

# RECENT GOLD DISCOVERIES IN CHILE AND PROSPECTS FOR NEW ORE DEPOSITS

## Copper, Gold, Silver, and Tin Elephants

The Andes Mountains comprise one of the world's great sources of metals. The range hosts the following greatest mines:

**Copper:** El Teniente, Chuquibambilla, Disputada-Rio Blanco and Escondida in Chile.

**Gold:** Yanacocha, Peru.

**Silver:** Cerro Rico Potosí and San Cristobal both in Bolivia.

**Tin** (in hard rock) Llallagua, Bolivia.

**Vanadium:** Mina Ragra, Peru.

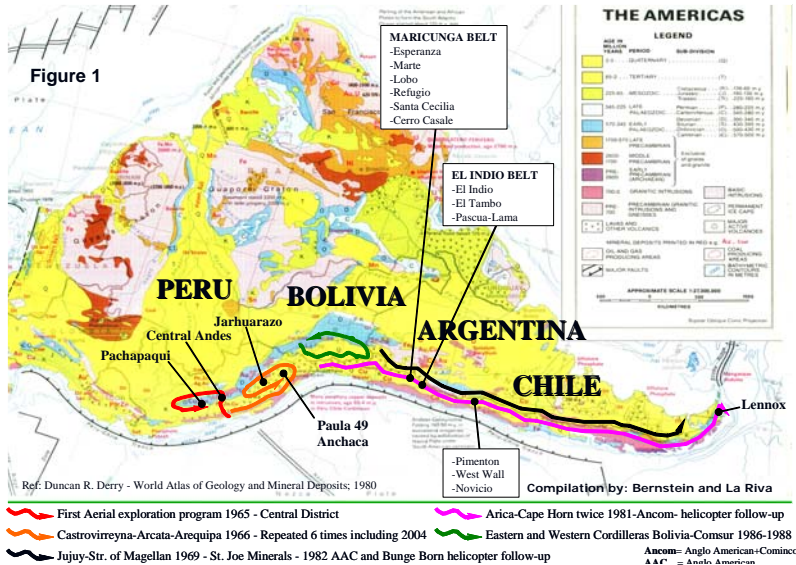
**Great polymetallic deposits:** Cerro de Pasco and Morococha, Peru.

The Andes have many other significant producers of gold, silver, copper, lead and zinc. Today I will talk about recent gold discoveries and where there may be opportunities for new gold ore in Chile.

## Pick-up Trucks, Horses, Planes and Helicopters

Figure 1 shows geological map of South America on which are plotted flight lines that I, BTX and NCE have flown in search of guides to ore over the Andes over the last 40 years.

**Trace of Aerial programs lead by Merwin Bernstein between 1965 and 2004. Some with significant helicopter follow-up, discoveries and production.**



I started as a junior mine geologist in Cerro de Pasco in 1952 and during May through September of 1955 I had the good luck to spend my time in and around the Central District in a pick-up truck and on horseback looking for another Cerro de Pasco or a bonanza lead-silver deposit for Kennecott.

This was an era when East Tintic, with its bonanza silver-lead ores, the Viburnum trend's great lead mines, lead-zinc in North Africa, gold in the Witwatersrand and gold in placer deposits were all attractive to Kennecott. KCC drilled the Santa River's, flood plain in Peru for placer gold in 1955 while I was with them. Our general manager was a mining engineer a specialist in gold dredging, and large placer gold deposits were among our exploration objectives.

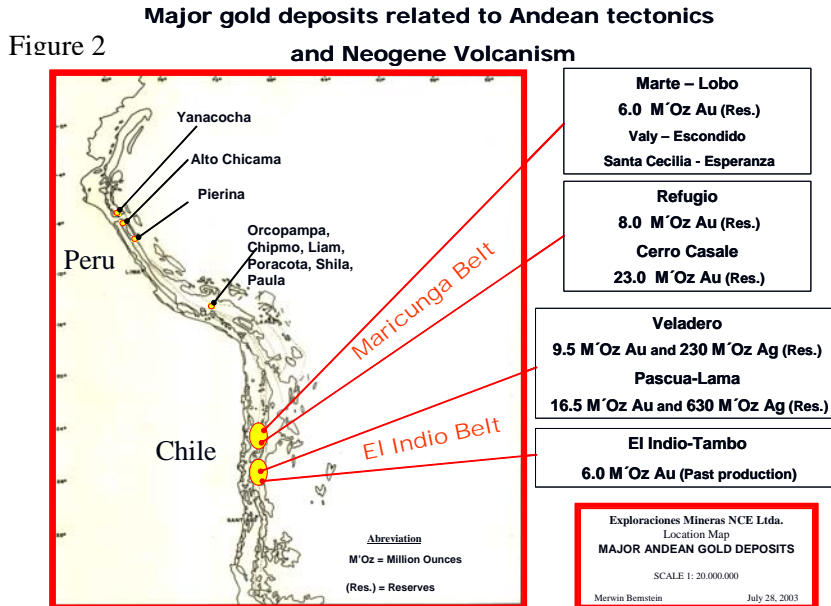
I soon began to believe the two most effective tools for exploration in the Andes were a DC-3 and a good horse that was close to 50 years ago. It was in the late 1960's before I used a helicopter in the Andes, but after I did I was convinced about their effectiveness. In steep country and at high elevations it makes 5 perhaps 10 geologist out of one in terms the amount of ground covered and the number of samples taken, especially above 4,500 meters elevation where there are deep canyons, and the two seem to go together .

Between 1957 and 1970 I spent plenty of time on a horse, as most other exploration geologist working in Peru did in those days. Some of the trips when into Chumbivilcas, or an investigation of the Rondoni District, would take two or three weeks. Eventually I was able to convince my bosses in Volcan Mines to fly the silver belt in a small Cessna between San Genaro and Caylloma, and those in St. Joe Minerals to fly the Cordillera Huayhuash, Pachapaqui and Antamina in a DC-3. The following examinations by horses and mules were effective but slow and time consuming.

### **Chilean Gold Deposits**

Figure 2 shows the position of the Maricunga and the El Indio gold belts. These lineaments supply most of Chile's gold production, have big reserves and should host plenty of undiscovered ore as well. I will discuss these two belts later;

However, I want to say something before about the generally unrecognized gold potential in the far south of Chile.



