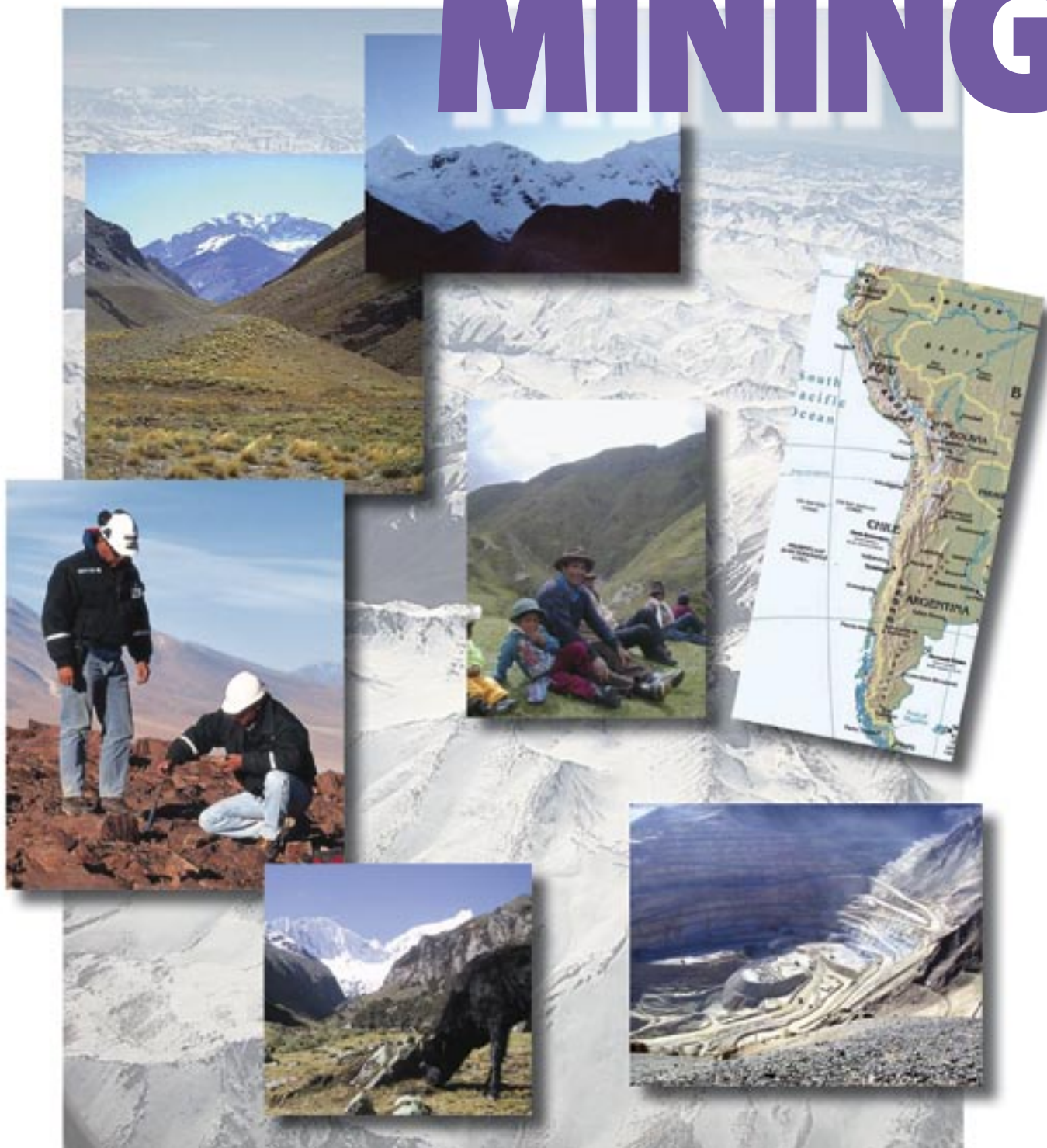


ANDEAN

MINING

Minjng Journal



A REVIEW OF MINERAL ACTIVITY DURING 2003

Argentina: up to US\$7 billion could go on mineral projects this decade

Bolivia: minerals hold a pivotal place in the economy

Chile: copper contributes 35% of export revenues

Ecuador: the next South American hotspot?

Peru: mineral exports jump by 21%

This supplement comprises reviews of mining and exploration activity during 2003 in five Andean countries – Argentina, Bolivia, Chile, Ecuador and Peru.

The reviews are abridged versions of reports contained in this year's edition of Mining Annual Review. The complete MAR will be available later this year.

Meanwhile, individual reports on countries and commodities can be purchased through MCL's online webshop: www.the-lode.com

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60 Worship Street
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Tel: +44 (0)20 7216 6060
Fax: +44 (0)20 7216 6050

E-mail: editorial@mining-journal.com
www.mining-journal.com

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ARGENTINA:

Major investments in the pipeline

BY GEORGE SANDERS AND NIVALDO ROJAS

ARGENTINA is recovering from a devastating three years of deep recession, civil unrest, devaluation and default. The economy grew by 8.7% in 2003 and is projected to grow by between 5.5% and 7% this year, in contrast to 2002 when the economy shrank by 10.9%.

The big question for the international mining industry is whether the current government will honour the commitment to tax stability for new mines made in the early 1990s, which led to the mining boom of the past decade. By all accounts, the answer to this question is a resounding 'yes', mining being one of the few bright spots in the national economy. President Nestor Kirchner, in office since May 2003, has made formal promises to the mining sector that the national government will strongly support sustainable growth of mining. However, the reality is that new mining projects face a tax regime far less favourable than that of the 1990s.

The biggest mining news of the year was Barrick Gold Corp's announcement of its decision to proceed with the US\$460 million Veladero project, scheduled

to begin producing 550,000 oz/y of gold in late 2005. Other new projects moved towards feasibility studies and, ultimately, production. The government estimates that US\$5-7 billion will be spent during the decade on about two dozen projects with estimated reserves worth some US\$50 billion. This compares favourably with the US\$7 billion invested in mining in the 1990s.

The national Mining Secretariat (under the Ministry of Production) has remained a stable and effective organisation since Argentina opened to mining in the early 1990s. There are three main branches: the Geological and Mining Service (Segemar), the National Mining Directorate (DNM) and the Directorate of International Relations (IRD). The link between national mining policy and its ultimate application in the individual provinces is Cofemin, the Federal Mining Council, made up of the heads of the individual provincial mining directorates and representatives of the National Mining Directorate.

Aquiline Resources Inc TSX-V : AQI

Calcatreu Gold Project, Patagonia, Argentina



- Mine Economic Scoping Studies Underway
- Major 12,000 meter Infill Drilling Program Just Completed
- New Resource Figure Expected June 2004
- 5,000 meter propeert Wide Exploration Drilling Program Underway

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Contact: Marc Henderson, The Exchange Tower, 130 King Street West, Suite 3680, Box 99, Toronto, Ontario, Canada, M5X 1B1
Tel: (416) 599-4133 Fax: (416) 599-4959 email: marc@aquilineresources.com website: www.aquilineresources.com

This body tackles reform of the Mining Code, the transfer of technology and information to the provinces, and the task of making mining compatible with all the economic, social and environmental issues throughout the country. Mining investment is crucial to the future of Argentina's poorest Andean and Patagonian provinces.

Work continues on a Bolivia-Argentina cross-border mining treaty modelled along the lines of the highly successful and progressive treaty with Chile.

The mineral potential of Argentina can be divided into five main regions:

- The Puna region (northwest Argentina provinces of Jujuy, Salta, Tucumán, Catamarca and La Rioja) hosts potential for large copper, gold, silver, tin, lead and zinc deposits and ferrous minerals; and its salars (playas) have potential for large deposits of borates, sulphates, common salt, and lithium brines.
- The northeast (provinces of El Chaco, Formosa, Entre Rios, Corrientes, Misiones and Buenos Aires) has potential for diamonds, nickel, amethyst, limestone and ornamental stone.
- The centre (provinces of Santiago del Estero, Cordoba, San Luis and the north portion of La Pampa) has potential for gold, porphyry copper, nickel-platinum and manganese deposits, beryl and other precious stones, ornamental stone, silica, feldspar and common salt.
- The Central Cordillera and Precordillera (provinces of San Juan, Mendoza, and Neuquén) have proven potential for large porphyry copper and gold deposits, and also chromium and talc, potash, aluminium sulphates, sulphur, gypsum and limestone.
- Patagonia (beginning in the southern part of La Pampa-Neuquén and extending to Rio Negro, Chubut, Santa Cruz and Tierra del Fuego provinces) has potential for large epithermal gold and silver deposits, polymetallic lead-zinc deposits, bentonite, kaolin and ornamental stone.

PUNA

The Puna region of Argentina has been relatively quiet recently, but given its proximity to giant copper deposits in neighbouring Chile, many consider Puna to be the sleeping giant of Argentina's mining.

