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Arizona Department of Mines and Mineral Resources Mining Collection

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PRINTED: 06/24/2002

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: SAN XAVIER COPPER

ALTERNATE NAMES:
SAN XAVIER SOUTH

PIMA COUNTY MILS NUMBER: 1141

LOCATION: TOWNSHIP 16 S RANGE 13 E SECTION 31 QUARTER NW
LATITUDE: N 31DEG 59MIN 23SEC LONGITUDE: W 111DEG 04MIN 15SEC
TOPO MAP NAME: TWIN BUTTES - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
COPPER SULFIDE
MOLYBDENUM SULFIDE
SILVER
ZINC SULFIDE
LEAD SULFIDE
SILVER PLACER
TIN PLACER

BIBLIOGRAPHY:
ADMMR SAN XAVIER COPPER FILE
SEE: ADMMR MISSION MINE FILE (PART OF MISSION COMPLEX, 1986) SOUTH PORTION OF SAN XAVIER
MINERALOGY OF ARIZONA, P 16
SKILLINGS MNG RVW 3/10/73 COVER STORY; 2/23/73, P 25; 3/9/74, P 27
E&MJ 3/73, P 87
MNG ENGIN. 2/73, P 51; 4/73, P 36
CONTRACTOR & ENGNR. 11/73, P12
MNG CNGRS JNL 12/74, P 53-57
METALS WK 12/3/73, P 2
MNG ANL RVW 11/73, P 15,219; 11/74, P 295

12/04/86

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: SAN XAVIER COPPER

ALTERNATE NAMES:

PIMA COUNTY MILS NUMBER: 1141

LOCATION: TOWNSHIP 16 S RANGE 13 E SECTION 31 QUARTER NW
LATITUDE: N 31DEG 59MIN 23SEC LONGITUDE: W 111DEG 04MIN 15SEC
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E&MJ 3/73, P 87
MNG ENGIN. 2/73, P 51; 4/73, P 36
CONTRACTOR & ENGNR. 11/73, P12
MNG CNGRS JNL 12/74, P 53-57
METALS WK 12/3/73, P 2
MNG ANL RVW 11/73, P 15,219; 11/74, P 295


3748 II SE
(SAN XAVIER MISSION)
R 12 E
R 13 E
MISSION 9 MI.
4'92 5'
4'93
4'95
2'30"
Settling Tanks
PRIVATE
Water Tanks
MISSION MINE
PIMA MINE
MINE
Mineral Hill
Tailings Pond
Banner Mine
Mine Dump
Water Tank
San Xavier
T16S R13E Sec. 31 NW
Settling Tanks
Tailings Pond
MINE DUMP
San Xavier Mine
Bobbie Mine
Radio Facility
Helmet Peak
Whitcomb Hill
BM 3454
Twin Buttes 7.5
HELMET PEAK
Wash
35
36
31
2
1
6
11
12
13
14
18

12/04/86

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: SAN XAVIER UNIT OPEN PIT NORTH

ALTERNATE NAMES:
SAN XAVIER COPPER

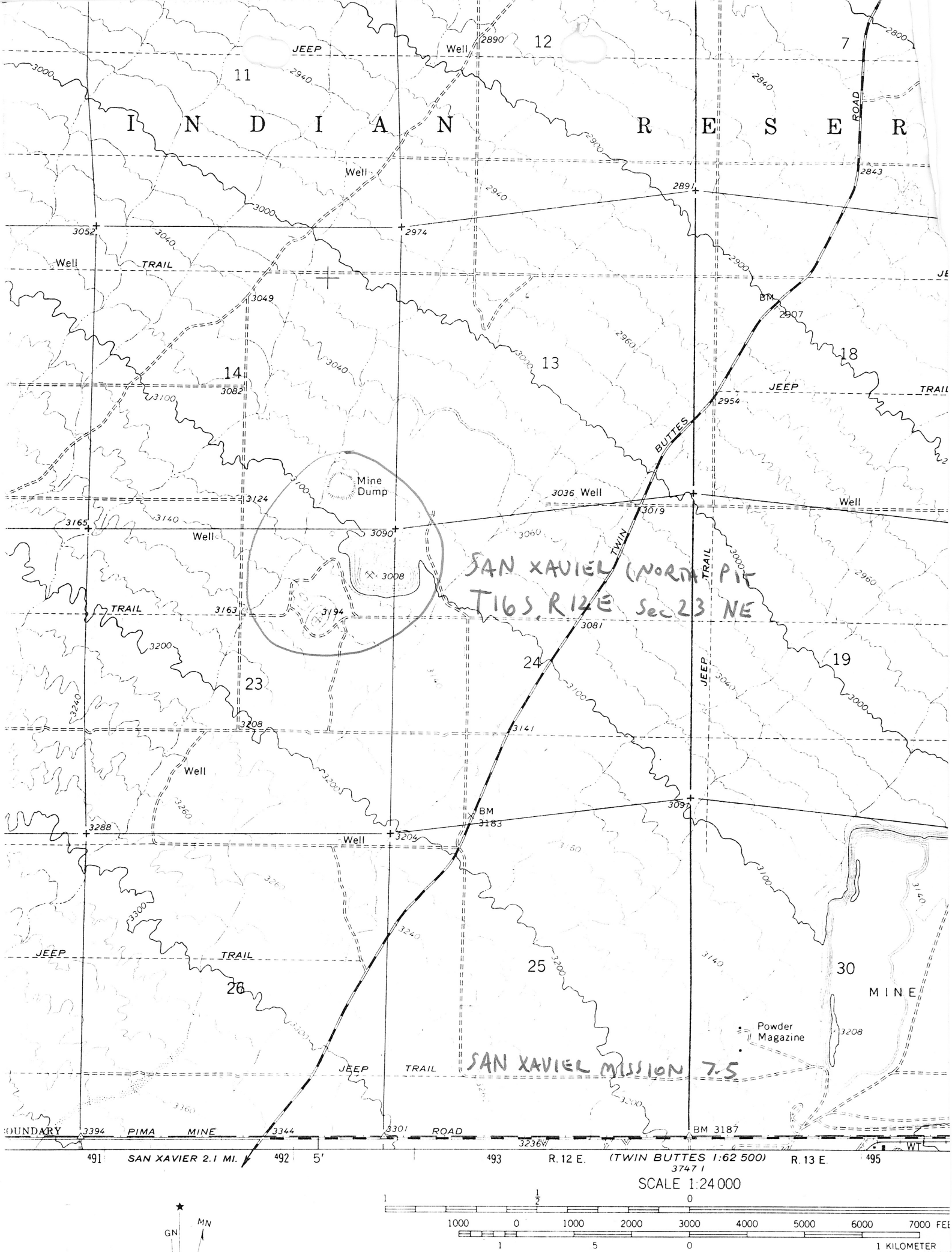
PIMA COUNTY MILS NUMBER: 241

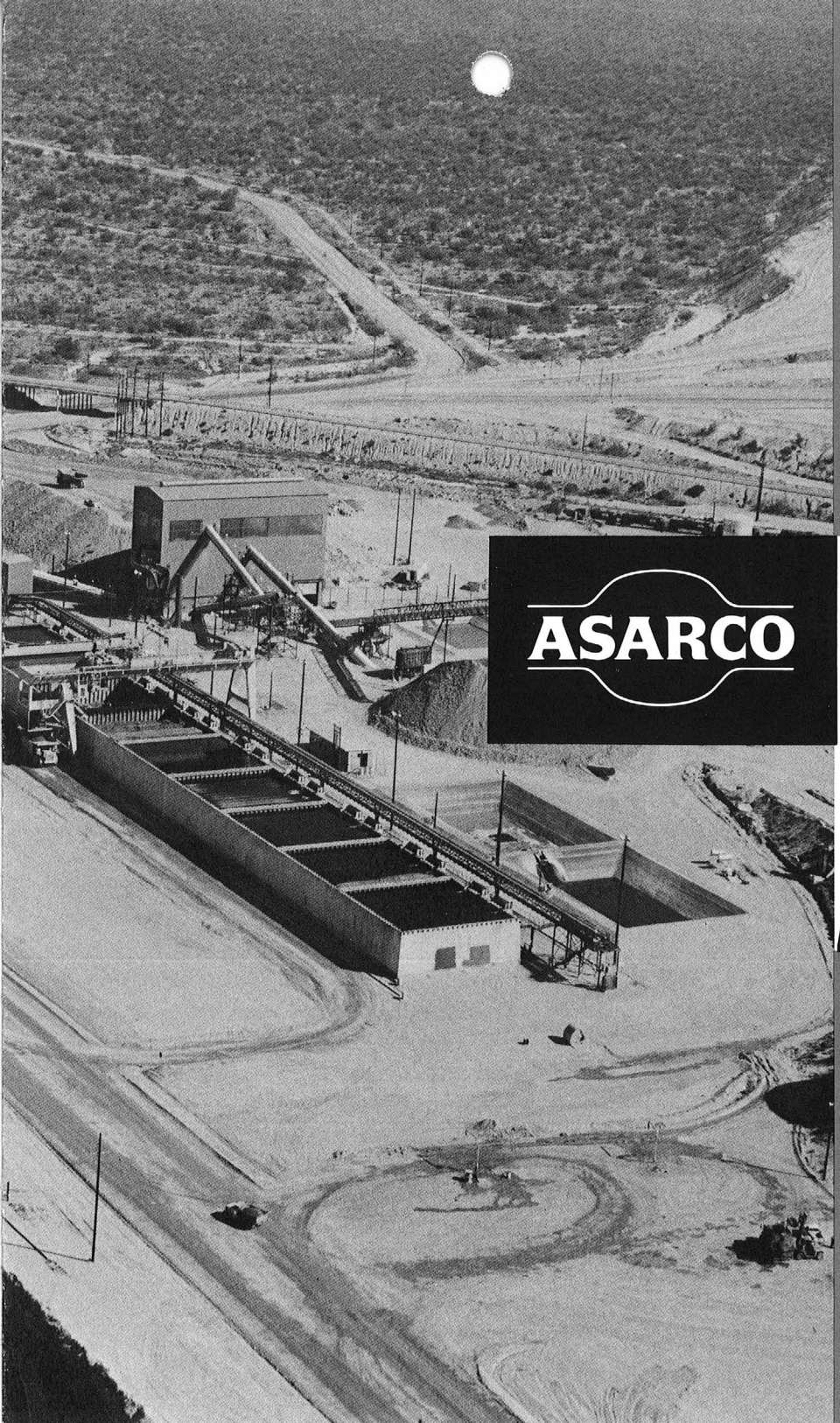
LOCATION: TOWNSHIP 16 S RANGE 12 E SECTION 23 QUARTER NE
LATITUDE: N 32DEG 01MIN 37SEC LONGITUDE: W 111DEG 04MIN 48SEC
TOPO MAP NAME: SAN XAVIER MISSION - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
COPPER
SILVER

