CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
1520 West Adams St.
Phoenix, AZ 85007
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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ADMMR
Arizona Department of Mines and Mineral Resources
1502 West Washington, Phoenix, AZ 85007 Phone (602) 255-3795
1-800-446-4259 in Arizona FAX (602) 255-3777 www.admmr.state.az.us

Field trip to Mineral Park, Mohave Co. November 17, 2005
In the company of P. K. Rana Medhi, ADMMR board member and former mine manager
and Jim Jenkins, Mining and Processing Equipment consultant.
From notes by Nyal Niemuth, Mining Engineer, ADMMR

Met Mike Surratt, President of Mercator Resources, who also provided a tour of the mine and this this information. Jim Thompson is the mine manager. Mercator is listed on the Toronto stock exchange and the company hopes to obtain a listing on the American Stock Exchange next year. Last year's major financing was obtained roughly half from Europe and one quarter each from Canada and the US.

The mine fleet consists of six 100 ton Terex trucks (obtained thru Road Machinery) and with Komatsu loaders (obtained thru Hoss). The mine plans to go to hydraulic shovels and may go to 150 ton trucks when the mine expands and resumes milling operations. Dagerstrom was the contract miner. Additional equipment includes a Komatsu 378 and Caterpillar D8 dozer and a small utility dozer. A Ingersol Rand blast hole drill rig (six and three quarter inch holes) prepares 30-foot holes for the 25-foot high mine benches.

The entire operation is on private land which facilitates permitting as well as other operations. Red Mountain Mining Ltd. leases a crushed stone quarry located in the red gossan zone of the deposit and also crushes mine waste, both sold as landscape material. The fines generated (normally unsaleable) are used on the haul roads and make them very smooth and thanks to the clay content, compact well. Kingman Turquoise has resumed production of turquoise for jewelry from the property.

The mine is currently operating at 30,000 tpd including waste and ore. Total reserves and resources are over 300 million tons. Chalcocite bearing ore is placed in 9-foot lifts and ripped 6 feet deep. The mine strip ratio is .5 to 1 waste to ore. The copper grade averages about 0.3 percent. The future molybdenum grade will be about 0.04 percent Mo. The leaching cycle takes 6 months to complete with a number of periods of draining to oxygenate the ore. The mine operates two - 10-hour shifts per day, while the SX-EW facility operates 24-7. The SX plant operates at 4100 to 5000 gpm rate. The tank house cells plate for 1 week, but a rotating harvest occurs every day. Current production is about 1 million lb. of cathode copper per month that is sold to a wire plant in Texas. The cathodes, although reported to be 99.99% pure Cu, are not registered with COMEX or LME. The EW plant currently uses titanium cathode sheets but is planning to switch to stainless steel. Although the ore is generally acid generating supplemental sulfuric acid is purchased from Los Angles area refineries for a delivery price of about $100 per ton. A recently purchased larger rectifier will be installed by the first of the year. Electricity is provided from the grid by 69 kw line by the utility Unisource at rate of 5.9 cents per kw.

The cash cost of cooper production is 85 – 95 a lb. with 40 cents attributed attributed to leaching and SX-EW, and 30 cents mining cost and other costs (DD&A, freight, environmental) about 15-19 cents.

The Mineral Park mine currently has 52 employees. Finding quality employees was reported to be a problem in the Kingman area due to the prevalence of drug use and lack of heavy equipment and mine operations experience. The mine is nonunion. Pay ranges from $14 to $20 per hour plus benefits.

Mercator purchased the Asarco Mission Mine's South mill mid 2005 and hopes to move it to Mineral Park by mid 2006 and will reconfigure it slightly. The mill will be installed in an unusual location – a barren zone in the middle of the pit. It is planned to be fed by two crushers. These will move down the pit as mining proceeds. The mill will allow not only expansion of copper production but also allow recovery of byproduct molybdenum (now priced in the mid $30 per pound today!) Previous milling operations by Duval ended during the 1980's and produced about 90 million tons of tailings The tailings dam has lots of room for additional mill waste.

Digital photos were taken are stored on the LAN server.

MINERAL PARK COPPER DEPOSIT

MOHAVE COUNTY

Visited with Ken Lamb and Bill Roper at the Mineral Park - nothing unusual to report. FTJ WR 3-6-70

Mineral Park operating at usual rate. FTJ QR 4-3-70

Visited Mineral Park - changes in personnel are: Ken Lamb to mine supt. at Sierrita, Kenneth Kelley, asst. supt. at Mineral Park to mine supt., George P. Boone promoted to chief engineer and J.E. Moss to asst. mining engineer (ore control). FTJ WR 5-8-70

Active Mine List May 1970 - 400 men - W.J. Roper, Res. Mgr.

At Mineral Park interviewed Bill Roper. Duval drilling deep hole around the known orebody in hopes of enlarging reserves. FTJ WR 7-11-70

Duval's Mineral Park mine produced at its regular rate for the year. FTJ Annual Report 6-30-7

Visited Duval's Mineral Park mine - visited Bill Roper - no change in operations, but Mr. Roper gave me some leaching figures. FTJ WR 9-4-70

Visited Bill Roper at Mineral Park. They have been drilling some deep hole near Nugget PK and others around Mineral Park. FTJ WR 11-6-70

To Mineral Park - interview with Bill Roper. He said Phillips Petroleum were drilling same area as Bear Creek - adjacent to Duval's tailings pond. Duval own the surface and Santa Fe the minerals. Mineral Park mills 16,420 tpd. FTJ WR 1-8-71

Active Mine List Oct. 1970 - 415 men

Mineral Park mine was operating at its regular rate. FTJ QR 1-13-71

To Mineral Park. Interview with Bill Roper who said they were having difficulties with the ball mills due to welding failures, otherwise operations normal. FTJ WR 5-10-71

Mineral Park, division of Duval produced at its regular rate throughout the year. FTJ Annual Report 8-19-71

To Duval Corp. Mineral Park operation and talked with Mr. McLean, mill supt. and Mr. Boone, mine engr. They, like everyone, have had considerable high water lately. GW - WR 9/3/71

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Ithaca Peak Prospect — Date July 15, 1959

District Mineral Park, Mohave County — Engineer T.P. Lane

Subject: Visits of May 21 and July 8, 1959

Operator Duval Sulphur & Potash Co.

The property consists of some 150 or more claims located by Duval in the Mineral Park region early this year; also a number of properties have been optioned in the region on short term agreements. All of the property comprises a block with three closely grouped peaks -- Ithaca, Turquoise and C&A peaks -- in about the center of the block. The last named is the scene of a drilling project by Calumet and Arizona many years ago. More recently Kennecott drilled in this same area. The optioned properties include the Keystone, Evahom, Ark, Lind and others which were active producers at one time or another.

Supt. Everett Smith

Cu

Engineer: Wm. Roper

At the time of the first visit an office and sample preparation room were under construction and a contractor was building rocks and excavating drill terraces on the east slope of Ithaca Peak. The drill contractor, Wininger Drilling Co., had moved one drill to the camp and expected to move in another within the next several days.

At the time of the second visit, work had been temporarily suspended because of a fatal accident on one of the drilling rigs.

The work has been going ahead with two drill rigs. Holes are being drilled on an 800' grid. 6 holes have been completed to depths of 200 to 400' and a 7th hole is being drilled.

The Company crew consists of Smith, Roper, and a geologist and assistant. Harrison Schmidt visits the project frequently in a consulting capacity.

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Mineral Park Porphyry Copper Deposit Date May 28, 1953

District Mineral Park (Wallapai) Engineer Geo. F. Reed

Subject: Former Drilling Results

Note:

This property now being drilled by Tom Chapman & Assoc., who would like someone to take over who has ample finance. See notes under this date on present drilling campaign, also April 15th and May 17th, 1953.

Churn Drilling in 1906:

In 1906 and 1907, three churn drill holes were put down in a high saddle about ½ mile South 20 degrees East from Chapman's No.2 hole. This would be approximately on South line of Sec.24, Twp 23N, R18W, and about one eighth mile West of the center of South line of section. The three holes were numbered from North to South. Results were approximately as follows:

Hole No.I, collar 4640 Elevl., 330 to 360 feet got 1.03% copper graded down to 520 to 580 feet Tr. copper.

Hole No.2., collar 4550.elev., best result was about 65 feet of 0.42% copper, this was not broken down and might have half the thickness of better grade.

Hole No. 3, collar at 4485 elev., 220 to 250 feet gave 1.09% copper.

Kennecott Diamond Drilling:

Kennecott Copper did some drilling, six diamond drill holes, a couple of years ago. Their drilling was done mostly along the Eastern side of Ithica Peak near the Turquhise Diggings. Elevations of collars varied from about 4400 to 470 feet. Approximate location would be near common line of sections 19 and 30, and a feet hundred feet East of line between Ranges 17 and 18 West, Twp.23 North. This is about a mile East of the 1906 drilling. No. I hole was at about 4650 Elev., pointed about North 60 West and inclined down at about 40 degrees. About 75 feet vertically down it went into a vertical depth of 200 feet of 0.6% copper, according to Tom Chapman. A flat hole from same point straight into the hill didn't get ore. Another hole farther North at 15 degrees down, cut a vertical depth of 80 feet, core length 200 feet of 0.9% copper. It was barren 1st 100 feet. Last part ran about 0.2% copper. Some of the other holes were vertical and were in dikes most of their depth and were barren.

The above gives a rough idea of the type of results obtained to date in drilling.

property tied up by Admiral 1960

Two old adits near Gross ranch were run by C. & A. about 1927. These are said to run around 0.20% copper and a little higher than the general average of 1. pound of Moly claimed by Chapman for the whole area.

George F. Reed

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine: Mineral Park Porphyry Copper Deposit Date: May 17, 1953

District: Mineral Park (Wallapai) Engineer: Geo. F. Reed

Subject: Additional Notes (see April 15, 1953)

Name of Property:-

This property as now rounded up by Tom Chapman & Associates comprises about three sections or roughly 2000 acres. The name given above is that used by Mr. Chapman, and Blakemore Thomas calls it a "Porphyry Copper Type", so it would seem that this name is quite suitable as well as descriptive.

Name of Owners:-

Tom Chapman, Box 243, Kingman, & Associates have rounded up about 80 claims and own an additional 50 themselves. These claims cover the full area of Sec. 24 & 25, Twp. 23N, R18W, and the Western halves of Sec. 19 & 30, Twp. 23N, R17W. Reference to the claim map shown between pages 4 & 5 of R. I. 4101, August 1947, "Examination of Lead-Zinc Mines in the Wallapai Mining Dist., Mohave County, Arizona", will give an idea of the claims, etc.

Addresses and names of owners, complete would take some research, partial list:

Tom Chapman & Assoc., Box 243, Kingman, 50 claims.

John Gross, Chloride, Arizona, 16 claims.

Lyon Kay, Kingman, Arizona, 13 claims.

Gates Ekdale, Pasadena, Calif., 12 patented claims.

Boehmen & Reynolds, 3 claims.

Guy Atlee, Kingman, Arizona, 4 claims.

Irma Prisk, 1 claim.

H. L. Jones, 1 claim.

Weaver Estate, 14 claims.

Wm. A. Epperson, 1 claim.

Walleck Family, 14 claims.

Progress of Drilling:-

First churn drill hole of present campaign went to about 275 feet near Ostrich Shaft of Kay Copper. Values were not as good as hoped for and hole started caving, so moved to South to near "White Mule" workings. Now drilling on this location.

George F. Reed

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DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine Mineral Park Porphyry Copper Deposit Date April 15, 1953.

District Mineral Park (Wallapai) Engineer Geo. F. Reed

Subject: Present Status, General Description

Location, Ownership and General Conditions:

This porphyry copper deposit is located in the general Mineral Park Area of the Cerbat Mts. It is reached by 16 to 18 miles of road from Kingman via Boulder Dam Highway (paved) and last 4 to 6 miles on dirt roads. Tom Chapman, a Mr. Giffen of Boulder City and Roy Hardy (Getchell Mine, Nevada) have tied up about three square miles including some they own themselves and are starting to churn drill in the area. They have practically all of sections 24 & 25, Twp.23N,R18W, and the Western halves of sections 19 & 30,Twp.23N,R17W. This includes the John Gross holdings, the Kay Copper and several other groups.

Geology & Topgrapgy:

This area is mostly rugged topgraphy from 4000 to over 5000 feet elev. The Northern part which covers part of the floor of Mineral Park is somewhat more level and is at lowest elevation. On the floor of the "Park", water stands in the shafts at about 20 feet from surface. The Ithaca Peak Granite Porphyry is a younger (Mesozoic ?) intrusive which has intruded the older Pre-Cambrian Granite, Gneiss and Schist. At shallow depth under the oxidised surface, sulphides of iron and copper beging to show and the primary ore here is said to assay 0.3% copper in large volumes. Local areas assay up to and over 1.0% copper according to Mr. Chapman.

According to Blakemore Thomas, three churn drill holes drilled in 1915 from quitehigh up in the area showed leached zone to 170, 180 and 290 feet, with the enriched zone going to 410, 520 and 340 feet. The first drill hole in the present campagn is being drilled near the Ostrich Shaft on Kay Copper where water level is only down about 20 feet. The limited workings and the dump at this (50 ~~feet~~/ feet deep) shaft are said to run 1.0% copper or better.

George F. Reed

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Grateful acknowledgement is made to the management of Duval Corporation for permission to present this paper.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
OWNERS MINE REPORT

Date December 25, 1940

Mine Hillside / Consumed by Open Pit

Mining District & County - Cerbat Range Mohave County

Location - 5 miles south and 3 miles east of Chloride in Mineral Park.

Former Name - Turquoise Blue

Owner - Geo. W. Newell

Address - Box 284 Chloride, Arizona

Operator - None

Address

President

Gen. Mgr.

Mine Supt.

Mill Supt.

Principal Metals - Turquoise

Men Employed

Production Rate - Virgin

Mill: Type & Cap.

Power: Amt. & Type

Operations: Present - None

Operations: Planned - None at present. If market for turquoise could be found, operations would be simply to place compressor on property and start taking out turquoise.

Number Claims, Title, etc. - One

Description: Topography & Geography - This claim is located on hillside of large mountain. Silver has never bee prospected for on this claim, however, silver and gold are being mined as well as turquoise very near this property.

Mine Workings: Amt. & Condition - I have only done the yearly assessment work. Such as blasting huge boulders from sides of mountains.

Geology & Mineralization - The mineralization is gold, silver, copper and turquoise.

Ore: Positive & Probable, Ore Dumps, Tailings - None

Vein Width, Length, Value, etc. - This is strickly virgin ground completely surrounded by producing mines of gold, silver and turquoise.

Mine, Mill Equipment & Flow Sheet - None

Road Conditions, Route - Good roads. Route described under "location."

Water Supply - Water can be obtained by drilling to depth of 65 ft. on southwest portions of this claim.

Brief History - Turquoise has been mined on claims surrounding this claim for 15 years. 2 claims touching this one is turquoise patented claims. 2 on south side are producing now.

Special Problems, Reports Filed - No reports have been filed on this claim. It has belonged to one fellow for 14 yeers and he never did more than assessment work. It was dropped last July and I picked it up.

Remarks - To anyone wanting turquoise, I will sell this for $1500.

If property for sale: Price, terms and address to negotiate - Yes, it's for sale, $1500. -- $500 cash and balance 2 years.

SIGNED - Geo. W. Newell
Box 284, Chloride, Arizona

Mr. James P. McCarty mill supt. for Duval at the Mineral Park, Arizona property was named resident manager at Battle Mountain.

Roland McLean replaced Mr. McCarty as mill supt. at Mineral Park.
Skillings Mining Review 3-2-68

Active Mine List Nov. 1967 - 390 men
Active Mine List April 1968 - 389 men

Interview with Bill Roper and Ken Lamb at Mineral Park - operations about normal.
FTJ WR 7-12-68

Visited Ken Lamb at Mineral Park - no changes in their operation. FTJ WR 9-10-68

Interview with Bill Roper of Mineral Park. There are no changes in operations. They were dozing a clearing on Turquoise Mts. Supposedly for Mr. Hardy (?) FTJ WR 11-8-68

Active Mine List Oct. 1968 - 385 men

Visited Mineral Park - interview with Ken Lamb and Bill Roper. They are pessimistic about future for copper and particularly molybdenum. FTJ WR 1-10-69

Interviewed Bill Roper at Mineral Park. Operations are normal. FTJ WR 3-7-69

Active Mine List April 1969 - 398 men - W.J. Roper, Res. Mgr., Duval Corp., P.O. Box 1271, Kingman

Mine visit - Ithaca Peak - Mineral Park. Sloppy roads around and in pit due to rains, but going okay. Are now interested in exploring in Cerbats as well as elsewhere.
FPK Field Trip Notes 5-15-69

Interviewed Bill Roper at Mineral Park. They were trying to control a break in their tailing line. FTJ WR 7-11-69

Mineral Park of Duval Corp. - mining and milling at their regular rate. FTJ QR 7-15-69

Bill Roper and Gordon Lyda visited at the Mineral Park mine. Apparently union in cooperation with mine inspector causing concern because of a fatal accident in August in the pit. FTJ WR 9-5-69

Active Mine List Oct. 1969 - 400 men - W.J. Roper Res. Mgr.

