



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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ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: VAN DYKE COPPER

ALTERNATE NAMES:

GILA COUNTY MILS NUMBER: 165

LOCATION: TOWNSHIP 1 N RANGE 15 E SECTION 30 QUARTER NW
LATITUDE: N 33DEG 24MIN 00SEC LONGITUDE: W 110DEG 52MIN 10SEC
TOPO MAP NAME: GLOBE - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:

COPPER OXIDE
COPPER SULFIDE

BIBLIOGRAPHY:

ADMMR VAN DYKE COPPER FILE
USBM WAR MINERALS REPT 378 1945
ADMMR PUB PROD POSS OF MARGINAL COPPER MINES
IN AZ 1941 P 93-94
AZ MNG JRNL JUL 1919 P 23, OCT 1919 P 19,
NOV 1919 P 34
ADMMR OCCIDENTAL MINERALS CORP FILE
ADMMR SEE VAN DYKE FILE FOR MORE REFERENCES
RAND L H & E B STURGIS MINES HANDBOOK VOL 18
1931 P 457
PETERSON N P GEOL & ORE DEPTS GLOBE-MIAMI
DIST USGS PP 342 1962 P 137
ADMMR VAN DYKE COPPER CO COLVO FILE
SME PREPRINT 88-66: VAN DYKE CASE HISTORY
INSITU COPPER LEACHING

See: Production Possibilities of the Marginal
Copper Mines in Arizona 1941 p. 93, 94

Mines Handbook 1931

✓ War Minerals Report 378(CFW Library)

Arizona Mining Journal July 1919 p. 23
Aug 1919 p. 18 Sept 1919 p. 19 Oct 1919
p. 19 Nov 1919 p. 34 Jan 1920 p 33
Feb 1920 p. 35 March 1920 p. 23 April
1920 p. 35, 43

Utah International file

See: Dept. of Interior, Bureau of Mines, War Minerals Report, #378, (Nov. 1942), 20 pages,
5/3/77 a.p.

SEE OCCIDENTAL mine file

MAPS upstairs in the flat storage area in the second drawer

VAN DYKE MINING PROJECT
P O Box 1693
Globe, Arizona 85502

ADDITIONAL REFERENCES

See: Production Possibilities of the Marginal Copper
Mines in Arizona, 1941, p. 93, 94.

*War Minerals Report 378
(C.W. Young)*

Pay Dirt 12/68
The Occidental N

PAY DIRT for December 24, 1973

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

MM 6380 Copper ore

GILA COUNTY

6381 Copper ore

6382 Copper ore

MIAMI

1329 Azurite, malachite, chrysocolla,
Turquoise

Occidental Minerals Mine

9415 Copper Ore

Van Dyke Project

MILS# 165
O-AKAIA
VAN DYKE COPPER (file)

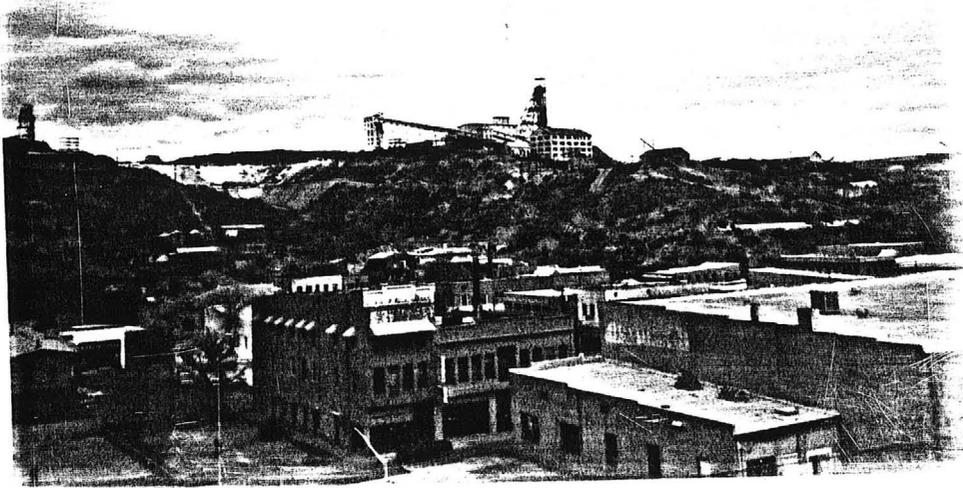
Van Dyke
2/1/89



Van Dyke
2/1/89

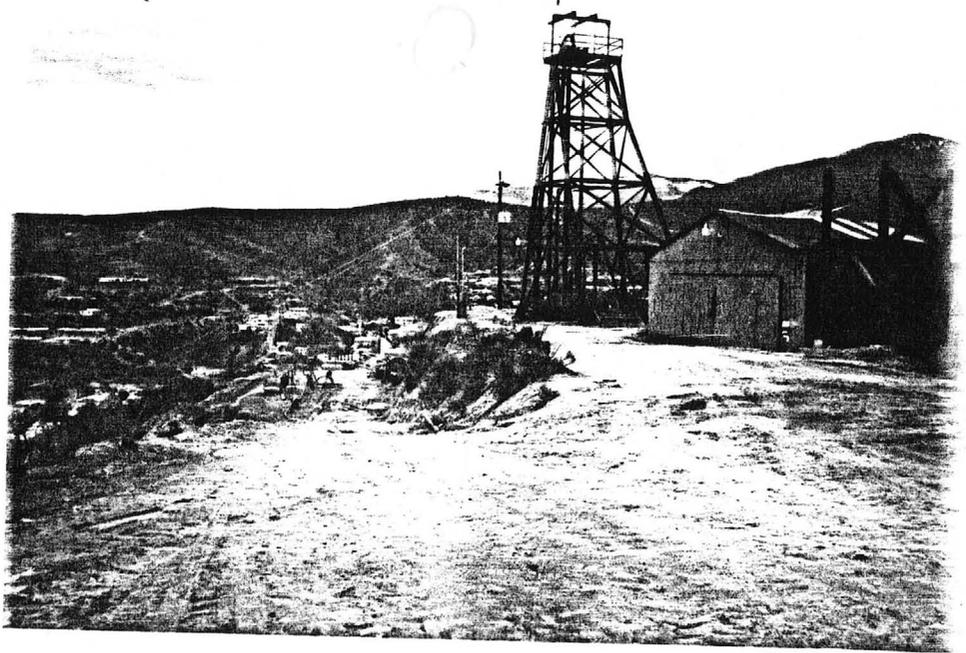


Van Dyke on left
Miami No. 5 center
2/1/89

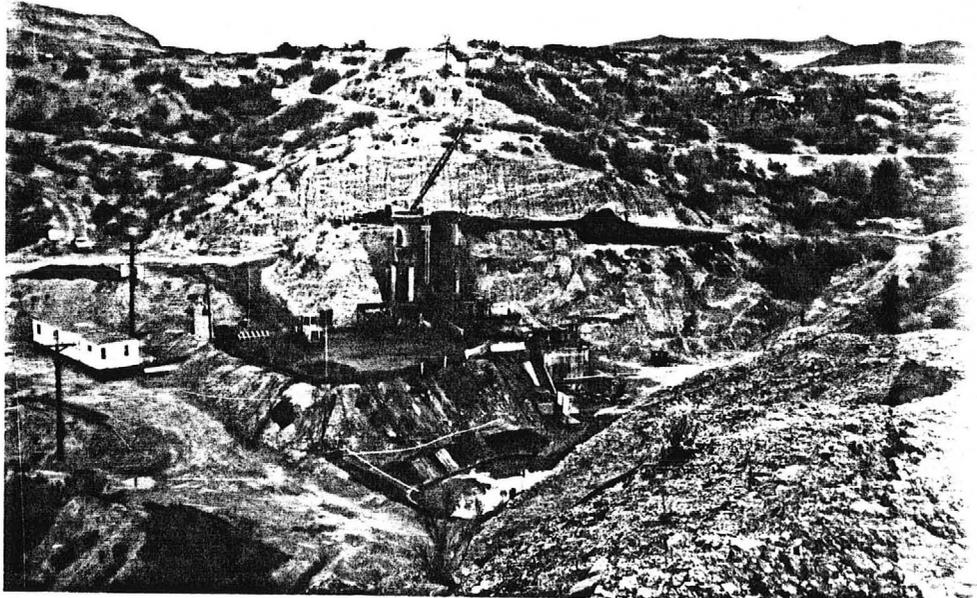


(Originals in photo file)

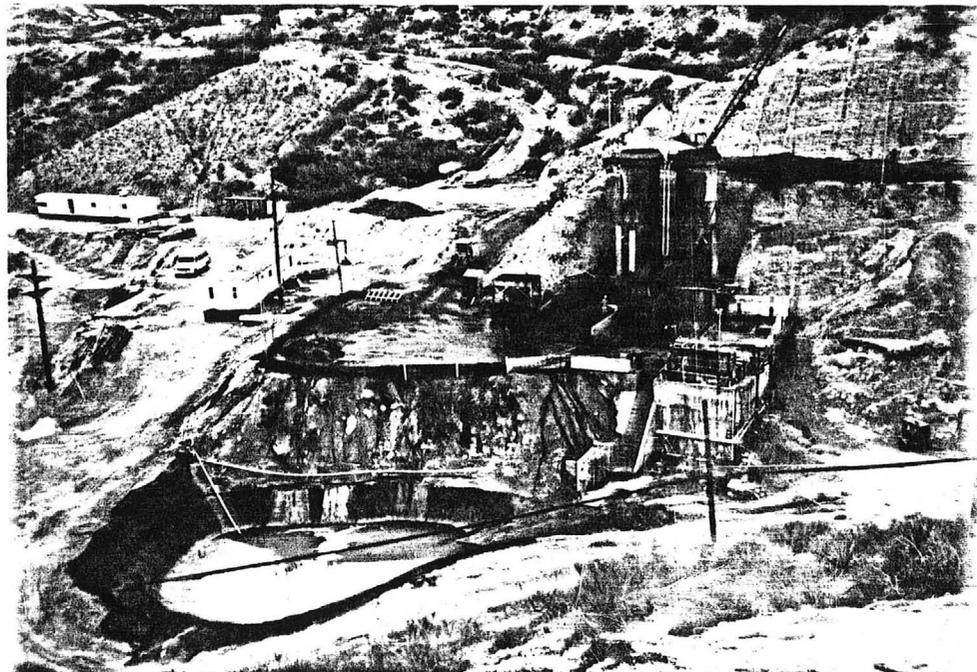
Van Dyke, 2/1/89
Headframe on old Van Dyke
shaft. In-situ injection
well on lower level to left.