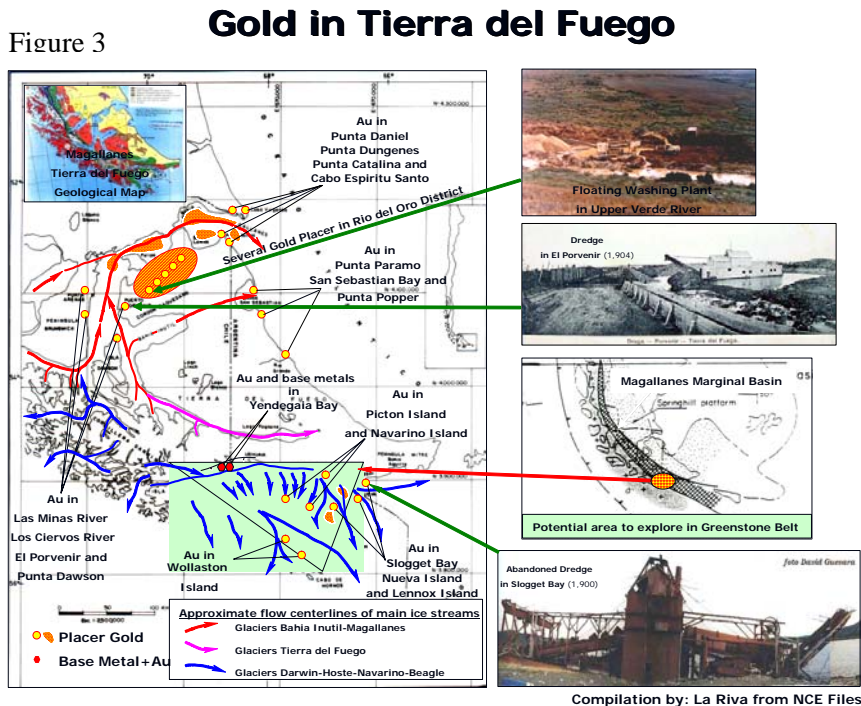
### Gold in Magallanes

Magallanes is that part of Chile around on the Straits of Magellan. I consider it to be the part which is south of 52° South Latitude.

The first discovery of gold in Magallanes was reported near Cabo Vírgenes in 1884. By 1887 and 1888 prospectors were mining the beaches of most of the islands south of the Beagle Channel. By 1890 there were three hundred miners working gravels at Caleta de Oro (Gold Cove), on Lennox Island which gained local fame at the time as an unusually prolific producer. The richest ores near surface became exhausted after 1895 and by 1902 there were only 30 men recorded as working on Lennox. Between 1905 and 1908 attempts were made to mechanize, and to find new ore apparently with no success, and by 1910 the area was virtually abandoned.

Historical records tend to document official reports which cite only two tons of gold produced between 1891 and 1894 for the Nassau Bay area; but, considering poor official record keeping and unreported gold in that day, it is difficult to say how much gold was mined. Figure 3 shows, Punta Paramo on San

Sebastian Bay where another 0.5 tons of official production was mined from beach sands about this time. Other production sites are shown by yellow circles. The greatest production in Magallanes probably came from the Rio del Oro district. The yellow and red colored areas in the Straits of Magellan and the Bahia Nassau show, off-shore, areas sampled by Anglo American in the early 1990s. This program found significant anomalies on the surface of the sea floor.



## Regional Geology

Lennox Island occurs near the southern tip of the South American continent, near the center of the arcuate belt of the geological formations which constitutes the southern extremity of the Andes range. The Paleozoic to Tertiary units may be important as the original source rock of alluvial gold in the Quaternary and Holocene fluvial glacial detritus.

## Jurassic To Tertiary

The geological formations are present in four parallel arcuate belts. The western most constitutes the southern end of the Andean batholith and consists of Mesozoic to Tertiary granites and granodiorites which are exposed in the labyrinth of fiords and islands along the Pacific coastline. This is the vast Patagonia

batholith a continuous calc-alkaline batholith averaging 60 kms in width. It is believed to represent the roots of an island arc active in the late Mesozoic along the basin's Pacific margin and intrudes into, and contains, large xenoliths of Paleozoic basement and overlying middle-upper Jurassic silicic volcanic greenstone on the western flanks. These are called the Rocas Verdes and are a eugeosynclinal sedimentary and volcanic sequence, partly metamorphosed, intruded by late Cretaceous and early Tertiary intrusives, and crossed by huge shearzones related to Plate Tectonics. The Beagle Channel north of Lennox follows the trace of a giant-strike-slip fault, an oceanic transform fault. The greenstones are exposed on islands such as Navarino, Lennox and Nueva, and stained greenstone boulders with some sulfides are common in the glacial deposits.

Some authorities believe the known showings of mineralization in the Rocas Verdes Belt provide evidence enough to demonstrate a local source for the regions placer gold deposits. This may be; but, the combination of calcalkaline intrusives into lower Cretaceous volcanics adds to potential guides. The locii of diorite and granodiorites bodies along faults and at their intersections in the Rocas Verdes also constitute a good guide especially if in addition the location of placer gold deposits are considered.

### **Quaternary Rocks**

The eastern part of the continent in these latitudes is largely overlain by unconsolidated deposits of Quaternary to Holocene age consisting of huge volumes of different types of glacial drift deposited during various phases of the Ice Age. A classic study in 1932 of Caldenius updated by Clapperton (1993) led to the recognition of four periods of major glacial advance ranging in age from Tertiary to Holocene. Glaciologists recognize 10 or more lesser advances each generally shorter than the previous within the major cycles. They conclude that the greatest advance occurred about one million years ago, when the ice reached the spit reaching south from Punta Dungeness. The last glaciation left an ice-front composed mostly of terminal moraines which is more clearly recognizable, since each

advance of ice tended to modified or obliterate the ones left by previous advances and retreats.

