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05/11/88

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: COPPER CITIES MINE

ALTERNATE NAMES:
SLEEPING BEAUTY SITE
LOST GULCH UNITED MINES CO.
PORPHYRY RESERVE GROUP

GILA COUNTY MILS NUMBER: 132B

LOCATION: TOWNSHIP 1 N RANGE 14 E SECTION 12 QUARTER C
LATITUDE: N 33DEG 26MIN 30SEC LONGITUDE: W 110DEG 53MIN 00SEC
TOPO MAP NAME: INSPIRATION - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
COPPER
COPPER SULFIDE

BIBLIOGRAPHY:
ADMMR COPPER CITIES MINE FILE
USAEC PRELIM RECONN RPT 172-480, P 45
PETERSON N P GEOL & ORE DPSTS GLOBE-MIAMI DISTS USGS PP 342 1962 P 88
AZBM BULL 180 MIN & WATER RES AZ 1969 P 121, 132, 137, 143 & 363
HARDWICK W R, ET AL, OPEN PIT CU MNG METH
ADMMR 1 PLAN MAP (FLAT FILE DRAWER 18)

05/05/88

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HARDWICK W R & M STOVER OPEN PIT CU MNG METH

COPPER CITIES MINE & MILL

Mining World February 1953 p. 2

Metal Mining & Processing Feb. 1964 p. 37
Metal Mining & Processing Apr. 1964 p. 25

USGS P.P. 342 p. 88

IC 8341, p. 10, 35

AEC 172-480, p. 45. In AEC files.
Uranium--0.05

ABM Bull. 180, p. 121, 132, 137, 139, 143, 363

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" " " September 6, 1975, p. 4 (closure)

Mineralogy of Arizona p. 13, 16


Dixon Spr
SILVER BELT SHAFT
Siphon
Basin
Whitebank Spr
Giacoma Camp
Sleeping Beauty Spr
Cottonwood Spr
Amateur Spr
TOP
MOUNTAIN
Sleeping Beauty
Skunk Spr
Cherry Spr
Tailings Pond
MONEY METAL SHAFT
BM 3933
Lost
Fly Ranch
Sycamore Spr
Day Peaks
Spring
Willow Spr
BONANZA TUNNEL
T. 2 N.
T. 1 N.
27'30"
(Globe)
3850 IV NE

Copper Cities Mine file
Gila County

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1992

YELLOW HAIR TRADING AND MINING

Sleeping Beauty Mine T1N R14E Sec. 12
P.O. Box 111, Globe, AZ 85502 - Phone 425-7625 or 425-0446 - Employees: 40 - Produces turquoise under contract with Magma Copper Company - Sorts, grades, and processes turquoise for worldwide distribution.
President & Co-owner W. H. Preston
Vice President & Co-owner Monty Nichols
Secretary-Treasurer & Co-owner Cheryl Preston
Sales Ed Wheeler

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1991

YELLOW HAIR TRADING AND MINING

Sleeping Beauty Mine T1N R14E Sec. 12
P.O. Box 111, Globe, AZ 85502 - Phone 425-7625 or 425-0446 - Employees: 30 - Produces turquoise under contract with Magma Copper Company's Pinto Valley Mine - Sorts, grades and processes turquoise for worldwide distribution.
President & Co-owner ..... W.H. Preston
Vice President & Co-owner .....Monty Nichols
Secretary-Treasurer & Co-owner.....Cheryl Preston
Sales .....
Ed Wheeler

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President ..... W.H. Preston

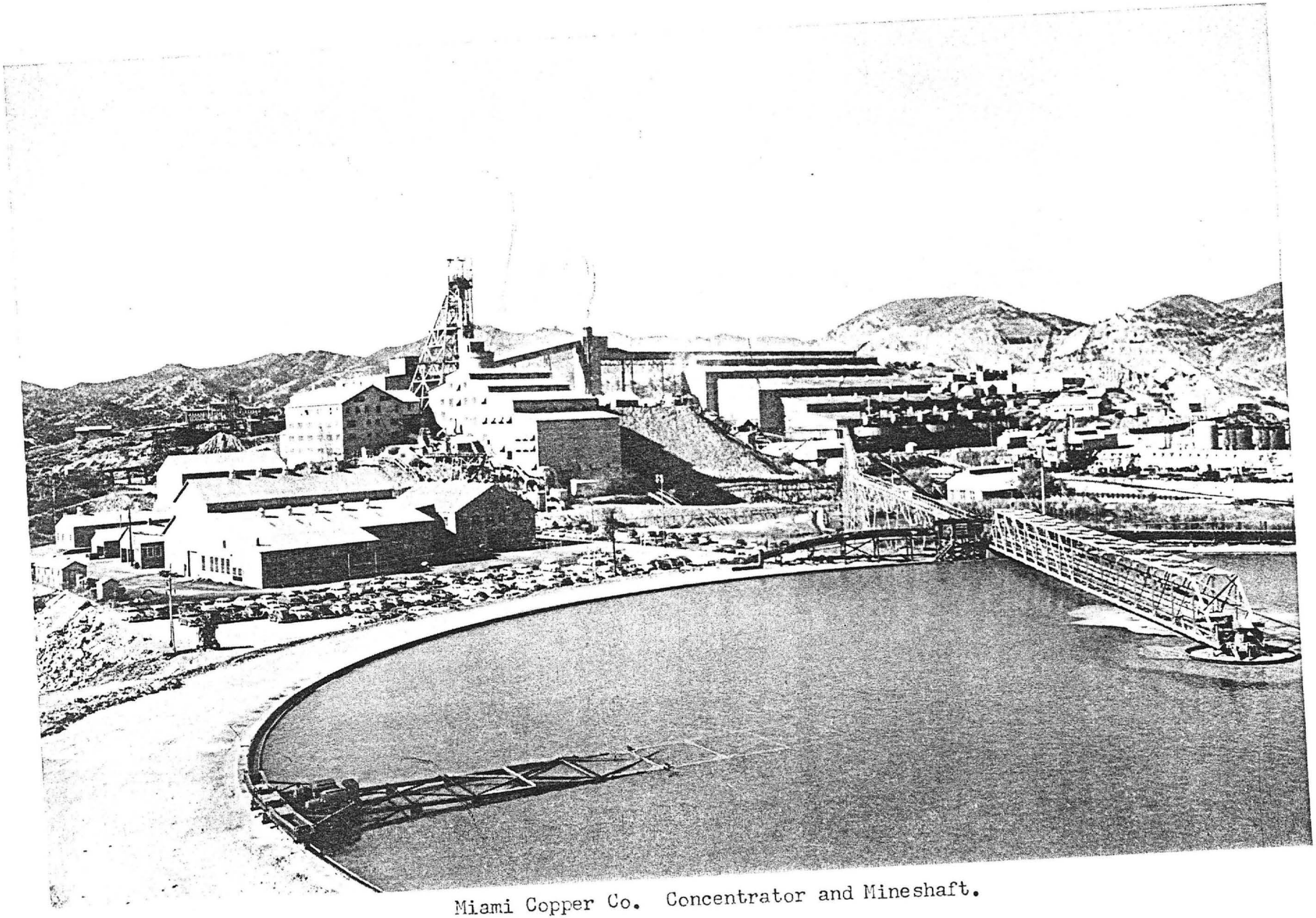
These maps have been microfilmed and the originals are stored upstairs in the flat files.

