



Leader of the BRICs



John Chadwick examines, among other projects, Vale's project pipeline, Votorantim's interesting expansion, including its Mirabela deal, and the expansion of the operations of Jaguar Mining and Yamana gold in Brazil

Construction for the 2014 World Cup and 2016 Olympics, fast growth and a strong auto industry (turning out close to 3 million cars a year), should all keep the Brazilian mining industry buoyant in the coming years. The construction of three new and badly-needed subway lines in Sao Paulo and more rail projects in other large cities will also add to demand.

Australian-owned Mirabela Mineração says development of its mining operations in Brazil "are facilitated by a supportive economic and political environment.

"As South America's leading economic powerhouse, Brazil is a country rich in history, people, culture and mining. It has a combined geographic size, population and economy shared by only the USA and China and ranks in the world's top five for production of a range of agricultural and mineral commodities.

"Brazil offers a stable monetary policy, controlled inflation, high levels of employment and falling country risk ratings. Foreign investment in Brazil is welcome. The Brazilian economy is diverse, and lead by its strong agricultural and mineral resources industry. The mineral extractive industry is one of Brazil's most important – with production value expected to reach \$25 billion by 2010. There is a significant level of foreign investment in the Brazilian mineral sector, including in commodities such as iron ore, gold, nickel, bauxite and oil and gas."

Brazil is famous for its iron ore and Reuters recently reported that the Mato Grosso state government has delineated a major iron ore discovery of an estimated 11,500 Mt grading 41% Fe. If confirmed it would be bigger than the country's massive Carajas iron ore resources in Para state, which the national mining department estimates at 2,000 to 3,000 Mt of ore. Brazilian mining giant Vale, which controls Carajas, says it holds 7,000 Mt of iron ore. Carajas, however, is of higher grade at 67% Fe content.

"The Mato Grosso state government named the concession holder of the deposit as GME4 of Global Mine Exploration," said Reuters. "The

Garimpeiros at Serra Pelada in 1983 – the largest gold rush in South America. Today Colossus Minerals is further defining the Serra Pelada deposit through underground exploration development. This will allow underground diamond drilling and for a bulk sample to be collected and sampled to better define the gold and PGM grades of the deposit. A decline is being driven using a 60 t roadheader. Roadheader technology was chosen over conventional underground drill and blast mining because of the low compressive strength (UCS = 10 to 15MPa) and relative competency of the meta-siltstone rock that the decline will be driven in. It is expected that the first underground exploration drilling will occur during the fourth quarter of 2010. Bernadelli (1983)

logistics of developing the mine will be challenging. The centre-west state of Mato Grosso is deep in the interior of Brazil and far from any ports. A railway or a river barge system would need to be developed to get any eventual production to the international market.

"China has been the main buyer of the 23-2 Mt of iron ore that Brazil exports monthly, with Vale accounting for the majority of those shipments."

Vale always has major projects on the go in Brazil. For instance, Onça Puma, the largest nickel mining and industrial processing project ever developed in Brazil, is based on a saprolitic nickel laterite deposit in Pará state, and is soon expected to reach nominal production capacity of 58,000 t/y. Vale's estimated total investment in the project is \$2.297 billion.

Brazil key statistics

Population 201.1 million (5th largest)
Labour force 101.7 million* (6th largest.)
GDP \$2.025 trillion* (10th largest)
•Real GDP growth 0.2%*
(Source: CIA, *2009 estimate)



located some 1,940 km north of Sao Paulo in Pará State, Brazil. SNCLavalin's services include engineering for the infrastructure and overland conveying facilities, civil works, electromechanical assembly, procurement support, construction management and providing key project management professionals and leadership to the project owner's team. WorleyParsons' services relate to the modular ore processing facilities, as well as collaboration on procurement, construction and project management support.

The Conceição Itabiritos project in the Southeast System will add 12 Mt/y of iron ore to present capacity. It involves investing in a new ore concentration plant to receive ROM from Conceição mine. The project has not yet been approved by Vale's board. Also awaiting board approval, the Vargem Grande Itabiritos project in the Southeast System will add 10 Mt/y of iron ore to existing capacity. It entails investments in a new beneficiation plant to be fed with low-grade ore from the Aboboras mines.

Tubarão VIII pelletising plant, to be built at the Tubarão Complex in Espírito Santo, will have production capacity of 7.5 Mt/y.

The performance of Vale's operations was good in 2Q10, seeing increased output for of all its products, "to meet the rapid recovery of the global demand for minerals and metals. After the deep recession of 2008/2009 and the effects of operational problems, weather conditions and the labour strike in Canada, a gradual normalization of our production is underway and it is set to grow at a fast pace due to the new projects coming on stream," the company reported.

Iron ore output reached 75.9 Mt, which was the best performance since the all-time high

Vale is currently implementing three copper projects – in Salobo (Brazil), Tres Valles (Chile) and Totten (Canada). Located in Pará, the Salobo project is based on the biggest copper deposit ever discovered in Brazil. Its nominal annual production capacity will be 520,000 t of copper concentrate and 255,000 t of metallic copper. The project, which is due to start up in the second half of 2011, will contribute significantly to development in the municipalities of Marabá and Parauapebas, both in the state of Pará.