BIBLIOGRAPHY:
S.B KEITH, AZBM BULL. 189, 1974, P.138
ADMMR SAN XAVIER COPPER MINE FILE

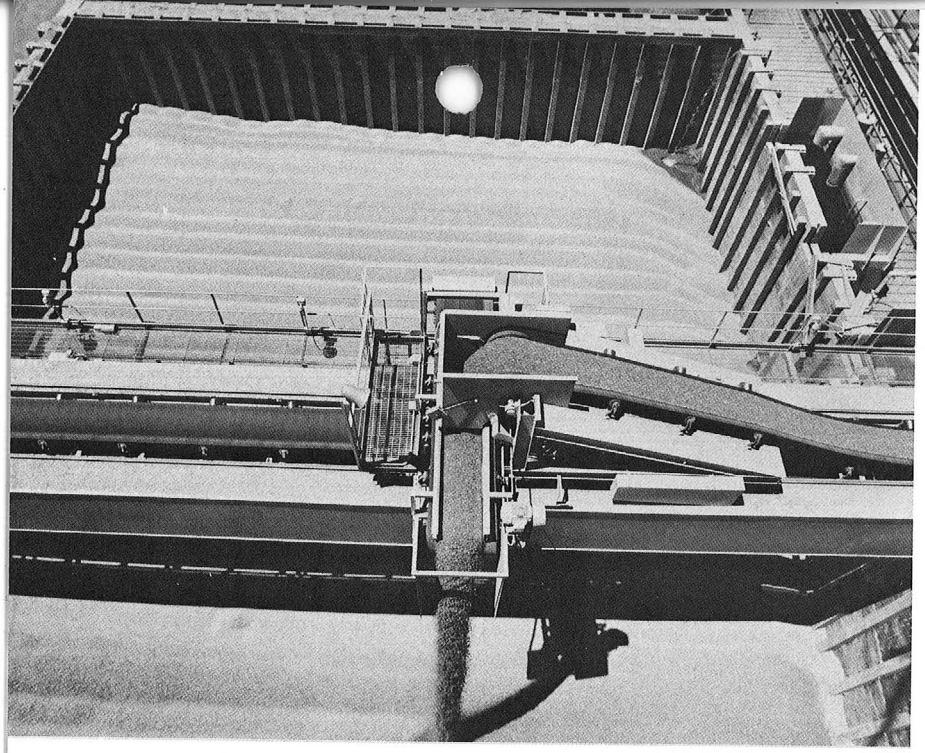

INDIAN RESER
JEEP TRAIL
Well
TRAIL
Mine Dump
BUTTES
TWIN
ROAD
JEEP TRAIL
BM 3183
Powder Magazine
MINE
SAN XAVIER (NORTH) PIT
T16S, R12E Sec 23 NE
SAN XAVIER MISSION 7.5
BOUNDARY
PIMA MINE
SAN XAVIER 2.1 MI.
(TWIN BUTTES 1:62 500)
SCALE 1:24 000
1 KILOMETER



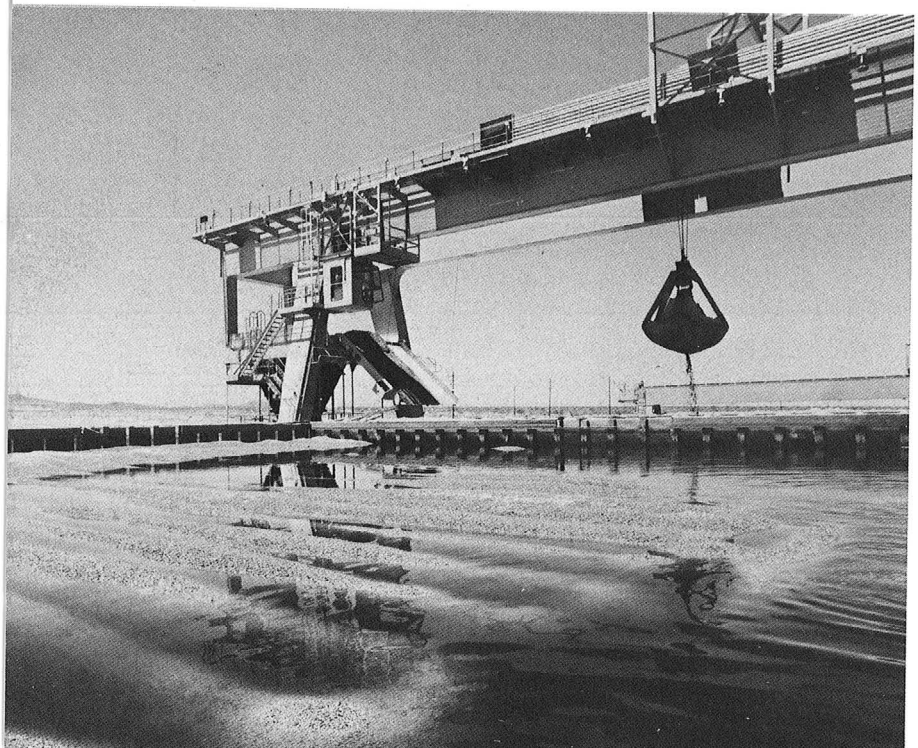
ASARCO

SAN XAVIER

Copper Leach Plant at Sahuarita, Arizona



Every day, one of nine leach vats (70′ x 70′ x 22′ deep), above, is filled with 4,000 tons of copper oxide ore. Dilute sulfuric acid (about 100 pounds per ton of ore) dissolves copper as it percolates downward.

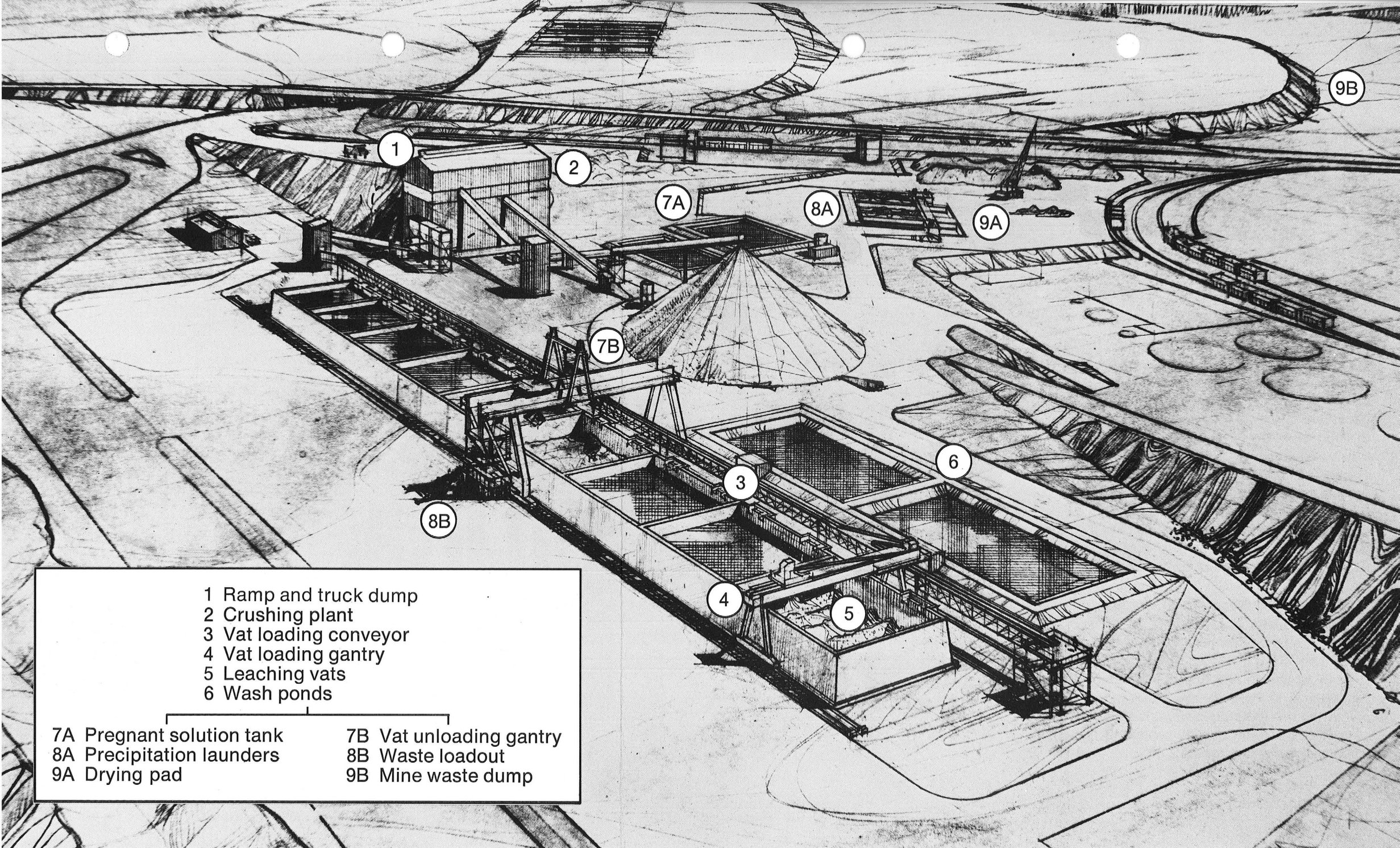


Plant recovers 16 pounds of copper per ton of ore

Production of cement copper at the San Xavier plant involves two distinct processes: leaching the mineral from the ore, and precipitating it out of the resulting 'pregnant' solution. Together, the processes recover approximately 16 pounds of copper from each ton of ore.

The leach cycle begins as each vat, one a day, is filled with ore crushed to ⅜″ diameter and under and percolated with 600,000 gallons of copper-enriched solution from the vat filled the previous day. After several hours, this final pregnant solution is pumped to the precipitation launders and replaced by solution from a vat filled two days earlier. This solution, in turn, is pumped to the next newly filled vat. In all, it takes six days for 'barren' solution of water, dilute sulfuric acid and copper sulfate passing through six vats to pick up 15 grams of copper per liter (about 2 ounces per gallon).

