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KOMATSU

Cu Peru 2



John Chadwick continues his detailed examination of Peru's copper projects and its growing world stature. The first part was published last month

According to Ministerio de Energía y Minas (MINEM) in November 2015, national production of copper reached 1.5 Mt, a new historical record for Peru. Marcos Villegas of MINEM said that "with this level of production, Peru would be close to reclaiming second place as a copper producer in the world, a place that is currently in dispute with China. Peru would finally take this second place in 2016 with the implementation of mega projects such as Las Bambas and the extensions of Cerro Verde and Toquepala".

According to the statistical report of MINEM, the cumulative copper production in the first 11 months grew 19.85% as compared to the same period in 2014, and increased 37.43% according to the same month. This growth is thanks to the now fully operating important copper projects and expansions that started in 2014 and continued throughout 2015 such as Toromocho (Junin), Constancia (Cusco), Antapaccay (Cusco) and Antamina (Ancash).

Accolades for Cerro Verde

Soc Minera Cerro Verde (SMCV – major shareholders Freeport McMoRan 53.56%, Sumitomo Metal Mining 21% and 19.58% Minas Buenaventura) has just completed a very successful expansion. The project primarily involved building a new 240,000 t/d copper concentrator bringing the total capacity of the concentrator facilities to 360,000 t/d and providing incremental annual production of

some 278,000 t of copper and 6,000 t of molybdenum beginning in 2016. First concentrate from this massive expansion project – it is now the largest milling and flotation concentrator complex in the world – was produced on time on September 17, 2015. Commissioning was completed at the end of 2015.

In a world leading superlative, building a 240,000 t/y concentrator in one go has never been done before. All other concentrators of that capacity have reached that mark in different expansion stages.

Most of the construction work was awarded to Peruvian companies (more than 50), with the majority of the work performed by GyM of the Graña y Montero Group (primary crushers, copper concentrator and moly plant). Other contractors included Cosapi (crushing /screening /HPGR), JJC (tailings), Mota Engil (piping), Abengoa (power), SSK (electrical), Skanska (waste water treatment plant WWTP), and SADE (WWTP piping).

<https://www.youtube.com/channel/UCwCXGcG3jRPZvInoRcxVPKQ>

The project also included one of the most modern waste water treatment plants in the world (*IM, November 2015, p3*).

SMCV makes extensive use of HPGRs. The new plant includes 8.2 m diameter ball mills (14.6 m EGL) and eight thyssenkrupp Industrial Solutions Polycom 24/17 HPGRs. ABB supplied six 22 MW GMD systems for the ball mills

The expansion of Cerro Verde primarily involved building a new 240,000 t/d copper concentrator, bringing the total capacity of the concentrator facilities to 360,000 t/d and providing incremental annual production of some 278,000 t of copper and 6,000 t of molybdenum beginning in 2016. It is now the largest milling and flotation concentrator complex in the world. Building a 240,000 t/y concentrator in one go has never been done before. All other concentrators of that capacity have reached that mark in different expansion stages. It was 2013 when SMI, a Peruvian subsidiary of Fluor Corp, was awarded a contract by Freeport-McMoRan to provide construction management services for the expansion. SMI had already provided engineering and procurement services beginning in early 2012

comprising of transformers, ring motors and complete containerised electrical houses as well as eight 2 x 2,500 kW twin-drive systems for HPGRs that include squirrel cage induction motors, transformers and ACS1000 frequency converters.

Each of the six GMDs are equipped with two of ABB's unique rotating air gap sensors, which together with the 12 standard air gap sensors on the stator give a true 360° overview of the stator and rotor. Whereas the HPGR drive systems work in accordance with the high demand requirements for such machines without using tachometers or encoders.

The original concentrator's comminution circuit consists of one 60" x 113" primary crusher, four MP-1250 secondary crushers in



The SMCV expansion used:

- 14,000 km of steel bar – the equivalent of the distance between SMCV and somewhere in central Australia
- The 50,000 t of steel would build six Eiffel towers
- 319 million m³ of concrete – 11 times the amount used in Arequipa's new Chilina bridge (a segmental continuous pre-stressed concrete viaduct, 562 m long with 157 m main span and two 11.3 m wide decks)
- There are 17 km of conveyor belt in the plant

closed circuit with dry screens, four Polycom 24/17 2.4 m x 1.6 m HPGRs (5 MW each) in closed circuit with wet screens, and four 7.3 m x 11 m gearless ball mills in closed circuit with cyclones. The HPGR circuit is fed by the secondary crushing circuit product at a T80 of 35 mm, and the HPGR circuit product feeds the ball mill circuit at a T80 of 3,000 micron.