Van Dyke, 2/1/89
Precipitation Plant



Van Dyke, 2/1/89
Precipitation Plant



(Originals in photo file)

VAN DYKE COPPER

GILA COUNTY

Mack Johnson of Kocide Chemical reports that work at the Van Kyke (file) property, Gila Co is progressing on schedule but that the start up time will be delayed a couple of months because of problems at the plant in Casa Grande. Production was scheduled to start in May, 1987. The new telephone number for Van Dyke is 473-2421.

NJN WR 11/27/87: Bob Zache (card) with Kocide Chemicals (card) reported they still are not producing at the Van Dyke Copper (file) Gila County. They are just monitoring their wells. In early '87 the project was put on the back burner by Kocide and restarted in September due to the current +\$1.00 price. They obviously wish they had not stopped.

NJN WR 12/29/87: R. V. Huff, S.G. Azen and D. Baughman gave a presentation at the SME annual meeting held in Phoenix January 24-26 entitled Case History, Van Dyke, In Situ Leach Copper Project (file) Gila County. A copy has been obtained for the file.

RRB WR 6/24/88: Visited Van Dyke Mine to gather information for Copper report. Discussed plans with Paul Musgrove, Bob Zache and Bob Welthal. They are currently drilling injection and production wells into old workings for insitu leaching. They are constructing a cementation plant using cone precipitation from Asarco's Ray Mines Unit.

VAN DYKE COPPER COMPANY

GILA COUNTY

Visited drill rig on Van Dyke property, block W. of Commercial Store.
Occidental Petroleum has option on property, Boyles Bros. the contractor.
They were down 2100 feet. Tom Clary is the Geologist.

FTJ WR 9/27/68

Occidental Petroleum have been drilling in the Miami Townsite and on the Van Dyke claims. Their findings are not available. FTJ Quarterly Report July 15, 1969

Occidental has been drilling at depths of more than 300 feet. It has an option to purchase more than 6,000 acres of mineral rights on what is known as the Van Dyke properties. This includes almost all of the underground rights beneath the town of Miami and extends into the Pinal Mountain foothills.

Pay Dirt Jan 1970

Occidental Minerals were drilling the Van Dyke and other claims during this quarter.
FTJ Quarterly Report 4/3/70

Occidental continued drilling the Van Dyke claims. FTJ QR 9/71.

AMAX continued to explore the Van Dyke property held by Occidental Minerals Corp. and was planning shaft sinking fo further assess the deposit. FTJ Annual Report 6/28/73

NJN WR 8/16/85: With Diane Bain assistance, straightened out the Occidental Minerals file, Occidental Miami Leach, Van Dyke Leach file and the Van Dyke Copper Property file. All data pertaining to the in situ leach is now in the Van Dyke Copper Co. Property file, Gila County.

NJN WR 6/20/86: Contacted Kocide Chemical (c) and obtained address for their Van Dyke Copper (f) project, Gila County. James "Mack" Johnson is manager and their mailing address is: Van Dyke Mining Project, P O Box 1693, Globe, Az 85502, phone 425-3197.

RRB WR 10/31/86: James "Mack" Johnson (c) of Locide Chemical (c) reported that the water permit has been approved for the in-situ leach-~~g~~ementation operation at their Van Dyke Copper (f) property at Miami, Gila Co. but that it needs the signature of the director. They expect to start work the 15th of November and will drill in January 1987. Production of 600,000 pounds of cement copper per day should start in May 1987.

*Van Dyke Copper file
Gila*

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1992

ARIMETCO INTERNATIONAL INC.

6245 E. Broadway, Suite 350, Tucson, AZ 85711, Phone 745-8882.

President H. Roy Shipes

Vice President John Bracale

Johnson Mine T15S R22E Sec. 26

Phone 586-2241. Employees: 46 - Open pit copper mine - Heap and dump leaching - Solvent extraction electrowinning plant - Capacity 30,000 lb. copper per day.

Van Dyke T1N R15E Sec. 5

P.O. Box 747, Miami, AZ 85539, Phone 473-2421. In-situ leach-solvent extraction electrowinning feasibility studies underway.

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1991

ARIMETCO INTERNATIONAL INC.

8835 E. Speedway Blvd. #A, Tucson, AZ 85710, Phone 290-9200

PresidentH.

Roy Shipes

Vice President John

Bracale

Van Dyke T1N R15E Sec. 5

Feasibility studies underway.

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1990

ARIMETCO INTERNATIONAL INC.

8835 E. Speedway Blvd. #A, Tucson, AZ 85710, Phone 290-9200

PresidentH. Roy Shipes

Vice President John Bracalek

Van Dyke T1N R15E Sec. 5

Feasibility studies underway.

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1988

KOCIDE CHEMICAL

Van Dyke Mine

T1N R15E Sec. 30

P.O. Drawer D, Miami 85502 - Phone 473-2421 - Employees 14 - In situ leach and cement copper plant - Production 4,000,000 pounds of contained copper further refined at Casa Grande plant to produce CuSO_4 .

Vice President, Mining Jimmy Whatley
General Manager Paul Musgrove
Operations Manager Clyde Caviness
Office Manager Ruth Joplin

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1989

KOCIDE CHEMICAL

Van Dyke Mine

T1N R15E Sec. 30

P.O. Drawer D, Miami 85502 - Phone 473-2421 - Employees 9 - In situ leach and cement copper plant - Production 4,000,000 pounds of contained copper further refined at Casa Grande plant to produce CuSO_4 .

Vice President, Mining Jimmy Whatley
General Manager Paul Musgrove
Operations Manager Ross Hoar
Office Manager Ruth Joplin

TUCSON, Ariz. -(Dow Jones)- Arimetco International Inc., a Toronto-based mining company, said its Arimetco Inc. unit has filed for reorganization under Chapter 11 of the U.S. Bankruptcy Code.

*Van Dyke Mine file
(file)*

The company said its U.S. unit has experienced "serious production problems" for the past six months at its Yerington Mine in Lyon County, Nevada, that resulted in lower output and higher operating costs.

Arimetco owns and operates two copper mines in the western U.S.

The company said the Chapter 11 filing will allow Arimetco Inc. the time required to solve its production problems and to reorganize its financial affairs. The U.S. unit will continue to operate its business as debtor in possession.

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Transmitted: 1/3/97 2:34 PM (L100PGtE)

VANDYKE (E)
STATE MINE INSPECTOR

RMB
C

COMPLETE AND MAIL TO:
STATE MINE INSPECTOR
1624 WEST ADAMS, ROOM 208
PHOENIX, ARIZONA 85007-2606

MAR 24 1988

FOR OFFICE USE ONLY
START-UP NUMBER 83943076
STATE NUMBER 1017320A
MSHA NUMBER _____

Gany

NOTICE TO ARIZONA STATE MINE INSPECTOR

In compliance with the Arizona Revised Statute Section 27-303, we are submitting this written notice to the Arizona State Mine Inspector of our intent to start stop _____ move _____ (Please check one) a mining operation.

If this is a move, please show last location: _____

If you have not operated a mine previously in Arizona, please check here: If you want the Education and Training Division to assist with your mine safety training, please check here:

Karen

If this operation will use Cyanide for leaching, please check here: _____

COMPANY NAME: Kocide Chemical Corporation

DIVISION: Kocide Chemical - Casa Grande

MINE OR PLANT NAME: Van Dyke Mine TELEPHONE: 602-473-2421

CHIEF OFFICER: Paul M. Musgrove General Manager

COMPANY ADDRESS: P.O. Drawer D

CITY: Miami, STATE: AZ ZIP CODE: 85539

MINE OR PLANT LOCATION: (Include county and nearest town, as well as directions or locating property by vehicle: Mine office - 210 Live Oak (Rear) - Miami, AZ.

Plant and mine located adjacent to north edge of town of Miami, AZ, Gila County. Access via north Miami Avenue, Miami, AZ.

TYPE OF OPERATION: Solution mining (d) PRINCIPAL PRODUCT: Cement copper

STARTING DATE: 7-1-88 CLOSING DATE: _____ DURATION: _____

PERSON COMPLETING NOTICE: Paul M. Musgrove TITLE: General Manager

DATE NOTICE MAILED TO STATE MINE INSPECTOR: March 23, 1988

COMPLETE AND MAIL TO

STATE MINE INSPECTOR
1616 WEST ADAMS, SUITE 411
PHOENIX, ARIZONA 85007-2627

Van Dyke (P)

8/15/88

FOR OFFICE USE ONLY
PART-UP NUMBER <u>83937190</u>
STATE NUMBER <u>10187600</u>
MSHA NUMBER _____

Gary New

NOTICE TO ARIZONA STATE MINE INSPECTOR

In compliance with the Arizona Revised Statute Section 27-303, we are submitting this written notice to the Arizona State Mine Inspector of our intent to start stop _____ move _____ (Please check one) a mining operation.

If this is a move, please show last location: _____
If you have not operated a mine previously in Arizona, please check here: If you want the Education and Training Division to assist with your mine safety training, please check here: ?
If this operation will use Cyanide for leaching, please check here: _____

COMPANY NAME: B.L. Walthall, Inc.

DIVISION: _____

MINE OR PLANT NAME: Van Dyke Mine TELEPHONE: 473-3434

CHIEF OFFICER: B.L. Walthall

COMPANY ADDRESS: PO Drawer D

CITY: Miami STATE: Ariz ZIP CODE: 85539

MINE OR PLANT LOCATION: (Include county and nearest town, as well as directions for locating property by vehicle: _____

North boundary, town of Miami, end of Chisholm Ave; access via Magma / Miami East main gate

TYPE OF OPERATION: Construction PRINCIPAL PRODUCT: precip. plant

STARTING DATE: 6-1-88 CLOSING DATE: 11-1-88 DURATION: 5 mos.

