



Orla Mining expects its Camino Rojo mine in Mexico to generate between 90,000 and 100,000 ounces of gold per year at an all-in sustaining cost of less than US\$700.

From gravel pit to gold mine

On the surface, Orla Mining's Camino Rojo gold oxide mine is about as conventional as they come, but dig deeper and it starts to get a little complex

By Herb Mathisen

The first gold pour is a major event for any gold mining company. It is made all the more memorable when it occurs during a global pandemic.

With three doré bars successfully poured on Dec. 13, 2021 at the Camino Rojo gold mine, located in the north-central Mexican state of Zacatecas, Orla Mining's president and CEO Jason Simpson could finally take a moment to enjoy the accomplishment. He joined the rest of the team to mark the milestone Mexican-style, with "a carne asada barbecue and beverages."

"It was a bit new for all of us, celebrating with masks on and trying to keep some distance," said Simpson. Although groups were kept in bubbles during the outdoor party, Simpson made some remarks to the gathered crowd, specifically thanking the Mexican teams on the ground – led by general manager Sergio Saenz – for bringing the project through permitting, construction and into production on time, on budget and during the COVID-19 pandemic.

The gold pour came just about one year after construction began on the US\$134 million gold oxide mine, and roughly four-and-a-half years after Orla Mining first purchased the project from Goldcorp.

"There was a lot of work that had to get done to achieve it," said Simpson, who came on as CEO of the Vancouver-based com-

pany in late 2018, after helping build the Morelos Gold project in Mexico as COO for Torex Gold. "Although we may look very smooth going across the water, trust that the legs underneath are paddling very quickly."

Conventional at the surface

As currently configured, Camino Rojo is a conventional open-pit operation.

Based on an updated feasibility study from 2021, the project has a 10.4-year mine life, with projected average annual production of 94,000 ounces of gold and 597,000 ounces of silver over that time. The mine's anticipated all-in sustaining costs are US\$543 per ounce, due in large part to the low strip ratio (0.92 waste-to-ore). In late February, Orla announced its first annual guidance with gold production from the Camino Rojo Oxide mine expected to be 90,000 to 100,000 ounces. All-in sustaining costs for the second quarter through to the fourth quarter of 2022 is forecast to be \$US\$600 to US\$700 per ounce of gold sold.

The Camino Rojo gold oxide project has proven and probable reserves of 1.6 million ounces, from 67 million tonnes grading 0.73 grams per tonne. The mine employs roughly 300 workers and runs 24 hours a day, with two Komatsu PC1250 excavators, one 993K and one 992 Caterpillar loader feeding a fleet of 777G



Even though the mine is now in operation, exploration is continuing. Orla intends to spend over US\$10 million in 2022 to further explore Camino Rojo.

Caterpillar haul trucks at the pit. The trucks move the ore less than one kilometre away to the crushing plant, which has throughput capacity of 18,000 tonnes per day. A Terex primary crusher and then secondary crushers break the ore down to 80 per cent passing 28 millimetres before it is moved via a system of fixed and mobile Dimisa conveyors for stacking on the heap leach pad. “We started with a five-metre lift, just to get better recoveries and stacking rates and [to] train our people,” said Saenz. “On the second lift, we’ll go with 10-metre lifts.”

Here, the ore is irrigated with a cyanide solution, and the pregnant solution passes through a Merrill-Crowe plant, where the metal is recovered. From there, the precious metal sludge moves on to the refinery, where it is filtered and dried in a mercury retort and then smelted to produce doré. “It’s a combination of gold and silver that’s shipped out to a refinery for final refining,” said Saenz. The 2021 feasibility study anticipates gold recoveries of 62 per cent and roughly 20 per cent silver recovery.

Right now, Orla is working through commissioning and it expects to achieve commercial production at the open-pit operation during the first quarter of 2022.

But when you dig a little deeper – specifically down to the project’s south-east sloping gold-silver-lead-zinc sulfide deposit below the current gold oxide mine – then Camino Rojo gets more complicated.

In total, the Camino Rojo property has a measured and indicated resource of 9.5 million ounces of gold from 353.4 million tonnes at 0.83 grams per tonne. Orla Mining will spend the next few years determining if, when, and how to mine the sulfide deposit, based on considerations that go all the way back to when it first acquired the property.