It takes another two days to remove the tailings (the now-barren rock) and pre-



1 Ramp and truck dump
2 Crushing plant
3 Vat loading conveyor
4 Vat loading gantry
5 Leaching vats
6 Wash ponds

7A Pregnant solution tank
8A Precipitation launders
9A Drying pad
7B Vat unloading gantry
8B Waste loadout
9B Mine waste dump

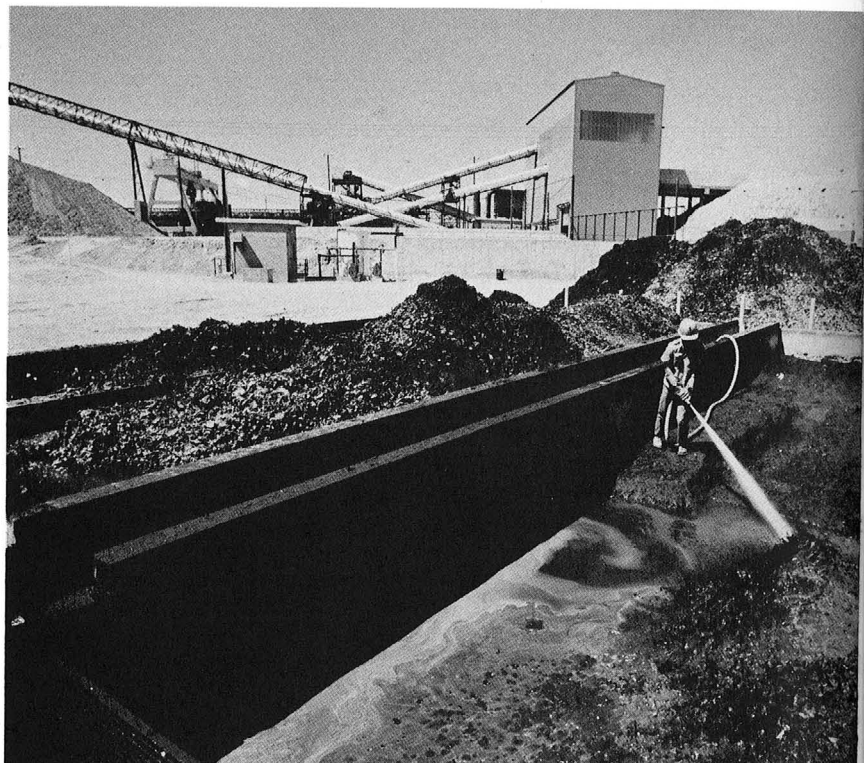
pare the vats for their next charge. Tailings are hauled to the waste dump.

Sulfuric acid for the leach process is manufactured by Asarco's 1,000-ton-per-day acid plant at Hayden, Arizona which uses essentially all of the sulfur dioxide generated by the Hayden smelter's converters. Completed in 1971 at a cost of $17 million, the acid plant was built as part of a $58-million air-quality control program at the Company's three copper smelters.

In the second, or precipitation stage, the final pregnant solution is diluted and fed to one to three precipitation launders filled with de-tinned scrap cans and/or shredded iron. Iron precipitates the copper in solution, which lodges on the cans. In the process, the iron goes into the solution as iron sulfate. Periodically, the solution in the precipitation launders is drained and the loosely-adherent copper is hosed off of the cans and removed from collecting sumps for drying. The copper-barren solution is bled off periodically to evaporation ponds to minimize contaminant build-up.

The precipitate (concentrate), averaging about 80-82% copper, dries in the atmosphere until moisture content is no more than 15%. It is then loaded and shipped to Asarco smelters at Hayden, Arizona and El Paso, Texas, where, as part of the reverberatory charge, it does not add to the sulfur dioxide content of emissions to the atmosphere.

About 1.5 tons of scrap goes into precipitating ton of copper (above). Iron displaces the copper in solution.



Copper, 80-82% pure, is flushed from tin cans (below). This sulfur-free copper becomes smelter feed.

vironmentally clean in its own right, :ona's newest copper recovery plant consumes two overly-abundant by-ducts of industry's environmental rovement measures.

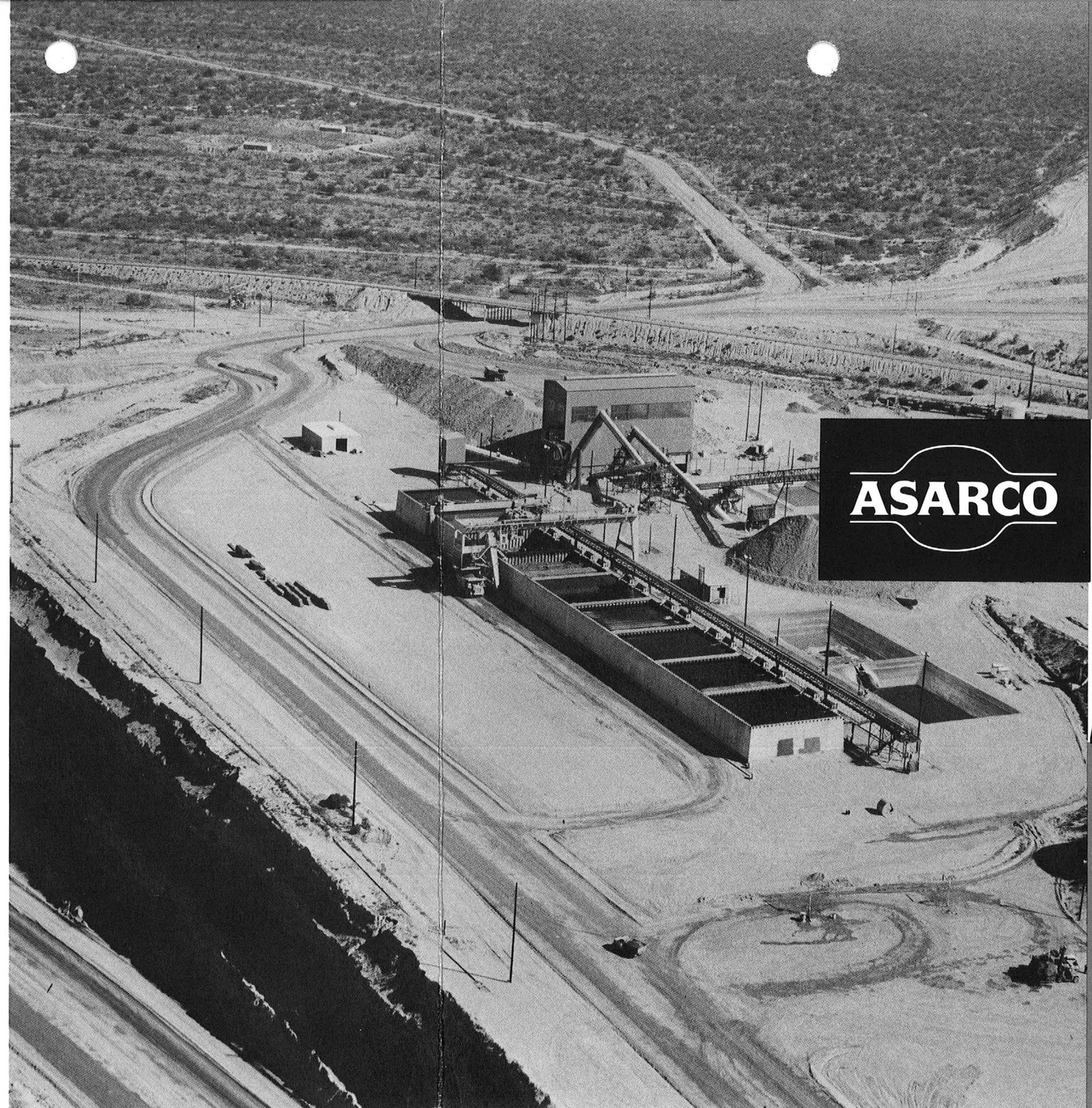
Completed in 1973 at a cost of approxi-ely $13 million, the San Xavier leach nt at American Smelting and Refining npany's Mission mill uses sulfuric d to leach copper from oxide ore, and scrap (such as de-tinned cans) to cipitate the copper from solution.

he nation's fourth largest producer of per by this method, the plant pro-es 1,250 tons per month of precipi-s containing 80-82% copper.

he San Xavier facility is so named be-se the mineralized areas being mined oxide ore lie principally on the San ier Indian Reservation. In 1956, rco geologists found a small mineral-l outcrop 2½ miles northwest of the of the leach plant. This provided the which led to the discovery of two de orebodies concealed beneath vel beds which range up to 200 feet hickness.

hese deposits were explored by dia-nd drilling beginning in 1957 after rco successfully bid for and was rded exploration permits by the ago Indians. Guaranteed royalties er the terms of the mining agree-nts provide the Papago Indians with a mum of $600,000 annually.

g and Refining Company



ASARCO

SAN XAVIER

Copper Leach Plant at Sahuarita, Arizona

CAPTION

Copper, 80-82% pure, is flushed from the tin cans in the "launder" units. Dried on an adjacent pad, this sulfur-free copper is then shipped to Asarco's smelters in Hayden and El Paso.

# # #

FROM: GLADYS SARLAT PUBLIC RELATIONS
149 N. Stone, Suite 403
Tucson, AZ., 85701 - 624-0493