Visited Mineral Park - Bill Roper on vacation. Operations normal. FTJ WR 11-7-69

MINERAL PARK MOHAVE COUNTY

Visited Duval's Mineral Park. Jim Eidel, geologist is resigning May 31 and will be geologist for M.A. Hanna Mining Co., who are opening office in Tucson. FTJ WR 5-6-66

Visit and interview with Bill Roper at Mineral Park. Operations normal. FTJ WR 9-9-66

15,500 to 16,000 tpd copper - 377 men working - FTJ 10-1966

Visited William Roper at Mineral Park. Operations normal. FTJ WR 11-4-66

Visited Duval's Mineral Park. Talked to the men in the Geology Department. They are not engaged at present in outside exploration. FTJ WR 1-7-67

Interview with William Roper at Mineral Park - no changes in operations - periodical trouble with grinding units. FTJ WR 3-10-67

Duval operated at capacity at Mineral Park. FTJ QR 4-5-67

Visited Bill Roper at Mineral Park - operations normal. FTJ WR 7-7-67

Visited Mineral Park - Interview with Bill Roper - operations satisfactory. FTJ WR 7-7-67

Interview with Gordon Lyda, geologist at Mineral Park. Operations normal. Bill Roper was in Tucson. FTJ WR 9-8-67

Interview with William Roper at Mineral Park. No change in their operations. FTJ WR 11-10-67

Interview with William Roper and Gordon Lyda. Operations about normal after storm closed them down for two days. Duval continues to look for outside prospects. FTJ WR 1-5-68

MINERAL PARK

MOHAVE COUNTY

Visited Duval's Ithaca Peak mine and mill - interviewed F. B. Phillips, gen. supt. Learned a test run was being made in one section of the mill. Slow delivery of electrical equipment is holding up completion of the mill. Mr. Phillips hoped the entire mill would be on stream between Dec. 1 and Dec. 15. EGW WR 11-6-64

Visited Duval's Ithaca Peak mine and mill. At the mill 3 of the 4 mills have been relined and are now using balls. It was explained that the autogenous grinding was too slow and balls will be used until they catch up with the stockpile. They are now milling expected tonnage. EGW WR 1-8-65

Visited Duval's Ithaca Peak mine and mill - interviewed Bill Roper, field engineer, in the absence of Edward E. Smith, new manager. Mr. Smith replaced F. B. Phillips who was transferred to Carlsbad. The mill is now taking 13,000 tpd. Work is in progress on the leach precipitating plant. A total of 299 men are now employed in the mine and mill. EGW WR 3-5-65

Mr. William Roper, the new resident manager, said leaching was taking about 750 gal. per minute. Shape of dump restricts the amount of water used. About 275 men are on payroll. Isbell had also cut employment. FTJ WR 9-10-65

Mr. J. J. Eidel, geologist for Duval Corp., Box 1271, Kingman, Arizona

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MINERAL PARK MOHAVE COUNTY

Visited Duval's Mineral Park project. Bill Roper, supt., reported that the contract adit job has already intersected a number of drill holes to check drill information and that one surface diamond drill rig and a churn drill rig are in continuous operation. Also, a crew of nine men is employed on geology, mapping, etc. TPL WR 5-19-62

This property active Oct. 1962

Visited Duval's Ithaca Peak Project. Interviewed Ben Messer, Chuck Benson and Al Patterson. Isbell is getting a good start on stripping. About 50 men working. EGW WR 1-11-63

Kingman, Arizona - Duval Sulphur & Potash will spend $28 million to develop open pit mining. A 12,000 tpd concentrator is planned to produce copper and molybdenum concentrates. E&MJ Jan. 1963 p. 81

Duval Sulphur & Potash Co. started construction of its copper-molybdenum open-pit project at Mineral Park. Concentrates produced by the 12,000 tpd operation will be shipped to custom smelters. It is estimated that ore grade will run from 0.08% to 0.12% Mo and between 0.60% and 0.70% Cu. Total tonnage is estimated to be around 50 million. Construction is expected to be completed by late 1964. E&MJ Jan. 1963 p. 124

Visited Duval's Ithaca Peak project. They now have 1 Bucyrus-Erie 8 yd. shovel in operation and 1 being assembled. 4 Le Tournew-Westinghouse Haulpack 65 ton trucks in operation and 6 more expected. 1 40 10E rotary drill in operation and 1 more on the way. Office and repair shop have been constructed. 86 men working. EGW WR 3-13-63

Interviewed Chas. Benson and Herb Jesse - 130 men now working. Visited mill site. Parson-Jurden Corp. of New York City have 50 men working. EGW WR 5-9-63

Visited Duval's Mineral Park project. Isbell now working 136 men on Ithaca Peak and 23 men excavating for mill foundations. EGW WR 7-19-63

Active Mine List Oct. 1963 - 159 men

Visited Duval's Ithaca Peak Project, 121 men working at the mine and 350 working for Parsons Con. Co. on the mill. Hope to have mill operating some time in July. EGW WR 3-13-64

Visited Duval's Ithaca Peak Project mine and mill. Mill construction is progressing nicely and was told a test run is expected between Aug. 15 and Sept. 1. There is a large stockpile at the mine waiting. EGW WR 7-14-64

Visited Duval's mill and interviewed F. B. Phillips, mgr., Mr. Phillips thinks the mill will be ready to start the first part of October. There are 744 men now at the mill and 109 at the mine. Visited the mine and interviewed Ed Covington. EGW WR 9-15-64

MINERAL PARK COPPER DEPOSIT
(ITHACA PEAK)

July 20, 1961 - Visited the Duval Project and talked with Bill Roper, Conover and Gray. Drilling was suspended a month ago. A crew of 5 is surveying, mapping, etc.

TRAVIS P. LANE - Weekly Report - July 22, 1961

Active 10-1961

Nov. 22, 1961 - Visited the Mineral Park project of Duval Sulphur and Chemical. Drilling was resumed recently with 1 diamond drill crew (Mettler Bros.) and 1 churn drill crew (Wininger). Also, an adit has been started with "Pat" Patterson of Chloride as Contractor.

TRAVIS P. LANE - 11-22-61 - Weekly Report

This property active Feb. 1962 - 20 men working.

ITHACA PEAK PROSPECT MOHAVE COUNTY

Visited the Ithaca Peak prospect of Duval Potash & Chemical Corp. No one was present at the camp but voices on the hillside indicated a survey crew was working at some distance. It was evident that drilling had been discontinued. It is said locally that work will be suspended until next spring when the season is more favorable for outdoor work at elevated locations. The company is reported to have exercised a number of its options on properties. TPL WR 11-21-59

Visited the Mineral Park project of Duval Sulfur and Chemical Corp. Harrison Schmidt was present, also William Roper, supt. and Conover, geologist. With Schmidt & Roper I visited a churn drilling operation on the western edge of the already drilled area centered about Ithaca Peak. Other holes will be drilled within the grid of earlier drilling. No data are available regarding results to date, but there seems to be an air of optimism concerning the venture. 6 men are working on geological geophysical work and supervising of the drilling which is contracted. TPL WR 3-19-60

Visited the Duval project at Ithaca Peak. One rig is drilling, and six men are doing geological and geochemical (soil sampling) work. Since the beginning of the year the company has staked 50 placer claims mostly on the gentle sloping plains adjoining the west and southwest border of the lode claims now under exploration. Also, the company staked 24 additional lode claims in April. TPL WR 5-21-60

Learned at ASMOA meeting in Kingman that exploratory development was continuing at Duval's Ithaca Peak project. Drilling for water is in progress in the recently staked area in Sacramento Valley. One well has been drilled 1000' deep, but has not yet been tested. The management estimates that a minimum of 3000 gals. per min. sustained volume will be needed for milling and other project needs. TPL WR 9-23-60

Visited Duval's Ithaca Peak project. Drilling is in progress (Contractor, Mettler Bros.) with 2 diamond drills and one churn drill all working 1 shift per day. 8 men are working steadily on company account including the supt., Bill Roper. The water well in Sacramento Valley has not yet been tested for potential. The company has taken up some 30 mill site claims in an area a little north of the feldspar quarries of Consolidated Feldspar (which are about 7 miles east of Kingman) apparently for water development.
TPL Memo 10-21-60

This property active Feb. 1961

Arizona keeps in the exploration news with more than 150 geologists of more than 30 companies seeking ore. Duval Sulphur & Potash Co.'s recent announcement of a copper-molybdenum discovery of major magnitude is Ithaca Peak, north of Kingman. Kennecott Copper Corporation drilled the area about ten years ago. Now Duval's 65 churn and diamond drill holes outline a deposit for open-pit mining with a favorable stripping ratio. Detailed geologic mapping played a key part in this discovery - Duval's second in less than ten years. Mining World 4-1961 p. 13

Visited Duval's Mineral Park project. No one was present and apparently work had been suspended very recently. TPL WR 6-24-61

ITHACA PEAK PROSPECT MOHAVE COUNTY

Visited the Mineral Park prospect of Duval Sulfur and Potash Co. - 3 men working in addition to a temporary dozer operator and a contractor who is building a combination office - sample room and storage building with surrounding parking area. This headquarters building is located at the north base of Ithaca Peak and is about 3/4 mile south from the old Keystone Mill. Everett Smith is the superintendent for Duval. A Mr. Conover is doing geological field work. Mr. Roper will direct churn drilling which is to begin soon. The Winiger Drilling Co. is the drilling contractor. Two drill rigs will be used, one of which is now on the property at the drill camp. TPL WR 5-23-59

Visited the Duval prospect at Ithaca Peak. Everett Smith, formerly in charge, has been transferred to the Esperanza project. Mr. Roper is now in charge of the project. He reports that a diamond drill hole is being put down on top of the Peak, also one churn drill hole is being drilled at the base. Equipment and supplies for the diamond drilling were landed on the peak by a helicopter. The churn drill hole is the twelfth and is a redrilling of No. 11 which was unsatisfactory because of encountering drilling difficulties. The churn drill holes drilled to date encircle the peak at its base except in a southwest sector. No log information was available. The company crew consists of three men. The contract driller is operating both the diamond drill and the churn drill on two shifts per day. TPL Report 9-1-59

Visited Duval's Ithaca Peak exploration job - Mr. Roper in charge. One diamond drill is in operation, drilling hold No. 16 on a high point about 900' southwest of hold No. 10 which was drilled on the pinnacle of Ithaca peak. A helicopter was used to transfer the equipment from the site of hole No. 10. No information was available regarding the findings to date in the drilling. The company field crew has been increased lately (now 6 men). The surface work consists of surveying, mapping, and soil and surface sampling. TPL WR 10-24-59

Visited Recorder's office in Kingman and learned that the Duval people are transferring titles to the Company from many individuals who, acting independently, had staked claims for them in the Ithaca Peak area. TPL WR 11-21-59

HILLSIDE MINE

MOHAVE COUNTY

No information on this property. Mark Gemmill
5-27-57

Reported that Duval Sulphur & Potash Co. has leased this property - Fred Roper, Kingman.
LAS Memo 11-21-60

NJN 4/87: This property was consumed in the Mineral Park Open Pit Mine.

PPT Slide

MINERAL PARK (FI MOHAVE

Summary

- Acquire a producing copper mine "Mineral Park".
-
- Consolidate the stock of Silver Eagle 5 for 1. Share structure after consolidation:
-

  Equatorial Mining Ltd. 4.6 million or 40%

  Management & Directors 3.3 million or 32%

  Float 3.2 million or 28%

  Outstanding 11.1 million 100%
  -
  -
- Form a strategic alliance with Equatorial Mining.
-
- Introduce new market profile and management.
-
- Complete an equity financing.
-
- Launch new company: Mercator Minerals Ltd.

  Introducing Mercator Minerals Ltd.

Previous slide Next slide Back to first slide View graphic version

RH

Arizona Department of Mines and Mineral Resources
Verbal Information Summary

Date: October 20, 1995 Engineer: Nyal Niemuth

Notes from talk by Jeff Clevenger President, Cyprus Climax Metals Co. to Maricopa Section SME on 10/19/1995.

The talk reviewed Cyprus' copper and molybdenum operations worldwide during the last couple of years, with a focus on cost cutting activities and modernization projects. Below are some comments on the Arizona operations.

General Comments: Cyprus company goal: to significantly increase productivity, reduce the number of employees. How? eliminate unproductive tasks, institute a bonus system for every employee, share cost/price information. At Sierrita the first year of this system resulted in a 20% bonus.

Other goals: 1) invest and modernize the mines. Replace the truck/shovel fleet with 240 ton trucks and 50 cubic yard shovels, 2) increase reserves, 3) produce copper at a cost of 60 cents per pound (at $3 LB molybdenum credit.) Through the end of 1994 73% of the company's truck fleet has been replaced. 11 more trucks replaced since then. The company has achieved a 50% increase in tons milled per man shift and a 50% increase in copper produced per employee. Reserves were increased by raising the copper price used in 1992 from $.65 to $.90 per pound. and the purchase of El Abra in 1994. When the grade turned out to be lower at El Abra Chile, they got the Chilean government to triple the area of the concession (future exploration potential) and grant a huge water allotment to the mine. In moly they were able to cut out $30 MM, mainly through the AMAX merger.

Comments on individual Arizona mines:

Bagdad (f) Yavapai Co. A 1 billion ton resource of 0.38 Cu and 0.028 Mo exists. A new technology, a water flush crusher was installed that takes 20% of oversize for autogenous mill, water flushes fines to floatation circuit. This increased capacity from 75,000 to 80,000 ton per day.

Sierrita (f) Pima Co. CRU International rates Sierrita as the most efficient copper mine in the world and it operates at the lowest grade for a milling operation, 0.28%. A current experiment at Sierrita is a 50-50 joint venture between Cyprus and the vendor. It involves one set of high pressure rolls used for crushing. With it a higher percentage of fines go directly to float cells without grinding. It appears 40% of product may bypass the ball mills. The cost of maintenance on the rolls is still unknown and will be a deciding factor in their success.

Cyprus received $9 per pound for moly in the 2nd quarter of 95, resulting in a cash cost of producing copper of $.07 per pound. Sierrita has both an moly roaster as well as a leach circuit to remove copper from off specification concentrates.

Twin Buttes (f) Pima Co. Cyprus is studying Twin Buttes as underground mine but its iffy as it is high cost even with the high 1.75% Cu grades. Part of the problem is that the ore isn't compatible with the ore at Sierrita so it requires a separate circuit or its own mill.

Lakeshore (f) Pinal Co. Cyprus bought the property to get the roaster due to a worldwide shortage of smelting capacity at the time, now the roaster is shutdown. The property has a 600 MM ton leach resource at 0.5% Cu, but it has a high acid consumption. As an open pit heap leach it can produce 40 to 50 MM lb. per year but at a high cost. A feasibility study is underway to see if it remains a permanent producer.

Inspiration [aka Miami (f)] Gila Co. Cyprus bought the property to acquire the smelter and refinery. When first operated SRP was able to provide cheap electric rates for the electric furnace. When the electric went up Cyprus installed a ISA melt furnace that initially had problems with the off gases hood. A redesign of the hood making it vertical (less heat build up) and increasing the temperature and pressure of the cooling tubes was completed in February of 95 and there have been no further problems. A $280 MM was invested in ISA technology for the electrolytic refinery (annual capacity of 150 MM lb). It uses stainless steel starter sheets. The new technology results in a savings $.02 per pound at the refinery and overall the refinery is now about $.05 per pound cheaper than a custom facility.

Mineral Park (f) Mohave Co. Installed a portable SX-EW plant. In situ leach research project is underway.

USBM/Cyprus Mineral Park CLEAN Mining Cooperative Research Project

Clean Mining Research

The goal of the Advanced Mining research program within the U.S. Bureau of Mines is to develop CLEAN mine designs which reduce the environmental impacts of mining.

Bureau /Cyprus Coop Agreement

Cyprus Mineral Park and the US Bureau of Mines recently formed a cooperative agreement with the intention of developing a modified design for leaching on the Mineral Park property which will reduce surface disturbance through blasting, and acidic drainage from disturbed sulfide waste.

The Current Leaching Method at Mineral Park

The leaching method that is currently used at Mineral Park is referred to as Drill & Blast leaching. With this method , bore holes are drilled into the chalcocite copper ore. The bore holes are loaded with explosives, and the ore is rubblized by blasting. Acidic ferric sulfate leach solution is applied to the rubblized ore using a network of sprinklers. Leach solution infiltrates the rubblized ore and is recovered from adjacent pits.

A Modified Design for Leaching at Mineral Park

A slight variation on this design involves drilling bore holes into the ore prior to leaching, but does not involve blasting and rubblization. Instead, the bore holes are used to distribute the ferric sulfate leach solution. Leach solution is also recovered using the bore holes.

The Clean Mining Advantage

The modified design would have two advantages for the Mineral Park site. First, it would reduce ground and surface disturbance in preparation of leach dumps at the site. And, second, it would reduce the acid producing potential of the site, since without blasting, the reactive sulfide surface area is minimized, and since sulfide minerals which currently reside below the water table in an anoxic state, would remain permanently below the water table when mining is complete.

The Pilot Test Site

To demonstrate the environmental and economic advantages of this modified design, the Bureau of Mines and Cyprus Mineral Park have agreed to conduct a small pilot scale test on the Mineral Park Mine property. The test site, which would otherwise be leached using the drill and blast method, is located at the edge of a large open pit excavation , known as Ithaca Pit.

Topographic location of test site

Figure 1 is topographic map of the Mineral Park mine site showing the location of the test site relative to Ithaca Pit. The test site is approximately 400 feet square and is located 350 ft from the southern edge of Ithaca Pit. To date, seven bore holes have been drilled on the test site.

Cross section of the test site

Figure 2 is a north-south cross section through the middle of the test site (A-A' in Figure 1) It shows the elevation of the chalcocite copper ore zone relative to Ithaca Pit which is north of the site and Turquoise Mountain which is south of the site. Figure 2 also shows the location of boreholes and the elevation of the ground water table. The chalcocite ore lies between 70 and 190 feet beneath the surface of the test site. The bottom of the Chalcocite ore is about even with the water level in Ithaca Pit.

Note that almost all of the sulfide ore (chalcocite and chalcopyrite) is below the water table. The weathered oxide cap above the water table is rich in iron oxide minerals which have replaced pyrite and other sulfides.

Natural Ground water gradient at the test site

Considering the test sites proximity to Ithaca Pit, it is not surprising to observe a relatively steep natural ground water gradient in figure 2. The "apparent" ground water flow gradient was estimated, using nine different combinations of bore hole head measurements. The steepest head gradient across the well pattern is oriented from N30E to N40E. The head gradient (vertical drop/horizontal distance) in this direction is approximately 0.14 to 1.0, i.e. for every horizontal foot in this direction , the water table declines 0.14 foot. Since the Ithaca Pit bottom (elevation 4110) lies between N27E and N47E from the test site (see figure 1), the direction of ground water flow at the test site is without question directly toward the pit.