Usually, the primary reason to choose HPGRs for hard rock comminution is the energy efficiency when compared to conventional crushers and mills. In addition, downstream energy use, typically in ball milling, is often reduced due to the increased fineness of the HPGR product (compared to conventional crusher product) and to reduced work indices caused by microcracking. There is also the benefit of reduced grinding media consumption.

Also, "HPGR also offers improved plant ramp-up times compared to SAG-based circuits, as an HPGR can operate at full throughput almost immediately, and has very high mechanical availability" (C. Morley, Fluor Australia in the 2010 SAIMM paper, HPGR—FAQ).

In the 2012 CIM paper *Cerro Verde concentrator – four years operating HPGRs*, S. Koski, J. Vanderbeek and J. Enriquez of SMCV report:

- The HPGRs have an effect in the reduction of the Bond Work Index especially in materials with higher BWIs
- Component wear and roll lifetime have

achieved the design projections

- The rolls can be refurbished a higher number of times than was originally estimated provided proper monitoring and scheduling is done
- All of the improvements to the HPGR operation have permitted circuit debottlenecking and achieving 10% higher throughput than design without being HPGR limited.

Toquepala, Tia Maria and more

While Tia Maria's EIA has been approved, "the issuance of the project's construction permit has been delayed pending the resolution of certain differences with community groups. The Peruvian government has recommended a dialogue roundtable for the resolution of these differences," SPCC states.

The company has established a multi-faceted encounter plan to explain the merits of the Tia Maria project. A national media campaign was launched in May and, after it, the company has conducted a door-to-door campaign in the neighbouring district of Cocachacra. This campaign had the purpose of explaining the relevant environmental topics of the project that concerned the local community, as the anti-mining groups had wrongfully confused the community with respect to the project's water source and consumption, as well as to the alleged emissions into the atmosphere.

"Tia Maria, when completed, will represent an investment of approximately \$1.4 billion to produce 120,000 t/y of copper cathodes. This project will use state of the art SX/EW technology with the highest international environmental standards. The project will only use seawater, transporting this more than 25 km and at 1,000 m above sea level, constructing a desalination plant representing an investment of \$95 million. In this manner, the company guarantees that the Tambo river water resources will be used solely for farming and human consumption."

The project represents a resource of at least 2.5 Mt of contained copper at a grade of 0.39% Cu. There are two deposits, Tia Maria with 193 Mt of mineralised material at 0.302% Cu and La Tapada with 445 Mt of mineralised material, at 0.434% Cu.

A lot of the antipathy to Tia Maria comes from worries about pollution of the Tambo Valley. SPCC counters this by explaining that stockpiles will be covered with domes and the distance of the facilities from the valley. La Tapada mine will be at 350 m above sea level (masl) and 2.5 km from the valley. Tia Maria is at 700 masl and 6.5 km from the valley. The processing plant will be at 1,050 masl and 11 km from the valley.

SPCC has a \$1.2 billion project for the construction of a new concentrator plant at the Toquepala mine (Tacna region) to expand the processing capacity of the existing plant. The concentrator expansion is a project that will not require the use of additional fresh water. Water supply will be covered by high efficiency thickeners to recover water from the company's tailings. SPCC says "this state of the art plant will allow for higher water recovery from the tailings facilities which, in turn, will be recycled for use in the concentration process."

For the expansion project, ABB is supplying two 25' gearless mill drive systems (GMD) of 15 MW and two complete high pressure grinding rolls (HPGR) drive systems of 2 x 2,650 kW. The HPGR drive systems feature the RollXtend™ technology, aimed to extend the rollers' overall lifetime and ease maintenance actions by application-specific control features.

Once in operation, the Toquepala expansion will increase annual production capacity by 100,000 t of copper, from 135,000 t in 2015 to 235,000 t in 2017, and will also increase molybdenum production by 3,100 t. The project also includes increasing storage capacity of the Quebrada Honda tailings dam from 732 Mt to 1,876 Mt. It is estimated that the project will generate 2,200 jobs during the construction phase and 300 additional jobs once finished, which will add to the current 1,500 permanent employees at Toquepala. The project should be completed in late 2017.