Gold on the side of the red road

Camino Rojo is a relatively recent discovery made by a Canplats Resources Corp. geologist in 2007.

“As the story goes, a geologist was driving down a gravel road, stopped, and got out and took some grab samples of the material on the road and determined that it had some anomalous gold,” said Simpson.

Investigating where the material had come from, the geologist was led to a gravel pit used to build the road. “The red road – Camino Rojo, as it became known – came out of that gravel pit,” said Simpson, adding that very gravel pit is the basin of the mine today. “What he determined, when he got to that aggregate pit, was that a few metres below the overburden was bedrock and the bedrock contained gold.”

Eventually, Goldcorp purchased Canplats and the property in 2010, just after it had built the Peñasquito mine – a large gold operation in Mexico – 50 kilometres to the northwest. Goldcorp would spend the next seven years defining the gold oxide reserve and drilling down to learn more about the larger sulfide deposit below.

In 2017, Orla Mining – formed two years earlier and in the process of exploring its Cerro Quema gold oxide property in Panama – purchased the project from Goldcorp during the major miner’s “asset rationalization process” and quickly got to work advancing it.

But when Goldcorp (now Newmont) sold the project to Orla, it made sure to keep an interest in Camino Rojo, including a possible option to take a major stake in the sulfide mine, depending on how Orla decides to mine it. At present, Newmont is a 16.6 per cent shareholder in Orla Mining and also holds a two per cent net smelter royalty (NSR) on Camino Rojo. (It sold its NSR on the gold oxide project, but retains the royalty for the potential sulfide project.)

Newmont also has a back-in agreement on that sulfide project. Since the ore from that deposit requires more milling and processing to recover the contained gold, Orla would have to build a processing plant.

That presents Simpson and his team with some options. If they decide to take an open-pit approach, Orla could transport the ore to Newmont's Peñasquito processing facilities. In that case, Newmont would earn a 70 per cent interest in that sulfide project, assuming control of it, with Orla retaining 30 per cent. Another scenario exists where Newmont could obtain a

controlling 60 per cent stake in the sulfide project if Orla defines a proven and probable mineral reserve of more than 500 million tonnes.

What does Simpson prefer? "We're agnostic about the option that carries the day, as long as it is in Orla's shareholders' best interests," he said. "If we build our own plant, we would retain

Photos courtesy of Chris Monette/Orla Mining



Clockwise from top: grasshopper conveyors transporting ore to heap leach pad; refinery workers in their protective gear; the first bar poured at Camino Rojo; crushed ore stockpile.

100 per cent of the value,” said Simpson – again, if the project’s reserve is below 500 million tonnes. “If we choose to process it at Peñasquito, we’ll need to share that value with our largest shareholder, Newmont.”

Complicating matters, the mine sits on the northern edge of Orla’s property. Based on the open-pit dimensions necessary to access its gold oxide deposit, Orla had to negotiate a layback agreement with its neighbour, Mexican miner Fresnillo, to build a portion of the pit on its property. (Orla recently made a US\$25 million payment to Fresnillo for the pit access and expects to pay US\$62.8 million in total.)

If Orla decides to mine its sulfide deposit with an open pit, it would have to negotiate a new agreement with Fresnillo to extend the pit’s boundaries. “For the wall angles, we would need to layback onto their ground further than we’re laying back with the oxide mine,” said Simpson.

Taking the next step

As it decides what to do with the sulfide deposit, Orla Mining will continue to look at other near-surface oxide deposits close to the current mine, which it could use to prolong the operation’s life. The company will spend roughly US\$15 million on exploration at its Panama and Mexico properties this year, with two thirds of that total being earmarked for Camino Rojo.

Orla will devote part of this budget to new targets its geologists have identified on the 163,000-hectare Camino Rojo property, said Simpson. “We have 10 million ounces on less than two per cent of that whole land package.”

The company has a 30-year concession agreement for the Camino Rojo project, which runs until 2043. Orla Mining has one Ejido agreement for the property. In Mexico, an Ejido is a communal area of land held by a community collective, primarily for agricultural uses, and miners must get consent from all the local owners to gain rights – but not ownership – over the land.