PERSON COMPLETING NOTICE: Robert J. Zache TITLE: Materials Expid

DATE NOTICE MAILED TO STATE MINE INSPECTOR: 8-26-88

VAN DYKE Copper Co (P) on
10



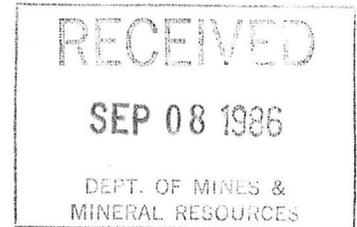
ARIZONA DEPARTMENT OF HEALTH SERVICES

BRUCE BABBITT, Governor
LLOYD F. NOVICK, M.D., M.P.H., Director

NOTICE OF PROPOSED ACTION

by the

State of Arizona
Department of Health Services
Division of Environmental Health Services
2005 North Central Avenue
Phoenix, Arizona 85004



(602) 257-2270

On Application for a Permit under the
Water Pollution Control Permit System
of the State of Arizona, Requirements
for Facilities Affecting Groundwater
Quality

The Arizona Department of Health Services (Department) is issuing the following notice of proposed action under the Arizona Compilation of Rules and Regulations (A.C.R.R.) Title 9, Chapter 20, Article 2.

The Department has received a complete application for a Groundwater Quality Protection Permit and has prepared tentative determinations regarding the permit.

On the basis of preliminary review of the requirements of A.C.R.R. Title 9, Chapter 20, Article 2 regulations, the Director proposes to issue a Groundwater Quality Protection permit to the following applicant subject to certain special and general conditions.

Public Notice No. 71-86-AZGW

September 8, 1986

X

Kocide Chemical
Box 1093
Globe, Arizona 85502
Groundwater Quality Protection Permit No. G-0003-04

The applicant will operate a solution mine for the recovery of copper values from ore in the existing mine workings of the Old Van Dyke Mine near Miami, Arizona.

Four class V injection wells will deliver a weak sulfuric acid solution, by gravity feed only, to the existing stopes. The injection wells will be constructed of steel and stainless steel and will be equipped with a concentric fiberglass feeder tube for the leaching solution. A fifth well shall serve as the recovery well for the copper-pregnant solution. This

The Department of Health Services is An Equal Opportunity Affirmative Action Employer.

recovery well will be constructed of steel and stainless steel and will be equipped with a 500 gallon per minute stainless steel pump and a stainless steel riser tube.

Following precipitation of the copper content of the pregnant solution and addition of sulfuric acid for pH adjustment the fluid shall be reinjected to the injection wells. The solution recovery rate shall be 500 gallons per minute. The initial injection rate shall not exceed 450 gallons per minute for the combined flows of the injection wells and will be adjusted in order to maintain a hydraulic sink and prevent migration of injection fluids from the discharge impact area.

Existing hydrogeologic conditions and extensive monitoring by the operator's hydrogeologic consultant should preclude migration of leaching fluids for the Old Van Dyke Mine. The applicant will monitor 20 wells for fluid level and /or water quality to detect possible migration of the leaching solutions. The ore body is located in a schist formation of low permeability and is confined above by a clay layer which varies from 60 to 100 feet in thickness. Perched above this clay layer is an overlying aquifer located in the Gila Conglomerate.

Locally, water from the Gila is used for industrial purposes, but no drinking water supply wells are operating within 3 1/2 miles of the mine site. Spill prevention and containment procedures have been incorporated in the permit conditions.

The Administrative Record, which includes the application, draft permit conditions and other relevant documents, is available for public review Monday through Friday from 8:00 a.m. to 5:00 p.m. at the address below. A copy of the draft permit may be obtained by calling or writing to the address below.

Persons wishing to comment upon or object to the proposed determinations or request a public hearing pursuant to A.C.R.R. Title 9-20-223.C should submit their comments or request in writing within thirty (30) days from the date of this notice, either in person or by mail to:

State of Arizona
Department of Health Services
Attn: OWWQM - Water Permits Unit
2005 North Central Avenue
Phoenix, Arizona 85004

Telephone: (602) 257-2270

All comments or objections submitted within thirty (30) days from the date of this notice will be considered in the formulation of the final determinations regarding the application. If the response to this notice indicates a significant degree of public desire for a public hearing, the Director shall hold one in accordance with A.C.R.R. Title 9-20-223.C. A public notice of such hearing will be issued at least thirty (30) days prior to the hearing. A request for a public hearing shall be in writing and shall state the nature of the issues proposed to be raised in the hearing.

The Director will finalize a determination on the permit within thirty (30) days following the last date on which comments may be submitted.

Please bring the foregoing notice to the attention of all persons you know would be interested in this matter.

Harry Hamilton
25-5124

OCCIDENTAL MINERALS CORPORATION

A SUBSIDIARY OF OCCIDENTAL PETROLEUM CORPORATION

VAN DYKE PROJECT
918 LIVE OAK
MIAMI, ARIZONA



P. O. DRAWER AG
MIAMI, ARIZONA 85539
(602) 473-4421

REPORT IN SUPPORT OF SPECIAL USE PERMIT APPLICATIONS

HISTORY OF THE VAN DYKE COPPER DEPOSIT

The Van Dyke deposit is part of the Globe-Miami Copper District. A simplified map and cross-section are shown in Fig. 1. The first mining in the area, beginning about 1896, recovered ore from the outcrop where the copper minerals had oxidized into high-grade ore. Leaching began in the district in the early 1920's and has continued up to the present time. Leaching is the extraction of copper from rock through the percolating of a weak acid solution which dissolves the copper minerals. Leaching has accounted for a major part of production from the district. Unlike most of the other deposits in the district, the Van Dyke deposit does not outcrop. It is completely buried under the Gila Conglomerate and underlies part of the Town of Miami. Within the town limits, the deposit lies at a depth from 1,100 to 2,000 feet below the surface.

After signing an option for the Van Dyke property in 1968, OxyMin started its exploration program and by 1975, about 40 holes had been drilled throughout the deposit. This drilling delineated about 100 million tons of oxidized copper mineralization with an average grade of about one-half of one percent copper (0.5%).

To date, OxyMin has expended in excess of \$11,000,000.00 in exploring, delineating, testing and developing the Van Dyke deposit.

STATE OF ARIZONA
DEPARTMENT OF MINERAL RESOURCES
MINERAL BUILDING, FAIRGROUNDS
PHOENIX, ARIZONA 85007

"U" corresp.
✓ Van Dyke file

December 17, 1975

Mr. L. Burton
3124 Military Avenue
Los Angeles, California 90034

Dear Mr. Burton:

The Van Dyke Mine is located in Sec. 30, Township 1 North, Range 15 East, Gila and Salt River Base & Meridian, within and under the town of Miami, Arizona. We have a variety of information on the mine in our files and library. If you have specific questions or need specific information on the mine, please do not hesitate to detail your needs and we shall endeavor to assist you.

Turquoise has become so popular that it is doubtful there are any known occurrences where rockhounding is allowed.

Please feel free to contact us any time we might be of further assistance.

Sincerely,

Ken A. Phillips
Mineral Resource Engineer

C
O
P
Y

Enc.

95

P K 342 Summary

Van Dyke Mine,

Miami - Globe District, Gila Co.

Date: 7-12-63.

Property (1963): 80 claims and fractions, 60 of which are unpatented.

Location: The ^{bulk of the} property adjoins Miami and Inspiration on the SE. and is on the SE, or hanging wall, side, of the Miami Fault.

Owners (1963): A. Watson Fritz and Mrs Fritz ^{6810 N. Central Ave.} own 70 percent of the stock, the rest being by several small stock holders. This comprises joint holding by Van Dyke Copper Co and Show Me Copper Co.

Minerals: Copper.

History: The property was acquired by ("Gleve") C.W. Van Dyke about 1916. at which time he organized the Miami Townsite Company. This company sold the surface rights, down to 40 feet below the surface, but retained the mineral rights. He then ⁽¹⁹¹⁶⁾ organized the Van Dyke Copper Co. During 1916 the latter company started a drill hole on the top of the ridge that is located 1000 feet southwest of the No. 5 shaft of the Miami Copper Co. At 1182 feet the hole intersected a fault zone that was heavily mineralized with copper carbonates and a copper silicate. At few feet below the footwall of the fault, the rotary bit twisted off, causing the abandonment of the hole. A second hole, 2600 feet east-southeast of the first hole, was then begun and this also struck 41 feet of mineralized breccia, that, according to the well log, averaged 4 percent copper, also in the form of carbonates and silicates of copper. A third hole, 6700 feet farther southeast, was abandoned after penetrating 1400 feet of Gila Conglomerate. (Later on, Miami and Inspiration, sunk a 2200 foot hole that ended in Gila)

During 1919 the Van Dyke Shaft was sunk, 200 feet south of the first drill hole, to a depth of 1692 feet and this struck the same mineralized fault zone that was cut by the first drill hole.

During 1921, the operation ^{temporarily} ceased due to unfavorable copper market conditions.

During 1923 the shaft was dewatered, and development of the copper-bearing zone, was resumed. Shipments of ore were made from 1924 to 1931. Production, 1929-1931, yielded 11,000,000 pounds of copper, valued at \$1,200,000. During this period a mile of power line was constructed from the Miami Power Plant to the mine, a new Ledge wood hoist was installed, a new gallows frame erected, ^{smaller} considerable equipment was added, and some surface buildings added. The water level, at the start of this operation, was about 300 feet below the surface.

Mines Handbook (1931) p. 457, lists the officers as follows:-

C. W. Van Dyke, president and director.

L. D. " " , V. " " " "

C. B. Loomis, Sec. and Treas. " " "

Edward A. Stone, Mine Superintendent.

The property, then, consisted of 1687 acres, of which 417 acres were patented. Workings then consisted of a 1700-foot shaft, with main lateral workings on the 1215, 1300, and 1550-foot levels.

According to a letter from Robert Rae, of Phoenix,

to Charles Willis (June 17, 1941), Rae reported that, in his opinion, the indicated reserve might be half-million tons of ore much of which would average 1-1½ percent copper but that some portions of the ore zone would run 6 percent copper. The better ore was said to reach a maximum width of 165 feet and to have a length of about 500 feet, ore continued, locally, to under 2000 feet.

Nels Peterson (US Geol Survey, P.P. 342 (1962) p. 138, ^{in 1943} reported that the mine was reopened, as a National Defence Project, but the resulting operations were not economically successful, although the ore assayed 5 percent ⁱⁿ copper. The failure to make money was attributed to the cramped operation in a single compartment shaft, at ^{the} a considerable depth of the stoping. During 1943-1945 the ore yielded 851,700 pounds of copper valued at \$1,313,330.

During 1944, the ^(May 1944) Arizona Department of Mineral Resources card shows that the property was shipping 30-40 tons of ore per day, to International Smelter, with a 5 cent premium price in effect, but also reported that the mine was idle in April, 1946.