Jujuy Province: Mina Aguilar, the oldest continuously operating metal mine in Argentina, was to close at the end of 1990, but discovery of the distal Esperanza orebody and deeper reserves at the Aguilar deposit gave the mine a new lease on life and enabled an investment of US\$12 million to be made last year for a new processing plant, a diesel-to-gas generator conversion and a 40 km gas pipeline. The 75-year-old mine, owned by the Bolivian company Comsur SA, produces approximately 2,000 t/d of combined 11% Pb-Zn ore averaging approximately 3.2% Pb, 7% Zn and 85 g/t Ag, and has a reserve plus resource base of approximately ten years.

Silver Standard Resources Inc continues to hold the Pirquitas Mine on a care-and-maintenance basis until such time as the silver price warrants development. A feasibility study in 1998 stated 30.4 Mt of proven and probable open-pit reserves averaging 128 g/t Ag, 0.17% Sn and 0.81% Zn at a 40 g/t Ag cut-off grade.

Cardero Resource Corp received some encouraging Ag values with associated Pb-Zn from drilling in lower Tertiary conglomerate and sandstone at the La Providencia silver mine and the adjacent Chingolo prospect. Mansfield Minerals Inc recently optioned the Loi Loi copper property near the Chilean border.

Salta Province: Iron oxide-copper-gold (IOCG) prospects are gaining increased attention in the

Andean Cordillera, and three have been defined at Rio Grande, Arizaro Lindero and El Camino in the Puna region. Mansfield Minerals commissioned an independent scoping study on its Rio Grande property drilled by former partner Rio Tinto. The independent study concludes that at a cut-off of 0.6 g/t Au, Rio Grande contains an inferred open-pit resource of 29 Mt at 1.08 g/t Au. Inferred low-grade gold resources reported by Mansfield are on a similar scale and grade at Arizaro Lindero, where Rio Tinto drilled eight holes. Iamgold Corp recently took an option from Mansfield to explore the high sulphidation gold-silver bearing system at Aguas Calientes. The thick, barren leached cap over the Taca Taca porphyry copper prospect has not deterred Lumina Copper Corp from taking another look at the property which has had 156 holes drilled in it by a succession of companies.

Catamarca Province: Minera Alumbra operates the Bajo de la Alumbra copper-gold mine, now

owned by Xstrata plc (50%), Wheaton River Minerals Ltd (37.5%) and Northern Orion Explorations Ltd (12.5%). Mining takes place under a joint-venture agreement with the owner of the mineral rights, Yacimientos Mineros de Aguas de Dionisio (YMAD). Pilot production began in 1997, and full commercial production was achieved in 1998 after expenditure of US\$1.23 billion. The mill was expanded to process 37 Mt/y of ore in 2002 at an additional cost of less than US\$28 million. For the next seven years, the mine is projected to produce an average of 561,000 oz/y of gold (in concentrate and doré) and 185,000 t/y of copper (in concentrate).

Northern Orion Explorations Ltd now owns 100% of the Agua Rica porphyry copper prospect located 34 km east of Bajo de la Alumbra. Agua Rica is richer in copper than Bajo de la Alumbra, but engineering challenges have so far prevented this project from moving forward despite BHP's expenditure of almost US\$50 million in exploration and prefeasibility work that included a bulk

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MINERAL PRODUCTION (t UNLESS STATED OTHERWISE)

	2001	2002	2003(p)	2004(e)
Gold (kg)	30,630	32,530	38,355	34,916
Copper	191,667	204,027	199,020	176,500
Silver (kg)	152,802	125,878	136,220	150,200
Zinc	39,703	37,325	29,839	34,740
Lead	12,334	12,011	12,079	11,120
Borate	512,624	509,630	545,304	567,000
Bentonite	123,404	120,006	128,406	133,540
Gypsum	582,377	362,556	387,936	403,450
Lithium carbonate	0	906	2,850	3,000
Lithium chloride	4,512	4,729	4,700	4,800

Source: Argentina Mining Sub-Secretariat. (p) provisional, (e) estimated

sampling adit completed in 1999 just before the project was terminated. Reserves at Agua Rica are 750 Mt averaging 0.66% Cu, 0.23 g/t Au and 0.037% Mo at a cutoff grade of 0.4% Cu.

Silver Standard Resources' Diablillos Project near the Salar del Hombre Muerto on the Salta side of the Salta/Catamarca border is also on care-and-maintenance awaiting a higher silver price. Open-pit resources in this volcanic-hosted epithermal precious metals prospect stand at 49.5

Mt at 68.3 g/t Ag and 0.42 g/t Au, at a cut-off grade of 0.4 g/t Au-equivalent.

Near Diablillos (and just south of the provincial border in Catamarca) is Condor Yácu, being explored by Maximus Ventures Ltd (formerly Essex Minerals) in an option agreement with Cardero Resource Corp. Drilling has returned encouraging values of gold and silver.

YMAD operates the Farallón Negro gold mine, the only active mine remaining from the days when the Argentine state controlled both mining and oil production. A production increase last year from 11,000 oz to 17,000 oz is now providing enough cash flow to justify some improvements to the mine's infrastructure.

La Rioja Province: The Famatina District, mined for gold in the first half of the 20th century, has not seen exploration activity since 2000 when Corriente Resources Inc gave up on its option with Yacimientos Mineros La Rioja SA, a private company that controls mining rights over this former Provincial Reserve Area. Golden Peaks Ltd is continuing to drill for gold and silver on its Sierra de las Minas property, in the southeast.

THE CENTRAL CORDILLERA AND PRECORDILLERA

San Luis Province: BHP Billiton is conducting ground and airborne geophysics and diamond drilling for nickel and PGM in a 100 km-long ultramafic complex at Vilorco- Las Aguilas in an exploration agreement with Marifil Mines Ltd. Geocom Resources is planning to drill new gold targets in the volcanic-hosted La Carolina district on ground optioned from TNR Gold Corp.

San Juan Province: Barrick has begun construction of the US\$460 million open-pit Veladero mine, with production scheduled to begin in late 2005. The 11 Moz oxidised heap-leach gold deposit is in the high Cordillera, entirely within Argentina and immediately adjacent to Barrick's other major project, Pascua-Lama, a sulphide deposit containing 28 Moz gold and 584 Moz silver within the 'mining operations area' straddling the international border between Argentina and Chile (created under the Cross Border Mining Treaty finalised in 2000).

Pascua-Lama is a huge low grade gold and silver deposit and it is an integral part of Barrick's future production profile. Its fast-track progress towards production was interrupted in 2001 by the fall in the gold price, and activity on the project did not resume until late last year. Barrick will complete an optimisation study in mid-2004 on Pascua-Lama with the goal of putting the property into production in 2008. However, the company has cautioned that the escalating cost, originally estimated at US\$1.18 billion, may delay a production decision.

Veladero's proven and probable reserves are 287.7 Mt at 1.09 g/t Au and 16.5 g/t Ag. Proven and probable reserves at Pascua-Lama are 268.9 Mt at 1.77 g/t Au and 61.3 g/t Ag.

Noranda Inc is actively updating a 1997 feasibility study of El Pachón, a copper deposit lying along the international border. The larger, Chilean portion of the mineralised system is currently being exploited by Antofagasta plc at Los Pelambres. El Pachón's stated reserves

are 880 Mt averaging 0.62% Cu, 0.015% Mo, 0.02 g/t Au and 2.4 g/t Ag, based on a cut-off grade of 0.4% Cu.

Tenke Mining Corp has increased its extensive holdings in the Vicuña-Batidero area along the international border in northern San Juan by optioning the José María property from the Juan Lirio group and the Las Flechas property from Viceroy Explorations Ltd. These properties total over 25,000 ha and hold significant potential for gold and copper-gold deposits. The Mogote prospect, immediately south of Vicuña, is being drilled by Amera Resources Corp, part of Grosso Group Management Ltd. Minera Andes Inc and Xstrata have teamed up to explore their respective portions of the Los Azules porphyry copper-gold system in the high Cordillera north of El Pachón.

Intrepid Minerals Corp is drilling to define resources for a prefeasibility study at the Casposo gold-silver deposit in the Precordillera. Mineralisation has been extended from the main Kamila zone to the northwest and southeast encompassing a strike length of over 3 km. Intrepid reports high grade intercepts of up to 70 g/t gold and 1,500 g/t silver in this vein system.

Elsewhere in the Precordillera at the Gualcamayo project, Viceroy Exploration is returning to the initial skarn discovery area drilled and tunnelled in the late 1980s by Anglo American plc. The Amelia Inés, Magdalena and 3D targets are being drilled in this year's programme.

La Mancha Resources Inc is undertaking geophysics and diamond drilling at the historic Hualilán property. This sediment-hosted vein and manto gold deposit lies along the same limestone belt that hosts Gualcamayo.

Mendoza Province: Lumina Resources has purchased the San Jorge porphyry copper deposit from Northern Orion. The property has an indicated and inferred resource of 57.3 Mt averaging 0.61% Cu at a 0.25% Cu cut-off grade, based on projected open-pit mining and heap-leaching of mixed copper oxide and chalcocite for SX-EW recovery.

Exeter Resource Corp is undertaking prefeasibility reverse circulation drilling to define the gold resource at La Cabeza, a gold property in southern Mendoza.