All of the advances originated in zones of major ice accumulation in the Darwin Range. Gold is ubiquitous in the glacial <sup>deposits</sup> in and around Nassau Bay and the Beagle Channel. The formation of placer deposits depends on the action of fluvial systems to work the glacial deposits in the lee of retreating glacial front and by the subsequent preservation of these concentrations, either by rapid burial or by having missed scouring in subsequent advances. Other mechanisms; such as gravitational sinking on to a stable substrata, or chemical remobilization or present day, reworking due to wave action on or near benches of tidal currents undoubtedly made contributions.

### **Anglo American Investigates Sea Floor Gold in the Straits of Magellan and Nassau Bay**

In 1898 gold was discovered in Anvil Creek and in Nome beaches on Norton Sound, Alaska. Nome's off-shore gold deposits were drilled by Asarco and Texas Gulf. WestGold an Anglo American subsidiary floats the Bima, a bucket line dredge, which dug off-shore in Norton Sound from 1986 to 1990 and produced 125,000 ounces of gold. A tin dredge the Bima was designed for Malaysian-waters and was not appropriate for Nome's off-shore. Partly, because the sound is frozen for 6 month a year.

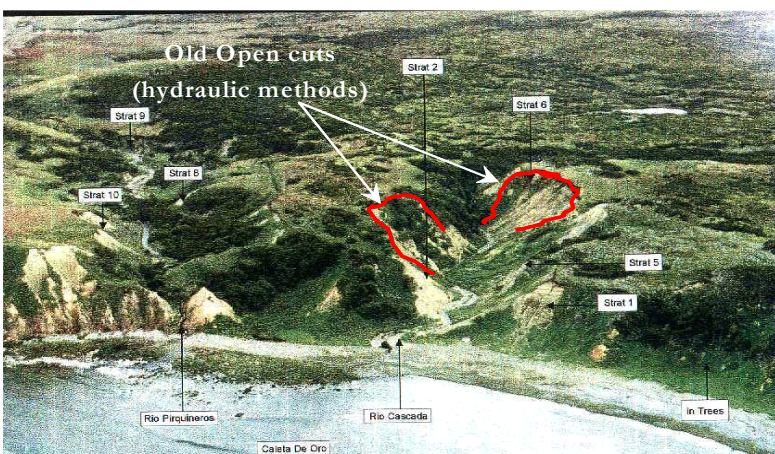
While the Nome operation was underway, Anglo American as Tierra Mar negotiated off-shore concession with the government of Chile for marine concessions in the Straits of Magellan and Bahia Nassau and does reconnaissance sampling for gold deposits where the Bima might have a place to dig during the Alaskan winter. After two years, the program failed to find good sites. The Bima was scrapped in 1995. Anglo drops off-shore gold, exploration in Magallanes and shifts to copper exploration and acquisition in the Central Andes. Anglo buys Quellaveco in Peru, Disputada and Collahuasi, which are enviable acquisition.

### **NCE and Placer Mining**

The placer gold province is first flown by NCE in a Twin Otter. Follow-up with a Chilean Navy helicopter is done by the late Robert Lyall, the manager of the abandoned Anglo off-shore program, Paul Gilmour a consultant from Tucson, and myself. The Caleta de Oro, hydraulic workings are recognized. Recon sampling is positive. Then Petral, a Chilean company composed of retired Chilean Navy officers and NCE form a placer exploration mining company called Cia Minera Mares Australes (Mares); after extensive reconnaissance through-out the area, Mares zeros in on southeastern Lennox Island. Then in 1995 Mares and Orvana Minerals, a Toronto Stock Exchange Company; form a joint venture to explore in and around old hydraulic mine workings, and conducts (1) a sampling program of the Caleta de Oro and contiguous placer ground, (2) does a reconnaissance geological mapping and geochemical program of the Lennox Island greenstones; (3) does two helicopter reconnaissance flights, in search mineralization in greenstone areas.

The fluvial-glacial gravels along Caleta de Oro beach are about 40m thick and raise that high above the ocean. The gravels are dissected by two creeks, Cascada and Pirquineros, both of which have eroded deeply through the entire thickness of the sea-cliff. The two creeks have been mined by the old timers and the valleys are widened. This can be seen very well in plate below. These two open cuts and the beaches and other nearby diggings probably produced something more than 500,000 oz of gold.

### **Lennox Gold Project**



**Caleta del Oro**

The setting of the area sampled by Mares-Orvana can be seen. Note the Sea-Cliff with the sample-channels cuts, which are designated by the flags with Stratigraphic Column Numbers.

## **LENNOX ISLAND**

### **Placer Gold Potential**

Sample crews guided by Orvana geologist, in the southern summers of 1995, 1996 and 1997 undertook sampling of sea-cliffs, beaches by trenches, and vertical one meter diameter shafts were completed to various depths some as deep as 30 meters. The following extract is from an Orvana Minerals Operational Report dated October 19, 1997.

“Recognition of potentially economics quantities of gold in the poorly sorted glacial tills is a “re-discovery” of this dispositional setting of a newly appreciated potential for a large bucket-line dredging operation. The consistently anomalous amounts of gold in the glacial tills, over a large area, suggest the potential for additional placer discoveries and source lode deposits. The island is accessible by a front-loading barge that can be rented at Punta Arenas. Safe harbors with easy beach landing sites are located adjacent to the Caleta de Oro basin.