According to the Engineering & Mining Journal, May 1947, Amico Mining Corp. had been formed by Anaconda Copper Mining Company, Miami Copper Company, and Inspiration Consolidated Copper Company, for the

Purpose of exploring undeveloped ground in the Globe-Miami District. Amico controlled, among other properties, the Van Dyke Copper Company's holdings. The Amico Company officers consisted of:

C. E. Weed, president & director

E. L. Rossin, V. " "

R. E. Schneider, Sec. & Treas. "

W. D. Thornton, director

R. S. Newlin, "

M. A. Craine, "

Since 1947, the property, as far as is known, has been idle.

In 1963 the timber in the shaft had largely been caved out. Equipment consists of the hoist, compressor, and some smaller equipment. Some surface buildings still remain (Interview with A. Watson Frite, 7-12-63)

Geology: The geology of the mine area is described by Nels Peterson, U.S. Geol. Survey, P.P. 342 (1962) pp 138-139.

June 19, 1941

Mr. Robert Rae
First National Bank Bldg.
Phoenix, Arizona

Dear Mr. Rae:

Many thanks for your letter of the 17th relative to the Van Dyke Copper Company and its potential copper production. I would take it from your statement that on a capital investment of approximately \$250,000 you believe that the Van Dyke could be brought into production and bring out 300 tons per day of 6 per cent copper ore. This certainly should qualify it for inclusion in our report.

There is some additional information that I want to get. Included within this report we anticipate putting a brief description of the properties which will be listed as potential producers. In order to have these brief reports uniform in their contents we have gotten up another questionnaire showing the points we want to cover, and it will be greatly appreciated if you will fill in one of these questionnaires for the Van Dyke and return it to us.

Thanking you, and with kindest personal regards, I am

Yours very truly,

Chairman, Board of Governors
Arizona Department of Mineral Resources

CFW:LP
Enc.

NAME OF MINE: VAN DYKE

COUNTY: GILA E

DISTRICT:

METALS: CU

OPERATOR AND ADDRESS:

MINE STATUS

DATE:

5/1/44

Gilva Van Dyke Estate
Miami, Arizona

DATE:

5/1/44

Producing 50 tons daily
Shipping 30 to 40 tons
daily to International
Smelter--Has 5¢ special
premium

4/46

Idle

VAN DYKE COPPER CO.

Cu

Gila

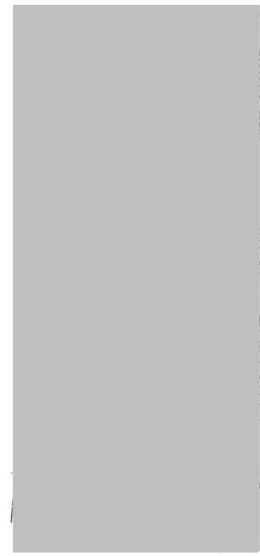
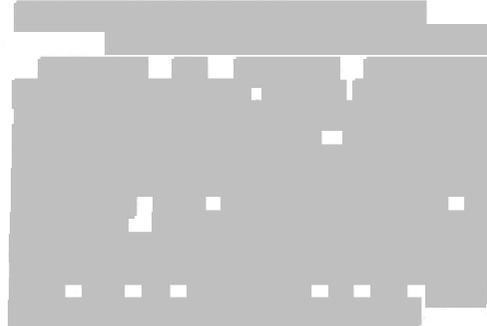
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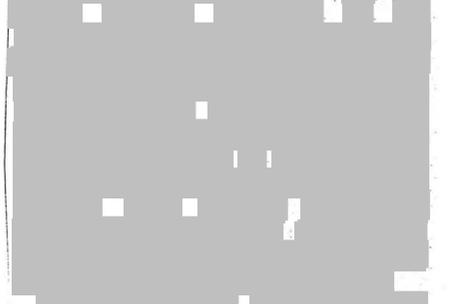
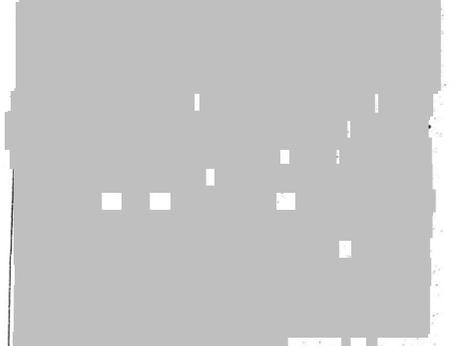
Van Dyke Copper Co., Miami

'41

for FEBRUARY 28, 1929



JOURNAL - 4-30-42



4-9-62 - FPK- Memo

See: Production possibilities of The Marginal Copp
Dept. of Mineral Resources, 1941.

Mines Handbook 1931.

May 1947

ROBERT RAE

PHOENIX, ARIZONA

June 17, 1941.

Mr. Charles Willis
 Arizona Mining Journal
 Phoenix, Arizona.

Dear Mr. Willis:

Inasmuch as you are unable to complete your survey through failure of the Van Dyke Copper Company to return your questionnaire, I am perfectly willing to give you all the information I have regarding this company and what might be done with it were it adequately financed and managed.

The property originally contained 1700 acres. This may have been reduced to about 1200 acres. From what I have been able to learn from Hoval Smith, Pat Van Dyke, and others, I should say that the body of ore 250 feet north of the shaft on the 1200 level has been developed more than 500 feet, and the easterly face was still promising, and that the westerly face had run into a north and south fault and was considerably broken up.

This ore runs in grade on the average of about 6 per cent with a maximum width, so far developed, of 165 feet. It has also been cut on the 1300 feet level and the strike is East and West. My informants say that there is a potential area for the continuation of this body for 3,000 feet, which has still been untouched, except by a drill which indicates the same ore as that developed on the 1200, and the ore samples taken at tremendous distances along the line of fracture from the point of discovery on the 1200 feet level are declared by one of the most eminent Crystologists to be identical in every way as the ore at point of discovery, and that they are one and the same thing in every respect and were created together.

As for the rest of the property, which has been more or less explored by drills, demonstrates that there is a solid tonnage of copper ore running in grade from $1\frac{1}{2}$ to $1\frac{3}{4}$ %.

The possibilities for the development of a tremendous ore body are great when one considers that mineralization has been demonstrated to extend below the 2,000 ft. level. It would be futile to enter into a discussion of the tonnage possibilities.

My information is that 200 tons per day were being shipped to the International Smelter in Miami, at the time of the shut down with the collapse of everything a little over ten years ago, and my belief is that a steady tonnage of 300 tons per day can be maintained over a long period when you consider that the high grade body is considered to have over a million tons. Of course, I do not say it has over a million tons and I am quite willing to admit that there is a fair chance of one-half million tons existing in the body as it is now developed, with a great, big chance of developing probably three or four times that amount.

170
 300
 360,000
 300
 1,080,000

300 + 6%

6/17/41.

To make it short and snappy, here is what I think can be done:

To unwater the mine, it will take	\$30,000.00
To put the underground workings in shape for production,	50,000.00
To provide adequate finances for a surface plant commensurate with the operation	25,000.00,
For a working fund	50,000.00
And a development fund which would undertake the expenditure of \$5,000.00 a month in opening up the known ore body	<u>30,000.00</u>
Or a total of	\$185,000.00

in 6 months

or say \$200,000.00. I believe that with, say, not to exceed \$250,000.00, the Van Dyke Copper Company could be brought into production on a scale of not less than 300 tons per day. But if the R.F.C. were to put up that much money, it must be understood that they would put in their own man. Someone like Rockwood or Bill Gohring, who are now in the Phoenix office, to direct and superintend all of the operations and I would take over and supervise the accounting as I do now for the Congress Mining Corporation, which is under the supervision of the Reconstruction Finance Corporation.

Please understand that my exclusion of Mr. Van Dyke from the operations is justified by the past and is in no way a vindictive matter. It is what the R.F.C. would insist upon, I think, and I want them to understand that so far as I am concerned I would have no objection whatsoever to the elimination of him running the mine until such time as they had refunded their borrowed finances to the R.F.C., and it would be back in the hands of the Van Dyke Copper Company.

If there is anything further you want to know about the property and I can furnish it, I will be very happy to do so.

I am of the opinion that a 16 cent copper market would permit the Van Dyke Copper Company to operate and to repay to the R.F.C. within a period of five years the \$250,000.00, or thereabouts, which might be loaned to it.

Yours very truly,



ROBERT RAE.

RR:n

SOCIETY OF MINING ENGINEERS

P.O. BOX 625002, LITTLETON, COLORADO 80162-5002

PREPRINT
NUMBER

88-66



CASE HISTORY: VAN DYKE ISL COPPER PROJECT

R. V. Huff

S. G. Axen

D. R. Baughman

Ray V. Huff & Associates, Incorporated
Golden, Colorado

For presentation at the SME Annual Meeting
Phoenix, Arizona - January 25-28, 1988

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IN-SITU LEACHING - WHY AND HOW

Due to the depth of the deposit, the low grade of the mineralization and the fact that a major portion of the deposit is under the Town of Miami, conventional mining methods, such as open pit or block caving, would result in major surface disturbance within the Town of Miami. A modern mining method, in-situ (in-place) leaching through drill holes, however, offers considerable promise. In-situ solution mining means dissolving and recovering the mineral values in the rock at great depths with solutions that are pumped down injection wells and pumped back up and out of recovery wells. The average copper mineral in hairline fractures is about five hundredths of an inch thick (0.05") or about as thick as a penny. A very minute amount of material, approximately four pounds leached from each ton of rock, will be removed. Because only this tiny fraction will be removed to the surface, no cavities will be formed. Collapse and surface subsidence is therefore impossible.

OXYMIN'S 'IN-SITU TESTS

Phase I

OxyMin in January, 1976, decided to start in-situ leach pilot testing through surface drill holes. Two holes were drilled to a little over 1,000 feet in depth and 75 feet apart. As shown in Fig. 2, the specific zone to be leach-tested was then hydrofractured with water and a fluid connection was established between the holes. Hydrofracing, or more properly, hydraulic fracturing, involves pumping water to the bottom of a cased well. When the fluid pressures from the water downhole exceed the rock pressure, the hairline fractures are opened slightly and thus form passages through which the fluid is circulated. Hydrofracturing, as used in the Van Dyke deposit, will extend the fractures a maximum of about 200 feet from the point of fluid injection.