Contact: Jess Riggle

AS 401-B
F-5-3

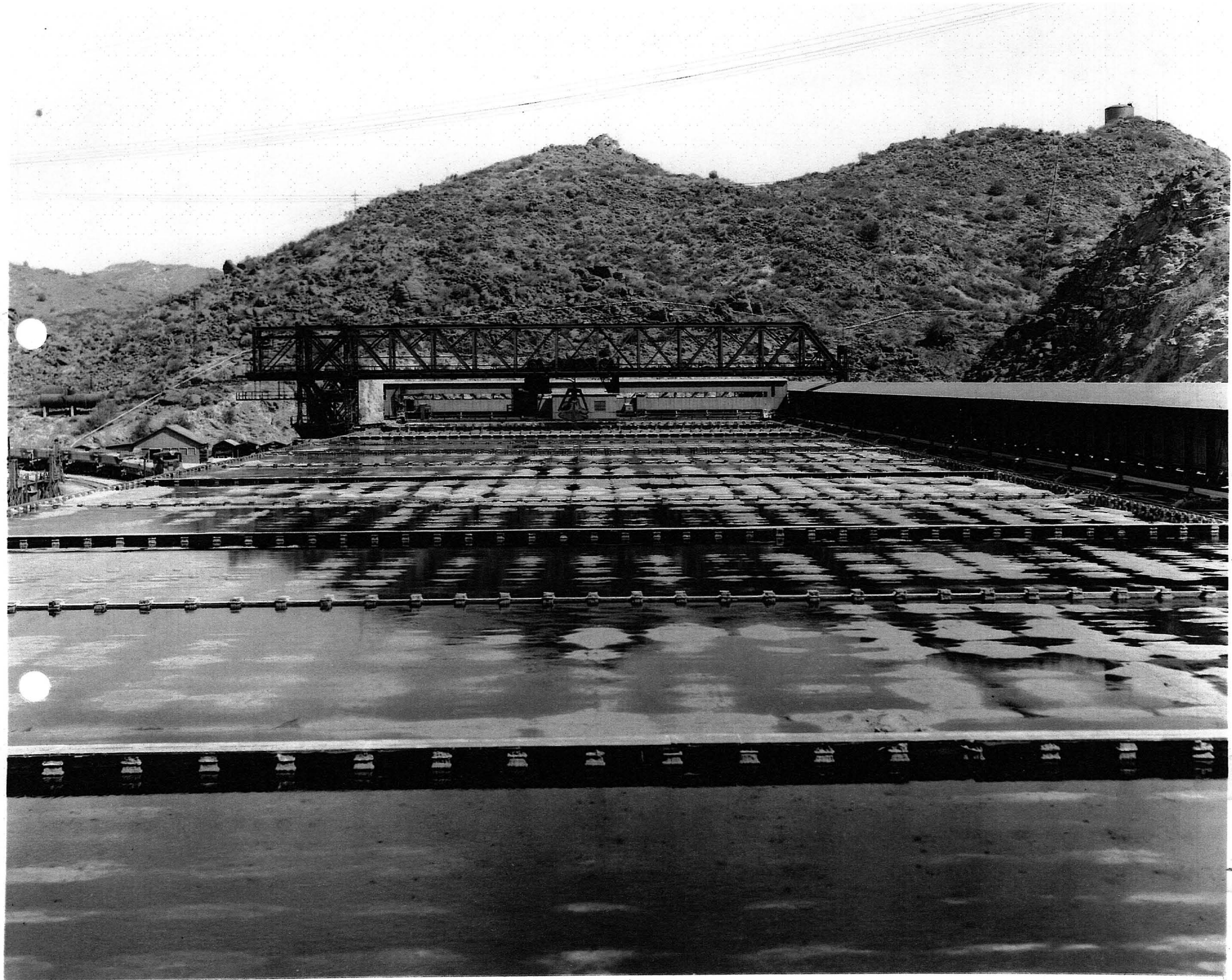
CAPTION

American Smelting and Refining Company's $13-million San Xavier Unit, 15 miles south of Tucson, which was dedicated today, is shown in this aerial view. Ore from the new San Xavier pit 2 ½ miles northwest of the facility is crushed in plant at center rear. Sulfuric acid from Asarco's Hayden smelter is used in the nine giant vats at left to leach copper from the crushed ore which is distributed by giant moving gantry. Shredded de-tinned cans (dark piles at right rear) are then used to precipitate copper from "pregant" solution from vats. Resultant "cement copper" is then dried before shipment to the company's smelters in Hayden and El Paso. The newly-dedicated plant is the nation's fourth largest producer of copper by this "vat leach" method, producing 1,250 tons of 80-82% pure metal per month.

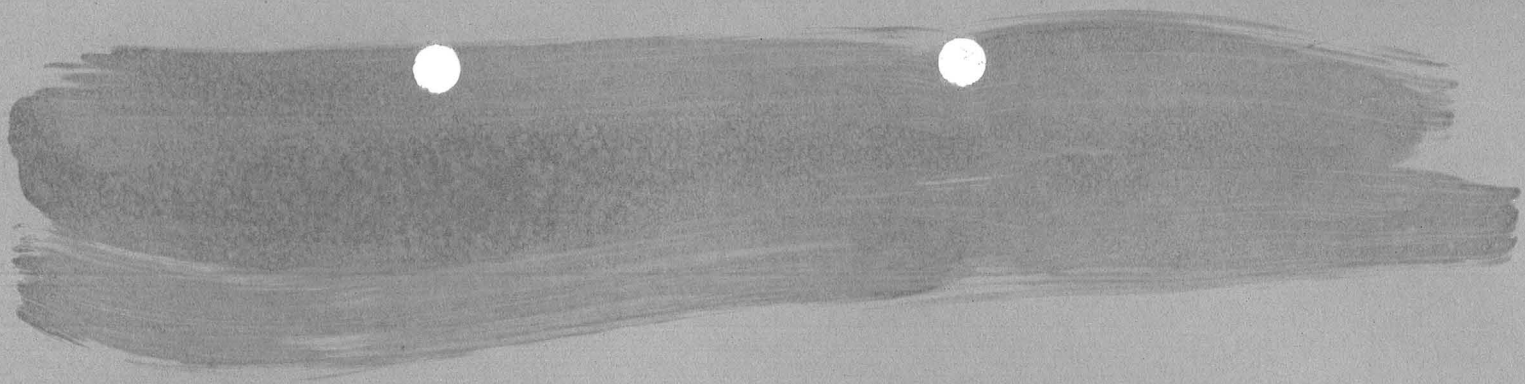
# # #

FROM: GLADYS SARLAT PUBLIC RELATIONS
149 N. Stone, Suite 403
Tucson, AZ., 85701 - 624-0493

Contact: Jess Riggle
AS 401-B/F-5-3



9"



CAPTION

Dilute sulfuric acid (about 100 pounds per ton of ore) dissolves the copper and forms copper sulfate as it percolates downward in the giant vats. Copper-bearing solution is piped to "launder units," remaining solid waste is removed by a clamshell bucket on a second gantry (above).

# # #

FROM: GLADYS SARLAT PUBLIC RELATIONS
149 N. Stone, Suite 403
Tucson, AZ., 85701 - 624-0493

Contact: Jess Riggle

AS 401-B
F-5-3

The Bavoquivari and Coyote.

The Sierritas are separated from the Bavoquivari and Coyote ranges by a wide area of grassy mesa, known as the Bavoquivari valley, devoted to cattle ranches, the principal one being owned by The Arizona Land and Cattle Company, Alfred Donau, manager.

In the Bavoquivari and Coyote ranges a great deal of prospecting has been done, and some of the more promising veins are being worked in a small way by Tucson people. Copper, gold and silver ores occur, and are generally of high value.

The Cababi.

The Cababi district, in the mountains of that name, in the very heart of the Papago country, contains rich sulphuret ores. Operations in a small way have proved the existence of large bodies of ore carrying gold in considerable quantity. This district was extensively worked when silver was king, and the ore was rich enough to ship a long distance. The development of the veins in which gold predominates has attracted some local attention lately, but capital is needed to prove their real value.

The Quijotoas.

West of the Cababi range are the Quijotoa mountains, famous for the so-called Bonanza mines, from which so much was expected and so little resulted. The steady decline in silver after active work was begun probably accounts for their failure to realize expectations. Mining operations are not entirely suspended, however, for a number of promising gold prospects are being developed in an extension of the range. The Indians have worked the gold placers on the slopes of the foothills for years, and the average product of the precious metal is estimated, by traders who purchase it from them, at not less than 100 ounces per month. The absence of surface water in this section has proved a drawback to placer mining on a large scale. Water, however, in abundance is found in the valley at a depth of 500 feet, and there is a well and pumping plant on the ground that could be utilized by an enterprising company.

Further west to the Colorado river are frequently occurring mineral deposits, principally gold and copper, but on account of their distance from lines of communication they are not much regarded.

The San Xavier Mines.

Returning to Tucson and traveling south, we reach the San Xavier group of patented mines, seven in all. They are located about sixteen miles south from Tucson and about four miles from the Santa Cruz river. There was a large amount of development work done on these properties prior to twelve years ago, the deepest workings being 230 feet. Large quantities of ore were taken out and shipped at a good profit when labor, supplies and freight rates and smelter charges were much higher than at present. These mines have been purchased by Eastern parties, represented by Messrs. Manning & Cameron, which means much for Tucson and the Olive camp. This is probably the most promising group of mines within a radius of sixty miles of Tucson. They have been extensively developed, and all show very large bodies of high-grade ore of lead, silver, gold and copper. The mines have been idle for years, owing to the fact that the stock was owned by people who were wealthy, and who knew the mines were very rich, and believed the money to be just as safe in the mines as in the banks. While they were right, this was of no advantage to the territory. The change of ownership of the properties will prove of great advantage to Tucson and this mining region.

It is the intention to commence shipping the high-grade ore as soon as the mines are in condition to extract the same, which will be in about

J. GEORGE HILZINGER
Treasure Land
1897
A Handbook to Tucson and Southern Arizona

The lowest grade of ore will be left on the dump to be worked as a plant will be erected there to handle the same. In some s lead and silver predominate, copper in others, and in others als are combined.

The Helmet Peak Company are working a few men, under Bob Roberts, superintendent, on their group of mines lying about a mile and a half south of the Olive camp, and twenty-two miles south of Tucson. The group consists of four claims, including the once famous Specu- worked some years ago by what was called here The Westing- any. The Helmet Peak Company was organized here a few and represents Tucson capital solely. The work now being e Atlanta mine (formerly the Speculation). At a depth of fifty is being done on the lead, which is several feet in width, with of ten to eighteen inches, which by sample assay shows sixty unces silver, and 40 per cent. lead. Other mines in the vicinity rked in a small way.

Traveling south and east about forty-five miles, we reach the Arivaca district, one of the oldest mining camps in the territory. It has a delightful situation among rolling hills and grassy plains, a fine climate and abundance of wood and water, but has, so far, been unsatisfactory to principally on account of mismanagement. The ledges, or silver, are generally exceedingly rich on the surface, and erated hopes which bring their own defeat. For several years ork has been done in this district, and we are of the opinion ally competent people get on the ground, it will prove to be a manent mining section.

Seven miles southeast of Arivaca lies the Oro Blanco district, containing over 100 square miles of country, mineralized, with surface croppings on almost every hill, and, like the Arivaca district, with gold literally in every gulch. The Mexicans have unremittingly worked these g the rainy season from the dawn of Arizona history and long Sam purchased the territory. The district has been held back of unfavorable circumstances. It is only reached after a long d it is only lately that any one has cared to seek gold. Then, en a victim to the common error of putting up mills before ie mines, and because undeveloped mines could not furnish ugh, confidence in them failed, or the work was abandoned unds originally provided were exhausted in building the mill ainable for procuring ore.

not to-day, so far as we can learn, a shaft 300 feet deep in strict, and it has produced more bullion to the cubic foot of an any district in the territory. We believe there is no better imate mining in Arizona, but visitors must not expect to find nes here. It is a region of prospects, but they are admirable ht to interest capital.

formations are generally granite and porphyry, with argil- , and seem to be everywhere gold-bearing. Gold can be panned vine and gulch, and even on the hillsides, especially when the ed by decomposed pyrites.

old, but silver, lead, copper and iron ores are found, but gold enerally diffused metal, and follows a broad belt through the

Albert W. Forbes
Sheriff of Pima County
came to Tucson from Colorado
to work in the San Xavier Mine
then went to El Grupo Mine about
15 miles southwest of Sasabe, Sonora

Form 1542–4
(August 1965)
(formerly 4–1123)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ROUTING AND TRANSMITTAL SLIP

TO CODE	NAME	ORGANIZATION	ACTION	ROOM NO.
	G W Irvin			

Indicate Action by Number

1. Necessary action
2. Approval
3. Signature
4. Prepare reply
5. Your comment and return
6. Note and surname
7. Note and return
8. Your information
9. See me
10.