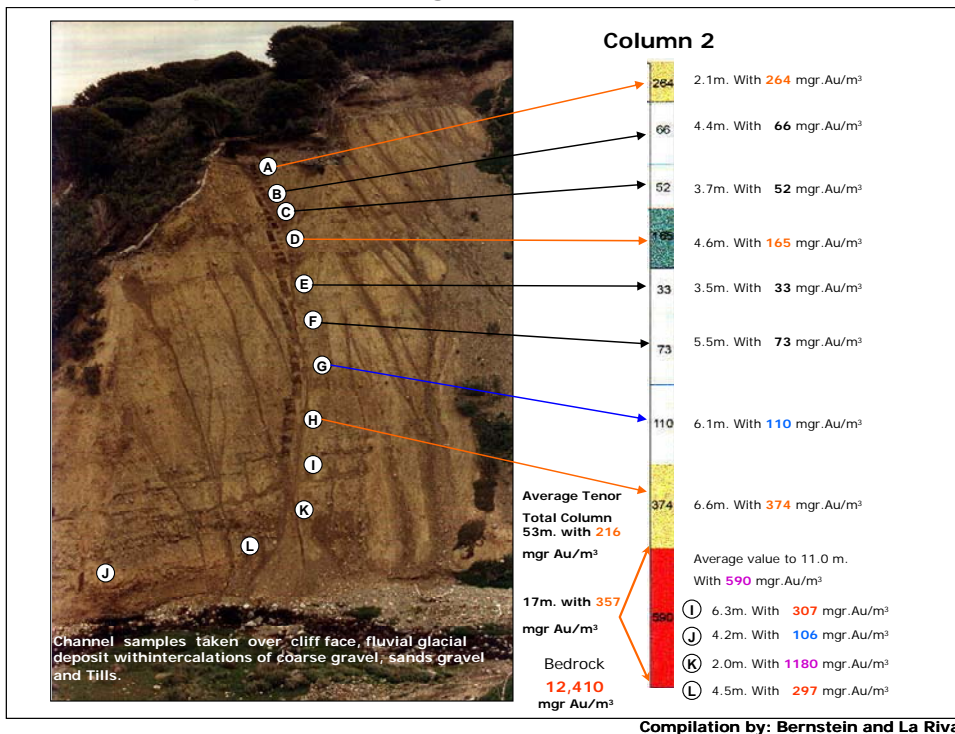
“The Bahia Nassau project was initiated by Exploraciones Mineras NCE Ltda. as a placer prospecting and land acquisition program. NCE’s exploration program during 1994 and 1995 identified the Caleta de Oro area of Lennox Island as top priority for further testing. Orvana joined the project with NCE at that time.

“In the 1995-1996 field season, the first season with Orvana’s involvement, vertical sampling was conducted along the 30-40 meters-high exposed cliff faces at Caleta de Oro. Seventy three samples were taken from 10 channels cut across the exposed strata, representing a composite of 231 meters of vertical sampling, showing an average grade of 276 milligrams of gold per cubic meter. This sample average does not include the higher grade zones (0.5-29 grams Au/m<sup>3</sup>) that were locally encountered at the base of the glacially derived sediments. The cliffs exposed a complex sequence of layered glacial sediments



that generally consist of two till units separated by three gravel units. The till units are consistently anomalous in gold, average between 30 -100 milligrams/m<sup>3</sup>. The gravel units represent either glacial fluvial events or sea advances that have washed out the clay and upgraded the material between 10 to 100 times their original value in gold. During the past field season (1996-1997), Orvana conducted exploration inland into the basin with exploratory shaft sinking and continued trenching. One hundred and seventy-three samples were taken from two completed shafts, ten incomplete shafts, and numerous trenches, representing a composite of 209 vertical meters that averages 151 milligrams/m<sup>3</sup>.

### Samples in trenching Cliff face - Cascada creek



“Sampling from the inland program has produce data from numerous incomplete stratigraphic sections. Samples are random windows into the stratigraphic package at different elevations in the basin. Only two allowed complete vertical sampling from surface to bedrock. Places where sampling was more extensive appear to have an overall increase in gold grade. This is probably due to the fact that sampling more complete sections allows for the opportunity to encounter more

strata that represent upgraded events, upgraded higher energy strata, which seem to be scattered throughout the glacial sequence. It is believed that more sampling of complete stratigraphic sections will result in an increase in the overall grade and an increase in the understanding of the stratigraphy allowing for better correlation of sedimentary units.

“Orvana’s work has shown that these partially and poorly sorted glacial sediments have sufficient lateral extensions and sufficient gold content throughout the stratigraphic sequence to justify continued exploration. A proposed next phase is designed to test the 12 square kilometer gravel basin further inland, confirm the validity of the current geology model, and establish an economic quantity of material within the basin to justify a gravel-pump or a bucket-line dredge operation.

“A geophysical survey (TEM 47) consisting of approximately 400 electrical sounding was completed in an effort to determine the volume of the glacial sediments throughout the basin, as well as to establish the surface and bedrock topographic configuration. Results of the survey suggest the presence of approximately 200 million to 250 million cubic meters of unconsolidated material within the basin. Additionally, an attempt has been made in interpreting the geophysical data, to distinguish between the till and the gravel units within the glacial sediments.

“Result from the inland shaft and trenching program confirmed the accuracy of the geophysical soundings. Tills and gravel zones found inland have similar characteristics and grade with the glacially derived material found in the cliff of Caleta de Oro. Over 240 samples, from approximately 50 locations, have been taken to date to test the potential of the basin, from the exposed sea cliffs to approximately two kilometers inland. The shafts and trenches represent an accumulation of 440 vertical meters sampled, averaging 216 milligrams gold per cubic meter. In addition, 150 million to 200 million cubic meters of untested material occurs along the southwestern shore of Lennox Island, west of the main basin, consisting of flat-laying glacial sediments similar to those tested at Caleta de Oro. Besides the geologic and topographic similarity, the presence of gold

hydraulic workings, coupled with results of Orvana's random pan sampling there, suggests similar gold potential for this relatively untested area. Because this zone is immediately west of Caleta de Oro, it would be relatively simple to incorporate exploration there into future evaluation programs, in the same season, for very little additional costs."

## **BAYS AND PALEO-BAYS**

### **The Cove Floor Sediments**

Since the Orvana report was written geological investigations have outlined additional targets. It was recognized early that the marine sediments underneath the sea-water in the coves such as Caleta de Oro must be enriched in gold. The cove is a bite made by the ocean waves into the 30-50M, thick gold bearing marine terrace now facing the cove from behind the beach. Nearly all the gold which was in these sediments must now be on the bottom in the cove, and the gold grade of these sediments must be enriched Orvana's sea-cliff sampling averaged about 275mg/m<sup>3</sup>. The terrace sediment may be reduced to say 5m of coarse material at the bottom of the cove and its grade in gold would thereby be increased about 8 times or to about 2.2 g Au/m<sup>3</sup>. Therefore it is reasonable to expect the sea –floor of the cove to have grades in the 1 and 2g Au range.