Ground water gradient beneath Ithaca Pit

In order to determine if an upward or downward ground water gradient exists beneath Ithaca Pit, (below 4100 ft elev.) a 100 foot deep bore hole was drilled near the bottom of Ithaca Pit just north of the test site. (collar elev. 4166 ft). The bore hole location is shown in figure 2.

A single packer was positioned in the bore hole, first at a depth of 47 ft and then at 83 ft from the surface and inflated. The water level above and below the packer was then monitored until it stabilized.

The results of the packer test are shown in figure 3. In both the 47 ft and the 83 ft tests, the pressure head above the packer remained unchanged after the packer was inflated. In the 83 ft test the pressure head below the also returned to the origninal level (i.e. 4141 ft which is essentially the water level elevation in Ithaca Pit). Tis shows that there is no vertical hydraulic gradient (either upward or downward) at this depth .

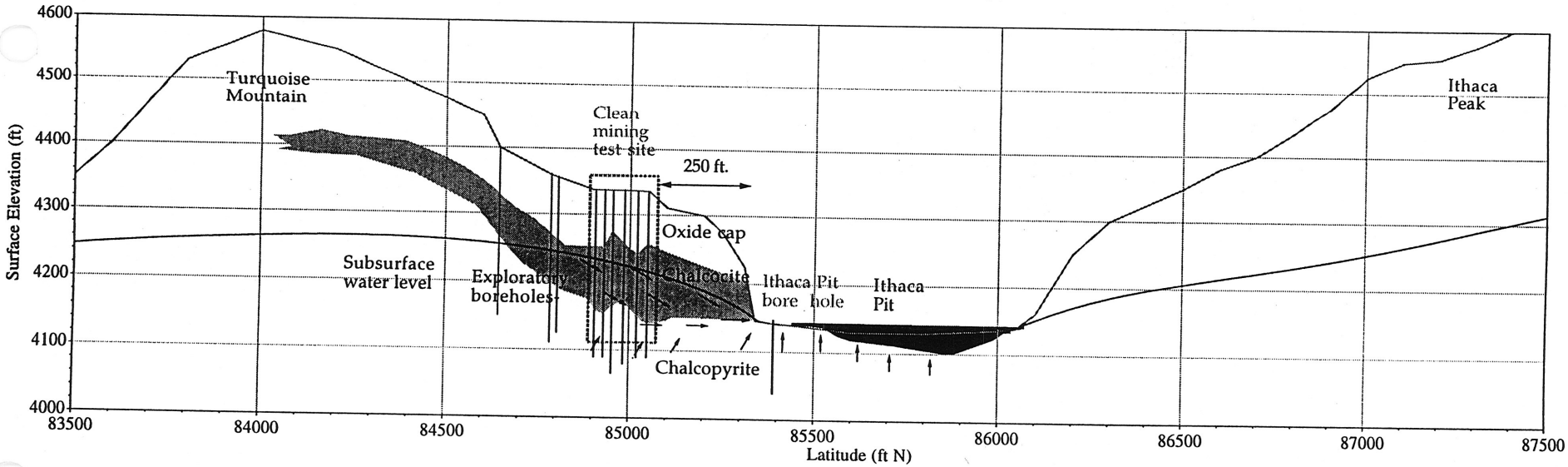


Figure 2. Bureau Test Site , A-A' Cross Section between Turquoise Mountain and Ithaca Pit

When the packer was positioned at a depth of 47 ft. (approx. 10 ft below the pit bottom) an elevated head condition was observed below the packer, while the head condition above the packer remained unchanged. The elevated head below the packer shows that the direction of ground water flow just below the pit bottom is upward. Ithaca pit is being recharged by natural ground water at this location. There is no evidence that Ithaca Pit is discharging into the ground water system at this location.

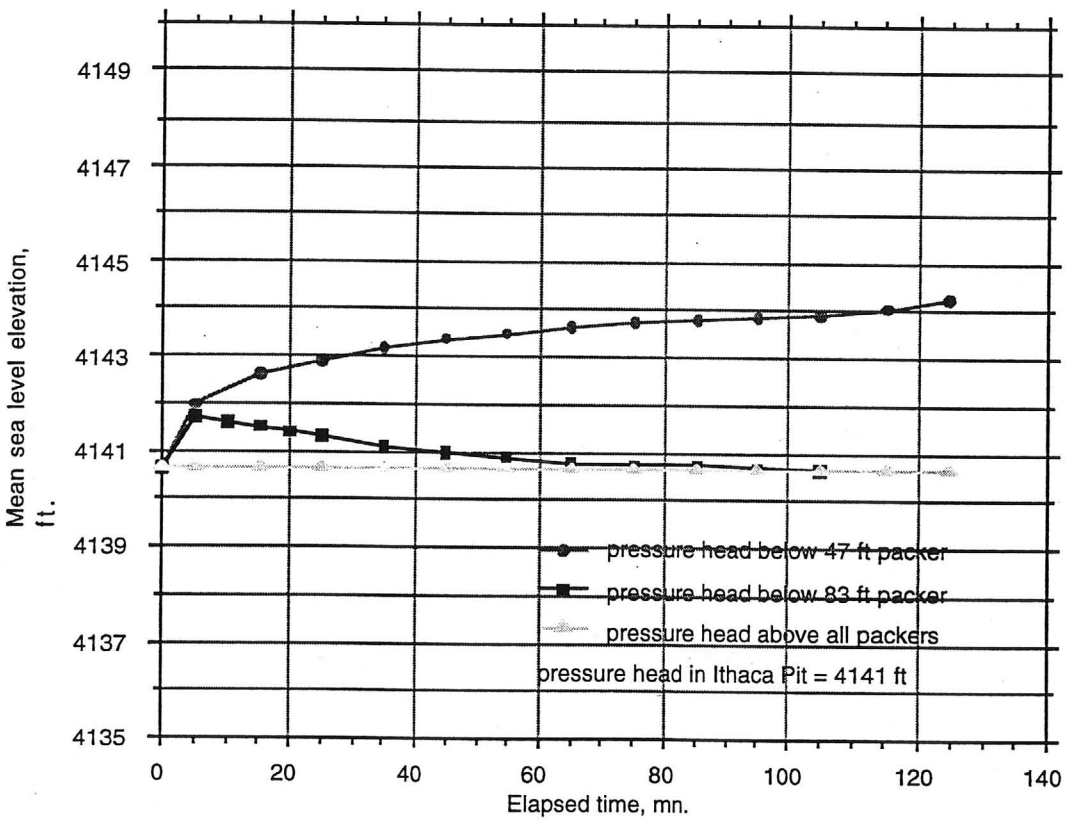


figure 3 Ground water head conditions beneath Ithaca Pit

Natural Ground water quality at the test site.

Comprehensive chemical analysis of ground water samples collected during the well pump tests are summarized in Table 1. In conformity with the Arizona DEQ Quality Assurance Project Plan (1991), 3 bore hole volumes were purged from bore holes A-3, E1, E2, and W2 prior to collecting samples for analysis.

All samples were filtered through a 0.2 micron filter within 1 hour of collection and sample splits were acidified with nitric acid within 12 hours of

collection. Comprehensive analyses were then performed at the U.S. Bureau of Mines TCRC laboratory. In addition, the pH, temperature, Eh, dissolved oxygen content, and conductivity of the sample were determined in the field within one hour of collecting the sample. The results of these analyses are provided in Table 1.

Table 1. Turquoise Mountain ground water analyses. Date Collected: 12/7/93 -10/1/94.

Field Analysis				
Sample	A-3	E1	E2	W2
pH	6.51	6.59	6.67	6.65
Eh, mV	274	260	269	215
Cond, mS/cm	3.35	3.15	3.26	3.37
D.O2, ppm	.6	3.20	0.90	2.22
T, degC	20.2	20.9	17.6	20.0

TCRC Chemistry Lab Analyses (units = ppm)				
Sample	A-3	E1	E2	W2
Cl-	63.2	42.8	49.2	107.7
F-	3.1	2.5	2.4	3.9
Si	25.7	23.1	23.3	24.8
Mn	4.0	2.6	3.9	3.7
Fe	8.2	11.3	11.3	9.6
SO4	1972	1946	1976	2087
Ca	750	689	717	761
Mg	128	123	125	152
K	13.0	13.1	13.0	13.3
Na	76.7	71.8	78.4	99.7
TDS	3044	2925	3000	3263

The quality of the ground water beneath Turquoise. Mtn. is not suitable for drinking with respect to USEPA inorganic drinking water standards. The total dissolved solids (TDS) levels are about 2900 to 3330 ppm, which is higher than the secondary, drinking water standard limit of 500 ppm. The concentrations of Fe, Mn, and SO_4 also exceed the secondary limits in all samples. Most importantly, the concentration of F in all samples is very close to the primary drinking water standard limit of 4 ppm, and these concentrations exceeds the secondary level of 0.3 by an order of magnitude.

Mass balance analysis of the acidic mine waters and the ground water beneath Turquoise Mountain suggests that mixing of leach solution and ground water does not occur to a significant degree except in Ithaca Pit. This can be attributed to dilution by high volumes of surface and ground water which discharge into the pit. These results are totally consistent with the results of packer tests conducted beneath Ithaca Pit.

Production at Mineral Park, Mohave Co. — ADMMR Compilation

Cyprus acquired the property from Duval in April 1, 1986. Property produced significant amounts of molybdenum during years concentrator was active.

Year	Ore (Tons)	Copper in Concentrate (pounds)	Leach Copper* (pounds)	Reported from dumps (pounds)
1965	4,600,426	36,618,689	1,483,888	
1966	5,559,094	46,294,180	4,836,610	
1967	5,687,478	47,282,120	7,004,597	
1968	6,226,284	50,357,689	7,051,189	
1969	6,030,700	51,219,897	6,221,380	
1970	5,951,896	46,699,924	7,709,843	
1971	5,645,080	43,495,519	7,315,234	
1972	6,975,594	44,181,863	8,935,811	
1973	6,754,708	40,920,576	6,431,410	
1974	6,379,877	32,535,537	6,801,301	
1975	5,573,875	27,472,411	6,915,000	
1976	4,726,075	19,498,473	6,817,000	
1977	5,960,235	25,022,050	5,260,000	
1978	6,427,450	25,539,227	4,813,000	
1979	6,321,305	22,187,904	3,348,000	
1980	6,258,100	25,294,199	3,690,000	
1981	6,284,936	29,892,180	4,194,000	
1982			3,191,000	
1983			3,101,000	
1984			2,718,000	
1985			3,798,000	
1986			4,251,000	
1987			4,405,000	
1988			4,500,000	
1989			3,338,000	1,812,000
1990			4,000,000	2,000,000
1991			3,800,000	2,800,000
1992			4,000,000	2,000,000
1993			3,600,000	2,000,000
1994			248,000	248,000
1995			3,339,000	3,339,000
Total	101,363,113	614,512,438	147,117,263	14,199,000

* SX-EW plant replaced precipitation in 1995.

* Leach from in-situ (rubblelized pit slopes and in pit blasting) and dump leach in 1988 through 1993. In 1994 -1995 all production reported as from dumps, but its likely in-situ was not separated.

Preliminary Ground water Modeling Results

A hydrologic model of the shallow ground water flow system that exists in weathered bedrock of the Mineral Park mine property, to the west of the Cerbat Mountains and to the east of the Sacramento Valley has been developed by the Bureau. The model will utimately represent shallow subsurface flow on the mine-scale and the test site-scale of measurement, as indicated in figure 4. Although the model has been calibrated on the test site scale, it is not completely calibrated on the mine-scale of measurement.

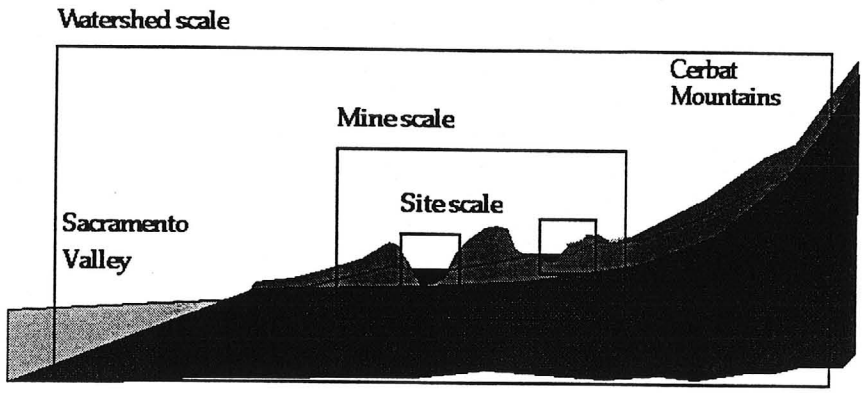


Figure 4 Mineral Park scale of ground water modeling

Figure 5 is the mine-scale piezometric head contour for Mineral Park that was generated using this model. The head contour is superimposed on a USGS 7.5 minute quadrangle topo. map of the area. (The USGS map predates much of the current mine development). Annotated on the contour map is the boundary of Ithaca Pit the test site and other mine features.

The model describes shallow subsurface flow in a 25000′ x 25000′ (7.6 km x 7.6 km) area which is roughly the Mineral Park property, to a depth of 220 feet. The area is bounded on the east by peaks of Cerbat Mountains which contribute to a natural east-to-west hydraulic gradient toward the SSW-flowing Sacramento alluvial basin.

Mining-hydrologic features such as Ithaca, Gross and Central Pits, and the various leach dumps are included in this model explicitly, as both flow and head specified hydrologic boundaries. The model provides for several possible exit points for ground water leaving the weathered bedrock and entering the alluvial basin. These include Ithaca pit, the tailings impoundment, Mineral Park Wash , Bismark Wash, and two other unnamed washes located west of the mine property.

Nevertheless, figure 5 shows that west of the Mineral Park property where the weathered bedrock outcrops, the piezometric elevation drops to the base elevation of the weathered cap. This hydrologic boundary has not yet been

calibrated against field measurements. While this piezometric boundary exists on the western edge of the property its exact location is not yet known.

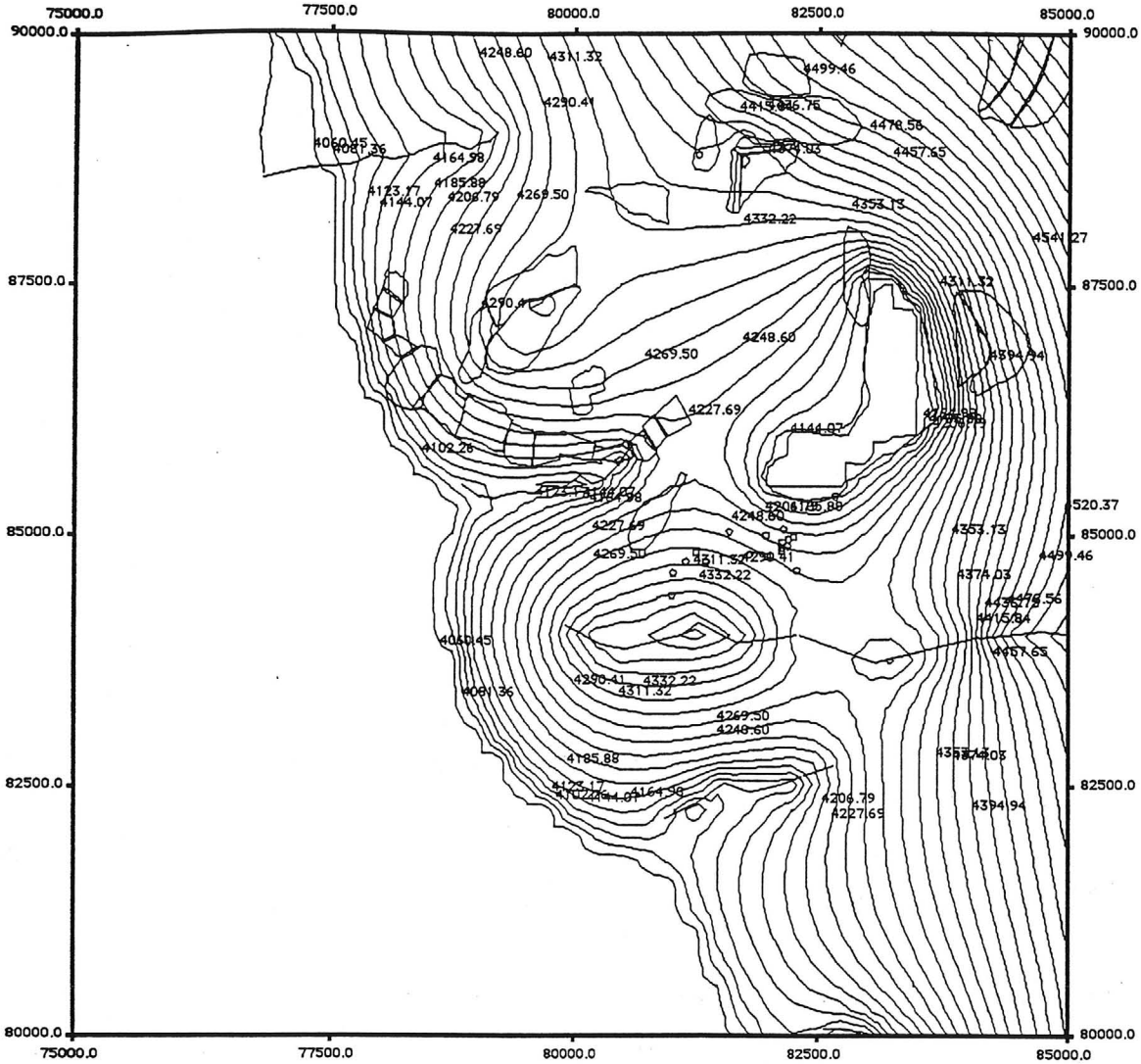


Figure 5 Mineral Park bedrock flow model (uncalibrated)

This model can be used to determine flow paths for leach solution infiltrating from dumps and heaps, it is possible to calculate discharge vectors and flow paths for natural ground water, although it is not yet possible to determine flow velocity or travel time along these paths.

