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U.S. Department of the Interior Bureau of Land Management Safford District Office

Gila Resource Area

March 1993



# Record of Decision Environmental Impact Statement Sanchez Copper Project







The Bureau of Land Management is responsible for the balanced management of the public lands and resources and their various values so that they are considered in a combination that will best serve the needs of the American people. Management is based upon the principles of multiple use and sustained yield; a combination of uses that take into account the long term needs of future generations for renewable and nonrenewable resources. These resources include recreation, range, timber, minerals, watershed, fish and wildlife, wilderness and natural, scenic, scientific and cultural values.

BLM/AZ/PL-93/004+1600

# RECORD OF DECISION SANCHEZ COPPER PROJECT

Case Number: A 25564

U.S. Department of the Interior Bureau of Land Management Safford District Office Gila Resource Area Safford, Arizona

Jester K. Rosenkrance

Lester K. Rosenkrance Arizona State Director

March 8, 1993



The Bureau of Land Management is responsible for the balanced management of the public lands and resources and their various values so that they are considered in a combination that will best serve the needs of the American people. Management is based on the principles of multiple use and sustained yield, a combination of uses that will take into account the long-term needs of future generations for renewable and nonrenewable resources.

December 1992

# BLM-AZ-PT-93-001-3000



### United States Department of the Interior

BUREAU OF LAND MANAGEMENT SAFFORD DISTRICT OFFICE 425 E. 4th Street Safford, Arizona 85546

(602) 428-4040

3809 AZA 25564 (044)

December 1992

Dear Public Land User:

Enclosed is the Final Environmental Impact Statement (FEIS) for AZCO Mining Company's proposed Sanchez Copper Mine. This document describes their proposed plan of operations and reviews potential environmental and socio-economic impacts of the proposal. The mine would encompass approximately 1,400 acres of public lands 10 miles northeast of Safford, Arizona.

Publication of the Final Environmental Impact Statement is the result of a 17-month review process which included public meetings and opportunities for public input. Numerous additions were made in the environmental documentation and analysis of the project as a result of the public review process which accompanied release of the Draft Environmental Impact Statement in March 1992. For several years prior to the preparation of this Draft Environmental Impact Statement, extensive investigations were conducted by AZCO to determine potential impacts on various environmental and socio-economic factors. Various alternatives for reclaiming the lands after mining were also evaluated by AZCO.

The release of this Final Environmental Impact Statement begins a 30-day comment period. During this period, we encourage you to review the document and provide us with your comments about the proposal and the alternatives.

Written comments on the project will be accepted until January 19, 1993 Please send your comments to Larry Thrasher, BLM Project Manager, Safford District Office, 711 14th Avenue, Safford, Arizona 85546. Please note that this is a new address for our office.

We would like to thank all of you who have participated to date in the public participation for this project, and encourage your continued involvement through review of the Final Environmental Impact Statement. After the comment period closes, input will be reviewed for incorporation into the Record of Decision. We anticipate the Record of Decision will be released in January.

Mut



U.S. DEPARTMENT OF THE INTERIOR Bureau of Land Management Safford District Office

**Gila Resource Area** 

March 1992

# Draft Environmental Impact Statement Sanchez Copper Project







The Bureau of Land Management is responsible for the balanced management of the public lands and resources and their various values so that they are considered in a combination that will best serve the needs of the American people. Management is based on the principles of multiple use and sustained yield, a combination of uses that will take into account the long-term needs of future generations for renewable and nonrenewable resources.

March 1992

# BLM-AZ-PT-010-3000





### United States Department of the Interior

BUREAU OF LAND MANAGEMENT SAFFORD DISTRICT OFFICE 425 E. 4TH STREET SAFFORD, ARIZONA 85546



IN REPLY REFER TO:

(602) 428-4040

3809 AZA 25564 (044)

March 1992

Dear Public Land User:

Enclosed is the Draft Environmental Impact Statement (DEIS) for AZCO Mining's proposed Sanchez Copper Mine. This document describes their proposed plan of operations and reviews potential environmental and socioeconomic impacts of the proposal. The mine would encompass approximately 1,400 acres of public lands 10 miles northeast of Safford, Arizona.

Publication of the DEIS is the result of an 8-month review process which included public meetings and opportunities for public input. For several years prior to the preparation of this DEIS, extensive investigations were conducted by AZCO to determine potential impacts on various environmental and socioeconomic factors. Various alternatives for reclaiming the lands after mining were also evaluated by AZCO.

The release of this DEIS begins a 60-day public comment period. During this period, we encourage you to review the document and provide us with your comments about the proposal and the alternatives. To increase your understanding of the proposal and the EIS process, we will schedule a public meeting in Safford. You will receive separate notification within the next month telling exactly when and where this meeting will be conducted.

Written comments on the project will be accepted until Please send your comments to Larry Thrasher, BLM Project Manager, Safford District Office, 425 E. 4th Street, Safford, Arizona 85546.

We would like to thank all of you who participated in the early stages of public participation, and encourage your continued involvement through review of the EIS. After the comment period closes, input will be reviewed for incorporation into the Final EIS. We anticipate the Final EIS will be released in May.

Sincerely,

Maguetexmoen

Margaret L. Jensen Gila Area Manager

# Draft

# Environmental Impact Statement Sanchez Copper Project

Prepared by

U.S. Department of the Interior Bureau of Land Management Safford District Office Gila Resource Area Safford, Arizona

Lester K. Rosenkrance Arizona State Director



SANCHEZ (F) FALCIN1992

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### EXECUTIVE SUMMARY

**The Company** The Arizona Copper Company, founded in 1988, is a U.S. based mining company dedicated to developing and producing low-cost copper utilizing the SX-EW process.

**The Projects** AZCO'S early focus is on the development of three substantial porphyry copper deposits amenable to the SX-EW process, all of which are situated along the 'Morenci' copper belt of southwestern North America: the Sanchez, Arizona, U.S.A., the Piedras Verdes and Suaqui Verde projects, Sonora State, Mexico. The mineable oxide copper reserve of the Sanchez is approximately one billion pounds recoverable. The two Mexican projects are under development and have substantial potential for reserve growth.

**The Management** AZCO is managed by a team of directors, staff and consultants who are recognized authorities on critical aspects of international mining, exploration, development, metallurgy, permitting, construction, operations and finance.

The Process Solvent Extraction Electrowinning SX-EW

Heap leaching, pioneered by Pegasus in the late 1970's, has revolutionized the mining of oxide gold bearing ores. Leaching of low-grade copper oxide deposits amenable to the SX-EW process was pioneered by Ranchers Exploration in 1968 and, in terms of cost and simplicity of operation is now set to revolutionize the copper industry.

The majority of the world's annual copper production of approximately 8.5 million tons is still produced via the conventional milling and concentrates route. Increasing environmental regulation is resulting in chronic shortages of smelter capacity. SX-EW has considerable advantages over the more expensive conventional route of copper production:

- No concentrate shipping costs.
- No milling costs.
- No ground contaminating acid tails are produced
- Lower energy costs than conventional smelters. Charges for smelting and refining of copper concentrate have more than doubled to \$0.34/lb in the last two years.
- Low labor levels.
- Declining trend in sulphuric acid costs, a significant cost component. A surplus of over 2 million tons of acid is forecast for the southwest Arizona (Sanchez) area alone.
- Operating costs for the Sanchez are estimated at a maximum of \$0.49/lb compared with conventional costs of between \$0.65-\$1.00/lb.
- Production of a premium quality cathode, generally a higher purity than conventionally refined copper. SX-EW produced cathodes sell at between \$0.02 - \$0.05/lb premium on Comex.
- Approximately 45% of **Phelps Dodge's** 900 M pounds/year production, as well as 40% of forecast new production from North and Latin America will be SX-EW produced. Worldwide, 1,000,000 tons/year (13%) is electrowon cathode, forecast to rise to 2,000,000 tons (18.5%) by the year 2000. The advent of SX-EW production has disguised the real shortage of smelter capacity that is only now becoming apparent.
- SX-EW is poised to do for the copper industry in the 1990's, what heap-leaching did for the gold industry in the 1980's.



# The Future AZCO intends to bring its three new generation projects into production on a fast track, commencing with Sanchez in 1994 (at an average of 56 million pounds per year copper), followed by Piedras Verdes. The aim is to be producing in excess of 100 million pounds of high grade copper cathode annually by 1997. The forecast for Sanchez's operating costs of \$0.49/lb will make AZCO one of the lowest cost copper producers in the world.

AZCO's asset diversification and low production costs make the company ideally situated to take advantage of the promising copper price scenario now widely forecast for the 1990's.