MIAMI COPPER COMPANY.

No.	Description of Map.
1	Captain-North 250 Section.
2	Section - North 0
3	Section 4 East 200.
4	80 Level.
5	107 Level.
6	135 Level.
7	162 Level.
8	190 Level.
9	220 Level.
10	245 Level.
11	270 Level.
12	295 Level.
13	320 Level.
14	345 Level.
15	370 Level.
16	395 Level.
17	420 Level.
18	470 Level.
19	570 Level.
20	Town of Miami
21	Surface maps.

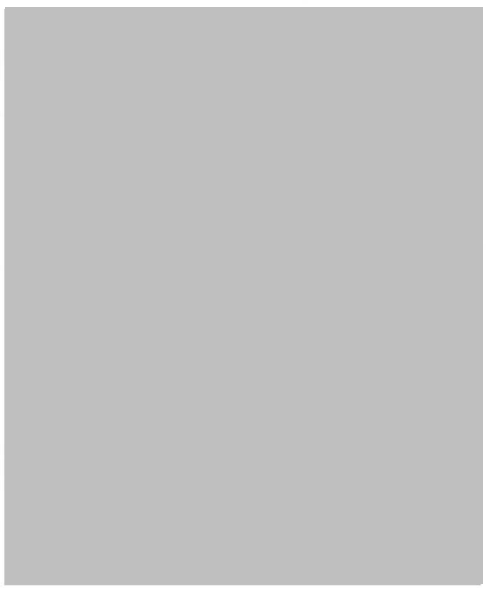
COPPER CITIES PRODUCTION

1954	------	Gold and Silver		$ 18,700
		Copper 12,515,108#	@29.6	3,704,000
1955	------	Gold and Silver		46,000
		Copper 55,097,164#	@37.5	20,661,000
1956	------	Gold and Silver		39,000
		Copper 55,652,641#	@41.8	23,263,000
1957	------	Gold and Silver		17,000
		Copper 41,492,801#	@30	12,448,000
1958	-----	Gold and Silver		26,000
		Copper 36,072,087#	@25.8	9,307,000
1959	-----	Gold and Silver		
		Copper 36,939,297#	@31	11,451,000
				$ 80,980,000



Miami Copper Co. Concentrator and Mineshaft.

Mining World 6/1956
11/1954
1956



COPPER CITIES MINING COMPANY

Anticipating the exhaustion of the Castle Dome ore body and the removal of the Castle Dome plant to the Copper Cities site, excavations and the pouring of concrete foundations for the concentrator, crushers, tailings thickeners and various other structures were carried on.

Of the 20,000,000 tons of waste which are required to be removed to expose the ore body before the operation of the concentrator, 6,500,-833 tons were removed during the year, bringing the total of such work to 9,171,450 tons.

As of January 1, 1953, the ore reserves of Copper Cities Mining Company are estimated to be 33,000,000 tons.