Figure 6 shows the flow paths (and head contours) generated by the model in the area of Central dump and Central Pit. Some of the path lines terminate in Cental Pit others continue south to Ithaca Pit. Two hydrologic parameters , need to be measured in the field before this model can be used to determine

flow rate and travel time along these paths. These parameters are effective porosity of the bedrock and dispersivity coefficient.

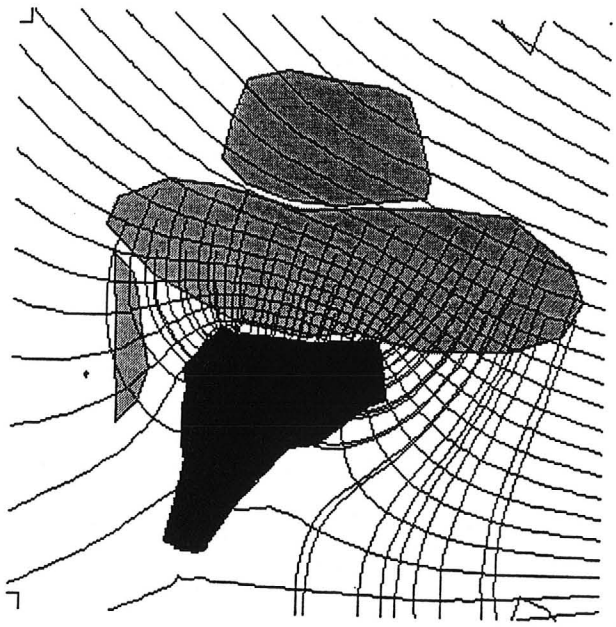


Figure 6. Flow path lines and head contours at Central Pit

Of particular modeling interest is the ground water movement in the vicinity of the Bureau test site. Figure 7 shows the head contours to the south and west of Ithaca Pit , which includes the Bureau test site. Seven flow lines originating at the locations of bore holes at the site, are generated in this figure. Figure 7 clearly shows that under the natural ground water gradient that exists, the direction of ground water flow is directly toward Ithaca Pit. This site-scale model is well calibrated with respect to ground water gradients and head conditions, however, once again, it is not possible to determine the flow velocity or the travel time from the site to the pit without measurement of effective porosity.

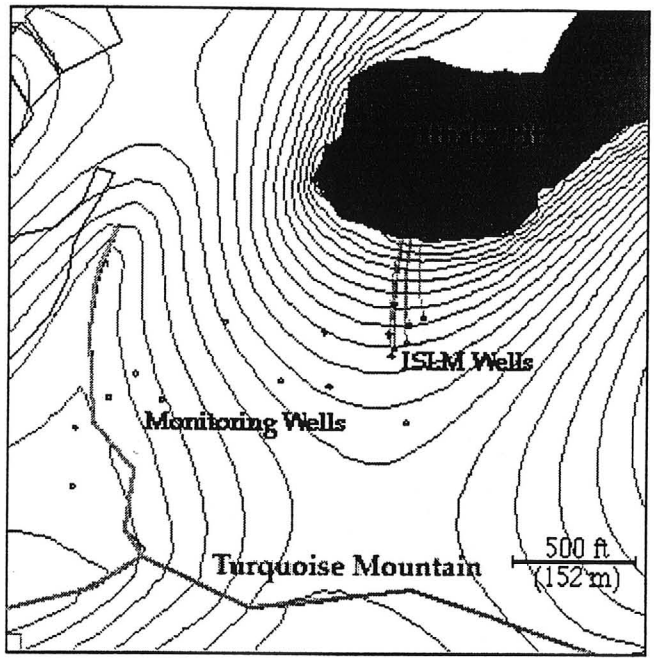


Figure 7 Flow path lines and head contours at the Ithaca Pit test site

The necessity for Tracer testing

Tracer testing will provide a means of measuring the two parameters that are critical for understanding the subsurface hydrology of the Mineral Park; effective porosity and dispersivity. Effective porosity is a measure of the pore volume of fractured rock which transmits ground water. Dispersivity is related to natural differences in ground water velocity caused by differences in fracture permeability. The complexity of the bedrock fracture flow setting is such that tracer testing is the only practical way of measuring these parameters.

Tracer testing will enable determination of;

1. the velocity and travel time of ground water constituents in the bedrock.

2. the extent to which spreading or dispersion of dissolved ground water constituents may occur from point sources within the bedrock.

3 realistic flow paths, and exit points by which dissolved ground water constituents might leave the bedrock flow regime and enter the alluvial basin aquifer to the west of the property.

Tracers and Tracer Test Procedures

The tracer tests will be conducted in shallow bore holes at the Bureau of Mines test site near Ithaca Pit, and in a single bore hole just north of the test site at the bottom of Ithaca Pit.

Two standard hydrologic tracers will be used, potassium bromide, and micron sized, latex plastic beads. Bromide is the most commonly employed anionic tracer used in hydrologic studies. It is inert, conservative, and has been recognized in EPA documents (Ground Water Tracers, Davis, Campell et al, 1985) as posing no environmental or health risks. MCL levels for Br^- do not show up on the USEPA primary or secondary inorganic drinking water standards. IC analysis of ground water samples from the test site showed that natural Br^- concentrations are less than 1 ppm. The relatively benign and conservative chemical character of Br^- make it the tracer ion of choice in hydrologic studies of ground water regimes.

The background concentration of bromide in the groundwater (and in Ithaca Pit water) is between .5 and 1.1 mg/ltr. The potassium concentration in the ground waters is about 12-13 ppm. Even relatively high concentrations of K in drinking water are generally not considered to be a threat to human health.

Very small latex microspheres (nominal diameter = 0.9 microns) will also be used to trace ground water flow. A latex bead tracer will help distinguish fracture porosity from inter granular porosity of the bedrock. Latex beads are totally inert and non-toxic. They are commonly used to assess the effectiveness of water filtration systems. The MSDS sheets for these two tracers are attached.

Tracer tests will be conducted using ground water that is pumped from bore holes at the test site. The tracers will be introduced as a slug in a single bore hole. The potassium bromide slug concentration will not exceed 500 mg/ltr. of water. The minimum detection level (above background) for bromide tracer is about 2 mg/ltr. The total amount of bromide tracer used in all tests at the site would not exceed 50 kilograms. Latex microspheres will be introduced in a bag containing 8.75 * 10^9 microspheres per ml of water .

Bromide tracer detection will be conducted using titration and ion specific electrodes. Latex bead detection will be conducted using a particle size analyzer.

Tracers will be introduced in a bore hole at the test site under three sets of hydrologic conditions

1) natural hydraulic gradient , (expected test duration 4-6 weeks)

2) an induced hydraulic gradient by pumping from one bore hole , (expected test duration 2 weeks)

3) above a packer while pumping from below the packer (expected test duration 4-8 hours).

Tracer testing is scheduled to begin at the end of January 1995. All tracer testing would be completed by October 1995.

Tracer Test Ground Water and Health Impact

Chemical and hydrologic evidence clearly shows that Ithaca Pit is not discharging into the bedrock system, rather just the opposite, that ground water from the bedrock is recharging Ithaca Pit. Because the ground water gradient which is recharging Ithaca Pit extends for several thousand feet around the pit, it is a virtual certainty that ground water tracers that are introduced at the test site less than 500 ft from the pit would flow directly into Ithaca Pit.

The quality of the natural ground water in the bedrock at Mineral Park is poor. It is below MCL primary and secondary standards and is not suitable for drinking.

The toxicity data for bromide reported by Dreisback (1955) and by Davis (et al 1985) showed that an adult would need to drink 6 liters of water containing 400 mg/ltr bromide in order to exceed the lower toxic limit for humans. This is virtually equivalent to drinking an entire tracer slug, undiluted.

Ithaca Pit contains between 250 and 300 million gallons of water (more than 1 billion liters). At present, the concentration of bromide in Ithaca pit water is close to 1. 0 mg/ltr. The maximum additional concentration of bromide in Ithaca Pit water that would result from use of 50 kg of bromide tracer at the test site is .05 mg/ltr .

Latex plastic beads are completely inert and non-toxic in any concentration.

EXECUTIVE SUMMARY
AQUIFER PROTECTION PERMIT NO. P - 100517

Facility Name

Equatorial Mineral Park

Regulatory Status

Post-it® Fax Note 7671	Date 3/25	# of pages ▶ 3
To DIANE BAIN	From DENNIS TURNER	
Co./Dept.	Co.	
Phone #	Phone # 207-4663	
Fax # 255-3777	Fax #	

The Mineral Park Mine is classified as an existing facility and has been operating under a Notice of Disposal Permit since 1985.

Facility Location

Equatorial Mineral Park, Inc. is authorized to operate the Mineral Park Mine and shall maintain technical and financial capability necessary to fully carry out the terms and conditions of this permit. The facility is located 16 miles north of Kingman, Arizona, Mohave County. It occupies a portion of section 19 of Township 23N, Range 17W and portions of Sections 24, 25, 26, 35, and 36 Township 23N and Range 18W of the Gila and Salt River baseline and meridian.

Latitude: 35° 22' 00" North
Longitude: 114° 08' 30" West

Facility Description

The Mineral Park Mine is an open pit copper mine utilizing a leaching process with recovery of copper from the leach solution through a solvent extraction-electrowinning (SX-EW) process. The facility is authorized to conduct dump leaching, in-situ leaching, and operate process solution ponds, stormwater runoff ponds, process pipelines, and ancillary maintenance operation facilities according to the design and operational plans approved by the Arizona Department of Environmental Quality (ADEQ), Water Permits Section.

Equatorial Mineral Park Incorporated (EMPI) is currently leaching the existing mine waste rock dumps, recently constructed dumps of blasted rock, and rock drilled and blasted in place around existing open pits with dilute sulfuric acid to recover copper. The pregnant leach solution (PLS) is collected and pumped to the SX plant where an organic solvent is added to extract the copper. The copper-rich feed solution is then pumped to the EW plant for electrowinning. The resulting cathodes are physically stripped of copper and the copper is shipped off-site for further processing. The residual solution (raffinate) is refortified with weak sulfuric acid and circulated back to the active leach areas.

Best Available Demonstrated Control Technology

The Mineral Park Mine relies on operational and hydrogeologic controls to demonstrate BADCT requirements and shall be operated to meet criteria as outlined in the *Final Draft, Arizona Mining*

BADCT Guidance Manual, (August, 1996). The mine shall also construct facility upgrades as outlined in Section 3.0, Compliance Schedule.

Monitoring Requirements

All monitoring required in this permit shall continue for the duration of the permit, regardless of the discharge or operational status of the facility.

The permittee shall collect and analyze a minimum of 8 quarterly groundwater samples to establish current water quality data for evaluating any long-term changes in groundwater quality in accordance with Section 4.0 of the individual Aquifer Protection Permit. Once the 8 quarterly groundwater samples have been completed, alert level concentrations will be calculated using an ADEQ approved methodology.

For each of the monitored analytes that are reasonably likely to be present in the discharge for which an Aquifer Water Quality Standard has been adopted, and for those analytes for which a numeric standard is adopted by rule at a future time, the Aquifer Quality Limit shall be established.

The point(s) of compliance designated for the Mineral Park Mine shall be located at monitor wells MW-2a, MW-5, MW-6, MW-19, and MW-20.

Compliance with Aquifer Water Quality Standards

The Mineral Park Mine will be operated to minimize discharge to the environment and to ensure that Aquifer Water Quality Standards are not violated at the point(s) of compliance. A comprehensive monitoring program has been set up to insure that no Aquifer Water Quality Standards will be exceeded at the point(s) of compliance.

A Remedial Action Plan (RAP) is included as part of this APP permit. The RAP shall consist of the number and identification of all wells to be monitored in the two distinct areas downgradient of the mine site where groundwater has been impacted by mining operations, the parameters to be monitored, the frequency of monitoring, and submittal dates for reports and time trend plots. The RAP shall also include all mitigation and remedial actions to be taken in the event of a possible threat to the water use of downgradient private well owners from the contaminated groundwater plume. Any violation of the RAP shall be a violation of this Aquifer Protection Permit.

Technical Capability

On the basis of prior mining activities and the Aquifer Protection Program application, Equatorial Mineral Park Inc., has demonstrated that their technical approach meets industry standards.

Equatorial Mineral Park Inc., has subcontracted with Montgomery Watson Americas, of Steamboat Springs, Colorado, formerly Terramatrix Environmental Consultants, to provide environmental consulting services under the direction of Mr. Mike Kondelis and Mr. Brian Henderson of Equatorial Mineral Park Inc.

Financial Capability

Equatorial Mineral Park Inc. has demonstrated to ADEQ that it can meet the financial capability requirements under A.R.S. § 49-243.N and A.A.C. R18-9-108.B.8. through a letter of fiduciary responsibility to Manny Sainz of ADEQ. In addition, Equatorial Mineral Park Inc. shall put into trust a total of $2,109,700.00 over a period of 10 years to cover all anticipated closure and post-closure costs

Zoning Requirements

Mine disturbances greater than 5 acres are exempt from zoning requirements pursuant to A.R.S. § 11-830.

INFORMATION FOR FILE

FILE: Mineral Park, Mohave County

Date: 8/28/95

BY: Diane Bain

Big Country Mining and Development Company, 2170 Northern Ave, Kingman, AZ 86401, phone 520-757-7711, reports they hold the contract for turquoise at Mineral Park. Mrs. Ford is the owner of the company. They sell both wholesale and retail, in-shop and mail order. They carry rough, slabs, beads and cabachons.

MINERAL PARK

MOHAVE COUNTY

NJN WR 8/19/88: Ed Barge of Colorado called and reported that the May, 1988 issue of Economic Geology discussed the structure of metallic zoning of the Ithica Peak porphyry at Mineral Park (file) Mohave County. The article has additional information for the other surrounding base and precious metal mines in the district.

Arizona Department of Mines and Mineral Resources

Verbal Information Summary

Mine: Mineral Park (f)
County: Mohave

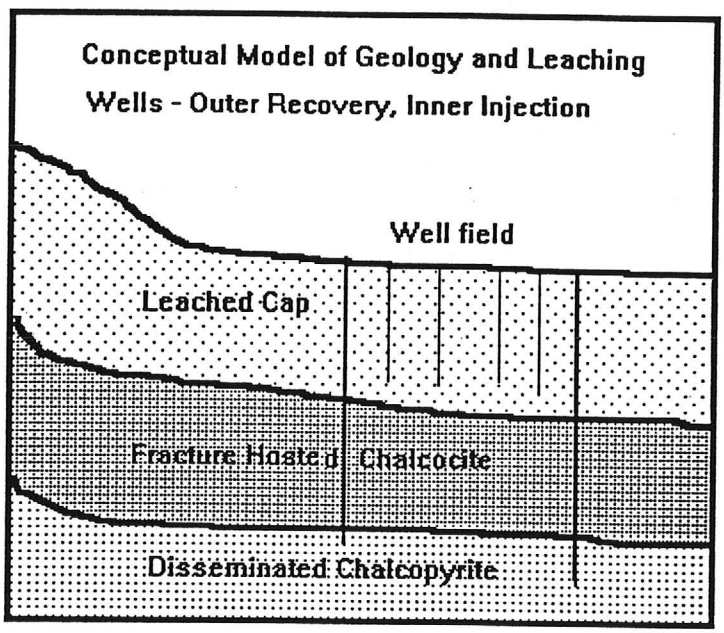
Date: March 1, 1995
Engineer: Nyal Niemuth

Summary of a talk titled "Update on in-situ leaching at Cyprus Mineral Park" by R.D. Schmidt, Mining Engineer with the U.S. Bureau of Mines Twin Cities Research Center at the U.S. Bureau Mines Copper Industry Briefing held at ADMMR's Office, February 28, 1995.

The research program involves the US Geological Survey, US Bureau of Mines and Cyprus Mineral Park. It was established about 1.5 years ago. The project is called "Characterization and design of in-situ leach operation in fracture hosted chalcocite at Mineral Park."

The property's main features consists of 3 pits: Ithica, Cross, and Central along with the Hardy dump. A solvent extraction - electrowinning plant was installed at the property in mid-1994 replacing the existing precipitation plant.

The US Geological Survey has conducted bore hole geophysics and video cammed fractures in the holes.



The proposed leaching system is "shallow injection, deep recovery". Injected leach solutions would be "flooded" on top of the fractured chalcocite and be recovered in the fractured and disseminated chalcopyrite as shown in the cartoon at left.

The mineralized fractures are steeply inclined . Some have clay associated with the fractures, how that will affect permeability is being assessed.

The project is expected to have 5 advantages. Among them long term acid rock drainage can be avoided, cost of drilling and blasting can be avoided, gossan supplies Fe^{+3} .

The deposit has 40 MM tons of deep reserves.

The property has a discharge permit now, and must submit an aquifer protection permit by October 1995. Project will use the US Bureau of Mines hydrologic model for the tracer test. All solutions not recovered if any should end up in the Ithica pit. So during the next few months the project will conduct the tracer test, test the bedrock flow model, and demonstrate fluid containment to the Ithica pit. The chalcopyrite zone will be geological characterized, fracture enhancement will be studied to see whether hydrofracturing or pellet injection will enhance the vertical component.

MINERAL PARK (f) MOHAVE CO.

On HML

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

Fife Symington, Governor   Edward Z. Fox, Director

NOTICE OF THE PRELIMINARY DECISION TO MODIFY A NOTICE OF DISPOSAL

Pursuant to Arizona Administrative Code, Title 18, Chapter 9, Article 1, the Director of the Arizona Department of Environmental Quality intends to modify a Notice of Disposal issued to the following applicant:

Public Notice No. 52-94AZAP
Mineral Park Mine
Cyprus Climax Metals Company
1501 W. Fountainhead Pkwy, Suite 290
P.O. Box 22015
Tempe, AZ 85285-2015

On or about: December 27, 1994

Eric Patanson –
602 565-2229
Bob Smidt – USBofM
612-725-4675 – He will send write up of the process.