After pressure testing with water to demonstrate the absence of casing leaks, weak sulfuric acid solution was then injected through one hole into a selected part of the copper oxide zone and retrieved up the other hole. Testing, to date, has proven that in-situ leaching of this deposit can be accomplished. A very important result of the completed Phase I test is that it proved that blasting is not necessary to increase permeability and that the continuation of OxyMin's tests will require no underground detonation.

Phase II

In January, 1978, OxyMin began to expand the pilot testing to learn more about the leaching process. With this in mind, nine additional drill holes were completed in the ore zone. Pumps, piping and tanks were installed on the surface to inject the weak sulfuric acid solution and recover the copper-bearing fluids. In the Summer of 1978, injection began. This test work has continued to the present. During this testing period, OxyMin has evaluated the fluid flow through the ore and the chemistry of the leaching process. In addition, much has been learned about the equipment used in the leaching process and about the preparation of drill holes for leaching.

The results of testing to date in Phase II are quite encouraging. Many important questions still remain unanswered, however, before the operation is commercially feasible. To answer these remaining questions, OxyMin needs to conduct further testing (Phase III).

Phase III

Prior to bringing the Van Dyke deposit into commercial production, OxyMin must determine that the in-situ leaching process will be economically successful. To do this, a demonstration test must be conducted. This test will be almost like a commercial operation but much smaller in size. OxyMin intends to drill 15 wells at Cities Service Company's old power plant site. Four wells will be used for solution injection and nine wells will be used to produce the copper-bearing liquid.

As soon as the permits are granted, preparation for drilling will start. At the same time, construction of surface equipment to handle the liquids will begin. About the middle of 1980, the demonstration test will begin.

This well field will be operated just like a full scale operation and will provide leaching data. The data, when analyzed, will allow OxyMin to determine if a full scale operation will be profitable.

Section 2.201 of the Miami Zoning Ordinance deals with public health, safety and welfare, particularly regarding nuisances arising from noise, smoke, odor, dust, fumes, vibration and illumination, and hazards arising from explosion, contamination, fire, flood or unusual traffic.

None of the listed hazards to the public are anticipated to result from the proposed drilling and testing operations at the old power plant site. Explosives will not be used. Applicable federal and state safety regulations concerning the prevention and control of fire, flood and other hazardous conditions are mandatory and are enforced by state and federal agencies and personnel. In addition, OxyMin's internal safety procedures and practices often exceed the federal and state regulation requirements. All OxyMin personnel have taken first aid courses and an OxyMin official was instrumental in setting up Mine Safety and Health Administration courses conducted in Miami and at Gila Pueblo College. Inasmuch as test site employees will be using the same access route as at the Phase II test site, no traffic hazards are anticipated. During routine operations, hazards from contamination (specifically of concentrated acid) resulting from equipment or storage tank failure, will be contained (by drainageways and berms) to the immediate working area, which will be off limits to the public. There will be no contamination of actual or potential groundwater sources of drinking water, as indicated by hydrological studies heretofore conducted by professional hydrologists.

Nuisances likely to arise during drilling operations will be handled as below:

1. Noise - Drilling equipment selection will include specifications regarding maximum noise levels, particularly from engines. Electric drive equipment may be selected on this basis. A wooden fence will be constructed to visually screen from public view those operations. Further, the fence will reduce noise and obscure stray illumination.

2. Illumination - In addition to the above, lighting will be designed to direct lights away from the Town of Miami.

3. Other - Smoke, odor, dust, fumes, vibration and traffic have not been a source of problems on our Van Dyke test site, and are not anticipated to be problems here.

HAS IN-SITU LEACHING BEEN USED BEFORE?

In-situ leaching operations under towns are not new. There are many present day examples of deposits being mined under towns at the same depths, or closer to the surface, than OxyMin's Van Dyke copper deposit. There are no commercial in-situ solution copper mining operations, but there are many successful commercial in-situ solution uranium and salt mining operations in existence today. In the State of Michigan, there are at least five commercial in-situ solution salt mining operations below towns, at depths ranging from 900 to 3,500 feet. There are two similar commercial in-situ solution salt mining operations in Ohio, and two in New York. One of the New York operations has been continuously operated for the past 70 years.

The objective of OxyMin is to apply some of the known and commonly used in-situ solution mining techniques to the Van Dyke property, so it will not be necessary to excavate large quantities of rock.

COMMERCIAL DRILLING WOULD BE UNDERGROUND

OxyMin anticipates in-situ solution leach mining from underground workings if further pilot test work proves the economic feasibility of commercial production. This would mean no noise, lights or vibration in the town. A vertical shaft will be sunk outside the town limits and a gridwork of nearly horizontal drifts will be driven below the town. The solution injection and recovery wells will be drilled and operated from the underground drifts, as shown in Fig. 3.

The leach solutions will be weak sulfuric acid, the same as used by several other copper mining companies in this part of Arizona. The copper in the leach solutions will be recovered by a conventional solvent extraction and electrowinning plant built on the surface. The solutions from the plant which are then barren of copper will be recycled into the in-situ leaching circuit.

There will be no mill, dumps, tailings or smelter associated with this environmentally attractive and technically advanced operation. The shaft and the extraction plant will be the only sizable surface installations and they will both be outside the town limits.

WHAT ABOUT WATER?

Ground water for municipal supply in the Miami area is now obtained from several wells in the Central Heights area, about three miles northeast of the Van Dyke deposit (Fig. 4). They tap the upper sandstone layers of the Gila Conglomerate and yield moderate amounts of good quality water. Ground water from the alluvium in Bloody Tanks Wash, closer to the deposit, is used only sparingly for municipal purposes in extreme dry periods when it is added in fractional amounts to the Central Heights water.

OxyMin has constructed two wells for monitoring purposes in the alluvium of Bloody Tanks Wash in Miami. These wells are about 100 feet deep, and are located within 500 feet of the test site. These wells were specifically constructed so that representative groundwater samples can be obtained by pumping from the

alluvial aquifer in the Bloody Tanks Wash. Sampling from these wells has continued monthly since May, 1976, and will continue in the future. The factual data from these samples have been, and will continue to be, submitted to the Miami Town Council. The data indicate that no significant change in chemical constituents in the ground water has occurred during the pilot test leaching activities. No less than two additional water monitor wells will be drilled at the test site and water monitoring will be conducted throughout the testing operations.

OxyMin has not conducted in the past, nor does it intend to conduct in the future, any operations that will impair the quality of the ground water within the Miami area. To this end, OxyMin will continue its hydrological evaluation and groundwater monitoring programs throughout all phases of its operations. All activities in the past and in the future will conform to or exceed proposed Environmental Protection Agency regulations for this type of operation.

WHAT WILL HAPPEN IF OXYMIN GOES AHEAD?

If OxyMin's further testing operations prove successful, full development will not only be compatible with the economic and environmental interests of the Town of Miami but will, in fact, be of substantial benefit to the entire Miami area. If the test proceeds, OxyMin anticipates spending approximately \$16,000,000.00 on the test over the anticipated two-year test period. If the test results warrant full scale commercial production, it is anticipated that more than \$360,000,000.00 will be spent in capital and operating costs and expenses over the 15-year estimated life of the deposit. In such event, OxyMin anticipates employing a work force of over 200 employees with a direct annual payroll of over \$3,500,000.00. The town's tax base will obviously benefit from such an operation as will the tax bases of the Miami Unified School District and of Gila County. On the other hand, if OxyMin abandons the Van Dyke

Project, the direct result will be the loss of no less than 35 to 40 jobs in the Miami area and of its present direct payroll of over \$1,000,000.00.

Respectfully submitted this 18th day of December, 1979.

OCCIDENTAL MINERALS CORPORATION

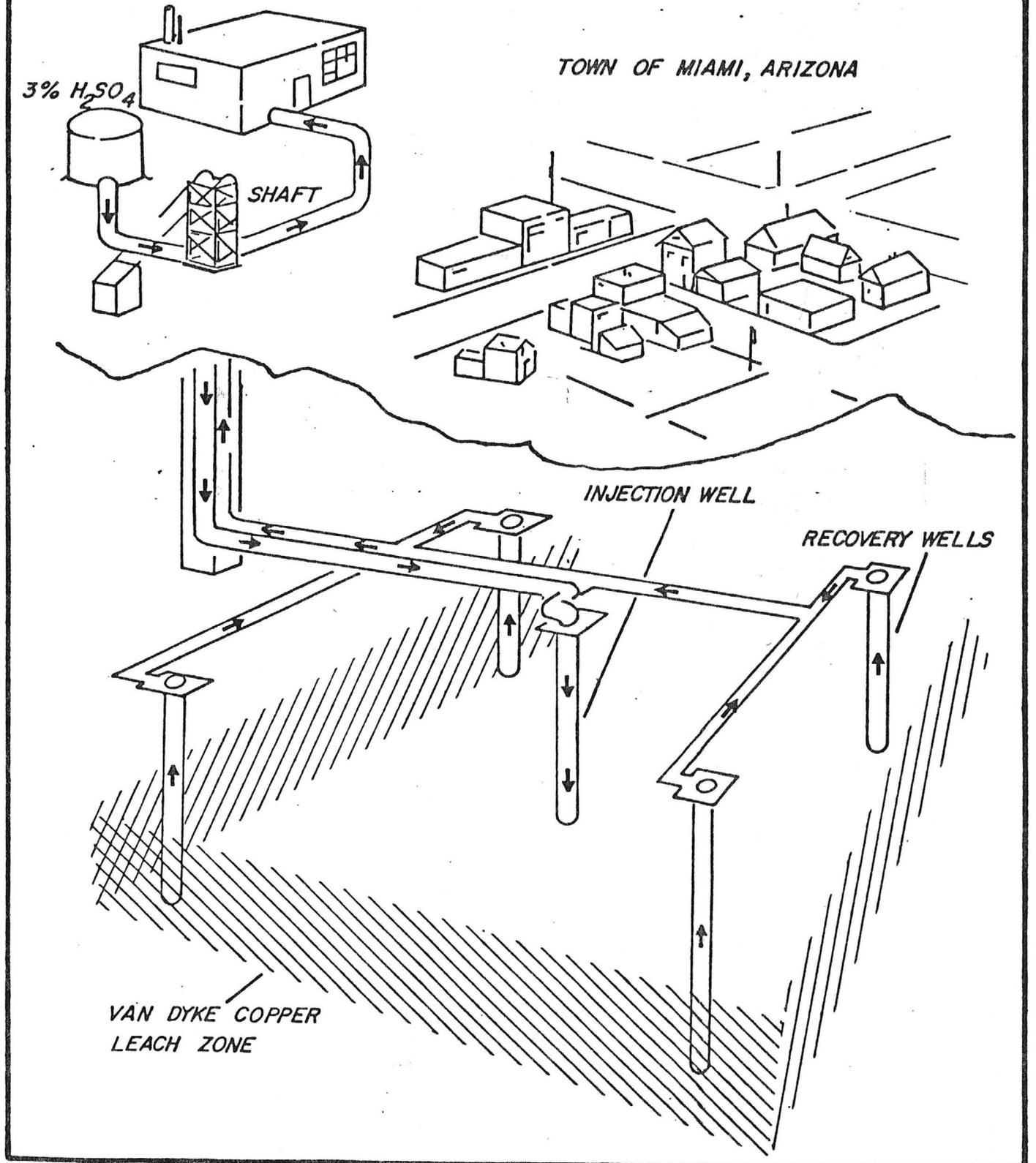
By 
Frank M. Monninger, Vice President
Development and Operations

Attachments:

1. Letter to Occidental Minerals Corporation from Mountain States Mineral Enterprises, Inc. expressing opinion that no subsidence will occur.
2. Letter to Occidental Minerals Corporation from John W. Harshbarger that no ground water contamination will occur.