As always, the world's largest iron ore producer has many projects on the go in that sector. At Carajás there is a new project to add 30 Mt/y to current capacity through the building of a new plant consisting of a primary crushing plant and ore beneficiation (upgrading) and classification units. There are also plans for significant investments in logistics. Another project will add a further 10 Mt/y to current capacity and involves investments to revamp a drying plant and acquire a new plant.

Carajás Serra Sul (S11D mine) is located in the southern hills of Carajás. There is also the

Apolo project in Vale's Southeast System, designed to produce up to 24 Mt/y of iron ore. This has not yet been approved by the board.

In June Vale awarded a cost reimbursable contract to a SNCLavalin/WorleyParsons consortium for the implementation of the S11D project in Brazil. Vale's S11D project is a worldclass 90 Mt/y iron ore processing facility



Overview of Itabirito ore treatment plant (ITM-I), in Itabirito, Credits Marcelo Araújo and Agência Vale



production of 85.8 Mt of 3Q08. As a consequence, it was sufficient to feed the second highest quarterly pellet output ever – 12.7 Mt.

In the first seven months of the year, Vale delivered three of the seven projects scheduled to come on stream in 2010:

- Additional 20 Mt/y, a low-cost high-quality iron ore brownfield project at Carajás
- Bayóvar, the phosphate rock mine in Peru, one of the lowest cost phosphate rock mines in the world
- TKCSA, a steel slab plant in the state of Rio de Janeiro, Brazil, with a capacity of 5 Mt/y. Manganese ore production – with improved

performance at all mines - was 494,000 t in 2Q10, versus 397,000 t in 1Q10, while the production of ferroalloys increased by 3.4% on a quarter-on-quarter basis and by 313.5% on year-on-year basis, reaching 113,000 t, the best quarterly performance since 3Q08. Ferroalloy quarterly production comprised 54,000 t of ferrosilicon manganese alloys, 55,000 t of high-carbon manganese alloys and 5,000 t of medium-carbon manganese alloys.

Sossego is currently Vale's biggest, and only Brazilian, copper producer, yielding 2,600-2,900 t each quarter. At the time of going to press, Vale was expecting to take over control of Paranapanema (PMAM), in an initiative to

Votorantim recently took control of Milpo with its various mines and projects in Peru, and one mine in Chile

speed up copper project development. Vale sees three major benefits in this acquisition:

- Consistent with the long-term growth strategy for copper
- Smelter can be used for processing copper concentrates with impurities
- Full capture of value of copper by-products.

Paranapanema was founded in 1969 and began operating in 1982. Located in the municipality of Dias d'Ávila, close to the Camaçari Industrial Complex, it is Brazil's sole producer of electrolytic copper by smelting. It produces and sells high-grade, 99.99% pure electrolytic cathode, from copper concentrates (average 30% Cu mainly from Chile). It produces both copper rods and wire.

In 2Q10, Vale's bauxite production reached 3.4 Mt, seeing a 4.4% quarter-on-quarter and 19.6% year-on-year increase. Vale's attributable production at Trombetas amounted to 1.6 Mt, up 2.9% quarter-on-quarter and up 10.6% year-on-year.

The Paragominas bauxite mine, located in the state of Pará, hit an all time-high production of 1.8 Mt, 5.7% up on 1Q10. This mine is linked to the Alunorte alumina refinery by the first bauxite pipeline in the world. The mine is operating at 83% of its nominal capacity, since the onset of the operations its bauxite product has given smaller granules than expected. Additional filters are already installed, which will allow Paragominas to run at its nominal capacity of 9.9 Mt/y.

Vale Fosfatados owns two phosphate rock mines, Araxá, in the state of Minas Gerais, and Cajati, in the state of São Paulo. Alongside the mining operations, the assets also comprise four processing plants for the production of phosphate fertilisers located at Araxá, Cajati, Cubatão (São Paulo) and Guará, also in São Paulo state.

In 2Q10 the output of Fosfertil's phosphate rock grew by 13.3% compared to 1Q10, due to the revision of the production planning and maintenance programs. Vale Fosfatados production reached 421,000 t – a 20.7% quarter-on-quarter increase due to the ramp-up of plant 2 in Araxá in May 2010. In total the production of phosphate rock rose 16% on a quarter-on-quarter basis, reaching 1.1 Mt.

Votorantim is another company on the move. On August 2, it took control over Peru's Milpo by increasing its stake to 50.02% through a public tender offer of shares on the Lima Stock Exchange. The company has not ruled out the possibility of further increasing its stake in the future.



This takeover could bring a new player into the three largest polymetallic producers in the world from 2014 onwards, when the mine expansions and projects that Milpo and Votorantim are developing respectively in Peru and Brazil, enter into production and double the combined polymetallic production that they achieved in 2009.

Votorantim is currently the fifth largest global producer of refined zinc, with production from its three refineries: Três Marias and Juiz de Fora, in Brazil and Cajamarquilla in Peru, a complex that is being expanded to support a capacity of up to 320,000 t of zinc. It is also among the 10 top global producers of polymetallic concentrates (zinc-lead), through the Vazante and Juiz de Fora mines, in the state of Minas Gerais. Control over Milpo's mines in Peru: El Porvenir (Pasco), Atacocha (Pasco), Cerro Lindo (Ica) and Chapi (Arequipa), will give Votorantim access to larger reserves of zinc as well as silver and copper ores that its mines in Brazil do not produce.

