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Arizona Department of Mines and Mineral Resources Mining Collection

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PRINTED: 09/05/2002

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES AZMILS DATA

PRIMARY NAME: UNITED VERDE MINE

ALTERNATE NAMES:
- HULL
- BIG HOLE PROPERTY
- HOPEWELL TUNNEL
- PATENTED CLAIMS MS 2812
- PATENTED CLAIMS MS 3348
- PATENTED CLAIMS MS 3480

YAVAPAI COUNTY MILS NUMBER: 551B

LOCATION: TOWNSHIP 16 N RANGE 2 E SECTION 22 QUARTER C
LATITUDE: N 34DEG 45MIN 10SEC LONGITUDE: W 112DEG 07MIN 20SEC
TOPO MAP NAME: CLARKDALE - 7.5 MIN

CURRENT STATUS: PAST PRODUCER

COMMODITY:
- COPPER SULFIDE
- COPPER OXIDE
- SILVER
- GOLD
- ZINC
- SELENIUM

BIBLIOGRAPHY:

- ADMMR UNITED VERDE MINE FILE
- ANDERSON, C.A. USGS PP 308 1958 P 101
- BLM MINING DISTRICT SHEETS 54 & 56
- LINDGREN, W. ORE DEPTS JEROME & BRADSHAW MTN QUADS USGS BULL 782 1926 P 61-78
- HANSEN, M.G. DIAMOND DRILLING AT THE U V MINE USBM IC 6708
- CLAIMS EXTEND INTO SEC. 15 & 22
- USBM IC 6248
- USBM IC 6250

07/08/86

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES FILE DATA

PRIMARY NAME: UNITED VERDE MINE

ALTERNATE NAMES:
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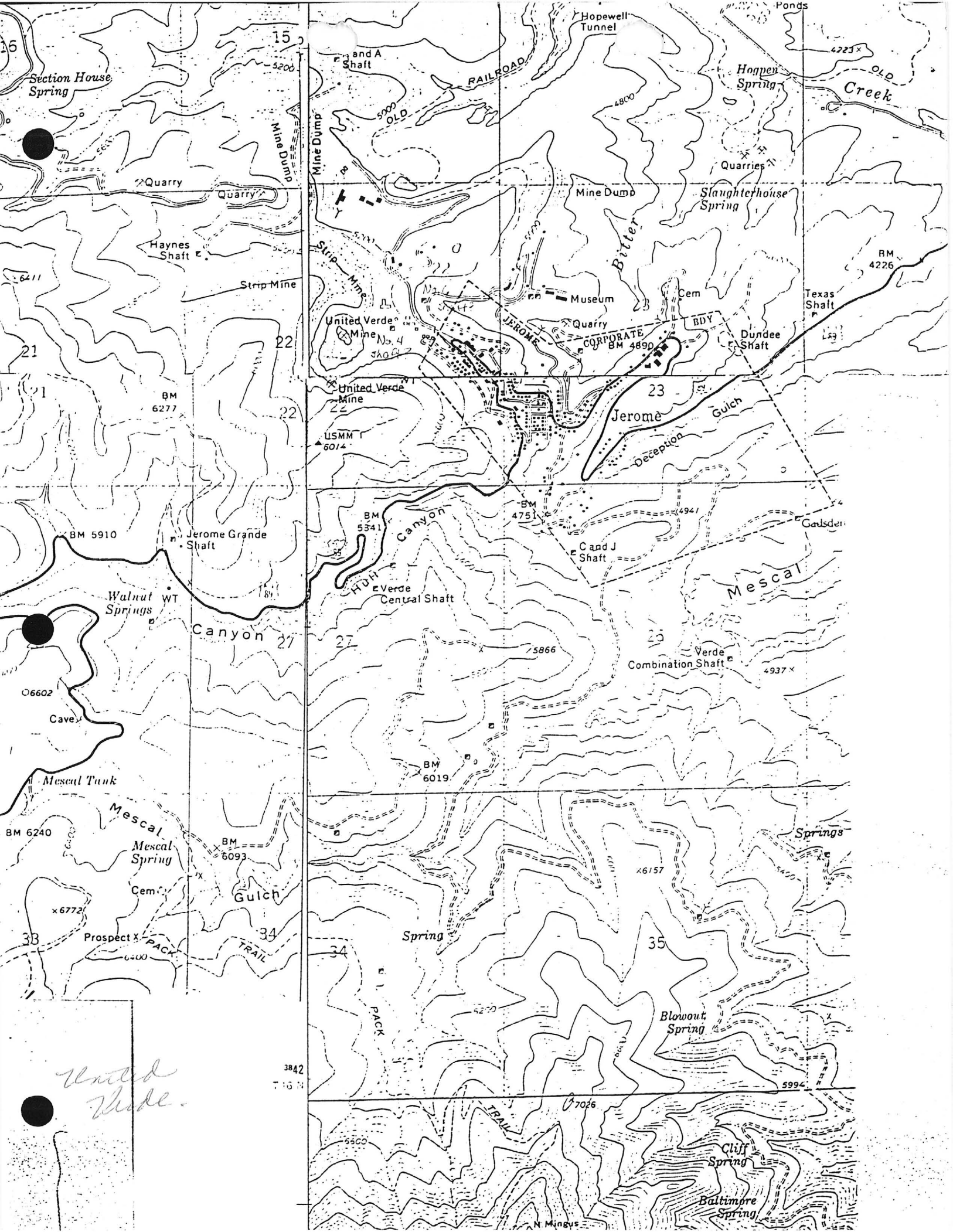
HANSEN, M.G. DIAMOND DRILLING ATTHE U V MINE USBMIC 6708
CLAIMS EXTEND INTO SEC. 15 & 22
ECONOMIC GEOLOGY VOL 67 NOV. 1972 NO. 7
ADMMR UNITED VERDE FILE
ANDERSON, C.A. USGS PP 308 1958 P 101


Section House Spring
Quarry
Quarry
Haynes Shaft
Strip Mine
Mine Dump
Mine Dump
Strip Mine
and A Shaft
RAILROAD
OLD
Hopewell Tunnel
Ponds
Hopper Spring
OLD
Creek
Quarries
Mine Dump
Slaughterhouse Spring
Bitter
BM 4226
Texas Shaft
Museum
Cem
United Verde Mine No. 4
Shaft
JEROME
Quarry
CORPORATE
BDY
BM 4890
Dundee Shaft
United Verde Mine
USMM
6014
BM 6277
Jerome
Gulch
Deception
BM 4751
BM 5341
Canyon
Gaulsden
BM 5910
Jerome Grande Shaft
C and J Shaft
Mescal
Walnut Springs
WT
Canyon
Verde Central Shaft
5866
Verde Combination Shaft
4937
6602
Cave
Mescal Tank
BM 6019
Mescal
BM 6240
Mescal Spring
BM 6093
Springs
6157
Cem
Gulch
6772
Prospect
PACK TRAIL
Spring
PACK
Blowout Spring
5994
7026
TRAIL
5500
Cliff Spring
Baltimore Spring
N Mingus

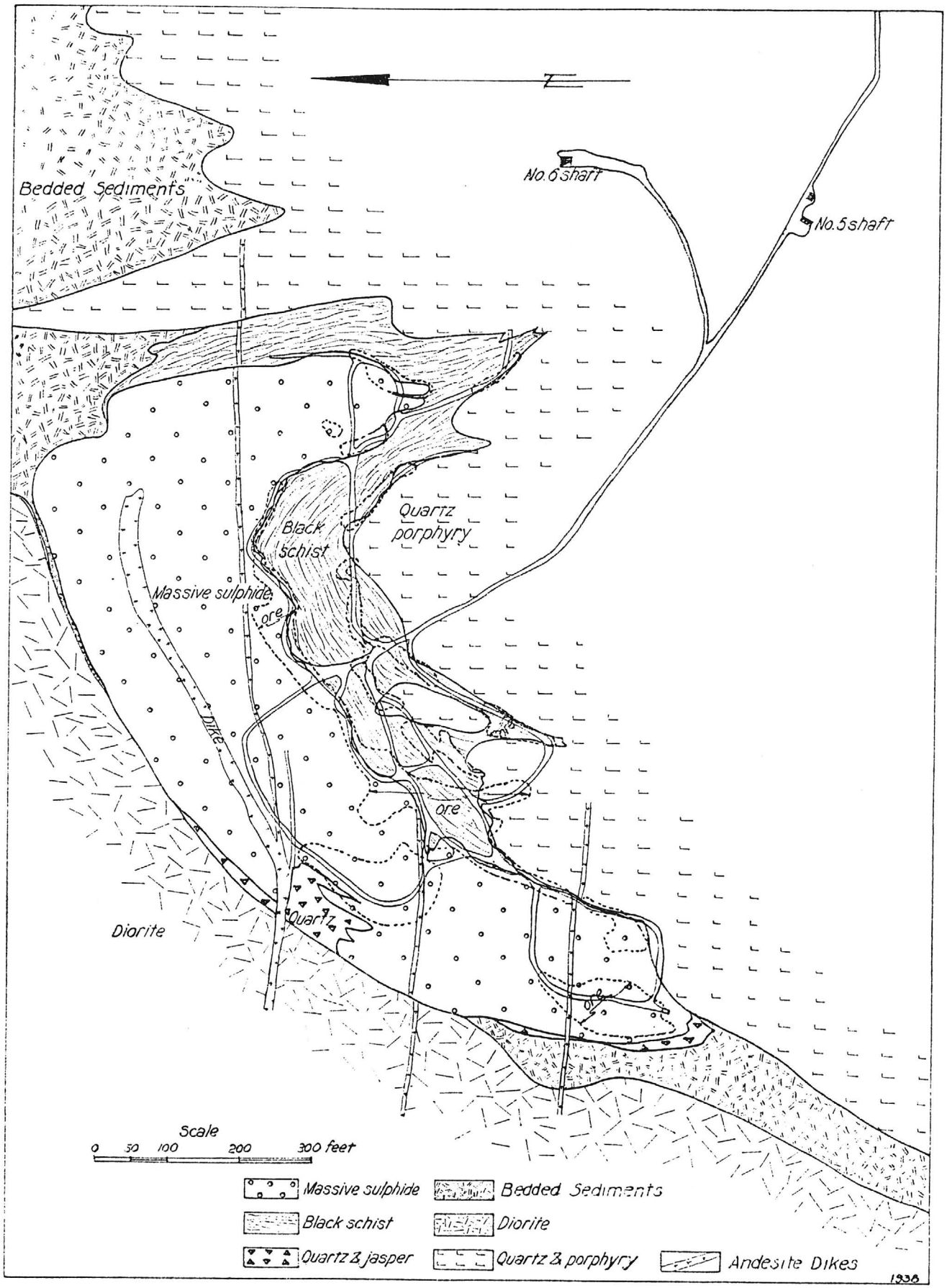


Plate XI.—Geologic map of United Verde 2,250-foot level, typical of lower part of developed ore zone.