From	Date	Room No.
Bob Mc		
Office BLM, ASO		**Phone**

Remarks

Hope these will be useful. They were the only ones showing drill-sites Date of drilling not given.

GPO 851-696

... S.E. Cor. N-E. Set [illegible]
[illegible] rock [illegible] and built
a monument of stones 3½ feet high
Thence I ran
Var 13° E.
350 S 9° E Along East Boundary
of Claim to place of beginning.

General Description

This Claim lies in a hollow between two Limestone hills about 3/4ths of a mile West of the Helmet peak in Pima Mining Dist Pima Co A.T. and about 18 miles S.W. of Tucson.

The Improvements made by the Claimants and Grantors are as follows

1 Blacksmith Shop - 12 x 14 ft
1 Store House 54 x 20 ft
Shaft No 1 - 5 x 8 - 140 feet deep
Shaft No 2 = 5 x 7 - 275 " "
Drifts & Winzes aggregating 472 feet
1 Tunnel 6 x 4 - 75 ft long.
Diamond Drill Hole No 1 = 280 ft deep
" " " No 2 = 275 ft "

SURVEY NO. 412

PLAT

OF THE

Western Ext.n San Xavier

MINING CLAIM,

Pima Mining District,

Pima County,

ARIZONA.

Claimed by *Santa Rita Land and Mining Company*

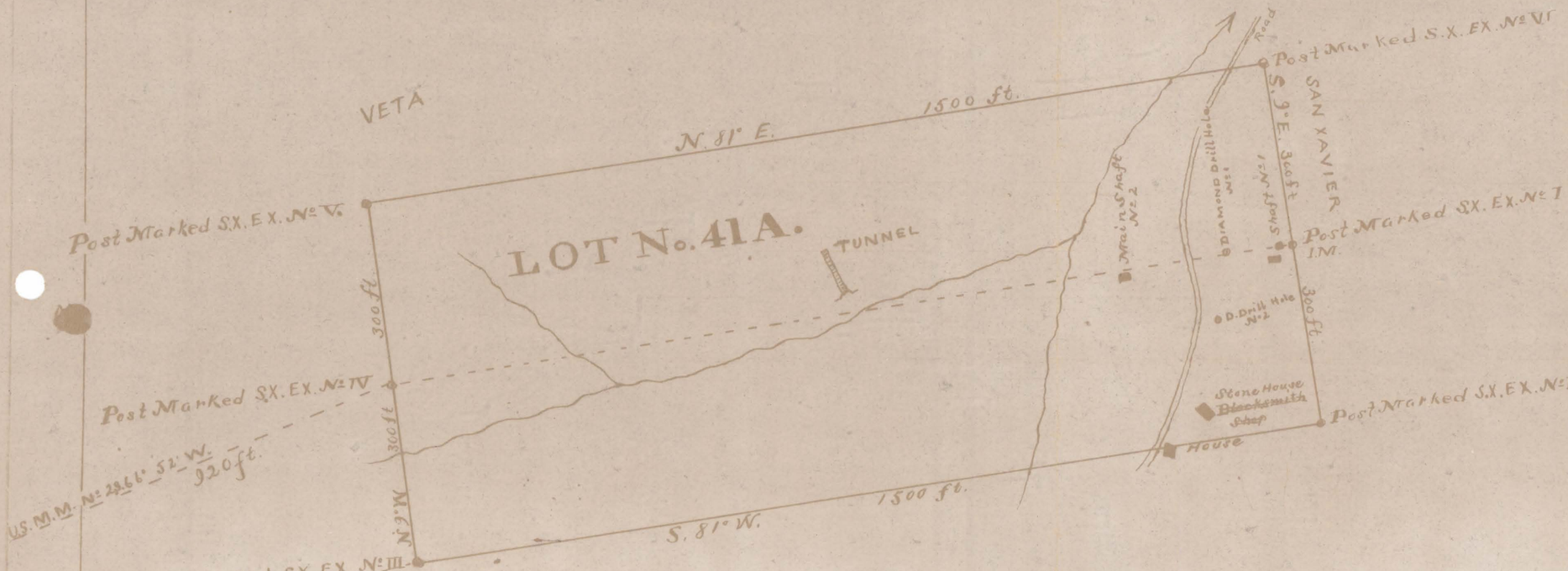
Surveyed by *Solon M. Allis* U. S. D. S.

Sept 12 1882

Containing an Area of *20.66* Acres.

Scale 209 feet to the inch.

Variation *13* East.



Patent Date
Patent No. 10422
Serial No.

I hereby certify that the Survey of the *West. Ext.n San Xavier* Mining Claim from which this plat has been made, have been examined and approved and are on file in this office; and I hereby certify that they furnish such an accurate description of said Mining Claim as will, if incorporated into a patent, serve fully to identify the premises; and that such reference is made therein to natural objects and permanent monuments, as will perpetuate and fix the locus thereof.

I further certify that the value of the labor and improvements placed thereon by the applicant or its grantors is not less than Five Hundred Dollars, and that said improvements consist of

Shaft No 1 5x8 ft. 140 ft deep
" No 2 5x7 " 275 " "
Tunnel 6x4 " 75 " long
Drifts Winzes Etc.

#1 280' TD
#2 275' TD

as appears by the report of the Deputy Surveyor and the testimony of two disinterested witnesses.

And I further certify that this is a correct Plat of said Mining Claim, made in conformity with said original field notes of the survey thereof.

J. W. Robbins
U S Surveyor General for Arizona.

U. S. Surveyor General's Office,
Tucson, Arizona,
October 4 1882

SURVEY NO. 415

PLAT

OF THE

San Xavier

MINING CLAIM,

Pima Mining District,

Pima County,

ARIZONA.

Claimed by Santa Rita Land and Mining Company

Surveyed by Solon M. Allis U.S.D.S.

Sept. 13 1882

Containing an Area of 20.66 Acres

Scale 200 feet to the Inch.

Variation 13° East.

The original Field Notes of the Survey of the San Xavier Mining Claim from which this plat has been made, have been examined and approved at once on file in this office, and I hereby certify that they furnish such an accurate description of said Mining Claim as will, if properly pointed into a patent, serve fully to identify the premises, and that such reference is made therein to natural objects and permanent monuments, as will perpetuate and fix the locus thereof.

I further certify that the value of the labor and improvements placed thereon by the applicant or its grantors is not less than Five Hundred Dollars, and that said improvements consist of

Shaft No 1 4x6 ft 10 ft deep

" No 2 4x6 " 10 " "

D. Drill Hole No 1 150 " "

" " No 2 100 " "

" " No 3 75 " "

as appears by the report of the Deputy Surveyor and the testimony of two disinterested witnesses.

And I further certify that this is a correct Plat of said Mining Claim, made in conformity with said original field notes of the survey thereof.

J. C. Pattison

U.S. Surveyor General for Arizona.

U.S. Surveyor-General's Office,
Tucson, Arizona,

October 7 1882

Patent Dr
Patent No. 8791
Serial No.

Loc. S23, 16S, 12E

SAN XAVIER MINE PIMA COUNTY

Asarco continues to mine silica ore from their San Xavier Extension pit on the reservation. GWI QR 12-1968

Asarco is producing from their San Xavier mine on the Indian Reservation. GWI QR 4-1-70

Active Mine List May 1970 - P.A. Lewis, Supt.

Asarco's San Xavier operated at the 4000 tpd rate. GWI QR 10-1-70

Active Mine List Oct. 1970 - 659 men - P.A. Lewis, Supt.

The San Xavier mine of ASARCO is down due to a law suit filed against the company by the Papago Indian Lawyers. GWI QR 6-30-71

San Xavier (ASARCO) down due to court action, but understand that the Indians want to deal directly with ASARCO.. GWI QR 9/71

ASARCO is going ahead with their new San Xavier mine on the Papago reservation. GWI 4 ¼ '72

Phone call to R. Crist, Asarco, for location of their San Xavier mine. All of 20, 21, 28, 29 & 30, T16S, R13E, 25, W½24, W½13, E½14, NE¼ & N½SE¼23, in T16S, R12E. The pit lies within sections 14, 13, 23 & 24 in T16S, R12E. GWI WR 3/5/74

MOR/86 IN MID 80'S BEGAN OPERATION AS PART OF ASARCO'S MISSION SUPERPIT COMPLEX

The original San Xavier Mine is located within section 2, Township 17 south, Range 12 East within the Pima Mining District. This is approximately 18 miles south and a little west of Tucson. The mine is reported to have been worked by the Spaniards and the Mexicans in the early seventeenhundreds.

According to an unpublished history of the pioneer Contzen family, Fred Contzen who worked on the Boundary Survey for the Gadsden Purchase Commission and his brother Julius established the Punta de Agua Ranch in the year 1856 along the Santa Cruz River about three miles south of the San Xavier Mission. Sometime after this date they located the San Xavier Mine.

In March 1872, S. W. Foreman a U. S. Deputy Mineral Surveyor surveyed the San Xavier Claim. At this time he surveyed two claims called San Xavier. One measured 1200 by 396 feet, the other one measured 3000 by 396 feet and completely overlapped the smaller one. It would appear that the mining laws were in the process of being changed so the mineral surveyor took two routes. Both surveys are for Lot No. 38 and were accorded the Number One for the first mining claim to be registered in the Arizona Territory. The claimants were M. B. Duffield and I. Q. Dickason.

Neither of the above claims were patented. In September 1882 a Deputy U. S. Mineral Surveyor, Solon M. Allis surveyed seven claims for patent. at the San Xavier Mine. The approximate area covered by the 3000 foot long San Xavier claim was covered by two claims of 1500 by 600 foot dimension. Survey number 412 the Western Extension of San Xavier and survey 415 the San Xavier. All seven of these claims went to patent. The claimant on record for this survey was the Santa Rita Land and Mining Company.

The patent survey for the Western Extension of San Xavier listed three shafts with depths of 140, 275 and 75 feet, a 75 foot tunnel plus unmeasured drifts and winzes and two Diamond Drill holes of 280 and 275 feet depth. On the San Xavier claim a 90 foot and a 10 foot shaft were listed along with three Diamond Drill holes with depths of 150, 100 and 75 feet. Underground workings later intersected one of these holes. It appeared to be about 4 inches in diameter. I have been unable to find any record of the drilling machines or the results of the drilling.