Because large scale exploitation of the evolutionary SX-EW process is a relatively recent phenomenon, with the majority of cathode production still being produced from conventional smelters, there is currently only one quoted, pure SX-EW producer, Arimetco (TSE).

Based on forecast production, AZCO will be North America's largest publicly traded mining company producing only electrowon cathode copper.

The spectacular success of heap-leaching of gold ores is set to be repeated for low grade copper oxide deposits using solvent extraction-electrowinning (SX-EW).

### THE NEW BREED OF COPPER PRODUCER

There is a revolution in the way that copper ore is being processed around the world. The revolution began in 1968 with the Bluebird Mine in Arizona. Today, approximately **1,000,000** tons of copper cathode are produced, by this cheap and efficient process, representing 13.0% of western world copper production. This figure is expected to rise to 2,000,000 tons by the year 2000, approximately 18.5% of forecast production. This new process is known as **SX-EW**.

Solvent extraction-electrowinning (SX-EW) is a proven method of extracting a high grade copper cathode from low grade copper oxide ore. The process utilizes a combination of conventional heap leach technology, electrolysis, and sophisticated chemical reagents.

SX-EW operating costs are typically **below US \$0.50/Ib** of copper produced against conventional sulphide milling and flotation costs of between US \$0.65/\$1.00/Ib. No smelting is necessary, and no contaminating acid tailings are produced.

In early 1988, AZCO's management recognized that this copper revolution was taking place and began to build a substantial oxide copper reserve asset base amenable to the SX-EW process. Today, AZCO owns a 100% undivided interest in three major mining properties. They are the **Sanchez** deposit in Arizona, USA, the **Piedras Verdes** and **Suaqui Verde** deposits, in Sonora State, Mexico. These three orebodies are all located along the porphyry copper mining belt of southwestern North America, the most prolific copper producing region in the world.

With reserves of over one billion pounds of **mineable** copper, AZCO's immediate aim is to become a producer of **100 million pounds** of copper cathode annually by 1997, using the SX-EW process. Projected mining costs of a maximum **US \$0.49/Ib** of copper produced will make AZCO one of the lowest cost producers in the industry.

The 1980's was the decade of gold heap-leaching, the process technology which built **Pegasus.** The 1990's promises to be the decade of copper SX-EW leaching, the technology which will build another significant mining company. **AZCO**, the new breed of copper producer.



# Location of Major Porphyry Copper Deposits in Southwestern North America



### THE SANCHEZ PROJECT

- Oxide Porphyry Copper Deposit
- Copper recovery by SX-EW
- +20 year project life
- Projected annual copper production = 50 million to 60 million pounds
- Production cost less than \$.50 per pound

### THE STRONG & HARRIS PROJECT

High-grade copper deposit

### THE SUAQUI VERDE PROJECT

- Oxide Porphyry Copper Deposit
- Copper zone is 1 km x 2km in area

### THE PIEDRAS VERDES PROJECT

- Oxide Porphyry Copper Deposit
- Copper zone is +3 km long and up to 450 meters wide
- Project is 12 km from City of Alamos, 5 km from hydroelectric station



Copper bearing solution from the heap is collected in pregnant leach solution ponds.



Copper cathodes are grown in an electrowinning facility.



150 lb. copper cathodes are harvested once a week.



**Recovery of Copper By Solvent Extraction** 

### **COPPER RECOVERY PROCESS**

1. After mining and a light crushing, Sanchez ore is stacked on an impermeable pad liner in 10' - 20' layers, known as "lifts." Over time, successive layers are stacked on top of older, previously leached layers, eventually reaching heights in excess of 300'. Each layer contributes additional copper during leaching.

2. Following accumulation of about one week's production of ore (about 230,000 tons), the stacked ore is leached with a weak acid solution, yielding a copper-bearing Pregnant Leach Solution (PLS), which flows to one or more collection ponds.

3. The collected aqueous phase PLS is pumped to the Solvent Extraction tanks for upgrading, where the weaklyacidic PLS is mixed with extractant-bearing kerosene that extracts copper from and reacidifies the aqueous phase (now called raffinate).

4. The copper-rich kerosene and barren raffinate are allowed to separate in large swimming pool-like settler tanks. The reacidified raffinate is pumped back to the heaps to leach out more copper, while the copper-rich kerosene is pumped to another tank where it is mixed with a highly acidic, copper-rich solution, the electrolyte.

5. The highly-acidic electrolyte strips the copper from the kerosene, further enriching the electrolyte with copper. Depleted kerosene is then recirculated back to the extraction units to mix with PLS, while the enriched electrolyte is pumped to the electrowinning tankhouse.

6. The electrowinning tankhouse consists of a number of large cells, like giant batteries, through which enriched electrolyte is circulated. A current is then passed through the cells, causing ultrapure copper to be plated onto thin, meter-square stainless steel blanks. Depleted electrolyte flows back to the strip unit.

7. Copper cathodes are harvested weekly. Ultrapure copper cathodes weighing about 150 pounds each are stripped from each side of the stainless steel blanks, which are then placed back in the cells to plate out more copper. Copper cathodes are bound in bundles approximating 5000 pounds for shipment to traders or end users. Quality exceeds Comex high-grade and LME grade A.

Comments written 3/18/92

MALE SELOND AINE EOLOGA



### DIRECTORS AND ADVISORS

Directors Anthony R. Harvey (U.K.) Chairman and Vice-President of Operations

> Alan P. Lindsay (Canada) President and Chief Executive Officer

Richard C. Moores (U.S.A.) Vice President, Chief Financial Officer and Secretary

John E. Dreier (U.S.A.) Vice President of Exploration

Andrew F. de P. Malim (U.K.)

Offices Registered Office 165 South Union Boulevard, Suite 350, Lakewood, Colorado 80228

> Canadian Office 580 Hornby Street, 5th Floor, Vancouver, B.C., V6C 2E7

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### Advisors Auditors

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Canadian Lawyers Devlin Jensen, Barristers & Solicitors 555 West Hastings Street, Suite 2550, Vancouver, B.C., V6B 4N5

US Lawyers Parcel, Mauro, Hultin & Spaanstra, P.C. 1801 California Street, Suite 3600, Denver, Colorado 80202

Engineering Consultants Fluor Daniel Wright Engineers Limited 1444 Alberni Street, Vancouver, B.C., V6G 2Z4

Brokers and Fiscal Agents Yorkton Securities Inc. Suite 406, 2nd Floor, Salisbury Hse., Finsbury Circus. London EC2M 5RQ.

Transfer Agents Montreal Trust 510 Burrard St. Vancouver B.C., V6C 3B9

Metal Marketing Agents Axel Johnson Ore & Metals Inc. 110 East 59th Street, New York, N.Y. 10022

### DIRECTORS AND MANAGEMENT

Anthony R. Harvey M.Eng., British, aged 55, is Chairman of the Company and Vice-President of Operations. He has been associated with the Company since its incorporation on 13th July, 1988. He has been a full time director since 18th May, 1989, prior to which he spent 30 years with Fluor Daniel Wright Engineers. Mr. Harvey has extensive worldwide experience in various management positions including mine construction, ore extraction, bulk handling and processing, project management, corporate development and marketing. He is a member of the American Society of Mechanical Engineers.

- Alan P. Lindsay Canadian, aged 42, is President and Chief Executive Officer of AZCO. He has been associated with the Company since its incorporation and became a director on 24th July, 1989. Mr. Lindsay has a background in business management and marketing. Prior to being an officer of AZCO, he headed up the Financial Services Division of a substantial financial institution in Vancouver. Alan has been involved in the mining business for the past five years and has been responsible for raising capital for companies with which he has been associated. He plays a key role in the financing of AZCO and is responsible for the corporate development of the company.
- **Richard C. Moores** A.B., M.Sc., M.B.A., American aged 43, is Director, Vice President and Chief Financial Officer and Secretary. He has been a director of the Company since the Company's incorporation and is now engaged full time on the Company's business. He received an A.B. in Geology from Cornell University and an M.Sc. in Geology and an M.B.A. from the University of Arizona. He has more than 20 years experience in the mining industry, including metals exploration in the western U.S., project evaluation, mine development, analysis and support of mine operations, short and long range planning, acquisitions, marketing, economic analysis, public relations, legislative/litigation efforts, negotiations and financing with several organizations. These include Silver State Mining Corporation, Shearson Lehman Brothers, Mobil Oil (Mining & Coal Division) and Conoco Minerals.
  - John E. Dreier B.Sc., M.Sc., Ph.D., American, aged 49, is a Director and Vice President of Exploration. He has been a director since the Company's incorporation. Dr. Dreier's professional experience in metals and mining spans more than 25 years. It includes management positions in exploration, mine development, mine acquisition and environmental assessment throughout North and South America. He previously worked on copper leach projects with Kennecott Copper Corporation and serves as an instructor in the A.I.M.E. Copper Leaching short course. He holds a doctorate in Geology and Geochemistry from the University of Arizona and is a member of the Geological Society of America, the Society of Economic Geologists, the American Institute of Mining Engineers and the Denver Regional Exploration Geologist Society.
  - Andrew F. de P. Malim Malim British, aged 48, became a director of the Company on 16th July, 1991. He is a founder and Managing Director of the Lion Mining Group, a London-based mining finance and consulting company. The Lion Group has been associated with AZCO since March 1989, and has been responsible for AZCO's European representation and raised the majority of AZCO's capital. From 1968 to 1977, he was one of the original members of James Capel's mining team and was a member of the International Stock Exchange, London, from 1967-1977.