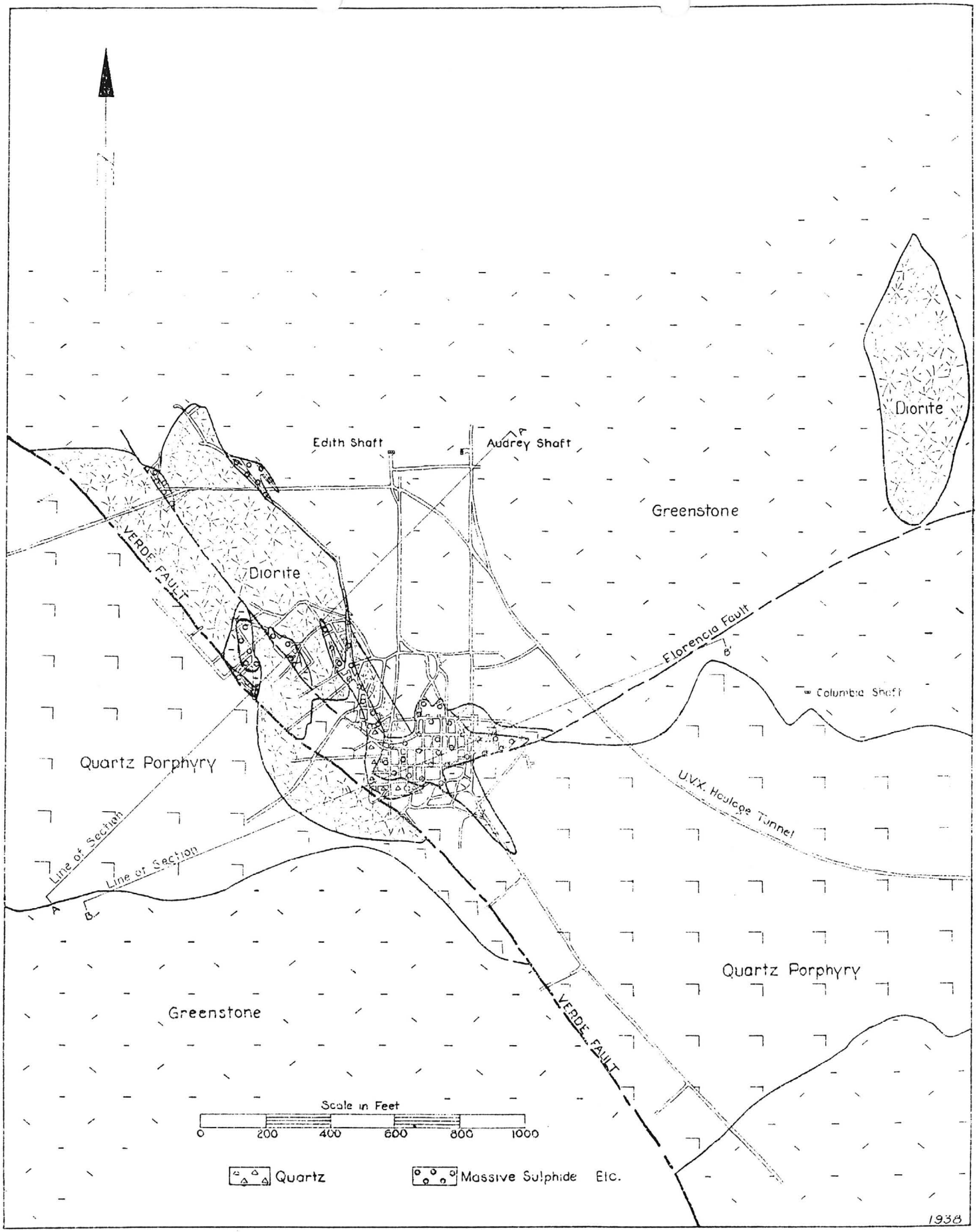


Plate XIII.—Generalized geologic map of United Verde Extension 1,300-foot level.

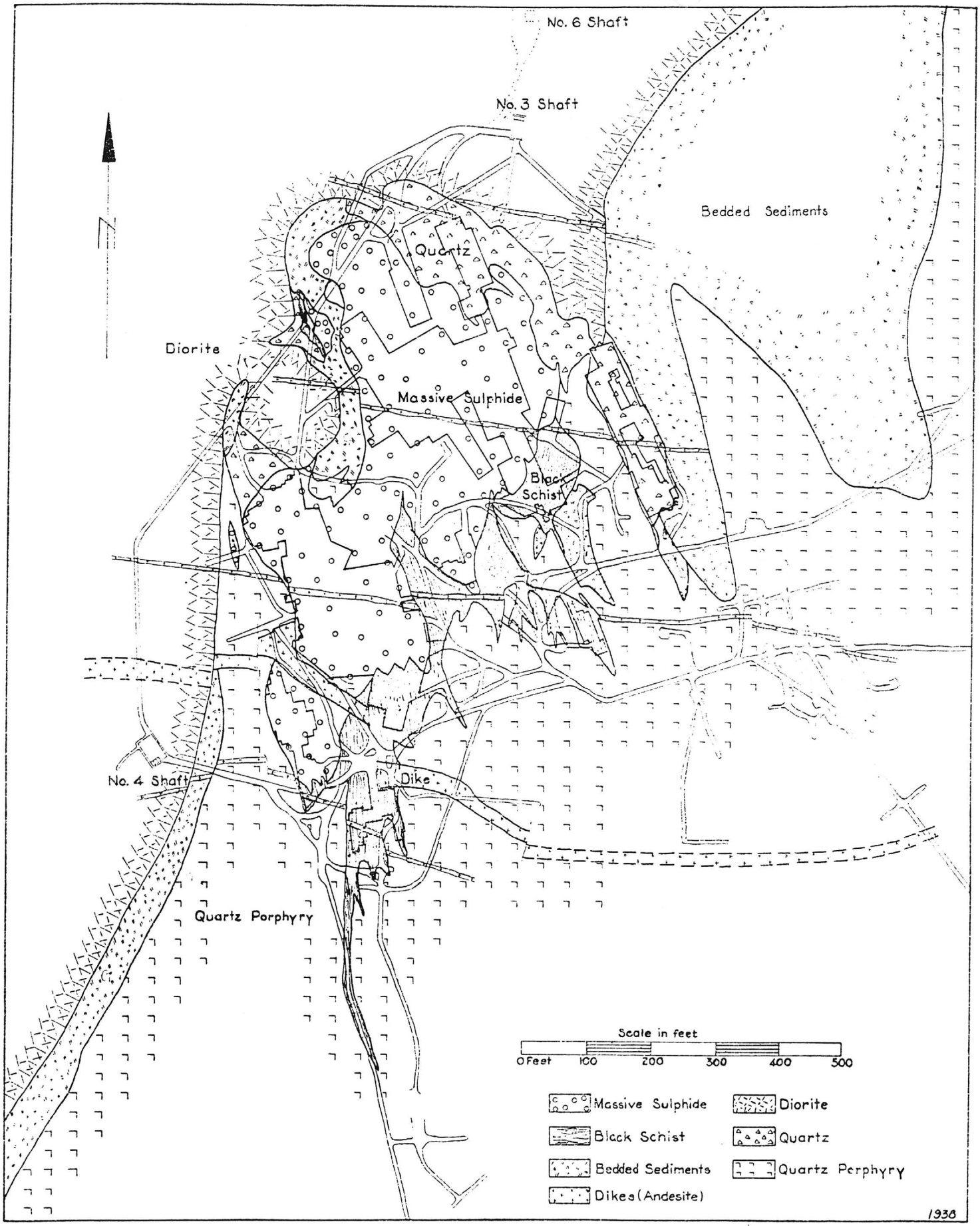


Plate X.—Geologic map of United Verde 300-foot level, typical of upper part of developed ore zone.

V.V.

CHARLES H. DUNNING
MINING ENGINEER

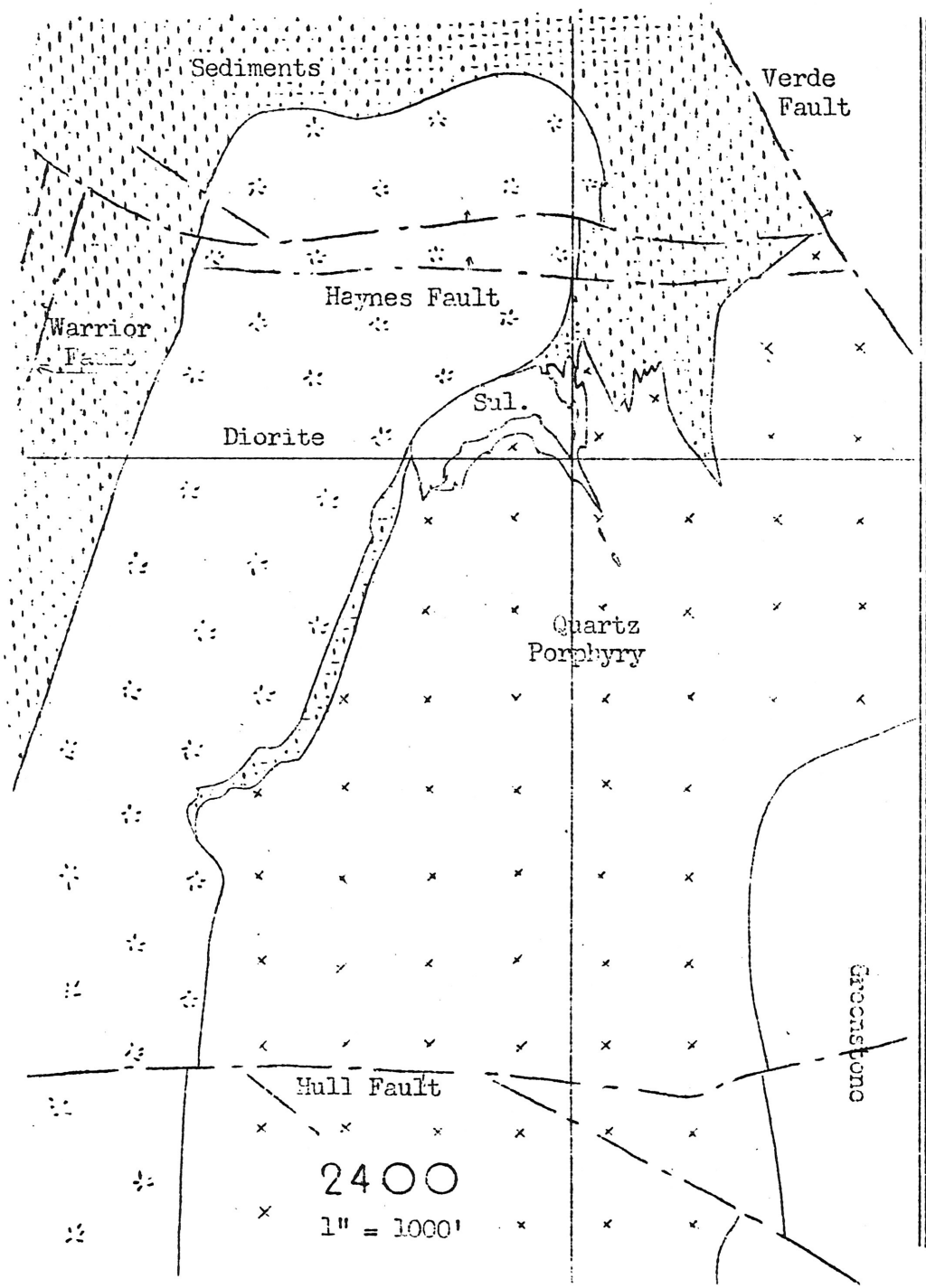
S K E T C H M A P.