The operation will improve its comminution circuit with the installation of a HPGR system, which will act as a quaternary crusher. The main objective is to ensure that the concentrator will operate at its maximum capacity of 60,000 t/d, even with an increase of the ore material hardness index. The budget for this project is \$40 million and is expected to be completed by the Q1 2017.

In the Cuajone mine (Moquegua), the project to improve the stability of slopes at the south of the mine continues as scheduled. A total of 148 Mt is to be removed by late 2018.

An IPCC project consists of installing a primary crusher at the Cuajone pit with a conveyor system for moving the ore to the concentrator. The project aims to optimise the hauling process by replacing rail haulage, thereby reducing operating and maintenance costs as well as the environmental impact of the mine. The crusher will have a processing capacity of 43.8 Mt/y. As of September 30, 2015, SPCC had invested \$65.8 million in this project out of the approved capital budget of \$165.5 million. The project is expected to be completed by the second quarter of 2017.

The contract awarded to thyssenkrupp includes engineering, procurement and construction supervision as well as commissioning support of the complete IPCC system to process run of mine copper ore. As part of the new order, thyssenkrupp is supplying a semi-mobile crushing plant with discharge, transfer and two overland conveyors with a capacity of 120,000 t/d of crushed ore transported to the existing coarse ore stockpile. The copper ore will be fed directly into a semi-mobile crushing plant located in the mine. Truck ramps made of sectional steel modules provide access for mine trucks with payload up to 360 t. The crushing plant's main service and operating areas, including electrical infrastructure, will be physically separated and independent from the truck dumping level, which will significantly reduce vibration, dust and noise levels. The semi-mobile design is especially suitable for mine sites affected by frequent seismic activities.

The 63–114 heavy duty thyssenkrupp gyratory crusher with its 1,200 kW direct drive takes the feed material from the feed hopper and reduces the run-of-mine copper ore to the required product size. The crushed ore is extracted from the surge bin underneath the crusher by means of a heavy duty low speed belt feeder. The 2,800 mm wide ST 1800 conveyor will run at a nominal speed of 1.5 m/s and is powered by one 800 kW conventional drive and a variable-frequency drive (VFD). A 400 m long sacrificial conveyor carries the crushed ore from the semi-mobile crushing plant and crusher discharge conveyor to two overland conveyors spanning the 7.5 km distance to the coarse ore stockpile. The first of the two



overland conveyors will be 1,830 mm wide with ST 6800 belting and will run at 6.2 m/s. It is powered by two 6,000 kW Siemens gearless drives. The largest of their kind in the world, these conveyor drives use Siemens Integrated Drive System technology to provide a high level of availability (exceeding 99%) by eliminating many of the traditional conveyor drive components.

In mid-2014, Siemens was chosen by thyssenkrupp to supply the electrical package and automation system, the power distribution equipment, and the drive system. Alongside conventional drives, Siemens is deploying primarily Integrated Drive Systems (IDS) with gearless drives which offer a high level of availability by dispensing with many of the wear-prone components such as gearboxes, couplings and motor bearings. Gearless drives also enable the use of a continuous conveyor belt, eliminating the need for transfer stations and so reducing susceptibility to faults, cutting out the need for high-intensity maintenance and driving down costs.

The conveyor belt system comprises three individual sections which are equipped by a total of five Integrated Drive Systems. For the largest of the belt sections, Siemens is supplying two gearless drive systems with an output of 6,000 kW each, comprising a low speed synchronous motor and a Sinamics SL150 cycloconverter. The two smaller feed and discharge belts will be driven by two 500 kW low-voltage motors using Sinamics S150 inverters with regenerative feedback capability and one 1,200 kW medium-voltage motor. The converters and motors as well as the gearboxes and couplings for these drives are all supplied by Siemens. The automation components as well as the drive and power distribution technology are provided in modular electrical rooms (E-houses).

Siemens is no stranger to the Cuajone mine facility, where it supplied a drive system for a HPGR system back in 2013.

Cuajone represents one of the largest copper reserves in Peru and in the world having estimated reserves of 1.6 billion tonnes of ore grading 0.57% copper

As always, water is a serious question. CiDRA Minerals Processing successfully installed the largest SONARtrac system in Peru for Cuajone. The 1,219 mm meter was installed on a reclaimed water line. The large diameter of the pipe had prevented a flow meter from previously being fitted. Water resources in this area are scarce and highly regulated, and having an accurate flow measurement on this critical reclaimed water line allows Cuajone better water balance accounting.