OXYMINS INSITU SOLUTION LEACH PLAN FROM UNDERGROUND STATIONS SCHEMATIC OF ONE BLOCK OF THE 51 PROPOSED LEACH GALLERIES. EACH GALLERY IS COMPOSED OF FOUR BLOCKS.

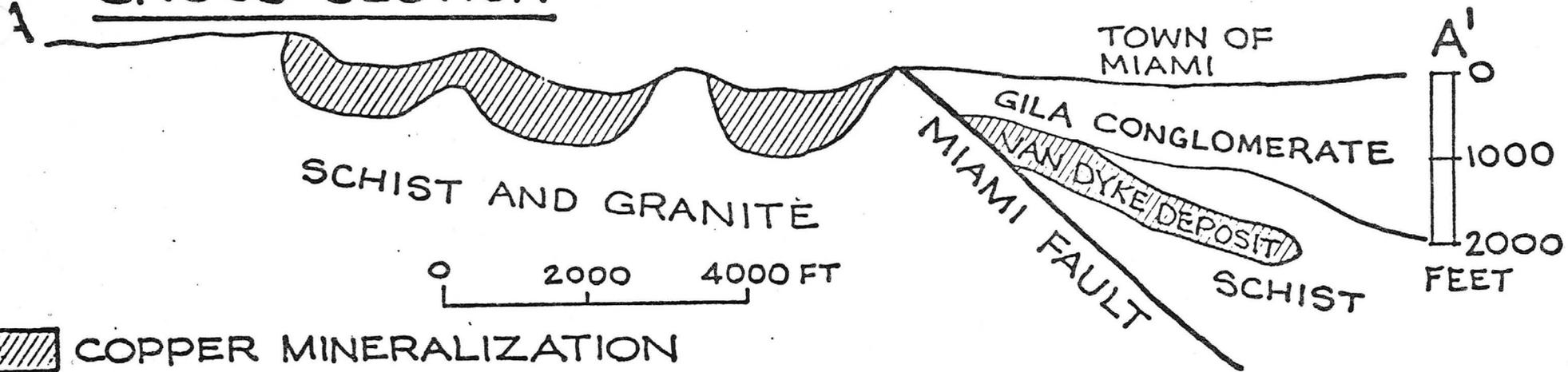
SOLVENT EXTRACTION-ELECTROWIN PLANT.
FINAL PRODUCT: 99.97% COPPER CATHODE.