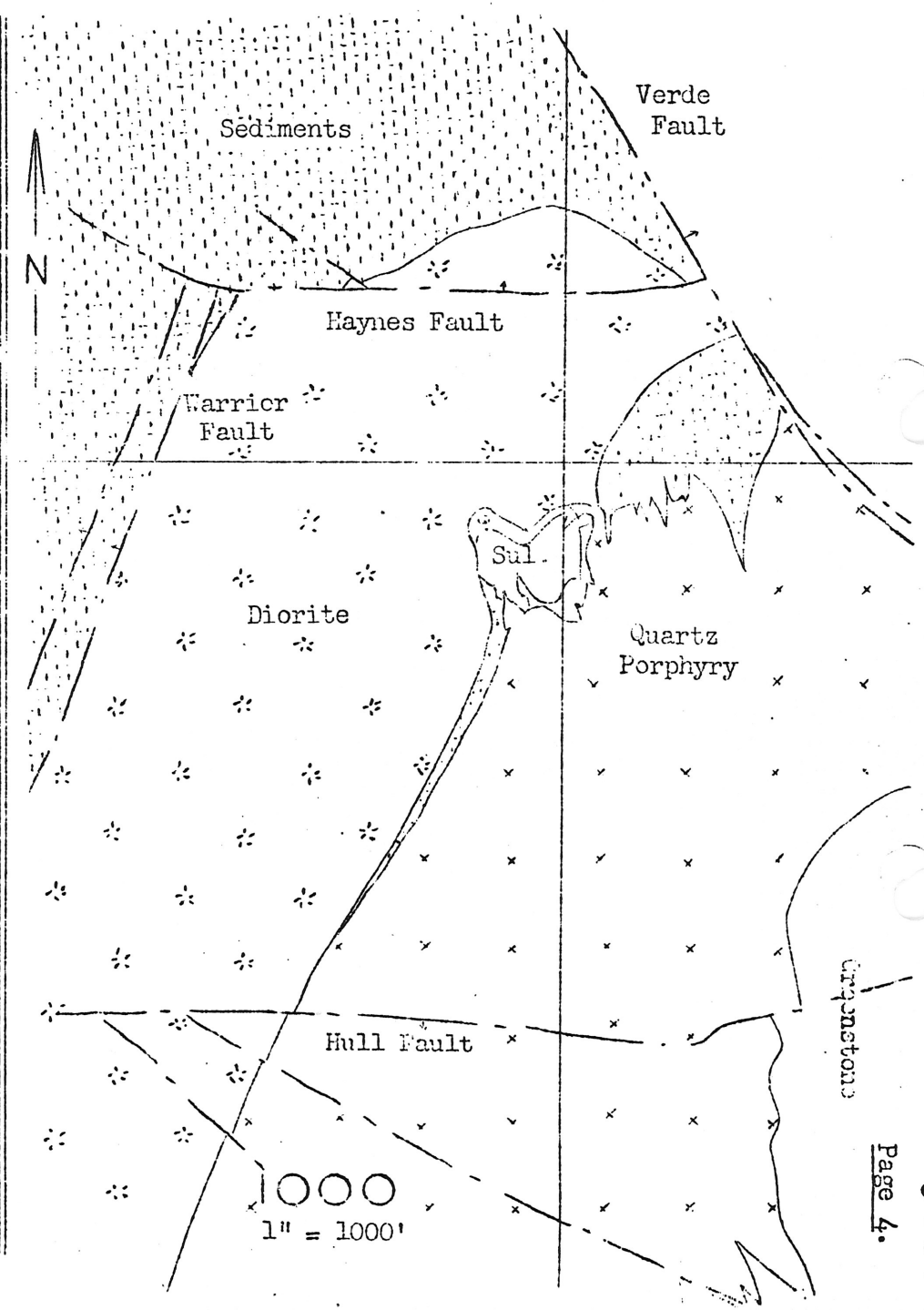
NOT TO SCALE

SILVER PLATE & CLIFF SITUATIONS.

BECCHETTI MINING CORP

to accompany report by
Chas. H. Dunning
for
Benton N. Lee,
Mar 30, 1957


Sediments
Verde Fault
Haynes Fault
Warrior Fault
Sul.
Diorite
Quartz Porphyry
Hull Fault
Greenstone
2400
1" = 1000'


N
Sediments
Verde Fault
Haynes Fault
Warrior Fault
Sul.
Diorite
Quartz Porphyry
Hull Fault
Greenstone
1000
1" = 1000'

U.V.

May 27, 1957

UNITED VERDE CONSOLIDATED COPPER CO. YAVAPAI COUNTY

No information on this property.

MARK GEMMILL

UNITED VERDE MINE YAVAPAI COUNTY

REFERENCES

USGS Bull #467, p. 104
USGS Bull. #625, p. 232
USGS Bull. #782, p. 60-78, 51-59

ABM Bull. #125 p. 46-51, 93, 96
ABM Bull. #129 p. 15-21
ABM Bull. #140 p. 101
ABM Bull. 178

I.C. #6708 USGS PP 308

Hydrous Sulphates Formed Under Fumerolic Conditions
at the United Verde Mine (Geology File)

UNITED VERDE COPPER CO., reprinted from AMC 1930 (in Library)

Ground Movement and Subsidence at the United Verde Mine
Geology files - AIME TECHNICAL PUBLICATION #551

Mining World, August, 1962, p. 35 - re demolishing
old smoke stack at (Clarkdale smelter).

See: ABM Bull. 180, p. 118, 123, 127, 128, 131, 320

Arizona Mining Journal 5/1918, p. 21
Economic Geology, Vol. 67, Nov.72, No. 7 - Geology of the Massive Sulfide
Deposits at Jerome, Arizona - C.A. Anderson and J.T. Nash

See: Arizona Mining Journal Jan. 1, 1922 p. 34, Jan 15, 1922 p. 27, 19
Feb. 1, 1922 p. 27, May 15, 1922 p. 9; May, 1918, p. 17, 21, 24, 26 &28;
August, 1918, p. 17;

GEOLOGY OF THE MASSIVE SULFIDE DEPOSITS AT JEROME, ARIZONA - Vol.68, August, 1973, #5, p 109-111

Skillings Mining Review, 2/8/75, p. 24 (2/9/34 info.)

Arizona Mineral Commodity Update, by D.D. Rabb, on Zinc, (Bureau of Geology and Mineral Technology. (Filed in Zinc commodity file)

Minerology of Arizona p. 29, 30

See: "United Verde Selenium Study" ~~in Arizona Geology Section of bookcase in Ken's office~~. NOW IN THE FILE
Nash, J. Thomas - Micro study of some surrounding minerals

ABSTRACTED FROM ADMMR ACTIVE MINES DIRECTORY, 1992

Yavapai County

PHELPS DODGE CORPORATION

Corporate Headquarters
2600 N. Central Ave., Phoenix, AZ 85004-3014 - Phone 234-8100.
Chairman of the Board and President D. C. Yearley
Senior Vice President and President Phelps Dodge Mining Company J. S. Whisler
Sr. Vice President and Executive Vice President Phelps Dodge Mining P. J. Ryan
Phelps Dodge Mining Company
2600 N. Central Ave., Phoenix, AZ 85004-3014 - Phone 234-8100.
Vice President & General Manager J. L. Madson
Vice President Engineering Services R. W. Rice
Controller, Phelps Dodge Mining R. G. Peru
Director, Employee Relations S. L. Marcus
Manager, Employee Relations D. E. Brooks
Assist. Director, Materials Management C. R. Jennings
Traffic Manager J. Sheridan
Western/US Exploration
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Manager, Western Exploration Office J. D. Forrester
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Senior Vice President A. L. Lawrence
United Verde Mine T16N R2E Sec. 22
Inactive copper mine - Located at Jerome - Phone 634-2622.
Agent Andrew Peterson

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Western Exploration Office ..... R. B. Ludden
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P.J. Ryan
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Peterson

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Agent ..... Andrew Peterson

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President, Phelps Dodge Mining ..... L.R. Judd

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Located at Jerome - Phone 634-2622.

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION FROM MINE CARDS IN MUSEUM

ARIZONA
Card # 1 YAVAPAI COUNTY
UNITED VERDE MINE
(JEROME)

Mils #551B
6-AKF'e
United Verde mine (?)

MM 769	Chalcopyrite & Bornite	2A-E
770	Chalcopyrite & Bornite	2A-E
771	Chalcopyrite & Bornite	2A-E
772	Chalcopyrite & Bornite	2A-E
773	Copper Ore	2A-E
MM 5601	Chalcoc ite	2A-I
6823	Chalcopyrite in bornite	
6824	Chalcopyrite in schist	
6825	Chalcopyrite in schist	
6826	Chalcopyrite	
6827	Pyrite	
6828	Ore, copper, burnt	
6829	Ore, copper, burnt	
6830	Copper, native	
6831	Copper, native	2A-C
5989	Chalcopyrite in schist	17-0
MM K001	Copper, native	
MM K002	Copper	
MM K003	Copper	
MM-K004	Chalcopyrite	
MM-K005	Hematite & limonite	
MM-K006	Limonite & hematite	
MM-K007	Azurite & malachite	

ARIZONA
Card # 2 YAVAPAI COUNTY
UNITED VERDE MINE
JEROME

Mils 551B

MM-K008	Malachite & limonite
MM-K009	Voltaite
MM-K011	Chalcopyrite in quartz
MM-K012	Pyrite
MM-K013	Chalcocite
MM-K014	Copper oxides
MM-K015	Chalcopyrite
MM-K016	Chalcopyrite
MM-K017	Chlorite schist
MM-K018	Chalcopyrite
MM-K019	Chalcopyrite
MM-K020	Chalcopyrite
MM-K021	Gypsum
MM-K022	Diorite
MM-K023	Rhyolite
MM-K024	Tuff
MM-K025	Chalcopyrite
MM-K026	Tennantite, Chalcopyrite
MM-K027	Bornite, chalcopyrite
MM-K028	Andesite
MM-K029	Chalcopyrite
MM-K030	Chalcopyrite
MM-K031	Copper, native

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

INFORMATION FROM MINE CARDS IN MUSEUM

Card # 3

ARIZONA
YAVAPAI COUNTY
FILE NAME → UNITED VERDE MINE
~~JEROME~~

MILS-551B

MM-K032	Pyrite, chalcocite
MM-K033	Tuff
MM-K034	Rhyolite
MM-K035	Andesite
K074	Copper Ore
K075	Copper Ore
K698	Pyrite & Quartz
MM K943	Native copper

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

UNITED VERDE COPPER COMPANY.

No.	Description of Map.
1	Mining Claims.
2	80 Level.
3	160 Level.
4	300 Level.
5	400 Level.
6	500 Level.
7	600 Level.
8	700 Level.
9	800 Level.
10	900 Level.
11	1000 Level.
12	1200 Level.
13	1350 Level.
14	1500 Level.

C-4 K074 [illegible] K4cm
Wt 10r4g

K075
9½ x 4½ x 4 cm

MINERAL SPECI. FOR DEPARTMENT OF LIBRARY AND CHIVES

This specimen now in the ADMR Museum

(Do not write in this space)	
Ore ____	(Wrap each specimen separately, or place it in a substantial bag, by itself, with a number attached, identical with the number on this card.)
Cabinet ____	
No. ____	Specimen No. 13, collected by Carl G. Barth, Jr. Field Engineer

Name of ore: Copper Ore

Minerals contained: Pyrite, Chalcocite

Gangue: Quartz

Depth at which taken: 650

Approximate mineral content (in terms of average per ton): 4.5 % Copper

Name of mine or claim: United Verde

Group: ____

District: Jerome

Location (distance and direction by highway from what town: At Jerome

Owner of property: Same

Operator: Phelps Dodge Corporation

Mine active or inactive: Active

If inactive, when operated: ____

Specimen presented by: ____

Date: March 1940

Notes (Any general information regarding the history of the property.) ____

If more space is desired for notes, use other side.

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

Acid Mine Drainage Management at the United Verde

Talk given to Maricopa SME March 17, 2005 byAnn Williamson, Phelps Dodge
From notes by Nyal Niemuth, ADMMR

Site History:

Mining started in 1883. The mineralization is volcanogenic massive sulfide; form of the deposit is a steeply dipping sulfide body. There are over 80 miles of underground workings. The Hopewell tunnel is at 1,000 level and it daylights a mile from the mineral deposit. The deepest workings are at the 3,000 foot level. Open pit mining started in 1910. Mining ceased in 1950.

Water impoundments have been active for 50 years. There are an umber of low-grade but highly strongly pyritic stockpiles on the property. There is an 8% grade from the open pit to the mouth of the Hopewell tunnel. Deposit is faulted against Paleozoic limestones – the Verde fault.
Majority of the drainage and impoundment facilities are in one drainage. Current situation is open channel flow which EPA doesn't like. Underlying aquifer meets Arizona water quality standards ,i.e. drinking water standards. EPA and Phelps Dodge have entered into a consent decree. EPA won't sue and PD is under tight timeline to do an improvement project. The one impoundment in a different drainage is pumped to the open pit that drains out the Hopewell tunnel.

Compliance Requirements:

The APP requires that PD operate impoundments that contain the 100 year 24 hour storm event. The consent decree requires that PD eliminate impacted water in natural channels, impound waters that don't meet SWQA (surface water quality standards) by implementing an appropriate design.

Business Drivers:

Cost effectiveness, Proven effectiveness of method, Must have low operating and maintenance costs including energy use, waste disposal and staffing, and reduce long term liability. The lowest ph of the acid mine drainage (AMD) is about 4.2 with the solutions containing lots of metals. Flow rates vary from a low of 80 gpm up to 50,000 gpm. The bulk of the AMD go to the Hopewell tunnel. There is no electrical power. Any process should be gravity driven.