### David C. Beling

B.Sc., Eng., American, is general manager of the Sanchez project and heads up the management team responsible for the construction and operation of the Sanchez Mine. In 1964, Mr. Beling graduated from the University of Arizona with University Scholarship Honours in Mining Engineering. Mr. Beling's employment from 1964 to 1975 included copper mining and processing with Phelps Dodge in Bisbee, Arizona, and with Essex Group of United Technologies in Milford, Utah. Mr. Beling has over 28 years experience in the mining industry, of which 20 years has been as a production general manager and corporate executive. During the past 5 years, he was Senior Vice President of Hycroft Resources and Development Inc., responsible for start-up and operations of an open-pit gold mine and heap leach plant near Winnemucca, Nevada. Mr. Beling is a Registered Professional Mining Engineer in the states of Arizona, Nevada and Wyoming.

### CONSULTANTS

**Fluor Daniel Wright** Fluor Daniel Wright Engineers Limited have acted as mining, engineering and construction consultants to the Company since February 1989.

The following individuals have also advised the Company on a consulting basis:

- **Richard Bideaux** Is a geological engineer with over 25 years experience. He has worked on the estimates of the mineable ore reserves at Sanchez. He previously worked with Cal Tech and the GFI Group and in 1971 founded his own company, CAI, offering a service involving mineral deposit modelling and ore reserve studies. Following the disposal of CAI to Control Data Group in 1978, he has acted as an independent consultant. He has a B.Sc. in Geological Engineering (University of Arizona), an M.A. in Geology (Harvard University) and an honorary degree in Professional Geological Engineering (University of Arizona). Mr. Bideaux is a fellow of the Mineralogical Society of Arizona and is a member of the Arizona Geological Society and the American Institute of Mining Engineers.
  - **Fred Brost** Has over 20 years experience as a mining engineer and has been retained by AZCO to oversee the permitting application process. Mr. Brost has a B.Sc. in mining engineering from the Missouri School of Mines and Metallurgy and is a member of the American Institute of Mining Engineers. Mr. Brost runs a private consulting practice Arizona Consultants & Investments.
- **Donald M. Duncan** Engineering consultant has 38 years of varied experience in the mining industry, of which the past 10 years have been mainly major consulting assignments related to heap leach mining projects. These include the Zortman/Landusky, Florida Canyon and Beal projects of Pegasus Gold and responsibility for development of the Pinson project. More minor consulting roles took place on many of the gold projects in the Western U.S. He managed Homestake's Pitch uranium project in Colorado and The Cortez Gold Mine during his 17 year tenure with Placer development. Mr. Duncan was Director of Hycroft Resources & Development Corporation from 1987 to 1989. His responsibilities included all aspects of bringing the 80,000 ounce per year Crofoot heap leach mine into production.
- **Dr. David Hackman** Has over 20 years experience as a mining geologist. He has worked with companies such as Amoco and Mobil, and is a principal of SAGE Associates Inc., a consulting company offering expertise in ore reserve estimation, mine evaluation, feasibility studies and mine development. Dr. Hackman has been engaged by AZCO to oversee and update the feasibility study. He has a B.Sc. from the Colorado School of Mines, a M.Sc. and Ph.D in Geological Engineering from the University of Arizona and is a member of the American Institute of Mining Engineers and Society of Economic Geologists.



- **Paul Hodges** Has over 35 years experience in the mining industry, specializing in project start-ups, management and financing. He was chief engineer for RTZ worldwide; President of ANAMAX (Twin Buttes); President of St. Joe (South America) (El Indio). He has a degree in Mining Engineering from the Colorado School of Mines, is a registered professional engineer in Arizona, and is a member of the American Institute of Mining Engineers.
- K. Wayne
  B.Sc. Honours Geology, M.Sc. Geology, formerly, president of International Baron Resources
  Inc., has 21 years experience in the mining business. He was senior geologist for Quintana
  Minerals Corp. and was responsible for the discovery of the main ore zone at The Fish Lake
  Copper Porphyry deposit in British Columbia. Wayne was a director of Hycroft Resources and
  was responsible for acquiring the Crofoot project and developing the reserve through to
  production.

### Michael Sierakoski

rakoski Has over 25 years experience as an engineering metallurgist. He has worked with Inspiration Consolidated Copper Co., Anaconda, Magma, and the Bagdad Copper Co. He is presently the Director of Marketing & Technical Service (Latin America) with the Henkel Corporation. His main area of experience has been the extraction of copper from acidic solutions via solvent extraction and has been engaged by AZCO to advise on various aspects of the SX-EW process. He has a B.A and B.Sc. from the University of Arizona and is a member of the American Institute of Mining Engineers.





### THE SANCHEZ PROJECT

### INTRODUCTION

AZCO was formed in 1988 to acquire the mining rights to the Sanchez porphyry copper deposit located about 10 miles northeast of Safford in southeastern Arizona. This deposit is estimated to contain 191 million tons with an average grade of 0.317% copper.

A final feasibility study prepared by FLUOR/WRIGHT (November 1990), indicates that the Sanchez project could be a viable copper producer at copper prices materially below those currently prevailing, capable of producing an average of 56 million pounds of high-grade copper cathode annually over the estimated 20 year life of the project.

The Company intends to seek approximately \$75 million by means of debt and equity financing to develop the Sanchez mine. Full production is anticipated to commence in the first quarter of 1994.

### HISTORY OF SANCHEZ PROJECT

Between 1957 and 1980 five operating companies conducted exploration programs at Sanchez. A total of 148 surface holes were drilled, most by Inspiration Consolidated Copper Company ('Inspiration'), the last company to conduct drilling at Sanchez. Inspiration also undertook underground sampling, metallurgical and mine testing and engineering work, the whole program costing approximately US \$12m. Historically low copper prices, coupled with financial and operating problems at other Inspiration properties, prevented development at Sanchez. Between 1984 and 1986 the site was not leased. Butte Resources Limited acquired a lease in 1986 but carried out no work on the site. Following improvements in the copper price and in the recovery process, AZCO acquired a lease over the property in 1988. The lease contains provisions for the payment of a royalty of 2% gross revenue up to a maximum of \$5 million, with advanced royalties of \$100,000 payable annually. Since 1988, AZCO has spent over US \$4 million on an intensive mine evaluation program, including drilling, metallurgical and environmental work, culminating in a final feasibility study prepared by FLUOR/WRIGHT.

### **GEOLOGY & ORE RESERVES**

Sanchez is a porphyry-type copper deposit located along the west flank of the Gila Mountains near Safford, in Graham County, Arizona. A cylindrical mass of monzonitic porphyry intruding andesitic volcanic rocks has been the focus of large scale, low-grade copper mineralization. The orebody is approximately 2,000 to 2,500 ft. in diameter, is zoned mineralogically with copper oxide minerals at the surface giving way vertically to mixed oxides and sulphides. The oxide zone, approximately 1000 feet thick, is the target AZCO is seeking to develop. Based on a cut-off of 0.20% copper, the ultimate pit design contains an estimated 168,027,000 tons of ore-grade materials, averaging 0.336% copper, and 23,104,000 tons of low grade material, averaging 0.176% copper, suitable for leaching. Another 205,810,000 tons of waste and low grade material that will not be leached must also be moved. The total quantity of material to be excavated is 396,941,000 tons, at an overall mine life stripping ratio of 1.08:1.

### NOTES ON SANCHEZ RESERVES

At Sanchez only the economics of the oxide portion of the ore body have been estimated. Because most drill holes terminate at the base of the oxide zone, the data base for determining a resource for the sulphide and mixed zones is somewhat limited. Statistics on average grade have been compiled for 40-foot drill intercepts of all assay data from the mixed and sulphide parts of the deposit, as well as that from the oxide zone. These statistics are given below where they are compared with the same statistics for 40-foot composites of drill intercepts in the oxide zone.