The system is required to measure water flow in one of the plant's principal feed lines. The recovered water comes from Cuajone's four thickeners and flows to a reservoir near the concentrator plant. The water is then distributed for reuse in the concentrator plant through the water feed lines to mills and flotation. Six pumps work alternately, depending on the amount of water recovered, to feed the lines in accordance with process demands. The fundamental characteristic of being a non-intrusive system allowed the installation of the 1,219 mm flow meter without having to stop the process or cut the pipe, which would have been required to install conventional flowmeter technologies.

And more.....

The Quellaveco open-pit copper project is on the Southern Peru belt. There are reserves of 938 Mt of copper and molybdenum ore. Once the project is ramped up to full production, initial planning estimates Quellaveco could produce 225,000 t/y copper, with molybdenum and silver byproducts. It is a JV between Anglo American (81.9%) and Mitsubishi Corp (18.1%), and is operated by Anglo through its local subsidiary Anglo American Quellaveco S.A. Although Anglo dropped Michiquillay last year, it currently remains committed to Quellaveco.

Both La Granja and Haquira are among the world's major undeveloped copper deposits with excellent potential for large-scale copper mines.

Haquira is located in southern Peru adjacent to Las Bambas. First Quantum's acquisition of Antares Minerals and its principal asset, the Haquira deposit, was completed in December 2010. The deposit has reported Measured and Indicated resources of 3.7 Mt of contained copper equivalent and Inferred resources of 2.4 Mt of contained copper equivalent. In 2014, First Quantum commenced an environmental impact review at Haquira.

Speaking at the VIII International Congress of Law in Mining, Oil and Energy, November 2-3, 2015, Rosa María Ortiz, Ministry of Energy and Mines, announced that the mining projects: Anubia (copper, in Apurímac) and Haquira (copper and molybdenum, Apurímac) are both about to submit their EIAs for project development in the coming years.

Anubia (Aruntani Group) will require an investment of \$90 million to produce 20,000 t/y of copper, while Haquira will require \$2,800 million for its start-up in 2019 and annually produce 193,000 t/y of copper.

The Quechua copper project is located in Espinar in Cuzco department. The elevation of the property ranges from about 4,000 to 4,600 m above sea level. Cía Minera Quechua expects to produce 75,000 t/y of fine copper. Quechua is expected to require an investment of some \$0.5 billion and produce 1.30 Mt of copper in concentrate over its 17-year life. Minera Quechua is a subsidiary of Japan's Pan Pacific Copper, established in 2008. Pan Pacific Copper is owned by JX Nippon Mining & Metal (66%) and Mitsui Mining & Smelting (34%).

Unlike these other projects and mines, Rio Tinto's La Granja is located in northeast Peru in the district of Querocoto, province of Chota, region of Cajamarca. La Granja was awarded to Rio Tinto in 2005, through an international public tender called by the Peruvian Government. Prior to this, it had been explored in 1994 by Cambior.

In 2006, exploration studies began as Rio Tinto Minera Peru. Technical, environmental and social assessments continue with the support and participation of the communities in the area. Rio Tinto says its "commitment is to establish a transparent and firm relationship with our neighbours in the project area."

In 2007, with the support and collaboration of surrounding communities, Rio Tinto started gathering information for the environmental and social baseline studies, as part of the Environmental Impact Assessment (EIA) required under Peruvian law, and for the design of the mine. In 2013, it updated the environmental and social baseline studies, and conducted the first round of workshops headed by the Peruvian

ZAFRANAL MINERAL RESOURCES † 44,000 t/d

Category	Mt	Cu %	Au g/t
Measured	212.7	0.43	0.08
Indicated	408.2	0.34	0.07
M & I	620.9	0.37	0.07
Inferred	49.2	0.26	0.09

authorities for the preparation of the EIA.

During this time geotechnical studies were also conducted to obtain information about the soil and ore grades in the area. To analyse the mineralogical content of La Granja's ore, Rio Tinto's laboratories in Australia and the US were used. Since 2009, as a result of an agreement with the Pontificia Universidad Católica del Perú, the project also performs digital analyses of samples taken from La Granja in the Geometallurgy Laboratory which it established and co-manages with the university. The laboratory has state-of-the-art equipment including QEMSCAN (Quantitative Evaluation of Materials by Scanning Electron Microscope) and NIR (Near Infrared Spectroscopy).