Technologies considered:

Additive driven - ammonia, molasses Had problems with mixing molasses at another property in district.
Process methods- selective (SX type technology), conventional (precipitation)
Passive methods – wetlands, limestone channel, quantity reduction, evaporation, natural attenuation, bioreactors

Selected Technology:

Combination of:
Minimization – cap existing stockpiles to reduce seepage and reduces long-term liability
Storm water diversion – reduce by 75% volume needing treatment
Infiltration/attenuation – lime naturally present, estimated it will attenuate for 100-2000 years.
Constructed open limestone channel – takes advantage of the abundant limestone on site. Extends the life of attenuating sediments within the impoundments.
Evaporation

Conclusion: Several million dollars worth of new clean water channels and acidic mine drainage boreholes are to be constructed. Big advantage of the property is the availability of so much natural limestone. PD plans to quit maintaining tunnel so unlikely to see any new mining at the mine unless for Zn at some future date.

NJN WR 12/12/86: Don White (c) reported that Phelps Dodge is planning to do some 2,000 - 3,000 deep durface drilling at the United Verde (file) Yavapai County. The target is a change in dip below the United Verde, identified by some zone geophysics.

NJN WR 1/16/87: Don White (c) reported during a program given to the Maricopa Section, AIME, that the largest zinc reserve, perhaps in the nation, certainly in Arizona, remains in the United Verde (file) Yavapai County. It totals probably greater than 20 million tons. Phelps Dodge has recently been exploring on this property and evaluating the zinc potential along with copper and gold.

NJN WR 3/13/87: Don White (card) reports that Phelps Dodge has one rig drilling north of the United Verde pit (file) Yavapai County. John Duhammel is in charge of the exploration for Phelps Dodge at United Verde. In the fall, Phelps Dodge did grade a ramp and establish drill pads which could have tested the silica cap and the zinc zone near surface with short holes, but has not yet done so. A possible gold target in the overlying chert at the United Verde could be as large as 100,000 tons of 1/4 oz.

UNITED VERDE YAVAPAI COUNTY

MG WR 1/12/78: Harry Metz of Phelps Dodge said there were no reserves left at the United Verde Mine in Jerome.

MG WR 9/11/81: Received report that Small Mines Division of Phelps Dodge is thinking seriously of re-opening the United Verde mine for exploration.

NJN 7/30/82: Chuck Bentzen of Reuter Equipment reported that Phelps Dodge's small mine division has halted work at the United Verde Extension, Yavapai County.

MHG WR 8/20/82: Phelps Dodge has reportedly ceased working in the Edith shaft on the United Extension property in Yavapai County.

MG WR 12/24/82: Have heard that Phelps Dodge is again working in the Edith Shaft on the United Verde Extension Mine, Yavapai County.

MG WR 8/9/85: For the record, the head frame at the C.F.& I. shaft at the Glove mine (Santa Cruz Co) was purchased by Phelps Dodge and installed at the Edith shaft on the United Verde Extension property (Yavapai Co.) for PD's exploration program in 1982.

NJN WR 3/21/86: It was reported that Phelps Dodge is going to start doing some new geophysical work to be followed by drilling on the north portion of their United Verde (f) property, Yavapai Co. It was also reported that there is 13 million tons of zinc ore grade material left in the United Verde massive sulfide deposit. This was not mined earlier and now would be difficult to mine due to bad ground.

CJH WR 5/30/86: Visitor: Howard G. King, Consultant, Mining and Civil Engineering and Management, 7200 N. Leornardo Da Vinci, Tucson, Arizona 85704, phone 297-2053. He is retained by DMEA (Ben Dickerson) to do a feasibility study on installing a skip and mancage in the Edith Shaft of the United Verde Mine at Jerome, Az. Supplied him with a copy of the Az Mining Code. They want to mine about 50 t/d.

UNITED VERDE YAVAPAI

Dick Gemmill and C. Robideau are searching the old mining records on the Big Hole in an attempt to determine how much, if any, ore remains on the east side. No work is being done presently due to the danger of falling rocks loosened by freezing and thawing, however, some oxide is being leached. GW WR 1/25/73

Went to the Big Hole in Jerome but neither Dick Gemmill or G. Robideau could be found. It was noted Anaconda Co. has started their second deep hole perhaps 3/4 mile east of the first. GW WR 5-17-73

WR KAP 7-15-77 - Met with "Duke", maintenance foreman with the United Verde Branch of Phelps Dodge. He reported that Phelps Dodge is preparing to complete assessment for the year on their claims in the Red Flat area. (T. 17N.R. 2E). 9-20-77 bh

---

WR MG 1/12/78 - Harry Metz of Phelps Dodge said there were no reserves left at the United Verde mine in Jerome. 2/27/78 sef

---

CH/WR 4/23/79 - Paul Handverger, Registered Consulting Engineer, 13 Old Jerome Highway, Clarkdale, Az. 86324, Phone: 634-8466. He wants to sample the lower levels of the Daisy shaft of the Verde EX Ltd. property near Jerome. Needs some experienced shaft repairmen to work on the deeper portion of the shaft where some of the wallplates have failed. Suggested he contact Ed Jones, Foreman of the Ida shaft repair work on the Tom Reed Jr. mine near Oatman. This property shut down very recently for some exploratory diamond drilling. 5/3/79 a.p.

UNITED VERDE [illegible] YAVAPAI COUNTY

Visited the Big Hole Mine. Conference with Richard Gemmill, operating as usual. TJ WR 11-21-69

Visited the Big Hole Mine - no change in operation. FTJ WR 3-20-70

Active Mine List May 1970 - 7 men - R.H. Gemmill

Visited the Big Hole Mine. Gate locked - called Dick Gemmill - he said they quit early. FTJ WR 9-18-70

Active Mine List Oct. 1970 - 7 men - R.H. Gemmill

The Big Hole Mining Company is producing as usual from the United Verde pit in Jerome according to Richard Gemmill, manager. He also stated they have started a small leaching operation at the portal of the old 500 level which has a flow of water. GW WR 11-20-70

Big Hole Mining Co. operated at its regular rate through the quarter. FTJ QR 1-13-71

To Jerome. Big Hole Mine gate closed. FTJ WR 3-22-71

The Big Hole mine was operating at its regular rate. FTJ QR 4-5-71

Went to Jerome but couldn't find Mr. Gemmill at the old P-D pit. 9/16/71 GW WR

Dir. of Mining - August 1971 - 6 men.

The Big Hole Mining Company activities at the United Verde pit, Jerome, was curtailed by the copper strike but by the end of the period were back in operation. GW QR 9/71

Stopped at the United Verde pit and met Messrs. Rubideau and Gemmill who continue to get some tonnage from the pit, and now have a small leaching operation with which they are having some difficulty due to the mineralized water. GW. Wr 1/27/72

Big Hole Mining Company, Jerome, has had some difficulty with their leaching operation, but otherwise have made regular shipments of copper ore to the Douglas smelter. GW QR 2/72

Stopped at the Big Hole in Jerome but the "dry" was locked. GW WR 9/21/72

Mark Gemmill was in to get acquainted and said the Big Hole Mining Company was about out of ore. GW WR 10/6/72

Active Mine List 1972 - Big Hole Mining Company, empl. 6

NITED VERDE [redacted] YAVAPAI COUNTY

Visited Big Hole but Mark Gemmill was not at property. 8 men employed.
FTJ WR 3-18-66

Visited Big Hole - Mark Gemmill was not present. 3 men working in pit and remainder of crew preparing for leaching operation. FTJ WR 5-20-66

Big Hole Mining Co. at Jerome are mining at about their regular rate. A leaching or precipitation plant was under construction. FTJ QR 7-8-66

Visited the Big Hole. Mark Gemmill not at operation. They have started their leach operation using about 200 gpm of water to flood the dumps. FTJ WR 9-23-66

Visited Big Hole Mine at Jerome. Mark Gemmill was not at mine, but was told they had found a new ore shoot (high grade) in a drift they had cleaned out. FTJ WR 11-18-66

Visited Big Hole mine, Jerome. Mark Gemmill had returned to Prescott. Big Hole's leaching operation is water from the Hopewell Tunnel that drains the mine workings above the 1000' level. It passes over the Hopewell dump. No indications of recovery disclosed.
FTJ WR 3-24-67

Active Mine List Nov. 1967 - 10 men

Visited the Big Hole - they were starting to ship ore and ppts that had been stockpiled. Snow during the Christmas storm collapsed the roof to the office and dry room destroying many valuable records. FTJ WR 3-22-68

Active Mine List April 1968 - 10 men

The Big Hole Mine at Jerome continued to mine and also make cement copper, from mine water. FTJ QR 7-1-68

Big Hole Mine mining as usual. FTJ WR 9-20-68

Active Mine List Oct. 1968 - 10 men

Big Hole at Jerome operated at usual rate during quarter. FTJ QR 12-31-68

Active Mine List April 1969 - 8 men - R. H. Gemmill, Big Hole Mining Co., P.O. Box 316, Ashfork

Active Mine List Oct. 1969 - 7 men - R.H. Gemmill, P.O. Box 125, Jerome

UNITED VERDE (F) MAUA

12 Q

COMPLETE AND MAIL TO:

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

FOR OFFICE USE ONLY
START-UP NUMBER 04302010
STATE NUMBER 141216
DEPUTY NUMBER HAMM
NEW ✓ MOVE 43

NOTICE TO ARIZONA STATE MINE INSPECTOR

In compliance with the Arizona Revised Statutes, we are submitting this written notice to the Arizona State Mine Inspector of our intent to start X, stop ____, move ____ an operation.

Please check the appropiate boxes: Contractor [X], Owner [ ], Operator [ ], Open Pit Mine [ ], Underground Mine [X], Mill [ ], Quarry [ ], Aggregate Plant [ ], Hot Plant [ ], Batch Plant [ ], Smelter [ ], Leach Plant [ ].

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

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

If this operation will use any hazardous material; ie. cyanide, please check: ____

COMPANY NAME: J.S. Redpath Corporation

MINE OR PLANT NAME: United Verde Tunnel

DIVISION: ____

CHIEF OFFICER: Bruce McKinstry, Sr. Manager of Contracting TELEPHONE: (602) 345-2611

COMPANY ADDRESS: 1855 W. Baseline Road, Suite #240

CITY: Mesa STATE: Arizona ZIP CODE: 85202

MINE OR PLANT LOCATION: (include county and nearest town, as well as directions for locating property by vehicle): 1/4 mile west of Jerome - Phelps Dodge Corporation mine site, Yavapai County

TYPE OF OPERATION: Rehab/Seal PRINCIPAL PRODUCT: None

STARTING DATE: January 1990 CLOSING DATE: ____

PERSON COMPLETING NOTICE: Alan Robert Barnes TITLE: Safety Coordinator

DATE OF REPORT TO STATE MINE INSPECTOR: 17 January 1990

FORM 101-106 REV. 03/89

UNITED VERDE TUNNEL

J.S. REDPATH CORPORATION

MINING CONTRACTORS PROJECT MANAGERS

1855 WEST BASELINE ROAD, SUITE 240 MESA, ARIZONA 85202
Telephone: 602-345-2611 Telefax: 602-345-2418 Telex: 669447

18 December 1989

Mr. Garry J. Day
Supervisory Mine Inspector
3221 N. 16th Street, Suite 300
Phoenix, AZ 85016-7154

Dear Mr. Day:

As per our conversation today, I am enclosing our Legal Identity Report for our contract work on the United Verde Tunnel for Phelps Dodge Corporation. We will be doing rehab work initially until we locate a secure location to install a permanent bulkhead to curtail/reduce mine drainage through this tunnel. We will probably be using approximately 4 hourly personnel with one supervisor. We expect the job to last approximately 2 to 3 months.

If you have any questions, please contact me at (602) 345-2611. We will notify you of a permanent emergency phone number when it is issued.