Local involvement has been key to developing a long-term operation in Zacatecas, explained Saenz. “We’re quite fortunate that Zacatecas has an experienced workforce in mining. Mining is a big industry here. We’re very close to some small communities, we’re able to get a lot of our workforce from the communities,” he said. “They go home every night, which makes it perfect.”

Right now, Saenz said 56 per cent of the workforce is local and roughly 78 per cent of the workforce is from the state of Zacatecas. “The rest are Mexican nationals and some of them work 14-and-seven [day] rotations,” he said.

The gold oxide mine at Camino Rojo was the obvious first move for Orla Mining, according to Simpson, based on its low stripping ratio, low capital costs, proven mining and processing methods and access to employees, contractors, suppliers and services in Zacatecas. “We had gold basically at surface, no mountains to move, low complexity construction,” he said.

“All of these things combined to give us the understanding that, strategically, the oxide mine was a good first step for Orla,” said Simpson, adding Camino Rojo proved to the market that the company could build and operate mines.

“But it is only the first step.” 



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Ivanhoe Mines has spent approximately US\$2 billion getting the first two phases of its Kamoakakula Complex in the Democratic Republic of Congo up and running. Ore was introduced into the phase two milling circuit on March 21, 2022.

A lot of copper – fast

Kamoakakula is well on its way to making Ivanhoe Mines one of the biggest copper producers in the world

By Carolyn Gruske

The number of exploration projects that become actual mines is vanishingly small. For the mines that do get built, most are delivered late and over budget. So far, Ivanhoe Mines' Kamoakakula Complex has defied the odds.

Situated in the Democratic Republic of Congo (DRC), approximately 25 kilometres west of the town of Kolwezi, the copper mine is in an area better known for cobalt mining, but, as Steve Amos, head of projects, Kamoakakula Copper, noted, "with cobalt comes copper, so there's a lot of copper coming from that area as well."

"A lot of copper" is a good way to describe Kamoakakula itself. The mine site has already seen the first two phases of construction completed. The Kakula deposit has been the focus of phases one and two. Kamoakakula, to the north, will be brought online during phase three. Early planning for phase four is already under way and there is also a phase five envisioned. Once phase three is completed in 2024, Vancouver-based Ivanhoe expects the underground mine (which has 30-year-plus life of mine plan) to be the third largest producer of copper in the world and yield 600,000 tonnes per annum. And it is that volume of copper

– and especially its grade – that is one of the key reasons why construction was undertaken at a lightning-fast pace.

The ore body

There was not supposed to be any copper at Kamoakakula, at least that was the general thinking about the site, according to Amos.

"All the geologists said the copper belt stops just outside Kolwezi and that there's nothing further west, so everyone [exploring here] was wasting their time. But for some reason, Ivanhoe and Robert Friedland believed and they started exploring."

Exploration is a slow process, and an expensive one. The current mining licence covers 400 square kilometres, and the initial exploration permits covered much more. The company drilled over 2,000 holes, each approximately 200 metres deep. At \$200 per metre, costs added up quickly. Early holes indicated copper, but they only came in around three per cent. The six per cent copper ore body – the ore body that is now being mined at Kakula was a later discovery.



Solomon Asemidi, a graduate mechanical engineer with DRA Global poses in front of an under-construction Jameson Cell.

While the other nearby mining deposits are hosted in mainly dolomites similar to the geology of the Zambian copper belt, Kamoia-Kakula's geology is different. The Kamoia-Kakula ore body is situated in the Grand Conglomerate, which is part of the Nguba supergroup and consists of diamictite, sandstone and siltstone. Copper appears at between 200 and 300 metres below the surface, deepening to the east and west.

"The ore body is cross-cut by a number of fracture zones that contain water. In order to mitigate the risk of excessive water entering the mine, significant drilling ahead of the faces occurs. The mine is still fairly wet though and we have installed approximately 4,000 litres per second of underground pumping capacity at Kakula. I suppose the biggest risk used to be underground water management but this is now under control; we also identified some recharge from surface, which has now been stopped. We realized that if there's any capital required for an extra pump station, we just put it in to de-risk the mine. The extent of water encountered was a bit of a surprise," said Amos.

He added that the mined rock is very hard and the copper minerals are very fine grained, which is a bit different than that found in most copper deposits, thereby requiring fine grinding and a relatively large amount of milling power to process.

