as president and CEO of Lumina Copper, which was sold to First Quantum Minerals in 2014. Before then, he spent time at Global Copper (sold to Teck Resources in 2008), Regalito Copper (sold to Pan Pacific in 2006) and Northern Peru Copper (sold to China Minmetals and Jiangxi Copper in 2008).

At the start of the year, Ero showed how it is rapidly maturing by publishing its first ever five-year production guidance, in which it said red metal output will increase incrementally in 2022 to 43,000 to 46,000t at MCSA before more than doubling to a range of 92,000 to 102,000t as Boa Esperança comes online.

"We are executing on a very exciting and compelling growth strategy, and felt that the time was right to share the details around how we plan to become a 100,000t a year copper producer," said Ero Copper president and CEO David Strang.

"We have grown tremendously since our IPO in 2017, when we produced just 20,000t of copper. In the last four years, we more than doubled our copper production to over 45,500t in 2021, and are now showing the pathway to doubling copper production once again."

The company's confidence in its guidance is rooted in its exploration success, which enabled it to report a 13% increase in its proven and probable reserves at MCSA to

607,100t of contained copper hosted in 59.3Mt grading 1.02% copper, with a 56% increase within the Deepening Extension zone of the Pilar mine to 194,200t of contained copper hosted in 11Mt grading 1.76% copper.

Despite the copper price being at an historically high US$4.50/lb, that increase was through the drill bit as the company maintained its reserve price of $2.75/lb in its recently published update.

"We continue to take a conservative approach with our resource estimates and cut-off grades. It's a controversial topic in the mining industry; many people believe that as metal prices increase, you should adjust your cut-off grade in lockstep. We don't aspire to that thinking. Our view is that you originally went to build a mine using the cut-off grade at that particular time, so as metal prices go up, excess returns should be returned to shareholders," said Strang.

Strang highlighted the continued expansion of the Deepening Extension Zone at MCSA which continued to exceed the company's expectations with year-on-year growth in the high-grade superpod through ongoing drilling since 2018. "These results support our decision in 2021 to undertake a redesign of the new external shaft. While the larger design requires a greater upfront investment, it will now allow us to effectively operate two separate mines from one deposit and ultimately increase overall production volumes from the Pilar Mine," said Strang.

"We are executing on a very exciting and compelling growth strategy"
— David Strang, President and CEO

Boa Esperança

Ero is not content to just grow production at MCSA and has its eyes set on being a multi-asset producer. The next phase

Aerial view of the Caraíba processing facilities at the MCSA mining complex of its growth will be the construction of Boa Esperança, an IOCG-type deposit in Pará, which is expected to produce, on average, 27,000t per year of copper for 12 years, with construction due to start in April of this year.

Boa Esperança was originally owned by Chile's state copper company Codelco, and after acquiring the project, Ero geologists saw possibilities that hadn't been recognised before and that allowed the company to model the deposit with enhanced selectivity, producing a reserve highlighting a better overall project.

Geological work included the identification of a gap in mineralised continuity within the open pit that hadn't previously been drilled.

"It was clear to us that it was a zone that was essentially joining the two high-grade zones between surface and depth, and based on the initial drill results we've seen so far, it appears that our intuition was correct," said Strang.

The company recently launched a US$400 million offering of 6.5% senior notes due in 2030 to provide funds for the development of Boa Esperança, as well as pay down some existing debt.

"With the recent completion of our senior notes offering, we have all of the pieces in place to aggressively execute on our plans to double copper production and continue generating industry-leading returns on invested capital.

Four years from now, we expect to be a very different company in terms of our size and profitability," said Strang.

NX Gold

Ero Copper is far from being a one-metal company as it also owns the NX Gold Mine in Mato Grosso, which produced 37,798 ounces of gold in 2021, providing a natural commodity hedge to the company's copper production.

NX was a bonus for Ero, an operation acquired with the acquisition of the copper assets with no reserves at the time of the transaction. This has been a considerable boon for the company as exploration by Ero has increased the mine life to six years with every indication that it will continue to grow.

In 2021, Ero increased the reserves at NX Gold by 25% to 306,800oz of contained gold hosted in 1.1Mt grading 8.64g/t.

Once Boa Esperança is underway, the sky may be the limit for Ero. With Dunn and Strang adept at transacting, the company could leverage its stock and cash flow to acquire other assets around its existing operations and perhaps even further afield in Latin America, where Strang has operated for more than two decades. Regardless of the direction the Ero team follows, the destination is sure to be high investor returns.

Ero Copper – at a glance

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Directors
Christopher Dunn, David Strang, Lyle Braaten, Steven Busby, Dr Sally Eyre, Robert Getz, Chantal Gosselin, John Wright and Matthew Wubs

Market Capitalisation
C$1.6 billion

Quoted Shares on Issue
89,696,342

Major Shareholders
Fidelity, 12.6%; T Rowe Price, 10.5%; David Strang (insider), 6.5%; BlackRock, 4.5%; Noel Dunn (insider), 3.2%

Continued from page 17

brining-in Kwanika - which has more typical BC grade of around 0.4% copper equivalent.

"Developing them together makes sense because you can share infrastructure, particularly the processing facilities, reduce your capital and increase the scale of the operation to get extra margin out of the start-up material that enhances the economics," president and CEO Peter Bell said. An initial combined PEA is due to be published this quarter.

In November 2021, Kutcho Copper announced a feasibility for its Kutcho copper and zinc project for an open-pit and underground mining operation.

The project could produce 533Mlb copper, 841Mlb zinc, 10.6Moz silver and 129,000oz gold in concentrate over an eight-year mine life and 11-year processing life at 3,900 tpd. It would have an IRR of 25% following an initial capital cost of $483 million.

The company said that after primary crushing, an ore sorter using an x-ray transmission sensor would remove low-grade and waste material from the feed to the SAG and ball mills, followed by conventional flotation, regrind and dewatering circuits.

In Yukon, Western Copper and Gold has held one of the largest metal endowments for a number of years. The company might finally be going to the ball: in May 2021 it attracted a C$25.6 million strategic investment from Rio Tinto through a JV agreement.

With exploration drilling underway again, it is reinforcing the importance of the core of the deposit with long intercepts of above-resource grades in the leached cap and sulphide zones. Highlights include more than 200m grading 0.86%, 0.97% and 0.81% copper equivalent in different holes within the sulphide zone.

"Intercepted grades encountered in and around this area are some of the highest drilled to date on the property, and importantly occur at the top of the sulphide zone in these areas, representing material that will be mined early on during operations," said Western Copper and Gold president and CEO Paul West-Sells.

The good news keeps on coming for Western Copper, which in November 2021 saw the Yukon government award a contract for the Carmacks bypass project, the first section of the Casino project access road and a $29.6 million investment.

Casino has a June 2021 updated PEA for a 25-year open-pit operation to produce an average annual 178Mlb copper, 231,000oz gold, 1.36Moz silver and 16.6Mlb molybdenum following an initial capital investment of C$3.25 billion.

In Quebec, QC Copper is undertaking a large drill

Photo: istockphoto.com

programme to increase the size of its Opemiska copper project, having reported a maiden resource of 81.67Mt grading 0.65% copper and 0.31g/t gold in September 2021.

"[2022] is about getting this bigger. [2021] was about confirmation and definition drilling for the resource. Now it is about drilling tens of thousands of metres to find more," CEO Stephen Stewart said at the time.

"There were 3Mt of reserves left at Perry, grading 3.5% copper. We have the data, but need the confirmation drilling to bring that into resources, then there is the blue sky," said Stewart.

A resource update could come towards the end of 2022, which could potentially be the basis of a PEA.

Further west, Trilogy Metals recently hit some of the highest grades ever from Arctic in Alaska, US. A highlight was 19.91m grading 6.75% copper, 7.59% zinc, 1.68% lead, 1.26g/t gold and 97.13g/t silver for a copper equivalent grade of 11.76%.

Also last year, local development partner the Alaska Industrial Development and Export Authority (AIDEA) formally approved a plan and $13 million budget for work on the Ambler road to provide access to Arctic.

An August 2020 feasibility detailed a conventional open-pit mine and mill complex for a 10,000tpd operation with annual production of more than 155Mlb copper, 192Mlb zinc, 32Mlb lead, 32,165oz gold and 3.4Moz of silver for a minimum 12-year mine life.

Recently, the company received push back from some communities who fear the impact the road's development will have on the wild game they depend on for subsistence.

Other regions in the US have copper potential, but companies in Minnesota, such as Antofagasta Minerals and PolyMet, are having to fight every inch of the way to advance and permit their respective Twin Metals and NorthMet projects.

Ecuador

Ecuador is also pressing to be a go-to jurisdiction for copper development to add to Mirador, its first copper mine, which began in 2020.

As an example of this, in August 2021, president Lasso signed Decree 151 to improve investment protections.