Sincerely,

J.S. REDPATH CORPORATION

Alan Robert Barnes
Safety Coordinator

ARB:alm
ID:M245

Enclosure

ARIZONA DEPARTMENT OF MINES AND MINERAL RESOURCES

VERBAL INFORMATION SUMMARY

May be Reproduced

1. Information from: Paul A. Lindberg, Consulting Geologist
   Address: 205 Paramount Dr., Sedona, AZ 86336
2. Mine: UNITED VERDE 3. ADMMR Mine File United Verde
4. County Yavapai 5. District Verde
6. Township 16N Range 2E Sec(s) 22
7. Location:
8. No. of Claims - Patented Unpatented
9. Owner (if different from above) Phelps Dodge Corp.
10. Address:
11. Operating Company:
12. Pertinent People and/or Firm:
13. Commodities: Copper, zinc, silver, and gold
14. Operational Status: Exploration
15. Summary of Information received, comments, etc.: Mr. Lindberg led a field trip of the mine sponsored jointly by AIPG and the Az Conf.-AIME. Mr. Lindberg has had many years experience with the United Verde ore deposit and its geologic setting. He has prepared numerous maps, tables, and cross-sections.

The massive sulfide deposits of the Verde district are no longer thought to be traditional hydrothermal replacements. It is now believed generally that these deposits represent an accumulation of sulfides on an ocean floor receiving submarine volcanic exhalations. Later the district was subjected to strong metamorphism and faulting.

A new theory proposed by Lindberg is that the United Verde deposit and the Little Daisy deposit (UVX) are separate accumulations, occurring at the same time, on the top of the Cleopatra Tuff. Large arcuate faults acted as feeders to the deposits. These arcuate faults may define a large caldera-like system. Incidentally, the Verde Central deposit is placed by Lindberg at the base of the Cleopatra Tuff; he believes it represents the first stage of mineralization immediately prior to the very rapid deposition of the ignimbrite (tuff) of the Cleopatra.

Phelps Dodge is testing some of these theories with deep drilling. Apparently they are looking for the top of the Cleopatra where it is intersected by arcuate faulting.

Date: July 18, 1987 Michael N. Greeley
(Signature) ADMMR

MEMORANDUM

To: John H. Jett, Director
From: Mike Greeley, Field Engineer
Subject: United Verde mine, Yavapai Co., AZ
Date: October 12, 1978

Conversations this summer with Mr. Dick Gemmill, P.O. Box 477, Clarkdale, AZ 86324 (phone 602-634-2239) provided the following information on the Big Hole Mining Co. operation at the United Verde mine:

Sulfide Ore Production and Grade

Year	Ore Mined (Short tons)	Ave. Grade Cu (%)	Recoverable Copper (lbs)
1954	5,004		605,319
1955	13,447		1,371,056
1956	14,928		1,545,434
1957	12,872		1,644,400
1958	16,010		2,067,960
1959	9,824		969,108
1960	17,010		2,229,799
1961	18,533		2,436,505
1962	10,477		1,770,601
1963	15,076		2,326,437
1964	8,250		876.828
1965	9,576		1,216,466
1966	5,552	4.9	543,943
1967	5,006	5.2	525,279
1968	5,218	5.4	565,219
1969	9,299	6.4	1,188,820
1970	11,062	6.3	1,392,423
1971	7,000	5.2	
1972	6,214	4.9	615,609
1973	1,705	5.1	173,170
1974	3,923	4.8	89,098 (?)
1975	575	5.7	64,808

Production from the United Verde mine ceased in June 1975.

* GENERAL REFERENCES

United Verde File

REFERENCE 1 F1 <USBM - ASSMT FILE DATA

REFERENCE 2 F2 <AZ DEPT MINERAL RESOURCES FILE DATA

REFERENCE 3 F3 <

REFERENCE 4 F4 <

U.S. CRIB-SITE FORM

RECORD IDENTIFICATION

RECORD NUMBER B10 <

*RECORD TYPE B20 <X,I,M>

DEPOSIT NUMBER B40 <

REPORT DATE G1 <8|4|2> YR. MO.

*INFORMATION SOURCE B30 <1,2>

*FILE LINK IDENT. B50 <USBM - 004 025>

REPORTER(SUPERVISOR) G2 <DEWITT, ED, H. (last, first, middle initial)> (last, first, middle initial)

REPORTER AFFILIATION G5 <USGS>

*SITE NAME A10 <ANCHOR MINE>

SYNONYMS A11 <ANCHOR DUMP>

LOCATION

MINING DISTRICT/AREA A30 <VERDE DISTRICT>

COUNTY A60 <YAVAPAI>

*STATE A50 <AZ>

*COUNTRY A40 <U.S.>

PHYSIOGRAPHIC PROV A63 <1,2>

DRAINAGE AREA A62 <1,5,0,6,0,2,0,2>

*LAND STATUS A64 <0|1> ( )

QUADRANGLE NAME A90 <CLARKDALE (1973)>

*QUADRANGLE SCALE A100 <24,000>

SECOND QUAD NAME A92 < ( )>

SECOND QUAD SCALE A91 <

ELEVATION A107 <5,000 FT>

UTM

*NORTHING A120 <3,846,500>

*EASTING A130 <3,982,100>

ZONE NUMBER A110 <+12>

*ACCURACY

ACCURATE ACC (circle)

ESTIMATED EST <

GEODETIC

*LATITUDE A70 < - - N>

*LONGITUDE A80 < - - W>

CADASTRAL

*TOWNSHIP(S) A77 <016N

*RANGE(S) A78 <002E

*SECTION(S) A79 <23

*SECTION FRACTION(S) A76 <NE OF NE

*MERIDIAN(S) A81 <GILA AND SALT RIVER>

*POSITION FROM NEAREST PROMINENT LOCALITY A82 <0.27 MILES NORTH OF EDITH AND AUDREY SHAFTS OF U.V.X. MINE>

*LOCATION COMMENTS A83 <0.5 MILES NORTH OF JEROME, AZ. MINE MATERIAL APPEARS TO BE DUMP MATERIAL FROM UNITED VERDE MINE. NO UNDERGROUND WORKINGS APPARENT. UTM COORDINATES TO CENTER OF PATENTED CLAIM>

* ESSENTIAL INFORMATION

+ ESSENTIAL SOMETIMES OR HIGHLY RECOMMENDED

COMMODITY INFORMATION

*COMMODITIES PRESENT C10 < CU, AU,
*ORE MINERALS C30 < CHALCOPYRITE, UNKN. IRONS
COMMODITY SUBTYPES C41 <
*GEN. ANALYTICAL DATA C43 <
COM. INFO. COMMENTS C50 <

* SIGNIFICANCE

	PRODUCER	NON-PRODUCER
MAJOR PRODUCTS	MAJOR < CU,	MAIN COMMODITIES PRESENT C11 <
MINOR PRODUCTS	MINOR < AU, AG,	MINOR COMMODITIES PRESENT C12 <
POTENTIAL PRODUCTS	POTEN <	
OCCURRENCES	OCCUR <	OCCURRENCES OCCUR <

*PRODUCTION

PRODUCER	NON-PRODUCER
PRODUCTION (YES) (circle) PRODUCTION SIZE (SML) MED LGE (circle one)	PRODUCTION UND NO (circle one)

*STATUS EXPLORATION OR DEVELOPMENT

PRODUCER	NON-PRODUCER
STATUS AND ACTIVITY A20 < 4 >	STATUS AND ACTIVITY A20 < >

*DISCOVERER L20 <
*YEAR OF DISCOVERY L10 < > *NATURE OF DISCOVERY L30 < > *YEAR OF FIRST PRODUCTION L40 < 1960 > *YEAR OF LAST PRODUCTION L45 < 1961
*PRESENT/LAST OWNER A12 < TONY A. LORENZO
*PRESENT/LAST OPERATOR A13 <
EXPL./DEV.COMMENTS L110 < PATENTED CLAIM = ANCHOR, M.S. 1432

DESCRIPTION OF DEPOSIT

*DEPOSIT TYPE(S) C40 < MASSIVE SULFIDE
DEPOSIT FORM/SHAPE M10 <
*DEPTH TO TOP M20 < > *UNITS M21 < > *MAXIMUM LENGTH M40 < > *UNITS M41 <
*DEPTH TO BOTTOM M30 < > *UNITS M31 < > *MAXIMUM WIDTH M50 < > *UNITS M51 <
DEPOSIT SIZE M15 (SMALL) M15 (MEDIUM) M15 (LARGE) (circle one) *MAXIMUM THICKNESS M60 < > *UNITS M61 <
STRIKE M70 < > *DIP M80 <
DIRECTION OF PLUNGE M100 < > *PLUNGE M90 <
DEP. DESC. COMMENTS M110 <

DESCRIPTION OF WORKINGS

*Workings are: SURFACE (M120) UNDERGROUND M130 BOTH M140 (circle one)
*DEPTH BELOW SURFACE M160 < > *UNITS M161 < > *OVERALL LENGTH M190 < > *UNITS M191 <
*LENGTH OF WORKINGS M170 < > *UNITS M171 < > *OVERALL WIDTH M200 < > *UNITS M201 <
*OVERALL AREA M210 < > *UNITS M211 <
DESC. OF WORK. COM. M220 <

GEOLOGY

*AGE OF HOST ROCK(S) K1 <
*HOST ROCK TYPE(S) K1A <
*AGE OF IGNEOUS ROCK(S) K2 <
*IGNEOUS ROCK TYPE(S) K2A <
*AGE OF MINERALIZATION K3 <
*PERT. MINERALS (NOT ORE) K4 <
*ORE CONTROL/LOCUS K5 <
*MAJ. REG. TRENDS/STRUCT. N5 <
*TECTONIC SETTING N15 <
*SIGNIFICANT LOCAL STRUCT. N70 <
*SIGNIFICANT ALTERATION N75 <
*PROCESS OF CONC./ENRICH. N80 <
*FORMATION AGE N30 <
*FORMATION NAME N30A <
SECOND FM AGE N35 <
SECOND FM NAME N35A <
*IGNEOUS UNIT AGE N50 <
*IGNEOUS UNIT NAME N50A <
SECOND IG UNIT AGE N55 <
SECOND IG. UNIT NAME N55A <
GEOLOGY COMMENTS N85 <

GENERAL COMMENTS

GENERAL COMMENTS GEN < ANCHOR MINE OR ANCHOR DUMP APPARENTLY PRODUCED WASTE MATERIAL FROM UNITED VERDE WASTE DUMPS. NO GEOLOGY OR DEPOSIT TYPES ARE WRITTEN DOWN BECAUSE NO DEPOSIT NAMED THE ANCHOR WAS MINED.

Pink - Reading
Alpha - G
✓Subject - Big Hole Mining Company
Copper Report
Copy - GM

April 22, 1977

Mr. R. H. Gemmill
Big Hole Mining Company
P. O. Box 477
Clarkdale AZ 86324

Dear Mr. Gemmill:

The Department of Mineral Resources is compiling data for its annual report on the copper industry, A PROFILE OF ARIZONA'S PRIMARY COPPER INDUSTRY FOR 1976, VOLUME I. Last year you kindly gave us your leach output, tons of ore mined for direct shipping and contained copper (see copy of attached letter). You also indicated that you ceased production in June 1975.

If production was resumed after June 1975, or during 1976, we would appreciate comparable data for inclusion in this year's report. Conversely, if there was no production from your operation, we would also appreciate that information.

Similar requests are being sent to all Arizona copper producers and a copy of the completed 1976 tabulations will be returned to you.

Thank you very much.

Sincerely,

Glenn A. Miller
Mineral Resources Specialist

GAM:klg

enclosure

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

July 20, 1976

COPY

Mr. R. H. Gemmill
Big Hole Mining Company
Box 477
Clarkdale, Arizona 86324

Dear Mr. Gemmill:

Thank you very much for furnishing the Department of Mineral Resources with the 1975 production data for your Arizona mining operation.

Enclosed is a copy of the completed 1974-1975 tabulations for all large Arizona copper producers.

If the Department, or I, can be of assistance to you at any time, please contact us.