The coves therefore constitute targets for submarine mining. What is more we believe we have identified paleo-bays which are now filled with gold bearing sediments and are covered with peat. These are ideal exploration targets for ore which may be mined by back-hoe floating washing plant-operations, and Mares plans are to drill several of these. We believe back-hoe operations may produce between 20,000 to 50,000oz Au/ year. They should be low cost gold producers.

## **EL INDIO DISCOVERY**

This section is included to inform exploration geologist who work in South America about the early history of El Indio and the techniques used to explore and develop the high grade ore. There are also some political lessons here which are worth knowing and remembering for an understanding of why Chile politically is the

way it is today. The original discovery was made by “pirquineros”, hand miners, from La Serena, who were employed by local entrepreneurs. In the mid-1960’s the pirquineros were drawn to the area by a huge and vivid color anomaly. Copper oxide paints on steep cliffs provided incentive to try to mine the copper minerals for which they were searching.

Little, but encouraging, prospecting had been done prior to 1970 when Salvador Allende was elected President of Chile. The economic justification to continue prospecting became unattractive during the early part of the Marxist Government and grew worse as time went by. On Sept 11, 1973 there was a Court de ‘Etat in which a military government led by Augusto Pinochet took power. The coup saved Chile from becoming another Cuba and Chileans went on to establish, today, what is economically and politically the most successful democracy in Latin America and one which must rank high in the rest of the world.



In 1975 I was International Exploration Manager for St. Joe Minerals and I was convinced about Chile’s return to free-market principle and that the country would be an attractive place for foreign mining investment. I asked David Thomson to scout possibilities and he made the first examination for St. Joe on the strength of smelter liquidations shown to him by the owners. The liquidations were for the sale of about 425 tons of ore which ran 80 Au/ton Au and 4-5% Cu. This remarkable achievement by Chilean pirquineros and local investors who supplied the risk capital, the grubstake, owes much to their confidence in one another and to a simple gold assay horn known as a puruña.

Dave met with the owners in La Serena and reviewed liquidations, geologic reports, claim maps, made by Enami’s geologist, Carlos Llaumett. There was a geologic map with assay results plotted on it, and a description of the prospect. Dave spent the night at the end of the summer-road, and before daybreak, mounted on a mule, rode to El Indio. He sized-up the geology, took samples of the pirquinero’s diggings and then rode back to Baños, in an eighteen-hour property examination and horseback ride. His samples of the veins assay averaged between 60-70 g Au/T, and confirmed Llaumett’s results.

This may have been one of the most important one day efforts in terms of accomplishment and in terms of down-stream economic consequences in modern Andean mining history. Following his positive recommendation the exploration, leading to the development and exploitation of El Indio was started and only 4 years later, St. Joe Minerals made shipments of bonanza grade ore containing 65,723 oz of gold by the end of 1979. El Indio sent more than 1.3 million oz Au of direct shipping ore, which averaged about 6.6 oz Au/ton, that is a little less than 200,000 tons of ore to smelters in Tacoma and Boliden before the flotation mill and roaster went on stream in 1982. The cash smelter payments contributed to the building of a 1,250 tons/day selective flotation concentrator and a roaster to reduce arsenic in the gold-copper concentrate. Within a year or two all of the ground which now comprises Sancarron, Nevada (now Pascua), and Lama to the north as well as Tambo, Elefante, Vacas Heladas to south were brought under St Joe's control through options and claim staking. The ground on the Argentine side was staked by St. Joe's Argentine subsidiary; Cia Minera Aguilar.

The contract negotiations with the sellers were successful. St. Joe obtained an option to buy 80% of El Indio shares at a fair price. The sellers, two Chilean families, received option payments, work commitments and cash payment for their shares and a 20% free ride in Cia Minera El Indio. St. Joe spent another year negotiating a Foreign Investment Contract with the Foreign Investment Committee. The St. Joe Contract, one of the first signed by the Chilean government contains many of its provision which were included in the general Foreign Investment Law, Decree Law 600 when it becomes law in 1980.

**EL INDIOMINE CHILE**

<p><u>Production for Year 1983:</u>  11.7 MT Gold  28.5 MT Silver  15,600 MT Copper</p> <p><u>Ore Reserves:</u>  5,065,000 MT  0.38 Oz. Au  3.60 Oz. Ag  4.90 % Cu</p>	 <p>After: El Indio end 1983</p>
 <p>Before: El Indio 1978</p>	<p>Exploration and Development was directed by:  Merwin Bernstein  David Thomson  Juan A. Proaño.</p>

## **Exploration Methods Used at El Indio**

The pirquineros mined the outcrops and the sub-outcrop of veins, which were well oxidized. There were residual box works after enargite and pyrite, much scorodite, a hydrous ferric arsenate paint on box works and quartz. Gold was residually enriched and grades were about 30-60 g Au. The El Indio crosscut (4,100 level) a tunnel which was 2.2 by 2.2 meters in cross-section, was driven with Eimco 911-B Load-haul-dumps and over 800 meters of tunnel advance was made every month. The crosscut adit intersected a vein with 188 g Au/ton over 2 meters with minor values of silver and copper. Drifts were driven on the vein. The purpose of using tunnels instead of drilling was to explore the veins and develop them simultaneously; giving geologist and mining engineers immediate access. Geologists could walk down the drifts to map dips, strikes, mineralogy, width, faults, splits, etc. The sample channels also helped with the geologic mapping by providing a clear view of the vein characteristics. The sample channel density in a two-meter interval in the back across vein width, gave very accurate information with which to estimate the grade. Samples were also taken of parallel stringers in back to accurately calculate dilution. There is no way drill holes in a vein system can compare with this. Tunneling continued with flat drill holes to test the walls in search of parallel veins and splits. Used in this way tunnels and drill holes together are very effective.