The rise in uranium prices has prompted Argentina's atomic energy commission, CNEA, to begin administrative procedures that may enable the reopening of the San Rafael mine which operated from 1976 to 1997. Currently, Mendoza Province has received US\$10 million from a US\$30 million World Bank loan for clean-up of uranium mill tailings in the town of Malargüe.

Neuquén Province: Minera Andacollo Gold is mining about 25,000 oz/y of gold from veins at the Erica and Sofia mines in the Andacollo district.

PATAGONIA

Río Negro Province: Barrick has taken an option on lamgold's Los Menucos district properties where previous drilling encountered encouraging gold values at Cerro La Mina, Cerro Abanico and Dos Lagunas. Golden Peaks Resources Ltd also continues to explore the Tanque Negro property, and Patagonia Gold plc

is exploring the Cuya and El Puesto prospects at Los Menucos. Elsewhere, Aquiline Resources Ltd has drilled 12,000 m on gold-silver veins at its Calcatreu prospect at the northern end of the emerging Gastre Fault play extending to the south into Chubut Province.

Chubut Province: IMA Exploration Inc has drilled 8,000 m on its grass-roots Navidad silver discovery in the central part of the province, and is consistently finding broad zones 50 m or more in thickness

carrying in excess of 150 g/t Ag. Recent drilling has linked the discovery with similar mineralisation at the Galena Hills zone some 1,200 m away. Silver and lead mineralisation with very minor copper is associated with calcite and barite. It is both structurally and stratigraphically controlled in Mesozoic volcanic and sedimentary host rocks believed to be contemporaneous with mineralisation. Drilling is ongoing, and engineering scoping studies are under way to determine a preliminary resource for the project. The discovery at Navidad has sparked considerable prospecting activity in this extra-Andean structural zone trending in between the Somuncurá Massif to the north and the Deseado Massif to the south known as the Gastre Fault system.

Meridian Gold Inc's Esquel project is on hold indefinitely, its fast-track development having fallen victim to a non-binding citizens' referendum on March 23, 2003, in which 81% voted against the project. Subsequently, the Province of Chubut passed legislation banning open-pit mining and the use of cyanide in the province. Meridian tried to continue fieldwork but was enjoined by a judicial order from a local court which specifically stopped all exploration in the Cordón de Esquel.

Santa Cruz Province: AngloGold Ashanti Ltd's 92.5% owned Cerro Vanguardia mine in Santa Cruz province produces in excess of 230,000 oz/y of gold and 2.0 Moz/y of silver in 2003 from approximately 0.9 Mt/y of ore, and has proven and probable open pit reserves to support operations until 2012. Reserves at Cerro Vanguardia are 7.8 Mt averaging 7.56 g/t Au and a little over 100 g/t Ag at a cut-off grade of 3 g/t Au-equivalent. Epithermal quartz veins averaging 3.5 m thick and ranging up to 10m in thickness carry the precious metals values, and the mine exploits 25 of these veins via steep-sided, open-pit 'slot cuts'. Exploration drilling has continued every year the mine has been in production, and Cerro Vanguardia has, so far, been able to replace and slightly expand its reserve base.

The Manantial Espejo project is the second-largest epithermal, low-sulphidation vein district in Santa Cruz. The 257 km² district, located about 100 km west and south of the Cerro Vanguardia mine, has approximately 70% of its silver and gold resources concentrated in the María Vein, one of the largest and most continuously mineralised quartz vein structures in the Deseado Massif. Pan American Silver Corp operates the project in a 50:50 joint venture with Silver Standard Resources. Measured and indicated resources as of December 31, 2002 were 4.39 Mt at a grade of 264 g/t Ag and 4.5 g/t Au, plus inferred reserves of 1.59 Mt at 258 g/t Ag and 3.6 g/t Au, mostly in the main María Vein. A feasibility study by early 2005 will probably envisage a combined open-pit and underground mining operation on distinct veins.

The San José project in the northwest of the province is under construction, with underground exploration and development currently being completed to define a mineable gold-silver reserve in the Huevos Verdes vein. Minera Andes discovered the property, originally known as El Pluma-Cerro Saavedra during grass roots exploration. Joint-venture partner Mauricio Hochschild

(51%) operates the project. For the Huevos Verdes and the Saavedra West areas, the combined total indicated resource was estimated to be 1.85 Mt at 214 g/t Ag and 2.1 g/t Au at a 50 g/t Ag cut-off grade.

Coeur d'Alene Mines Corp continues to mine high-grade ore (>1,000 g/t Ag) from the Martha Vein and the R-4 zone at its Martha mine. The direct-shipping ore is bagged and transported by truck over 450 km to Coeur's Cerro Bayo mine and processing plant in neighbouring Chile's IX Region.

Yamana Gold Inc continues to explore its large land package in the eastern and central portion of Santa Cruz Province in a three-way partnership with Compañía de Minas Buenaventura SA and Mauricio Hochschild. Buenaventura is operating the joint venture.

Immediately south of the San José project, Austral-

ian companies Oroplata Ltd and Kanowna Ventures have acquired the Cerro Negro project from Xstrata. Encouraging Au/Ag results have been obtained on this epithermal low-sulphidation vein system believed to host an inferred resource of 6 Mt averaging 3.2 g/t Au in the Eureka vein system. Exeter Resource Corp acquired an option from Cerro Vanguardia and AngloGold Ashanti to explore some 39 properties throughout Patagonia, the most advanced being Cerro Moro.

NON-METALLIC MINERALS

Rio Tinto, through its subsidiary Borax SA, spent US\$3 million for borate plant improvements last year to process ore from its Tincalayu mine in northwest Argentina. A number of small borate mineral and boric acid producers also continue working in the region. FMC

Lithium has resumed production of lithium carbonate in addition to lithium chloride from its US\$137 million Fénix project located at the Salar del Hombre Muerto in Catamarca Province. The salar is a unique deposit that contains lithium brines at depths much greater than its neighbours, with grades of 600-650 ppm Li and very low potassium values.

George Sanders is a consulting geologist, with many years of experience working in Argentina and Chile. He now lives in the US and works for Materials Testing and Consulting, Inc., of Burlington, Washington.

Nivaldo Rojas is a consulting mining engineer, and has lived and worked in Argentina since 1985. He currently heads his own mining consulting business, Rojas y Asociados, based in Mendoza, Argentina.

BOLIVIA:

Minerals hold pivotal place in the economy

BOLIVIA is in many respects a challenging country for miners. The country is large – covering about 1 million km² – but the population of about 9 million is small. The country is landlocked, and access to Pacific ports in Chile and Peru is dependent on the consent of its larger neighbours. The western frontier of the country is separated from the coast by the barren waste of the Atacama Desert, and reached at about 3,000 m in the high basin-and-range country of the desolate Altiplano. The Altiplano is overlooked to the east by the 5,000 m high, glacial peaks of the Andean Cordillera, at its continental widest in Bolivia.

In contrast, the eastern half of the country is part of the great never-ending sweep of the Amazonian lowlands, in the north still clothed in primeval forest and dissected by the meandering headwaters of the great rivers feeding into Brazil, and in the south by the amphibious seasonal swamplands of the Pantanal. The tropical latitude of Bolivia, combined with an extraordinarily diverse topography, creates a range of mining scenarios relatively costly to exploit. Access is often difficult and expensive: deposits are remote at both the national and international scales.

The majority of Bolivians live in poverty, and Bolivia is internationally recognised as the poorest country on the continent. 2003 saw 30 years of relative political stability in Bolivia broken by significant popular unrest which, in October, brought the premature downfall of the government: President Gonzalo Sánchez de Lozada resigned and was replaced by his erstwhile Vice-President, Carlos Mesa.

Mr Sánchez de Lozada has played a critical part in the recent political history of Bolivia, and he remains Bolivia's leading mining entrepreneur although now in voluntary exile in the US. He was the architect of the orthodox, market-based economic policies favoured by the International Monetary Fund introduced by the reformist government of the late-1980s, and which have continued in force ever since.

President Carlos Mesa is an independent, an historian by profession, and has built a cabinet drawn

BY DAVID FOX

from individuals owing allegiance to a variety of the traditional political parties or none. The new president has tackled some of the issues articulated by the protestors. He has set up a commission to reform the constitution, agreed a referendum on the export of natural gas, disassociated himself from the negotiations within the Andean Community on a proposed Free Trade Area of the Americas (FTAA), and withdrawn seemingly intrusive security legislation likely to disadvantage those working in the informal sector.

Bolivia's minerals – both metallic and energy – continue to hold a pivotal place in the Bolivian economy. In 2002 they accounted for 10% of GDP and in the first nine months of 2003 for 50% of the value of all exports.