AQM Copper Peru, local subsidiary of AQM Copper, expects its Zafranal copper project to start production in 2020-2021, said Bruce Turner, President and CEO, during his presentation at Perumin.

"Although it looks like a small project, we keep on exploring because we are committed to the project and expect to move forward", he said. Highlights from the January 2013 PEA include:

- LOM production estimates: concentrator – 3,100 Mlb copper and 479,000 oz gold and leach - 266 Mlb copper
- Copper concentrate 28% Cu & 3 g/t Au
- Recoveries – Cu : 87.7%/Au: 49.0%
- Conventional open pit with 15 year mine life and a 1.06 strip ratio
- Concentrator throughput planned at 80,000 t/d
- Near-surface supergene blanket
- Heap leach and SX/EW plant to produce 10,000 t/y of Cu cathode
- Tailings disposal at 65% solids is 10 km downhill from plant site
- Fresh water supply option of desalination plant at Pacific Ocean

Cía de Minas Buenaventura is waiting on the approval of the updated EIA for its San Gabriel gold-silver-copper project located in the district of Ichuña, province of Sánchez Cerro, Moquegua region, explained Igor Gonzales, Vice-President of Operations, during his Perumin presentation. Basic engineering and a feasibility study were also to start as the follow up of a conceptual change that started in 2013, seeing an open pit proposal become an underground mining project. It was expected that by the first quarter of 2018,

San Gabriel could become the next mine owned by Buenaventura, at a Capex of between \$480 and \$500 million. San Gabriel is an intermediate sulphidation deposit with a resource of 12 Mt @ 6.5 g/t Au.

However, Buenaventura decided to suspend operations at the end of last year after it became clear that communities living in the areas affected by the project were dissatisfied with the information provided to them by the company. They had refused to attend a public meeting convened by Buenaventura to debate its EIA. Local communities argued they lacked sufficient prior information about the proposed mine's environmental and social impacts to enable them to register an informed opinion.

The local authority has now agreed to enter into discussions with the company. To this end, a 'technical commission' involving 11 community representatives has been set up. All parties have indicated that they hope an agreement can be reached. The communities say they want their concerns heard, and hope that sustainable solutions to these can be found. The district mayor, Juan José Casillas, has said that the communities are not against the mining operations as such, but want mining operations to be accompanied by a real commitment to social responsibility and that money generated by the mine should be invested in meeting local needs.

Buenaventura also has the Trapiche copper-molybdenum deposit property in the southeast highland region of Apurímac. At the 2013 Denver Gold Forum, CEO Roque Benavides explained it has reserves of 623 Mt at 0.46% Cu, and could process at a rate of 60-80,000 t/d of ore and could be in production within three to four years.

However, Peru's largest locally owned precious metals producer probably wants a partner for the project. "Copper projects require a great deal of capital and we are primarily a precious metals company," Benavides said. "We're looking for mergers and acquisitions that make sense for the company and add value."

Slow progress at Conga

The Conga project is a copper-gold porphyry deposit 75 km northeast of the city of Cajamarca, and 24 km northeast of Newmont's Yanacocha gold mine. Currently, Newmont is taking a slower, "water first" approach to developing Conga by focusing on the construction of reservoirs for

Los Calatos Mineral Resource estimate at June 2015:

Resource category	Mt	Cu (%)	Mo (%)
Measured	73	0.73	0.051
Indicated	63	0.73	0.034
Total Measured & Indicated	136	0.73	0.043
Inferred	216	0.78	0.024

downstream communities. Should construction of the Conga project move forward, Newmont says that it “and its partners, Buenaventura and the IFC, plan to leverage existing operations at Yanacocha to develop Conga’s potential within a world-class mining district.”

Newmont says the project will generate 300,000-350,000 attributable oz gold and 80-120 Mlb copper (attributable from the estimated average annual production in first five years).

Newmont reported last year: “To better understand the reasons behind the public’s negative perception of Yanacocha and the Conga project, in early 2012 Yanacocha engaged the University of Queensland’s Centre for Social Responsibility in Mining (CSRSM) to undertake a thorough, independent assessment of community perceptions. The findings from this Listening Study included the perceptions that:

- The company’s operations and community engagement created economic inequalities and a negative emotional legacy
- Yanacocha did not effectively listen to the community
- Structural and systemic factors within the organisation compromised Yanacocha’s ability to build and maintain relationships
- There was a lack of clarity around Yanacocha’s development agenda
- The suspension of the Conga project was linked to Yanacocha’s legacy
- Historical events, such as the protests in the early 2000s over Yanacocha’s Cerro Quilish project, continue to impact relationships with the community

- The company’s approach seemed to be more short term to obtain permits and licence to operate than long term in support of sustainable development.