In its March 2020 resource update, Ivanhoe and its partners – Zijin Mining Group, Crystal River Global and the government of the DRC – reported that the total indicated mineral resources for Kamoia and Kakula were 83.7 billion pounds of copper from

1.38 billion tonnes, with a grade of 2.74 per cent. The inferred numbers are 339 million tonnes at 1.68 per cent resulting in 12.5 billion pounds of copper.

Those broader-focused numbers, however, do not paint a full picture of what convinced Ivanhoe to move forward with the mine. The preliminary economic assessment predicted getting grades as high as 6.8 per cent copper in the first year of production and 5.1 per cent during the first 10 years of operations.

In August 2021, Ivanhoe reported that "a total of 414,000 tonnes grading 5.16 per cent copper was mined in July and comprised 367,000 tonnes grading 5.29 per cent copper from the Kakula mine, including 85,000 tonnes grading 7.70 per cent copper from the mine's high-grade centre."

More recently, in a statement issued in July 2022, Ivanhoe reported that Kamoia-Kakula produced 30,379 tonnes of copper in concentrate. It milled 1.95 million ore tonnes during the second quarter of the year at an average feed grade of 5.44 per cent copper with copper recoveries averaging more than 86 per cent during June. During the same quarter, feed grades averaged approximately 5.5 per cent copper. Production costs are roughly US\$1.25 per pound of copper.

These high grades of copper were (and still are) the driving force to getting the mine built and into production as quickly as possible, according to Thys De Beer, program manager at DRA Global in South Africa. DRA is the engineering, procurement and construction management company for the majority of the work being done at Kamoia-Kakula. "We fully understood that, based on what's in the ground, this project was going to be extremely time sensitive. We were definitely going to have to fast track the project to execute," he said.

"The thing that's typical to most mining projects, especially if they have a very good resource, is that cash is king. You would like to get cashflow as early as possible. It doesn't help if you've got this magnificent resource but you can't actually put money in the bank. That's where the pressure comes from. It's from that point of view that we knew that it was going to be a very fast-paced time-sensitive project."

Successes and milestones

The speed of construction at Kamoia-Kakula is something both Ivanhoe and DRA talk about proudly. Amos stressed that it took only 22 months from the time that orders were placed for long-lead-time items of equipment for the plant to May 2021, when phase one was commissioned. Phase two was commissioned this year in March, four months ahead of schedule. Phase three is currently under way while, at the same time, the mine is also involved in a US\$50 million de-bottlenecking effort for its phase one and two operations – an effort that should maximize the existing milling capacity and increase annual copper output by 50,000 tonnes per annum to approximately 450,000 tonnes per annum.

While not exactly cutting corners, Ivanhoe kicked off the project by skipping a traditional step or two.

Opposite page, clockwise from top: ongoing excavation and construction of the Kamoia 1 and Kamoia 2 box cut, ramp and twin declines, which will provide access to Kamoia-Kakula's main phase three mining areas; the phase two high-pressure grinding rolls (HPGR) stockpile feed conveyor began commissioning in February 2022; Kamoia-Kakula's phases one and two HPGR towers and stockpiles; Kamoia-Kakula's phase two concentrator has 14 flotation cells.



All photos courtesy of Ivanhoe Mines



“Kamoa generally starts early works execution based on a pre-feasibility study. With such an exceptional deposit, we are not believers that we need to go all the way through feasibility, and then getting a basic engineering and order of magnitude capex estimate before starting. Speed is important with the obvious regard for safety, quality and cost. If you bring a mine on a month early and you are producing 400,000 tonnes of copper per annum, you can work out how many million dollars that generates you,” explained Amos.

For DRA, that meant taking an unusual approach to how it even started the phase one construction process, said De Beer.

“On a standard project, you would normally do a lot more study work and project setup prior to starting with execution. This time around, we had to commence with mining development, on the back of a much higher-level mine design than is the norm.”

Long-lead procurement and earthworks design also started much earlier than one would find in a typical project life cycle. This early-start approach is continuing as the next phases begin.

“I cannot overstate the impact that effective and early decision taking by the Kamoa client team made in assisting DRA to execute in this manner,” said De Beer. “Add to this a skilled and experienced project team and you have a recipe for success.”