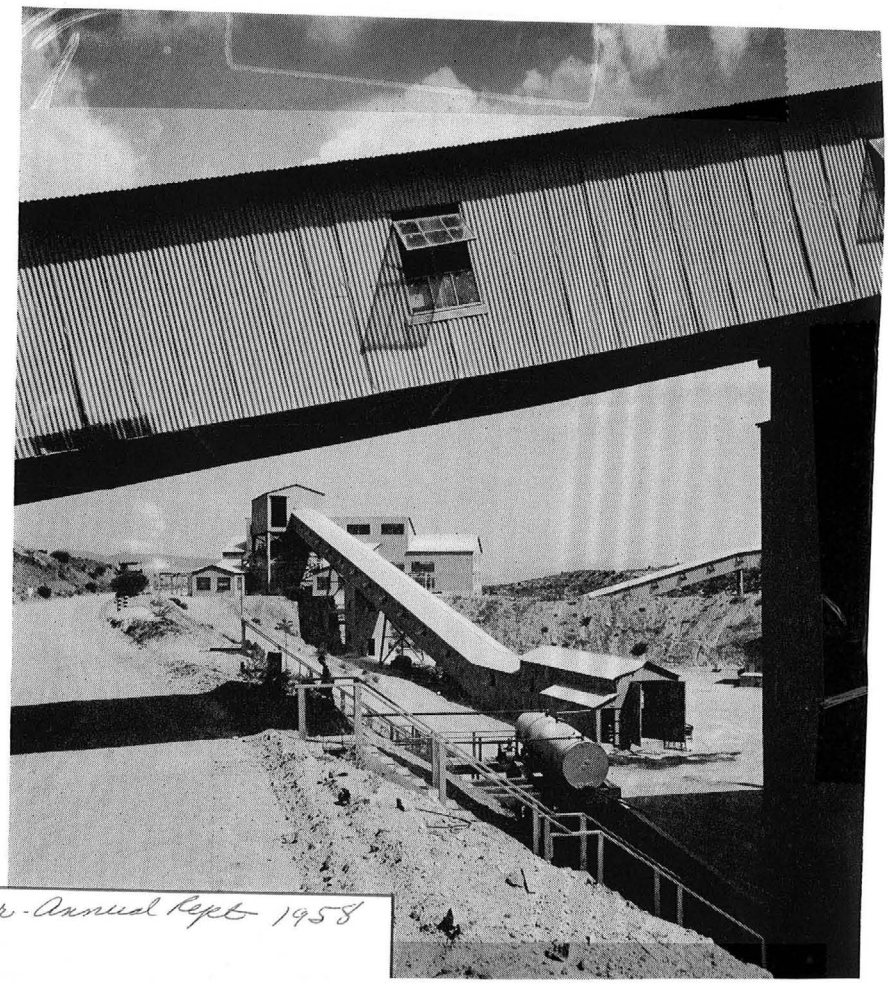
Miami Copper Annual Report 1952

COPPER CITIES

Copper Cities Mining Company, a wholly-owned subsidiary, executed a purchase contract with the General Services Administration of the United States Government providing, among other things, that Copper Cities Mining Company has the right to call on the Government to purchase, at the contract price of 23¢ a pound (subject to escalation) a maximum of 170,000,000 pounds out of the first 192,500,000 pounds of copper produced, if the Company is unable to sell such copper for domestic use at a price equal to or higher than the contract price.

Preparatory work at the site of Copper Cities Mining Company's ore body continued during th year with satisfactory progress.

Production from the Copper Cities mine scheduled to start the latter part of 1954. T will allow approximately one year to move Castle Dome plant and mining equipment and erect it at its new location at Copper Cities fol ing the conclusion of the Castle Dome opera As stated in last year's report, ownership of facilities will be vested in Copper Cities M Company at the conclusion of the Castle operation. This ownership, of course, will el further rental charges.



Conveyor ways at Copper Cities crushing plant

Miami Copper - Annual Rept 1958

COPPER CITIES MINING COMPANY

At the conclusion of operations at Castle Dome, dismantling and moving of that plant began. Work schedules at Copper Cities preparatory for this move were fully met and were accelerated early in December by the transfer of crews released from Castle Dome.

The stripping of the waste overlying the ore body totaled 4,929,633 tons for the year, bringing this work to 14,101,083 tons. It will be necessary to move a total of 20,000,000 tons of such overburden before starting operation of the concentrator.

Ore reserves of Copper Cities Mining Company are estimated to be 33,000,000 tons.

Miami Copper Annual Report 1953

COPPER CITIES

Miami Annual Report 1953

During 1953, expenditures in preparation for operations on the property of Copper Cities Mining Company totaled $3,434,896 of which $3,309,236 was from amounts borrowed from the Reconstruction Finance Corporation. Through December 31, 1953 expenditures totaled $9,039,542. Of this amount $3,938,574 was obtained through the Reconstruction Finance Corporation loan and the balance of $5,100,968 was provided by Miami Copper Company. A balance sheet of Copper Cities Mining Company, as of December 31, 1953, is included with the financial statements. Immediately after operations at Castle Dome were shut down, cleaning up and dismantling of the plant commenced preparatory to moving it to the Copper Cities location. As a result of favorable progress in preparatory work, it now is estimated that production of concentrates will start during the second half of 1954, rather than early in 1955 as mentioned in last year's report.

OPPER CITIES

Expenditures during the year in preparation for operations on the property of Copper Cities Mining Company, a wholly-owned subsidiary, totaled $2,791,700. Of this amount, $629,300 was provided from the proceeds of a Reconstruction Finance Corporation loan, as referred to in Note 3 to the Financial Statements. The total expenditures by Copper Cities Mining Company to December 31, 1952, amounted to $5,604,600. It is estimated that production of concentrates will commence early in 1955. As reported last year, under the terms of a Government contract the Company has the right to call on the Government to purchase 170,000,000 pounds of the first 192,500,000 pounds of copper produced at the contract price of 23¢ per pound (subject to escalation) if the Company is unable to sell such copper for domestic use at a price equal to or higher than the contract price.

OUTLOOK

As stated earlier in this report, since price decontrol of copper by the Government the metal has sold at various prices and at present it is impossible to predict what the average future price will be or to foresee all of the economic factors affecting the industry. However, with the exception of 1954 when Castle Dome operations will be completed and its production will not yet have been replaced from the Copper Cities pit, expectation of satisfactory production over the next few years appears reasonably justified. Floor prices on certain tonnages of copper and molybdenum concentrates and a price incentive to produce copper from a low grade section in the Miami mine, provided in contracts with the Government discussed elsewhere in this report, appear to furnish a sound basis for this outlook. As a consequence, ore reserves of the Company have been increased, its productive life substantially extended, and, in the case of the Miami low grade section, provision made for recovery of copper which otherwise would be permanently lost.

It is the intention of the Company to continue and intensify its search for additional ore deposits.

* * *

On behalf of the Board of Directors, it is a pleasure to express appreciation to our General Manager, Mr. R. W. Hughes, his staff, and the other employees of the Company and its subsidiaries for their continued co-operation and efficient performance during the past year.

COPPER CITIES PRODUCTION

1954	-------	Gold and Silver		$ 18,700
		Copper 12,515,108#	@29.6	3,704,000
1955	-------	Gold and Silver		46,000
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1958	------	Gold and Silver		26,000
		Copper 36,072,087#	@25.8	9,307,000
1959	------	Gold and Silver		
		Copper 36,939,297#	@31	11,451,000
				$ 80,980,000

COPPER CITIES MINE (P) GILA

NOTICE OF PRELIMINARY DECISION TO ISSUE INDIVIDUAL AQUIFER PROTECTION PERMIT NUMBER P-101888

Pursuant to Arizona Administrative Code, Title 18, Chapter 9, Article 1, the Director of the Arizona Department of Environmental Quality intends to issue Aquifer Protection Permit Number P-101888 to the following applicant:

Public Notice No. 58-98AZAP
BHP Copper, Inc.
Copper Cities Deep Pit Tailing Repository
7400 N. Oracle Rd., Suite 200
Tucson, AZ 85704

On or about:
July 8, 1998

The Copper Cities Deep Pit Tailing Repository is located near the town of Miami, Arizona, Gila County. It occupies portions of Sections 14, 15, 22, and 23 of Township 10N, Range 5W of the Gila and Salt River baseline and meridian.