Recognising the need to re-establish the relationship with the community and earn the social licence to operate, in 2013 Yanacocha implemented its Regaining Social Legitimacy program. The four pillars of the program include:

Respect for Cajamarca – Social responsibility awareness training with employees and contractors and more face-to-face community engagement with urban and rural stakeholders to improve community perceptions of Yanacocha workers

Transparency and Credibility – Increased communications and engagement about mine plans, policies, employment, social programs and other activities to improve the company’s reputation at the national and local level. In the 2013 Merco/Datum International Ranking of the most responsible companies in Peru, Yanacocha moved from 12th in 2012 to sixth in 2013

Partner for the Development of Cajamarca – Educating local vendors about the company’s bidding process and developing a capacity-building program to train local contractors in submitting successful bids. As a result of these efforts, the number of Cajamarquino companies invited to bid increased 87%, and the amount of contracts locally awarded increased from \$3.4 million in 2012 to \$7.6 million in 2013

Responsible Actor for Water and Environment – In alignment with Yanacocha’s “water first”

approach to developing its Conga project, building the Chailhuagón reservoir and several water infrastructure projects to improve water quality and supply reliability.

Los Calatos and Cotabambas

Following the release of the Los Calatos Strategic Mining Study last September, a number of parties have entered into a process with a view to forming an alliance with Metminco for the development of this 100% owned project in a similar geological setting to the three large operating copper-molybdenum mines of Cuajone, Toquepala and Cerro Verde.

Highlights of the study include:

- Post-tax ungeared NPV of \$447 million (at a 8% discount rate)
- Post-tax geared NPV of \$456 million (at a 8% discount rate) and IRR of 20% assuming 60% gearing and US LIBOR of 0.33% plus 4% per annum
- Project of National Interest status for the project
- C1 operating costs of \$1.29/lb copper after byproduct credits
- Initial capex of \$655 million

*Long term median consensus metal prices (post 2019) from up to 40 institutions (source BMO): Cu = \$3.00/lb, Mo = \$11.16/lb; Au = \$1,250/oz; Ag = \$19/oz. Re price = US\$5,773/kg (MNC).

Los Calatos can be accessed via the Pan American Highway from Moquegua, and a 50 km unsealed road north of the highway to the project. The port of Ilo is located approximately 160 km by road to the southwest of the project area.

In late September 2015, Panoro Minerals received the results of an updated independent PEA of its 100% owned Cotabambas porphyry copper-gold-silver project. The results show strongly improved economics compared with PEA results announced on April 9, 2015 as the result of an optimised mine plan and processing cutoff

Cotabambas Mineral Resources, Tetra Tech, October 2013.

Resources Category	Zone	Cut-Off Grade%	Million Tonnes	Cu (%)	Au (g/t)	Ag (g/t)	Mo (%)	Cu (Blb)	Au (Moz)	Ag (Moz)	Mo (Mlb)
Indicated	Hypogene Sulphide	0.2	84.2	0.37	0.21	2.73	0.0018	0.69	0.58	7.39	3.43
	Supergene Sulphide	0.2	8.9	0.73	0.31	3.07	-	0.14	0.09	0.88	0.01
	Oxide Copper-Gold	0.2	23.8	0.49	0.24	2.63	-	0.26	0.18	2.01	0.01
	Oxide Gold	Na	0.2	-	0.66	3.74	-	-	0	0.02	-
	Total			117.1	0.42	0.23	2.74	0.0013	1.09	0.86	10.3
Inferred	Hypogene Sulphide	0.2	521	0.29	0.18	2.41	0.0021	3.36	2.94	40.35	24.22
	Supergene Sulphide	0.2	7.4	0.73	0.18	1.93	0.0007	0.12	0.04	0.46	0.11
	Oxide Copper-Gold	0.2	75.8	0.41	0.15	1.82	0.0003	0.68	0.37	4.44	0.5
	Oxide Gold	Na	1.2	-	0.61	3.27	-	-	0.02	0.12	-
	Total			605.3	0.31	0.17	2.33	0.0019	4.16	3.38	45.37

grade strategy along with associated improvements to waste rock and tailings management. Highlights, at the updated base case prices of copper at \$3.00/lb, gold at \$1,250/oz and silver at \$18.50/oz, gave after tax economic metrics of:

- NPV(7.5%) of \$683.9 million, increased from \$379.4 million
- IRR of 16.7%, increased from 11.8%
- Payback of 3.6 years, decreased from 4.8 years.