Sincerely,

Glenn A. Miller
Mineral Resources Specialist

Enclosure

GAM:jm File: Cyprus Pima Mining Comp
Big Hole Mining Company
Yellow Alpha "B", Copper Report, GAM file

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

April 21, 1976

COPY

Mr. R. H. Gemmill
Big Hole Mining Company
P.O. Box 125
Jerome, Arizona 86331

Dear Mr. Gemmill:

Last year you kindly gave us your leach putput, 89,098 pounds of copper in precipitate, for 1974, (see attached copy of letter).

We would appreciate a like figure for 1975. In addition, we would also like tons of ore mined for direct shipping and contained copper.

Thank you very much.

Sincerely,

Glenn A. Miller
Mineral Resources Specialist

jm
cc: Pink Reading, Yellow Alpha "B"
Copper Report file
Big Hole mine file

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

FEBRUARY 25,1966

Production from the Verde (Jerome) District including the United Verde Mine and the United Verde Extension.

The United Verde Mine:

From the date of purchase by William A. Clark in 1888 to the end of 1935, this mine had yielded: 1/

20,346,000	tons of ore
1,979,105,400	pounds of copper
971,735	ounces of gold
34,358,390	ounces of silver

Total value slightly more than $350,000,000

From 1936 to end of 1951 production of United Verde Mine: 2/

11,294,072	tons of ore		
896,271,904	pounds of copper	376,500 45,527,000	pounds of lead pounds of zinc
387,437	ounces of gold		
15,115,521	ounces of silver		

Total value - $162,277,295

From 1952 to termination of United Verde operation on March 23, 1953:

			Copper ore	Cu-Zn Ore
Year 1952	155,642	tons of ore	18,281	137,361
Year 1953	29,164	tons of ore		
Year 1952	10,406,232	lbs. of copper	9,613,749	Lbs. of zinc
Year 1953	2,020,981	lbs. of copper	2,199,620	lbs. of zinc

1/ Stories of Arizona Copper Mines (page 70) April, 1957, Ariz. Dept. of Mineral Resources

2/ Geology and Ore Deposits of Jerome Area (page 101), 1958, Geological Survey Paper 308.

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

Summary of United Verde Mine Production:

	Tons Ore	Lbs. Copper	Ozs. Gold	Ozs.Silver	Total Value
1888 to 1935 Incl.	20,346,000	1,979,105,400	971,735	34,358,390	$350,000,000
1936 to 1951 Incl	11,294,000	896,271,904	387,437	15,115,521	162,277,295
1952 to Mar.23, 1953	184,806	12,427,213	?	?	?
	31,824,806	2,887,804,517	1,359,172	49,473,911	$512,277,295

United Verde Extension Mine:

Production on Page 136 of "Geology-Ore Deposits of Jerome, Area"
Geological Survey Professional Paper 308

Production started in 1915 and mine was closed in May of 1938

3,878,825 tons ore mined

793,331,100 pounds copper recovered.

152,756 ounces of gold recovered

6,449,156 ounces of silver recovered

$125,000,000 Estimated value of copper, gold and silver

$ 50,531,250 Dividend record from 1916 to 1938 Incl.

Production Big Hole Mining Co

Dry Tons	Gold oz	Silver oz	Copper lbs
1951 – 6 Mos	5,004.	31.49	3,604.1	605,319.
55	13,477.3	77.6	9,453.4	1,371,056.
56	14,928.5	84.0	10,843.	1,545,434.
57	12,872.1	333.75	14,772.	1,644,400.
58	16,010	586.7	27,723.	2,067,960.
59	9,842	290.6	9,627.	869,108.
60	17,010.1	101.72	19,081.	2,299,799.
61	18 533	143.19	16,186.	2,436,505
62	10,477	113.82	8,794.	1,770,601
63	15,076.	177.06	13,414.	2,326,437
64	8,249.67	105.14	7,9474	876,828
65	9,576.5	152.3	7,601.	1,216,466
Totals	151,057 Tons	2,199.37 oz.	150,995.9 oz.	19,029,913 lbs.

Frank —

Dam sorry I have been so long getting this to you. After returning from Phoenix, the weather has been so bad I did not get over to Jerome until today.

Best Regards —

Mark G

Mark Gemmill

Jerome - March 4, 66

BIG HOLE MINING CO.
P. O. BOX 115
JEROME, ARIZONA
86331

REPORT ON THE UNITED VERDE SOUTH EXTENSION GROUP.
JEROME, ARIZONA.

The Property.

This group comprises nine unpatented lode mining claims, viz; Montana Verde No. 2, and Montana Verde No. 4 to No. 11 inclusive, held in possessory title under the United States mining laws and ha having an area in the neighborhood of 180 Acres.

Location.

The center of this property lies one and one half miles in a Southwesterly direction from the town of Jerome, the main distributing point of the well known Verde Mining District, Yavapai Co., Arizona. The general topography of the district can be said to consist of a range of rugged hills running in a northerly direction which rise to an elevation of 1000 feet or more from the plateau to the West, and then drop precipitously 2500 to 3000 feet to the Verde Valley on the East. The Verde District occupies the Easerly slope of those hills. The elevation at the claims is around 6000 feet above sea level.

Accessability.

The property is at present reached by trail from Jerome. Construction of not over one mile of road through moderately rough country would give wagon connection to town over roads already built to surrounding properties. Jerome itself is served by the narrow gauge United Verde and Pacific Ry. connecting with the Santa Fe 30 miles away. The contract has been let for the extension of the Santa Fe from a point 4 miles West of Clarkdale to Jerome; and when this is finished will materially reduce freight rates

Climate.

Ideal weather is usual from May to December, with intermittant thunder storms during the month of August. Snow falls in December or January, accumulates to a depth of 3 or 4 feet at this altitude, and disperses in May. In short, there are no climatic conditions to retard mining the year round.

Geology.

The group is traversed by one of the pronounced faults of the district, having a strike of nearly due North, and passing through the Easterly portion. To the West of this fault, the surface rocks are sedimentary limestones and sandstones capped on the peaks with basalt. To the East, various eruptives are exposed when not covered by agglomerates. Carbonate copper ore is to be found in places along the contact. While not in commercial quantities, in view of disclosures elsewhere in the district, it is reasonable to assume that an intelligent development campaign would be well worth while

Surrounding Properties an d Mines

The main shaft and workings of Senator Clark's United Verde Copper Co lie one mile in a Northeasterly direction from the Northeast corner of this group, and an outlying group of this Company adjoins directly on the North. Present production of the United Verde is at the rate of five to six million pounds of copper per month, with immense reserves to draw upon. East of the United Verde is the U. V. Extension, whose sensational find of a remarkably rich shute on the 1400 level led to the recent stimulation of the district.

Within a radius of two miles are at least six companies financed and equipped for deep development.

Conclusion.

Comparing their geology and location with other portions of the district, this property merits a more exhaustive study than could be given in the time devoted, which research shuld reveal the best proceedure for economic development.

Respectfully submitted,

Richard D. Brauer E. M.

UNITED VERDE 1899

The far-famed United Verde copper mine, although originally located back in the sixties, had a struggle for existence, as a paying property, until 1887, when capital and intelligence came to its resuce, and placed it among the foremost copper producers of the world. The property was purchased by Hon. W. A. Clark in 1888. Copper production began in March and continued during the summer at the rate of about 600,000 pounds per month, this being the quantity required by contract with the syndicate. (Vide Min.Res. U.S. 1888, p. 59)

Taken from the Report of the Governor of Arizona 1899

Taken from the Report of the Governor 1899

YAVAPAI COUNTY

1897

The United Verde Copper Company's group, located at Jerome, 28 miles northeasterly from Prescott is not only the largest property in Arizona, but ranks among the largest in the world. While the ore is copper, it contains a larger per cent of both gold and silver, and the value of either of the three metals in the ore is sufficient to pay a handsome profit for mining were the other excluded. Exact statistics in regard to its output are not obtainable, but a close approximation places it at 30,000,000 pounds of copper per year, the value of the daily product being from $15,000 to $20,000, or from $5,000,000 to $7,000,000 per annum And now comes the remarkable feature connected with the operation of this property. While the company has on its pay roll between 700 and 800 men employed in various capacities , the number actually employed in mining does not exceed 20 men. This number of men remove from its place, where nature has stored, the ore from which the above values are extracted. Additions are constantly being made to the plant for the reduction of the ore, the capacity having been doubled during the past year, and consequently the number of men employed having been proprtionately increased, or nearly doubled, an idea of the increase to the machinery may be obtained when it is stated that during the past year eight boilers of 2,500 horsepower capacity each have been placed in position to furnish the necessary increase of motive power.

YAVAPAI COUNTY 1897

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TAKEN FROM THE REPORT OF THE GOVERNOR OF ARIZONA 1899

THE UNITED VERDE COPPER MINES

The United Verde copper mines, situated at Jerome, 28 miles from Prescott, in Yavapai Co., and owned by Senator W. A. Clark, of Montana, have a world-wide reputation. Their production in both copper and gold has been phenomenal. While it is not the policy of the company to furnish detailed information for publication, enough is known to justify the statement that the yield in copper bullion of these mines per month is approximately 3,000,000 pounds. Some months the yield exceeds this amount. The bullion contains considerable gold and some silver. The ore bodies in the mines are of great extent and value, and can not be exhausted in a lifetime. The mines and reduction works of the United Verde Copper Company are at present employing about 1,000 men. The principal shaft is about 600 feet deep. From different levels tunnels have been driven, and the underground workings are extensive. The engine capacity of the plant amounts to 2,000 horsepower, which is utilized in hoisting ore, operating air drills, copper converters, machine shops, and a 40-ton crane. A vast amount of new ironwork has been put in, consisting of structural works for buildings covering the entire plant, engine and boiler rooms, converters, blast furnaces, machine shops and foundry. The plant in some respects is the most complete in the country, and the converters in use there are said to be the largest in the world. A reverberatory furnace is used in smelting the finer ores, especially those rich in silver. A greater part of the ore when taken from the mines is first roasted in heaps, extending along the slope of the mountain in three long rows, whereby it is desulphurized. It then goes to the blast furnaces and finally to the converters. The copper bullion which is thus produced is about 99 per cent pure copper. The mines, smelting plant, and town of Jerome are situated on the east slope of the Black Hills range, pretty well up toward the crest, at an altitude of about 5,600 feet above the sea level, and at least 1,800 feet above the Rio Verde Valley, which spread out in grand panorama to the east and south. The town contains about 4,000 people. A considerable amount of prospecting is going on in the adjacent territory, and mining is active in that vicinity. The equipment of these mines is thorough and complete in every way, and the property is conceded to be one of the greatest and most valuable in the known world.

TAKEN FROM REPORT OF THE GOVERNOR OF ARIZONA 1895

Plants in operation	Number of Stamps	Daily Capacity of Smelter Tons	Annual Product
United Verde (Gold, copper, and silver)		150	$3,500,000.
Congress	40		
Congress (cyanide)		60	750,000
John S. Jones (Little Jessie)	20		240,000
Roberts	5		20,000
Crowned King	10		360,000
Mescal Co	20		25,000
Barrett's	5		10,000
Whipsaw	10		150,000
Swallow	5		20,000
Harlan's	5		25,000
Senator	10		75,000
Groom Creek	5		24,000
Morse's	10		60,000
Lane's	10		150,000
Wade's	5		15,000
Marshe's	10		20,000
Schuroman's	5		12,000
Sattes & Co.	5		12,000
Ryland	20		40,000
Humbug	20		20,000
Last Chance	10		20,000
Venezia (not working)	10		
Big Bug	5		25,000
Sines & Co.	3		15,000
Dekhunes (not working)	10		
Del Pasco	5		40,000
Prescott Sampling Works		100	75,000
Phelps, Dodge & Co.		100	50,000
Santa Maria	5		15,000
Callen & Co.	10		25,000
Yarnell	10		35,000
Catoctin (not working)	10		
Gladiator (not working)	10		
Rupert's (not working)	5		
Turkey Creek (n t working)	10		
Peck	20		50,000
Total Quartz mines	350	410	5,949,000
Placer mines			250,000
Shipments			750,000
Aggregate production			6,949,000

U.V.X.

April 24th, 1920

Mr. George F. Shurtleff,
8 West 40th St., New York.

My Dear Mr. Shurtleff-:

I enclose herewith a brief report on the United Verde Extension as it is at present. I trust that it will give you all desired information.