Latitude: 33° 26' 44" North
Longitude: 110° 52' 24" West

The Copper Cities Deep Pit Tailing Repository is located within the Globe-Miami mining district in the Weaver Mountains of Gila County, approximately five miles north of Miami, Arizona. The permitted facility consists of the excavation for the former Copper Cities open pit mine. The repository receives reprocessed tailing from the Miami Unit No. 2 Tailing Reprocessing Project. Tailing slurry from the Miami Unit No.2 Tailing Reprocessing Project is pumped through a 4-mile long overland pipeline from the Miami Unit to the Deep Pit Tailing Repository and process water is returned to the Miami unit for reuse.

This permit supersedes the provisions for the deep pit groundwater elevation in the Groundwater Quality Protection Permit (GWQPP) No. G-0008-04 issued in 1988. BHP Copper Inc. continues to operate the Miami Unit No.2 Tailing Reprocessing Project pursuant to the terms and conditions of the GWQPP.

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. Please call 207-4692 to schedule an appointment to view the file. Persons may submit comments or request a public hearing on the proposed action, in writing, to Tony Bode, 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 Tony Bode, Environmental Program Specialist, Aquifer Protect Program, Arizona Department of Environmental Quality at (602) 207-2255.

Information from MINE INSPECTOR'S OFFICE - August 15, 1957

COPPER CITIES - MINE & MILL (Formerly SLEEPING BEAUTY MINE) Miami, Arizona — GILA COUNTY — 2-25-57

COPPER CITIES MINING CO., New York City, N.Y.
Pres. E. F. Westlake "
Sec. H. Kaufman "
Gen. Mgr. B. R. Coil, Box 100, Miami, Ariz.
Supt. Mayard Stover, " " "

COPPER — 25,000 tons — 99 men

L.A.S.

COPPER CITIES LEACH PLANT

GILA COUNTY
Miami District

Active Mine List Oct. 1963 - 512 men

Interview with A. Warner, Asst. Chief Chemist, Miami Copper Co.

Mr. Warner stated that the grade of the water, now reaching to precipitation plant at Copper Cities, had declined. This is believed to be due to channeling that is commonly encountered in high dumps of this sort. Drying out period may help, to some degree, in preventing this trouble. Otherwise, Miami's operation was normal.

The stripping of higher ground in Copper Cities pit appears to have begun.
Memo LAS 11-27-63

Interview with J. H. Gray and Woodrow Simmons, 1-30-64

J. H. Gray, Assistant General Manager of Miami Copper Company, stated that the stripping on the west side of the Copper Cities Pit was well begun. This development is to clear ore that was encountered below the present pit toward the west. The area further west is overlain by a "ribbed" gossan that contains heavy limonite in bands separated by areas that show much less. Drilling showed this to contain heavy pyritic bands but little copper. Gray said that he believed that the enrichment probably did not exceed 1½ to 1 at Copper Cities although Nels Petersen believed it to be more. Simmons reported that two drills were still operating on the Cactus ore zone below Castle Dome. This ore zone has developed to over 10,000,000 tons, but it has some serious problems as far as mining is concerned. Gray mentioned that the Copper Cities leaching project was continuing satisfactorily. Memo - LAS 1-30-64

Active Mine List April 1966 - B. R. Coil, Gen. Mgr. - Miami Copper Co. - Box 100 - Miami
Active Mine List April 1967 - 757 men
" " " Oct. 1967 - 732 men
" " " April 1968 - 708 men
" " " Oct. 1968 - 671 men
" " " April 1969 - 672 men
" " " Oct. 1969 - 711 men - Wm. Sloan Chief Mining Engineer (1970)
" " " May 1970 - 724 men - B. R. Coil, Gen. Mgr. Cities Service Co.

John Brandon, Project Manager - 7-1970

Active Mine List Oct. 1970 - 776 men - B. R. Coil retired 11-1-70 - Replaced by R. P. Hughes

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Copper Cities operated at its regular rate. FTJ QR 4-5-71

Copper Cities unit were operating at their regular rate. FTJ QR 3¼ 71-72

Active Mine List - Oct. 1972 Empl. 745 (1971 figures - 13,500 TPD milling, 27,000 TPD Leach)

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine COPPER CITIES LEACH PLANT Date January 30, 1963

District MIAMI DISTRICT, Gila Co. Engineer Lewis A. Smith

Subject: Visit with Jim Fletcher (Leach Supt.) Harmon Keyes and F.L.C. Price

Location: About 3/4 mile east of Copper Cities mill.

Dump: The dump is variable in height since it occupies a steep V-shaped ravine, the maximum height being approximately 300 feet. An area on the top, 600 x 150 feet was leveled and plowed. Banks, 2 ft. high, separate this into several comparts, 150 x 50 feet. Three or four rows of plastic pipe are strung lengthwise, or at right angles to the length of the dump. The pipes are perforated at regular intervals. Water is supplied from a well. It is sprayed under pressure on the dump. Certain sections can be shut off at intervals for drying. The pregnant solution comes out at the dump low point in a sump from whence it is piped to the precipitation vats. So far this solution has assayed 3.5 to 3.8 pounds of copper to the ton of water.

The precipitation vats are charged with mangled cans. There are two concrete vats in each group at the same elevation, followed in series upset upward to the center of the plant, there being several similar groups on the opposite side of the center, the vat groups similarly descend. Thus the flow of solution is in both directions from the center or solution feed vat. Two men stir or agitate the cans in the vats. The precipitates are removed when ready by a portable crane and clam shell. The pregnant solution is sampled at various stages of its progress down through the vats. The barren precipitated solution is discharged into a concrete sump that underlies the vat system. It is later pumped back to the leach dump storage for re-use. The precipitate is spread onto a large concrete apron for preliminary drying. So far this precipitate has run 82.5 - 82.7 per cent copper.