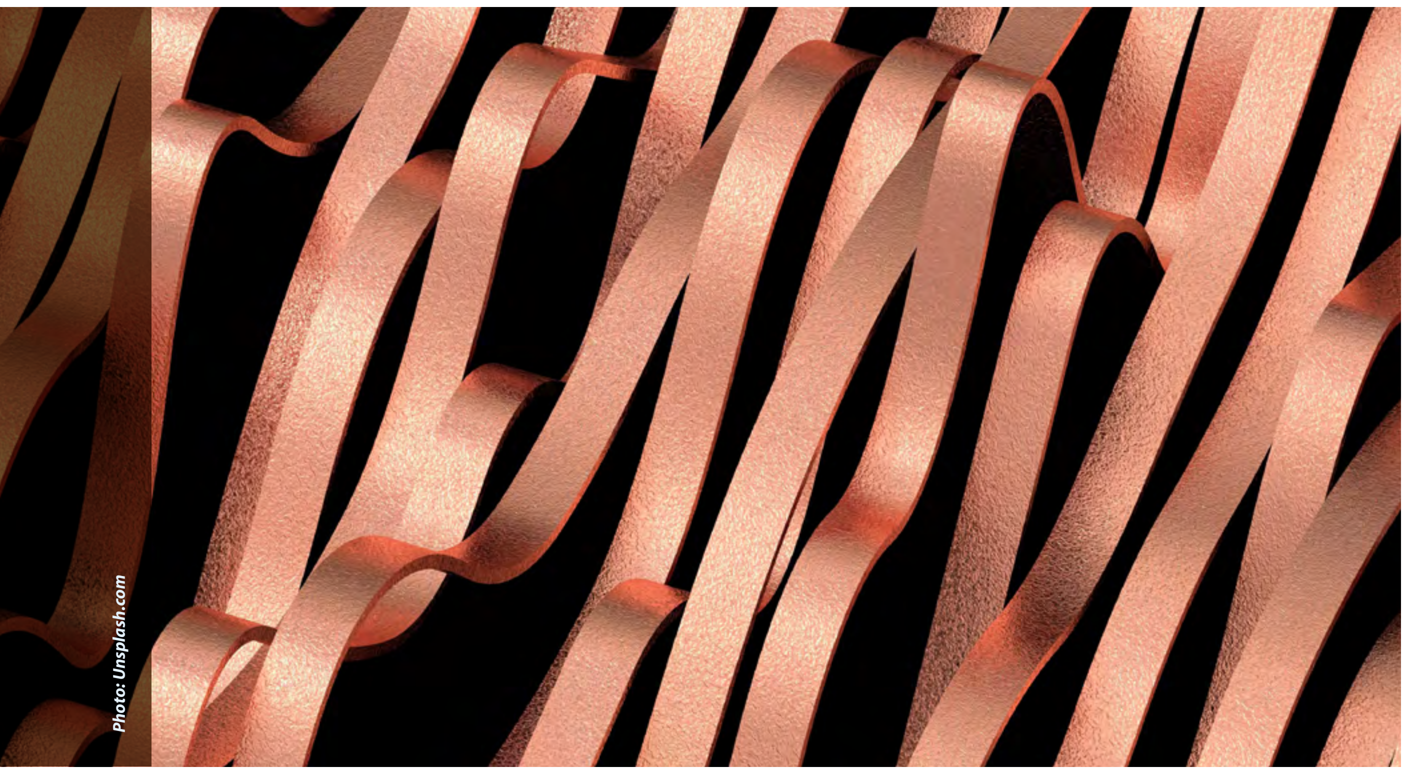

Photo: Unsplash.com

These included a 5% reduction on income tax for all new investments under the agreement, exemption from the currency outflow/remittance tax for the import of goods needed for the new investment, an exemption of all import duties and taxes for the import of goods needed for the new investment, international arbitration for investments exceeding $1 million, and a tax stability regime for mineral exploitation investments.

"The Lasso administration is continuing to streamline and improve the permitting and regulatory environment, as well as the fiscal regime that applies to the mining sector," Solaris Resources president and CEO Daniel Earle said.

Solaris is looking to show the world-class credentials of the Warintza Central deposit at its Warintza project in southern Ecuador. A resource update targeting an initial 1Bt of copper is due in March. "The drilling for the forthcoming resource update is complete and within that 1Bt we expect to have a high-grade starter pit to really drive robust cash flows in the early years, capital payback, and a high internal rate of return," said Earle.

Solaris has already electrified the market with intercepts such as 1,067m grading 0.60% copper equivalent, and subsequently added new discoveries within the 5km-by-5km Warintza cluster of outcropping porphyries.

"We could take that inventory and then double or triple it with additional drilling at the other targets," said Earle.

Solaris has a lot of follow-up drilling ahead on the West and East discoveries, and potentially at Warintza South once initial results come back from there.

"Ecuador is a very immature jurisdiction from an exploration standpoint and we think there are many world-class discoveries going to be made in the coming decade and beyond. Warintza has the potential to deliver a massive win for Ecuador," said Earle.

Solaris has stolen some of the thunder from SolGold and its Alpala deposit at Cascabel, although the latter's repeated PFS postponement has not helped. The 2019 PEA looked at four mine-production cases from 40Mtpa to 60Mtpa, with pre-production capital expenditure estimated at $2.4 billion-$2.8 billion.

SolGold's preference at the time was for an underground block-caving development to exploit 2.4Bt grading at 0.54% copper equivalent. The 50Mtpa mining scenario would produce an estimated 207,000tpa copper, 438,000oz gold and 1.4Moz silver in concentrate for the first 25 years.

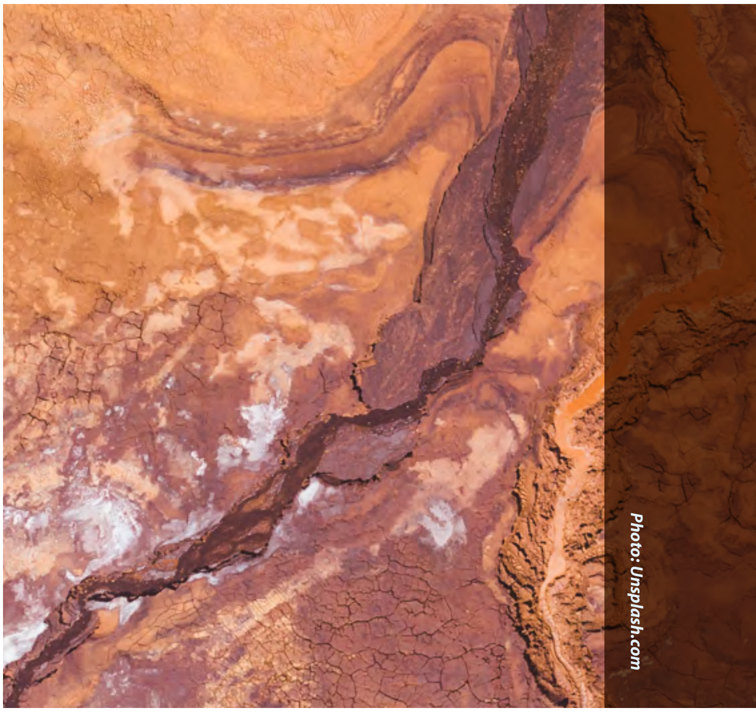
Photo: Unsplash.com

Chile

Copper powerhouse Chile is far from being dormant and it has a number of projects in junior hands. These include: Hot Chili, which recently listed in Toronto as it looks to advance Costa Fuego; Marimaca Copper; Los Andes; World Copper; and, NGex Minerals.

However, juniors are in the minority. State copper agency Cochilco reports 83% of exploration spend in 2021 was by majors, 9% by juniors and 4% mid-tier companies. The 2021 exploration budget was $548 million, of which 51% was mine exploration, 18% advanced exploration and 31% basic exploration.

The number of active explorers in Chile is increasing - Cochilco reported 57 companies with active projects in 2021, compared with 47 in 2020. Of the 103 active exploration projects in Chile, 48% are for copper.

NGex Minerals, the Lundin explorer mother company, has been in the shadow of its offspring in recent months, with the company essentially waiting for higher copper prices to continue advancing its Los Helados project. It is now re-emerging following a C$25 million raise in November

2021 to continue exploration. Los Helados has an indicated mineral resource of 2.1Bt grading 0.38% copper, 0.15g/t gold and 1.37g/t silver, or 0.48% copper equivalent.

Los Andes has a 2019 PEA on the Vizcachitas copper project, which outlined a $1.8 billion project to produce 179,000tpa of copper in concentrate in the first eight years, with a 45-year mine life, from a 1.28Bt resource grading 0.45% copper equivalent.

Since publishing a PEA in August 2020 on its Marimaca deposit, Marimaca Copper has been drilling to expand the resource at depth and test other near-surface oxide targets. The PEA outlined annual production of 35,800tpa of copper cathode over a 12-year mine life following an initial capital cost of $285 million. A resource update is planned for the first semester, with a feasibility study also targeted this year.

Australia's Hot Chili dual-listed on the TSX-V in January, having raised C$30 million in its IPO, a move it believes will boost its valuation as a large copper developer. The company plans to update the Cortadera resource during the March quarter to include 46,000m of additional drilling completed in 2021 in order to upgrade inferred resources to indicated, as well as providing a global resource for Costa Fuego with the inclusion of the Productora resource.

A combined PFS will follow in the September quarter. Costa Fuego has a global resource of 724Mt grading 0.49% copper equivalent. "We found ourselves the biggest fish in a small pond in Australia, which is not known for its large-scale copper developers," managing director Christian Easterday said.

"When we took on Cortadera in 2019 we tripled our resource base, we found ourselves as the only senior copper developer that wasn't listed in North America. In the last cycle, there wasn't the rerate in the Australian market that occurred in the North American market.

"Craig Williams at Equinox Mining took a A$400 million company to North America at $4/lb copper, financed the mine, built it and nine months later was taken over for C$7.3 billion [in 2011 by Barrick Gold].

"We're trading three or four times out of the money compared to the values paid in the North American market for senior copper developers."

Diversified miner Glencore came in as a 9.99% shareholder prior to the IPO, attracted by the potential for low-arsenic copper concentrate production, with an offtake agreement expected later this quarter that might see the major take a 60% offtake on the first eight years of production.

"The Glencore investment gives us a solid endorsement and provides a good rubber stamp on what we're doing and the asset we have," said Easterday.

Glencore is also pushing Hot Chili to explore the broader district potential in order to have a better idea of what the ultimate mining potential could be.

"We're aiming for a multi-decade project that's going to put out 100,000tpa copper and 70,000-80,000oz gold. If we can add another asset of scale, it's not inconceivable that this year we'll answer the question of whether this is a 150,000tpa copper project over 20 to 30 years," said Easterday.