METAL MINING

Bolivia was unable to profit fully from the surge in the gold price in 2003 since this coincided with the final run-down of Kori Kollo, the country's most productive gold operation and responsible for 75% of Bolivian gold production over the past 20 years. During 2003, mine output was estimated to be some 200,000 oz, produced at a cost of about US\$200/oz. Kori Kollo was Bolivia's first open-pit gold mine and, when opened in 1985, was given a working life of about 15 years. Limited new reserves and improved heap-leaching techniques extended the life of the pit and until recently there had been hopes that another deposit at Kori Chaca, 40 km away, would prove a useful additional supply of ore and add a further two years of life to the operations. Kori Chaca has reserves of about 230,000 oz of gold and was offered for sale towards the end of the year.

Newmont Mining Corp holds an 88% interest in Kori Kollo with EM Inti Raymi holding 12%. Kori Kollo is situated 200 km south of La Paz on the arid Altiplano north of Oruro and the bleak Altiplano has little to tempt the modest workforce (of about 550) to stay once operations cease. But the housing and other social facilities provided by the company are good by Bolivian

standards and will not go to waste. Although mining has effectively finished, milling of stockpiled material will continue into 2004 – but full closure will happen before the year ends.

There are a number of other gold mines reaping the benefits of higher gold prices although none the size of Kori Kollo. The Tipuani area in the Yungas, east of La Paz, where alluvial gold has been worked for upwards of a century and continues to be extracted by mining co-operatives, has attracted some external investment.

Golden Eagle International Inc began producing gold at Cangalli in September 2002 and during the first 17 months of operation produced 7,316 oz from 577,000 t of ore. The company doubled capacity in mid-2003 and gave reported production costs of about US\$218/oz. The company has also outlined gold and copper resources at Buen Futuro in the Precambrian Shield of eastern Bolivia, and its total mining concessions in the country cover some 650 km².

Franklin Mining Inc has been drawn to explore the possibilities of working the gold-containing terrace material of the Kaka River at Mayaya, the scene of South American Placers' (SAPI) dredging 50 years ago.

The importance of a sensitive approach to the rural communities living in areas rich in minerals is being learnt. For example, Luzon Minerals Ltd is hoping to exploit the gold-bearing potential of the Amayapampa area which, according to feasibility studies conducted by Vista Gold Corp, could yield 41,000 oz/y over a ten-year mine life at a cost of US\$168/oz. Luzon is currently in negotiation with the local communities to win their agreement to proceed. Initial cash requirements are expected to be about US\$26 million.

Eaglecrest Explorations Ltd continues to explore its San Simón property near Paititi in northeast Bolivia; the zone of gold mineralisation on a plateau rising 350 m above the forest has been known since colonial days.

The major focus of mining exploration and development in 2003 was the San Cristóbal zinc-silver-lead deposit in the southern Altiplano southwest of Uyuni and 40 km from the Rio Grande railway station. Andean Silver Corp, a local subsidiary of Apex Silver Mines Inc, expects the open-pit mine to be amongst the world's largest- and lowest-cost producers of both silver and zinc. Drilling began in 1996 and the company is believed to have invested some US\$100 million in the project to date (with a further US\$40 million budgeted in March 2004) developing proven and probable contained reserves of 450 Moz of silver, 1.8 Mt of zinc, and associated lead. The deposits are contained in disseminated form and in stockworks associated with volcanics.

METAL MINING PRODUCTION ('000 t)

	1997	2001	2002	2003	
				Jan-Jun	% change over Jan-Jun 2002
Zinc	155	140	151	72.5	5.1
Gold	13.29	12.42	11.3	4.60	18.6
Silver	387	434	441.9	240	16.5
Tin	14.4	12.4	14.5	8.5	21.4
Lead	18.6	9.1	8.5	4.8	1.2
Antimony	6.0	2.0	2.2	1.1	9.1
Wolfram	0.6	0.7	0.5	0.3	0.7

Source: Viceministerio de Minas y Metalurgia, EIU

Apex anticipates operating costs of the order of US\$1.95/oz of silver and US\$0.26/lb of zinc, with lower costs during the first five years of operation. At the end of 2003 the company claimed proven and probable reserves of 211 Mt at 66 g/t Ag, 1.63% Zn and 0.61% Pb at a silver price of US\$4.62/oz, a zinc price of US\$0.38/lb and a lead price of US\$0.22/lb.

The company has exploration rights over 160,000 ha in Bolivia covering 11 different properties, of which Ubina and Buena Vista in Potosi Province (both silver-gold prospects), are the most important after San Cristóbal.

The major Bolivian mining company is Cia Minera del Sur (Comsur), which has been built up over the past half century by ex-President Gonzalo Sánchez de Lozada. The Rio Tinto group holds about 30% of the company's stock. During 2003, Comsur was awarded US\$12.3 million from the IFC towards a US\$55 million investment programme to increase zinc production and reduce operating costs: the expectation was that the investment would generate additional employment for some 500 people and generate additional export earnings of US\$30 million. During the previous ten years it has won US\$35 million of IMF support for various capital investments at Asientos (zinc) and at Bolivar (managing a joint venture open pit with Comibol).

During 2003, a political attack was launched on the operations of a mine in which Comsur holds an interest. This was Don Mario, a gold-silver-copper mine with reserves of some 424,000 oz of silver located in the lowland forests of Santa Cruz. Production was scheduled to begin this year at an eventual rate of 60,000 oz/y and at an operating cost of US\$100/oz. Orvana Minerals Corp has a 3% royalty on the property and the World Bank, through the IFC, holds an 11% equity interest – a stake which has proved significant. In May 2003, a group of

local Indians filed a petition to the IFC's Compliance Advisory Ombudsman's office claiming, successfully, that the company had complied with neither Bolivia's environmental legislation nor the Bank's criteria governing the protection of indigenous peoples.

The sensitivity of Comsur to domestic politics was further illustrated by the thwarting of the sale by the liquidator of the assets of Allied Deals/RBG Resources of the Vinto refinery and the Huanuni tin mine to Empresa Minera Colquiri. Colquiri was a JV company in which Comsur held 51% of the shares and the UK development agency CDC Group held 49%.

Huanuni is the last significant remnant of the former nationalised state mining corporation, Comibol, and the miners and the corporation feared the consequences of privatisation and did not co-operate with the prospective new owners, whom they saw as the architects of the dismemberment of their once-proud industry. It is estimated that an investment of at least US\$10 million is needed to deepen the mine to exploit new reserves. A condition of the transfer was that law and order would prevail at the mine, which did not, and Huanuni is now back in the hands of the liquidator, Grant Thornton, and its future is uncertain. It is no coincidence that one of the groups who rallied to the call to oust President Sánchez de Lozada in October was the militant miners of Huanuni.

One of the problems for any company deciding to in-

vest in Huanuni is that the upper reaches – and most depleted – of the mineral deposit are in the hands of mining co-operatives. Some 2,000 members scavenge the workings of the old mine but their pickings are very slim. The temptation to invade the lower workings is strong and there is a powerful lobby demanding that more of the deposit be transferred to the co-operatives. Mining co-operatives are a

long-standing feature of Bolivian mining and they have been a favourite way of pacifying surplus miners made redundant when mines have exhausted their apparent commercial viability.

The gold co-operatives of Tipuani are the most successful and some have invested in modern, or at least not ancient, technology. But most other co-operatives employ only primitive hand-working methods reminiscent of earlier centuries. They vary in membership but probably give some more than casual employment but a very modest living to up to 50,000 – by far and away the majority of Bolivia's miners. There are 87 co-operatives working ground leased from Comibol – 55 in the department of Potosi, 17 in Oruro and 15 in La Paz – and others are relics of private mining companies. A significant proportion of Bolivia's tin production is won by co-operatives (and some is imported clandestinely from Brazil).

Comibol remains a shadow of its former self – a mere holding company of the former state mining company's concessions. The major joint ventures and leased properties are with Comsur (Bolivar, Porco), EM Barrosquiara (Caracoles), Andean Silver Corp (San Antonio de Lipez), Pan American Silver (San Vicente), and CM Don Mario (Planta Plahipo and the tailings of Potosi).

David Fox is an academic geographer based in Manchester, UK. E-mail: david.fox@man.ac.uk

CHILE:

Copper provides 35% of export revenues

THE gloom from low metal prices in 2002 continued into the early part of 2003 as more mining companies, in addition to Codelco and BHP Billiton, considered cutting production. However, optimism grew as the year progressed and market forecasts for 2004 improved appreciably. For copper, price forecasts ranged from US\$0.82/lb to as high as US\$1.12/lb. In addition, a number of mining projects were dusted off which had been kept on hold. Chile's economic performance improved during 2003: GDP improved by 3.6% to US\$68.8 billion, and total exports increased by 16.4% to US\$21.4 billion. Mining accounted for US\$8.46 billion, with copper contributing US\$7.5 billion, or 89% of mining exports and 35% of total exports. Inflation slowed to 1.1% and unemployment dropped slightly to 7.4% from 7.6%.

The possible imposition of royalties on mineral products has been a consistent theme in Chile for some two

BY SIMON TARBUTT

years. A charge ranging from zero to 3% on gross sales is proposed as of 2007, based on profits: the higher the operating margin the higher the charge. Those companies with gross sales of less than 2,000 Annual Tax Units (about US\$1,185,000) and those with less than a 5% operating margin would be exempt. The proposal claims to be fair and equitable as it takes into account both the differences in the amount of investment and operating costs between properties, as well as the fluctuations in metal prices. It is also proposed that the proceeds will go to a fund to finance innovation and technology initiatives in mining that will benefit future generations.