The tin cans are stored on a hill nearby and conveyed to traveling spreader which feeds a conveyer over the vats. Both conveyor systems are on steel supports. This saves much work as compared to the feeding by a crane and it gives an even replacement rate throughout the length of the vat system.

The plant has been running for two weeks and has yielded several cars of precipitates.

Copper
R.B. MULCHAY
Duplicate - Original in MULCHAY COLLECTION

CALCULATION OF PIT LIMITS AND ORE RESERVES, COPPER CITIES MINING COMPANY

BY J. H. Gray and W. W. Simmons

INTRODUCTION

Copper Cities Mining Company operates an open pit mine in a disseminated copper deposit which is located in the Globe-Miami district, Gila County, Arizona.

Some attention was given the deposit early in the history of the district, but the first major exploration was begun in 1917 by the Louis d'Or Mining and Milling Company. This work, consisting of a shaft 360 feet deep and 12 drill holes, totaling nearly 9000 feet, was completed in 1922. Further exploratory drilling was done in 1929 and 1930. These efforts showed the presence of disseminated copper minerals, but the grade was too low to be considered ore at that time.

Miami Copper Company purchased the property in 1940 and organized a wholly-owned subsidiary, Copper Cities Mining Company, to operate the property. This paper is chiefly concerned with exploration by this company.

Systematic exploration by churn drilling was started in 1943 and completed in 1948 with the blocking out of 33,800,000 tons of low grade ore amenable to open-pit operations. Stripping was begun in November, 1950, and mill production was started in August, 1954.

ACKNOWLEDGEMENTS

The writers are indebted to many people for help of various kinds. We are particularly indebted to Dr. N. P. Peterson and Mr. E. N. Pennebaker. Their excellent work, Dr. Peterson's published paper

and Mr. Pennebaker's private reports on the Copper Cities ore body are the basis for much of the geological thought in the present work.

GENERAL GEOLOGY

Figure 1 is a generalized geologic map of the Copper Cities pit and the immediate area around it. The Lost Gulch quartz monzonite is the predominant rock in the pit. The other important rock in relationship to the ore is granite porphyry. In general, the quartz monzonite is the better grade material. A small amount of diabase is included within the pit limits.

STRUCTURE

The most important structures in relationship to the ore body are the Coronado and Drummond fault zones. The Coronado which lies near the west side of the pit, strikes north and dips steeply west. The Drummond, near the eastern pit limit, strikes northwest and dips about 60° northeast. Along the northern edge of the pit is the Sleeping Beauty fault which strikes northeast; its dip is unknown. The area bounded by these faults has been raised relative to the adjacent blocks. The ore body itself is intricately dissected by many minor fractures with no dominant pattern.

MINERALOGY

The principal hypogene minerals in the deposit are quartz, pyrite, chalcopyrite and molybdenite. Chalcocite is the predominant supergene sulfide mineral, and malachite, azurite and turquoise are the principal acid-soluble copper minerals in the ore body.

CHURN DRILLING

The base pattern for churn drilling was a 250 foot grid. From previous experience in the district, this was thought to be sufficiently close for accuracy of grade and tonnage calculations, but as a measure of insurance, some holes were drilled at intermediate points. Drilling at intermediate points was also used to more precisely define the pit limits on some sections. The base grid was oriented to make the sections at right angles to the supposed elongation of the ore body. As finally developed by the drilling, the right angle relationship did not hold exactly, but no serious error was introduced by this fact.

The churn drill holes were sampled at 5 foot intervals using the conventional Jones splitter. Each 5-foot sample was assayed for total copper and oxidized copper. Composite samples of each 50 feet were assayed for gold, silver and molybdenum. All samples were logged for rock type and other geological features.

Preceding and concurrent with the drilling, a geological map of the surface was made as a guide for the exploration. At the completion of the drilling, a map was prepared showing surface geology, topography and drill hole collars.

COMPILATION OF DATA FROM EXPLORATION PROGRAM

Using the plan map as a base, cross sections and longitudinal sections were made showing the assay data of drill holes. By inspection, it was obvious that correlation between drill holes on assay data alone did not show a coherent nor probably true relationship. By plotting rock types and other

geology on the sections, more reasonable ore outlines could be drawn.

On the basis of previous district experience, it was decided that a 45 foot bench height would give the best mining operations. By inspection and cut and try, the elevation of the bottom level of the pit was set at 3600 feet. Factors which influenced this selection were maximum ore production, working room, pit drainage, haulage and others, but to some extent the final figure was arbitrary and depended on the judgment of the planners. Using this base, the upper bench elevations were drawn on the sections and the average grade of the holes through each bench was plotted along the hole. These sections were the work sheets for the determination of the ultimate pit limits.

DETERMINATION OF ULTIMATE PIT LIMITS

The exploration indicated an ore body of small tonnage and low grade. It was improbable that mining would disclose enough additional ore, or that market conditions would change sufficiently, to justify enlarging the initially set pit limits. For these reasons, it was of prime importance that the pit as initially planned be the best economically for the life of the operation. This meant that the pit limits must be extended to the theoretical slope lines which would just meet a set of conditions to give an acceptable minimum profit.

From the exploration, it was known that the waste to be stripped was a relatively uniform cover. It was also evident that the copper mineralization was largely gradational which meant that the pit limits would be assay boundaries rather than some other geologic feature. For these reasons, it was believed that the pit limits could

be set by consideration of a line rather than by calculating a three-dimensional tonnage figure. This concept materially reduced the required calculations.

To locate the theoretical slope lines certain assumptions were necessary. These were grouped as the cost to concentrate one ton of ore, the costs per pound of copper, and the per cent copper extraction.

The cost to concentrate one ton of ore includes:

a. Cost per ton mined.
b. Cost per ton milled.
c. Miscellaneous costs per ton.

The costs per pound of copper include:

a. Smelting cost per pound of copper.
b. Miscellaneous costs per pound copper.
c. Minimum acceptable profit per pound of copper.

The gross value per pound of copper can be defined as the market value minus the costs per pound of copper.