"That's what Glencore wants us to answer quite quickly, before we move into feasibility, so we have given our exploration team the ability to drill 12 large-scale targets in a short period of time."

With Costa Fuego being in the coastal range at low elevation, Easterday says the project has infrastructure advantages that will translate into a lower development cost compared with other projects. The company has secured easement corridors to build a water pipeline from the coast and transmission lines, a tailings storage facility

and a water licence. "We are the only non-major in Chile that holds a maritime concession to extract seawater, which will provide all the water requirements for the entire combined development," said Easterday.

"We can process with salt water because of the metallurgy. That means we don't have to build a $500 million pipeline to bring water up into the Andes and, because of the metallurgy, we skip a $500 million item as we don't have to build a desalination plant.

"We are potentially looking at a $1.3 billion project, rather than a $3 billion one."

World Copper reported a sizeable copper resource at its Escalones project in central Chile in August, 2021.

The report highlighted 426Mt grading 0.367% total copper and proposed reconfiguring the project to focus on heap leaching.

With only half the copper anomaly drilled to date, the company could potentially double the resource by drilling to the south.

"As a sulphide project, it would be two to three times larger in order to start thinking about the economics. Previously, the project was characterised as a sulphide project and people were looking at a flotation plant, which are very large, expensive, low-margin operations. For an oxide project, 0.367% is quite an attractive grade," president and CEO Nolan Peterson said in August. With a heap-leach process using three-to-four-times less water per pound of copper produced than a sulphide flotation plant, the recast makes sense given the historic drought in Chile's central region. The company aims to complete a PEA in 2022.

ALSO OF NOTE

Cordoba Minerals published a PFS in January for the Alacran copper-gold-silver deposit within its San Matias project in Cordoba, Colombia. The report outlined a 22,000tpd open-pit mining operation, with average annual production of 31,200t copper, 55,000oz gold and 386,000oz silver over a 13-year mine life following an initial capital expenditure of $434.9 million.

The project would yield an after-tax IRR of 25.4%, and a 2.9-year payback. With the study not including all the deposits at San Matias, this is likely to grow.

"Having started the PFS in December 2019, we had to contend with severe national and international lockdowns, travel disruptions and the obligation to meet the Mining Technical Work Plan submission deadline, which meant a very limited window to collect PFS data. As a result, we had to focus on the Alacran deposit only," president and CEO Sarah Armstrong said.

John Black is also CEO at Regulus Resources, which is exploring the AntaKori copper deposit in Peru. The deposit has a 2019 resource estimate of more than 500Mt of copper-gold mineralisation.

The company is now drilling the Anta Norte target and seeks to complete 10,000m this year, culminating in a resource update. AntaKori hosts 250Mt grading 0.48% copper, 0.29g/t gold and 7.5g/t silver for a 0.74% copper equivalent.

"The first holes are to scout the Anta Norte area to see what we have. If we hit what we anticipate we have, we will push directly into a phase-three programme and continue drilling through the year to demonstrate the size of the overall district and set the stage for an eventual consolidation, while we're managing the interaction socially in the communities and making sure people are comfortable with what we're doing," said Black.

Copper at the core of Zenith Minerals project portfolio

Copper exploration provides encouraging result as company eyes lithium expansion

After building a strong portfolio of copper and gold projects that span across Australia, the ASX-listed gold and base metals development company Zenith Minerals is adding another string to its bow this year, with a foray into lithium exploration. Zenith advised on January 13 that it will be focusing more on EV metals this year following the announcement of its joint venture with the publicly unlisted company EV Metals Group. The agreements will include a new joint venture over two of the company's projects in Western Australia, as well as providing the opportunity for either party to bring in additional projects for lithium or EV metals exploration.

With the company's focus now on EV metal project generation in 2022, Zenith expects it will demerge all the non-EV metal projects into one or more new companies to be listed on the ASX.

This includes its base metals and gold assets. Zenith Minerals' CEO, Michael Clifford, said the company is ready to hit the ground running at the start of a new year, with further development at its flagship Develin Creek gold and copper project – even as it shifts focus to lithium exploration.

"We're looking forward to an exciting 2022," Clifford said. The news about the new joint venture follows the most recent drilling update at the Scorpion deposit of Zenith's Develin Creek copper-zinc project in central Queensland, Australia, which returned wide high-grade copper. Located 80km northwest of Rockhampton, the base metals project has several copper-zinc-gold-silver volcanic hosted massive sulphide deposits, in addition to stringer and breccia style copper-zinc-gold-silver deposits hosted by basalts.

Zenith is also awaiting assays for a further nine drill holes, with four at Wilsons North and three at Snook, two of the prospects where massive copper-zinc sulphides were discovered last year. The remaining two drill holes are in Sulphide City. Clifford also notes there is additional drilling planned in the first quarter of 2022 with work expected to commence once the current La Nina weather conditions have cleared.

"What's important now is how we can drive the best value from not only Develin Creek, but our entire portfolio," Clifford said. "The formation of our portfolio has proven to be such a key achievement for Zenith," he continued. "Great companies are a combination of the people, discoveries and projects. We are only just beginning to unlock the value of the portfolio". Zenith Minerals has a varied portfolio that spans a number of projects across Australia. The Split Rocks gold project is 100% owned by Zenith Minerals and is located within the Southern Cross region in the Forrestania greenstone belt, about halfway between Perth and Kalgoorlie in Western Australia. Zenith's third fully-owned project is the Red Mountain gold-silver project in Queensland, where an initial 10 RC hole drill programme was completed in May 2020 and returned near surface high-grade gold results. The company believes the site's gold mineralisation is analogous to known large scale commercial gold deposits in the state. For Clifford, the company's talented and experienced team lies at the heart of its success. "Success means having the right people, from the field crew and geologists right through to the board. Everyone plays an important role in Zenith's success," he said, adding that it's also important for a company to recognise when it is in its best interest to partner with specialists for certain projects as it can add significant value to these projects.

While demand for copper and gold, especially from Australian producers, remains strong, Clifford acknowledged the push for decarbonisation in the mining industry was one of the reasons why they have shifted focus towards EV metals, such as lithium.

"We see the theme of decarbonisation continuing to grow in the future, with demand growing for EV minerals such as lithium and graphite," Clifford said. "However, he said there is still plenty of demand for base metals such as copper, as the electricity industry still depends heavily on its usage within numerous components. Ultimately everyone in the mining industry is working towards green markets," he said. "And copper is the ultimate green market, as it is used in every electric device. We have already seen a massive increase in copper demand, with spot prices still increasing, and that isn't going to change".

For Australian copper producers, the exchange rate has been beneficial due to the low Australian dollar. After reaching an all-time high in 2021, the spot copper price remained above US$10,000/tonne. Clifford also noted that the industry is heavily weighted in favour of already-operational mines, as COVID-19 has delayed the arrival of new copper mines coming online.

Problems with supply chains during the COVID-19 pandemic have lifted spot prices higher over the past two years and seems unlikely to change in the near future as the world continues to grapple with the newest variant. "We are starting to see the impact on our people," Clifford said. "The flow-on effects from COVID has affected staff shortages and assay turn-around times are being blown out of the water. We have protocols in place and use our common sense when it comes to keeping our people safe and healthy, but at the moment it also seems to be all about luck, if a crew member or one of their family members just happens to have had contact with a covid positive case…"

Although most of Australia has now opened its borders to other states and the rest of the world, there are still restrictions in place in Western Australia and Queensland, making it difficult for international workers to enter.


A Zenith employee extras drill cores

However, Clifford is confident about the company's outcome with rigs already booked for 2022 at sites in both states. They are also looking at how to improve turnaround for results from the assay labs with portable prep facilities.

Although the new year may have brought some additional challenges with the La Nina weather system wreaking havoc across the eastern states of Australia, especially in Queensland, the company is prepared to hit the ground running in 2022. "After seeing the opportunities Develin Creek offered us, we plan to kick off again as soon as weather permits with two drills, whilst also waiting on those additional holes at Sulphide City," Clifford said. While 2022 may be a year of transformation for Zenith Minerals, Clifford said it is important for the company to continue moving forward and "continue doing what it does best". This includes developing its projects through to operation and production, while always keeping an eye out for additional copper opportunities.

Zenith Minerals – at a glance

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Market Capitalisation
A$114.9million

Quoted Shares on Issue
323,804,155

Major Shareholders
HSBC Custody Nominees (9.97%), Citicorp (7.7%), BNP Paribas Nominees Pty Ltd Six Sis Ltd (5.52%), Ms Nada Granich (3.75%), Ms Suzi Queli Miquilini (3.06%)

Hegarty sees ‘unstoppable’ commodities demand

Mining industry veteran Owen Hegarty says Australia is in poll position to take advantage of looming metals demand growth.

Speaking at the Melbourne Mining Club in late 2021, ever-bullish Hegarty said there would be blips along the way, but strong commodities demand would continue for at least 50 years.

“We believe we’re in for long, strong multi-decade growth in commodities led by China, followed by India, the rest of the developing world, including Indonesia, all chipping in from the edge of the green, all looking to get on that super highway of economic growth and prosperity,” he said.

“It’s unbridled, it’s unstoppable and it will absolutely continue.” In addition to existing demand, Hegarty said decarbonisation would add a “very serious lift” to commodities demand.

“That is also unstoppable,” he said.

“In other words, it’s no longer a thematic. People are putting flags in the sand and making targets, 2030, 2040, 2050, 2060 with China and 2070 with Modi, so we’ve got 50 years of all of this going to happen.”

Hegarty said the transition would be capital intensive, but also metals intensive.

“Who are the winners and who are the losers? Well the good news is, everyone’s a winner,” he said.

“The main winner here is Dr Copper … the most noble and versatile of all metals.

“You want to be as long and as strong as you possibly can on quality, unhedged copper.”

Hegarty estimates an additional 20 million tonnes per annum of global copper supply will be needed, which will be difficult, given the dwindling pipeline and low discovery rates.