## **Discovery of the 3500 Ore Shoot**

The drifting and crosscutting done in 1976 and 1977 was about 65 meters below the outcrop. Therefore, there was far less leached box works and scorodite, and more hypogene mineral content, which was mostly enargite and pyrite, some of it massive. Quartz was ubiquitous. Every 50 meters or so, crosscuts were driven into the walls and through the zone of veins. After a vein was intersected by a crosscut, drifting was done on the new vein as well! Late in the 1977 field season after we had pulled out of El Indio for the winter results from a newly interested vein on the east side of the 150-meter wide zone of veins returned high assay. The new star of the assay map was a 2-meter wide sample, which ran 3,543 g Au/ton (11.4 oz Au). The samples on each side ran over 800 g Au. These samples were in a very high-grade portion of the Inca Sur Vein, an oreshoot, and

this particular, extraordinary, ore shoot was called the 3500-ore shoot of the Inca Sur Vein.

### **Guides to Ore**

A rule of thumb in epithermal vein system exploration is to drill for structure and drift for tonnage and grade, and to follow the ore even if it goes up a tree. David Thomson and I had, each, over 20 years experience in epithermal silver vein mines in Peru prior to El Indio, this gave us good insights on how to find veins and ore shoots and to economize on footage driven, time and money, in the early days at El Indio.

It was then obvious that El Indio had good potential for three types of ore: 1) Bonanza Ores, high-grade-direct-shipping (worth from \$600 to \$1,000/ton in 1977 prices and over \$2,800 ton at 2005 prices. 2) high grade milling ore. The sulfide potential for which was very large. The amount estimated in 1977 was 1.5 million tons of 16g Au, 134g Ag and 2,25% Cu, and 3) porphyry gold copper ore. The potential for porphyry copper ore was believed to be good then. I still believe it is good today.

### **Exploration of Pascua (Ex- Nevada)**

Exploration in Pascua was managed by Pedro Ly. He was the first to explore the deep tight narrow cleft in the mountain side called Quebrada de Pedro. There was no doubt it was eroded though an orebody, apparently a great one. A quartz porphyry dacite breccia infills an east-west elongated volcanic pipe of more than 2,000 meters by roughly 200 meters. The pipe cuts andesite at the higher elevations and granodiorite of a very large batholith that crops out to the west at depth. Alteration was very strong with silicification predominating. Very strong gold and silver anomalies coincide with the volcanic pipe over a vertical range of 350 mts. on north – northeast facing slope that reaches from 4000 to 5200 meters in elevation.

The strongest part of the anomaly is near the 4500 meter contour. Fortunately nearby a gully with very steep sides cuts across the mineralization at right angles. In this gully, the Quebrada de Pedro, leached mineralization is exposed; and a 300 m long line of samples assayed as follows.

### Quebrada of Pedro Trench Assays

	<b>Total length</b>	<b>Au (gr/ton)</b>	<b>Ag (gr/ton)</b>	<b>Cu (%)</b>
	300 m	0.91	22.81	0.10
Including	115 m	2.6	15.3	0.32
Including	5 m	9.75	19.51	4.6

We were sure based in our experience elsewhere with geochemistry in the greater El Indio district, that Nevada had a multimillion ton potential for high grade copper-gold-silver ores. Nevada was subsequently thoroughly explored and 26 million ounces of gold and 630 m ounces Ag were outlined by St. Joe Mineals, Anglo American, Bond Gold, Lac Minerals and eventually Barricks Gold, but through the latler part Ramon Araneda and Raymond Jannsus had the most to do with making an orebody.

### Formation of BTX and Aerial Exploration

About mid-1978, David Thomson and I had a meeting in which we proposed to St. Joe's President Jack Duncan and the Vice President for Latin America, Roy Wheelock, an aerial exploration program along the Andes to find another El Indio. There was some discussion about our idea in New York; but, as it was our idea was turned down for corporate reasons. Therefore I resigned as St. Joe's International Exploration Manager, on Dec 31, 1978 but guaranteed 50% of my time as a consultant during 1979. Dave Thomson resigned from St. Joe in November of 1979. During the year one of my principal tasks with Dave's help after he left was to prepare a Multiclient Survey about Chilean Ore Deposits, which was purchase by 12 major mining and exploration companies. The idea was to inform financially strong international players in exploration about Chile's geologic potential, its political stability and its attractive investment climate, all of which was discussed in detail in the Multiclient Survey about Chilean Ore Deposits, which was purchase by 12 major mining exploration companies.

Two of the subscribers agreed to back BTX in a two year aerial exploration program in Chile between the Peruvian border and Cape Horn. They were Anglo American and Cominco. Their partnership took the name Ancom. The Ancom-BTX joint venture started exploration in late 1980, and by late 1981 had found many of the prospects, which are now known to host major orebodies. About this



time, in 1981, St Joe's new decision makers merged St. Joe into Fluor Corp and then not long afterward Fluor sold El Indio for cash. Allan Bond of Australia offered more cash sooner than anyone else.

## **MARICUNGA**

Many of the gold discoveries in the next round of exploration, from 1980 to 1982, came out of the airborne, length-of-Chile exploration and prospecting program conducted by Bernstein y Thomson Ltda (BTX) and financed by Ancom.

In late 1980 and the early summer of 1981 a fixed-wing aerial reconnaissance of the Andes from the Peruvian border to Tierra del Fuego, the equivalent of a coast-to-coast survey in United States, was made over a four-week period. This identified color anomalies, the preliminary exploration targets. This was followed by a Lama Helicopter, an Allouette I airframe powered by an Allouette III motor, which was brought to Chile especially for this program. This flying tractor of a chopper supported ground investigations, which consisted of geological observations, and reconnaissance geochemical sampling. The helicopter gave the BTX & Ancom joint venture the advantage of making our field crews for more effective in the altitude than those in jeeps. The contract with Ancom specified that Dave or I had to be in the helicopter whenever it was working. We had a system with a carrot where everyone who was part of the exploration crew in the helicopter and two or three others shared in BTX reward for discovery which was paid on each property on which Ancom made a production decision.

By 1982 the word was out that the joint venture was exploring with a helicopter and for the first time we started to have competition for ground, but we had definite advantages in addition to the high altitude helicopter and the good field teams our organize field support consisting of fuel trucks, mobile camps, speed wagons to deliver samples to bus terminals in towns on the Pan American highway, the busses were met at the terminal and the samples were immediately delivered to an Anglo American owned assay laboratory for fast turn around times on assay results. This helped us to decide when to go back to a color anomaly or to do more sampling, or to move on which meant when to move camp. Our

seasoned geological – sample crew was composed of Pedro Ly, the late Tyler. Kittidge, Dave Thomson, John Tayler and myself. We had an experienced land group composed of a lawyer and land men in Jaime Alvarez, Mario Hernandez and Jorge Romo and an all around coordinator, expediter, and trouble shooter in Julia Aspillaga, who liaised with Ancom, and the Chilean government and others.