The Handbook Of Arizona dated 1878 reported that Colonel Sykes, a well known former New York publisher was the present proprietor of the San Xavier mine. At that time he was mining argentiferous carbonates and sulfates of lead estimated to average $65 in silver per ton of ore and to run from 40 to 65 percent lead. At this time the Colonel was planning to install furnaces to enhance his profit margins.

Later the Manning, Goldsmith and Zepeda Mining Partnership operated the mine. Around 1879 General L. H. Manning reopened the mine and did exploration for several months. After this the owners formed the Meyer-Clark-Rowe Mines Company and continued development until August 1901. By 1903 they were reported to have shipped 50,000 tons of oxide to the El Paso Smelter.

The Empire Zinc Company acquired the mine in 1912 and operated it until 1918. In 1916 mining was confined to oxidized lead and lead copper ores with a production of 20 to 30 tons per day. Most of this production came from an area east of the number 2 shaft on the 100' level, from the surface between shafts 1 and 2. Some very good carbonate ores from near shaft number 3 on the 100' level. Some copper ores were mined from the number 6 shaft area.

In 1916 the Empire Zinc Company started the number 6 shaft. This was sunk to a depth of 250 feet with levels at the 100, 150 and 250 foot depths. This is the mine that has been acquired from the Anamax Company by the College of Mines of the University of Arizona for their mining laboratory.

The mine remained idle from 1918 to 1942 when it was acquired by the Eagle-Picher Mining & Smelting Company. Eagle-Picher built a 400 ton a day flotation mill at Sahuarita to mill custom ores in addition to the mine production. The site of the mill was the location of the old Pioneer Smelter. During the ten years that Eagle-Picher operated the mine a shaft was completed from the surface to the 900' level. This was the number 7 or main shaft. The stations on this shaft were at the 340, 420, 500, 580, 660, 740, 820 and 900 foot levels. Development and mining was done on all of these levels with the 340 and 660 levels being driven westerly to a point down-dip from the number 6 shaft. A connection via raises and stopes was then made to a x-cut from the number 6 shaft 250 level.

Mining methods were adapted to the conditions in the various ore zones. At times water was a problem. In 1948 the mine was making 730 gallons per minute. During this period up to 300 men were employed by the company. More than 600 diamond and churn drill holes were completed. Most of these were underground, but the churn drill holes and several diamond drill holes were drilled in the vicinity of the mine.

Eagle-Picher ceased operations in 1953 except for repair work with a skeleton crew. In 1955 McFarland & Hullinger of Toole leased the mine and operated it and the mill on a somewhat smaller scale. They eventually purchased the mine and mill. In 1959 it was closed. The Banner Mining Co. purchased the mine. Both the mine and mill site are now part of the Anamax Company holdings.

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SAN XAVIER VAT LEACH PLANT OPERATION

by

Rollin W. Roberts, Leach Plant Foreman
American Smelting and Refining Company
Sahuarita, Arizona

Presented at the 1974 Mining Convention/Exposition of the American Mining Congress, Las Vegas, Nevada, October 7-10

B7

The San Xavier Leach Plant is American Smelting and Refining Company's newest sulfuric acid leach operation and is located 20 miles southwest of Tucson, Arizona. The plant went on-stream in March of 1973 under the management of ASARCO's Mission Unit.

The 12 million dollar plant was designed by Kaiser Engineering of Oakland, California, to process 4,000 tons of oxide copper ore per day. The plant has a life expectancy of about 8 years.

The Leach Plant was named for the San Xavier Indian Reservation upon which the orebody lies. The ore reserve consists of two separate orebodies. The South San Xavier pit will be an extension of the Mission Unit's present orebody. Stripping for this pit was begun in March of this year. The North San Xavier pit is located approximately 2.7 miles northwest of the Mission Unit. This pit is currently supplying ore for the leach plant and will continue to do so for the first 5 years of the plant's operation. The South San Xavier pit will supply ore for the last 3 years of the plant's life.

Geologic studies indicate that an ore grade of 1.0 per cent copper is available. The present cutoff grade is 0.40 per cent copper. The ore consists of silicified and sericitized Arkose and Argillite containing copper mineralization in the form of oxides, silicates, carbonates, and minor amounts of sulfates and native copper. The oxidized zone of the North San Xavier orebody varies in thickness from 50 to 140 feet and lies under 150 feet of overburden and low grade waste. Mineable ore was first encountered at a depth of 80 feet.

Irvin

Some Geologic Notes on

San Xavier Mine

In spite of the detailed geologic work that has been done here for the past six years, the significance of the "17" fault is not clearly understood. We have avoided taking a dogmatic stand on some theory, and thereafter collecting facts to prove it. Instead, the facts have been accumulated, and they can be used by anyone interested in developing a theory. Listed below are certain facts about the "17" fault.

1. It strikes northeast and dips southward. It is far from being the textbook plane type of fault, as it has many irregularities in both its strike and dip. It changes course abruptly, and has been known to flatten and steepen down dip.

2. It has a tendency to split in the direction of strike and dip. These splits probably originate at places of change in strike and dip. Because it intersects the bedding planes of the hanging wall limestone at an acute angle, many splits leave the main fracture and follow out along some bedding plane. The contacts between limestone and dense shaly quartzite, or limestone and quartzite seem to have localized some of the more prominent splits. Splits into the foot-wall formations have not been recognized.

3. It is usually characterized by four to six inches of greenish gray gouge on its foot-wall side. In places, it is mineralized, usually in the foot or two of brecciated rock above the gouge.

4. The displacement (if any exists) of the arkose-limestone contact along the "17" fault is very obscure. The apparent displacement of the Permian beds has not been measured. It may be great or small depending upon the identification of the beds in the foot wall and hanging wall, which to date has not been positively made.

5. It has been conveniently used as a geologic marker in development work to date. No ore bodies of any size have been found in the foot wall of the "17" fault east of about coordinate line 100,200 E. (The east wall of No. 7 shaft is 100,184 E.) This does not mean that ore bodies may not exist beneath the fault farther east than 100,200 E, and, as will be explained later, exploration should be directed to prospect this possibility.

Some Geologic Notes on San Xavier Mine

Theory:

In order to understand the significance of the "17" fault one must first appreciate the broad geologic features as exhibited by the local surface geology.

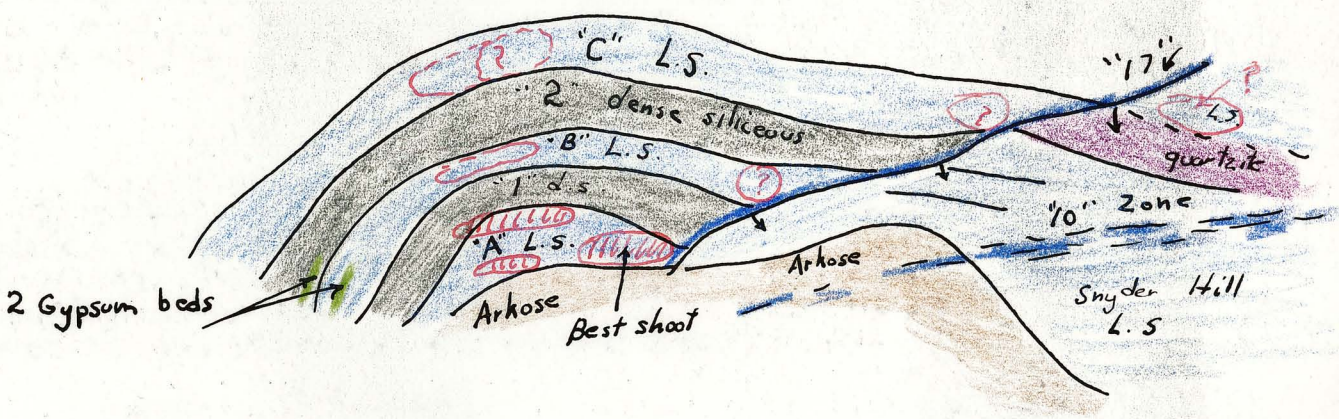
The ridge above the mine is made up of Permian limestone and quartzite which strike about east-west and dip southward at a moderate angle. In the north slope of the ridge and in the gully beyond, there is exposed a series of white and dark gray limestone beds with interbedded shaly quartzites, marls, and gypsum beds. These underlying beds strike northwest and dip to the south. Their exposure is roughly triangular in shape, the base being about parallel with the highway (probably a fault contact with the Pennsylvania Naco beds), and the apex being to the east at the head of the gully. The north side of the triangle may well be a vertical fault, along which the block on the north side has been dropped. The south side of the triangle is marked by an angular unconformity with the overlying upper Permian (Snyder Hill) beds. The fault which makes this angular unconformity is the most important as far as the geology of the San Xavier Mine is concerned. The fault dips south and the movement along this fault must have been reverse, i. e., the hanging wall block moved up relative to the foot wall. The faulting was not confined to a single break, but rather to several faults which intersect each other either along the strike or down the dip. I believe the "17" fault is part of that system of reverse faults.

Evidence of thrust faulting in this part of Arizona (Santa Rita Mountains, Empire Mountains, and Tucson Mountains) is common. Thrust faulting would be expected in this area, and strong evidence is found to support the expectation. The reverse faults described in the preceding paragraph are considered to be related to the broader structural features of the area, specifically to the thrust faulting.

Below the 500 level, in the west half of the mine, evidence has been accumulated which when recently reviewed established the presence of five beds below the arkose (and the "17" fault). The continuity of these beds from the deepest level to the surface is best shown in section C-C (200' scale). The five beds comprise three limestone beds and two "dense siliceous" beds (predominantly very fine-grained, shaly, and possibly limy quartzites). The limestone beds can be conveniently called the A, B, and C members. The "dense siliceous" beds can be numbered 1 and 2. From arkose down, the stratigraphic section is then: A, 1, B, 2, C, 3? At present, the continuation of the alternating beds is not known underground stratigraphically below limestone member C, except at the surface where the third "dense siliceous" bed appears. All five members, and possibly the overlying Cretaceous sediments, have been folded into a southeastwardly pitching syncline. The east limb of this syncline is known definitely to have been truncated by the "17" fault and by others belonging to the reverse set mentioned previously. Development work underground has not proceeded far enough west as yet to ascertain if the west flank of the syncline is similarly truncated.

Some Geologic Notes on
San Xavier Mine

As may be seen in the following sketch, all five beds (at least) butt up against the "17" fault.