He is also long potash, gold and metallurgical coal.

“[Met coal] came out of COP26 unscathed and in fact, it came out of COP26 as part of the solution, not part of the problem,” Hegarty said.

“Steel is such an important ingredient in the whole energy transition, you won’t have much energy transition if you don’t have lots more steel.”

Hegarty expects demand for most metals to rise as the world decarbonises.

"Who is best-placed in the world, on the planet, in the universe probably, to take advantage of all of this? That is of course, Australia," he said.

"We are blessed with wonderful resources, critical minerals, there's nothing we don't have here.

"We're now ready to take advantage of that serious competitive advantage and the position we're in to be able to drive the industry forward and drive the supply into the waiting arms of demand."

Hegarty is chairman of EMR Capital, which he describes as "private equity with soul" and recently listed "new force in copper" 29Metals.

29Metals owns the "sensational" Golden Grove copper-zinc mine in Western Australia, which recently celebrated its 30th anniversary. Hegarty believes it will be around for at least another 30 years.

"Think Broken Hill, think Mount Isa, think Kidd Creek, think some of these other big systems," he said.

29Metals also owns the Capricorn copper mine in Queensland, which is "spinning like a top".

Hegarty said the company's A$527 million float would allow the it to give Capricorn some "oomph" and fully realise the exploration potential.

Like other miners, 29Metals is working on the gradual electrification of its operations.

"In fact, if you pay a visit to any of our sites, and you stand still for about longer than 20 seconds, you might get a battery pack attached or inserted one way or the other," Hegarty said.

The reporter is a volunteer member of the Melbourne Mining Club's steering committee.

Photo: unsplash.com

For C3 Metals, X marks the spot

Large drill set up to test a high potential copper-gold porphyry and stacked skarn target at Jasperoide

This year promises to be define the Americas focused copper explorer

C3 Metals' Jasperoide copper project lies at the intersection of large-scale structures traversing through two of the world's most productive copper porphyry strikes – and in 2022, the company plans to drill deeper than ever before.

Southern Peru is crisscrossed by some of the world's largest copper-bearing geological formations. Follow the Benoni Fault east from the Las Bambas mine for 40km and it eventually meets the north-south trending Constancia Fault, from which Hudbay Minerals' Pampacancha and Constancia projects lie a similar distance to the South.

At the intersection of these two prolific structures, C3 Metals is gearing up to explore deeper than ever at its Jasperoide project.

"The two faults intersect at Jasperoide and that's significant because intrusive rocks commonly exploit fault intersection zones. These are excellent settings for the development of porphyry copper systems" says Stephen Hughes, the company's VP of exploration.

"Three world-class copper deposits are located within 40km of Jasperoide, and each system is comprised both of skarn and porphyry mineralisation. At Jasperoide, we have identified significant copper-gold skarn mineralisation, and we are now testing for porphyry and stacked skarns at deeper levels of the hydrothermal system."

Jasperoide was discovered in the mid-1990s, but only has only had four years of sustained exploration since discovery, notably in the early 2010s by Peruvian precious metal miner Hochschild Mining.

In January 2021, C3 Metals restructured its management, bringing in Kevin Tomlinson as CEO and Alec Rowlands as VP of Investor Relations.

Both men were part of the Cardinal Resources team that developed the Namdini project in Ghana before its sale to China's Shandong Gold in December 2020.

Drilling began shortly afterwards, and most holes drilled in 2021 intersected high-grade copper-gold mineralisation from near surface.

Drill results were met with enthusiasm by investors and the company's share price soared from C$0.08 to a high of C$0.23 in October of that year.

Drilling at the main zone identified an oxidized skarn body that occurs for at least 450m along strike. It is laterally extensive for up to 650m, with true thickness varying from

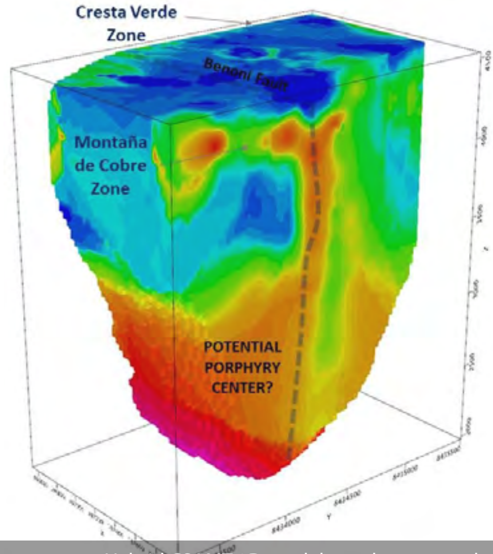
50m to 250m.

"We started drilling at Montaña de Cobre Zone because of the very high copper-gold grades intersected in historical drilling, such as 24m at 5.76% in a Hochschild drill hole," says Tomlinson.

Due to the high-grade nature of the mineralisation, the company opted to drill fans along 50m-spaced lines across the main skarn zone.

"Our first 30 holes all intersected copper and gold mineralisation, including 38m at 3.5% copper and 229m with 1% copper with good gold credits," says Tomlinson.

In late 2021, C3 moved the rig 1,800m north of the main skarn to the Cresta Verde Zone and intersected over 500m of skarn, massive sulfides and diorite.



Hybrid CSAMT 3D model porphyry target below Montana de Cobre

The hole excited the geologists, as the rock contains significant pyrite, chalcopyrite and pyrrhotite, an indication of a significant hydrothermal system at Jasperoide.

Cresta Verde is located along trend of the Constancia fault and less than 800m north of where it crosses the Benoni fault, strengthening C3's theory that the source of the mineralising fluids is controlled by this important structural intersection. Copper demand is set to reach new highs, with the continued push towards electric vehicles and producers of the metal are looking to shore up reserves.


Drilling at C3 Metals' Jasperoide project

"We completed a near drill out of the main skarn, undertook various geologic studies and geophysics surveys and increased our land holdings four-fold in this highly prospective porphyry skarn belt," says Tomlinson.

C3 has gone from an initial 57sq km to more than 250sq km in land holdings and tenement applications in less than a year.

Tomlinson attributes much of the company's early success to a "boots on the ground" strategy, while developing and maintaining excellent relations with the local communities. "We believe in hiring and buying locally and undertaking sustainable programmes that help the community over the long term," he says.

A phase-two, 5,000m drill programme had already begun by February 2022, with the bigger drill rig positioned near the main skarn area.

This will be the first deep hole drilled at Jasperoide and the company expects first assay results sometime in mid-2022.

In addition to its Peruvian assets, the company also holds over 200sq km of mineral concessions in Jamaica. Jamaica is bisected by the Crawl River Fault, a massive structure that can be observed on Google Earth.

The island was the focus of significant copper and gold mining during the 1600s and 1800s – by the Spanish and the British – and is situated west of major mineral deposits, including the Romero and Pueblo Viejo deposits in the Dominican Republic.

Since 2011, C3 metals has spent more than $17 million on drilling, geophysics and geochemical studies. Drilling at Bellas Gate intersected strong copper-gold mineralisation from surface, including 114m at 0.69% copper and 0.52g/t gold.

In 2022, C3 plans to further develop copper and gold prospects at its Bellas Gate, Arthur's Seat and Main Ridge projects, all within the Crawl River Fault zone.

The company's geology team spent the last six months on the ground in Jamaica, preparing targets for drill testing. "We're very excited about Jamaica, there are multiple porphyry and epithermal targets that show significant potential," says Tomlinson,.

"We know from previous drilling at Connors that coincident IP and mag features are commonly associated with porphyry systems and one of our first drill holes will be testing the largest coincident feature below Epidote Ridge."


Kevin Tomlinson, President & CEO

As a junior chasing porphyry deposits in two jurisdictions, drill results obtained over the course of 2022 could make it a defining year for C3 Metals.

C3 Metals – at a glance

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Market Capitalisation
C$70.4 million

Quoted Shares on Issue
586.77 million

Major Shareholders
Insiders ,11.9%; Ingalls & Snyder, 8.5%; RCF 6.1%; Thebes, 4.7%; Hochschild 4.3%

Junior copper explorers blossom in the Americas

High copper prices, a forecast supply deficit, a global move towards electrification and a decade of little investment mean it has never been a better time to be a copper explorer.

Copper exploration budgets rapidly fell as the super cycle came to an end a decade ago, with the scant exploration spend since then largely brownfield. As the industry again faces boom times it is grappling with declining grades and an absence of new discoveries, and so the purse strings are opening. Arizona Metals' had an upsized C$49.8 million bought deal, Arizona Sonoran Copper's initial public offering on the Toronto Stock Exchange raised C$46.7 million, Hot Chili raised C$33.8 million with its Toronto Stock Exchange Venture IPO, American Pacific Mining had an oversubscribed placement of C$10.1 million, Libero Copper an upsized C$8.3 million and Solis Minerals completed its Australian Stock Exchange IPO and raised A$5.5 million.

At least three other companies are preparing IPO's. CopperEx, with its Exploradora North and Kia Buggy projects, Key Metals with Fiel Rosita and McEwen Copper with its Los Azules project in San Juan, Argentina. "The market loves copper but people are selective. They look at the team and the assets, they are more selective than previously. People are very keen but there is no easy money out there. There is a focus on jurisdiction and the scale potential," David Prins, president and CEO of CopperEx told Mining Journal.

Improved access to finance saw juniors' budgets surge 62% in 2021 to US$4.1 billion across all metals, although majors are still the biggest spenders and account for half of the global exploration budget at $5.6 billion. S&P Global Market Intelligence said the global exploration budget for non-ferrous metals jumped 35% in 2021 to $11.2 billion from $8.3 billion in 2020. However, the firm also noted that fewer resources are dedicated to grassroots exploration with allocations at an all-time low of 24% in 2020 while minesite allocations hit an all-time high of 41%. "When you look at the amount of exploration budgets that go into precious metals versus base metals, and what component actually goes into copper, it's still a very small amount and that's not a problem that's been fixed. Fundamentally, copper supply is not there and it's not going to be there to meet demand for the next 10 years," Teo Dechev, president and CEO of Royalty Generator Mundoro Capital told Mining Journal.