Mineral type	Mean (% Cu)
Primary sulphide	0.60
Mixed zone	0.38
Oxide zone	0.30



The apparent high-grade of the primary sulphide designation is probably the result of the following: 1. It is based on only 3, 40-foot composites; 2. the sulphide below the mixed zone show signs of enrichment by chalcocite; 3. the deepest holes are in the center of the deposit where the oxide grades are highest (the center of the oxide deposit grades above 0.5% Cu). The slightly higher grade of the mixed zone shown in the table results from secondary chalcocite enrichment.

Although some gold values have been encountered, it is unlikely that they will be recoverable in the leaching operation.

### MINING AND PROCESSING

AZCO proposes to mine the ore body, at a nominal rate of 12.0 million tons per year of ore, using conventional open pit mining techniques and equipment. The ore will be hauled by truck to an on-site two stage crushing plant. The crushed ore will be transported by conveyor belts to a stockpile adjacent to the leach pad area, then discharged via a movable stacker conveyor onto the leach pad.



The crushed ore will then be impregnated (cured) with a strong sulphuric acid solution for a minimum of three days. The wetted ore will then be continuously washed with weaker raffinate solution for approximately 119 days (17 weeks), completing one leach cycle. Successive layers of cured fresh ore will be stacked on top of this layer with additional leaching occurring each time. Production will increase with each succeeding cycle. In this process the copper oxide is dissolved to produce a pregnant leach solution ('PLS'), which then flows down to the leach pad and is collected in a pond. The PLS will then be transferred to a Solvent Extraction ('SX') plant where the PLS, by a process using organic reagents and gravitational separation, will be turned into a solution containing 50-60 gms/litre pure copper sulphate solution. This solution will then be transferred to the electrowinning ('EW') plant where high purity copper cathode sheets will be plated out by simple electrolysis. These sheets require no further refining.

The SX-EW process is a tested and proven method of copper recovery and is used as a low cost alternative to the smelting process. There are now some 40 SX-EW plants throughout the world. Over the last 15 years, in particular, leaching and SX-EW techniques have been refined and improved, resulting in a higher percentage extraction of copper. Wright Engineers engaged the services of specialist SX-EW consultants to conduct a series of tests to determine the optimum economic level of copper recovery by leaching and SX-EW process. An operating team is currently being assembled, headed by David Beling (see 'Directors and Management')

### METALLURGICAL TESTWORK

Metallurgical testwork is currently underway to demonstrate the recovery of copper and the consumption of acid from the Sanchez deposit, under the operating conditions defined by the Wright Engineers Ltd. Feasibility Study of November 1990.

## Column tests point to significant reduction in acid consumption.

The new tests consist of 4 columns of ore extracted from deep in the deposit in large diameter drill core, and one column from the surface. In the new tests, the strong acid solution was added in an agglomerator and the



acidified ore was placed in columns 20 feet in height to duplicate the height of the proposed leach lifts. Rinsing of the acidified ore columns began three days after loading. The rinse solution used is raffinate collected from another leaching operation. As of day 48, these tests indicate copper kinetics virtually identical to those from previous tests of surface material in 20 foot columns. In these previous tests, copper recoveries averaged 82% after 240 days of rinsing, with copper continuing to leach from the columns until they were taken off stream. In the current tests, which duplicate proposed operating conditions, the only acid that has been added to the columns was put there during the initial step of acidification in the agglomerator. The amount used was 25 pounds per ton of ore. Judging from the results of other tests of this type conducted in 1990 and 1991, no further acid addition to the ore will be necessary. Thus the total acid consumption by the ore will amount to 25 pounds per ton or about 4 pounds of acid per pound of copper, is significantly less than the 50 pounds referred to in the Wright Engineers feasibility study.

Metcon Research Inc.'s Progress Report dated 29 January 1992, compiled by Mike Sierakoski (see 'Consultants'), states: "The use of lower aquifer water from the Sanchez deposit was another question that was discussed in regard to possible higher concentrations of chlorides and other ions. The chloride concentration would be more a concern for the materials of construction used in the solvent extraction facility than its effect on the leaching kinetics. The current locked cycle column testing is being done for the Sanchez ore is using barren leach solution from an operating copper facility as the rinse solution. Each cycle, this solution has the copper removed via solvent extraction and is then recycled as the rinse solution for each respective column. This solution was chosen to match the chemical composition of the proposed Sanchez solutions and is expected to yield leaching data that will simulate the actual operation.

The latest lock cycle tests on the Sanchez ore was done to duplicate the proposed actual operating conditions, using columns twenty feet in height. Prior to loading into the columns, the ore was crushed to minus one inch and a strong sulphuric acid cure solution was added by direct application technique at the rate of 25 pounds of acid per ton. The raffinate solution from the solvent extraction contains sufficient free acid to serve as the rinse solution for the life of the project. Results after 120 days of rinse are listed below with a comparison to previous twenty foot column tests on similar ore. The acid consumption of 25 pounds per ton determined by the latest tests is consistent with other operating plants that use strong acid cure leaching techniques.

### 120 Days of Rinse

New Columns Indicated % Copper Ext	Old Columns (20') Actual % Copper Ext	Acid Consumption for New 20' Locked Cycle Tests Pounds of Acid/Ton of Ore
52.11	61.56	24.97
56.18	61.47	25.00
60.00	63.58	26.09
71.68	72.88	25.70
77.42	75.57	24.97
	New Columns Indicated % Copper Ext 52.11 56.18 60.00 71.68 77.42	New Columns      Old Columns (20')        Indicated %      Actual %        Copper Ext      Copper Ext        52.11      61.56        56.18      61.47        60.00      63.58        71.68      72.88        77.42      75.57

These results indicate that the copper extraction for ore from both the surface and the subterranean portions of the Sanchez deposit are similar. The latest series of tests demonstrate that the monzonite ore leaches at a slower initial rate than the andesite ore, consistent with all other tests done to date on this project.

# ACID SUPPLY AND CONSUMPTION IN ARIZONA AND NEW MEXICO

Currently, sulphuric acid production from smelters in the southwestern US totals 2,820,000 tons per year. By 1993, this will increase to 2,950,000 tons per year. The breakdown of acid production is as follows:





Company/Smelter	Annual Production (tons			
Asarco, Hayden, Arizona	620,000 - 650,000			
Asarco, El Paso, Texas	170,000 (1992)			
Cyprus, Miami, Arizona	650,000 (1993)			
Magma, San Manuel, Arizona	300,000			
Phelps Dodge, Chino, New Mexico	350,000			
Phelps Dodge, Hidalgo, New Mexico	700,000			

Current acid consumption in Arizona/New Mexico by leaching operations is approximately as follows:

Asarco, Ray - oxide leach	320,000
Cyprus, Miami - oxide leach	400,000
Magma, San Manuel - oxide leach	100,000

As can be seen from the above production/consumption figures, compiled by Paul Thompson, P. Eng., production of acid in Arizona and New Mexico exceeds consumption by over 2,000,000 tons. The extent of this imbalance is so large that Phelps Dodge actually incurs a loss in transporting acid to Florida, where it is used in the phosphate industry. According to Michael Levanger, Regional Sales Manager for sulphuric acid sales for Asarco, the company sells acid from its Hayden, Arizona plant to destinations in Ohio and the Pacific Northwest in order to dispose of it. For this reason, Asarco is eager to discuss sales of acid to AZCO.

### WATER RESOURCES

AZCO has obtained two separate legal opinions on the subject of water rights, and under the present planning and assumptions, water rights problems are unlikely. The subject of water accessibility and rights has been researched by Fred Brost, President of Mining and Environmental Consultants Inc., Arizona (see 'Consultants'). A complete report is available at AZCO's offices.

### SALES AND MARKETING

Under an agreement dated 15 August 1991, AZCO appointed Axel Johnson Ores and Metals Inc., (Axore) New York as exclusive marketing agent for its copper cathode product. Axore will negotiate terms for potential buyers and arrange contracts; organize freight; insurance; prepare bills of lading, etc. In addition to these customary sales functions, Axore also will organize all hedging and other risk offset programs on behalf of AZCO.

AZCO has agreed to pay fees to Axore of US \$20.00/ton cathodes shipped, with a minimum of US \$250,000/year. These fees commence once production from the Sanchez has reached 75% of design capacity, continuing for a period of 4 years. Normal force majeure conditions and waivers apply. This agreement will continue in full force and effect while Axore retains its share position in AZCO of 263,158 shares.