"Our horizon, from 2014 onwards when Hilarion (Ancash) enters into production and the expansion of Chapi, Cerro Lindo, Atacocha and El Porvenir is completed, looks very promising and will place us in a solid position among the three main polymetallic producers in the world," explained Paulo Motta, Votorantim's Zinc Business Director. He confirmed that Milpo's growth strategy will not change and that Milpo will continue to maintain its corporate identity. He also confirmed the investment of \$400 million that Milpo has committed to the expansion of its mining units and the construction of future mines: Hilarion and Pukaqaqa (Huancavelica).

Votorantim is also exploring the Bongará (Amazon), Shalipayco (Junin) and Cerro Puagjanca polymetallic projects. The company is a Sao Paulo-based mining, energy, financial and agroindustrial consortium with operations on four continents (South America, Europe, Asia and Oceania).

With a fully integrated production process – aluminium, nickel and zinc mining and metallurgy operations – Votorantim Metals

(VM) is a leader in the Brazilian aluminium, zinc and nickel markets and the fifth largest global zinc producer.

In Brazil, the company operates four industrial plants and seven mining and processing facilities. It also holds ownership interest in a refinery, steel mill plant and a bauxite mine. Overseas, the company has exploration offices in Argentina, Bolivia, Canada, Colombia, Mexico, and Peru.

In 2010, VM's Cajamarquilla refinery, in Peru, was expanded and doubled its production from 160,000 to 320,000 t/y. The expansion is part of a strategic plan to increase the plant's capacity to 1 Mt/y of zinc by 2012.

Another project is the company's aluminium expansion from 475,000 to 570,000 t/y. The company's leadership in primary aluminium in Brazil was consolidated in 2008 through the roll-out of the 475,000 t/y, world's largest integrated aluminium plant: CBA (Companhia Brasileira de Alumínio). The company is self-sufficient in bauxite production and generates approximately 70% of all the electrical power consumed in its industrial processes – well above the 26% world average.

VM is the largest producer of electrolytic nickel in Latin America, exporting nearly 70% of its production. In 2009, it upgraded its operating facilities and entered into a partnership agreement with Mirabela Mineração for the supply of raw materials according to its industrial needs. It operates two mining and processing facilities (Niquelândia, Goiás State, and Fortaleza de Minas – Minas Gerais State), and one metallurgical operation (São Paulo, São Paulo State).

Votorantim Cement is one of the world's ten largest producers of cement, concrete and aggregates. The company boasts plants in Brazil, USA, Canada, Bolivia, Chile, Argentina, Paraguay, Uruguay, and Portugal. It is a leader in the Brazilian cement market with 20.7 Mt/y.

Votorantim Steel (VS) increased sales volumes in the three markets where it operates – Brazil, Argentina and Colombia – in 2009. Several factors led to this new competitive benchmark

The installation of a second ball mill at Mirabela will increase the mill's operating capacity to 6.4 Mt/y and production of 26,000 t/y of nickel in concentrate

in the industry, namely, the Resende (Rio de Janeiro State) steel mill startup with a steel capacity of 1 Mt/y and milling of 500,000 t/y, the start of iron ore extraction in Ubalá (Colombia) which brought the supply of raw materials at competitive costs and the setting up of a service network with cut and fold centres in the three countries.

VS owns four steel mills in Latin America. The Barra Mansa steel mill – the company's oldest – dates back to 1937 and the newest, Resende, opened in 2009, are located in Brazil. The other two mills (Acerias Paz del Rio in Colombia and Acebrag in Argentina) were acquired in 2007. Besides producing and trading steel, VS operates iron and coal mines, and it develops and manages eucalyptus forests to produce the charcoal used in the production of pig iron.

Mirabela Mineração

Australian-owned Mirabela's primary focus is the 100% owned Santa Rita nickel sulphide deposit, located in Bahia state. This is the world's largest greenfield nickel sulphide discovery in over a decade. The complex comprises an open-pit mine and concentrator, producing a mixed nickel-copper-platinum-cobalt sulphide concentrate for sale and shipment to third party smelters. Nickel concentrate is delivered to Votorantim.

The pit employs 100 t and 150 t trucks (Caterpillar 777 and 785s) combined with Bucyrus O&K RH90 and RH120 excavators and Caterpillar 982 wheel loaders. Ramp-up to the plant's current name-plate capacity of 4.6 Mt/y was achieved this year and Mirabela's production guidance for 2010 is between 10,500 and 12,500 t of nickel in concentrate.

Nickel processing uses proven sulphide flotation methods as follows:

- Primary crushing down to minus 220mm with a Metso gyratory crusher 1,500 t/h
- Grinding to a P80 of 125µm with an



Santa Rita Proven and Probable Reserves

(As announced November 2008)

JORC Reserve	Mt	Ni	Cu	Co	Pt (ppb)
Proven	15.1	0.65%	0.16%	0.017%	108
Probable	105.9	0.59%	0.16%	0.015%	89
Total	121.0	0.60%	0.16%	0.016%	91

Outotec 30' SAG mill, 20' Ball mill and an HP400 pebble crusher rated at 575 t/h. Throughput was expected to be increased to 800tph with the addition of a second 20' ball mill and pebble crusher in 2010

■ Flotation of sulphides with a conventional rougher, scavenger and cleaning process using Outotec flotation tanks as follows:

■ 12 x 160 m³ cells for roughing and scavenging (with foundations for four additional cells if required)

■ 9 x 70 m³ cells for cleaning (with foundations for three additional cells if required)

■ 4 x 30 m³ cells for recleaning (with foundations for one additional cell if required)

■ Tailings thickening (tank capacity 800 t/h) and concentrate thickening (tank capacity ~50 t/h) are used to remove excess water from tailings and concentrate

■ Filtering of concentrate (Larox pressure filter capacity 33 t/h).