Mundoro Capital has also seen the purse strings open, which specifically signals that funds are increasingly

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Mundoro Capital has also seen the purse strings open, which specifically signals that funds are increasingly

Photo: istockphoto.com

available for grassroots exploration targeting porphyries and deposit styles that can deliver big. "At the beginning of 2021, we started a $1.5 million raise and ended up at $3.5 million although we had subscriptions for around $5 million. That is an example of the appetite in the marketplace," said Dechev.

A key element here is the type of deposit investors are providing funds to explore, the large, long-like deposits that take years to drill and that the large diversified salivate over for their multi-decade production potential.

"If you're going to be in the copper business, you've got to be in the porphyry exploration business. Skarns are not the future of copper; porphyries are and possibly IOCG's and some sediment-hosted systems. That's a tough exploration model to fund as you could spend $20 million on a porphyry and still not know where you are in the system, because they are such monsters," said Dechev.

Rick Trotman, president and CEO of Barksdale Resources agrees. "Those very large, very coveted projects that the major mining companies would be interested in, with billions of tonnes of copper resource above 0.4% or 0.5% copper are incredibly difficult for juniors to push forward so

"If you're going to be in the copper business, you've got to be in the porphyry exploration business."
— Teo Dechev, President and CEO of Royalty Generator Mundoro Capital

they need very high quality committed capital sponsors like the Lundin's and Ross Beaty's of the world," he said. Or in Mundoro's case funding partners among the world's largest miners.

Trotman also sees space for the smaller, higher-grade deposits. "The other bucket of projects that tend to do well are the higher-grade smaller footprint deposits with manageable capital expectations that a junior company could actually push forward and raise the capital to develop on its own. Those are the types of projects that can have quite a bit of torque and that is what San Javier is, a project that could probably be built for less than $150 million," he said.

The poster child of this path is Ero Copper, which has grown to a C$2 billion market capitalisation based on its production in Bahia, Brazil.

With copper prices having established a base over US$4 per pound for the past two years, lower grades are less of an issue as higher prices allow lower cut-off grades, although with the caveat that developers increasingly have to consider the carbon emissions generated from moving an increasing volume of rock. What were low grades a decade ago may now be considered high grade as the average production grade has fallen from about 1% a decade ago to 0.69% now, with cut-offs increasingly around the 0.2% or even 0.15% mark. For explorers, long sub 1% hits can have a big impact such as Solaris Resources and Filo Mining showed in 2021.

With the emerging copper cycle likely to have long legs, and investors increasingly looking to back junior exploration, we start 2022 with the fool's errand of trying to make sense of the plethora of pre-resource copper explorers. While this review is intended to have depth, it cannot be exhaustive, and it will focus on the Americas.

Chile

Chile built a leading position in the copper market on the back of massive porphyry deposits and this is the prize newcomers such as CopperEx and Key Metals are chasing.

The emergence of new explorers means fears about the impact a Gabriel Boric presidency on mining investment may have may be overstated, or at least explorers are sanguine that given the 10-20-year timeframe to bring a copper exploration project to an investment decision, there is a likelihood of a more mining friendly president being in La Moneda in the future.

“People recognise there will be additional cost structure in Chile under a Boric government, but there won’t be appropriation. Tax increases are also happening in Peru and the US. Boric has moved from an extreme left view and picked a road for economic success as to produce the social programmes he promised he needs money and that mainly comes from mining in Chile. He knows that if he crashes the mining industry it would be fatal for him and his plans so he knows he cannot do that,” said David Prins, president and CEO of CopperEx.

Prins, who was previously project director for Pretium Resources’ Brucejack mine development in British Columbia, Canada also previously worked at the Zaldivar copper mine in Chile. He is joined by other Pretium alumni Joe Ovsenek and Bob Quartermain at CopperEx. The company raised C$6.3 million in mid-2021 and plans to conduct initial drilling at Exploradora Norte this year ahead of an IPO. In addition to Exploradora North, it has the Kia Buggy project, with both in the heart of the Eocene-Oligocene porphyry copper belt which includes the giant Chuquicamata and Escondida copper mines.

“At Exploradora, our drilling is targeting a starter open pit resource of a minimum 100Mt grading 0.7% copper equivalent. We are in a neighbourhood that offers scale and grade, is easy to get to and not too rugged terrain, we can get seawater and there is a transmission line near by, so the project is buildable,” said Prins.

Further south, in Region III, Key Metals is starting with a 362.8Mt indicated resource grading 0.4% copper at the Fiel Rosita breccia-skarn-porphyry project it optioned from lithium producer SQM, which completed 52,238m of drilling in 175 holes.

Chile’s IOCG belt in the coastal cordillera also holds the promise of hosting more standout mines such as Lundin Mining’s Candelaria and Mantos Copper’s Manto Verde. In this region, Nobel Resources has embarked upon a 10,000m drilling programme to test five magnetic and coincident IP anomalies at the Algarrobo project, where drilling previously returned 2m grading 1.28% copper. Nearby, it also has the La Salvadora IOCG project where it intends to drill an initial 2,000m on three targets.

Peru

Junior exploration in Peru has arguably been stronger in recent years than in Chile with companies like Chakana Copper drilling its Soledad breccia pipe project in the Miocene copper belt in Ancash. It has drilled more than 60,850m to date but got creamed when it issued a maiden inferred resource in January, with its stock trading dpwmn 11%. The underground resource of 4.8Mt grading 0.72g/t gold, 61g/t silver and 0.97% copper and open pittable resource of 1.9Mt grading 1.29g/t gold, 37.1g/t silver and 0.65% copper elicited a market yawn for the contained 130Mlb copper, 190,000oz gold and 11.75Moz silver.

Also in Peru, C3 Metals drilled 23.5m grading 1.86% copper at its Jasperoid project in the Andahuaylas-Yauri porphyry/ skarn belt in Cusco along strike from the main skarn where historical drilling returned up to 24.3m grading 5.76% copper and 0.09 grams per tonne gold. A secondary copper enrichment zone has been found with intercepts of 53.24m grading 3.11% copper and 0.46g/t gold.

Hannan Metals has a sediment-hosted copper-silver system at its San Martin project in San Martin with potential for basin scale. Hannan entered into an option and joint venture agreement with Japan Oil, Gas and Metals National Corporation (JOGMEC), under which JOGMEC can earn up to a 75% interest by spending up to $35 million up to the delivery of a feasibility study. Channel sampling highlights include 1m grading 2.1% copper and 29g/t silver. MAX Resource has a similar sediment-hosted target with its Cesar project in Cesar, Colombia with sampling highlights of 14.8% copper and 132g/t silver at Uru and 12.5% copper and 84g/t silver at Conejo. MAX plans to undertake maiden drilling at Cesar in 2022

Ecuador is also proving to be fertile ground for copper exploration. Australia's Sunstone Metals returned 480.85m grading 0.41g/t gold, 0.15% copper, 3.4% molybdenum and 0.74g/t silver from its El Palmar porphyry.

Canada

A confluence of factors has reignited copper exploration in North America including political risk perceptions, strategic metals messaging from governments as well as existing infrastructure. As British Columbia is rising fast as a copper exploration destination, where its political stability and availability of hydroelectric power increasingly attractive. Hydropower means projects in BC have the potential to have industry-leading low carbon footprints, which will prove advantageous when seeking development investment. "Everybody's dismissed BC copper because they say BC porphyries are always the 0.3% copper 0.3g/t gold kind of porphyry and people lift their nose up.

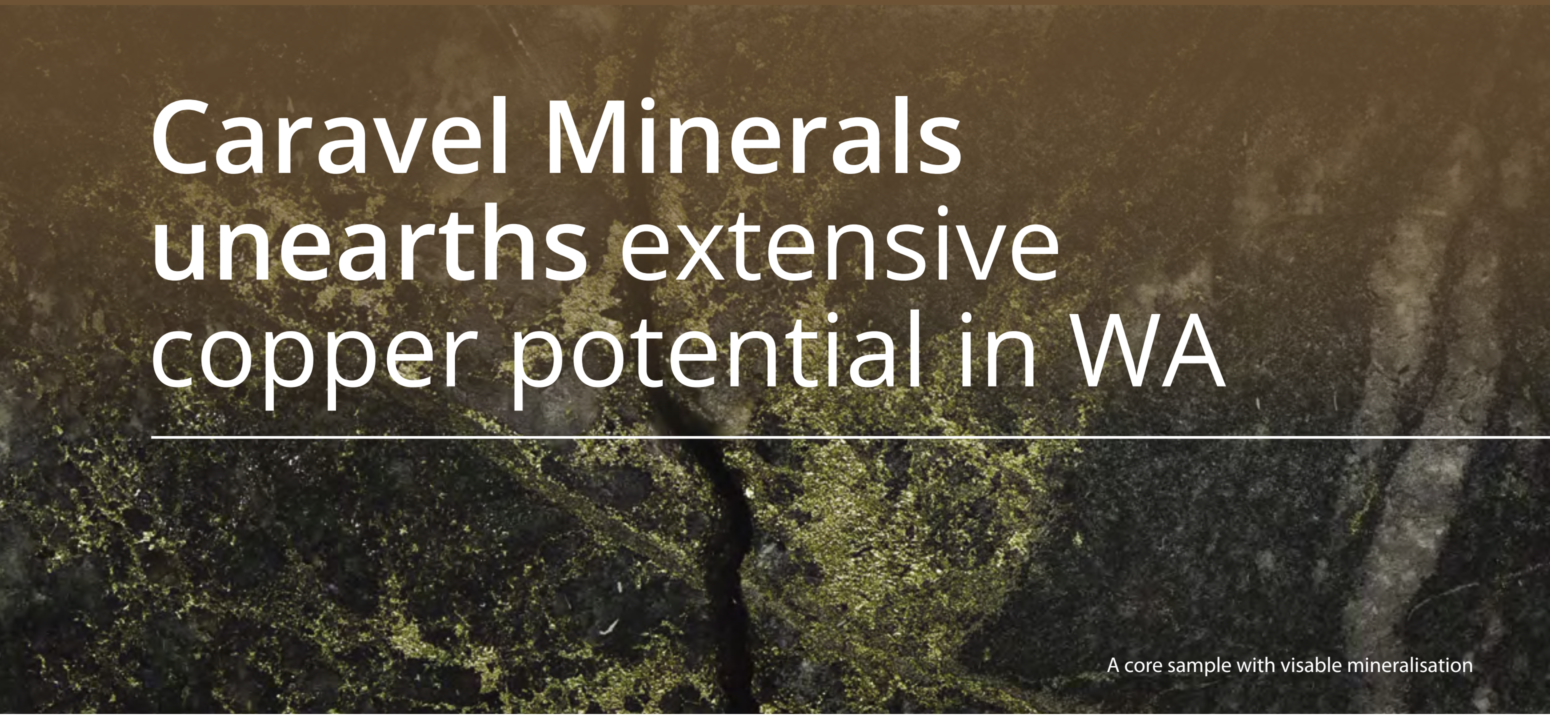
I wouldn't be surprised if copper goes to $10/lb and in that case 0.3% BC porphyries are going to make a lot of money," Walter Coles, president and CEO of gold developer Skeena Resources told Mining Journal.