### ENVIRONMENTAL AND REGULATORY BACKGROUND

The Sanchez Copper Project is located on unpatented mining claims on public lands under the jurisdiction of the U.S. Bureau of Land Management (BLM). An Environmental Impact Statement (EIS) will have to be reviewed and approved by the BLM before development can commence. The Arizona Department for Environmental Quality (ADEQ) will require an Aquifer Protection Permit (APP) and an Air Pollution Control Installation Permit (APC). Several other State and County permits will be obtained during construction (water well, building, sanitation). Of these, the EIS is viewed as the most difficult to obtain and is the focus of our current activities.

The project is located in an area zoned for mining by the BLM Area Resource Management Plan (RMP) and by the State and County planning and zoning agencies. Baseline data have been collected over the past several years and a Plan of Operations (POO) developed, and it has been determined that there are no Threatened and Endangered (T&E) species nor significant archaeological sites on the property. This means that **there is nothing** 



on the property that could preclude development. Over the past few years, AZCO has developed a good working relationship with local and County officials, who actively support development of the mine.

In August, 1991, the POO was filed with the BLM, initiating the formal permitting process. Public presentations of the project and proposed environmental impact and mitigation measures have been very well received. The Safford Area Manager, who is responsible for reviewing and approving the project, has expressed satisfaction with AZCO's efforts. The entire draft EIS has now been reviewed by the BLM and the revised completed document was submitted in March of 1992. The EIS remains on schedule for the third quarter 1992 approval.

As part of the overall approval program, the BLM is coordinating with a number of State and Federal agencies, including the U.S. Bureau of Mines, the U.S.G.S., the ADEQ and the State Historical Preservation Office (SHPO). This works to our advantage, since it brings these agencies into the process ahead of our formal applications to them and should accelerate the processing of our applications. AZCO has been keeping the various agencies involved and informed, with formal applications to the SHPO for clearance and to the ADEQ for an operating permit. Approval is anticipated for late 1992.

### FINANCING

A preliminary estimate of the cost of funding the Sanchez Project is approximately \$74.9 million. This is analyzed as follows:



It is the Directors' intention to maximize borrowing according to market conditions and to fund the balance of the Company's funding requirements by way of equity.

**NOTE:** In July of 1991 Caterpillar World Trading Corporation ('**CATERPILLAR**') submitted a proposal July 1991 offering to supply AZCO with an initial fleet of new mining equipment worth approximately US \$15 million, with repayment in cathode copper. This offer will be considered as part of the overall financing strategy.

### CAPITAL EXPENDITURE

In April 1992, AZCO raised C\$6.5 million through the sale of shares to continue its program to put the Sanchez project into production at the earliest possible date. This phase of the work includes; environmental and permitting, detail engineering, firm prices for major equipment and construction contracts. Also, funds have been budgeted to carry the Piedras Verdes project to the completion of a feasibility study and to continue with the Suaqui Verde development. In addition, AZCO is in the process of raising approximately US \$75 million to meet the estimated cost to bring the Sanchez mine into production.







FINANCIAL PROJECTIONS

	24.94	06.84	£8.8 <b>‡</b>	£8.74	85.24	17.24	10.04	80'22	34'09	01.05	56.33	\$25.04	75.81	78.ET	01.11	\$0°2	69'8	20'1-	Z8'⊅-	\$1.21·	87.21.	DISCOUNTED NCF (15%)
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122.984	4.384	754.4	4.738	217.81	186.42	54.995	24.683	195.72	\$19.55	32,444	244.12	619'12	624.15	120.05	812.62	286°2Z	26.92	\$88.22	8££.2S	35.446		TOTAL OPERATING COST
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11/976	0000	997.11	947'51	\$65'95	596'65	54/.45	888.02	\$57'St	\$75'9C	\$5579	518.55	P80.05	0/6'5	\$79'15	68675	080.25	\$8.534	996.75	815.64	45.630		# PRODUCTION FROM NORMAL ORE (MM)
700 066	864.61	997.01	967'51	P65.0C	05/.09	078.95	t9/75	756'55	\$75.79	877'89	\$15.12	+8575	0/8.12	\$75'/S	952.95	\$85.02	019.12	285.62	946'85	48.530		PAYABLE COPPER (MM LBS)
120'267	\$774	27143	\$29'2	28'542	0/2'02	014'82	785,382	126'92	291'15	34,114	LSL'8Z	Z6Z'9Z	SE6'SZ	Z9Ľ'8Z	521,85	242'52	028'52	169'6Z	886'97	54'565		PAYABLE COPPER TONS/YEAR
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### SANCHEZ PROJECT - FINANCIAL SUMMARY

Projected	1995	1996	1997
Revenues (\$'000) Cu 1US\$/Ib	48,53O	53,976	59,382
Operating Costs	25,446	25,338	25,884
Operating earnings	22,113	27,558	32,310
Profit before tax	17,000	21,011	25,196
Tax	2,679	4,550	5,942
Net earnings	14,321	16,461	19,254
EPS (20MM Shares)	0.72	O.82	0.96
EPS @ \$1.10/lb EPS @ \$1.20/lb	0.95 1.19 1.40	1.O3 1.38 1.41	1.16 1.38 1.6









# Piedras Verdes project

# SONORA

Hermosillo

ledra Verde



### THE PIEDRAS VERDES PROJECT

### HIGHLIGHTS

- A large oxidized porphyry copper deposit approximately 3 kms long, 150 to 400 meters wide and several hundred meters thick.
- · Good access, power, water, labor and acid supplies.
- Based on historic drill data, preliminary reserves are estimated at 105 million tons grading 0.33% Cu.
- SX-EW process technology.
- Chip line sampling of the western surface exposure assayed 0.46% Cu over 561 meters.
- Objective is to define an economic orebody amenable to the SX-EW process and to bring the mine into production.

### LOCATION/ACCESS/INFRASTRUCTURE

The Piedras Verdes copper deposit is located in southern Sonora, Mexico about 17 kms. north of the city of Alamos. Access to the property is excellent, with a paved road to Alamos and a graded road from Alamos to within 5 kms of the property. It is anticipated that this graded road will be paved this year. There is also a paved airstrip on the edge of Alamos, a town of 5,000 inhabitants. The airstrip is capable of servicing small twin-engine planes.



The hydro-electric dam at Mocuzari, about 12 kms northwest of the property, provides **electric power** to the area and a power line from the dam passes through the property. **Ground water** is anticipated to be present within the mine area; additional water is available from the lake at Mocuzari. **Labor** is readily available from the village of Piedras Verdes and surrounding villages, as well as Alamos.

### ACID

Currently, Mexicana de Cobre is shipping sulphuric acid to Chile via the port city of Guaymas, which contains an acid storage facility. Piedras Verdes is located about 250 kms by highway from the acid storage facility at Guaymas.

### **OPTION AGREEMENT**

The agreement with Minera Serrana, owner of the majority of the mineral rights in the area, requires that a net smelter royalty of 3% be paid during the life of the operation. Additionally, a net present value of U.S. \$1,400,000 is to be paid out of an additional 2% royalty from the start of production.

### **EXPLORATION HISTORY**

The deposit was drilled by Cominco in 1969 using a conventional rotary rig. Little is known of their technique for sampling the cuttings. Cominco drilled 57 holes in the deposit, using a rough grid with a spacing of more than 200 meters between holes. They also drilled eight diamond core holes. Cominco drilled a total of 4,429 meters (14,527 feet) with the rotary rig and 974 meters (3,195 feet) with the core rig. The eastern part of the district was mapped and drilled by Minera Trion (Homestake) from 1973 to 1975. Trion drilled 19 holes with a rotary rig for a total of 2,833 meters (9,253 feet). The combined drilling of Cominco and Trion totals 8,236 meters (27,015 feet). Assay logs have been obtained from most of the Cominco drilling. A surface geologic map, summaries of the drill hole assay and geologic logs for each hole, and a geologic report have been obtained from the Trion staff.

### GEOLOGY

AZCQ

Company

Piedras is an oxidized porphyry copper deposit approximately 400 meters wide and more than 3 km long. It is elongated in an east west direction. The porphyry copper deposit displays a zoning of alteration and sulphide minerals akin to the model of Lowell and Guilbert, in their Economic Geology article of 1969.