The company has agreements to sell 100% of production to two off-take partners until end 2014: Norilsk Nickel, the world's largest nickel producer and VM. Half of the concentrate product is trucked 1,350 km directly to the VM smelter in at Fortaleza de Minas and the other half is shipped to the Norilsk smelter at Harjavalta, Finland. Each partner will take 50% of all production and provided \$50 million in subordinated loans.

The Santa Rita mine is based on a world-class inventory of contained nickel resources, including 900,000 t of open-pit and 690,000 t in underground resources. It is a long life project, with 19 years of open-pit reserves and a low cost structure.

■ Contained nickel – 726,000 t

■ Strip ratio – 7.2 to 1

■ Weighted average recovery – 70.2% Ni

The reserve estimate is based upon the Potential Mill Feed Resource Estimate (pit optimised resource) announced in September 2008 as follows:

When project approval was given in late 2006, Anglo American estimated a capital cost of \$1.2 billion. Production from Barro Alto will contribute significantly to a potential doubling of the Group's nickel production to around 90,000 t/y

■ Measured and Indicated resource – 130 Mt grading 0.60% Ni and 0.16% Cu

■ Inferred resource – 20 Mt grading 0.60% Ni and 0.16% Cu

■ Strip ratio – 7.6 to 1.

Anglo American's Barro Alto nickel project is on schedule for first production in the first quarter of 2011, with development 94% complete at June 30. This project, which has further potential from an extensive resource base, leverages an existing operation and proven technology and is positioned in the lower half of the cost curve. Barro Alto will produce an average of 41,000 t/y of nickel over the first five years of full production and 36,000 t/y of nickel over the life of the mine.

Barro Alto is located in the State of Goias, about 170 km northwest of Brasilia, 240km north of Goiania and 150 km from Anglo's existing Codemin nickel operation. The Barro Alto nickel deposit was discovered in the late 1960s and Anglo American completed its purchase of the deposit for \$35 million in 2002. A feasibility study was initiated in 2004 and completed in September 2006. The deposit contains resources of 116.2 Mt, at an average grade of 1.54% Ni, of which 62.4 Mt at an average grade of 1.66% Ni will be mined by conventional open pit methods and treated over a 26-year period.

Back in 2006 part of the Barro Alto deposit was being mined to feed Anglo's Codemin

plant in Niquelandia, Goias. Ore was trucked to Codemin for processing in the existing facilities. This successfully extended the life of Codemin and permitted an increase in production from 6,000 to 10,000 t/y. Barro Alto ore will continue to be transported to Codemin throughout the life of the new Barro Alto project. The experience gained in mining and treating Barro Alto ore at Codemin significantly reduced the technical risk of the project.

The construction of Barro Alto included extending the existing open-pit mining operation and constructing a new ferronickel smelter and refinery. A long term power supply has been secured. The operation will use tried and tested technology currently used by Anglo American at Codemin and Loma de Niquel in Venezuela.

At Anglo American's 26.5 Mt/y Minas Rio iron ore project, progress continues to be well executed on those areas of the project where the necessary approvals have been secured. The development of the port at Açú, for example, is ahead of schedule and the installation of the pipeline from the mine site to the port is underway. However, a number of key approvals remain outstanding, principally the award of the second part of the installation licence, which would enable the construction of the beneficiation plant to begin, the land clearance permit for a section of the pipeline and land access for certain areas around the mine site and at specific sections along the pipeline route.

Anglo says "it is clear that the environmental permitting processes and standards in Brazil have become increasingly rigorous and more complex in recent years. Considerable resource has been deployed to resolve these issues, in addition to ongoing constructive high level





In July Centaurus Metals exercised its option to acquire a further 16 prospective iron ore tenements in the southeast under an innovative arrangement with the leading Brazilian pulp company, Cenibra. The new tenements – most of which are located immediately west of the recently acquired Jambreiro Project in the Guanhões Group of tenements – further enhance Centaurus’ project portfolio in the State of Minas Gerais, around the “Iron Quadrangle” region

dialogue with local and federal authorities in Brazil. Given the stage of development that the project has reached, the grant of the approvals affects the critical path of the project towards the delivery of first ore.” Following a thorough review of the project, Anglo American estimates that from the date of securing the remaining initial approvals, it should take between 27 and 30 months to construct and commission the mine and plant, complete the project and deliver the first ore on ship.

“Due to the inherent uncertainty around the timing of the award of key licences and permits, it is not possible at this stage to forecast an accurate final capital expenditure figure for the project. However, it is expected that there will be an increase in cost to the project relating to changes in scope and licensing conditions of \$210 million. In addition, based on a range of potential outcomes and in order to give as complete a picture as possible, it is currently estimated that on the basis of initial approvals being awarded within a nine month period from June 2010, increased schedule related costs to the project will be incurred, equivalent to a quarterly amount of roughly \$180 million.