"There's a heck of a lot of good-looking exploration projects in British Columbia that have been unloved for from five to 50 years. Carruthers Pass is an example of that, with the

Continued on page 43

Photo: istockphoto.com

Caravel Minerals unearths extensive copper potential in WA



A core sample with visable mineralisation

Location and infrastructure a boon for large-scale project

It takes a team effort to recognise and deliver on the huge potential of a large-scale, underexplored region, but that is exactly what the ASX-listed copper exploration and development company Caravel Minerals is doing in Western Australia's Wheatbelt region at its namesake project. The Caravel copper project is an undeveloped conventional open-pit mining and processing project with a mineral resource of 2.84 Megatonne contained copper. It is 150km northeast of Perth, between the towns of Calingiri and Wongan Hills. The project would produce 35,000 tonnes of copper in the first 5 years, ramping up to 55,000t of copper for export from year 6 onwards.

Managing director Steve Abbott said the project was lesser known, despite recently being announced as Australia's largest undeveloped copper project following extensive drilling programmes and a new mineral resource estimate that was released in November 2021.

"Exploration drilling spanning over 10 years has proven a very large resource with significant size and scale," Abbott said. The area was first assessed in 2005 by Dominion Mining, which was looking for gold through the Wheatbelt region. Initial data showed areas of anomalous copper, which eventually led to the first mineralisation discovery in 2009. The discovery was of such potential that it was spun out by Dominion into Caravel Minerals in 2013. Caravel Minerals then drove further drilling and feasibility studies at the copper discovery at Wongan Hills, while selectively assessing prospects within its comprehensive proprietary database – the result of systematic regional-scale exploration programmes by Dominion throughout the South West Yilgarn Terrane during the 1990s and early 2000s. The Caravel copper project will be a conventional mining and processing operation that has a low strip ratio and major locational advantages – which include being on the power grid and close to established towns. Abbott said it is a simple project to execute that is very viable, particularly at current and projected copper prices. There is a strong resurgence in the copper demand outlook that is being driven by global policy shifts towards lower-carbon economies and electrification. After reaching an all-time high in 2021, the spot copper price continued to hover around the US$10,000/t mark in January, with some analysts predicting that prices could reach US$15,000/t within the next three years. For Australian companies, the favourable exchange rate gives an added incentive.

"The copper price has also been in our favour and a range of market indicators on both the demand and the supply side give us confidence this will continue to be [the case] for the foreseeable future," Abbott said. This has created strong interest in new copper projects that are near development stage. However, a lack of exploration in recent decades means there are fewer new mines coming online even as copper grades are starting to decline, which has shifted the supply/demand fundamentals in recent months. Many of the world's leading copper producers are in South America, where operations continue to be constrained by government intervention around royalties and labour regulation. Despite the concerns over border shutdowns, the political and economic stability of WA continues to make it a desirable destination as a mining jurisdiction. The timing couldn't be better for Caravel and its shareholders, as the company is completing a pre-feasibilty study (PFS), which is due at the end of Q1 2022. The PFS will be based on the November mineral resource, which followed major drilling programmes between December 2020 and August 2021.

A key advantage for Caravel is its close location to the ports of Bunbury and Geraldton, both of which are capable of exporting bulk and containerised copper concentrate. With the project less than 150km from the state's capital city and major highway upgrades completed or planned, field crew and future employees can easily commute from Perth, rather than relying on a fly-in, fly-out workforce. Unlike remotely located projects that generate power using diesel or natural gas, the Caravel project is situated within the state power grid, which offers direct access to electricity generated by renewable and other sources. During the PFS, Caravel is assessing options for the electrification of its mining fleet, which offers significant cost advantages in fuel and maintenance costs and reduced emissions. Hand in hand with this would be the use of autonomous equipment, and a greenfield project such as Caravel is able to effectively incorporate the technologies in mine planning and design.

The project's location and scale are also positive for the WA government. Estimated royalties of up to A$810 million, and significant private investment within the Wongan-Ballidu Shire, are expected. "There is keen interest in this project from regional stakeholders and during this project-planning stage we are consulting to ensure opportunities will flow from what will be a long-life, modern, copper production project," Abbott added. "This project is going to bring employment to the local towns as we move into construction and then full-scale operation and an increase in underlying demand for local goods and services". The company plans an initial processing production of 12 Million tonnes per annnum in the first five years at Bindi, providing Caravel with early access to higher-grade ore, while mining is likely to start at the Dasher deposit around 15 years later. "Stage one of the project is mining and processing 12Mtpa of ore for five years, moving to stage two

Daniel Davis, CFO and Company Secretary

mining and processing 24Mtpa of ore from year 6 onwards for a current total mine life of around 28 years. "There is plenty of potential for us to add significant value in the project area," he added. For Abbott, this means there is no interest in diversifying into other metals or minerals as plans ramp up towards production and meeting that future demand. Further work is ahead for the team at Caravel in order for the company to begin production within the next five years. The next 18 months will consist of finalising studies and financing, Abbott said, followed by the construction of the mine. "Copper is in everything," he said. "Some other metals and minerals will come and go, but copper will always be in demand".

Caravel Minerals – at a glance

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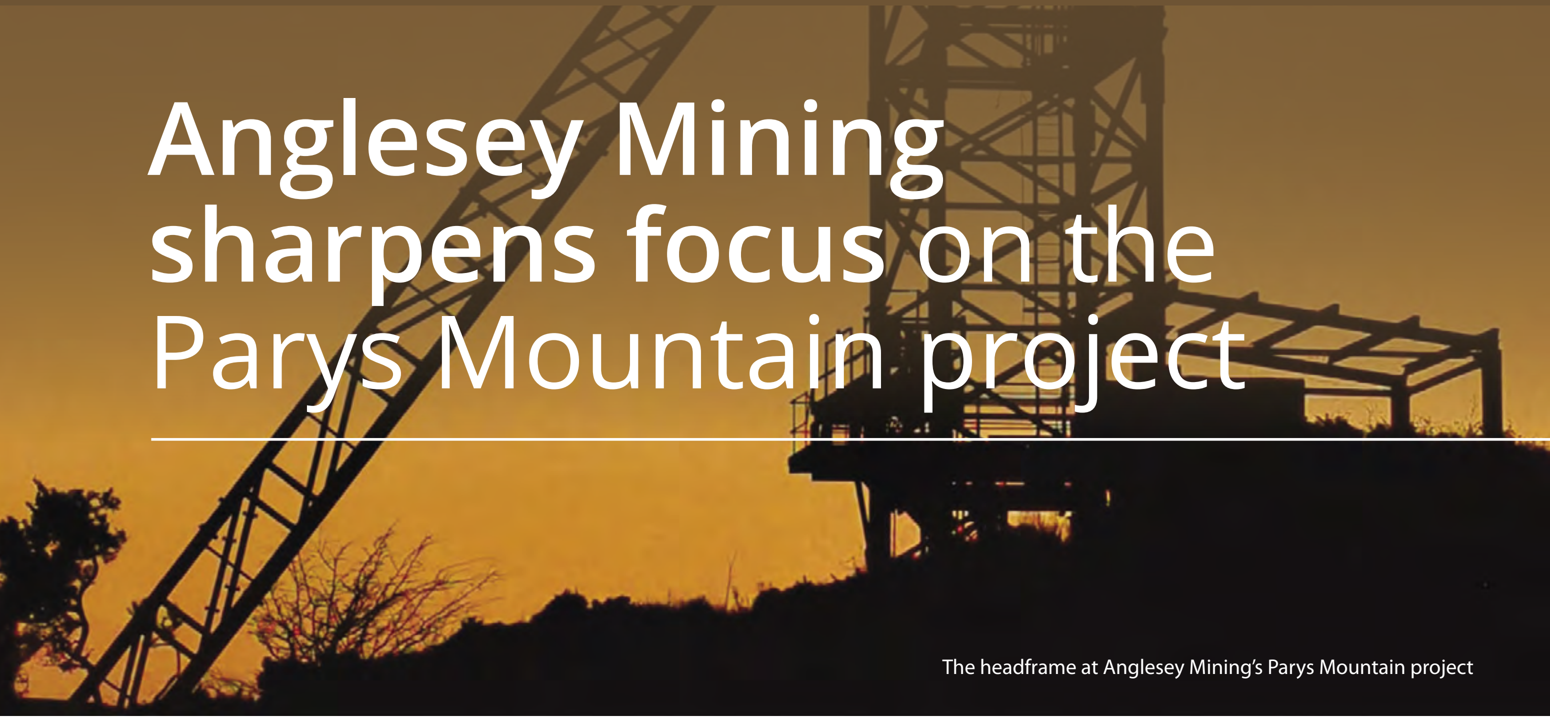
Market Capitalisation
A$111.1million (January 31)

Quoted Shares on Issue
389,850,017

Major Shareholders
Paradice Investment Management (7.86%), Alasdair Cooke (6.46%), Alma Metals Limited (3.92%), Glenvar Nominee Pty Ltd (3.81%), Ms Pamela Julian Sargood (3.2%)

Anglesey Mining sharpens focus on the Parys Mountain project



The headframe at Anglesey Mining's Parys Mountain project

A change of leadership at the LSE-listed firm has brought a new lease of life to the historical mine in Northern Wales

Since its 1988 float on the London Stock Exchange, Anglesey Mining has strived to bring modern, underground mining to the Parys Mountain project on the isle of Anglesey, which is off the north coast of Wales.