According to the Lowell-Guilbert model, porphyry copper deposits may be subdivided into three roughly concentric zones. The inner zone is characterized by a low sulphide content and with most of the sulphide minerals containing copper. In this zone, rock-forming minerals are altered to quartz, biotite and feldspar. The inner zone is typically surrounded by the ore shell. In the ore shell, sulphide mineralization is more intense and copper values are higher than in the inner zone. Peripheral to the ore shell is the pyrite halo. In the pyrite



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halo, sulphide mineral content of the rocks is very high (typically 10% to 20% by weight). Oxidization and weathering of the inner zone generally leads to the in-situ development of a copper oxide deposit. Oxidization and weathering of the outer ore shell and inner pyrite halo (where sulphide minerals are very plentiful), leads to the removal of copper from the rocks above the water table, and to precipitation of copper in the rocks below the water table. This process, known as 'copper enrichment', has played an important role in significantly increasing the grade of many porphyry deposits. Notable examples are: El Salvador, Porterillos, Escondida, Chile; Cananea, La Caridad, Mexico; Ray, Morenci, Casa Grande and Miami in Arizona.

The most important single body of copper mineralization presently known at Piedras Verdes is situated in the inner zone (see geologic map). This body is about 3 kms long, 150 to 400 meters wide, and up to several hundred meters in thickness. It occurs along the northern contact of a quartz monzonite porphyry stock. This body is defined by semicontinuous outcrops and 23 rotary and core drill holes. The largest continuous surface exposure of this body, which is situated along a ridge at the western end of the zone, is about 800 meters long and up to 250 meters wide. This surface exposure contains numerous shafts, adits, caved stopes and shallow diggings and was the site of numerous small, hand-operated mining efforts that produced high-grade, direct shipping ore from oxidized chalcocite veins.

Drs. Eric Braun and J.E. Dreier (AZCO VP Exploration) sampled the western surface exposure by means of chip sample lines in November 1991. The results of this program are as follows:

Line 1: 190 meters @ 0.34% Cu Line 2: 70 meters @ 0.39% Cu Line 3: 147 meters @ 0.44% Cu Line 4: 154 meters @ 0.69% Cu

Surrounding the inner zone of the Piedras Verdes copper deposit to the north and south is a pyrite halo which consists of intense quartz-sericite alteration and the oxidized remnants of sulphide minerals. Two drill holes situated in this zone penetrated an oxidized enrichment blanket up to 100 meters in thickness grading above 0.40% copper.

### RESERVES

Preliminary reserves for the deposit, based on 12 north-south cross-sections and east-west cross sections, were estimated to be **105 million metric tons grading 0.33% copper** above a 0.20% copper cut-off grade.

Although over 80 holes have been drilled in the property, much of the drilling was inadequate, resulting in substantial losses of the samples. Hence, it is expected that copper grades derived from these drilling programs are **lower than in-situ grades**, due to the friable nature of the supergene copper minerals relative to the host rock. Trion previously calculated a preliminary mineable reserve of approximately 50 million tons grading 0.47% copper with a 0.30% cutoff and a stripping ratio of 1.7:1.0.



# Suaqui Verde project

# SONORA STATE

Hermosillo

Suaqui Verde



### THE SUAQUI VERDE PROJECT

### HIGHLIGHTS

- A large porphyry copper deposit having an exposed area of more than 4 sq. km. Potential believed to be + 1 billion ton orebody.
- Upper 50 to 100 meters of the deposit is oxidized and appears highly amenable to acid heap leaching from preliminary metallurgical testing.
- Contains a surficial zone of drill indicated oxide/chalcocite mineralization containing + 30 million tons.
- Accessible within 10 km. by paved roads, close to acid supplies and a town with abundant electrical power.
- Objective is to develop the project and complete a positive feasibility study.

### LOCATION AND ACCESS

The Suaqui Verde copper deposit is located in south-eastern Sonora, Mexico, near the **town of Suaqui Grande**, approximately 350 kms south of the US Mexico border and 160 kms southeast of Hermosillo, the state capital. **The road from Hermosillo to Suaqui Grande is paved** and the 10 kilometer road east from Suaqui Grande to the property is unimproved dirt. Suaqui Grande (population 4,000), a regional agricultural center, is situated at an elevation of about 350 meters, in a region of moderate relief typical of the low semi-desert regions of Sonora and Arizona. **Power and water are available locally**.

### ACID

Currently, Mexicana de Cobre is shipping sulphuric acid to Chile via the port city of Guaymas, Sonora which contains an acid storage facility. To bring the acid to Guaymas, it is trucked from the Nacozari smelter, through Hermosillo, which is about 160 kms from Suaqui Verde.



### **EXPLORATION HISTORY**

The Suaqui Verde property has undergone sporadic exploration since at least the mid 1940's when Asarco controlled the property.

Between 1956 and 1958 the property was controlled and explored by Holly Corporation, a uranium exploration company based in Albuquerque, New Mexico. Holly's exploration work concentrated on and around an outcropping deposit of high-grade copper oxide ore with the objective of proving up several tens of millions of tons of + 1% copper. Holly's program terminated when it was acquired by an oil and gas company.

Holly's program consisted of 3,400 feet of rotary drilling in 13 holes; 3,500 feet of core drilling in 29 holes from which only cuttings were recovered; and several thousand feet of underground workings. The deepest drill holes penetrated to a depth of 300 to 400 feet. All of the drill holes terminated in mineralized rock and most bottomed in mineralization grading above 0.40% copper.

Holly's work resulted in a reserve of about 10 million tons grading 0.53% copper but the zone was defined as open at depth and on all sides. As channel samples from the underground workings averaged about 1.0% copper, it is likely that the overall grade of the deposit is higher than indicated by the drilling. Data from this program consists of drill logs and assays, assay maps of the underground workings and weekly reports. Holly's program was terminated when it was acquired by an oil and gas company.

In 1964/5, Penoles conducted an inconclusive IP Survey and 5,000 feet of core drilling in 6 holes. Core recoveries were poor.



In 1972 and 1973, Cominco conducted a grid geochemical survey over the entire property and drilled 5,000 feet in 19 small diameter percussion holes. The geochemical survey succeeded in outlining a zone of + 0.10% copper extending over a surface area of more than 2.5 sq kms and terminating to the west where outcrop was overlapped by alluvium. The drilling technique was unfortunately unreliable and its use was further reduced by the fact that it was not guided by geologic mapping. Nevertheless, Cominco's drilling did demonstrate the widespread nature of copper mineralization on the property. Data from the Cominco program includes a geological map, drill logs with assays and a final report.

In 1972 & 1973, Duval made a brief examination that included the first geologic mapping of the property. Duval terminated work when they were unable to come to terms with the property owner. Data from the Duval program included maps of geology, alteration and mineralization, plus a geological report.

### CONCLUSION

Within a small portion of the Suaqui Verdi porphyry copper system, closely spaced drilling and shallow underground workings have outlined a shallow zone of oxide/chalcocite mineralization. This zone measures about 1800 meters east-west and 400 meters north-south and is open to the south (surface exposures suggest a width of more than 1000 meters). Drilling has been localized in the low sulphide part of the system, has defined a partly oxidized chalcocite enrichment blanket. Above a .20% cutoff grade, the upper portion of this enrichment blanket grades between 0.35% and .40% Cu. Within a small portion of the deposit, drilling and shallow underground workings enabled **Dr. David Hackman** (see 'Consultants') to estimate a **mineral inventory of about 30 million tons grading .32% Cu.** Preliminary metallurgical testing has shown that **ore from this zone is amenable to acid leaching.** 

As yet unexplored in the Suaqui Verde porphyry copper system are zones where the original sulphide contents were high, such that leaching and enrichment of the original copper minerals may have created large enrichment blankets of high grade ore. Worldwide, such high-grade enrichment blankets have been found in many porphyry copper deposits. In the western hemisphere, notable occurrences of high grade enrichment blankets include those at La Caridad and Cananea Sonora, Mexico; Miami, Morenci, Silver Bell, Ray, Bisbee, Casa Granda Arizona; Santa Rita, New Mexico; and Chuqicamata Chile.

### GEOLOGY

Copper Company

The Suaqui Verde copper deposit lies within a belt of porphyry copper deposits extending from central Arizona to southern Sonora. Major mining operations along the copper belt in Sonora include Cananea and La Caridad, while in neighboring Arizona and New Mexico, 15 major operations or development projects are active and another 9 are inactive due to depleted reserves.



Deposits along the belt on both sides of the border are late Cretaceous to early Tertiary in age and are related to porphyritic intrusions of generally granitic composition. Hosts to the intrusions along the belt are metamorphic, igneous and sedimentary rocks ranging in age from Precambrian through early Tertiary.