The Minas-Rio project is located in the state of Minas Gerais. The project includes open-pit mines and a beneficiation plant producing high grade pellet feed which will be transported through a slurry pipeline, over 500 km to the Port of Açú in the state of Rio de Janeiro. First production of the project was expected in the second quarter of 2012. Planned annual capacity will be 26.5 Mt/y of iron ore pellet feed.

Centaurus Metals has commenced a resource

upgrade diamond drilling program at its Itambé iron ore project in the State of Minas Gerais. The program comprises 1 km of diamond drilling with the key aim being to upgrade the established Inferred Itabirite resource of 15.5 Mt grading 37.2% Fe to a Measured and Indicated status in advance of completion of a feasibility study on the project.

The drill program at Itambé was the second program to be commenced by the company in July, having commenced drilling at its recently acquired Jambreiro iron ore project. Previous beneficiation test work indicates that the Itambé mineralisation can be upgraded to a high grade (67% Fe) product via a low intensity magnetic separation process.

The Itambé project forms part of the company’s iron ore business in Brazil whereby 3 Mt/y of production is planned by the end of 2013. The project is located only 30 km from Vale’s Itabira operations and is well located to the existing steelmaking regions of Ipatinga and João Monlevade, where steel makers, Usiminas and Arcelor Mittal are located.

Sleek Jaguar performance

There are many non-Brazilian operators in the country’s mining sector, like Mirabela. Canada’s

Volvo articulated haulers work in three, six-hour shifts at Jaguar’s Mineração Turmalina mine, located in São Gonçalo do Paraná, Minas Gerais. Conditions can be difficult as the temperature in the mine can reach up to 40°C degrees. The drifts are 5 m wide by 4 m high. Volvo’s dealer in the area, Tracbel, has been supplying Jaguar with Volvo machinery since the company started its operations in Brazil in 2005 – and the companies have formed a close relationship. Vice President of Tracbel, Luiz Gustavo, says the first machines they supplied to Jaguar were 10 Volvo L980E wheel loaders – with a 500-600 mm lower cab to fit inside the mine. Today, Jaguar has 20 Volvo L980Es and they acquired the six Volvo A30E articulated haulers in February this year.

Valter Oliveira, Administrative Director for Jaguar Mining, says: “The machines have great productivity and fuel consumption, and the onboard technology is second to none.” Jaguar has noticed a distinct change in its working methods since acquiring the Volvo haulers. “Besides the improved safety, which we need when working with large machines, the mine’s productivity has increased considerably,” says Oliveira





Jaguar Mining, for instance, is one of the fastest growing gold producers in the world. Its plan is to significantly expand gold production from 70,000 oz produced in 2007 to 600,000 oz of gold in 2015 through its wholly-owned operations in the Iron Quadrangle region of the state of Minas Gerais. It is actively exploring and developing additional mineral resources at its +26,500 ha land base in Minas Gerais and on an additional concession base totalling over 75,500 ha in the state of Ceará in the northeast of Brazil through a joint venture.

Jaguar is currently producing gold at its Sabará, Turmalina and Paciência mines and processing facilities and completed the Caeté Project feasibility study in 2008. There it has initiated civil works for the milling and treatment circuits on the site of its previously operated CIC (carbon-in-column) processing plant. The future Caeté regional processing plant will treat ore mined at Jaguar's Pilar and Roça Grande mines. Jaguar intends to use a combination of cut and fill and selective stoping methods at both mines, with a treated tailings backfill system. The processing facilities will include crushing and grinding circuits followed by a gravity separation circuit along with a leaching and CIP-ADR (carbon-in-pulp adsorption/desorption/recovery) plant. All necessary permits and licenses for the construction and commissioning phase have been received. Construction of the Caeté underground mine and plant is underway; commissioning is expected to begin during the third quarter of 2010. It is located 65 km from Belo Horizonte by paved road.

Proven and Probable reserves amount to 6,106,160 t at an average grade of 4.57 g/t to an average depth of 465 m.

Measured and Indicated resources (including the mineral reserves above) are 9,341,400 t at an average grade of 4.44 g/t. Projected annual production is 35,000 to 45,000 oz of gold in 2010 rising to between 160,000 and 175,000 oz of gold by 2013.

Jaguar's plan is to add tonnage from the multiple mineralised zones identified at the Roça Grande zone and additional exploration and development of the higher-grade Pilar orebody. As these gold bearing structures are further developed, Jaguar intends to expand the processing plant presently under construction in several phases to ultimately reach the 100,000-oz level of annual production by 2012. As the existing structures at both Roça Grande and Pilar are open at depth, Jaguar's management believes additional resources will support operations at this level for many years beyond the current resource base. In addition, Jaguar has an active

exploration program in close proximity to the Caeté processing plant where several additional mineralized zones are known to exist.