The Cyprus Climax Metals Company - Mineral Park Mine located north of Kingman, Arizona, Mohave County, over groundwater of the Sacramento Valley groundwater basin in Township 23 N, Range 17/18 W, Sections 19,24,35, & 36 - Gila and Salt River Base Line and Meridian Latitude 35° 20' 30.00", North, Longitude 114° 10' 00.00" West.

The facility operates as an open pit copper mine and ore concentrator that utilizes pit wall and heap leaching for the extraction of copper minerals. The facility is operating under a Notice of Disposal and is currently preparing an Aquifer Protection Permit (APP) application for submittal in September 1995.

The facility is proposing to conduct a series of aquifer tracer tests to help evaluate the feasibility of changing the pit wall leaching process from a "drill & blast" technique to a variation utilizing drilling with no blasting or rubblization. The advantages of the new mining technique include: reduced surface disturbance in relation to site preparation and a reduction in future acid rock drainage potential.

The proposed tracer testing will consist of injecting water containing potassium bromide and micron sized latex beads into wells constructed in the existing open pit mine. The wells are located in an area that will be leached in the future. Tests will be conducted under 3 sets of hydraulic conditions: 1) natural hydraulic gradient, 2) induced hydraulic gradient by pumping from 1 bore hole, and 3) above a packer while pumping from below the packer. A total of no more than 30,000 gallons of water will be injected for all tests, which will be conducted over a several month period. Hydrologic information indicates that all injected water will be

recovered by the existing leaching process.

The technical materials are available for public review Monday through Friday 8:00 a.m. to 5:00 p.m. at the Arizona Department of Environmental Quality, 3033 N. Central Avenue, 4th Floor, Phoenix, AZ 85012

Persons may submit comments or request a public hearing on the proposed action, in writing, to Michael Wood, ADEQ, at 3033 N. Central Avenue, Phoenix, AZ 85012 within thirty (30) days from the date of this notice. Public hearing request must include the reason for such request.

For further information contact Michael Wood, Environmental Program Specialist, Aquifer Protect Permit Program, Arizona Department of Environmental Quality at (602) 207-4585.

HMCE M

Mineral Park Project
Mohave County

Bureau of Mines - Cyprus Mineral Park Cooperative Project
Revised planning schedule, January, 1994

Objective:
Develop and demonstrate a mining technology for economical and environmentally acceptable in situ chemical extraction of fracture-hosted Chalcocite ore at the Mineral Park Mine site.

Motivation:
The Bureau is seeking to develop more efficient mining methods that reduce the environmental impact associated with the long-term weathering of exposed sulfide-metal mine waste in dumps and heaps.

By incorporating in situ leaching technology into the development plans for the remaining reserves at Mineral Park, Bureau researchers estimate that only about 0.1 kilogram of sulfuric acid will be required per kilogram of copper produced, since the oxidation reaction with disseminated pyrite is minimized during in situ leaching of primarily fracture-hosted chalcocite ore. Most importantly, after in situ leaching ceases, the undisturbed anoxic environment of the deep ground water system will quickly be reestablished, slowing the rate of acid production from pyritic material to its natural background rate.

The Cyprus Minerals - Bureau cooperative work represents a significant opportunity for the Bureau to develop and demonstrate in situ mining technology and pollution prevention through joint hydrologic, geochemical, and geomechanical design of an in situ leach mining system in a fracture hosted copper sulfide ore deposit.

Three Year Time Table

1994 - Two major goals:

I. Conduct all hydrologic, geochemical, and geologic characterization, including fracture characterization, in existing seven-well pattern.

Focus on three areas of characterization...

A. Hydrologic Characterization

Objectives:

1. Determine natural hydraulic gradient in the ore zone (deep versus shallow and horizontal gradient).

2. Determine permeability profile in ore zone as a function of depth.

3. Determine hydraulic conductivity of individual fractures (compare mineralized versus unmineralized)

4. Measure horizontal and vertical anisotropy in permeability.

5. Measure fracture connectivity between wells.

B. Geochemical Characterization
Objectives:

1. Determine composition of natural ground water and variation in composition with depth.

2. Identify potentially problematic gangue mineral reactions, especially biotite-leach solution

reactions.

3. Determine chalcocite leaching kinetics under in situ leaching conditions and optimize leach solution system for fast Cu recovery.

4. Find ways to passivate or minimize adverse gangue mineral reactions during leaching.

C. Geologic (Mineralogical, Structural) and Geomechanical (Fracture) Characterization.

Objectives:

1. Determine composition, mineralogy, and texture of ore at test site

2. Quantify fracture orientation, density, distribution, tortuosity, and aperture.

3. Determine geologic structure, including fracture distribution, and the continuity of that structure between wells with crosshole electromagnetic and seismic tomography. (The geologic structures of contrasting electrical properties will be investigated with crosshole electromagnetic tomography, and the structures of contrasting seismic velocities will be investigated with crosshole seismic tomography. The electromagnetic and seismic methods are complementary; the two methods together will provide more complete and reliable results than either could alone.)

4. Determine large-scale subsurface geologic structure, including fractured regions, that could affect solution flow with surface seismic reflection surveys.

5. Continue development of geophysical methods for locating subsurface leach solution. (Method development will continue in the dumps near the seven-well area where electromagnetic induction was applied to determine the subsurface pattern of dump leach solution. Results were promising. This research will prepare for monitoring during injection.)

II. Resolve Arizona DEQ permitting issues for pilot scale test involving 10 to 12 wells at current test site.

Focus on demonstrating three things...

1. The proposed in situ leaching is hydrologically and geochemically identical to leaching operations currently being conducted in dumps under existing permit.

2. In situ leaching has potential for minimizing long-term exposure of acid-producing pyrite to oxidizing conditions, thereby reducing the need for costly long-term treatment, because pyritic material is left in its natural anoxic state below the water table.

3. Hydrogeologic conditions at the test site including its proximity to Ithaca Pit guarantee that all injected leach solution not recovered by wells will be recovered in Ithaca Pit.

1995 - Two Major Goals

I. Develop and test an ore zone conditioning procedure which selectively dilates the mineralized fractures in high grade secondary enrichment zone (between 70 and 175 feet).

Focus on two conditioning techniques...

1. Presplit blasting with conventional explosives aimed at generating precisely oriented fracture manifolds which cross-cut existing mineralized fracture planes and thereby provide greater

connectivity between mineralized fractures.

2. Hydrofracing techniques to dilate existing mineralized fractures in injection and recovery well bores, to enhance connectivity between existing mineralized fractures and the wellbore. The pattern of fracture dilation will be determined with passive seismic methods that sense the acoustic energy produced by induced fracturing.

II. Design a pilot scale test of an injection and recovery system for in situ leaching.

Focus on two design alternatives...

1. Push-Pull Design.
With this design, each well (completed in just the high-grade mineralized zone) is equipped with both injection and recovery capability. Because the enriched ore zone is comparatively shallow, this capability can be provided economically by two high-pressure pumps located on the surface. With suitable valving, the two pumps will serve all of the injection and recovery wells in the test pattern. One high-pressure pump will be used for injection of raffinate solution. The other will be used to recover PLS by driving jet pumps located in well bores.

With the push-pull design, each well will be operated on high-pressure injection for a period of time, followed by a low- pressure recovery for another period of time. The interval of injection and recovery will be customized for each well, based on continuous monitoring of five key hydrologic and geochemical variables. These are:

1. well flow rate (injection or recovery mode)
2. well pressure head (water level mode)
3. pH change in solution (in recovery mode)
4. copper grade in solution (in recovery mode)
5. Eh (i.e. Fe^{+3}/Fe^{+2} ratio) and dissolved oxygen concentration in solution (in recovery mode)

Collectively, these variables will indicate the transport and reaction rate of leach solutions with copper and gangue minerals in the ore zone and will provide a means of identifying an optimal time frame for injection and recovery operation in each well.

To give the operator sufficient flexibility to manipulate leaching conditions by controlling well flow rates and pressure conditions, a test of the push-pull scheme requires more wells then a well-to-well scheme. Bureau researchers estimate that at least 12 wells would be required for a pilot scale leaching test that would begin in a push-pull operating mode.

2. Shallow injection-deep recovery design

A second alternative for injection and recovery of leach solution, referred to as shallow injection-deep recovery, is a modified well-to-well design. Acid-augmented raffinate leach solution would be injected at an elevated temperature, (40-50^{o}C) into the leached cap (gossan zone) at the top of the enrichment zone and recovered from below the enrichment zone.

Because of the higher permeability and unsaturated condition of the leached cap, solution will spread laterally from the well bore more easily in the gossan than in the enrichment zone. In addition, the pH of the solution would remain low and the Fe^{+3} would remain high, as a result of the solution reaction with remnant pyrite and iron oxides in the gossan. The leach solution would follow fracture pathways through the enrichment zone that are steeply inclined, reacting with fracture hosted chalcocite. The natural downward hydraulic gradient that exists in this shallow ground water system would be enhanced by deep well pumping from below the enrichment blanket. At depth, a naturally occurring

upward ground water gradient prevents PLS from migrating below the level of recovery wells.

Chalcocite leaching rates are maximized by ensuring that the majority of the accessible copper would be recovered before adverse gangue reactions degraded the leach solution.

1996 - One major goal

Implement a pilot scale test of injection recovery design involving a minimum of 12 wells. Monitor results.

Focus on pilot site physical plant for pilot test..

Bring 220 volt electrical power to the test site.

Drill 5 to 10 additional wells

Apply selective conditioning procedures in wells.

Install two high-pressure pumps for injection and recovery

Install piping for injection and recovery of leach solution.

A pipeline to bring Gross pit leach solution to the test site for mixing with the concentrated sulfuric acid to the desired strength (~200 g/l) plus associated valving and plumbing for mixing the two reservoirs.

Extra black pipe for construction of a south-facing salient of leach solution-bearing pipe to employ solar heating. A special "berm" might be needed for this task.

Install real-time data acquisition system for hydrologic and geochemical monitoring. During injection, determine the pattern of flow of leach solution between wells with geophysical techniques, probably crosshole electromagnetic tomography and electromagnetic induction.

Operate the site for at least 6 months.

STATE MINE INSPECTOR
SEP 27 1988

MIN-MK PARK (f)

Cyprus Mineral Park Corporation
An Affiliate of Cyprus Minerals Company

Post Office Box 6249
Kingman, Arizona 86402
Telephone: (602) 565-2226

SEP 1 : 1988

September 14, 1988

Arizona State Mine Inspector
1624 West Adams, Room 208
Phoenix, AZ 85007

Gentlemen:

This letter is to inform the State Mine Inspector's office that we have signed a five-year contract with a mining company out of Beaver, Utah to remove Turquoise from the Cyprus Mineral Park property.

The company is:

Big Country Mining and
Development Corporation
P. O. Box 848
Beaver, UT 84713

The proprietors, Steve Maycock and Eddie Bradshaw, may be reached locally at the following address:

Big Country Mining and
Development Corporation
c/o John E. Bradshaw
1830 Golden Gate
Kingman, AZ 86401
(602) 753-5137

Big Country Mining currently holds MSHA ID No. 02-02452. They plan to begin mining in the very near future. If there is any other information which you require, please let us know.

Very truly yours,

CYPRUS MINERAL PARK CORPORATION

Kevin M. Kenney

Kevin M. Kenney
Plant Superintendent

rah

CYPRUS

Namm
9-28-88

BIG COUNTRY MIN[illegible]
& DEVELOPMENT CORP.
[redacted]
1830 Golden Gate Road
Kingman, Arizona 86402

Sept, 19, 1988

LEHER OF INTENT

DEAR SIRS

OUR MINE will be AN OPEN PIT TURQUOISE OPERATION.
WE REQUEST A ~~START UP PACKAGE~~ FROM YOUR OFFICE.
OUR PROPOSED START UP DATE will be SEPT, 27, 1988.

WE APPRECIATE YOUR INFORMATION, AND HOPE TO HAVE AN EXCELLENT WORKING RELATIONSHIP WITH YOUR OFFICE.

THANK YOU.
Steve Maycock (PRES. BCM.)

IN CHARGE OF OPERATIONS & SAFETY:

JOHN E BRADSHAW.
STEVE MAYCOCK.

MINERAL PARK (C)

Cyprus Mineral Park Corporation
An Affiliate of Cyprus Minerals Company

Post Office Box 6249
Kingman, Arizona 86402
Telephone: (602) 565-2226

NOV 16 1987

November 13, 1987

Mr. Jim Matt, Deputy
Arizona State Mine Inspector
1624 West Adams, Room 208
Phoenix, AZ 85007

Dear Mr. Matt:

Pursuant to our recent telephone notification, we would like to take this opportunity to remind you that Cyprus Mineral Park Corporation is conducting a small drilling and blasting program to prepare areas for in-situ leaching. The work will be performed by qualified Cyprus personnel.

We will notify your office upon completion of the project, which is expected to be sometime in the second quarter of 1988.

Sincerely,

CYPRUS MINERAL PARK CORPORATION

P. K. Medhi
Resident Manager

rah

xc: Joe Mortimer
Dwayne Pergrem

CYPRUS

MINERAL PARK MOHAVE COUNTY

NJN WR 4/3/87: Phil Blacet, geologist for Cyprus Mines Corp, (file) reports that Ronna Medhi is the new manager at Cyprus' Mineral Park (file) Mohave County. They are considering drilling and shooting some of the high walls and perhaps some of the rich areas in the pit in an effort to increase leach copper production. Over the last year Cyprus did conduct limited evaluation for precious metals in the district and completed 3 diamond and 7 reverse circulation holes on the Mineral Park property.

NJN WR 7/24/87: Phil Blacet (card) geologist with Cyprus Bagdad (file) reprots that Cyprus has conducted some drilling in the Alum Wash area (Mineral Park Mine (file) Mohave County but their fill in drilling indicated aht a continuous, thick calcite blanket is not there as Duval's data had indicated.

NJN WR 7/31/87: Chuck Benson (card) reported that Southwest Energy (no card) is planning a large blast at Mineral Park (file) Mohave County to expand copper leach production there.

MG WR 9/25/87: Mr. P. K. (Rhana) Medhi, Manager at Cyprus Mineral Park, reports he is trying to expand production at Mineral Park (file) Mohave County. May do some controlled blasting in oxidized zones and leach ore in place; collect pregnant solutions in bottom of pit and pump to a proposed SX-EW plant.

MG WR 9/25/87: Mr. P.K. (Rhana) Medhi, Manager at Cyprus Mineral Park, reports he has requested bids to mine turquoise at Mineral Park (file) Mohave County. He thinks there will be bidders other than Hardy Turquoise.

MG WR 10/3/87: Mr. P.K. (Rhana) Medi reports that while he does want to expand production at Mineral Park (file) Mohave County, he will not convert the copper recovery method from cementation to solvent extraction. He will continue to produce cement copper.

NJN WR 11/27/87: Joe Orlando of Hardy Turquoise (card) reports that they quit mining turquoise at Mineral Park (file) Mohave County in early 1987. No one is currently mining turquoise at Mineral Park.

ACTIVE MINE FILE
DI
MINERAL PARK DIVISION

DUVAL CORPORATION

4715 EAST FORT LOWELL ROAD • TUCSON, ARIZONA 85712 • (602) 881-6200

JAN 18 1984

START

January 17, 1984

Mr. James H. McCutchan
State Inspector of Mines
705 Capitol Tower
Phoenix, Arizona 85007

Dear Jim:

This is to update your office on the status of our Mineral Park operation, located in Mohave County, Arizona.

We presently employ 28 persons at that location, 9 of which are hourly employees. The property continues on a care and maintenance status with the only recovery of minerals being our operation of copper leach dumps and precipitation plant. Mr. Hardy, a contractor, continues to recover some turquoise from a small area of the mine.

Mr. George P. Boone is the senior company official in charge of the Mineral Park operation.

If you need any additional information, please contact me in Tucson.

Very truly yours,

N. C. Gonder

N. E. Gonder
Director of Safety

NEG/cfh

cc: G. P. Boone

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THE MINERAL PARK MINE

The Mineral Park mine is a porphyry copper-molybdenum deposit developed within and adjacent to a Laramide quartz monzonite porphyry stock which intrudes Precambrian rocks in northwestern Arizona. The Precambrian sequence consists of older, broadly folded metasedimentary and metavolcanic rocks which were intruded by a 1700-1800 m.y. old granite gneiss batholith. The contact between the two Precambrian terranes is a major structural element in the district and appears to have been important in localizing the Laramide intrusions and mineralization.

Alteration is defined by early pervasive biotitization of hornblende in the Precambrian rocks and by recrystallization of rock biotite in the quartz monzonite porphyry. Pervasively biotitized rocks are crosscut first by biotite and then by K-feldspar veinlets. Fracture-controlled, economic sulfide mineralization then began with quartz-molybdenite-K-feldspar-anhydrite and was followed by quartz-chalcopyrite-K-feldspar-anhydrite. This potassic alteration and accompanying mineralization occur throughout the deposit and are crosscut by later quartz-pyrite-sericite veinlets. Orientations of mineralized fractures evolved through time from EW during molybdenum mineralization to NW during quartz-pyrite-sericite mineralization. Fracture densities during

AGS 1984 Fall Field Trip, p 85

molybdenum mineralization averaged 0.05 cm^{-1} and increased to 0.14 cm^{-1} during quartz-pyrite-sericite mineralization. Sulfides were deposited from low salinity fluids (0.5 - 2.0 molal) in the temperature range 330°-360°C. High salinity fluids occurred only with quartz that was earlier than sulfide deposition. No homogenization temperatures greater than 440°C were observed.