The Suaqui Verde copper deposit is localized in volcanic and intrusive rocks of late Cretaceous to early Tertiary age, and is part of a porphyry copper system of the type described by Lowell and Guilbert in their article published in <u>Economic Geology</u> in 1969. The deposit contains an inner potassic zone, an intermediate ore shell and an outer pyrite halo. The entire system, including the pyrite halo, is exposed throughout an area of more than 4 square kilometers, but its actual size is probably much larger than that (the western part of the system is covered by a veneer of gravel). **The area of exposed copper mineralization is about 2.5 sq kms**.

# By way of comparison, the zone of copper mineralization at Sanchez, which contains approximately 200 million tons to an average depth of 330 meters, is only 0.6 sq kms.

In 1991, AZCO conducted a 10,000 foot reverse calculation drilling program in this area which consisted of 43 holes drilled in 14 north/south fences. This work resulted in the partial definition of an oxide/chalcocite deposit about 1,880 meters in length, 20 to 150 meters in thickness and up to 400 meters in width and open to the south. Along most drill fences, copper grade improved to the south. The average copper grade of line 1, the line having the greatest density of drilling, is 0.40% Cu using a cutoff grade of 0.20% Cu. In addition to exploration drilling conducted in the potassic zone, two holes were drilled in the pyrite halo in search of a chalcocite blanket.

### **EXPLORATION POTENTIAL**

AZCO's exploration drilling program was conducted within an area representing only about 25% of the potassic zone and a very minor portion of the surrounding pyrite halo. If the entire potassic zone is mineralized to the same degree as that already explored, **then it would contain a mineral inventory significantly in excess of 100 million tons**. As AZCO's drilling only amounted to 10,000 feet, the grade and size of the ultimate deposit within the potassic zone will depend on the outcome of a substantially larger drilling program.

In addition to outlining part of the oxide/chalcocite deposit within the potassic zone, drilling also encountered a chalcocite enrichment blanket in the pyrite halo. Two holes drilled in the pyrite halo penetrated a chalcocite blanket 55 feet in thickness averaging 0.50% copper. As the prospective part of the pyrite halo is at least as large as the potassic zone, definition of a copper deposit within the pyrite halo will also require substantial drilling.

### PROPOSED EXPLORATION PROGRAM

The exploration program will have the following objectives:

- 1. Drill out the presently defined near surface oxide/chalcocite blanket.
- 2. Enlarge the zone by drilling to the south.
- 3. Explore for a high-grade enrichment blanket by drilling along the southern contact between the potassic zone and the pyrite halo.



# Strong & Harris project

ARIZONA

Pboenix

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### MINING IN MEXICO

### **Economic Background**

On 20 September 1990, the Mexican government officially issued new regulations for its mining law as part of a national program to modernize the country's industrial and mining sector by 1994. The regulations are intended to simplify the bureaucratic procedures in granting mining concessions. There are also new regulations governing foreign investment which will permit 100% foreign control in some industrial sectors, including mining. Ownerships will be under a 12-year licensing agreement ('Fideocomiso') after which 51% ownership must be sold either to a Mexican company or via flotation on the Mexican Stock Exchange. Exploration concessions are to have a three-year duration and are renewable. A number of mining companies are currently active in Mexico, including Kennecott, Cominco and Asarco.

When these measures were announced, the Mexican stock market rose dramatically, which now has a market capitalization of US \$32 billion which equals the combined figures for Argentina, Brazil and Chile, and is comparable with Singapore.

The abolition of dividend withholding tax and the creation of Neutral Trusts has already attracted substantial inflow from U.S. Institutions. The prospect of favorable Free Trade negotiations with the U.S.A. and Canada may cause institutions to re-evaluate their weightings in the Far East and switch their investments to Mexico.

Inflation is projected at around 14 - 20% at the year-end, decelerating to an average of 13.5% during the 1991 - 1994 period, and down to 12% in 1994.

Royalties and corporation tax are currently set at 36%, a lower tax rate than a number of North American states.

Oil, gas, and uranium production will remain under state control.

Mexico is the world's leading producer of silver and bismuth and is a major producer of antimony, arsenic, barite, cadmium, celestite (source of strontium), copper, fluorspar, graphite, lead, manganese, mercury, molybdenum, salt, selenium, sulphur and zinc. Within these, the principal exports by value are copper, silver, zinc and sulphur. Mexico still has significant mineral potential for porphyry-type copper deposits, replacement type lead/zinc deposits and precious metals ores.

MINERAL PRODUCTION							
METRIC TONNES	1987	1988	1989	1990			
PRECIOUS METALS							
GOLD	9.0	10.7	11.5	9.6			
'000 METRIC TONNES							
OTHER METALLICS							
ALUMINIUM	64.9	70.9	71.7	69.7			
COPPER	230.6	268.4	249.0	293.0			
IRON ORE	4,965.0	5,564.0	5,116.0	5,150.0			
LEAD	177.2	171.3	163.0	160.0			
MANGANESE	146.4	168.6	163.0	165.0			
SILVER	2.3	2.3	2.3	2.1			
ZINC	271.5	262.2	288.0	302.0			
FUELS							
COAL	11.1	10.6	10.6	10.6			
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Restrictions on foreign capital, combined with high taxes, have retarded development of the nation's resources. Only 3 - 4% of the nation's total mineralized area is being exploited, only 20% is being explored, but up to 60% is considered to have some commercial potential, according to SEMIP's latest estimates.

### THE COPPER BELT

The porphyry copper belt of southern Arizona and New Mexico now produces approximately 1 million tons of copper per year. Up to the end of 1989, the belt had a cumulative copper production of about 50 million tons.

This production has come from 25 separate ore deposits of which 12 are currently being mined. Our map illustrates that the porphyry copper belt does not stop at the U.S./Mexico border: it continues through the northern Mexican states of Sonora and Sinaloa, where its presence is expressed by widespread porphyry copper occurrences. In Sonora, the belt contains four deposits that have produced significant amounts of copper: Cananea, La Caridad, Pilares and Cumobabi. Currently, the combined annual copper production from Cananea and La Caridad is about 250,000 tons.

The discovery of the La Caridad orebody in 1967 (700 million tons grading 0.70%), aroused great interest in the copper potential of northern Mexico. Thus began an epoch of intensive porphyry copper exploration that lasted from the late 1960's through the early 1980's. During this period, teams of exploration geologists scoured the region identifying porphyry systems, mapping them, taking samples and carrying out drill programs on the majority of the targets. The intensity of the effort meant that most of the projects were explored by at least three or four companies. With the collapse in copper prices in the early 1980's, the boom ended and the properties reverted to claim holders or were simply abandoned.

Northern Mexico is no longer an undeveloped, isolated part of the world. Over the past 20 years, the region has seen the steady growth of a now extensive network of paved roads, power lines and telephones. Access to the region is now on a par with many parts of the western U.S., and much better than some areas now being intensively explored in Canada.

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### THE OUTLOOK FOR COPPER

### PRICE

The copper price performance during the present recession has been impressive. Unlike other metals the price has risen in the last four months, from a low in May of \$0.98/lb, having touched a recent high \$1.09/lb. The chronic unreliability of copper supply, combined with relatively low inventory levels have conspired to keep prices at relatively high levels, The U.S. \$1.09/lb level now appears to be a solid support level, that will require an extended economic recession to be broken conclusively.

### **RECENT DEVELOPMENTS**

The focus of recent events has been the situation in Zaire. As a major producer of both copper and cobalt, the result of the coup/unrest in Zaire will have a major effect on future copper prices. At present Gecamines say that the mines are working, but without expatriate labor. What the sustainable production rate is in this scenario is open to question. With much of Zaire's infrastructure damaged, or out of action, physical transportation of any production may prove difficult. Gecamines has declared 'force majeure' on deliveries from Zaire but, due to the 40/50 day pipelines from the mines to the market, the effects of this have yet to be felt. In any event it is unlikely that Zaire will produce anywhere close to its 340,000 tons potential.

Perhaps the most significant development in the copper market has been the emergence of a huge structural imbalance in the concentrate to smelting/refining system. While copper mine output has been growing at a steady pace, there has been a dearth of new smelter construction in recent years. The addition of the giant Escondida project, the expansion in Indonesia, and assorted smelter problems, have tipped the copper concentrate market into surplus. Thus TC/RC's (treatment costs/refining costs) have expanded to their current levels of \$0.32/lb. While there is obviously a limit to how far TC/RC's can go, they should continue to increase.

This situation is unlikely to be resolved in the near future. A number of new smelters are in the planning and conceptual stage, but none are under construction at present. The first of these that will come into production is Mitsubishi's Texas City smelter, followed by proposed units in Portugal and Thailand. Texas City is, however, unlikely to come into production until late 1993 early 1994. By then there will be a requirement for another smelter anyway, so it is unlikely to redress the balance. Thus the current situation is likely to persist until 1994 to 1995.