The site was once home to the world's largest copper mine, but price fluctuations, economic crises and a diversification into Canadian iron ore projects meant that it remained undeveloped. However, new leadership, a robust preliminary economic assessment (PEA) and rapidly improving macro conditions mean that Parys Mountain is once again at the forefront of Anglesey Mining's strategy.

"I've followed the Parys Mountain project for many years," says Jo Battershill, who became CEO in August 2021. Born in Cornwall, he developed his career in mining, finance and broking in Australia.

"Last year I dusted off my folder on Parys Mountain to take a deeper look. It's a project with extensive mining history, world-class infrastructure and a supportive local community.

And in terms of the geology, there's still a lot of unfinished business." The preliminary economic assessment on the polymetallic project was released in January 2021.

The indicated resource estimate of 5.2 million tonne of ore includes over 220,000 tonnes of copper, zinc and lead. A further 11.7Mt of ore remains in the inferred category and contains an additional 320,000 tonnes of metal.

Even using the conservative price estimates from the PEA of $2.80 per pound of copper, $1.20/lb zinc and $1,500 per ounce of gold, the economics look robust. The PEA offers various scenarios for mine development, ranging from 1,000 tonnes per day throughput to 3,000t/d.

Under the larger mine plan, the project would generate a net present value of US$120 million using the base prices over a mine life of 12 years. Using current prices, that figure rises to over $250 million. Furthermore, the project would require a modest capex of $99 million and take just two years to build out from financing. That's a testament to the work already done at the site and the strong transport and power infrastructure in the region.

In the late 1980s, a 300m shaft was sunk into the project, 1,000m of underground development work undertaken and a 2,000 tonnes bulk sample taken. The project is close to existing road infrastructure, just 21 miles away from Holyhead Port and already linked to the power grid on an island that is home to numerous wind farm projects. The UK government is also in exploratory talks to revive the site of the Wylfa nuclear powerplant on Anglesey.

"We believe that with the local renewable energy, or potentially through nuclear, we could produce low- or zero-carbon copper," Battershill says. "The proposed mine development is all underground and has a tiny footprint.

"There is a history and understanding of mining on the island and a high unemployment rate. Subsequently, we have experienced strong local support for the project. We know that to build a mine today, we have to employ world's best practices and ensure that the community benefits from the project in both the short and long term."

In the current political and financing climate, there are also strong incentives to develop smaller, less intrusive mines in friendly jurisdictions that provide a secure supply of base metals, according to Battershill.

Anglesey Mining holds the freehold rights to the land and the original planning permissions for the mine and decline development – the permissions were obtained in the late 1980s and early 1990s and are still valid.

The UK's Planning Act has been updated since then, however, and Anglesey Mining has volunteered the permits for review. The company has entrusted Richards, Moorehead & Laing – a leading local environmental consultancy – to review the historical data from the site prior to presenting a pre-application to the North Wales Mineral Planning Authority. The results of that process will determine what further work will be required for the project to achieve full permitting.

"We've committed to doing everything by industry best-standards," Battershill says. "The permitting process can be unpredictable, sometimes. But, even if we need to do a full environmental impact assessment for the project, the abundance of data from the mine site and local area could see the that work completed in a very reasonable timeframe."

Concurrently, the company is making inroads into mine development studies. The White Rock and Engine Zone deposits are well defined, with a current infill drilling programme aiming to lift the resources indicated category from 75% to over 90%. Metallurgical testing and geotechnical modelling to assist with the mine plan will begin in the coming months.

Anglesey Mining has a long-term partnership with QME, an Irish technical services company, to assist in the development of the project and the contractors have an option to earn-in 30% of the project in return for self-

White rock core from Anglesey Mining's Parys Mountain project funding the underground development.

"QME is part of the DNA of the underground project already, and would likely tender for the development of the project when that time comes," Battershill says.

"The QME earn-in option means that a significant amount of the pre-production capex is potentially underwritten already. That would obviously mean some dilution, but it would ensure the project is developed by a very credible and experienced mining team.

"From an investor perspective, this should bring some confidence that the [Anglesey Mining] will be in a position to close the large gap between our market capitalisation of £9m and the NPV of Parys Mountain implied by the PEA … even if we did end up with 70% of it."

That low market capitalisation also fails to reflect the unlocked value in Anglesey Mining's other two projects. Under previous management, the company shifted its focus towards iron ore projects in Canada and retains a 12% holding in the OTC-listed Labrador Iron Mines. Anglesey also has just under 20% equity – with the option to acquire another 50% – in the Grängesberg Iron project, which was Sweden's third-largest mine until its closure in 1989. Anglesey Mining is currently updating a 2012 prefeasibility study on the project that outlined a 3Mt/y project producing greater than 68% iron.

"This project could be enormous, but so far it has sat in the background of our valuation," Battershill says.

In order to better reflect it's status as a mine developer, Anglesey Mining announced in February that it would be moving its listing to the AIM board of the London Stock Exchange.

"The board have always been rightly proud of the company's listing on the main board and the premium segment does expose you to indexes and institutional investors," Battershill says.

"But with the current market cap, we aren't going to be included in any indexes and the strict corporate governance on the premium segment limits our flexibility with respect to funding development work across our assets. As a junior mining development company, the AIM listing is better suited to Anglesey Mining."

The new listing, combined with new management, is


Jonathan Battershill, CEO

another marker of a fresh start for Anglesey Mining and for Battershill. For the undervalued company, 2022 and 2023 could be formative years.

"For a £9 million market cap you get exposure to a solid base metals asset with strong financial metrics and substantial exploration upside," Battershill says.

"After a slow five years, Anglesey Mining has a clear strategy and path to bring both Parys Mountain and Grängesberg to development decisions in the coming years."

Anglesley Mining – at a glance

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Directors
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Market Capitalisation
£8.45 million (at press time)

Quoted Shares on Issue
248.1 million

Major Shareholders
Juno Ltd, 23.3%; Monecor Ltd, 4.65%

Continued from page 37

original work done back in 2011 and now it's time for a fresh set of eyes to go back over that project and see what might be there," Craig Parry, executive chair at Vizsla Copper told Mining Journal.

Having been spun-out from Mexican silver explorer Vizsla Silver in 2021, Vizsla Copper has an option on the Carruthers Pass copper-zinc-silver-gold-cobalt volcanic massive sulphide (VMS) project where historical drilling intercepted 3.1m grading 6.2% copper, 5.8% zinc, 2.37g/t gold and 192g/t silver.

Vizsla also has the Blueberry project immediately adjacent to Aurwest Resource's Stars porphyry copper-molybdenum project, which it consolidated in December 2021, by agreeing to buy M3 Metals 50% interest. Stars is contiguous Aurwest's Stellar property and so it consolidated ownership of a 28,294 hectare prospective porphyry camp. Stars has returned similar grades as MPD with a highlight of 204m grading 0.45% copper. Aurwest said it intends to conduct a 3D modelling of all available historical exploration data on the two properties to prepare an exploration programme and budget. Meanwhile, the company is focused on gold exploration in Newfoundland, Canada.

"It was a very good deal that Aurwest has done in a district that is starting to emerge and is part of a larger district around Huckleberry. The M3 Metals discovery hole was 204m grading 0.45% copper and 0.5g/t gold, so pretty good looking intercepts there. We've got some good targets on our own ground at Blueberry there but the area is ripe for consolidation," said Parry.

The MPD project of Discovery Group company Kodiak Copper more than fits bill of the the typical BC deposit. It is located between the Highland Valley and Copper Mountain mines and returned an intercept of 535m grading 0.49% copper and 0.29g/t gold for a 0.76% copper equivalent, which is perhaps why BC stalwart Teck Resources invested C$8 million for a 9.9% stake in the company.

Kodiak drilled 21,675m in 2021 and extended the Gate Zone mineralised footprint from 125m to 950m. Some 25,000m of drilling in planned for 2022 at Gate and other targets.

In Northern BC, Brixton Metals' Thorn is a district-scale porphyry copper-gold-molybdenum exploration project where drilling returned 554.7m grading 0.57g/t gold, 0.24% copper and 43.18g/t silver or 1.09% copper equivalent. Brixton counts Eric Sprott, Robert Friedland and Rob McEwen among its shareholders. In addition, Friedland's High Power Exploration has a $44.5 million earn-in agreement on Brixton's Hog Heaven project in Montana, USA, where a maiden drill programme in 2020 returned 82m of sulphide grading 67.09g/t silver, 0.73g/t gold and 0.23% copper.