Molybdenum mineralization cuts all rock types and defines a vertical cylinder with a distinct low-grade core. Ore grade molybdenum mineralization is equally distributed between Laramide and Precambrian rocks, and overall grade decreases with depth. Hypogene copper mineralization has a greater lateral distribution than molybdenum mineralization, and surrounds a low grade core coincident with the low grade molybdenum core. The distribution of alteration and mineralization assemblages and the fact that both of these features crosscut all exposed rock types suggest that copper-molybdenum mineralization was not temporally related to the quartz monzonite porphyry exposed in the mine area. The narrow range of homogenization temperatures observed and the lack of high homogenization temperatures compared with the results of computer modelled systems indicate formation of mineralization 2 to 3 km above a source intrusion. Because no evidence for boiling was observed, only minimum pressures of formation can be determined. Minimum pressures during sulfide deposition varied from 180 to 80 bars. These

pressures correspond to minimum depths of formation of 2 to 3 km which is in good agreement with an inferred depth of burial of approximately 3 km based on stratigraphy restored from the adjacent Colorado Plateau.

THE ALUM WASH PROSPECT

The Alum Wash prospect is a weakly mineralized porphyry copper occurrence in Precambrian rocks in northwestern Arizona. Located just north of the Mineral Park mine, it is genetically related to the mineralizing events that produced the copper and molybdenum mineralization at the mine.

The Precambrian terrane includes an older succession of folded metavolcanic and metasedimentary rocks intruded by a granite gneiss batholith. Localization of the mineralization was controlled by the Precambrian intrusive contact, premineral faulting, and the intrusion of Laramide dikes. Mineralized fractures are oriented N 30°-50° W, N 50°-80° E, east-west and north-south. The NNW to NW direction is the dominant orientation of mineralized fractures at Alum Wash.

Hypogene mineralization consists of an upper zone of quartz-pyrite-magnetite-chlorite-chalcopyrite veinlets and a lower zone of quartz-K-feldspar-molybdenite-anhydrite veinlets. Supergene processes have formed an enriched blanket with copper values between 0.15% and 1.50%. Continued erosion has modified the blanket, which, at present, is in the process of being weathered.

a AS. 1984 Fall Field Trip, p. 89

U. S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
"Public Lands for Public Needs"

Office of the State Director
3022 Federal Building
Phoenix, Arizona 85025
Ph: 261-3873

FOR RELEASE: THURSDAY, JULY 14, 1966

BLM PATENT GIVES BOOST TO COPPER INDUSTRY

One of the largest single mining patents for multiple lode copper claims was issued today by the U. S. Bureau of Land Management to the Duval Corporation.

According to BLM Arizona Director Fred J. Weiler, 56 mining claims are included. The 961-acre patent is located in the "Mineral Park" district approximately 17 miles northwest of Kingman in the Cerbat Mountains. It is called the "Ithaca Mine".

This area had been a rich lead, zinc and copper producing region in early years, with considerable mining activity before the turn of the century.

The Duval Corporation has been mining the area since 1959, and applied for a mineral patent in 1964. It is estimated that 12,000 tons of copper ore are being mined each day.

"It is noteworthy that 54% of the nation's copper and 18% of the free world's copper production comes from Arizona. Mining, therefore, represents a key part of our state's economy", Weiler said.

(more)

He pointed out that the Duval patent is an outstanding example of the Bureau of Land Management's aid to private industry to further mining and resources development.

"Patents give assurance of titles to mineral lands not afforded by unpatented mining locations. This encourages private enterprise to invest large sums in the development of new mines. Such investments assure the continued growth and economic stability of our state", he continued.

New properties such as the "Ithaca Mine" help to assure Arizona's continued leadership in copper production. Further explorations to locate new ore deposits in the region are planned, according to company officials.

-30-

DUVAL CORPORATION

MINERAL PARK PROPERTY

KINGMAN, ARIZONA

DESCRIPTION OF DUVAL'S MINERAL PARK CONCENTRATOR

PRESENTED BEFORE THE

MINERAL DRESSING DIVISION, ARIZONA SECTION, A.I.M.E.

MAY 6, 1966

PREPARED BY

ANTHONY GOMEZ JR. - METALLURGIST

MINERAL PARK CONCENTRATOR - DUVAL CORPORATION

HISTORY

Mineral Park is located in Mohave County, Arizona, about 16 miles northwest of Kingman. It is situated on the western slope of the Cerbat Mountain Range in the Wallapai Mining District, which is about 10 miles long and 5 miles wide.

The earliest mining in the area was for turquoise by Aztec Indians 500 or more years ago. Crude stone hammers and other stone artifacts are still found in ancient trenches, adits, and other workings in turquoise Mountain.

In 1863, gold was discovered in the Cerbat Mountains; however, the camp of Mineral Park is not mentioned until 1870, when rich silver ore was found in the Keystone Mine. The richest ore in the district was produced from the Keystone Mine. It's production is reported to have totaled 3,000 ounces of gold, 450,000 ounces of silver, and small amounts of copper, lead and zinc.

News of the Keystone discovery brought prospectors and miners into Mineral Park from the mining camps of Utah, Nevada and Northern California. In 1876, Mineral Park had a population of 500 and had become the county seat. Soon a number of small mines were discovered and placed in operation. The principal metal values were gold and silver and most of the ore was shipped to the Selby smelter in San Francisco at a cost of $125.00 a ton. Some of the richer ores were shipped by mule drawn wagons to Hardyville on the Colorado River, then by steamer to Yuma, Arizona.

From there it was sent to San Francisco over the newly built Southern Pacific Railroad, and finally, by sailing vessel to Wales in Great Britian.

Declining silver prices in 1882 curtailed much of the mining activity around Mineral Park, although several small lead-zinc and copper properties continued to operate, almost continuously, as late as World War II. As metal prices declined, and high grade reserves were depleted, practically all of the operations in the district were forced to shut down. Only a few gem quality turquoise mining operations were able to continue.

The first drilling in the area was done in 1906-1907 by Calumet and Arizona on what is now known as Gross Peak. In 1948, another copper company drilled six holes in and around Ithaca Peak.

In October 1958, Duval Corporation began acquiring claims in the Mineral Park area and during the period from June 1959 to July 1962, 89 churn drill holes and 34 diamond drill holes were completed. This program outlined a crescent shaped porphyry-type copper-molybdenum ore body embracing Ithaca Peak.

An underground sampling program confirmed the continuity of the ore body and the samples taken from the raises checked the drill hole results. After the final feasibility and engineering studies were completed in late 1962, the decision was made to develop the property as an open pit mine with milling facilities to treat 12,000 tons per day.

Stripping operations commenced in January 1963. Construction of the concentrator and auxiliary facilities started in March 1963. The concentrator start-up and testing began in October, 1964, and the first concentrates were produced in early November 1964. By February, 1965, the designed 12,000 tons per day milling capacity was reached and the plant has been in production ever since and is currently milling 14,000 to 15,000 tons per day.

February 1966

B47

MINERAL PARK

MOHAVE COUNTY

NJN WR 4/20/84: It was reported that L. W. Hardy Co (c) turquoise operation continue at the Mineral Park Mine Mohave County despite the suspension of the molybdenum-copper operations by Duval there.

NJN WR 11/23/84: Luis Vega, geologist with Duval's Mineral Park (f) Mine Mohave County reported though the mine has been down for 2½ years, dump/leach precipitation production continues. Also Hardy's turquoise production continues. To the north of the present pit at an area called Alum Wash exploration has discovered 7 million tons of .3% Cu in a 200-300 thick enriched chalcocite blanket.

NJN WR 2/14/86: Joe Langlois, Mining Engineer for the State Department of Revenue reported that L.W. Hardy Co. continues to mine turquoise at Duval's Mineral Park Mine (f) Mohave Co. They are currently mining on the southwest side of Turquoise Hill and probably have enough reserves available to mine ±there for about 2 years.

NJN WR 4/18,25/86: Phil Blacet, geologist with Cyprus Bagdad called seeking information on the mining properties in the Mineral Park (f), formerly Duval, mine area, Mohave County. Cyprus mining is evaluating the possibility of expanding the copper leaching precipitation operation there. Some of the old mines might be valuable as additional sources of water.

NJN WR 6/6/86: Information for the Mineral Park Mine (f) Mohave Co: the new address to contact the mine is Cypress Mineral Park, P O Box 2649, Kingman, Arizona 86402. The phone remains the same at 565-2226. There is currently only temporary employees on the property on loan from Bagdad. Permanent employees will be hired at a later date.

NJN WR 11/7/86: Hardy Turquoise Company (c) reported that they have a turquoise mine agreement with Cyprus at the Mineral Park Mine (file) Mohave County. They currently have 3 miners working there.

MINERALOGY AND GEOLOGY

The Ithaca Peak ore body is a disseminated porphyry-type copper deposit. It consists of a stockwork or fractured mass of quartz monzonite and quartz porphyry. This stock intrudes precambrian schist, which is also fractured and mineralized. The ore mineralization consists predominantly of chalcocite and molybdenite. The chalcocite extensively replaced pre-existing chalcopyrite and coats nearly all pyrite. Minor amounts of sphalerite, argentiferous galena, covellite, as well as chalcopyrite are also contained in certain areas of the pit. Turquoise and minor copper sulfates are the only copper minerals in the shallow oxidized capping. Ferrimolybdite is also abundant in the capping. The gangue consists of quartz, sericite, and clay.

CRUSHING

Crushing of the ore utilizes conventional three stage crushing by a 48 x 77 primary gyratory crusher, followed by one 13 x 84 secondary cone crusher, and two 7 x 84 tertiary cone crushers, operating in closed circuit with vibrating screens. The crushers are equipped with hydraulically supported mantles to facilitate the the adjustment of the crusher settings while operating under load. These hydraulic installations are equipped with Duval designed instrumentation and automatic controls. Thus, the secondary-tertiary crusher circuit is subject to fully automatic control by setting the tertiary crusher at a desired product size and operating each crusher in the circuit at optimum capacity.

Ore is delivered from the mine to primary crusher by 65 ton end dump trucks. The ore is dumped directly on the crusher and the crushed ore, usually minus 8 inches, discharges onto a 72 x 16 inch apron feeder. The coarse crushed product is conveyed to a 35,000 ton live capacity open storage pile.

The coarse ore is drawn from the stock pile by 28 Jeffrey vibratory feeders each capable of feeding 0 to 200 tons per hour. It is then conveyed on 48" belts to the secondary crusher plant and the ore is weighed by a nuclear belt scale. The ore is fed to a 6 x 12 vibrating grizzley with 1-3/8" slots. The oversize from the grizzley is crushed by the secondary crusher and the undersize discharges on a 6' x 14' vibrating screen with 5/8" slots. The secondary crusher product discharges to another vibrating screen. The oversize from this screen joins the oversize from the first screen and is conveyed to the tertiary crushers, which are in closed circuit with vibrating screens. The circulating oversize material is returned to the tertiary crushers and the undersize joins the undersize from the first two screens on a 48" conveyor which takes it to a 10,500 ton live capacity fine ore bin in the mill where a Link Belt traveling tripper distributes it over the length of the bin.

The primary crusher has a design capacity of 1,500 tons per hour and operates 2 shifts a day six days a week. Design capacity of the secondary-tertiary circuit is 1,000 tons per hour. This provides for a 7 day week, 2 shift per day operation. Crusher and auxiliary equipment maintenance is performed on the off-shifts.

Each crushing plant has its own dust collecting system. The dust is recovered with centrifugal type rotoclone collectors with pick-up points also located in the fine ore bin and the wet grind feed belts.

WET GRINDING

Wet grinding operations, along with flotation, are performed in two mill sections that are metallurgically independent. Each section produces its own

final concentrate and tailings. This allows for competitive plant scale metallurgical testing.

Each grinding section consists of two grate discharge mills each in closed circuit with 20" cyclone classifiers. The mills are 20' diameter by 11' long and are powered by 1500 HP synchronous motors. These mills were designed as autogenous mills, using ore media instead of steel grinding media. Although the mills are capable of production in excess of their designed capacity as autogenous mills, additional tonnage capability was realized by using conventional steel media and the mills are presently operating as ball mills.

The mills reduce 80% minus 1/2" feed to a 80% minus 100 mesh product at 35-38% solids for flotation feed. Each mill is fed from four feeder chutes located under the mill fine ore bin. The belts for these chutes are driven by a variable speed motor that is controlled by the operator for making manual tonnage changes. These belts discharge into two gathering belts and then into the mill feed belt which passes through a nuclear belt scale and discharges into the mill feed spout. The mill feed rate is subject to automatic control by utilizing the power draught of the mill, which is measured continuously. The mill speeds are 65% of critical.

Total water addition to the grinding circuits is controlled by instruments. The water is divided between the mill feed spout and the mill discharge pump sump to maintain the desired mill discharge pump density.

The ball mill discharge is delivered to the cyclones by a 12 x 10 Denver SRL pump or a 10" Wilfley. These pumps are used interchangeably. The cyclone and pump arrangement was engineered for minimum head. The cyclones are mounted with their axis 15 degrees from horizontal, and the underflow discharges are oriented toward the mill feed spout. The cyclone overflows are gathered together

and discharged into a pipe that feeds the rougher flotation pulp distributor. The cyclones are equipped with 3" refrax apex inserts and 6-3/4" nihard vortex finders. The cyclone connections are victaulic couplings to allow for easy removal of individual cyclones for repairs.

Three of the mills are charged with 2" and $2\frac{1}{2}$" forged steel balls. The fourth mill is charged with $1\frac{1}{2}$" and $2\frac{1}{2}$" cast steel balls. The ball size feed ratio is 1 to 1 on all mills. Double wave chrome-moly shell liners are used. The feed head liners and discharge grates are also made of chrome-moly steel. Other wear parts are made of nihard or chrome-moly steel. Three mills have 3/8" discharge grate slots and one mill has $\frac{1}{2}$" slots.

FLOTATION

The two flotation sections are equipped with No. 24 Denver free flow cells with double froth overflows and froth paddles. The roughers are arranged in 14 parallel rows (banks) of 10 cells each in each flotation section. Each rougher bank is provided with Duval automatic pump level controls at each of three levels.

The tailings from the roughers are the final plant tailings and are flowed by gravity to the tailings thickener. The rougher flotation concentrate is advanced for up-grading and is first re-ground in two ball mills, one per section. The re-grind mills are 10' x 10' grate discharge mills charged with $1\frac{1}{2}$" cast steel balls, to grind to essentially all minus 200 mesh. Initially, the rougher concentrate is pumped to three 10" cyclone classifiers per mill. The underflow is fed to the re-grind mills and the overflow is pumped to a pump distributor for feeding to parallel rows of cleaning flotation cells.

The cleaner cells are arranged in 8 banks per section, and 4 cells per bank. Duval automatic pulp level controls are provided on each bank. Finished concen-

trate is produced in the first two cells. Concentrate from the last two is fed to re-cleaner cells for further cleaning. The cleaner rejects are returned to the primary grinding circuit as part of the automatically controlled dilution water.

Re-cleaning is accomplished in each section by two rows of 4 cells each. The re-cleaner rejects are returned to the cleaner feed and final copper-molybdenum concentrates are flowed to a 50' diameter thickener on each section.

Flotation reagents currently in use are: Potassium Amyl Xanthates and Reagent S-3302 as copper-molybdenum flotation collectors along with stove oil as the molybdenite promoter. MIBC is the frother. The reagents are fed by flowrators located on instrument and flotation control panels. Recorders provide a continuous and permanent record of reagent consumption. Flotation feed alkalinity, normally in the PH range of 11.5, is automatically controlled by instrument controlled addition of milk of lime to the grinding mill feed.

All the flotation products are sampled by automatic samplers. The mill feed is sampled manually by the operator.

TAILINGS DISPOSAL

The final plant tailings are thickened in 225' thickeners, one per section. Make-up water is added to the tailings thickener. The thickener overflow is used in the mill as process water. Thickener underflows are controlled manually by darts in spigot lines. The pulp density is maintained at 55% solid and the slurry flows by gravity through 15" transite pipe to the tailings dam. Where they are required, drop boxes are provided to maintain a line gradient of 0.8% to control pulp velocity.

The tailings line on the dam is maintained horizontal with 149 outlets spaced 39' apart provided for cyclone connections. The tailings dam is developed by raising an 8 foot berm with a 3/4 yard dragline using the coarse sands

deposited in front of the berm by cyclone classifiers. The cyclone overflow material is released 40 feet in front of the berm. After the sanding phase is completed, the tailings are released without classification at a high volume flow rate to permit transport of tailings as far beyond the dam as possible.

Water from the tailings collects at the end of the tailings disposal area and is diverted by channels following the natural contours to a pond or ditch. The reclaimed water is returned to the mill by a skid mounted pump with a suction hose.

CONCENTRATE HANDLING

The final copper-molybdenum concentrates are advanced to 50' diameter thickeners in each section. Thickener overflows join the mill water circuit and the combined underflows are pumped to the molybdenum recovery plant. The pulp density of the underflow is controlled by instrumentation.

Finished copper concentrate is the reject of the molybdenite rougher flotation. The concentrate is piped to one 60' diameter thickener. The underflow is pumped to one of two 8' x 10' four disc filters. One filter is used most of the time; however, the second one is maintained ready for use as required. The filtered concentrate cake is conveyed to a storage area, then loaded by front end loader into 25 ton trucks and hauled to the railroad siding in Kingman for shipment.

MOLYBDENUM RECOVERY

The thickened copper-molybdenum concentrates are pumped to the molybdenum recovery plant. After conditioning, the pulp is steamed and heated in a 6' 6" pressure vessel. The hot pulp leaving the steamer passes through heat exchang-

ers to transfer the heat to the cold pulp feeding the steamer. Instrumented controls are provided for the steaming operation.

The steamed pulp is cooled by dilution and conditioned with the flotation reagents and then pumped to flotation. Rougher flotation is conducted in two parallel banks of 10 Number 24 Denver flotation machines having double froth overflows and equipped with froth paddles. The pulp level in the cells is controlled automatically. Rougher tailing is the final copper concentrate. The rougher concentrate is piped to a 40' diameter thickener. Thickener underflow is fed to a 6" cyclone operating in closed circuit with a 5' x 6' ball mill. The cyclone overflow is pumped to the head cell of a 10 cell bank of cleaner flotation machines.