Decreased average direct cash costs (C1) to \$1.22/lb of copper, decreased from \$1.26, net of byproduct credits. Increased average annual payable metal of 155.1 Mlb copper, increased from 143.3 Mlb. Gold 95,100 oz, increased from 88,000 oz and silver 1.018 Moz, increased from 967,000 oz. The proposed processing throughput is 80,000 t/d.

Luquman Shaheen, President & CEO of Panoro Minerals states, "The optimised mine plan together with the resulting changes and improvements to the mine waste rock and tailings management plan have resulted in strongly improved project economics. There are more project enhancement opportunities which will be investigated at the prefeasibility stage of the project but let's not forget the significant upside to the project in the excellent remaining exploration potential. The current resource is open along strike and at depth and there are a



number of clustered porphyry and skarn zones in the vicinity of the current resource that have not yet been drilled. The scale of the growth potential for the Cotabambas project remains impressive."

The PEA was prepared by Amec Foster Wheeler Americas and Moose Mountain Technical Services.

Panoro is advancing its significant portfolio of copper and gold projects in the key Andahuaylas-Yauri belt in south central Peru, including its

Hauling empty core boxes to a drill site on Panoro's Cotabambas project

advanced stage Cotabambas copper-gold-silver-molybdenum and Antilla copper-molybdenum projects.

The allocation of resources to the updated PEA for Cotabambas has deferred completion of the PEA for the Antilla project, which will now become the company's focus. **IM**

International Mining Editor Paul Moore and Publisher John Chadwick go the extra mile to report on real mines and mining projects globally, in addition to the major tradeshow and exhibitions. So far from 2011 to early 2015, visits have included the following:

COUNTRY	OPERATIONS REPORTED ON	COUNTRY	OPERATIONS REPORTED ON
AUSTRALIA	FMG Christmas Creek (iron ore) Xstrata Coal Mt Owen (coal)	IRELAND	Boliden Tara (zinc)
BOTSWANA	Gem Diamonds Ghagoo Debswana Jwaneng (diamonds)	MOROCCO	Maya Zgounder (gold-silver)
BRAZIL	Samarco (iron ore)	NAMIBIA	Diamond Coast
BULGARIA	Chelopech (gold)	NORWAY	Store Norske Svea Nord (coal)
CANADA	IAMGOLD Westwood (gold) Cameco McArthur River (uranium) Vale Orebody 114 (nickel)	POLAND	NWR Debiensko (coal) PG Silesia (coal) JSW Zofiwka (coal) LW Bogdanka (coal) KWSA Bobrek-Centrum (coal) KRU Taldinski (coal)
CHILE	Anglo American Los Bronces (copper) Codelco Radomiro Tomic (copper)	RUSSIA	Premogovnik Velenje (coal)
CHINA	SD-Mining Sanshandao (gold) SD-Mining Xincheng (gold) Xinjulong Jonggu (coal)	SLOVENIA	Frontier Zandkopsdrift (rare earths)
CZECH REPUBLIC	OKD CSA (coal)	SOUTH AFRICA	De Beers Venetia (diamonds) Assmang Black Rock (manganese) LKAB Malmberget (iron ore)
FINLAND	Northland Resources Kaunismaara (iron ore) Dragon Mining Orivesi (gold) Endomines Pampalo (gold) Altona Kylylahti (copper-gold-zinc) Agnico Eagle Kittila (gold) First Quantum Kevitsa (nickel-copper-PGM)	SWEDEN	Iberpotash Cabanasas (potash)
GERMANY	GEOMIN Erzgebirgische Kalkwerke (marble) RWE Garzweiler (lignite)	SPAIN	Ferrexpo Yeristovo (iron ore)
INDIA	Kayad/Rampura Agucha (zinc)	UKRAINE	Galantas (gold) Compass Minerals Winsford (salt)
		UK	Duluth Complex (copper and nickel) Stillwater Mining (platinum/palladium) Peabody Energy NARM (coal) Peabody Energy Rawhide (coal) ARM/Vale Lubambe (copper)
		USA	
		ZAMBIA	