The mine grade which will just satisfy the assumed costs per ton of ore and per pound of copper can be calculated by the following formulae.

A. $\dfrac{\text{Total cost to concentrate 1 ton ore}}{\text{Gross value/lb. Cu}}$ = Net lbs. Cu/ton ore required to give minimum acceptable profit.

B. $\dfrac{\text{Net lbs. Cu/ton ore}}{\text{\% Extraction}}$ = Gross lbs. Cu/ton ore required to give minimum acceptable profit.

C. $\dfrac{\text{Gross lbs. Cu/ton ore}}{2000}$ = % Cu required in mill heads to give minimum acceptable profit.

To illustrate the use of the above formulae, certain figures, not necessarily those used at Copper Cities, are shown as follows:

Cost to concentrate 1 ton of ore: $0.94

Cost/lb. Cu: $0.0575 = Cost/lb. Cu to put 1 lb. Cu in concentrate into a market product.

Market price/lb. Cu	$0.18000
Minus cost/lb. Cu	0.05751

$0.12249 = Gross value/lb. Cu at mimimum acceptable profit.

$\frac{\$0.94 \text{ (cost to concentrate 1 ton)}}{0.12249 \text{ (Gross value/lb. Cu)}} = 7.674$ = Net lb. Cu per ton of ore required to give minimum acceptable profit.

$\frac{7.674 \text{ (Net lbs. Cu/ton ore}}{.87511 \text{ (\% extraction)}} = 8.769$ = Gross lbs. Cu/ton ore required to give minimum acceptable grade.

$\frac{8.769 \text{ (Gross lbs. Cu/ton)}}{2000} = .438\%$ Mine grade necessary to satisfy above assumptions.

The mine grade of ore necessary to meet the above conditions plus the mining of 1 ton of waste is calculated by the same basic formula, but must include the additional cost of mining 1 ton of material, i. e.,

$$\frac{\frac{\$0.94 + \$0.20}{.12249}}{\frac{.87511}{2000}} = 10.635 \text{ lbs. Cu ton} = 0.532\% \text{ mine grade.}$$

The grade necessary to give the minimum acceptable profit with a different tonnage of waste removal is calculated similarly.

A table of waste to ore ratios for which a corresponding mine grade of ore will meet the assumed conditions including profit is presented in Table 1.

With the aid of this table, the determination of theoretical slope lines which fix the ultimate pit limit can more easily be made.

At Copper Cities, it was decided that a 45° backslope could be safely maintained. The initial step in locating a backslope line on any section was to arbitrarily draw a 45° line on the section.

This initial line was, of course, located near one extremity of the ore body and as near the correct position as judgment based on quick visual inspection permitted.

In the investigation of the slope lines, it was assumed that ore grade in any prospect drill hole could be projected to the mid point between 2 adjoining holes. This assumption was subject to modification by geological conditions. The investigation consisted of several steps. First the total length of the backslope line from the bottom of the lowest ore bench to point where the line intersected the surface was measured. Next, the integral lengths of lines along the slope through each ore bench was measured, and each length multiplied by its related grade of ore. The summation of these "Grade Lengths" divided by the summation of the integral length of slope line through the ore benches is the average grade along this section of the backslope line. The total length of backslope line minus the length in ore is the measured length of slope line in waste.

By reference to Table 1, a waste to ore ratio corresponding to the average grade as computed can be found. By multiplying this waste figure by the length of ore line, a theoretical length of waste line is obtained. If this theoretical length of waste line is greater than the length of line actually measured, the ultimate slope line lies in the direction away from the center of the pit. Conversely, if the theoretical length of waste line is less than the measured waste line, the ore along this slope will not pay for the waste and the ultimate pit limit lies in a direction toward the pit center. By sufficient trial and error, a slope line can be located along which the measured waste will just equal the theoretical waste that can be carried by the ore under the assumed conditions.

Figure 2 is a section of Copper Cities. On line A, the total length of the backslope line from pit bottom to intersection with surface is 545 feet. The summation of the integral length of line through each ore bench multiplied by its related grade of ore divided by the total length of line in ore is .674%, which is the average grade of that portion of the slope line in ore. The length of the slope line in waste is 290.40 feet. By reference to Table 1, the waste ore ratio corresponding to .674% is 2.5. By multiplying the waste figure by 254.60, the length of line in ore, we see that the slope line can be moved outward. By similar calculations on Line B, the waste-ore ratio was found to be 1:1, and the waste figure multiplied by the ore length exceeded the measured waste length and the slope line must be moved inward. On Line C, the theoretical waste line was 323.33 feet and the measured waste was 329.05 feet. It was felt that this was as close as the accuracy of the original data and assumptions permitted, and this line was used. The detailed calculations of the lines are given below as illustrative of the method.

CALCULATIONS: INVESTIGATION OF SLOPE LINES

LINE A

Measured line			Slope Line Thru Ore		Grade
Designation	Length Feet	Bench	Length	Grade	Length Units
Ore	255.0	3645	45.40	.55	25.02
Waste	290.40	3645	18.15	.47	8.53
	545.40	3690	63.65	.70	44.56
		3735	63.65	.58	36.92
		3825	63.65	.89	56.65
			254.60	.674	171.68

From Table 1: .674% ore grade will carry 2.5:1 waste to ore
∴ 254.6 (ft. ore) x 2.5 = 636.50 ft. of waste which 254.6 ft. of .674% ore will carry. Since this is greater than the 290.4 ft. of waste actually measured along this slope (A), line B was tried.

LINE B

Measured line Designation	Length Feet	Bench	Slope Line Thru Ore Length	Grade	Grade Length Units
Ore	88.65	3645	63.65	.47	29.92
Waste	456.35	3690	25.00	.70	17.50
	545.00		88.65	.535%	47.42

From Table 1: .535% ore grade will carry 1:1 waste to ore ∴ 88.65 ft. x 1.0 = 88.65 ft. of waste which 88.65 ft. of .535% ore will carry. Since this is less than the 456.35 ft. of waste measured along this slope line B, line C was tried.