The late Robert A Lyall, a life long Anglo American geologist was the Ancom manager. He was a good friend and enthusiastic about the program and spent plenty of time with us in the field and made timely contributions Geoff Harden looked in on our effort for Cominco and had constructive ideas and was a good man in the field. We had a Ex-Chilean Navy helicopter pilot Jose Miguel Infante who flew prudently, fiercely maintained safety standards and yet to get us to where we wanted to land he was imaginative and intrepid, and never so much as bent a skid or a rotor, or left any of us out overnight.

These factors led to the following land position identified from south to north: Cerro Catedral, Cerro Casale, Cacique, Santa Cecilia, Refugio, San Damian, Lagunas, Escondido, Valy, Lobo, Marte, Coipa and Esperanza. Most of the land position were obtained by staking some were by option. Briefly BTX-Ancom fell into in a law suite over Coipa with Gold Fields, but neither Anglo nor Cominco wanted to pursue it and Ancom-BTX dropped out. A complex lengthy legal battle ensued over Coipa and eventually Place Dome and Ike Batista bought out litigants in an inspired and courageous move.

There was some horsetrading. Anglo controlled all of Cerro Casale at one time and sold to Bema in two installments. A Chilean group headed by Mario Hernandez in which Dave and I were partners obtained Refugio and optioned it to Bema Gold. Lagunas, Escondida, Valy, Lobo and Marte now belong to Teck-Anglo and BTX was paid a reward for Marte .

From Cerro Casale in the south to Esperanza in the north these properties have been studied by well known economic geologist. Their published reports indicate along with the press releases the extraordinary seize of these deposits in ounces of gold. I have watched Maricunga grow over the years and have been impressed.

Esperanza which is about 10 kilometers north of Coipa belongs to Anglo and BTX and is now under option to Placer Dome. Several high grade silver orebodies have produced about 50 Million ounces of silver were mined by Placer Dome and Can Can. Coipa has been the most profitable gold-silver operation in Chile and probably will remain so for a long time, Coipa is currently developing the Puren orebody. Marte in 1989 and 1990 under Anglo management was mined for a short period of time but because of metallurgical problems produced copper bars instead of gold bars. Marte was closed and has not been reopened. However Marte-Lobo have between then 5 and 6 million ounces on the books and have excellent potential to become profitable producer in depth and from challenging nearby targets. Refugio may be an emerging giant. It is owned by Kinross the manager and Bema Gold. The mine has been plagued by management inability to meet its production goals over the year. Recent executive changes may help. CMR a Chilean group in which BTX participates was once the owner of Refugio and now earns a royalty. CMR own Santa Cecilia the next prospect to the south. Surface evidence indicate Santa Cecilia may host a porphyry gold deposit similar to those known at Refugio and Cerro Casale at depth

Cerro Casale with it 23 million ounces of gold and significant copper awaits a production decision. Some authorities who rank gold projects around the world place Cerro Casale in the top the most promising.

### **Gold in Chile's Future.**

The Pascua and Cerro Casale ore deposits are being prepared for production and are huge, and together will probably produce well over a million ounces of gold a year. Refugio is increasing production to 250,000 ounces/year, Marte, Lobo and satellites have about 5 million high cost ounces but there may be undiscovered ores at depth and nearby. Teck-Anglo have plans for these deposits. Coipa is busy exploring, Puren and Esperanza . Much futher north on another belt Meridian is mining high grade gold and silver from an extensive vein system at Penon. The veins have negative outcrops and are difficult to find; however, Meridian has developed good technique with which to locate them.

El Indio has been closed, and I hope closure is not final. There is no doubt in my mind that El Indio is not mined-out. Good vein mines of the strength of El Indio's veins do not die from one day to the next. I know geologists who worked there toward the end and they agree. I would certainly be happy to take another look at El Indio.

Eliminado: next .

The Pimenton district is worthy of further investigation and this is being done by South American Gold and Copper. In the coastal belt Alway has been a solid producer in a small way in a district with small relatively rich but hard to find orebodies. Alway does good exploration.






The porphyry copper belt has not been well explored south of Teniente largely because the Andes have been eroded deeper, there is less chance for supergene copper orebodies, the topography is less precipitous, the overburden is deeper and the vegetation is thicker. I believe also there has been less exploration for gold deposits, which do not require secondary enrichment to make ore. The north-south faulting, the volcanic -sedimentary country rocks and the Calkalcaline intrusive rocks continue to the far south. Along the way there are many placer gold deposits which may flag areas of hard rock gold orebodies. This segment of the range may represent an opportunity.

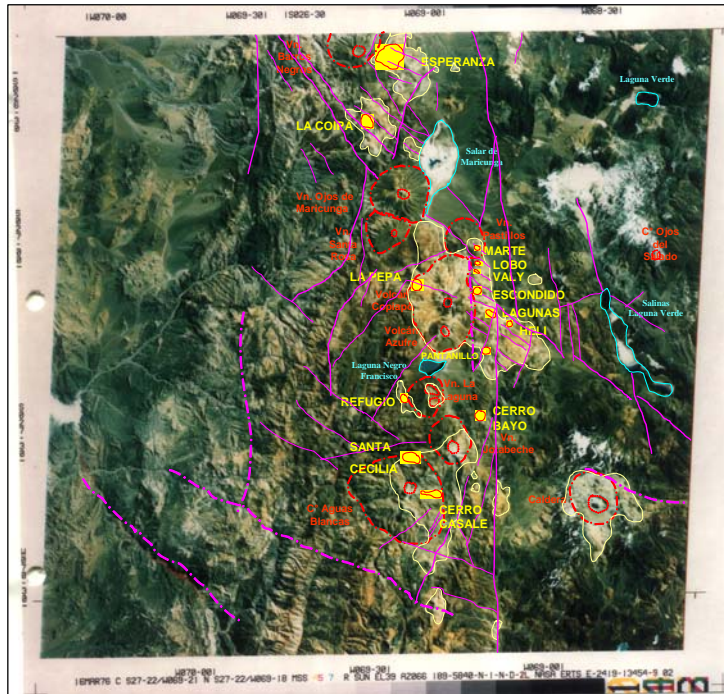
Major exploration efforts will largely be done north of EL Indio, probably to the Peruvian border; however, wildcatters may do well further south. Chile offers good hunting to the gold explorers.