I made an arrangement with Mr. Peach the Phelps Dodge manager here to fix it up with George Kingdon so I could go through the mine. We talked it over with him over the telephone and Peach gave me a good letter to him but when I got to Jerome Kingdon had left hurridly for Prescott. So I got in touch withthe new mine supt Mr. Nickerson, and he seemed to take me for a director of Phelps Dodge Co or something and he gave me a far better deal and more information than I could have possibly gotten out of Kingdon. He even turned over all the working maps and I made a study of them. I went through all levels from the I200 to the I700 with hims and spent the entire day undergcound, he also answered anything I asked him as far as his knoledge went.

Before I went in the mine I had quite a talk with Dave Morgan and others at Jerome who are supposed to be in close k touch with th situation and found them very bearish in regard to it on account of the orebody being smaller and lower grade on the I500 than above. On an inspection of the mine however I found that the developments of the past week or so prove that the orebody is merely changing shape and will probably be as large or larger than above. Even if it were smaller it would be noth ing to worry about as all the orebodies pinch and swellbut in the United Verde none of them has ever pinched out yet. In fact they are inclined to join with other bodies at depth and it appears to me that the U.V.X orebody is doing the same thing, and will join with the smaller bodies to the north and form one continuous orebody parallel to the fault.

On a whole I can see a very excellent future for the stock although there are no doubt some interests that are trying to depress it and it may go still lower.

I did not go to the Shea Copper Co Mine but understand that they have a very good showing of tetrahedrite ore in vein formation. The veins are narrow and the formation is entirely different and distinct from the schist replacements of the Verde District.

If there are any further details you want I can probably get them for you.

Very Sincerely,

Bert Hore, the general foreman at the Pilares will be foremen at the U.V.X after May Ist. He is a very good man. I will no doubt be able to keep in close touch of I600 develo ments

April 24th, 1920

UNITED VERDE EXTENSION.

The attached sketch will show the dip and relation of the orebodies on the I300, I400 and I500 levels.

On the I300 level the orebody has an area of approximately I00,ooo sq. ft. The apex of the main orebody takes place on a horizontal plane between the I240 and the I280 averaging I250. Between the I200 and the I300 there is approximately 350,000 tons developed in the main orebody less the tonnage already stoped.

On the I400 level the orebody has approximately the same area, giving 700,000 tons between the I300 and the I400.

On the I500 the orebody appears to be changing shape, it is getting longer and thinner, and the end lying nearer the fault is dipping at a lesser angle, When developmmnh was first startedin this orebody on the I500 level there was much dissípointment on account of the narrowing width, but it now appears that this is only a change in shape and that the area on the I500 will be as large and possibly much larger than on the I400. In fact it appears to me that this orebody is lining up with the general shear zone and the smaller orebodies to the north, and that they will all form one oreBody atthe I500 or a lower level. Taking into consideration the extent of the present provem area only there is at least 600,000 tons between the I400 and the I500.

This is a total of I,650,000 tons for the main orebody to which we may safely add 350,000 tons for the smaller orebodies to the morth. The average grade of all this ore is I5% or 300 lbs to the ton. On an average copper market a profit of at least ten cents per lb can be made, giving the profit in sight for the mine at $60,000,000. To this should be added something for the silver ores which are mentioned below.

The I600 and I700 levels are being pushed, have about 400 feet to go to the orebody and will reach it the latter part of July.

FLORENCIA :-
The Florencia Claim is owned one third by the Clark interests and two thirds by the U.V.X. A point of the main orebody extends into this claim but a dead line has been established I7 feet from the boundry, beyond which there has been no stoping or development. At this dead line on the I300 level the ore is 20 feet wide and averages 20%. It is not known whether or not the ore opens up again on the Florencia ground, but it is generally supposed that it does. It is also understood that the U.V.X has some agreement with Charles Clark to purchase their one third interest after the

Clark interests have been inherited by him.

HULL.

The Hull ground lies south and west of the Florentia. I am informed very confidentally that on the I200 level a drift was run through the Florencia and into the Hull ground and entering an excellent orebody on th latter ground. The drift was immediately a caved by some of the officials themselves anf a fight starte d for this ground which ended in anagreement between the U.V.X and U.V. whereby the divide the Hull ground and have to buy in all outstanding stock before it can be worked. If there is such a thing as the U.V.X. ore body being the faulted overburden from some other point it is supposed that the main body is th is body on the Hull ground.

The above information was given me in strict confidence by a party very high up.

THE FAULT.

The main north and south fault through the Verde District lies about 300 feet west of the orebody on the I300 foot level and dips east 75 feet to I00 feet vertical. If the fault and the orebody maintain this dip it would touch the west end of the orebody at the I600 and entirely cut it off at about 3200. It seems now however that the orebody is changing dip, lining up with the fault and dipping with it, that it is very doubtful if the fault will have any effect on it, and that they know where to go for it if it does cut off. They expect to explore this faul on the ?I500 level.

SILVER ORE.

The silver ores occur as a margin and a capping around the main orebody. They are very silicious, and contain very little coppier. The values are spotty and occaisonally run up as high as 300 oz. The ore is mined and used for convertor lining only and the average grade is about 30 oz. There is plenty of this ore to last for convertor lining indefinately.

CAPACITY.

At present the smelter is making 4,500,000 lbs of copper per month and is running at just one third capacity or 500 tons per day. This will not be increased until the copper market justifies it. Most of the ore is coming from development work, fire breakes etc. Such stoping as is being done is cleaning up the ragged edges of the orebodies and getting everything in the best possible shape. All efforts are being made to keep the grade of the ore at the supposed average of I5% but it is found very difficult to keep it that low. It will be very easy for the mine to produce from I5,000,000 to 20,000,000 lbs per month if desired, without selecting high grade ore.

GENERAL.

Everything seems to be well run and well organized although it is evident that the present organization has had some little difficulty in straightening out some of the first work done.

Very Respectfully,

U.V.

72 Patented and 16 Unpatented Claims 1051 acres of ground.

Two groups are known as the Green Monster and the Verde Combination Group.

Northern most point is within 1 mile of Jerome, and extends to the SE for app 4 miles toward the Copper Chief.

The thorium is located in the Verde combination Group which is about two miles north of the Cliff.

Strike of the Thorium vien is to the NE. Dip is about 42°.

Silver plate tunnel is about 298 feet to the face.

Gorge tunnel has about 3200 fet of workings.

Surface chalcopyrites on the Road to the Gosson is about 4,000 feet.

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MINING METALLURGY

SMELTER CLEANUP
CONCLUSIONS AND ECONOMIC CONSIDERATIONS
UNITED VERDE AND UVX SMELTERS
Clarkdale and Cottonwood, Arizona
4/20/71

Available slag and smelter cleanup material = 20,000,000 tons

Process: Rip and bulldoze slag and feed bank run material to portable conveyors with magnetic head pulleys for primary separation, stacking tailings and magnetic concentrates separately, per Patent Applied for: Group 111, on 09-04-70, serial No. 69 932.

Upgrade magnetic concentrates by heavy media using Akins separator and spherodized ferrosilicon.

Ship concentrates to custom smelter, or treat otherwise.

	Weight	Wt-%	Assay	Per Ton Units
Head Feed	20,000,000 tons	100.00%	0.60 % Cu	0.6000
Magnetic Sep. Tails	18,000,000 "	90.00%	0.40 % Cu	0.3600
Heavy Media Tails	1,634,000	8.17%	0.70 % Cu	0.0570
Heavy Media Conc.	366,000	1.83%	10.00% Cu	0.1830

Magma Smelter Schedule: Pay for copper - 90% of contained copper at market price less 4.5 ¢. Smelter charges $6 + $3 + 5% of value over $30/T. Assume freight = $7.00/ton and Royalty =10%

Pay: 0.90 x 2,000 x 10.0 x (54.5 - 4.5) = $90.00
Charges (12.00)
Net Smelter Returns 78.00

Less: freight = $7.00
royalty = 7.80
14.80 (14.80)

Net value at plant site 64.20/ton HM conc

Weight-percent x net value HM conc = recoverable value
0.0183 x 64.20 = $1.175/ton
= $23,500,000 for the pile

Estimated costs = 55¢ per ton = (11.000.000)
ESTIMATED NET PROFIT 12,500,000

Market price of copper is assumed to be 54.5 ¢ per lb.

With this analysis, bulk sampling test work should be pursued.

Thomas C. King

SMELTER CLEANUPS

During 1969 and 1970 I made a study of the old copper smelter sites at Cottonwood and Clarkdale, Arizona. The object of the study was to determine if there remained commercial values in the old slag dumps and smelter foundations, the smelters themselves having been junked out.

The United Verde and United Verde Extension mines at Jerome, Arizona, were among the richest in the world during their production period, and the United Verde was considered the most profitable mine ever owned by one man, Senator William A. Clark. The United Verde produced from 2,000 to 3,000 tons per day of about 6% copper ore with substantial values in gold and silver, for an operating period of 40 years from 1914 to 1956 with a down period during the depression. The United Verde Extension, theoretically a down-faulted block of the U. V. pipe, was an enriched pipe, producing over 6 million tons of exceptionally high grade ore, said to average 25% copper with considerable gold and silver. It operated from 1923 to 1931, shutting down in the depression and never starting up again.

The combined slag piles by my measurements aggregate 16.4 million tons at the United Verde and about 3.6 million tons at the UVX for a total of 20 million tons. It is possible the toe of the piles has subsided below ground level, as this estimate of mine from contours and cross sections from top to toe is about half other peoples estimates.

The smelter reports published indicate slag to contain about 0.35% copper. Actual assays by extensive sampling and analysis by both myself and the Copperas Co. indicate the slag will actually assay 0.60 % copper, a difference in copper assay of 0.25%. This is a considerable difference, and the test work and investigation is an attempt to account for the discrepancy and determine if it can be turned into a profit.

The ores from these mines was for the most part, direct smelting, with roasting to eliminate some of the sulphur, and grinding and flotation to upgrade some of the lower grade material.

In the normal smelting practice the ore, concentrates and flux were roasted, blended and fed to the reverbatory melting bath furnaces where the charge is melted and the spent gases are sent to waste heat boilers for the generation of steam for power. The melted charge then separates into calcium-iron-aluminum silicates called slag (Spg. 3.45) and copper-iron sulphide called matte (Spg. 4.38). The two are immiscible in each other and form separate distinct layers under normal conditions so that they can be tapped off separately. Such matte from these smelters assays about 25% copper, 8 oz/ton silver, 0.25 oz/ton gold, 40% iron, 25% sulphur, 3% zinc and traces of lime, alumina, and silica. This matte is tapped into ladles and poured into the converters where silica flux is added, and hot air blown into it to oxidize the iron and sulphur. The silica combines with the iron oxide to form converter slag which is poured off and recycled back to the reverb from time to time. The sulphur escapes as sulphur dioxide gas which goes through the dust collecting equipment and up the stack. Continued converting results first in the elimination of all iron, leaving "white metal" or copper sulphide in the converter with a characteristic change in flame color.

Continued blowing past the "white metal" stage eliminates the remainder of the sulphur leaving blister copper, with a second characteristic flame change. The blister copper is then poured into anode molds and shipped to the electrolytic refinery for purification and recovery of the gold and silver and associated other metals.

Back to the reverb, the slag overflows the back of the furnace slag tap more or less continuously into the slag pots of the slag train, where intermittent trips are made to the slag dump. Matte is tapped intermittently into ladles in the converter aisle, where it is transferred by the crane man into the converters. Converter slag, since it contains considerable matte, is poured back into the reverbs by the crane man, a spout in the front or converter aisle side of the reverb being placed to receive the converter slag from the ladles.