LINE C

Measured line Designation	Length Feet	Bench	Slope Line Thru Ore Length	Grade	Grade Length Units
Ore	230.95	3645	63.65	.47	29.92
Waste	329.05	3690	63.65	.70	44.56
	560.00	3735	63.65	.58	36.92
		3825	40.00	* .50	20.00
			230.95	.569	131.40

* Assume .5% grade from midpoint to fault.

From Table 1: .569% ore grade will carry 1.4:1 waste to ore. ∴ 230.95 ft. of .569% ore will carry 323.33 ft. of waste. The slope line thru waste actually measures 329.05 ft. As this is as close as the accuracy of data, this line was used as theoretical slope line.

The back slope lines on all sections were calculated by a similar process.

The portion of the line near the Drummond fault illustrates a modification of the basic method based on geological conditions. Ore was figured to the fault rather than to the midpoint between holes.

After completion of the sections, the data was transferred to plan maps. The initial step was to pick a key level near the midpoint of the ore column. A composite plan map was constructed by mechanical development from the key level up slope to surface, and down slope to the pit bottom. Individual bench maps were then made by transfer of theoretical bench outlines from the composite map and plotting of prospect holes with average grade and geology as derived from the sections.

Polygonal areas of grade influence modified by the geology were constructed around each hole. By planimeter, the area of influence of each hole was determined. From this data, the average grade and the tonnage of ore and waste on each bench was computed. The total tonnage of ore and waste in the pit was obtained by addition of individual bench tonnages and average mine grade by the bench average grade weighted by bench tonnage.

Based on these calculations, the Copper Cities pit contains 33,800,000 tons of ore. The waste to be removed at the start of mining totaled 34,700,000 tons which is a 1.03 to 1 waste to ore ratio.

TABLE 1

ORE-WASTE RATIO AND ITS REQUIRED MINE GRADE

Ratio Waste to Ore	Mine Grade Ore	Ratio Waste to Ore	Mine Grade Ore	Ratio Waste to Ore	Mine Grade Ore
0.0:1	.438%	1.7:1	.597%	3.4:1	.756%
0.1:1	.447	1.8:1	.606	3.5:1	.765
0.2:1	.457	1.9:1	.616	3.6:1	.774
0.3:1	.466	2.0:1	.625	3.7:1	.784
0.4:1	.475	2.1:1	.634	3.8:1	.793
0.5:1	.485	2.2:1	.644	3.9:1	.803
0.6:1	.494	2.3:1	.653	4.0:1	.812
0.7:1	.504	2.4:1	.662	4.1:1	.821
0.8:1	.513	2.5:1	.672	4.2:1	.831
0.9:1	.522	2.6:1	.681	4.3:1	.840
1.0:1	.532	2.7:1	.690	4.4:1	.849
1.1:1	.541	2.8:1	.699	4.5:1	.858
1.2:1	.551	2.9:1	.709	4.6:1	.868
1.3:1	.560	3.0:1	.718	4.7:1	.877
1.4:1	.569	3.1:1	.727	4.8:1	.886
1.5:1	.578	3.2:1	.737	4.9:1	.896
1.6:1	.588	3.3:1	.746	5.0:1	.905

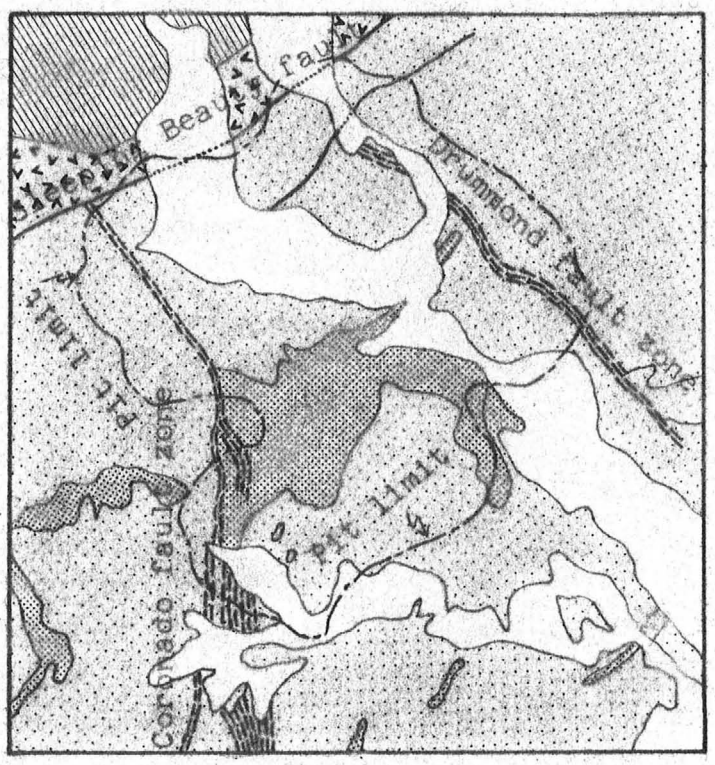

Fig. 1 Geologic map of the copper-bearing area
(After: N. P. Peterson)