Greater clarity and definition is required in the royalty proposal as regards "operating margin", "operational profit" and 2,000 UTA as the exemption limit. This will be

for Congress to decide. The royalty proposal will require modification of the Mining Concessions Constitutional Law, and will need a 4/7 majority vote by both senators and deputies as it would represent a change in a constitutional law. Thus it is likely to require at least partial support from opposition parties.

PRODUCTION AND DEVELOPMENT

Chile produced 4.91 Mt of copper in 2003 and 5.47 Mt is forecast for 2004. During 2003, the Los Pelambres division of Antofagasta plc (60%) and a consortium of Japanese smelters (40%), completed the expansion of ore capacity to 120,000 t/d through general upgrading and the installation of a new crusher. This year, production is expected to be 338,000 t of copper in concentrate and 7,000 t of molybdenum. An EIS was presented for the extraction of additional reserves that will allow the property to mine up to 2,100 Mt of ore at a rate of up to 175,000 t/d.

Escondida produced 847,121 t of copper in concentrates and 147,598 t in cathodes during 2003. A start was made in September on the next expansion phase, the US\$400 million Escondida Norte pit, with a 250 Mt stripping programme to be completed in October 2007. Meanwhile, the EIS was approved for the US\$1.13 billion project to leach low-grade sulphide dumps to produce initially 84,000 t/y of cathodes, and eventually 234,000 t/y.

The US\$654 million expansion by Minera Doña Ines de

Collahuasi (owned 44% by Falconbridge Ltd, 44% by Anglo American plc and 12% by a consortium of Japanese smelters) is reported to be on schedule for completion by mid-2004. The Ujina concentrator will process 110,000 t/d of ore and mining will be transferred from Ujina to the Rosario pit. Copper production for 2003 was close to 400,000 t, including some 60,000 t in cathodes from oxide ore extracted from the smaller Huiniquintipa pit. With the expansion, total annual production is anticipated to increase to close to 500,000 t for a few years.

The expansion at Codelco's El Teniente Division advanced mainly through increasing concentrator capacity to 130,000 t/d of ore. This is now 90% complete. The project also encompasses new underground areas and infrastructure, as well as the concentrator, and is now due for completion towards the end of 2005 at an estimated cost of US\$736 million. With parallel environmental measures, the total investment will approach US\$1.1 billion. Production in 2003 was 339,440 t of copper. The expansion will raise this to some 500,000 t/y.

Codelco Norte (involving the integration of the Chuquicamata and Radomiro Tomic divisions) advanced on four main fronts: the crushing complex at Chuquicamata is being replaced by an in-pit system for a total estimated cost of US\$82 million; US\$76 million is being invested in raising concentrator capacity to 182,000 t/d, and improving recoveries of both copper and molybdenum; US\$172 million is being committed to improving environmental standards at the smelter to reduce sulphur and arsenic emissions; and at the No2 refinery, there is a conversion from electro-refining to the permanent cathode process. complete. It will increase production to 855,000 t/y of copper in 2005

and will cost a total of US\$143 million.

Codelco moved to dispose of some non-core assets during the year. It sold 60% of Soc Fundición Talleres SA to Elecmetal, a Chilean metals and mining services company, for US\$9.23 million. Talleres, located in the city of Rancagua, Region VI, originally operated the workshops for El Teniente, before being made a separate division in 1992 and a limited company in 2003. Also at El Teniente, the Coya (39.3 MW) and Pangall (37 MW) hydroelectric generating stations were sold in April this year to Pacific Hydro of Australia which bid US\$75.6 million, and agreed a four-year total electric supply contract to El Teniente at a predetermined rate, renewable once.

During the year, Biosigma, a research project headed by Codelco and Nippon Mining & Metals Co Ltd of Japan, selected three proposals from 21 submitted from Chilean and Japanese universities, for research into the bioleaching of low-grade copper oxide ores. Funding will come from the Chilean State and the Inter-American Development Bank.

Amerigo Resources Ltd of Vancouver acquired Minera Valle Central which processes 90,000 t/d of tailings from El Teniente mine and produces some 13,000 t/y of copper in concentrate. The purchase price was US\$20 million. Amerigo is studying an expansion to 120,000 t/d and a further 10,000 t/d increase based on feed from old tailings at El Teniente's nearby Colihue dam.

In Region III, a decline was begun from the pit at the Candelaria open-pit mine (Phelps Dodge 80% and Sumitomo Metal Mining Co 20%). Development for underground mining of the Candelaria Norte deposit was also started. Reserves amount to 10.9 Mt at 2.15%

Cu and production is estimated to begin in the fourth quarter of 2004. It is forecast that copper output will be maintained at the present level. In 2003, Candelaria produced 212,700 t of copper in concentrates.

The Refugio gold mine, operated by Compañía Minera Maricunga, owned equally by Bema Gold Corp of Vancouver and Kinross Gold Corp of Toronto, is forecast to restart production in the fourth quarter of 2004. Recent exploration drilling has expanded reserves to justify increased capacity and extension of mine life. A US\$71 million investment programme is estimated for plant modifications and upgrades, a modest pre-stripping programme and a 110 km power line to connect to the main grid. This will replace the previous diesel-generated power. A new mining fleet is also contemplated, possibly under a lease capital arrangement.

Minera Cerro Dominador, owner of a copper concentrator in Region II, has reached an agreement with the Codelco Norte group to process 1,200 t/d of 3.8% Cu ore from the Mansa Mina prospect some 85 km distant, and return the 40-45% concentrate to Chuquicamata for smelting and refining; Mansa Mina is not in commercial production as yet. Near the end of the year the company also presented an EIS to reopen and expand its 5,700 t/y cathode copper SX-EW plant, in the same location, to 10,000 t/y. Feed would be 3.0 Mt/y of ore averaging 0.92% Cu from Chuquicamata, a volume considered to be too small for Codelco to handle economically. Agreements will also be sought with small-scale oxide miners in the vicinity who have the potential to provide up to 10 Mt at 1.55% Cu.

Soc Punta del Cobre SA (Pucobre) in Region III obtained approval for its US\$6.3 million EIS to develop



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the Venado Sur deposit as an open pit. This will entail the mining of 100,000t/mth of oxide ore at a 1:1 stripping ratio, and shipping the ore 35 km to the existing plant. The company owns the Socavón Rampa/Socavón Trinidad/Abundancia underground mines, the Biocobre plant and the San José concentrator. In 2003, Pucobre produced 45,906 t of copper.

State-owned Enami's debts increased to some US\$485 million, the two principal items being US\$240 million for environmental measures taken at the smelters a few years ago and financed by commercial loans, and US\$164 million of 'advance profits' taken a few years ago, to repay Treasury-supplied mining promotion funds. Part of the solution is to sell the Ventanas copper smelter and refinery (323,00 t/y of cathode) to Codelco which needs additional capacity. The proposal was presented to Congress (a legal requirement for both state companies) in mid-year, with Ventanas valued at US\$373 million. The proposal has recently received consent from the House of Deputies, along with a recommendation that the state would become the guarantor for the remaining debt.

One of Enami's principal functions is to promote mining, and it received a further boost during the year when a decree was signed committing the government to annual funding of US\$8 million to assist some 12,000 small and medium-scale copper and gold miners. This will provide a floor to guarantee services and technological promotion, even at times of low metal prices.

In line with the improvement in metal prices, the number of small-scale miners of copper, gold and silver increased from 463 to 489 during the year.

Soc Química y Minera de Chile SA (SQM), which produces fertiliser minerals, iodine and lithium from a number operations in Regions I & II, had an active year apart from production. A contract to supply 150,000 t of potassium chloride was signed with PCS Yumbes, which operates a new nitrate mine and fertiliser plant in Region II, and SQM has since taken up an option to purchase Yumbes for US\$35 million. SQM also purchased the new La Coruña iodine property of Falcon de Chile SCM for US\$13 million. There are no immediate plans to develop the reported 37,000 t of contained iodine reserves.

On the lithium front, an EIS was approved for the construction of a US\$14.9 lithium hydroxide processing plant, to produce 4,000 t/y of lithium carbonate, with a possible expansion to 6,000 t/y, depending on demand.

EXPLORATION

The register of exploration claims maintained by the National Geology and Mining Service (Sernageomin) increased from 19,215 to 24,615 in 2003 covering a total area of 81,000 km².