Single froth overflow flotation machines are used for cleaner flotation. The cleaner rejects are returned to the copper-molybdenum concentrate thickeners. All of the cleaner concentrate is pumped to the number five cell of a 10 cell bank of recleaning flotation machines. Cell-to-cell re-cleaning is provided with concentrates advancing to the number 1 cell in the bank, which produces the final molybdenite concentrate. Re-cleaner rejects are returned to the cyclone feed in the re-grind circuit.

Molybdenite concentrate is stored in a surge tank and pumped to a 4' x 4' drum filter. The filter cake discharges to a conveyor belt equipped with a load cell belt scale and fed into a 20 foot I.D. ten hearth roaster. The roasting operation is fully instrumented with hearth temperature recorder controllers, burner flame-out protection, draft controllers, and automatic lighting of pilot lights and burners. The roaster calcine discharge is passed through a hammer-mill to reduce lumps. The calcine is further purified by leaching. It is filtered, washed and finally dried in a 10 foot I.D. four hearth dryer. Purified molybdenum trioxide calcine is weighed and packaged in 55 gallon drums for shipment.

Reagents used in molybdenite flotation are: Sodium ferro cyanide as depressing agent, stove oil as collector, MIBC as frother, and sulfuric acid for PH adjustment.

REAGENTS

The reagents used in both plants and their amounts are shown in the table below.

TABLE I

COPPER-MOLY FLOTATION

REAGENT	LBS. PER TON ORE MILLED
Potassium Amyl Xanthate	0.006
S-3302	0.020
Stove Oil	0.050
M. I. B. C.	0.080
Lime	3.20
MOLY FLOTATION	
Sodium Ferro Cyanide	4.75
Stove Oil	0.75
M. I. B. C.	0.80
Sulfuric Acid	1.60

Mixing and storage of all reagents is performed in one building. Stove oil, MIBC, and concentrated sulfuric acid are stored outside the reagent building in steel tanks. Stove oil and MIBC are piped and gravity fed directly to points of use. Concentrated sulfuric acid is diluted before piping it to the feed points.

The xanthate and sodium ferro cyanide are mixed with water in tanks and gravity fed to the mill and points of use. Reagent S-3302 is fed from stock tanks in the reagent building.

Lime is purchased as pebble quick lime. It is slaked on day shift only in a 5 x 6 ball mill operating in closed circuit with a 24" spiral classifier. The slurry produced, 18% solides, is piped to two lime storage tanks and then circulated through the lime loop.

WATER AND POWER

Fresh water is pumped from five wells located about 14 miles southwest of Mineral Park. The water system is capable of delivering 3,000 gallons per minute into a 16" pipeline to two booster stations and then to a 46,000 gallon raw water terminal tank located on the mill site. It is then pumped to a 281,000 gallon head tank for distribution throughout the plant. A radio microwave system automatically operates the pumping system.

Reclaimed water from the thickeners is reconverted into pump sumps and then pumped to the points of use in the mill loop. Reclaim water from the tailings disposal dam is pumped to a 3,000,000 gallon concreted reservoir. Storage tank overflows are collected in this reservoir. The reservoir provides make-up water to the tailings thickener overflow for the mill loop.

Mine water and fire protection water is taken off the line from the terminal tank and the head tank.

Power to the plant is supplied by Citizena Utilities Company by a generating plant located at Mineral Park. Three phase alternating current is supplied at 4,160 volts and 60 cycles. The voltage is stepped down by transformers as required for distribution to the various circuits throughout the plant. The water field is supplied current directly from Davis Dam. The average power consumption for 1965 was 16.74 KWH per ton of ore milled.

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LABOR

Mill operations are under the supervision of the Mill Superintendent, assisted by a Mill Foreman. All of the mill operations are supervised each shift by a shift foreman.

Crusher and mill maintenance is performed by day crews from the Maintenance Department, except for routine repairs which are made by a shift mechanic. Also, an electrician and instrument technician are assigned to every shift.

Mill operating hourly rated personnel averaged 73 in 1965. This includes operators, sub-operators, and laborers.

METALLURGY

The principal recoverable minerals in the ore are chalcocite and molybdenite. Ore milled in 1965 averaged 0.460% total copper with .050% as acid soluble copper and .030% molybdenum. The ore is metallurgically classified as two types - monzonite and schist. Blending of the two types of ore is practiced whenever possible.

Daily laboratory analysis of all flotation and end products serve as means for quality control and metallurgical production statistics.

Typical metallurgical performance data are shown on Table II.

MINERAL PARK

MOHAVE

Went on to Duval Corp., Mineral Park operation where Mr. Boone and Mr. Teissere said that their supplies of explosives, diesel fuel and natural gas were becom ing increasingly short. They said the cost of explosives have increased almost 100% in a short period. Apparently amonium nitrate is being utilized more for fertilizer than for explosives. GW WR 11/7/73

Went to the Mineral Park operation of Duval Corp. and visited with Messrs. Boone & Teissere who said they were continuing to have difficulty obtaining explosives (prills) and diesel fuel. There is no new activity to their knowledge. GW WR 12/5/73

Visited with Ron Teissere at Duval Corp., Mineral Park operation. They were down temp. reconditioning the mill motor windings. He doesn't have a copy of the report on their drilling and testing of the perlite deposit west of Yucca. He had read it sometime ago and said they drilled 3 or 4 holes from which firing tests were made which were favorable. He said the company would have entered into the manufactured product but they discovered that it was uncommerical to "puff" it at the mine and ship it to the west coast; this is elementary. GW WR 4-3-74

Went on to the Mineral Park operations of Duval Corp. where Messrs. Tessierre and Boone said things were rocking along as usual. Explosives are their biggest gripe having doubled in price during the past year. GW WE 5-1-74

Went on the Duval Corp. operation at Mineral Park where Messrs. Boone and Teissere said things were rocking along as usual except repair parts for the heavy equipment were becoming increasingly difficult to get in reasonable time. GW WR 8/27/74

I drove to the Mineral Park mine to meet Ron Teissere and renew acquaintance with Bill Roper. Neither was in. VBD WR 1/8/75

I drove to the Mineral Park mine where I met Ron Teissere for the first time. VBD WR 2/5/75

Duval's Mineral Park operation is on a 10 day "on" and 4 day "off" schedule. GW WR 8/26/75

TABLE II

Tons milled per day = 14,000 to 15,000

Operating time, % of possible = 95.0

COPPER-MOLY FLOTATION

FEED	
% Total Copper	0.480
% Acid Soluble Copper	0.065
% Sulfide Copper	0.415
% Molybdenum	0.030
% Acid Soluble Molybdenum	0.002
TAILS	
% Total Copper	0.075
% Acid Soluble Copper	0.040
% Sulfide Copper	0.035
% Molybdenum	0.006
CONCENTRATE	
% Copper	22.0 to 25.0
% Molybdenum	1.25
RECOVERIES	
Total Copper	85.0
Sulfide Copper	92.0
Molybdenum	80.0

MOLYBDENUM FLOTATION

Feed, % Mo	1.25
Tails, % Mo	0.040
MoS_2 Concentrate, % Mo	55.50
MoO_3 Calcine, % Mo	62.0
Section Recovery	96.0
Overall Recovery	76.0

1965

Tons ore Mined - Pit Run 4,914,494

-13- lbs of Concent. 36,618,689

PPTS 1,483,888

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THE PORPHYRY COPPER-MOLYBDENUM ORE DEPOSITS AT MINERAL PARK, ARIZONA

By
Harrison A. Schmitt

GEOGRAPHY

The Mineral Park area of the Wallapai mining district is approximately 16 miles north 22 degrees west from Kingman, Arizona. The highway distance to the area from Kingman and from the Santa Fe railroad which serves Kingman is about 18 miles. Las Vegas, Nevada is about 105 miles to the northwest. The climate is semi-arid with rainfall of approximately 10 inches per year. The elevation averages around 4,250 feet.

The district is in the northwest trending Cerbat mountain range. The town of Kingman has a population of about 7,000 and for income depends on the tourist trade, ranching, and the railroad and mining business. The presently developed ore body lies in Ithaca Peak which is near the west center area of the Cerbat range. The Mineral Park townsite is in a mountain valley adjacent to the peak. It is on an early wagon trail which crossed a divide to the east.

HISTORY

The townsite was completely abandoned a few years ago. The old cemetery testifies to the hardships of the early days.

Various geologists have described the district. Important publications include those of Schrader (7), Dings (1) and Thomas (8).

The Wallapai district is well known for its lead-zinc veins with minor silver, gold and copper which have produced about $27 million in gross value of metals. In the past decade, however, production has been negligible.

The resemblance of the outcrops to those of the "porphyry coppers" attracted early attention. The Utah Copper Company (around 1910 ?) may have been the first company to drill an exploration hole in the district. Their drilling consisted of a churn drill hole on the southeast side of Ithaca Peak within the area of the present ore body. In 1915 the Calumet and Arizona Company drilled three churn drill holes on Gross Peak, about 3,000 feet southwest of Ithaca Peak. In the 1950's a Mr. Chapman drilled two holes 2,500 feet north of Gross Peak and in 1952 Bear Creek Mining Company drilled six holes in the area of Ithaca Peak.

In 1949 Thomas in his paper (8) remarked that "the mineralization is of the well-known disseminated or porphyry copper type." Dings (1) called it a stockwork. Actually, it is a porphyry copper deposit with much of the ore mineralization in small gash veins.

About September 1958, Mr. Keith Martin said that he liked the area and urged me to visit it. This I did at the request of Duval Sulphur & Potash Company. At that time, Page Morris was president of Duval Sulphur & Potash Company and George Atwood was resident manager of its Copper Division. Further reconnaissance work was started in November. Late in December, it was decided that Duval would endeavor to option and/or purchase the mining claims needed for a mine and plant and locate all the intervening ground. This encompassed an area totaling about four sections. Later, several more

sections were added. Churn and diamond drilling was started May 1, 1959. The decision to build a plant was made in October 1962. William Roper was in charge in the field and George Atwood and Ben Messer carried out the often difficult land acquisition negotiations. Messer had the overall responsibility for the last stage of the drilling and underground work. Dr. H. J. Thiele was hydrological consultant. Two water fields were developed.

Dorman O'Leary, an engineering consultant, did much of the early claim location work. Robert Lenon, a mineral land surveyor, surveyed a large number of claims for patent. Boyles Brothers Drilling Company drilled some of the first diamond drill holes, particularly the ones which were located on the top of Ithaca Peak and required helicopters for transportation of drilling equipment and supplies. Metler Brothers Drilling Company of Tucson did most of the later diamond drilling and the churn drilling was done by the Mike Wininger Drilling Company of Phoenix. Aerial Mapping Company of Boise, Idaho carried out the aerial photography and made the photogrammetric contour maps.

GEOLOGY

Except for the mineralization, that is, the hypogene and supergene phases including the capping, and the broad structural features, I did not have much to do with the detailed geologic studies. Don Clippinger, John Frost, Irving Gray and Keith Martin did most of the work on the lithology and local structure. Because of the time limitation, their data were largely unavilable for this paper. Much remains to be done.

The Cerbat range (Schrader (7)) appears to be a tilted fault block with critical boundary faults on the southwest and with a tilt to the northeast. The range is only about 24 miles west of the Colorado plateau. It is marked by numerous northwest dikes, faults and fault veins, although a few of the dikes, faults and veins bear north-south and east-west and there are a few other deviations. An early (?) pre-Cambrian terrane of schists and gneisses and gneissoid granite is cut by younger granite and porphyry which in turn is cut by largely rhyolite dikes (Dings (1)).

The ore mineralization is later than the dikes. Thomas (8) believes that it occurred at the close of the Tertiary volcanic acticity and that the Ithaca Peak porphyry may be Tertiary in age. Dings thinks it is Mesozoic, Nevadan in age. The mineral suites include chalcedonic quartz and complex silver minerals. Vugs are present. Thus shallow (epithermal) hypogene deposition is suggested. Dings, however, thinks it is mesothermal.

The Mineral Park ore and gangue mineralization chiefly affects the pre-Cambrian rocks and the Ithaca Peak intrusives. The chief hypogene gangue minerals are sericite, quartz, pyrite, clay (?) and secondary biotite. The hypogene ore minerals known to date are chalcopyrite and minor bornite and molybdenite. Secondary minerals include chalcocite and the various secondary iron, copper and molybdenum minerals. Turquoise was mined for many years and is still mined under lease.

The Ithaca Peak ore body is a typical enriched chalcocite blanket. The capping thickness is approximately 150 feet; the ore thickness, 140 feet. The tonnage estimates vary from 40 to 60 million depending upon basic assumptions used as to costs, cut-off, recoveries and copper price. The per

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ton value of the ore is about the same as at the Esperanza property although the ratio of the molybdenum to copper is greater. The waste overburden to be removed prior to commencement of ore production is 23 million tons. It is estimated that the pre-mining stripping will be completed by June 1964.

The aerial photographs reveal a circular form centering around Ithaca Peak. This is perhaps a resolution due in part to the topography and in part to the "circular" "granite" and porphyry intrusions. However, it has been noted previously that in aerial photographs ore mineralization centers in places show such circular or knotty forms. The regional northwest lineation, i.e., the dike, fault and fault-vein swarm stands out as well as does the northeast pre-Cambrian lineation. Less prominent are the north-south and east-west faults and fault veins. In the area of the ore body the northwest and northeast lineations can be distinguished. Clippinger's mapping of the surface area of the ore body reveals intricate shattering with joints, sheeting and faults predominating in the north 40 degrees west, east-west, north-south and north 60 degrees east directions.

Two plans and two sections of the ore body are shown in Figures 1, 2, 3 and 4. The axial trend is northwest. The south end bends southwest. East-west cross-section 2 on the north side reveals a normal blanket-like form, but 400 feet south in about the center, east-west cross-section 6 suggests the presence of a root. A diamond drill hole put down in the center of this thick section bottomed at 876 feet in fair grade, largely primary, ore. This part of the ore body has the highest molybdenum content. The highest molybdenum intercepts contained abnormally abundant sericite and/or

muscovite. The central waste area has a high quartz content. The three dimensional form of the ore body is that of a mushroom.

The outcome of the preliminary reconnaissance capping-alteration observations compared with the known ore body is shown by Figure 2. The lack of good correspondence on the northwest is explained by the normally unfavorable high-pyrite type gossan in that area. The open end to the south contains marginal ore that possibly will be mined at some future date. The exact south limit has not been defined.

GENERAL DISCUSSION

The classic requirement for the genesis of the chalcocite blanket or horizontally tabular type of ore body is a ground surface that is not being eroded too rapidly and a fairly stable ground water surface. Most of the ore bodies in the Southwest are only roughly tabular and some depart greatly from tabularity.

Although the top of the Ithaca Peak ore body appears to conform generally with the present ground surface, it appears unstable. Thus, there are several large oxidation holes (or cones or fissures) cutting through the blanket from which the copper has been largely leached out. The pyrite in the capping is "lagging behind," i.e., some occurs above the chalcocite. The ground water in the adjacent valley stands at about 4,250 feet, but the top of the blanket only 4,000 feet away is at 4,800 feet. In the valley, the sulphides are only a few feet from the surface. Thus, the conditions for enrichment do not seem to follow the classical concept. The ore body, furthermore, seems out of adjustment with the present ground surface and ground water surface. Erosion appears well ahead of oxidation and enrichment.

Nevertheless, the conformation, i.e., parallelism, of the mountain surface and the top of much of the ore body needs to be rationalized. At several places on the lower slopes, the top of the blanket is less than 50 feet below the surface. The capping in places is very dense and impervious.

The Tertiary history of the Southwest is gradually being unraveled. Gregory, Lance, McKee and others offer converging evidence of a Tertiary history somewhat as follows: The last convulsive type of orogeny that included thrusting appears to have occurred in the Miocene, possibly late Miocene. This was closely followed by erosion with some areas approaching a base level possibly near sea level. This relative quiescence may have lasted until the end of the Miocene or early Pliocene. During this period, the Colorado river system was established on a poorly drained broad valley with neighboring mature uplands. This was terminated by the epeirogenic uplift that gave rise to the Colorado plateau and that may have started slowly in early Pliocene and climaxed in upper Pliocene and Pliestocene. The basin and range faulting accentuated with time. We see much evidence of the youthfulness of the present erosion cycle. Thus, in the Southwest, stream gradients are high and sulphides are found in stream bottoms or even at high elevations.

The Ithaca Peak ore body, therefore, may have been largely concentrated in pre-Pliocene time. Since then, the Colorado basin, of which this is a part, has been uplifted some thousands of feet. It seems apparent that the ore body is trying to adjust itself to the mountain profile. This appears possible in some places because of the tightness of the rock, with retained water in the pores in fairly recent times when there was more rainfall. In

some places the ore body appears to be in a process of destruction rather than in one of reconstitution. It may be that the large accumulation of copper at the Emerald Isle mine was derived from the copper released to the ground water through accelerated erosion and oxidation.

The localization of the copper in the Mineral Park area by position and by genesis is of probable interest. It lies only slightly off center from the larger and surrounding area of lead-zinc veins containing some copper, gold and silver. Some of the lead-zinc veins "cut" the porphyry copper ore. The district along with Bagdad and Jerome is part of a northwest prong or extension from the "copper oval" in the Tucson area. Mineral Park is only 24 miles west of the fault that bounds the Cottonwood-Aguarius cliffs on the west.

Without going into detail at this time with respect to the evidence and interpretation of the regional structural conditions, we should note that the Mineral Park and Bagdad copper deposits are very close to the west "boundary" of the Wasatch-Jerome zone of deformation or orogen. Actually, with the exception of Santa Rita, Tyrone and Ajo, all of the major southwestern copper deposits are in this zone or adjacent to it.

In detail the Ithaca localization appears to be a three or four way lineation intersection intimately associated with one or more plug-like (?) intrusives (Figure 1). The localization of the peak with nearly exact conformation to the ore body appears to be related to (1) the reinforcing of the rock, especially by alteration, (2) the resistant high quartz center (Figure 2), and (3) the soft pre-Cambrian schist on the north and southeast sides.