MIAMI AREA - PLAN VIEW

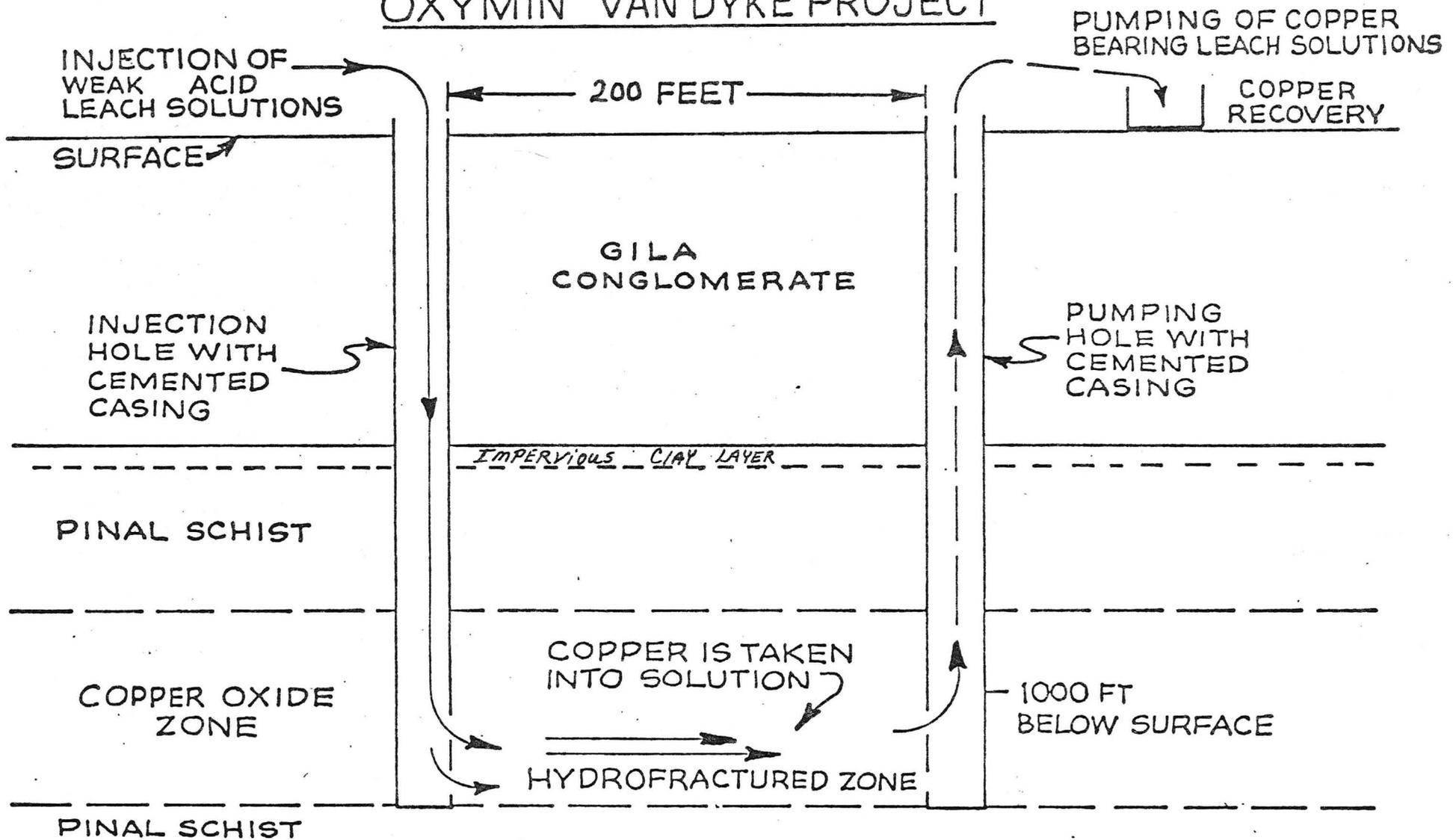


CROSS SECTION



 COPPER MINERALIZATION

OXYMIN VAN DYKE PROJECT



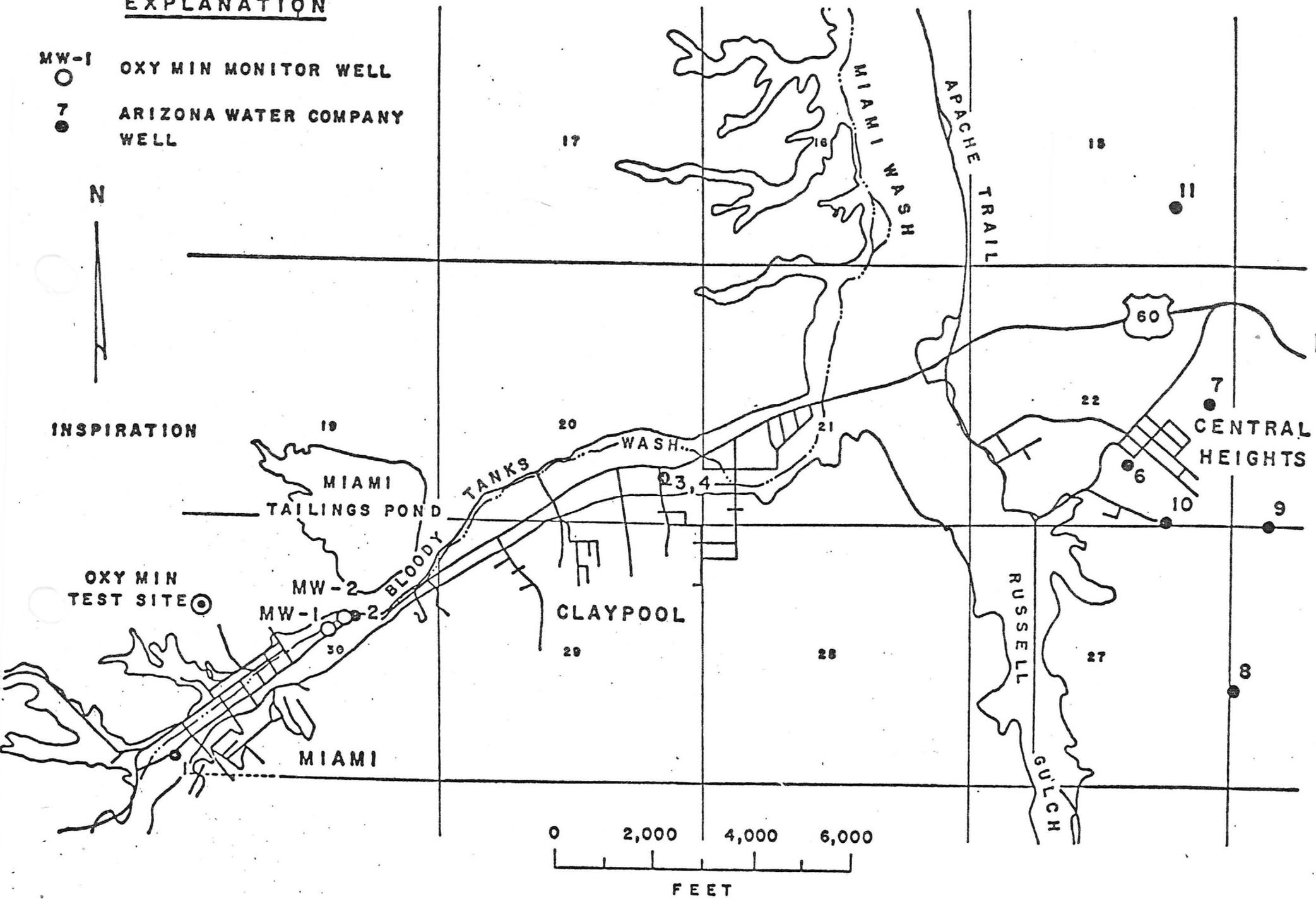
SCHEMATIC REPRESENTATION OF SOLUTION MINING TEST

EXPLANATION

- MW-1 ○ OXY MIN MONITOR WELL
- 7 ARIZONA WATER COMPANY WELL

N

INSPIRATION



MAP OF MIAMI-CLAYPOOL AREA, ARIZONA

Van Dyke file
Kocide Chemical (Griffin Corp.)
Gila Co.
K

KOCIDE CHEMICAL - CASA GRANDE



Miami, Arizona
January 16, 1986

wholly owned subsidiary
of Griffin Corporation

Contact:

Mack Johnson
General Manager
425-3197

VAN DYKE COPPER MINE REOPENS

FOR IMMEDIATE RELEASE

The Van Dyke Copper property which last produced during World War II and was the site of extensive research on the in-situ leaching process five years ago is about to come back to life.

Kocide Chemical-Casa Grande, a wholly owned subsidiary of Griffin Corporation of Valdosta, Georgia has an agreement with the owners of the Van Dyke Copper Company to operate the Van Dyke Copper Mine in Miami, Arizona.

Work has resumed to begin leaching the underground workings and application for permits to drill have been taken out with the Town of Miami.

Kocide Chemical Corporation's offices are in Houston, Texas and they have manufacturing facilities in Houston and Casa Grande, Arizona. The company manufactures and markets a full line of agricultural products, the majority of these products having a copper base. The Van Dyke mining operation will be a division of Kocide Chemical-Casa Grande.

Kocide intends to commense production during the month of July and will employ approximately twelve people. Additional employees will be added as the production levels of the mine increase.

Kocide, during the initial phases of operation, plans on producing approximately 600,000 pounds of copper per month. The production level of copper should increase to approximately 1.5 million pounds within two years.

ARIZONA DEPT. OF MINES & MINERAL RESOURCES
STATE OFFICE BUILDING
416 W. CONGRESS, ROOM 161
TUCSON, ARIZONA 85701

FROM: PROB. POSSIBILITIES
OF MARGINAL CUMULATIVE, 1941
ADAR

VAN DYKE COPPER COMPANY

The property of the Van Dyke Copper Company is located at Miami, Arizona, and adjoins holdings of the Miami Copper Company and the Inspiration Consolidated Copper Company. It is well situated insofar as transportation and rail facilities are concerned.

The company was incorporated in 1916 and the property originally contained 1,700 acres but this may have been cut to 1,200 acres, of which 393 are patented, later. For many years development operations were carried on and in 1929 production was started with shipments going to the International smelter at Miami.

During that and the following two years, the company shipped ore containing 11,000,000 pounds of copper valued at \$1,200,000. This production came from ores from 5 to 10 per cent copper, but plans were made for the construction of a leaching plant for the treatment of ores containing less than 3 per cent copper. This proposed plant was never built and all production was brought to a halt in 1931 as a result of depressed prices.

The mine has not been worked since the 1931 shutdown and financial difficulties in the years following necessitated a reorganization. This was effected with the approval of both the creditors and stockholders.

The copper deposit of the Van Dyke company is in Pinal schist capped by a blanket of conglomerate. There are two leading types of ore in the property.

One is a highly brecciated ore of silicates and carbonates running from 5 to 15 per cent copper — it is a broken schist highly impregnated with malachite and veined with azurite and chrysocolla. The other is a somewhat massive black ore veined with malachite and azurite and often seamed with streaks of chrysocolla. Chalcocite is reported to be present at lower levels.

A body of ore 250 feet north of the shaft on the 1,200-foot level of the mine has been developed for more than 500 feet. This ore averages about 6 per cent copper with a maximum width, so far developed, of 165 feet. It has been cut on the

1,300-foot level and according to responsible engineers there is a potential area for its continuation for a distance of 3,000 feet. This extension has not been touched except by drill but drilling indicates that the ore is the same as that developed on the 1,200 level.

The rest of the property which has been pretty well explored by drilling appears to contain a solid tonnage of copper ore running in grade from $1\frac{1}{2}$ to $1\frac{1}{8}$ per cent copper. The possibilities of the development of a tremendous ore body are great when it is considered that mineralization has been demonstrated to extend below the 2,000-foot level.

At the time of the shutdown, about 10 years ago, 200 tons of ore were being shipped to the International smelter daily and it is believed that steady shipments of 300 tons of ore a day could be maintained over a long period. There are probably 500,000 tons of ore reserves in the deposit as it is now developed and reliable engineers state that there is a big chance of developing three or four times that amount.

To place the mine in production would probably cost not more than \$250,000. This would include unwatering, putting the underground workings in shape for operations, provision of a surface plant commensurate with the operation, working capital, and a development fund for opening up the known ore body. With this expenditure, it should be possible to bring the Van Dyke into production at a rate of 300 tons of ore a day.

The production of the higher grade shipping ore at a rate of 300 tons a day should yield 10,800,000 pounds of copper a year, but capital would have to be provided and a higher price would be needed. It would take a price of 16 cents a pound and this would have to be guaranteed for a period of five years to permit recovery of the capital investment. A number of months would be required to make the necessary preparations for production.

ore body, dacite forms the hanging wall on the south side, and schist the footwall. This interval probably presents a normal contact along which the dacite presents a steep cliff on the old land surface possibly formed by the fault scarp. The cross sections of the ore body, of which figure 12 is typical, indicate an offset in the base of the dacite of 90 to 100 feet. The outcrops over this offset in the base of the dacite are generally free of detritus, yet, despite careful search, no evidence of a fault through the dacite has been found. The Geneva mine is about 2,000 feet east of the Black Warrior mine, near the intersection of the Warrior fault zone with the Miami fault. The copper deposit is in a narrow graben of interbedded tuff and conglomerate in the Warrior fault zone. According to Ransome (1903, p. 158-159), the tuffaceous conglomerate is about 4 feet thick. The ore body was nearly horizontal, 4 feet in maximum thickness, and 15 feet wide, lying near the base of the tuff. It rarely possessed definite boundaries but graded into low-grade ore, and this into argillized tuff faintly tinged green by copper. The ore is similar to that of the Black Copper and Black Warrior deposits; the best ore contained about 20 percent copper.

LIVE OAK AND KEYSTONE VEINS

HISTORY

The earliest mining in the area of the Miami-Inspiration disseminated-copper deposits was done on the Keystone and Live Oak veins, which cropped out in the eastern part of the mineralized area. All outcrops of these veins have long since been obliterated by caving operations of the Inspiration mine.

Development of the Keystone vein was begun in 1897; and to 1905, about 1,000 tons of hand-sorted silicate ore had been shipped to various reduction works. In 1905, the Keystone Copper Co. was organized to continue exploitation of the deposit. A chlorination leaching plant having a daily capacity of 25 tons was built to treat the ore. This operation never became an economic success but was continued until 1907, when the bottom of the silicate ore had been reached.

The Live Oak Copper Mining and Smelting Co. was organized in 1898 to develop a group of four claims owned by J. J. Marshall, who had sunk a shaft 160 feet deep on a copper-silicate vein resembling the Keystone vein. The company started sinking a new shaft which reached a depth of only 40 feet, when all work was discontinued. The operation was resumed in 1905 and continued until 1907.

Since 1909, the history of the Keystone and Live Oak properties is concerned with the exploration and development of the Miami-Inspiration ore body.

The Keystone and Live Oak deposits are credited

with productions of 427,000 pounds and 2,890,000 pounds of copper, respectively, with a total value of about \$600,000.

DESCRIPTION

The Keystone and Live Oak veins occupied fissures in the sill-like body of granite porphyry facies of Schultze granite that overlies the schist in the western segment of the Miami-Inspiration disseminated copper deposit (pl. 7). Ransome (1903, p. 160-161) described the ore in the Keystone vein as "bluish-green, brittle chrysocolla adhering finely to the porphyry walls of the fissures and frequently inclosing fragments of the country rock." The ore contained a little quartz and malachite, the latter as streaks in the chrysocolla. It appeared to fill mechanically formed spaces for the most part, but there was also a little replacement of the wall rocks. The richest ore contained about 25 percent copper, and the maximum width was about 18 inches. The ore was followed down to the underlying schist where it ended at the contact (Ransome, 1919, p. 19).

The chrysocolla undoubtedly was deposited by supergene solutions that collected in the fissures and contained copper leached from the surrounding rock which is now being mined as low-grade oxidized copper ore. In the general area in which these veins occurred, there are many small veinlets containing chrysocolla similar to that described by Ransome.

VAN DYKE DEPOSIT

HISTORY AND PRODUCTION

When exploration in the Miami-Inspiration area showed promise of future large scale mining operations, Cleve Van Dyke acquired the property on Miami Flat, which is now the site of Miami, and organized the Miami Townsite Co. This company sold building lots to individuals but retained the mineral rights below a depth of 40 feet from the surface. Van Dyke then organized the Van Dyke Copper Co., and these mineral rights were transferred to it.

In 1916, Van Dyke Copper Co. started a drill hole from the top of a ridge 1,000 feet southwest of the present main (No. 5) shaft of Miami Copper Co. The hole was drilled with a rotary rig similar to those used in drilling for oil. At a depth of 1,182 feet the drill intersected a fault zone heavily mineralized with copper carbonates and copper silicate. A few feet below the footwall of the fault, the bit twisted off, and the hole was abandoned. A second drill hole, 2,600 feet east-southeast of the first hole, intersected a zone of mineralized breccia for 41 feet that, according to assays recorded in the drill log, averaged about 4 percent copper, in the form of carbonates and silicate. A third hole, about 6,700 feet farther southeast, was abandoned

at a depth of 1,400 feet, without getting through the Gila conglomerate.