To date, only the A limestone member has been productive. The largest and most productive shoot of the mine yet found was in the "A" bed where it abuts the "17" fault. There appears to be a chance that shoots may exist in the B and C limestone members where they abut the "17" fault. Diamond drilling through the "17" fault to the north is necessary to ascertain where along the underside of the "17" fault the B and C members are likely to be found in this apparently favorable structural relationship. Considerable work has already been done which will be useful.

It should also be kept in mind that a similarly favorable situation may exist if the "17" fault truncates the west limb of the syncline.

Still another possibility exists in the hanging wall block of the "17" fault, where the limestone below the quartzite abuts the fault and even elsewhere in it to the east.

Recently in Diamond Drill Hole No. 238 (660 level) two beds of gypsum have been penetrated in what appears to be the "B" member of the series. There is some chance that a large fault was crossed before hitting the gypsum, which would mean that the gypsum was not in the "B" member. If the gypsum beds are confined to one layer of the Yeso section, the

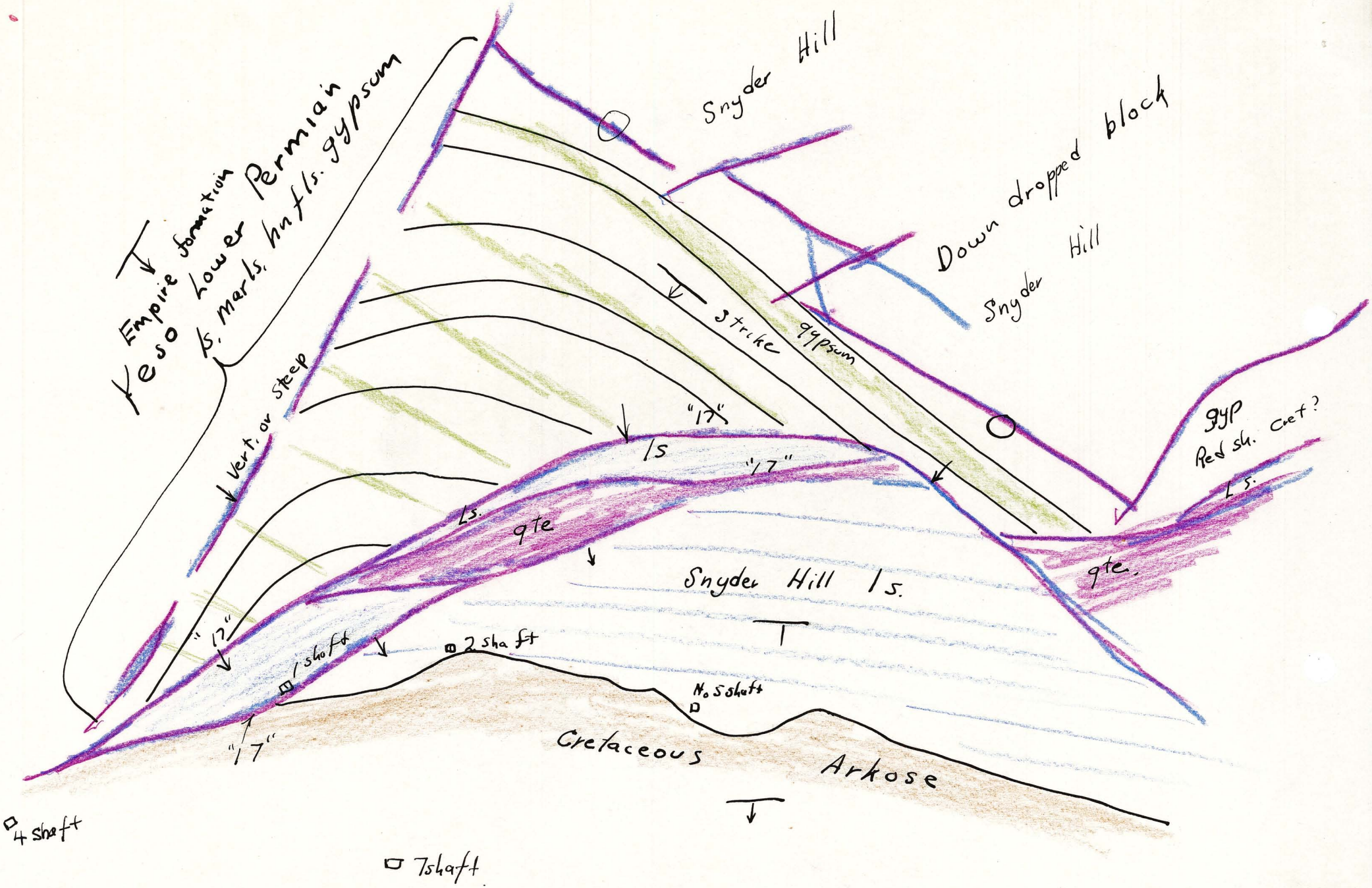
gypsum exposed in the gully north of the mine would be the same bed as hit in Diamond Drill Hole No. 238. The occurrence of the gypsum in the Yeso should be well known to F. W. Galbraith and B. S. Butler, who have seen many Yeso sections. The extraordinary thickness of the "B" in Diamond Drill Hole No. 238 can be explained by the flat dip of the beds (see log).

The previously mentioned syncline apparently truncated by the "17" and allied faults is probably also truncated nearer the trough of the fold by a set of steep northeast fissures which can be observed underground on the 340 and 270 level in the vicinity of the No. 4 shaft, Churn Drill Hole No. 1.

There is an area above the 270 level, between the No. 4 and No. 1 shaft, which has not been sufficiently explored. If any ore exists, it may be in part oxidized. The area could be drilled from the surface or the 200 west face could be advanced as suggested several years ago. See longitudinal projection. Some work in this direction was done on the 115 level, but not much lateral work was done from this drift.

W. R. Jones, Geologist
The Eagle-Picher Mining & Smelting Co.

March 14, 1949


Empire formation
Lower Permian
Yeso
ls. marls, hn fls. gypsum
Snyder Hill
Down dropped block
Snyder Hill
Strike
gypsum
Vert. or steep
"17"
ls
"17"
Ls.
gte
gyp
Red sh. Cret?
Ls.
gte.
Snyder Hill ls.
"17"
1 sh aft
2 sh aft
No 5 shafts
"17"
Cretaceous
Arkose
4 shaft
7 shaft
Scale 1" = 200'

Sept 1948

GEOLOGY

THE EAGLE-PICHER MINING AND SMELTING COMPANY'S

SAN XAVIER MINE

Pima County, Arizona

by

W. R. Jones*

Mine Geologist

*Member A. I. M. E.

LOCATION

The San Xavier Mine is in the Pima Mining District, Pima County, Arizona, five miles north of the old Twin Buttes Camp and twenty miles south of Tucson.

HISTORY

Lead and silver are reported to have been mined at this location as early as 1870. The mine was idle for some time until reopened by General L. H. Manning in 1897. By 1903, 50,000 tons of oxide ore had been shipped to the smelter at El Paso. The Empire Zinc Company acquired the property in 1912 and operated it until 1918. The mine was idle for the next twenty-four years and in 1942 was bought by The Eagle-Picher Mining and Smelting Company.

GEOLOGY

Sedimentary Rocks

The sedimentary rocks in the mine area include Permian marl, gypsum, grit, sandstone, quartzite, and limestone, and Cretaceous arkose, shale, argillite, quartzite, graywacke, and limestone. Only those rocks encountered in mining will be described.

A Permian quartzite bed lies stratigraphically below the productive Permian limestone at the surface and in the eastern part of the mine. The quartzite is light gray to brown, is fine-grained, and consists of well cemented, round grains of quartz. It varies in thickness from about 30 feet within the mine to about 100 feet in adjacent, less deformed areas. The variation is due primarily to deformation, although part may be due to irregularities in deposition.

The productive limestone bed is underlain in the western part of the mine by a light to dark green,"dense-siliceous" rock. A similar bed occurs between two productive limestone beds in the eastern part of the mine. In several places it is known to grade rapidly into a medium-grained quartzite. Although limestone adjacent to some fissures has been altered to a deceptively similar rock, the "dense-siliceous" rock is considered to be a clastic member of a predominantly limestone formation. The "dense-siliceous" bed varies in thickness from 25 to 60 feet.

The productive limestone bed is dark gray to blue-black, thin-bedded, and in places contains large chert nodules. Pre-Cretaceous erosion cut deeply into this limestone and completely removed it in some places. The maximum thickness measured within the mine is 140 feet. Its contact with the overlying Cretaceous arkose or shale is an irregular erosion surface.

The Cretaceous arkose is usually light gray, is fine- to medium-grained, and consists of subrounded to irregular grains of quartz with unaltered microcline and lesser amounts of unaltered plagioclase and orthoclase feldspar. It is remarkably free of clay in unaltered specimens. Where the rock above the limestone is not arkose, it is a dense, light-greenish-gray argillite or shale. It is not always easily distinguished from the "dense-siliceous" rock described above.

Rock Alteration

The quartzite shows few signs of hydrothermal alteration, but in places it is recrystallized and recemented by quartz and is brecciated wherever seen.

The "dense-siliceous" rocks have been replaced by epidote, quartz, calcite, clay and pyrite. Commonly the rock is bleached to lighter shades of green, pink, and brown. Angular fragments of pyritic, dense, green, siliceous rock, fragments of white limestone or calcite and fragments of ore occur as

irregular masses of cemented breccia near faults and faulted contacts.

Limestone, near and within the ore shoots, has been altered. The alteration varies from merely recrystallization and reorientation to complete replacement by hydrothermal quartz, garnet, or hedenbergite. Pyrite is commonly associated with the garnet-quartz alteration, especially at the extremities of the altered zone, but it is rarely associated with hedenbergite. Euhedral crystals of pyrite, sometimes an inch square, are found in the clay gouge of certain faults.

The arkose is usually altered near the limestone contact. Although epidote has completely replaced the feldspar in many places, the quartz grains were altered only around their borders. Hydrothermal quartz, late calcite, and clay have also been added to the arkose. Pyrite is usually disseminated throughout the arkose.

The type of alteration is sometimes of aid in determining the original rock. In general, epidote replaced siliceous rocks, whereas garnet and hedenbergite replaced limestone. The formation of hedenbergite in only the lower beds of the productive limestone is of interest, and may be related to an original difference in chemical composition of these beds.

Igneous Rocks

Granite crops out over a vast area north and west of the mine. The contact between this granite and the sedimentary rocks is at a radius of 2000 to 3000 feet from the San Xavier Mine proper and about 1500 feet from the center of mineralization near the Number 6 shaft. The granite is light gray and consists of course-grained quartz, orthoclase, perthite, and microcline feldspar. The matrix is a finer grained assemblage of the same minerals. Muscovite is abundant and femic minerals are rare. The grains vary

in diameter from 5 to 25 mm. and probably average between 5 to 10 mm.