In closing I believe in the long term Maricunga may be enormous and perhaps host another 50 million ounces or more in Cerro Casale, perhaps Santa Cecilia, at depth, Refugio, the Marte-Lobo group and Coipa-Esperanza. All I can say is the Maricunga fishing hole looks better than ever. The illustration at the end of this paper point to these possibilities.

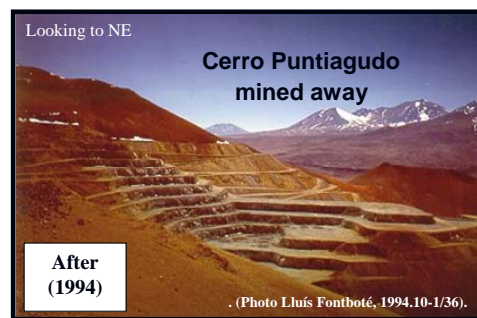
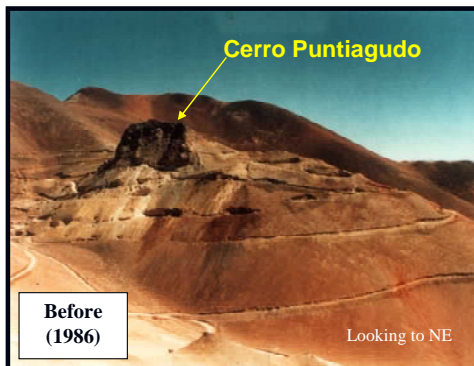
The state of knowledge of the placer gold deposits in Magallanes Island are in their early days and are believe worthy of follow up because of their potential value as placer ore and as geochemical guides to hard rocks ore. Chile future as a gold producer looks bright.

# Maricunga Belt System

- Legend**
-  Lakes
  -  Principal Structures
  -  Volcanic centers and Calderas
  -  Alteration areas
  -  Deposits and Prospects

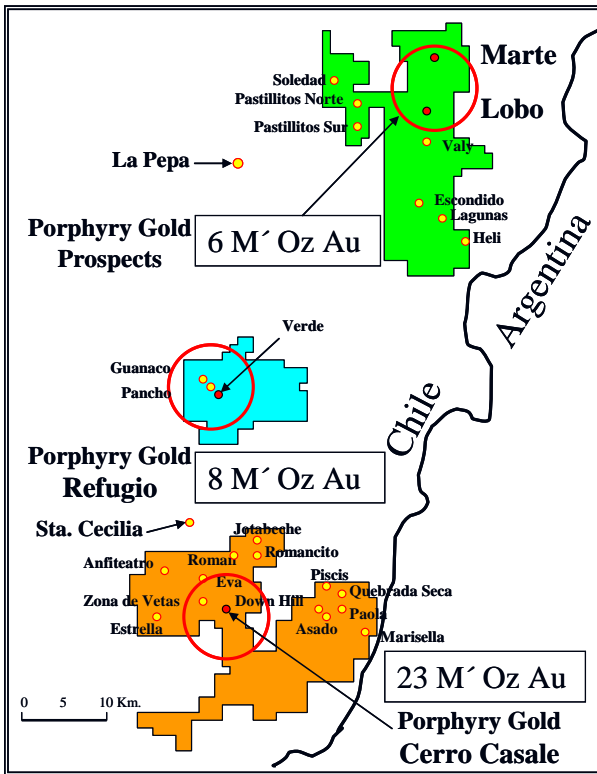


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Source: NCE Files Compilation by : La Riva

# Principal Projects in Maricunga Belt

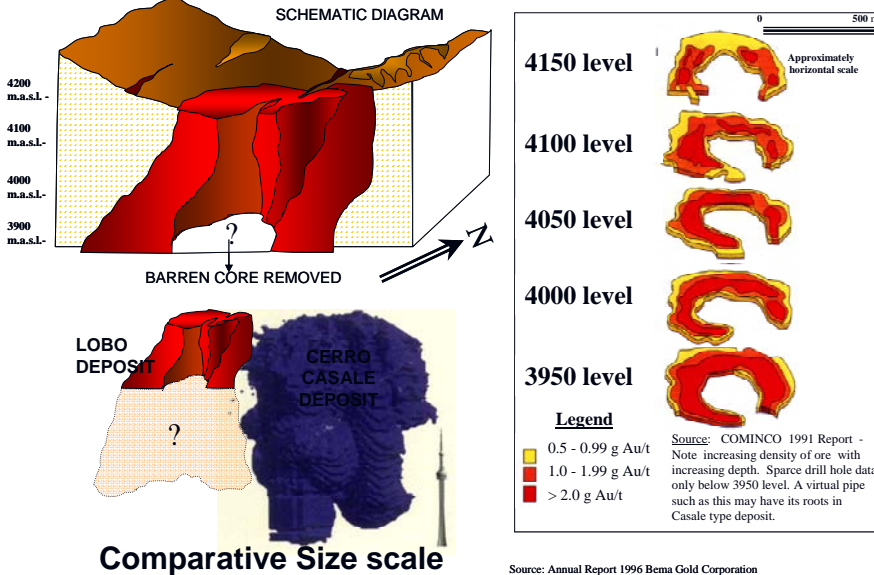


### Symbology and Legend

- Properties
- Anglo-TeckCominco
  - Kinross – Bema Gold
  - Placer Dome – Bema Gold
- Prospects
- Prospects
  - Measured Reserves

Source: NCE Files Compilation by : La Riva

## LOBO GOLD DEPOSIT



Source: Annual Report 1996 Bema Gold Corporation

Source: COMINCO 1991 Report - A virtual pipe such as this may have its roots in Casale type deposit. From NCE files