In 1919 the Van Dyke shaft was sunk at a location 200 feet south of the first drill hole to a depth 1,692 feet and intersected the same mineralized fault zone that had been cut by the drill hole. The sharp decline in the price of copper in 1921 discouraged development at that time, and exploration was discontinued.

In 1928 the shaft was unwatered, and development of the copper ore body was resumed. Shipments of ore were made the following year and continued until 1931, when the decline in metal prices made further operation unprofitable.

The mine was reopened in 1943 as a National Defense project, but the ensuing operation was not an economic success, although the average copper content of the ore produced was about 5 percent. The difficulties experienced in getting the ore to the surface from the 1,212-foot level and servicing the underground operations through the single small hoisting compartment of the Van Dyke shaft were largely responsible for the excessive costs that precluded the mining of lower grade ore. The mine was closed in June 1945 and is now inaccessible.

The production of the Van Dyke mine during the two periods of operation is shown in the following table 6.

TABLE 6.—Copper production of the Van Dyke mine

	Copper (pounds)	Value
1929-31.....	¹ 11,000,000	\$1,200,000
1943-45.....	² 851,700	113,330
Total.....	11,851,700	\$1,313,330

¹ Elsing and Heineman (1936, p. 92).

² Published with permission of Van Dyke Copper Co.

DESCRIPTION

The Van Dyke deposit is in the depressed hanging-wall block of the Miami fault, opposite the east end of the Miami-Inspiration ore body. The Van Dyke shaft was sunk in Gila conglomerate and entered the underlying Pinal schist at a depth of 760 feet (fig. 13). To a depth of 1,440 feet, the schist has the general characteristics of capping formed by supergene oxidation and leaching of a low-grade disseminated-sulfide deposit. It contains residual limonite and small amounts of oxidized copper minerals. According to the mine records, the shaft passed through a low-grade chalcocite zone from 1,440 to 1,600 feet below the collar; and below this passed through schist containing a little pyrite and chalcopyrite. The lower 60 feet of the shaft is in very heavy ground, possibly the Miami fault zone.

The shaft intersected a breccia zone from 1,183 to

1,218 feet below the collar. The zone was sufficiently mineralized with copper carbonates and silicate to constitute an ore body. The footwall of the ore body is clearly defined by a layer of tough red gouge that strikes a little west of north and dips 20° E. The most extensive development in the ore body is north of the shaft. About 200 feet northeast of the shaft, the ore body is

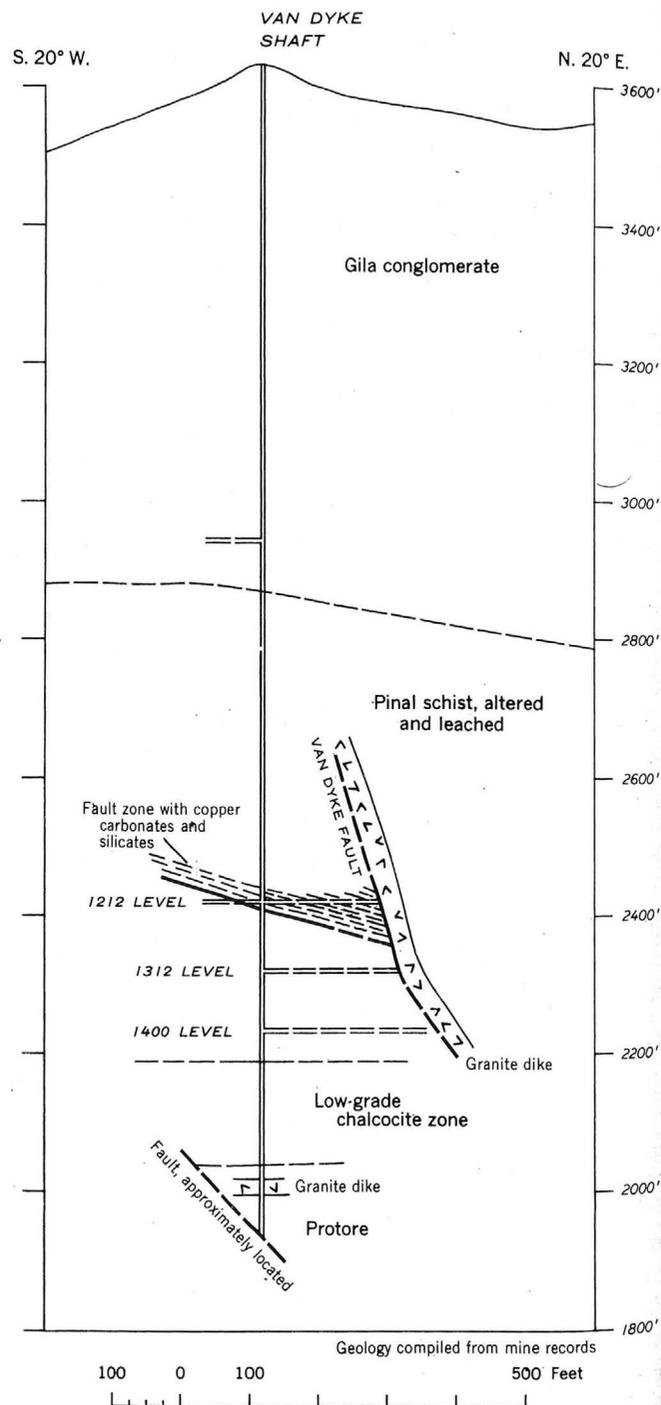


FIGURE 13.—Section along a line striking N. 20° E. through Van Dyke shaft.

terminated by the Van Dyke fault which is coincident with the footwall of a granite porphyry dike. The fault and dike strike N. 70° W. and dip 70° NE.

The localization of the copper minerals appears to have been controlled by the intersection of the low-angle fault zone with the Van Dyke fault. The greatest amount of brecciation and the best ore occurred near the intersection, and the amount of brecciation and ore minerals decreases progressively southwestward. The Van Dyke fault clearly served as a barrier to the copper-bearing solutions that seeped into the low-angle fault zone.

The copper minerals in the ore consist entirely of azurite, malachite, chrysocolla, and tenorite. According to I. A. Ettlinger (written communication, 1929):

These oxidized copper minerals are not the result of oxidation in place of a primary sulphide ore body which contained copper but were first deposited as carbonates and silicates by laterally moving or descending solutions either in a practically barren fault zone or at least a fault zone containing small amounts of pyrite and traces of chalcopyrite. This fact is clearly demonstrated by the oxidized copper minerals which are filling voids and act as a cementing material for irregular angular fragments of practically unaltered schist. The oxidized copper minerals in filling these voids between the schist fragments appear as crustations and in many places assume botryoidal form.

The deposition of the copper carbonates and silicate may have occurred while oxidation and leaching of the surrounding sparsely mineralized schist protore was in progress, probably before the Gila conglomerate was deposited and possibly before the eruption of dacite. The age of the faults has not been determined. The Van Dyke fault, if projected upward, would intersect the shaft near the point where it enters the schist; but whether the fault displaced the Gila is not known. At the time the shaft was sunk, the ground-water level was at 300 feet; that is, about 900 feet above the ore body. Most likely the ore body was formed before displacement occurred on the Miami fault, when the water table in the block now depressed was below the level of the ore body.

The mineralized zone cut by the second drill hole is about 670 feet lower in elevation than the ore body cut by the first hole, but its attitude is not known. The intersection of the faults, as seen in the mine workings, plunges southeastward with a dip and bearing that, if projected, would pass near the ore zone cut by the second hole. It is possible that the two bodies are along the same structure, and they may be connected.

CARLOTA DEPOSIT

Near the southwest corner of the Inspiration quadrangle, deposits of copper carbonates and silicates occur in shattered rock along the Kelly fault zone (pl. 7).

At two places the rock has been sufficiently mineralized to constitute ore; one is on the Carlota property, the other is 2,000 feet southeast of the Carlota mine near the old Arizona National shaft.

The Kelly fault zone has an average strike of N. 60° W., and it dips 60° to 70° NE. At the Carlota mine and northwestward to the edge of the quadrangle, a diabase sill intruded between Pinal schist and the base of the Apache group forms the footwall of the fault zone, and dacite forms the hanging wall. In the vicinity of the mine, the dacite is underlain by Whitetail conglomerate and hydrothermally altered Pinal schist; but farther westward, it probably is underlain by Whitetail conglomerate and Paleozoic limestone. The details of structural relationships as they were before the eruption of the dacite cannot be determined. Southeast of the Carlota mine a wedge of shattered but unaltered schist crops out within the fault zone; whereas just northwest of the mine the fault structure becomes complex, and lenticular blocks of Whitetail conglomerate, Paleozoic limestone, diabase, and altered schist crop out in the fault zone.

In the Carlota deposit, the copper minerals occur in brecciated diabase in the footwall of the fault zone. The ore body has no sharp boundaries but grades into low-grade material in which the mineralized fractures are too narrow and too widely spaced to make ore. Its maximum dimensions at the outcrop are about 250 feet long by 100 feet wide. The depth to which rock of ore grade extends is not known. On the deepest level of the mine, about 200 feet below the outcrop, the mineralized zone appears to have contracted to a few major fractures.

A small ore shoot 2,000 feet southeast of the Carlota mine occurs in schist breccia within the Kelly fault zone. At this point altered schist forms the hanging wall of the fault and unaltered, coarse-grained, quartz-sericite schist the footwall. About 1904, a shaft was sunk by the Arizona National Copper Co. to explore the fault zone in the vicinity of the ore body. According to the mine records, which are rather meager, the shaft was sunk about 250 feet in schist breccia, at which depth it entered diabase. A crosscut driven northeastward on the 280-foot level is reported to have intersected a zone of carbonate ore, but the extent of the ore and its location in relation to the shaft are not described. The shaft and a northeast crosscut on the 125-foot level should have intersected the ore zone, but the records do not show that they did. The shaft is now caved.

Some shipping ore was produced in 1943-45 from an open-cut on the outcrop of the fault zone. The mineralized fault breccia is mainly of unaltered schist, but in places there is considerable admixture of frag-