Jaguar states: "The Iron Quadrangle is a prolific greenstone belt that has produced significant quantities of gold at competitive costs per ounce from open pit and large-scale underground mining operations for more than 300 years. However, it remains relatively under-explored compared to the other great greenstone belts around the world, with a relative absence of active junior mining and exploration companies. An encouraging fact is the existence of multiple examples of gold resources running to depths exceeding 2,000 m, with similar widths and grades to those seen at shallower depths. This is important to Jaguar because the average depth of its resources is less than 400 m from surface. The bulk of these resources are open at depth and laterally, giving the potential for substantial discoveries."

Expanding Yamana

Yamana Gold is also from Canada and is a major producer in Brazil. Its Chapada mine is a shallow open-pit copper and gold operation in northern Goiás State northwest of the national capital of Brasília. Yamana describes it as "a predictable and consistent worldclass mine."

It completed construction at Chapada ahead of schedule and on budget in October 2006, commercial production was declared in February 2007 and Yamana completed a further plant expansion in 2009. With a remaining mine life of more than 13 years, Chapada is expected to produce a total of at least 1.7 Moz of recoverable gold and 2,000 Mlb of recoverable copper.

Last year it completed a 25% expansion to 20 Mt/y throughput and produced 156,200 oz of gold, exceeding its original guidance of

140,000 to 155,000 oz. A new discovery was made, the Suruca mineralized zone. Drill results demonstrate the potential to add oz from the areas surrounding the mine further extending Chapada's already long mine life of 17 years. Yamana is currently advancing a feasibility-level study for Suruca, which it expects to complete by the end of 2010. Plant optimisations are scheduled to increase throughput to up to 22 Mt/y by 2012.

Yamana's Jacobina complex of underground mines serving a central CIP processing plant is located in the state of Bahia, in northeast Brazil near the Serra do Jacobina mountains. Jacobina was commissioned in the first quarter of 2005 and commercial production was declared on July 1, 2005. It completed a plant expansion in 2008 increasing capacity over 50%.

With an expected mine life well in excess of 15 years Jacobina is one of Yamana's longest life mines, with a total mineral reserve and resource base of more than 4.2 Moz of gold. 2009 production of 110,515 oz of gold was 51% higher compared than 2008. Following the plant upgrade in 2008, it achieved production throughput levels of 6,000 t/d. A newly discovered mineralised zone, Lagartixa, exhibits substantially higher grade than the current mineral reserve grade. The operation plans to process ore at the increased rate of 6,200 t/d by early 2011 and continues to focus on improving dilution and recovery. Exploration continues, discovering and developing higher grade areas including Canavieiras and Largatixa.

Fazenda Brasileiro is an underground gold mine located in northeast Brazil, 180 km north-northwest of the state capital of Salvador. The property also includes approximately 197,000 ha of adjacent exploration properties. The mine began production in 1984 as an open-pit,





heap-leach operation, however, in 1988, production began from underground operations with processing in a CIP plant and has been in continuous operations since such time.

In 2009 the mine produced 76,415 oz of gold, completed a tailings dam expansion and discovered further mineralised zones, Lagoa do Gato and CLX2, which represent significant potential to increase the mine life.

Four of Yamana's six major projects are in Brazil. The C1 Santa Luz project is located within Yamana's 180,000 ha of mineral claims on the Rio Itapicuru Greenstone Belt, approximately 60 km north of the Fazenda Brasileiro mine and 160 km east of the Jacobina mine. Yamana has advanced C1 Santa Luz from a grassroots exploration prospect to an advanced development stage project. The construction decision has been made.

It is planned as a conventional open-pit mine with processing through a flotation and CIL circuit and throughput of 2.5 Mt/y. The mine life for the project was increased from the initial feasibility study estimate of some seven years to 10 years. Average annual gold production is estimated at approximately 104,000 oz for an initial mine life of 10 years with production expected to exceed 130,000 oz in the first two full years of production. The estimated production start is 2012.

Proven and Probable mineral reserves are 23.8 Mt grading 1.55 g/t Au; Measured and Indicated mineral resources (exclusive of reserves) are 22 Mt grading 1.57 g/t Au and the Inferred mineral resource is 4.83 Mt grading 1.40 g/t Au.

Ernesto/Pau-a-Pique is located in the prolific Guapore Gold Belt property which covers 450,000 ha. The significant existing infrastructure including paved roadways supports the development of Ernesto/Pau-a-Pique as two operating mines with a common processing plant. Yamana has advanced Ernesto/Pau-a-Pique from a grassroots exploration prospect to construction decision made. Pau-a-Pique is planned as an underground bench-and-fill mine and Ernesto is planned to be mined both open-pit and cut-and-fill underground. Annual gold production is expected to be about 100,000 oz over the seven year mine life, with the first two years of production averaging some 120,000 oz, further improving project economics. The feasibility study completed in early 2010 confirmed the robust return and comparatively low capital cost for the project.

There is potential to extend the mine life as efforts continue to upgrade mineral resource ounces to the Proven and Probable category



and expand mineral resources. Yamana continues to progress more detailed engineering and an exploration drift to facilitate drilling in deeper areas where there are further resources. It also continues to conduct pilot tests on metallurgy and recoveries. Permitting is underway and construction is expected to begin in 2010 with production commencing in 2012.

Proven and Probable reserves are 7.1 Mt grading 3.11 g/t Au; Measured and Indicated resources (exclusive of reserves) are 2.0 Mt grading 1.93 g/t Au and Inferred, 4.5 Mt grading 1.79 g/t Au.