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SAMPLING

Much of the drilling was done by churn drills. For dependable sampling of bulk type ore bodies, I prefer the churn drill using the now more or less conventional procedures. The chief argument for the churn drill is that in ore bodies as erratic as the "porphyry" coppers often are, as large an amount of spoil as possible is usually desirable depending upon the distribution of ore values. With this type of drill, this spoil may be from 10 to 40 times as much as with the diamond drill. The diamond drill may be more advantageous where geological information is needed. It can be used for inclined holes and is cheaper. I like to use a few diamond drill holes interspersed with churn drill holes, usually in the earlier stages of drilling until the best and cheapest method is apparent. At Mineral Park, many inclined diamond drill holes were needed because of the inaccessibility of many of the drill locations.

As is well known in sampling, we contemplate possibilities from the rarely encountered good homogeneity to extreme inhomogeneity. In the latter case, especially encountered in some gold ores, the entire ore body must be mined before the grade of the ore is known. The bulk copper deposits may fall between these extremes.

In addition to the above aspect of ore bodies is the problem of isolated bunches and masses of ore, i.e., plums in a pudding versus a continuity of streaks, veins, beds, etc. Where the ore body is hidden, we may not be able to be sure, even after extensive drilling, that we do not have "plums in a pudding." Drilling of this latter type of distribution may give deceptively low or high average values. For this reason, most

MINERAL PARK DIVISION

MOHAVE

George Boone at the Mineral Park mine of Duval Corp. ways they still have a small amount of Cu cons stockpiled but hope to get them shipped this month. They have increased mine production from 17,000 to 19,000 tons per day. GW WR 9/6/72

Went to the Duval Corp., Mineral Park, operation where a short visit was made with Messrs. Boone and Teissere (geologist) who said operations were normal and that they had recently completed a geologic reconnaissance of the north part of the Hualapai Mtns. They will have a look at the Golconda mine when its rehabilitated sufficiently for an examination. GW WR 11/1/72

Went on to Duval Corp's Mineral Park operation where Mr. Boone, Chief Engineer, said they were operating at about their usual rate. GW WR 12/6/72

George Boone at Duval's Mineral Park operation said they were progressing as usual also. GW WR 1/4/73

Visited with Mr. William Roper at Duval's Mineral Park mine where he said they were "rolling along" mining 19,000 tons/day with about 450 people. GW WR 2/8/73

Stopped at Duval Corp. operation in Mineral Park and visited with Mr. McLean, mill supt., who said they had about finished replacing the Transite tailings pipe with larger size steel pipe. The inclement weather has been rather bothersome to the pit operation although capacity has been maintained. GW WR 3/7/73

Got to the Mineral Park operation of Duval Copr. just at quitting time but delivered theprinted matter to Mr. Teissere. He said they were hampered considerably by the wet muck sticking in the primary and secondary crushers. GW - WR 4-6-73

Mr. George Boone, chief engineer at the Mineral Park operation of Duval Copr. said they were drilling some development holes with a down the hole hammer; so far they haven't encountered ore. GW - WR 5-4-73

Visited briefly with Messrs. Teissere and Boone at the Mineral Park operation of Duval Corp. where they said they were still drilling a few holes and that there was no activity in the district. GW WR 6-6-73

Went to Duval Corp., Mineral Park operation, where a brief visit was made with Messrs. Boone, McLean and Teissere, none of whom had any new developments to report. Mr. Roper was out, so Mr. Boone made the changes on the Active Mine Directory. GW WR 10/3/73

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engineers and geologists feel that some testing by workings of greater or lesser extent is needed to reveal the character of the distribution of the valuable minerals. At the same time, the adequacy of the sampling procedures may be checked by raises and winzes on some of the diamond and churn drill holes. A further dividend is bulk samples for mill tests.

At Kingman, a program of underground testing was carried out that eventually totaled 3,500 feet of drifts and raises. In the beginning, the fact that the assays in raises for, say, ten foot intercepts were appreciably lower than certain relatively high runs in the churn drill holes that were being checked caused some dismay until it was realized that the large bulk of a raise sample smooths out the erratic distribution of the copper in the much smaller samples from drill holes.

This theory seems to have been supported at Mineral Park for when the 3,500 feet of underground work had been finished the average assay when compared with that of the drill holes deviated by only 0.01% Cu.

ACKNOWLEDGMENTS

I am indebted to Duval Sulphur & Potash Company for suggesting that I be the first to announce the details of the development of this new porphyry copper-molybdenum deposit and to John Frost, Don Clippinger, William Roper, Irving Gray and Keith Martin for many field data and ideas. Bill Bessinger took, and kindly supplied, the excellent helicopter project slides.

Presented at the Tucson
meeting of the AIME
December 3, 1962

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MINERAL PARK DIVISION

MOHAVE COUNTY

Dir. of Mining - August, 1971 - 420 men.

Went to Duval's Mineral Park operation and met Messrs. Roper and Boone. Their operation is about as usual. GW WR 11/4/71

Visited the Mineral Park operation of Duval Corp. George Boone, chief engineer conducted a tour of the open pit which produces 17,000 tons per day by use of 4--8 cu yd. electric shovels, one 10 cu yd. diesel front-end loader and 3 - 40D Bucyruc-Erie diesel drill rigs which drill 43 ft. 9" diameter holes for blasting 35 ft. high benches. Almost in the center of the pit is an area of schist with a very high content of pyrite which presently is not being mined due to an adverse problem in milling this material. GW WR 12/2/71

The Mineral Park operation of Duval Corp. was not affected by the copper strike, other than their inability to sell their concentrates. GW QR 9/71

Went to the Mineral Park operation of Duval Corp., where Mr. Boone said they were down temporarily due to low gas pressure. He also said the daily concentrates were being shipped, but the stockpile couldn't be moved due to lack of smelter capacity. GW WR 1/372

Neither Mr. Boone nor Mr. Roper were available at Duval's Mineral Park Operation. GW WR 2/2/72

Went to Duval's Mineral Park operation where both Messrs. Boone and Roper were unavailable, but talked with Mr. McLEan, mill superintendent, who was interested in the possibility of a market for their concentrates. GW WR 3/3/72

At Mineral Park, Duval Corporation is mining about 17,000 tons of ore a day from the open pit. The concentrates produced during last summer's strike of the copper smelters is still unsold. GW QR 2/72

Saw Mr. McLean, mill supt., at Duval's Mineral Park operation who said both Messrs. Roper and Boone were in Tucson. We briefly discussed the roadless literature. GW WR 4/7/72

Mr. Roper, Mgr., Mineral Park operation of Duval Corp., made a few changes in the active mine list and stated they still have approximately 7,000 tons of cons. He thinks they ar e recovering about 50% of the Cu from their dump leaching operation over a 5 year period. An irony crust forms which prevents penetration of the solution but they try to break it with a 7 foot long ripper tooth on a D-9 Cat. Spent 2 hours or more with Mr. J. Hubert Smith, Attorney in Chloride and received the history of mining in the Cerbats from 1879 when his father arrived there. GW WR 6/8/72

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bench, the contractor advocated a waste haul road at a 10% grade.

In order to develop sufficient ore, more of the capping on Ithaca Peak had to be removed because of the precipitous terrane than would have been necessary if topographic conditions had been less severe. All of the upper 240 feet of the peak had to be mined at this stage. A total of 23,000,000 tons of pre-mine stripping were estimated as the minimum quantity that had to be stripped to properly develop the mine and still maintain prudent and orderly mining procedures. Subsequently, a 2:1 waste-ore ration was required for at least two years. This stripping ratio included not only that waste removed as overburden but also that waste sorted from the ore horizon.

Estimates on the cost of capital mining equipment were prepared, together with estimates of mining costs derived from studies of the Esperanza mining operation and from consultations with other operators. After careful study of these estimates, of the experience at Esperanza and of firm bids of four mining contracters, the Duval management decided to again contract the stripping and initial mining.

The mining contract was awarded to the Isbell Construction Company, on November 1, 1962. On the 19th of November, the first mining equipment was moved in. Shortly thereafter, access roads were prepared and the mine shop and office site were cleared and levelled. After sufficient ground control was established and pre-marked by Duval engineers, the mining area was photographed from the air at a scale of 1:3,000, principally for use in future excavation quantity determinations. A 1:1200 scale topographic map, with the same coordinates as the base bench map, was also prepared from this photography.

By the end of 1962, a 9-inch blast hole drill, a 7-yard shovel, several 65-ton trucks and miscellaneous other equipment were delivered and assembled. Air Trac drills, air hammers and dozers were set to work on access and service roads from the 4600-foot shop elevation to the 4800-foot dump elevation and from the 4800-foot elevation up the sides of Ithaca Peak. On the 18th of January, 1963, the first large bench blast was fired in the Little Ithaca Peak area. During this month, the first stripping material was loaded by a 7-yard shovel from a 6% mine access road and hauled down to enlarge the shop and office yard; shortly thereafter, dumping commenced on the 4800 dump site. Drill, access and service roads were pushed towards the summit; drilling blasting and mucking of the haul road followed as rapidly as possible.

Haulage road progress up the east side of Ithaca Peak to the 5100-foot elevation was slow and laborious. Pneumatic drilling, blasting and dozing established room to operate the nine-inch diameter rotary drills. Usually two rotary blasts were required to reach the haulage road grade and mucking elevation. Oversized material, high bottoms and high banks further plagued progress.

Although blast hole drilling efficiencies are higher than at Esperanza the increased elasticity and toughness of the rock has resulted in poor fragmentation and numerous hard toes, which has necessitated considerable secondary blasting.

In May, the crags at the summit had been completely drilled, blasted and dozed off, providing a comparatively flat area at approximately the 5140-foot elevation. From here, rotary blast hole drilling penetrated to the 5100 elevation and then more or less standard

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benching procedures followed. The intent had been to work the overburden material in 50-foot benches to the top of the ore at the 4900-foot elevation, but because of poor breakage and poor fragmentation, the depth was reduced to 35 feet. One other major problem encountered was the obstruction of the lone haulage road with material dislodged by blasting and mucking operations from benches above the road. This problem was eliminated by the establishment of a secondary haul road on the opposite or back side of the peak.

In July and August of 1963, twelve 200-foot development holes were drilled with a rotary blast hole machine from the 5060 Bench into an area which had previously been poorly developed because of access difficulties. This drilling increased the original ore reserves in the upper elevations, which in turn resulted in a decrease of approximately five million tons in the overburden stripping requirement and a decrease in the waste-to-ore ratio during the first year of ore production.

Progress surveys were made for the first two mining periods ending on the 31st of March, 1964, utilizing aerial photographs and a terrain data translater together with a computer. The mined quantity thus determined differed only 2.3% from the quantity based on a truck count of material hauled plus an estimate of material dozed or blasted down road and bench slopes.

As of the 31st of July, 1964, slightly in excess of 16,000,000 tons of stripping had been removed. Included in this quantity were some 1,000,000 tons of ore which were stockpiled. Three 7-yard shovels, three 9-inch diameter rotary drills, one 6-inch diameter down the hole drill, twelve 65-ton and four 25-ton trucks, nine dozers of four different

sizes, two road patrols and miscellaneous other pieces of equipment have generally been working three shifts per day, five days per week, to complete the stripping program and to prepare the mine, by the time the mill construction is completed in October, 1964, for ore production sufficient to satisfy milling requirements of 12,000 tons per day.

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STATE OF ARIZONA
DEPARTMENT OF MINERAL RESOURCES
MINERAL BUILDING, FAIRGROUNDS
PHOENIX 7, ARIZONA

24 November 1964

SUMMARY OF FACTS ON DUVAL CORP.'S ITHICA PEAK PROPERTY

from files of Arizona State Department of Mineral Resources

COPY

Special to: Vince Gullete, Business Editor, The Arizona Republic

From: Edward H. Peplow Jr., Assistant to Director

The porphyry copper deposit in the Mineral Park area of the Cerbat Mountains in the Wallapai Mining District some 14 miles N and W of Kingman has been known to exist for many years. Arizona State Department of Mineral Resources files show there was churn drilling in the area in 1906 and 1907.

Efforts to block out an important ore body continued over the years, but the ore consistently proved too low-grade to warrant development and mining by then existing methods. Calumet & Arizona in 1927 ran two adits near Goose Ranch and is reported to have found 0.2% copper and 1-pound-per-ton molybdenum.

In the early 1950s Kennecott Copper Corp. drilled the area and supposedly found copper ore varying from 0.2% to 0.9% in spots. They still did not prove an economical ore body, however.

In 1959 Duval Sulphur & Potash Co. (renamed Duval Corp. March 19, 1963) located some 150 claims and took short-term options on a number of nearby

properties. All of the property comprised a block around three closely grouped peaks, Ithaca, Turquoise and C&A Peaks. Among the optioned properties were the Keystone, Evahorn, Ark, Lind and others which had been small but active producers at one time or another.

Duval undertook an extensive program of exploration by geophysical methods, diamond drilling and churn drilling. In 1959 heavy diamond drilling and accessory equipment was carried to the rugged top of Ithaca Peak by helicopter (see Arizona Days & Ways, 9/13/59, for story and pix). Concurrently a surface work program consisted of surveying, mapping and geological and geochemical sampling. Water wells had to be located and proved to meet the anticipated needs of the mill if the exploration program indicated the advisability of developing the mine. Company officials estimated they must have a sustained yield of 3,000 gal. per minute. The operation will not, however, consume this amount, for the largest proportion of water used in such a milling operation is recovered and re-used.

During this part of the exploration program there were an average of 10 men working at the site.

In 1961 Duval announced a copper-molybdenum discovery of major magnitude at its Ithaca Peak property. Its 65 churn drill and diamond drill holes outlined a deposit suitable for open-pit mining with a favorable stripping ratio. Detailed geologic mapping was credited with playing a key role in this discovery.

From 1959 through 1962 William Roper was superintendent. Harrison A. Schmitt, prominent Arizona and New Mexico geologist, was consulting geologist throughout the Duval exploration of the property.

Feb. '62: 20 men working at site. Later in '62 Isbell Construction began stripping and the property entered the development stage. By end of '62, 50 men working at site. Duval announced plans for expenditure of $28 million to develop the open pit mine and construct a 12,000-tons-per-day concentrator to produce copper and molybdenum concentrates, which were to be shipped to custom smelters.

It was estimated that the ore would run 0.08% to 0.12% molybdenum and 0.60% to 0.70% copper. Total ore tonnage was estimated at 50 million tons.

In late '63 Robert Lenon, mineral surveyor from Patagonia, Ariz., announced he had completed the field work for the patenting by Duval of 84 lode claims in the Mineral Park area. Work force at the site now 86 men.

Mid '63 payroll up to 160 men stripping overburden and preparing mill foundations. March '64 saw 121 at mine, 350 working on mill. Sept. '64 there were 109 at mine and 744 working on mill construction.

The anticipated beginning of mill operation in the fall of '64 was postponed by late delivery of recently developed automated milling machinery. Development of such machinery was a key factor in making it economically feasible to undertake to mine ore of such low grade that only a very few years ago it was rejected as waste rock.

There is no reliable way of estimating how much time and money have been spent in all in efforts to convert this deposit into a workable mine to create new wealth. It is safe to say it is considerably more than the $28 million Duval alone has spent.

Estimated permanent work force: 125.

I. B. Phillips, Jr. general superintendent, hopes mill will be operating shortly after December 1, '64.

Isbell Construction has done the stripping of overburden on contract. Parsons-Jurden, a subsidiary of Ralph M. Parsons Co., contractor on mill.

Note: Original estimates were that 24 million tons of waste capping would have to be removed. As stripping proceeded, however, a body of some 6 million tons of good ore was uncovered that had been previously undiscovered. Thus stripping of overburden was reduced to 18 million tons.

Duval's last annual report shows Phillips as general supt. S. C. Polasek Chief accountant A. E. Smith, maintenance supt. Your Kingman Correspondent can get mine supt. and mill supt. names.

Any other dope you want, Vince, give us a call.

ehp

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EXCERPT FROM ANNUAL REPORT OF DUVAL SULPHUR & POTASH CO. - 1961

Field work consisting primarily of exploration drilling continued during the year at the Company's Mineral Park copper-molybdenum property near Kingman, Arizona. Near the end of the year a program of close pattern drilling and underground development work was initiated. The close pattern drilling will provide detailed information required in connection with the development of a plan for stripping and mining the mineral deposit. The underground development work will permit the checking of drill hole results, provide material for metallurgical testing and determine continuity of the deposit. All work now in progress will be completed by mid-1962, at which time final development of the property for production operations will be considered. The Mineral Park property is considered to be a significant molybdenum discovery. Its mineral reserves constitute an important addition to the reserves of the Copper Division.

EXCERPT FROM ANNUAL REPORT OF DUVAL SULPHUR & POTASH CO. - 1960

The Company is conducting an extensive exploration and evaluation program on a porphyry copper deposit in northwestern Arizona. This property is located at Mineral Park, some fourteen miles from the city of Kingman. Fifty-two drill holes completed at year end developed a substantial area of copper-molybdenum enrichment. Additional drilling and evaluation work designed to futher delineate the areas of proven and potential mineralization and appraise the commercial possibilities of the property will be carried on in 1961. Mineral rights in the area of interest are held by the Company under mining claims and locations. Certain of these were filed by the Company; others are held under lease and option from the owners.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine	Ithaca Peak Prospect (Duval Sulphur & Potash Co.)	Date	Sept. 3, 1959
District	Mineral Park, Mohave Co.	Engineer	T. P. Lane

Subject: Visit of Aug. 21, 1959

Everett Smith, formerly Supt., has been transferred to the Esperanza division of the company and Wm. Roper is now in charge at Ithaca Peak. Sayer (?) is geologist assisted by Conover and a sample helper.

At the time of visit the drilling contractor was putting down a diamond drill hole on top of Ithaca Peak and was drilling the twelfth churn drill on the base of the peak. This hole is being drilled near the site of hole No. 11 which encountered drilling difficulties. The churn drill holes that have been drilled to date surround the peak on its flanks except in a southeast sector. No information was available regarding the drilling results. The diamond drill and accessory equipment and supplies were landed on the rugged top of the peak by helicopter.

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