EXPLANATION

Alluvium

Paleozoic limestones
and Apache group

Granite porphyry

Diabase

Lost Gulch
quartz monzonite

Fault

Contact

Scale
1 inch = 1000 feet

N

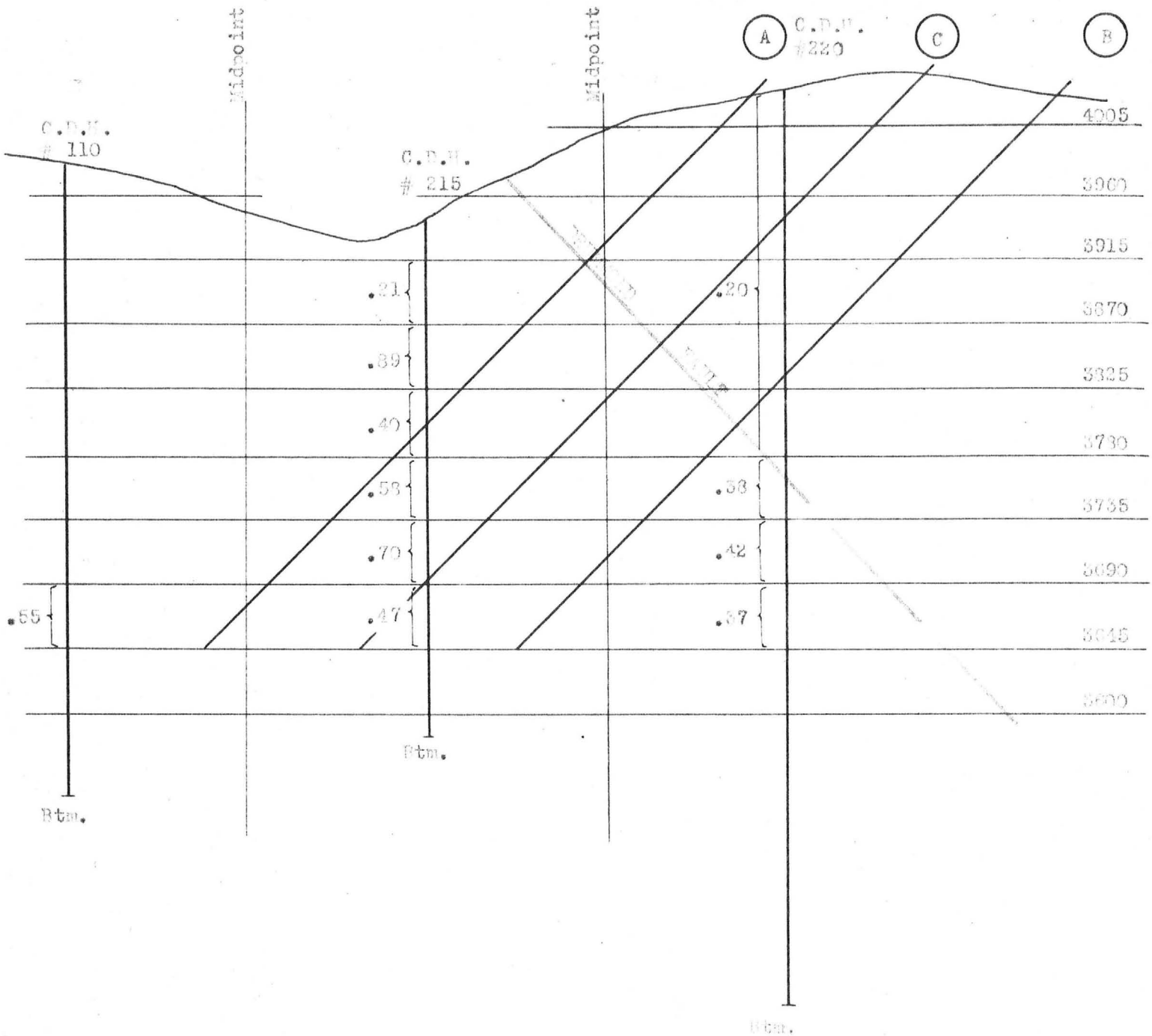

Fig 2. Portion of section N 3500 illustrating investigation of slope line.

MEMO

SLEEPING BEAUTY PIT
MIAMI DIST., GILA CO.

9-22-61
Lewis A. Smith

A visit was made to an area immediately south of the Pit to observe some highly-iron impregnated gossan. The gossan is strongest in certain bands which appear to be shear fractures. The gossan indicates high pyrite with some copper. It was felt that this gossan warrented some drilling, even though the area may represent the high iron halo which commonly is found around the periphery of disseminated ore deposits.

ACTIVE 2-1962 - 413 men working.

Simmons stated that some deep hole drilling was under way between the Pit and the Miami Fault to the north. Variable results have been obtained so far. Drilling is still being done on the Pinto Creek orebody.

Interview with Woodrow Simmons, Chief Geologist, Miami Copper Co.

MEMO-LEWIS A. SMITH - 9-28-62.

Mr. Simmons stated the dump leaching set-up at Copper Cities is about ready to go. The dump material will be relatively low-grade material. Some drilling W and N of Copper Cities was not too satisfactory. Drilling is still active in the Pinto Creek area.

MEMO - 11-29-62 - LAS - Interview with Woodrow Simmons, Chief Geologist of Miami Copper Co.

TO: DAVID MANQUEROS APRIL 16, 1976

FROM: L.W. HARDY CO. FRED GRONLUND MINE GEOLOGIST.

SUBJECT: MERCER FLAT MINING PLAN AT COPPER CITIES

ON MERCER FLAT (4050 ELEV.) WE PROPOSE TO MINE 2 BENCHES (90 FT) IN THE TURQUOISE AREA WHILE WE DEVELOPE SOUTH HILL.

AS SOUTH HILL BECOMES PRODUCTIVE WE THEN PROPOSE TO DEVELOPE THE AREA ABOVE MERCER FLAT AS SHOWN ON THE '200 SCALE COMPOSITE MAP.

WE ALSO PROPOSE TO MONITOR THE 3690 BENCH BELOW THE TURQUOISE AREA ON A WEEKLY BASIS AS YOU REQUESTED.

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

3-AKA's

GILA COUNTY MLS # 323

Copper Cities Mine (Jct)

SLEEPING BEAUTY MINE

MMM-930	Turquoise
M-931	" "
M-932	" "
M-933	" "
M-934	" "
M-935	" "
M-938	" "
M939	" "
M-940	" "
M-941	" "
M-942	" "
M-943	" "
M-945	" "

MM 1429	Turquoise
972	Turquoise
4770	" "
4771	" "
4772	" "
4773	" "
4774	" "
4775	" "
4776	" "
4777	" "
4778	" "
4779	" "
4780	" "
MM- 4769	Turquoise (Carved Leaf)
MMM-924	Turquoise
MM N439	Turquoise
MM N440	Turquoise
MM N441	Turquoise
MMM-925	Turquoise
M-926	" "
M-927	" "
M-928	" "
M-929	" "

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA

GILA COUNTY

MIAMI COPPER CO. MILS # 132 B

Copper Cities Mine (#20)

3-AKA's

MM 1207 Miner's Oil Lamp & Cap

MM5620 Copper Milling Ore - Chalcopyrite