De Beer was quick to point out that the pace of mine advancement was also faster than he was used to as the mining teams, including Chinese contractors, frequently developing two kilometres per month. “This, in turn, added a lot of additional pressure on design and procurement teams to have materials for underground infrastructure delivered in time, allowing the construction crews to keep up with these mine development rates.”

Fortunately, the Kakula ore body lends itself to a relatively straightforward design, explained De Beer. Two decline systems access the ore body. One is a dual portal and the other a single. The dual contains a rock-handling conveyor system that cycles 2,000 tonnes per hour, bringing the rock to the surface. Copper ore is fed into a large 3.8 million tonnes per annum base-metal concentrator with fine grinding in a M2F (mill float) configuration. “Unique to the concentrator was the inclusion of HPGR [high-pressure grinding roll] technology, in closed circuit with the primary milling,” explained De Beer. Since the mine is a drift and fill operation, backfill is required, which necessitated that a backfill plant be built. According to DRA, it is the largest paste plant in the world, designed with two separate streams each with a capacity of 150 cubic metres per hour of paste.

As far as the process plant is concerned, phase two essentially duplicated phase one in terms of design, engineering and construction. The total capital investment for the first two phases was approximately US\$2 billion.

The next stage

With phase three, Ivanhoe hopes to up copper production at Kamoa-Kakula to 600,000 tonnes per annum. Again, two declines will access the Kamoa 1 and Kamoa 2 orebodies with the existing twin decline access to the Kansoko ore body. The Kamoa-Kansoko mines are situated around 10 kilometres north of Kakula. Excavation of the Kamoa box-cut is essentially complete with decline development well under way. Water-handling is a big focus based on the lessons learned from Kakula, which has a similar geology. The planned phase three Kamoa concen-

trator plant has been designed for a capacity of five million tonnes per annum, with the front end (crushing and screening) sized for 10 million tonnes per annum.

One new feature will be the addition of a US\$800 million Metso Outec direct-to-blister flash smelter, which Ivanhoe claims will produce 99 per cent copper material. China Nerin Engineering Co. has the engineering contract for the smelter.

A major difference between phase three construction and the earlier stages will be the state of the world. The COVID-19 pandemic was at its height during the initial phases, and DRA took advantage of the changes it wrought on the engineering and manufacturing worlds. De Beer said with other projects being placed on hold, engineers and designers were suddenly freed up to work on Kamoa-Kakula.

Amos said at the peak, there were approximately 10,000 people, including contractors and owners’ team members working on site.

With manufacturing shut down and goods not moving, logistics were cheap and available. Since China experienced the earliest wave, and as a result, came back from shutdown first, its manufacturing industry was ready to produce when Kamoa-Kakula needed it. Fast manufacturing times in China forced DRA to shorten up its own timelines for designing and issuing drawings.

Now, however, the situation has changed. Logistics operations have snarled around the world. Charges to ship a container from China increased from US\$1,500 during the height of the pandemic to as high as US\$6,000, said Amos. Supply shortages of vital equipment such as electrical components are also problematic, especially when working to tight deadlines. Inflation and rising prices of copper, iron ore and steel will also provide a challenge, he said.

Additionally, Ivanhoe (in conjunction with the DRC’s national energy producer) has committed to replace a non-operational turbine at the Inga 2 power station. This will generate 178MW of hydroelectric power required for phase three. This is a similar model to the one Ivanhoe used to supply power for phases one and two as part of its deal to access green electricity from the DRC’s national grid – a vital part of allowing the mine to achieve net-zero emissions and become a “green” copper producer.

The cost estimate for phase three will be released in the fourth quarter of the year, along with the phase three pre-feasibility study.

Despite the growing scope of work with each subsequent phase, Amos is completely confident phase three, and the subsequent phases, will run as smoothly as the first two did.

“One thing that people often say to me is ‘Look at all these big projects in the world. They’ve all been late and over budget. What did Kamoa do differently?’ And I always say to them, ‘There’s no secret. You should be looking at your project and determining why it was late, because there’s a reason. Something went wrong somewhere.’

“Having said that, good planning and good people are the two key attributes you need to be successful. And obviously, support from the shareholders.”

De Beer echoed Amos’s thoughts about the importance of having the right people.

“The successes achieved on this project can only be attributed to a world class project team. This project team demonstrated a relentless passion and dedication and I am positive that this team will make the future phases of this exceptional project an even better success.” **CIM**