Located 80 km south of Chapada, the Pilar exploration concessions comprise 590 km² overlying an under-explored Archean Greenstone Belt. Yamana made a construction decision on Pilar based on positive feasibility study results in mid-2010, with production targeted for mid-2013. It is expected to commence production as an underground mine before developing into an open-pit for the latter part of its mine life. Estimated production is about 120,000 oz/y.

Pilar is located on a greenstone belt known to host at least 38 gold occurrences and with documented historic gold production of more than 2 Moz. Virtually unexplored when acquired, Pilar has since advanced to be one of Yamana's most important development projects. During the permitting period which is expected to continue into the first quarter of 2011, the company is advancing exploration and development work to upgrade mineral resources to mineral reserves.

Total Proven and Probable reserves are 8.9 Mt grading 4.01 g/t Au, Measured and Indicated resources (inclusive of mineral reserves) are 7.6 Mt grading 4.94 g/t Au and Inferred, 207,650 t at 5.27 g/t Au containing 35,155 oz of Au

Caiamar is located 38 km from the Pilar project and just east of the Crixas Greenstone belt. It is in the intermediate development stage

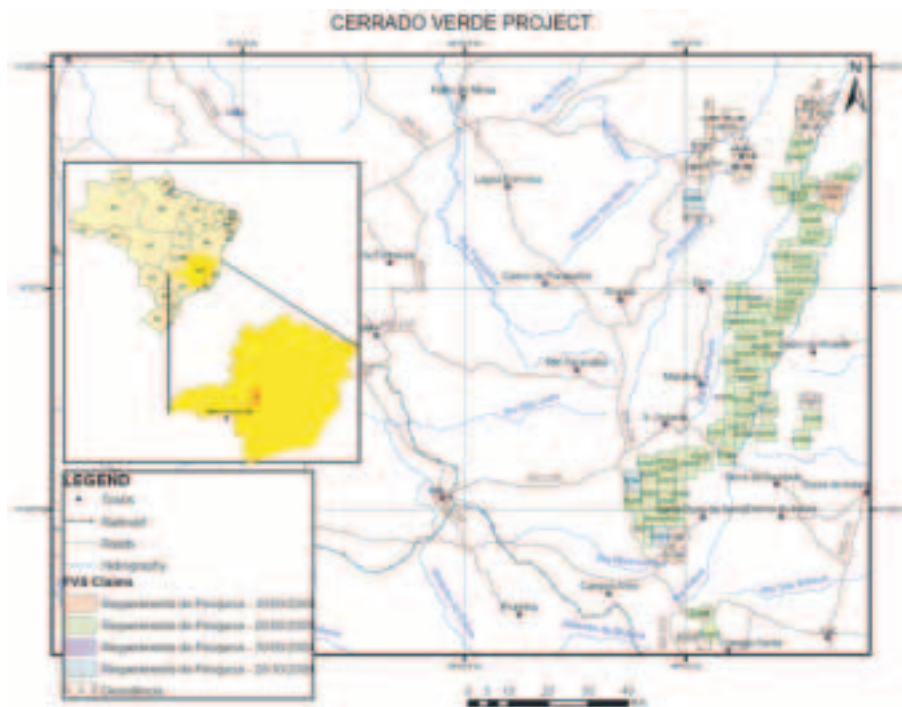
Luna Gold's plant

with a mineral resource estimate expected this year. Before Yamana purchased the project in mid-2009, a total of 16,000 m of drilling and 2,000 m of underground development in 2 m x 2 m sections and three levels (55 m, 110 m and 150 m) were conducted by previous companies. In 2009, Yamana conducted 15,000 m of drilling at Caiamar which has similar geology and prospectivity as Pilar. It believes that the combination of these two areas will meaningfully increase the potential for increased resources and rapid advancement of project development.

The definitive feasibility study for the Tucano gold and iron ore project in Brazil has been awarded by Beadell Resources to Ausenco with specialist technical input from SRK Consulting. The project, formerly known as Amapari, has been renamed to reflect the transition from the former heap leach operation to a new CIL phase for this large gold project in the State of Amapa, in the north. The DFS is to be completed by late November 2010 and will focus on converting the existing heap leach operation, currently on care and maintenance, into a conventional CIL plant based on a mine production rate of around 2.5 Mt/y of gold ore for an anticipated 110,000-130,000 oz/y of gold poured. Ausenco is responsible for authoring the document, plant design, and metallurgy. SRK Consulting is responsible for resource modelling, mining optimisation, hydrogeology; tailings dam design, geotechnical and environmental studies.

A study of the potential benefits and logistics of co-mining the extensive iron ore mineralisation within Tucano's gold pits in conjunction with Anglo American will be assessed.

In May Luna Gold completed the commissioning of the Aurizona gravity circuit and gold for refining is being produced from that part of the plant. The CIL plant and



Amazon Mining's Cerrado Verde project

ancillary facilities are also complete. Luna's CEO, Jim Bahan said at the time: "We are very pleased at the quick evolution of Luna Gold from an exploration company to producer status. Site preparation of Aurizona began in August 2009 and nine months later we were pouring gold. We look forward to full commercial production in the near future. The milling plant is already working close to feasibility study expectations despite having only two of the three ball mills in operation. The prospects are good for a significant increase in the plant throughput rate once the plant has been fully commissioned and optimised. As of today, over 600 oz of gold have been produced."