Also hunting for BC porphyries is Libero Copper whose Big Red project has returned 21m grading 0.86% copper and 0.4g/t gold from near surface and the nearby Big Bulk which returned 97m grading 0.19% copper, 0.97g/t silver and 0.18g/t gold for 0.34% copper equivalent.

USA

Arizona, the Copper State, is copper heartland in the USA which produces 74% of its red metal and is the backbone of Freeport-McMoran's copper operations as well as where other majors have development stage projects, such as Rio Tinto's Resolution and Hudbay Mining's Rosemont. Grassroots exploration is returning, spurred no doubt by moves at a government level for the nation to be less dependent on imports of critical and key metals, such as copper. The newest entrant, Mundoro, branched out from the Western Tetyhan belt in Eastern Europe to explore the Larimide copper belt, together with partner Vale, in what Dechev believes is the first concerted generative exploration effort in the region for years.

"Going into the southwest US is something I've wanted to do for the last five years. There hasn't been a real influx of exploration activity for new copper discoveries. Putting an asset through engineering studies does not mean that there is exploration for new discovery and that's what Mundoro is keen to focus on in the southwest USA. That's going to be undercover exploration, which is what we've been doing for the last 10 years in the Timok region in Serbia so we're using similar exploration techniques, the same expertise and knowledge, and applying it to a belt where most of the recent exploration has focused on near surface," said Dechev. Mundoro's deal with Vale will fund generative

exploration projects under cover in Arizona and New Mexico, with each designated project that results to be covered by a separate option agreement under which Vale can acquire 100% through sole-funding exploration and, upon completion of the option, make aggregate cash payments to Mundoro of $9 million over four milestones and grant to Mundoro a 2% net smelter returns royalty. Mundoro has already generated one property on which Vale has signed an option agreement.

Mundoro is not a sole junior in Arizona. Arizona Metals has a 75,000m expansion drilling programme underway at its Kay VMS with a highlight of 54m grading 1.9% copper, 2.9g/t gold, 5% zinc and 29g/t silver. Bell Copper is exploring Big Sandy, a porphyry copper-molybdenum target and also has the Perseverance porphyry upon which Cordoba Minerals has an earn-in agreement, and is close to taking its interest to 51%. "We have earned a 25% interest and we're in our second phase and we should be meeting the 51% milestone sometime in December [2021]. The exploration team have identified anomalies and we're drilling the first hole," Cordoba Minerals president and Sarah Armstrong told Mining Journal.

Barksdale Resources also aims to start drilling in 2022 at its Sunnyside project adjacent to South32's Hermosa project near the border with Mexico, although its main interest is south of the border at San Javier, a shallow copper oxide project. Barksdale completed 5,000m of drilling there in 2021, with intercepts including 105m grading 0.63% copper and 0.4g/t gold.

"The goal was to confirm the historical resource and start working towards expansion. We know there's an oxide copper deposit there with some sulphide at depth. Our job was to go in and fill in some rather large gaps within the resource area and start stepping out. We've released maybe the first 20 holes out of a 36-hole programme so once [all the results are back] and all that data is incorporated into the geologic model, we can start working on a resource estimate," Rick Trotman, president and CEO of Barksdale Resources told Mining Journal.

With metallurgical testing underway to show whether the copper is recoverable via simple and cheap recovery methods, Barksdale will potentially be able to publish a preliminary economic assessment before mid-year. "We'll move pretty quickly to push this to a place where we can demonstrate to investors that there'll be a mine and a mine that is cashflow positive and can make money," said Trotman.

Also in the USA, in Montana, American Pacific Mining acquired the Madison project in June 2020 and an earn-in agreement with Rio Tinto, under which the major can invest up to US$30 million to earn 70% of the project.

Madison is a porphyry-fed skarn which produced ore grading up to 25-35% copper. Some 4,000m was drilled in 2021 and a magnetic survey was completed. Drilling reported in January returned 6.5m grading 14.44g/t gold and 0.11% copper.

"Rio Tinto understands the porphyry copper-gold models better than anyone in the business and they realise that this portion of Montana is well known for porphyry systems, including the very prolific Butte mine which produced 23Blb copper, 700Moz silver and 3Moz gold.

This extremely large deposit is located 48km north and on the same structural trend as Madison. This is the type of ore body that Rio is exploring for," American Pacific Mining president Eric Saderholm told Mining Journal. With a number of junior explorers funded and working in the Americas, 2022 promises to be a year of share pops on drilling.

Alma Metals seeks the future of copper in Australia

A core sample with visable mineralisation

ASX-listed company exploring for vital green-energy metal in Queensland and Western Australia

There is plenty of untapped potential beneath the Australian soil for ASX-listed copper exploration company Alma Metals, as it focuses on identifying today the low-risk copper projects that will be economically viable tomorrow.

Alma Metal's CEO Frazer Tabeart said the company's years of experience in the exploration and mining industry means it is well-placed to unearth the next large-scale copper deposit in Australia, as the industry continues to factor in global decarbonisation.

"Copper is the critical metal which underpins that decarbonisation shift and is unlikely to be materially substituted by other metals or replaced by a new technology," Tabeart said. "Copper demand is actually more likely to accelerate in the coming years to ensure we have access to clean and sustainable electricity, so there will be more opportunities to mine lower copper grades to meet that demand. "This means there are plenty of opportunities out there, projects which were traditionally seen as uneconomic but which are now considered viable under current and predicted long-term copper price trends," he added. This strong focus on the copper market has pushed Tabeart and the Alma Metals board to concentrate on low-risk projects in low-risk jurisdictions. The perception shift on climate change in recent years also had a major impact. Although the spot copper price recently dipped below the US$10,000/t mark, 2021 saw record highs for the bullish copper market. This was led by rising demand as global policy continues to shift towards lower carbon economics, vehicle electrification and renewable energy sources.

"We felt strongly that copper was a very robust industry to move into," Tabeart said. "When you look at sustainable-energy generation like wind turbines, solar panels, electric motors – what they all have in common is copper. Electrification will always need copper. We know markets are cyclical, but we identified that copper would be an excellent strategic move for our own transition."

Alma Metals is focused on its flagship project, known as the Briggs, Mannersley and Fig Tree Hill porphyry copper project, which is located 50km west of Gladstone in Queensland, Australia. The Queensland copper project, which is currently owned by Canterbury Resources, includes three exploration permits over an area of 241sq km and contains a JORC inferred mineral resource estimate of 143 million tonnes grading 0.29% copper at a 0.2% cut-off grade in the central porphyry zone of the Briggs project. Alma has secured an exclusive option agreement over the project, which provides the company with the opportunity to enter an earn-in joint venture. The earn-in will be a three-stage process, initially reaching 30%, moving to 51% and finally to 70% ownership if the company completes stage three.

"It has massive potential and is currently our flagship project," he said. "We're convinced the resource can grow substantially – we see a lot of upside on that." The next six months will be busy for Alma, with the assay results due from the last round of drilling and a decision to be made on the project, Tabeart said. If it does exercise the option, Alma will enter a major drilling phase at the Queensland site as part of the first stage of the earn-in.

"What has been discovered so far is very promising, with a large copper porphyry deposit known to exist," he added. "Preliminary results indicate that it has the potential to be much larger than previously expected." While the project has undergone exploration in the past 50 years, only 32 drill holes had been previously drilled at Briggs, most of which were less than 100 metres depth. This drilling encountered relatively low grades of copper, but the industry has seen a drastic change in recent years with large-scale, low-cost projects becoming more viable.

"If you have good metallurgy and good infrastructure and can get a decent amount of tonnage, 0.3% copper can be very robust, especially in a long-term bull market," Tabeart said. For Alma, this is part of the company's long-term growth strategy as the company continues to monitor additional opportunities across Australia. "We consider copper mineralisation in secure jurisdictions to be a very attractive target, especially with our expertise and access to great consultants," Tabeart added. "We have a very strong technical background in a variety of copper deposit styles, and a board with strong commercial experience evaluating and developing such deposits." Alma has also been granted exploration licences for three projects in the world-class South West Terrane in Western Australia. The Tarin Rock and Sunnyside-Mayanup projects have a similar geological setting to the large-scale porphyry deposits of Boddington and Caravel, while the Kondinin project is located close to the boundary between the South West Terrane and the Youanmi Terrane.

Alma also has two additional projects in WA under application. The Cambridge Gulf project and the Menuair Dome project are located in the East Kimberley within a 100km radius of Wyndham. These two projects are still in the application stage, Tabeart said, with the company currently engaging with traditional owners to better understand the views and aspirations of the local communities and to discuss cultural heritage and access agreements.

"We generally tend not to focus on pure grassroots exploration because the risk profile is much higher," he said. "Occasionally the potential rewards justify the higher risk, which is what we are doing in the Kimberley, where we feel there is an unrecognised terrain for sediment hosted copper mineralisation similar to the spectacular African Copperbelt, which hosts some of the world's greatest copper deposits."

For Alma, the immediate question is whether the resource at the Briggs porphyry copper deposit in QLD will be large enough to be economically viable, providing the company with the opportunity to progress the project through resource delineation, pre-feasibility studies and potentially develop an operational mine over the next five-year-period.

"A major drilling campaign would help us answer that question," Tabeart concluded. In the meantime, Alma will also be ensuring they don't "drop the ball" on other emerging opportunities, especially projects that may be out of favour at the moment, but prove to be a worthwhile investment in the long-term as lower grades continue to become more economic. "We are always looking for specific types of copper projects where we have the personal professional experience to identify resources that can be reasonably and economically mined," Tabeart said.

Alma Metals – at a glance

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Market Capitalisation
A$24.4million (February 8)

Quoted Shares on Issue
739,472,257

Major Shareholders
First Quantum Minerals (Australia) Pty Ltd, 11.7%); Alasdair Cooke, 7.4%; PS Consulting Pty Ltd, .8%); Wimalex Pty Ltd, 2.7%; Clear Elm Pty Ltd,2.6%