A strong flat fault marks the granite-sedimentary contact wherever seen, and the granite beneath the fault is crushed in some places. No dikes or stocks of this coarse-grained granite are known to intrude the relatively thin block of sedimentary rocks which rests upon the granite.

A biotite-rich, fine- to medium-grained granite crops out in several isolated areas south and southwest of the mine. Tabular and prismatic, euhedral phenocrysts of black biotite account for about 40 per cent of the mineral content. This rock definitely intruded the Cretaceous rocks, as may be seen in an outcrop 800 feet southwest of the Number 6 shaft, and in an outcrop just north of the Olivette Mine, a few thousand feet south of the San Xavier Mine.

A dark green, fine-grained granodiorite crops out 2000 feet northwest of the mine. It is apparently intrusive into the sedimentary rocks exposed there.

The Cretaceous series includes numerous flows of andesite, and andesite breccias and tuffs. Dikes of purple andesite, and dikes of dark green, dense to fine-grained diorite or diabase cut diagonally across the trough of a major synclinal fold in the Cretaceous rocks 1000 to 1500 feet southeast of the mine. The mine is located within this same syncline, where the Paleozoic limestones have been folded.

STRUCTURE

Folds

The San Xavier Mine is located in a syncline with a moderately steep pitch to the south or southeast. The eastern limb is steeper than the western, and the structure appears to narrow with depth. Within the limestone are minor

anticlines and synclines whose axes are approximately parallel to the axis of the major syncline. Changes in the dip of the beds, as seen in north-south vertical sections, are evidence of another set of folds whose axes trend east-west, at nearly right angles to the axes of the other set and to the axis of the major structure. These secondary corrugations are rarely as perfectly developed or as obvious as the above may imply, and complex faulting has made them even more obscure, especially in the upper levels.

Although some folding of the Paleozoic beds may have taken place before the Cretaceous period, the syncline was formed in post-Cretaceous time.

Faults

Faulting within the area is extensive and complex, and is probably related to thrust action of considerable magnitude. Within the mine the "17" fault is most prominent and important. It strikes northeast and dips from 40 to 80 degrees southeast, intersecting both the dip and strike of the limestone, and the sedimentary rock contacts at a small angle. Because of this, the amount of movement along the fault is not known. Even considerable movement could have resulted in small offsets. The fault zone usually consists of 1 to 3 feet of sheared and brecciated rock above 3 to 6 inches of green, clay gouge. It is not everywhere mineralized. Numerous faults split off into the bedding planes of the hanging wall limestone, and these are often mineralized to a greater extent. The "17" fault has been followed on most levels from where it enteres the favorable limestone beneath the arkose (near the center of the mine) to the eastern part of the mine where it tends to turn to the right so as to enter the bedding planes or the contact between the limestone and the underlying quartzite. The imperceptible offset of the arkose-limestone contact, and the undulations in the fault plane suggest that the irregularities in dip and strike may have been acquired

during the development of the syncline, along with renewed movement. All the ore shoots in the central and eastern parts of the mine are in the hanging wall of the "17" fault. These shoots have a remarkably constant rake to the south--a fact which may or may not be related in part to the fact that the line of intersection of the "17" fault with the arkose-limestone contact and with the limestone bedding also strikes about due south. However, the south rake of some shoots is primarily related to the axes of the folds, which in most cases strike south.

The "10" fault is a prominent structure in the eastern half of the mine. It strikes about north 70 degrees east and dips south at an average of 70 degrees. Above the 420 level it is steeper than the beds, but below the 420 it appears to parallel more or less the contact between a limestone and a "dense-siliceous" bed. It is mineralized everywhere, and the arkose-limestone contact is offset to the left by it. The "10" fault is in the hanging wall block of the "17" fault to which it is linked in the western part by several steep, northeast-striking mineralized fissures.

Several less important sets of pre-mineral faults have been observed. One set strikes northeast and dips 80 degrees northwest. Still another set strikes approximately east and dips 10 to 20 degrees south. This flat set is encountered in some stopes. High grade ore is usually found beneath the slip and barren silicate rock above. In the western part of the mine, especially, there are many strong northeast striking faults which dip steeply to the southeast. They are all mineralized. No post-mineral faults of any significance have been observed.

LOCALIZATION OF ORE

Relation to Kind of Rock

The favorable bed is the thin-bedded, dark gray Permian limestone beneath the Cretaceous arkose and argillite. Little if any replacement took place in the arkose, argillite, quartzite, or "dense-siliceous" rocks. Sulphides occasionally filled narrow fissures in these siliceous rocks, but no ore of any importance is found in them.

The limestone was first replaced by quartz, garnet, or hedenbergite and to a lesser extent by other silicate minerals. The metal sulphide minerals were deposited later as replacement of residual limestone surrounding the silicate minerals, as replacement of large blocks of limestone between gouge-lined slips in an otherwise silicified and silicated mass, and as filling of innumerable cracks in the earlier gangue minerals. The highest grade ore shoots were formed where earlier alteration merely changed the limestone to marble. Great volumes of limestone exist between and beyond the ore shoots. Inasmuch as the ore shoots coincide with the zones of greatest deformation, it is obvious that brecciation of limestone was a primary prerequisite for ore deposition in important quantities.

Relation to Structure

The ore shoots are all found within the limits of the major synclinal structure. Individually, the ore shoots usually occupy within the limestone the crests and flanks of small anticlines, and the troughs and flanks of small synclines. Some production has come from deposits associated merely with steep northeast faults where the mineralization has made out from a fault along minor fissures and bedding planes in the limestone. The shape of any particular ore body is related to the strike and dip of the limestone at that place and to the strike and dip of the mineralized fissures which pass through or near the ore body.

The ore shoots occur in the lower, middle, and upper beds of the limestone. Mineralization is nearly always found in the limestone along its contact with either the arkose, quartzite, or "dense-siliceous" rock. Differential movement improved the permeability of the rocks along these contacts.

Summary of Events and Factors that Localized Ore

1. The area was folded into a syncline.

2. Within the favorable limestone, beneath the arkose, secondary corrugations developed; the limestone was brecciated in the zones of greatest bending, especially within anticlinal "rolls".

3. Northeast fissures developed, intersecting the permeable zones, and provided access for the mineralizing solutions.

4. The overlying arkose and shale was a relatively impermeable barrier, and diverted the ore solutions into the permeable zones of the limestone. A foot of high grade ore occurs at the limestone-arkose contact at nearly every ore body, and wherever the impermeable hanging wall extended flatly over the limestone, rich ore was deposited.

5. The presence of the favorable limestone was a controlling factor in the localization of the ore. In some places within the mine, pre-Cretaceous erosion had removed it. Where arkose or shale rests directly upon the "dense-siliceous" rock, no ore was deposited. Such a place is evident on the longitudinal section above the 270 level in the west-central part of the mine.

CHARACTER OF ORES

Ore Minerals

As is often true in this type of deposit, the ore minerals are few and of simple composition. The ore is a variable assemblage of rather coarsely

crystalline sphalerite and galena, with subordinate chalcopyrite. Silver is an important accessory and is believed to be in solid solution with the ore minerals as no silver mineral has been recognized. Gold is not present. The average zinc-lead ratio is 2 to 1, and the zinc-copper ratio about 12 to 1.

Gangue Minerals

Yellow to light green and radite garnet, usually associated with the hydrothermal quartz, is the most abundant gangue mineral. Brownish-green, bladed, hedengergite pyroxene is the next most abundant gangue mineral, followed by pyrite, calcite, epidote, hematite, wollastonite, tremolite, serpentine, clay, magnetite, and pyrolusite.

Paragenesis

From a microscopic examination of ore specimens collected above the 200 level in 1941, Mayuga[1] determined the following paragenesis for the hypogene minerals:

garnet, epidote, and other silicates
primary magnetite
hematite
pseudomorphic magnetite (after hematite)
hedenbergite
quartz
pyrite
sphalerite
chalcopyrite
galena

His study also revealed that quartz was deposited later than galena in some specimens. Chalcopyrite has been observed as filling cracks in massive magnetite pods in several places in the central part of the mine.

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[1] Mayuga, M. N., The geology and ore deposits of the Helmet Peak Area, Pima Co., Arizona: Univ. of Arizona thesis, 1942.

CHARACTERISTICS OF ORE SHOOTS

General

The numerous shoots and ore bodies are grouped for convenience into four ore zones, numbered 1 through 4, west to east across the mine. Each shoot has certain characteristics peculiar to it alone, a fact that is not easily explained. Certain mineralogical differences are best explained by assuming a variation in the chemical composition of the ore solutions which migrated through the permeable zones. As no two ore shoots of different character are known to intersect, it is impossible to say that one type of mineralization is earlier or later than another, although such may be the case. The following generalizations may be drawn from the more detailed description of the ore zones which appears later in this paper.

1. The proportion of the metals in several ore shoots is sufficiently constant and unique to be useful in identifying new penetrations of these ore shoots.

2. To a vertical depth of at least 660 feet, no important changes have been noted in the mineral assemblage of any one shoot.

3. Exceptionally high grade ore (50 per cent metal) is found as small bodies in small structural "traps". The silver content appears to have increased slightly with depth.

4. Shoots having a hedenbergite gangue occur only in the eastern half of the mine in the limestone beds which are between "10" and "17" faults. Lead and zinc is usually of equal abundance when associated with hedenbergite, and copper is scarce.

5. Shoots having a garnet-quartz or a calcite gangue are usually in the hanging wall part of the limestone beneath the arkose.

6. Shoots above the "17" fault have a remarkably constant rake to the south, regardless of the attitude of the limestone. Shoots beneath the "17" fault rake to the south and southeast with the dip of the beds.

7. Shoots of sphalerite with spotty concentrations of chalcopyrite, but with little if any galena, occur only in the western part of the mine.

OXIDATION

The bottom limit of extensive oxidation is irregular but, in general, is between the 100 and the 200 levels. Isolated bodies of ore have been partly oxidized as deep as the 420 level, and unoxidized sulphide ore has been mined to within 30 feet of the surface in some shoots. The water level stood a few feet above the 200 level when the mine was re-opened in 1942 after being idle for twenty-four years. The oxidized part of the ore shoots consists of various mixtures of cerrusite and smithsonite, usually coated with limonite. The rare, bluish green, translucent, and fibrous variety of smithsonite has been found in the upper levels. A few specimens of wulfenite, and molybdenite were found, and native copper is associated with chalcocite in one place at the east end of the 340 level. A conspicuous limonite, jarosite, mineralized gossan marks the outcrop of the ore deposit.