In the far north, in Region I, Minera CanCan, part of the Copec group, completed a decline into the gold orebody beneath the old open pit at Choquelimpie. Exploration drilling and metallurgical tests on the oxide and sulphide ores are continuing to determine reserves and the scale of the future operation. Elsewhere in Region I, Silver Standard Resources Inc made the final payment of US\$600,000, for a total of US\$1.5 million to acquire 100% of the Chalcollo silver project, where contained resources amount to 10.2 Moz indicated and

MINE PRODUCTION ('000 t EXCEPT WHERE STATED)

	2002	2003
Copper	4,620	4,909
Molybdenum	29	33
Gold (t)	39	39
Silver (t)	1,210	1,313
Iron Ore	7,269	8,011
Nitrates	1,174	1,134
Iodine	12	16
Sodium chloride	3,503	6,213
Lithium carbonate	35	42
Lead	3	2
Zinc	36	33

Source: Sernageomin

36.9 Moz in the inferred category.

Towards the end of the year Nittetsu Mining Co Ltd received the approval of an environmental impact statement (EIS) for a US\$3.6 million exploration programme in Region II, principally for copper. The programme includes 18,000 m of drilling in 30 holes. Also in Region II, Expatriate Resources Ltd of Vancouver, through its Chilean subsidiary Compañía Minera Ltda, carried out 4,488 m of reverse circulation drilling on its Isoleña copper-silver property. Various intercepts were made of copper-silver mineralisation.

Codelco continued to explore the Toki cluster in Region II, consolidating inferred copper resources of 11.2 Mt at Toki, 3.8 Mt at Quetena and 2.0 Mt at Geneveva. In Region III, a new gold discovery, Purén Norte, was made in conjunction with Cia Minera Mantos de Oro (Placer Dome Inc). The plan is to complete a feasibility

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ity study by the end of 2004 and to recover the gold at the nearby La Coipa (Mantos de Oro) plant.

The updating of studies of the Spence copper project, Region II, owned by Riochilex, a subsidiary of BHP Billiton, continued through the year. Production is now predicted to start in 2007 at 200,000 t/y of cathode copper and could involve an investment of some US\$800 million.

Region III was probably the most active region for exploration in 2003. Latin American Copper plc, a company quoted on the London AIM exchange, signed an agreement with Phelps Dodge Corp to examine the latter's database for available information on Chile's iron oxide-copper-gold (IOCG) area. A second phase would involve exploration and Phelps Dodge's local subsidiary, Ojos del Salado, would contribute US\$150,000 of drilling per target. Subsequent stages would continue on a mutual option basis.

Also in the IOCG belt, Far West Mining Ltd examined anomalies identified by BHP Billiton's patented Falcon airborne gravity gradiometer. Some 27 targets have been identified and three selected for an initial 5,000 m of drilling. Far West has raised funding in Canada to pay for a 70% earn-in. For one area, identified as 4c, BHP Billiton has decided to exercise its option on any second-phase exploration, which will increase its participation from 30% to 51%.

Minera IPBX Ltda, a subsidiary of International PBX Ventures Ltd of Vancouver, now has a significant stable of prospects. During the year Hornitos (Cu, Au) covering 3,100 ha, and San Pedro (Ti, Au, Cu) covering 1,000 ha were acquired. These are in addition to Tierra de Oro (Au, Ag, Co, Cu) covering 3,056 ha, Las Lomitas (Cu, Au, Ag) covering 1,000 ha, Sierra Pintada (Cu, Au, Ag) covering 3,300 ha, Tabaco (Cu, Au, Ag) 393 ha, Zulema (Cu, Au) 3,600 ha, and La Totorá (Cu, Au, Ag, Co) 1,600 ha. Exploration drilling at Tabaco confirmed historic drilling, and an IP survey was carried out.

At Tierra de Oro, detailed surface mapping and sampling revealed gold-bearing structural zones. Under a 70% earn-in agreement, Pathfinder Resources Ltd of Vancouver carried out initial drilling on Zulema and encountered a large mineralised system geologically similar to the Candelaria orebody, some 20 km to the east.

Close by, Solomon Resources Ltd of Vancouver has carried out 125 line-km of detailed magnetics, IP and a 300-station gravity survey over its Annie and Santa Candelaria concessions, where previous mapping and sampling confirmed Candelaria-type geology and mineralisation.

In the first half of 2003, Samex Mining Corp paid US\$50,000 to acquire a 1,475 ha claim area, Los Zorros, where there are many abandoned small-scale gold operations. The owners have maintained a back-in option should Samex discover a deposit in excess of 2 Mt of contained equivalent copper on, or within, 500 m of the property. Some US\$371,000 was raised for an exploration programme. Later in the year an additional 209 ha were acquired for US\$230,000 in staged payments, and NSR royalties on gold, silver and copper; the first payment of US\$30,000 has been made.

Mandalay Resources Corp made substantial progress at its 100 km² La Quebrada property. Utilising mapping, sampling, geophysics and some shallow drilling, near-surface copper sulphide and stratabound silver mineralisation have been identified.

Lumina Copper Corp of Vancouver acquired the Regalito copper prospect in October 2003 for C\$900,000 payable over eight years. Resources have been estimated at 200 Mt averaging 0.5% Cu, using a 0.3% Cu cut-off. Lumina also reached agreement with General Minerals Corp of Denver to acquire the Vizcachitas property in Region V. Resources have been estimated at some 645 Mt averaging 0.45% Cu and 0.014% Mo, at a 0.3% Cu cut-off.

Elsewhere in Region V, South American Gold and Copper focused attention on its Pimentón gold property, and a due diligence study was carried out by Pincok Allen & Holt on behalf of the Overseas Private Investment Corp of the US. OPIC was reviewing a US\$2.8 million loan application as part of the estimated US\$4 million that will be needed to reopen the mine at 100 t/d. This would yield 19,600 oz/y of gold. Production is expected to begin in mid 2004. The funds generated would contribute to continued exploration on the property.

During 2003, a tourmaline-rich breccia pipe was identified, lending credence to the belief in the geological similarity of Pimentón to the Andina (Codelco), Disputada (Anglo American) copper properties to the south and Pelambres (Antofagasta) to the north. Four holes were drilled and yielded positive results.

Further South in Region XI, Patagonia Gold plc of the UK (formerly HPD Exploration) in partnership with Minera Puerto Madryn of Argentina, purchased West-Mag's 75% interest in the Coyhaique gold project. It is located 15 km east of the city of Coyhaique and covers 20,800 ha. After resubmitting an environmental impact statement, a 10,000 m drilling programme was started in late November.

In the far south, in Region XII, an exploration programme is under way at the Estancia Invierno coal prospect on the Isla Riesco, to determine open-pit reserves. Previous resource evaluations have demonstrated 670 Mt of sub-bituminous coal (4,300-5,500 kcal/kg). The prospect was awarded to Minera Otway in 2002, a company jointly owned by Ingeniería del Sur (related to the coal producer Carbonífera Catamutún) and Ingeniería Civil Vicente.

Simon Tarbutt has worked for 40 years on non-ferrous mining projects and operations in South America. He is now based in Santiago and runs his own consultancy.

ECUADOR:

The next South American hotspot?

ECUADOR is the smallest Andean country in South America. It is also one of the continent's largest exporters of crude oil. High oil prices in 2002 and 2003 helped the country recover from the severe economic crisis of 1999, and oil revenues now provide 40% of export earnings and account for about one third of government revenue. Growth in real GDP, however, declined from 5.4% in 2001 to about 1.7% in 2003. Continued IMF support during this recovery process is expected shortly, with provision for a new standby loan facility.

The government's popularity has declined steadily since the surprise election result of November 2002, when left-leaning Lucio Gutiérrez, a former coup leader, beat conservative banana billionaire Alvaro Noboa. The PSP party's success was gained through alliances with Pachicutik, representing the indigenous population, and the radical left-wing MPD party. Both were rewarded with key ministerial appointments in the

BY JOHN SUTCLIFFE

government. However, the alliance with Pachicutik did not last; pre-election aspirations were left unfulfilled, and in September 2003 it broke off relations with the government.

Mr Gutiérrez was subsequently widely criticised for the appointment of family members and military friends to key posts. These included Carlos Arboleda, the controversial Minister for Energy and Mines, who was forced to resign in April 2004. The recent political disarray has been exploited by the right-leaning Partido Social Cristiano (PSC) party.

Ecuador has a modern mining law and a diverse inventory of mineral deposit types, including: copper and gold-copper porphyries; high- and low-sulphidation epithermal gold deposits; two gold-rich VMS deposits; and a large gold-skarn district. The country's mineral

potential lies mostly within the Andes. These mountains form the 600 km-long backbone of Ecuador, rising to over 6,000 m, and include Cotopaxi, the world's highest active volcano.

Ecuador has no significant mining industry, but two projects at the feasibility stage could form the basis of an embryonic mining industry. Current gold production is estimated at 8 t, derived largely from informal vein operations in the Portovelo-Zaruma and Ponce Enríquez districts of the Western Cordillera. The Portovelo-Zaruma district has produced an estimated 4 Moz gold since the colonial period. However, the lack of environmental controls over the more recent mining in this historic district has tarnished the image of mining within Ecuador.

The country's principal gold deposits are located in the Western Cordillera, which comprises mainly Tertiary volcanic rocks. The most advanced project is Rio Blanco, located about 40 km west of Cuenca, and owned by International Minerals Corp (IMC). This project comprises several low-sulphidation epithermal veins and breccias, characterised by bonanza-grade gold and silver mineralisation.