In these circumstances, any growth in copper output will come from new SX-EW facilities, where a smelter is not required. Proposed new SX-EW projects will not be able to make up the balance of future copper demand even at low growth rates. The smelting problem would also seem to preclude the reopening of Bougainville, unless this was tied to a smelter construction project. Additionally, strikes or disruption at custom concentrate producers, such as Highland Valley will not have as drastic an effect on the copper price as they might have had previously. Conversely, disruption at smelters, such as the recent fire and closure of Cyprus's Miami smelter will be doubly significant.

### DEMAND

Balancing the litany of supply side problems has been a slackening of demand in all the major copper consuming areas. The upturn in U.S. consumption in the summer, has not continued, allied to weakening demand in Japan and Germany, and continued slack European consumption. Net consumption of refined copper in 1990 is estimated by the WBMS to have been 8.81 m t, a growth rate of 1.8%. This year copper demand will probably fall to approximately 8.75 m t.

The continued malaise of the transport and construction industries are the principal reasons for the fall in overall consumption. Recent data on both of these give little sign of encouragement that a pick-up is just around the corner. Until there is a general economic improvement, and OECD industrial production picks up, the copper market will continue to be in surplus and prices under pressure. A number of infrastructural projects such as rebuilding of the Eastern European telephone system should ensure that copper demand growth remains strong. While we do not expect that the 3.6% consumption growth of the 1982-90 period will continue, 2% growth should be in equilibrium in 1992, and move into deficit in 1993.

### SUPPLY

Recent events have done nothing to allay the perception that the supply side of the copper industry is so prone to problems that any price falls will be relatively short lived. While we don't agree entirely with this, there is no doubt that further supply problems could emerge. In addition to disruptions of supply from Zaire, Bougainville remains closed; strikes and threats of industrial disruption continue in Chile, Peru and Canada; and natural disasters occur with frightening regularity in copper producing areas. Reports of supply side disruptions tend to obscure success stories such as Escondida and Sar Chesmeh.

In the short term, supply disruptions will continue to occur. Cananea's much delayed strike has been postponed until the end of November. Union activities and the Shining Path guerrilla movement will continue to disrupt production from Peru, and continued threats of disruption emanate from Chile.

Total supply, including E Bloc exports, should amount to marginally above 8.8 m t. This would imply a stock increase of 50,000 tons. Provided some measure of economic growth returns in 1992, and supply disruptions continue, the prospects for a higher copper price are probably better than for the other base metals.

	1990	1991(f)	1992(F)
CAPACITY	9.65	9.88	9.96
UTILIZATION	88%	86.5%	87%
PRODUCTION	8.5	8.55	8.67
E BLOC EXPORTS	0.25	0.25	0.25
CONSUMPTION	8.81	8.75	8.92
NET STOCK CHANGE	-0.56	+0.25	0

### OUTLOOK

In the short term, the unsettled situation in Zaire and at the Cyprus Miami Smelter will continue to support the copper market. Balanced against this will be a weak demand profile. In this context we expect the copper price to remain above U.S. \$1.00/lb, except for a brief period. We believe that 1992 will see slightly firmer prices in the range U.S. \$1.00 - U.S. \$1.25, with an average price of U.S. \$1.15. Should there be another major smelter disruption, then the upper end of the range may well be exceeded in extremely volatile trading.

On a long term basis, copper has perhaps the best fundamentals of all the base metals. A sustained economic recovery will put the market into a serious supply deficit. This, allied to continued disruptions and supply side smelter constraints, could result in another copper boom, with 1988/1989 prices being exceeded.





### **COPPER GREENFIELD PROJECTS FOR THE 1990's**

According to a new study by Commodities Research Unit (CRU) Ltd., copper will be in short supply through the 1990's, despite intense activity in development of new mine projects. The tonnage from known projects that could be brought on stream by the year 2000 will be nowhere near enough to offset closures and to match expected growth in demand for copper.

The study entitled 'Copper Greenfield Projects for the 1990's' surveys the 27 most significant copper greenfield developments actively being considered at this moment, equivalent to 1,615,000 tons/year of copper capacity, and provides a detailed technical and financial assessment of each one. Of this, some 700,000 tons/year would be viable at a copper price of 90cts/lb and could be in production by 1995, with a further 510,000 tons/year by the year 2000.

The net outcome, after allowing for expansions and closures of existing capacity, is growth in mine production of 2.6% a year to 1995. If consumption were to continue growing at 3.5% a year (as it has since 1985) this implies continuing undersupply to the market. This situation could deteriorate after 1995, when the pace of scheduled closures brings calculated net production growth down to 0.4% a year.

Even if growth in copper consumption through the 1990's falls to 2.5%, CRU estimates that between 850-900,000 tons/year of capacity still will be needed by the year 2000, over and above 1,615,000 tons of greenfield capacity already under construction or actively being considered. While such an outcome is not impossible, it will take an extended period of high prices, reminiscent of 1964-74, to bring it about.

Of the 27 projects surveyed in the study, four emerge as outstanding, all of them in Chile. Twelve others are of good or medium quality: seven in Chile, two in the U.S.A., and three elsewhere. Attractive geology and a favorable investment climate are key factors favoring Chile and the U.S.A..

The increasing dominant position of these two countries and the dependence that relies on political developments in the former and environmental regulations in the latter may stimulate greater interest in some of the Canadian projects, if investors are inclined to favor security of supply considerations over economics.

Another key factor is the rapid progress in heap leaching, solvent extraction and electrowinning technology. These developments have transformed the economics of a number of known copper resources not previously considered viable. Well over 40% of the production from the new capacity will come in the form of electrowon cathode.

This will have significant consequences for the custom concentrate and blister markets, because about half of the mines in operation today will close over the next 15 years due to reserve exhaustion. The great majority produce sulphide concentrates.

Surprisingly, the investment needed to start a new copper production facility is considerably less than 10 to 15 years ago. The average capital cost per annual ton of installed copper production capacity (to refined product) for the projects surveyed is less than U.S. \$5,000. This falls to less than U.S. \$3,000 per annual ton for heap leach operations.

The new generation of mines also will have low cash operating costs. Over 75% will produce copper for 50 cts/lb or less, (constant 1989 terms) while 90% will see their cash costs covered by a copper price of 50 cts/lb. Producers of electrowon cathode will have costs of less than 60 cts/lb.







of any of these persons becomes unavailable to AZCO, there is no assurance that AZCO could find a qualified replacement on acceptable terms. There also is no assurance that AZCO will be able to obtain any additional management personnel it may need. AZCO also will depend upon recruiting and maintaining other qualified personnel to staff its operations. Although AZCO believes that such personnel currently are available in the future. In addition, it cannot be predicted whether the labor forces staffing any of AZCO's projects will be unionized, resulting in potentially higher operating costs.

**Conflicts of Interest.** Although AZCO has attempted and will continue to attempt to minimize conflicts of interest, there is always the possibility that an officer or director of AZCO may be involved in a conflict between his own interests and those of AZCO as a result of competing time demands, outside investments in other business activities or other matters.

**Uncertainty of Title.** Certain of AZCO's mining properties are unpatented mining claims located in the United States, and AZCO has only possessory title with respect to such properties. Because title to unpatented mining claims is subject to inherent uncertainties, including paramount title to the United States, it is difficult to determine conclusively ownership of such claim. In addition, and in order to retain title to an unpatented mining claim, a claim holder must meet annual assessment work requirements (\$100 per claim) and comply with stringent state and federal regulations pertaining to the filing of assessment work affidavits. Since most mining claims in the United States are unpatented, this uncertainty is inherent in the mining industry. AZCO also owns properties in Mexico. These properties are subject to the paramount title of the State of Mexico and will revert to the Mexican Government after 12 years from commencement of operations on the properties (unless control has been sold to a Mexican entity prior to such time), and the properties are subject to Mexican property law including the requirement for proper registration of title to maintain and enforce property rights.

### ACKNOWLEDGEMENTS

Sanchez Feasibility Study - Fluor-Daniel Wright - November 1990 Copper Statistics: James Capel & Co. Yorkton Natural Resources Commodities Research Unit Ltd. Goepel Shields Mining in Mexico: Mining Journal James Capel & Co. Lion Mining Finance Azco would like to express its sincere thanks to the consultants whose advice, and enthusiasm has been a source of constant inspiration and encouragement. These consultants have contributed substantially to the technical data contained in this

inspiration

report. Dick Bideaux Fred Brost Ross Glanville & Associates Metcon Research Inc. Dave Hackman Paul Hodges Mike Sierakoski Diane Watts of Watts Design Group/Graphic Design

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