In April, Aura Minerals completed the acquisition and assumed operational control of the Sao Francisco and Sao Vicente gold mines, located in Mato Grosso State. These are open-pit, heap-leach operations, which together produce about 140,000 oz/y of gold. The company's focus for 2010 is operational improvements to increase productivity, improve overall gold recovery and lower cash operating costs at both mines. The company has identified several areas to target such improvements.

Key operational initiatives at the Sao Francisco mine will include updating the mine plan to improve grade control and improve mine contractor productivity. It will also

upgrade and make minor modifications to the current crushing plant to increase feed to the gravity circuit. It will reconfigure the gravity circuit to improve recovery and increase overall gold security.

At the Sao Vicente mine, which is located about 50 km to the north of Sao Francisco, operational improvements will include specific upgrades to the crushing and process plant to increase equipment availability and thereby increasing plant throughput and reducing operating costs. Such improvements will include installation of certain critical standby equipment to increase plant availability. There will also be minor upgrades to the gravity circuit to increase recovery and modifications to the heap leach stacking system to reduce compaction thereby improving heap recoveries.

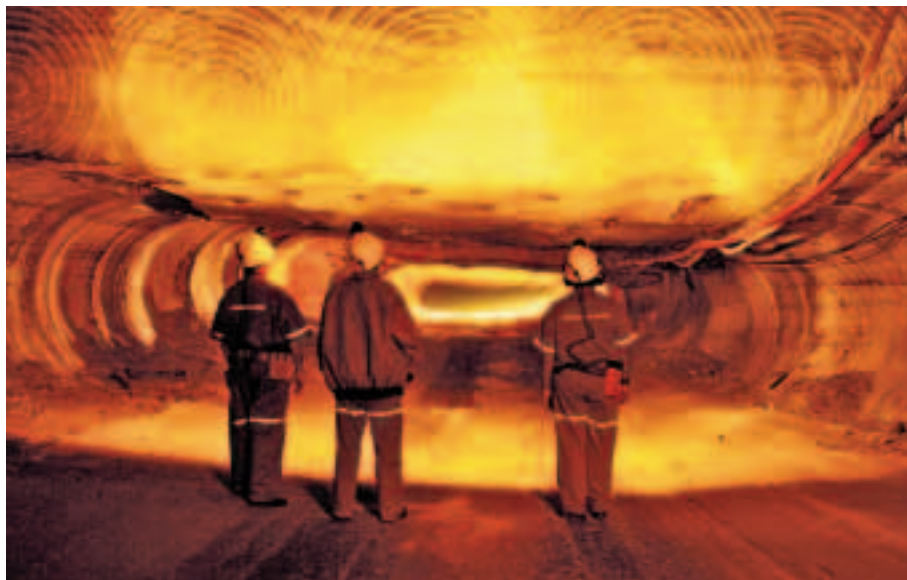
Aura is conducting a definition and expansion drilling program to increase the resource base and drilling nearby targets identified for increased production.

Gold production attributable to Aura Minerals in 2010 is expected to be 60,000 to 65,000 oz from the Sao Francisco mine and 35,000 to 40,000 oz from the Sao Vicente mine.

More fertiliser

Brazil's great agricultural heritage is attracting a great deal of interest in mining for fertiliser products. A particularly interesting example is Amazon Mining, which recently announced from nutrient availability tests completed on its proposed ThermoPotash product.

ThermoPotash is shown to provide similar availability of potassium nutrient (K₂O) as muriate of potash (KCl) in both clayey and sandy soils. In addition, tests showed that ThermoPotash is also a source of calcium and magnesium, two essential macronutrients not available in KCl. Amazon Mining is focused on the development of Cerrado Verde project. Cerrado Verde is an open pitable source of verdete slate, a potash rich rock from which Amazon plans to produce a slow-release nonchloride multinutrient fertiliser product. K₂O contents range from 5% to 14%. It is located in the western part of Minas Gerais state, in the heart of Brazil's agricultural region and covers 118,742 ha. The project focus aims at the economic recovery of potash from sedimentary deposits in the Serra da Saudade Formation. The deposit contains extensive strata of a rock known locally as verdete (green) slate, in which the main potash-bearing minerals are glauconite (a hydrated potassium-iron silicate) and sericite (a monoclinic, basic potassium aluminosilicate of the mica group).



Vale's Taquari-Vassouras mine, Sergipe state. Credit Agência Vale



industrial plant able to produce, initially, an estimated 1.2 Mt/y of potash. The operation is expected to start up in 2014.

Amazon Mining notes that the agribusiness represents 24% of Brazil's GDP and employs 35% of its working population. However Brazilian soils are poor in potash and most of the crops grown require significant potash quantities (such as sugar cane, soy beans, coffee, corn). Currently Brazil imports 90% of its internal potash demand and it is the world's fastest growing consumer. It is the world's second largest importer and fourth largest user and potash is one of the country's most significant commodity imports by dollar value. Amazon concludes that "growers spent \$4.5 Billion in potash during 2008 at current prices. Farmers tend to use sub-optimal concentrations of fertiliser because of [the] high cost, impacting productivity. *IM*