In October 2003, the company released the results of an independent scoping study undertaken by BISA (part of the Peruvian Buenaventura group) on the Alejandra vein. This 500 m-long structure, up to 30 m wide, has been proved to at least 300 m below surface. IMC estimated a diluted inferred resource of 744,000 t

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- Working Capital \$2.7 million
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Contact

David A. Meyer, President & CEO
Largo Resources Ltd.
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Toronto, Ontario
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at an average grade of 18.3 g/t Au and 146 g/t Ag. A feasibility study is being undertaken by Micon International of Canada, and results are expected early in 2005. Water Management Consultants of Chile is undertaking the EIA.

As part of this study, IMC is completing a 10,000 m infill drilling programme, and earlier this year reported results which included some high-grade intersections (eg, 2.1 m at 27.4 g/t Au and 116 g/t Ag in hole BC-94; 7.4 m at 25.2 g/t Au and 51 g/t Ag, including 0.4 m at 360 g/t Au and 656 g/t Ag in BC-95; 0.8 m at 44.2 g/t Au and 275 g/t Ag in BC-98; 3.0 m at 16.8 g/t Au and 199 g/t Ag in BC-102; and 5.2m at 32.5 g/t Au and 376 g/t Ag in BC-104).

Later, the company will turn its attention to other targets in the project area, such as the Dorada zone, located about 700 m south of the Alejandra Vein and about 600 m lower in elevation. A short adit at Dorada completed earlier this year intersected a faulted vein with a true width of about 3.5 m, and possessing average grades of 90.8 g/t Au and 643 g/t Ag.

IMC is also updating the 1997 pre-feasibility study on the Gaby gold porphyry and the prefeasibility study conducted by Cambior Inc on the adjacent Papa Grande deposit, (now owned by IMC). The Gaby-Papa Grande deposit, located in the foothills of the Western Cordillera near Machala, is Ecuador's largest undeveloped gold resource.

The 1997 studies estimated an inferred mineral resource of 5 Moz in the two adjacent bodies with 211 Mt at an average grade of 0.82 g/t Au (0.5 g/t cut-off). Gaby lies close to the Ponce Enríquez gold vein district, which has produced about 1-2 Moz of gold since the early 1980s.

The Cangrejos project, located 30 km south of Gaby, was explored by Newmont Mining Corp in the late 1990s. This gold-copper porphyry has similar potential to Gaby, but no resource figure is available.

Iamgold Corp continues work at Quimsacocha, a high-sulphidation gold prospect located 90 km south of Cuenca. Previously explored by Newmont and Cogema of France, it contains extensive low-grade disseminated gold mineralisation and a series of high-grade gold and silver-bearing quartz-energite veins. Iamgold reported the results from 6,000 m of diamond drilling in early 2004. One of the better intersections was 2.1 m at 34.8 g/t Au and 260 g/t Ag in Vein 11. Follow-up work will focus along strike from Vein 11 and test six other veins. The margin of the Tres Lagunas diatreme will also be tested.

Iamgold continued work on a 50:50 joint venture with Gold Fields Ltd, targeting epithermal gold mineralisation in a 2.2 million km² area of predominantly Miocene volcanics in southeast Ecuador. The JV includes IMC's Cañicapa high-sulphidation target, where a 3,000 m reverse-circulation drilling programme was completed earlier this year. Significant zones of vuggy silica were intersected from which assay results are awaited.

Iamgold also has a joint venture with Minera Cachabi on El Mozo, a high-sulphidation gold target in Azuay Province. Reviewing the company's exploration work in the region, Iamgold's exploration director Dennis Jones, predicted that Ecuador will be the next 'hotspot' in South America.

In the Eastern Cordillera (Cordillera Real), Corriente Resources Inc continued work on the Corriente Copper Belt. This new porphyry copper district, discovered by Gencor/Billiton in the mid-1990s, is related to Jurassic granites. The belt contains three known copper porphyries, which together contain an estimated 600 Mt at an average grade of 0.81 % Cu, with some gold-molyb-

denum credits. The district contains several untested targets.

Amec is undertaking a feasibility study on the Mirador deposit, scheduled for completion in mid-2004. A 2003 scoping study at Mirador, which gave an estimated resource of 98 Mt averaging 0.78% Cu, demonstrated the economic feasibility of a 20,000 t/d operation at a capital cost of US\$134 million.

Dynasty Metals and Mining is a new arrival on the exploration scene in Ecuador. It was established in 2003 to focus on precious metals exploration in southern Ecuador. The company owns part of the Chinapintza gold-vein deposit, where TVX (now Kinross Gold Corp) estimated some 215,000 oz gold and 1.4 Moz silver. Dynasty recently reported four new veins discoveries, including the Teniente Vein, which has a strike length of over 500 m. Channel samples yielded gold grades of 9.8-57 g/t and silver grades of 225-2,500 g/t, with an estimated average true width of 0.6 m.

The company also owns the Dynasty concession in Loja Province, southern Ecuador. This shows large areas with reported porphyry-style alteration which contain gold- and silver-bearing veins. The company also controls a significant part of the historic Portovelo-Zaruma mesothermal vein gold camp.

Aurelian Resources, another recent arrival in Ecuador, has reported promising results from the Condor project in the Eastern Cordillera of southeast Ecuador. Eight diamond drill holes were completed earlier this year to test a 2 km-long gold soil anomaly in the Bonzas-Las Peñas zone. These intersected broad zones of mineralisation including 101 m of 2.3 g/t, and 110 m of 1.3 g/t Au. The mineralisation, which is described as epithermal low-sulphidation type, follows a district-scale north-south fault zone.

The Nambijas gold skarn deposit, also located in south/east Ecuador, has produced more than 1 Moz of gold from bonanza-grade pods since it was discovered in the early 1980s. Nambijas is now worked out, but Sultana del Condor is currently exploiting a high-grade skarn nearby, with a reported drill-inferred resource of close to half a million ounces of gold.

Sultana also own La Plata, a gold-rich polymetallic deposit located 160 km west-southwest of Quito on the western flanks of the Andes. The drill-indicated resource stands at 686,000 t averaging 6.3 g/t Au, 76 g/t Ag, 5.7% Cu and 5.1% Zn. La Plata is one of two Kuroko-type VMS-type deposits hosted by dacitic rocks that are part of a Palaeogene oceanic arc. Amec is finalising a scoping study at La Plata and results are expected shortly.

Elsewhere in the Macuchi-La Plata volcanic belt, Toronto-listed Largo Resources Ltd has begun a two-phase, US\$1.5 million exploration programme over two years in order to earn a 51% interest in the Macuchi property. There are four major targets: Mercedes, Esperanza, Minchoa 3 and Minchoa 1. In the 1930s, Cotopaxi Mining Co discovered the Mercedes deposit, and in the early 1940s some 435,000 t was mined averaging 11.5 g/t Au, 4.7% Cu and 68 g/t Ag. Diamond drilling at Mercedes has recently begun.

In conclusion, Ecuador has several advanced exploration projects that have the potential to form the basis of a modern mining industry. This section of the Andes is well endowed with a range of mineral deposit types, but is still relatively under-explored. The few exploration companies that have persisted here have all been rewarded with promising discoveries – and more should follow.

John Sutcliffe is head of exploration for International Minerals Corp

Mineral exports jump 21% by value

PERU experienced 3.6% growth in GDP during 2003, unchanged from the previous year, and inflation for the year was 2.5%. The value of all Peruvian exports increased by 17% to US\$8.96 billion during 2003, and imports increased by 11% to US\$8.2 billion. Peru's net international currency reserves at the end of 2003 increased to US\$10.61 billion, 11% above that of the previous year.

Among the most important mining news during 2003 was Barrick Gold Corp's decision to start construction of the Alto Chicama gold project during the first quarter of 2004, and the difficulties faced by Manhattan Minerals Corp concerning its Tambogrande project. At the end of 2003, the mining industry was shaken by a proposal submitted to Congress to impose a 3% royalty on gross sales. The government said that it was looking at the possibility of reducing the percentage and that it was also considering whether the royalty could be regarded as an early instalment of income tax.

In December, the government agency Centromin Peru concluded that Manhattan had failed to comply with the contract conditions of the option agreement to maintain a 75% interest in the Tambogrande concessions, and that the agreement was therefore terminated. The decision was questioned by Manhattan, which announced it was taking the case to arbitration. Local opposition to the project, with support by anti-mining groups, obstructed the public hearings legally required for the approval of the environmental impact study for Tambogrande. Controversially, the US\$405 million project requires the relocation of 1,800 Tambogrande homes to the south of the town.

The Tambogrande option agreement with Centromin includes ten mineral concessions covering 10,000 ha. Manhattan's 53,700 ha comprising the Lancones and Papayo concessions are not affected, and the company will focus its activities on exploration to the south of Tambogrande where it has already discovered the B-5 deposit.

MINERAL PRODUCTION

The value of Peru's mine production grew by 21% to US\$5.6 billion during 2003 and output of most metals increased. The biggest increases were recorded for cadmium (16%), zinc (12%) and gold (9%). The value of mining products exported during the year also rose, by 21%, to US\$4.25 billion. Together, export earnings from mining and oil amounted to US\$4.91 billion, representing 60% of the country's total export income.

COPPER

Peru's copper production in 2003 remained very close to that of the previous year, reaching 839,223 t, worth an estimated US\$1.34 billion. Copper exports totalled 787,300 t, valued at US\$1.26 billion (including the value of by-product silver contained in copper concentrates).

Southern Peru Copper Corp (SPCC) remained the largest copper producer, slightly increasing its output, to 371,415 t, from its mining operations at Toquepala and Cuajone. Antamina retained its position as the second-largest Peruvian copper producer, although

BY CARLOS SOLDI

output was 22% lower than in 2002, at 267,876 t. Cerro Verde remained the country's third-largest producer, reporting an output of 87,327 t, a slight increase on the previous year.

Tintaya more than doubled its output, to 51,644 t, having resumed production after temporarily suspending mining operations during 2002. Doe Run produced 16,225 t of copper from its Cobriza mine and Cia Minera Condestable increased production by 19%, to 11,227 t, after completing a plant expansion. Amongst the other producers, Cia Minera Raura went back into operation, producing 5,016 t; Atacocha increased its output to 3,111 t; Empresa Minera Los Quenuales (previously Yauliyacu) produced 4,499 t; Pan American Silver Corp reported an output of 2,337 t from its Quiruvilca mine; Cia Minera Milpo 2,302 t; Cia Minera Colquisiri 2,232 t; and Cia Minera Huaron 2,121 t. Other medium and small-sized mines located throughout the country accounted for the remaining 11,860 t of copper produced during 2003.

The government is planning to auction the large Las Bambas copper deposit in July this year and 14 companies have pre-qualified for the auction.

LEAD, ZINC AND SILVER

In 2003, Peru produced 307,705 t of lead, 1,368,606 t of zinc and 2,775 t of silver. Exports were worth US\$201.3 million for lead (containing by-product silver), US\$528.7 million for zinc (also containing by-product silver) and US\$191.0 million for silver. Volcan Cia Minera remained the country's largest lead producer, with output of 54,254 t. The company also produced 224,382 t of zinc and 296 t of silver.

Antamina became Peru's largest zinc and silver producer, reporting outputs of 400,703 t and 316.8 t respectively. The company also produced 5,887 t of lead.

Cia de Minas Buenaventura SA was Peru's second-largest silver producer, with output of 316.2 t. It also produced 6,889 t of lead and 7,235 t of zinc. Cia Minera Atacocha remained the second-largest lead producer, with output of 39,420 t, plus 66,109 t of zinc and 147 t of silver. Empresa Minera Los Quenuales, the Glencore-owned mining company that now incorporates the Iscaycruz and the Yauliyacu mines, produced 138,102 t of zinc, 8,984 t of lead and 183.2 t of silver. Cia Minera Milpo, the country's third-largest lead producer, produced 30,003 t, plus 95,095 t of zinc and 133 t of silver.

Soc Minera El Brocal remained as the country's fourth-largest lead producer, with output of 23,208 t, plus 58,457 t of zinc, and 90.8 t of silver. Empresa Administradora Chungar, the mining operation now under the administration of Volcan Cia Minera, produced 22,129 t of lead, 56,905 t of zinc and 52 t of silver, and Cia Minera Santa Luisa, the Mitsui Mining subsidiary, produced 20,487 t of lead, 44,601 t of zinc, and 46.8 t of silver from its Huanzalá mine. Pan American Silver produced 19,847 t of lead, 34,070 t of zinc and 249.7 t of silver from its Quiruvilca and Huaron mines, and Soc Minera Corona produced 16,096 t of lead, 27,498 t of

zinc and 139 t of silver from its Yauricocha, Manuelita and Carolina mines.

TIN

Minsur remained Peru's only tin producer and its output for the year was 40,202 t from its San Rafael mine, a 4% increase on the previous year's production. Minsur also operates the Funsur tin smelting and refining installation located in Pisco, south of Lima.

IRON AND STEEL

Shougang Hierro Peru, the country's only iron-ore producer, increased its production by 11% during 2003, reporting output of 3.5 Mt. The value of Peruvian iron exports during 2003 was US\$94.1 million for all iron products (pellets and sinter feed), 14% more than in 2002.

GOLD

Peru's gold production increased by 9% in 2003 (after a 13% increase in 2002), to reach 171,551 kg (5.5 Moz). Exports were valued at US\$2.05 billion, an increase of 38% over 2002. Gold represented 47% of the value of all mining exports in 2003 and 23% of Peru's total exports. Minera Yanacocha and Minera Barrick Misquichilca contributed 68% of the total output, informal gold miners 17%, and Cia Minera Ares and Cia de Minas Buenaventura each contributed 3%.

Yanacocha was again Peru's largest gold producer. It increased output by 22% to 88,583 kg, representing 52% of all the gold produced in the country. Other

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MINE PRODUCTION (t UNLESS STATED OTHERWISE)

	1998	1999	2000	2001	2002	2003 estimate
Gold	93.57	128.09	132.59	138.75	157.3	171.6
Silver	2,025	2,217	2,438	2,673	2,761	2,774
Copper ('000 t)	483	536	554	722	843	839
Lead ('000 t)	258	271	271	290	298	308
Zinc ('000 t)	869	899	910	1,057	1,222	1,369
Tin ('000 t)	25.7	30.4	30.4	38.2	38.8	40.2
Iron ore (Mt)	3.2	2.5	2.5	3	3.1	3.5
Molybdenum	4,300	5,500	7,200	9,500	8,600	9,600
Arsenic	624	1,611	2,495	2,800	2,970	1,600
Antimony	364	255	461	274	356	606
Bismuth	868	705	744	640	568	821
Cadmium	132	465	483	456	456	529
Indium	4.23	5	5.1	4	5.5	5.5
Selenium	18.01	23	23	16	20.6	23.4
Tellurium	21.68	17	22	19	21.6	25.3
Crude oil (Mbbbl)	42	37	36	35	35	33

important producers were: Minera Barrick Misquichilca, with 28,358 kg from its Pierina mine; Cia Minera Ares, with 5,763 kg; Cia de Minas Buenaventura, with 5,655 kg; Minera Aurifera Retamas, with 5,181 kg; Consorcio Minero Horizonte, with 4,574 kg; Cia Minera Aurifera Santa Rosa, with 3,682 kg; Cia Minera Poderosa, with 2,501 kg; and Inversiones Mineras del Sur, with 1,707 kg.

Other medium and small mines contributed 12,700 kg, and an unknown number of informal miners accounted for 12,849 kg, or around 7% of the country's total gold production.

Barrick will invest around US\$110 million this year on construction at the Alto Chicama project, and expects to pour the first gold the third quarter of 2005.

Reserves at the deposit, located in Peru's northern Andes, amount to some 7.2 Moz contained, operating costs are anticipated to be about US\$135/oz and annual production is projected at about 540,000 oz over a mine life of at least ten years. There is optimism that more gold will be found in the vicinity of Alto Chicama and the company expects to spend US\$5 million on further exploration during 2004.

EXPLORATION

There has been considerable gold exploration activity in Peru over the past year. Much of it has been to the north of Yanacocha at La Zanja, where a resource of at

least 900,000 oz has been delineated by a joint venture involving Buenaventura and Newmont Mining Corp, the operator at Yanacocha. At Marcapunta in the Colquijirca mining district, some 49 Mt averaging 1.9% Cu, 22 g/t Ag and 0.3 g/t Au have already been identified; at La Virgen, reserves of 7.2 Mt averaging 1.4 g/t have been proved; and at La Arena there is a porphyry hosting a 19.7 Mt resource averaging 1.07 g/t Au.

Peru's southern Andes are also generating considerable interest, not least as a result of the discovery and development of a large, low-grade gold deposit by the wholly-owned Peruvian company, Minera Aruntani. The deposit is located about 800 km southeast of Lima

between the departments of Puno and Moquegua, and the company began open-pit production in March last year. It produced 120,000 oz during 2003, plus some 200,000 oz of silver, and expects to produce 200,000 oz in 2004 and build to 250,000 oz from 2005. Start-up costs for the mine are reported to have been just US\$25 million and the company says that production costs are around US\$150/oz.

Mineras Aruntani hopes to increase reserves to about 3.0 Moz, has identified a further three gold districts within its 750 km² exploration licence area and is planning to spend US\$3 million on exploration.

The Rescatada gold deposit lies within the same gold belt, and although the owner, AngloGold Ashanti Ltd, is seeking offers for the project because it is too small, it will seek a 'back-in' clause in any sale or joint venture, in case the deposit proves to be larger than originally calculated.

Newmont is focusing the bulk of its exploration in the north around Yanacocha, but has allocated US\$5-6 million on gold exploration in south and central Peru, and Minsur SA, Peru's largest tin miner, is reported to be exploring a promising gold prospect in the south at Santo Domingo.

Carlos Soldi is general manager of SVS Ingenieros SA, a Peruvian consultancy specialising in geotechnical engineering and waste management



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Tel: 604.241.5712
www.cesl.com