In theory with everything functioning properly a near perfect process results. There seems to be a bottom limit for the slag assay of about 0.35% copper due to some form of chemical reaction in which this percentage of copper is combined with the slag or suspended in it as a colloid matte very difficult to recover by any known means. Slag losses above this,however, are usually due to human and process errors some of which investigation has revealed as follows:

1. Any number of things can go wrong with the converters while feed continues to be charged into the reverb. A hole can be burned in a converter shell for example, and another not available or warmed up to receive the charge. The resulting flaming spill onto the floor can help keep things popping for the whole crew while the matte level builds up in the reverb, finally overflowing into the slag cars. There are slag pits provided on the slag dumps for such an eventuallity, but it is so much easier to pour it over the side. A smelter superintendant told me in confidence that he started out with the company years ago and part of his job was sampling the slag poured out the night before. He was sent back to re-sample five times before he finally got wise and brought in an "acceptable" sample. All the rest were fair samples, ranging from 0.7 to 1.4%. The fifth sample he made sure had no visible matte in it, and ran 0.41% copper. He finally took the attitude that it wasn't his copper, and if the boss wanted it that way, his job was more important than [illegible] the truth for the head office. As years went by he came to realize there was no way you could run a smelter without mistakes and human error, but also no way that top management would accept anything less than a perfect job, so mistakes were simply covered up and the job run as best they could.

2. Magnetite is formed in the converting step. Magnetite with a Sp G of 5.17 is heavier than either matte or slag and insolubile in both. It exists as a cloud of particles suspended in either and continually tries to settle in either, but is swept with currents as wind sweeps dust. Magnetite formed in the converting step is rejected from the white metal, Sp G greater then 5.3, and is recycled back into the reverb, where it again tries to settle into the matte.

2.(continued) As the magnetite crystals build up in the cyclic return of converter slag there is formed rafts and islands of mushy magnetite-slag-matte mixtures which are a form of furnace indigestion, causing it to "belch" occasionally to clear itself. High grade magnetic slag is discharged or overflowed into the slag pots and dumped over the side.

3. Color changes in converting occur in a matter of seconds. It is necessary to observe the exact instant when "she turns green" to know the blister copper is ready. If for example the converter man is sleepy, or talking to someone else, or has to go to the bathroom, or is eating lunch, or is occupied with a break down or burnout, he is apt to miss the end point, and if the air is allowed to blow beyond the end point, the copper itself starts to burn. "Burned" copper is brittle and unsatisfactory for anodes. A severely burned pot of blister copper presents some real problems. In the first place it is cooler than it should be, and may solidify or freeze in the converter if not removed. If it is poured back into the reverb, or if mixed with matte, a sudden reaction takes place which is a disaster in the smelter. The copper oxide dissolved in the blister copper reacts with the copper iron sulphide matte to produce sulphur dioxide gas and metallic copper which dissolves in the remaining matte. The gas liberated within the melt starts a foam within the furnace which is not unlike an erupting volcano, and before the eruption is over there is probably "lava" flows all over the converter aisle and the slag aisle, and the slag pots have been filled with an average of the reverb contents, averaging at least 6% copper and probably 10% copper.

Tight operation of the smelter would mean that the burned pot would be dumped back in the reverb nearly every time. A crane man for the converter aisle told me that the reverbs foamed over on the average of once each three weeks, and the opinion was that it was due to some peculiarity of the feed composition. Who would ever admit that someone burned a pot of copper.

Loose smelter operation would mean that the burned pot of copper would be dumped out on the slag dump, while everyone turned their backs. This would mean a loss considerably less than if it were dumped back in the reverb causing it to foam all over. If management were understanding of human error, then the burned pot would be dumped in a slag pit to be blasted up and recovered. If not, and this was generally the case, the burned pot was dumped over the side and a trainload of slag dumped over it.

4. In general copper bearing cleanup and "reverts" were sent back and blended with the regualar feed. In this way it was assumed that no copper was lost from these sources, other than the normal slag losses. There were certain exceptions to this, however, which presented threats to the operation of the smelter itself and which were seggregated and dumped out on top of the slag dump hoping for a method or process or a suitable opportunity to effect recovery of the contained copper. These exceptions involved converter brick and reverb bottoms from repairs.

4. (continued) Converter brick is either magnesite or periclase and due to the formation of magnetite within the converting reaction, it is usually full of it. Reverb bottoms and sides are also magnesite and are full of or impregnated with magnetite. Both bricks run from 10% to 30% copper so should be recovered, but since feed containing quantities of coarse magnetite or magnesite brick will settle to the bottom of a reverb, causing the floor to rise as islands of the material settle, this class of material is shunned by the wise smelter superintendent and is dumped out on the dump. In 1943, the only year I have a precise record from the U. V. Smelter under Phelps Dodge operation, the converter repairs were documented. There were 18 individual relinings.
It would seem from a review of published data that lists furnace campaigns of from 9 months to 2 years, that with an average of 3 reverbs in operation, that a reverb was rebuilt every 4 months, with a wasting to the slag dump of 5,000 tons of 10% copper.

A review of the sampling in the smelter records against sampling of the actual dump indicates a discrepancy of about 0.25% copper, or 5 lb. of recoverable copper per ton of slag. The above four sources of additional but unreported losses might well account for this discrepancy.

Test work was instigated to determine if this portion of the overall slag losses could be recovered. Since magnetite features in almost every cause of smelter losses, it was assumed that the magnetite would be associated with the copper as a result of its physical properties under smelter conditions, and magnetic separation was tried with success.

A patent was filed covering the process called "Combination Smelting and Magnetic Process for Recovering Relatively Non-Magnetic Metals Such as Copper, Gold, and Silver, and for Upgrading Smelter Slags, Converter Slags, and Smelter Trash Bearing These Metals." Group 111, on 09-04-70, under serial no. 69 932.

Test work was mostly concentrated on cleanup material within the old smelters themselves, involving reverb bottoms, converter aisle bottom, and general smelter trash. Test work on the slag dump was incomplete but all tests were favorable and there was definite upgrading in every case. It now appears that by far the greatest potential is in the magnetic separation of slag dumps involving the simplest kind of equipment: Bulldozer with rippers, Loader, Grizzley feeder, Conveyor with Magnetic Head Pulley and splitter box underneath. Magnetic or relatively magnetic material is deflected slightly downward out of the trajectory off the magnetic head pulley and can be split from the main stream. Upgraded material can then be re-cleaned magnetically or treated by heavy media to further upgrade it. Close sizing is required for magnetic cleaning operations.

Heavy media, using sphoradized ferrosilicon in an Akins separator can be used for separations up to or above the Sp. G. of the average slag, to upgrade the product above 10% copper.

Recovery of copper from the upgraded slag might be accomplished in several ways. Some are listed as follows:

1. The ideal method is the use of a blast furnace to resmelt the material with silica flux ore to produce a high grade matte, which can either be converted to blister copper or shipped to a smelter. Capital cost of this installation would be high, as it would involve construction of a blast furnace, small reverb for a settler, and a converter. Air polution requirments would be minimal, however, since the gases from such an installation would contain less than 10% of the SO_2 normally found in smelter smoke. This would be particularly true if the converter were not used.

2. As before mentioned, the use of heavy media should be investigated to upgrade the concentrate further for shipment to a smelter.

3. Hydrometallurgical methods are a possibility. The most promising is fine grinding (65-mesh) of the upgraded slag, preferably dry grinding, moistening with concentrated sulphuric acid, and treatment in a shaft furnace or rotary kiln to react the acid with the copper, then solution of the pellets with water to extract copper sulphate.

More recent developments such as grinding, suspension of the ore in an electrolite such as acid or brine, passing an electric current through the slurry to alter the ore minerals, and recovery of the metals by flotation or solution, might be investigated.

Grinding and solution of the copper with acid chlorine water might be investigated, as the chlorine would oxidize the sulphides.

Of the various methods, the upgrading of the magnetic concentrate by heavy media and shipment of the concentrates to a smelter is the best approach, at least to begin with, while other test work is carried out.

Test work on the slag dump will involve a set of portable stacker conveyors, at least two of which should have the strongest magnetic head pulleys available. A grizzley top bin with pan feeder should be fitted to the main stacker conveyor with the widest magnetic head pulley and belt as the primary separator.

Magnetic separation may then be carried out on dump run material most of which will pass a 3 inch grizzley, at least after it is ripped and dozed, or dug with a back hoe.

A screen should be hung on the end of the concentrate conveyor and the undersize of $\frac{1}{2}$ inch should be treated by itself with a magnetic drum separator, and the oversize on + $\frac{1}{2}$ inch passed over another magnetic head pulley. Magnetic separators are sensitive to material sizes and should have sized products upon which to operate. It is not practical to size the feed to the main separator, but it is practical to size the feed to the cleaner separators and use more selective machines.

SPIN-BREAKERS

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Thomas C. King
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PRESCOTT, ARIZONA 86301

MINING METALLURGY

8/10/70

Mr. John F. Shackelford
P. O. Box 368
Putney, Georgia 31782

Dear John,

So glad to hear from you (7/28/70); wish you could have stayed longer but I guess you had to get back and shake those trees. Best always for a man to be present at his harvest.

Last year I got to wondering about cleaning up the old Smelters at Clarkdale and Cottonwood, Arizona, and did a lot of work sampling, testing, and excavation to see how much was left around after the shut down and sale in 1956. The United Verde and United Verde Extension mines were among the richest in the world during their time, and the United Verde was considered the most profitable mine in the world ever owned by one man, Senator William A. Clark. It produced from 2,000 to 3,000 tons per day of 6% copper with high gold and silver values. The United Verde Extension ran only about 8 years but they produced about 1,500 tons per day of 25% copper. Combined slag piles from the two operations (direct smelting) aggregate some 45,000,000 tons. Both smelters have been dismantled and scrapped out.

It would appear that the combined production of several billion dollars at todays prices would have made them a little reckless and that they would have spilled a little here and there that has been overlooked by clean up men, who have shipped about $700,000 out of floor cleaning so far.

All previous efforts at clean up involved no processing, just careful pick and shovel and broom cleanup. I sought a method by means of which all waste materials could be processed and the easy-to-get copper bearing materials could be recovered. Of course there were values in the slag which were refractory; but there were the following sources of spillage which were not refractory and could be recovered if a means were found to separate them physically from the materials containing chemically combined or refractory copper:

1. In the year 1943 which I have record of, converters were relined 18 times, wasting to the slag dump about 900 tons of periclase and magnesite brick assaying about 30% copper.

2. In the year 1943 there was indications that about 5,000 tons of reverb bottoms assaying 15% copper were wasted over the slag dump. No furnace man likes to get magnetite back in the circuit. Both converter linings and reverb bottoms are high in magnetite and infusible periclase and magnesite brick which are wasted rather than resmelted.

3. According to Cal Wilson, crane man in the converter aisle for over 10 years, the charge to the reverbs would get the wrong composition and the reverbs would start to foam and boil over. The only practical remedy was to stop the feed and tap them down until the boiling subsided, clean up the "lava flows" which were by this time all over the converter aisle and slag aisle, and and start the feed slowly and get the reverb back on stream smelting concentrates and ore. This situation I am told happened on the average of once every three weeks, and as much as 1,000 tons of 30% copper was dumped over the dump or in xkxg matte pits each time it happened. The matte pits provided for the purpose were too oftened filled, there was not time to "skim" each slag car of its slag and xxxxx save the matte as the situation in the smelter was somewhat desperate, so over the side it went. The aggregate of such a loss over 40 years is considerable.

4. In the normal smelting practice the ore, concentrates and silica flux are roasted, blended and fed to the reverbatory furnaces where the charge is melted (at about 3 to 5% thermal effeciency) and the heat in the spent gases recoverd in waste heat boilers. The melted charge then separates into silicates and sulphides. Xx The silicates are called slagx, and the sulphides are called matte. The matte is heavier than the slag, and separates to the bottom. It is predominately copper-iron supphide with the gold and silver values dissolved, assaying about 25% copper, 8 oz/T Silver, 0.25 oz/@ Gold, 1% silica, 40% iron, 25% sulphur, 3% zinc, and traces of lime and alumina. This matte is tapped into ladles, and poured into converters where silica flux and oxygen is added by hot air blowing, oxidizing the sulphur which escapes as sulphur dioxide gas, oxidizing the iron which combines with the silica to form slag, and oxidizing the xxxpxxx copper to copper metal. In the latter stages of this blowing some iron combines with oxygen as magnetite, a hard, insolubile and infusible (under the conditions) crystalline compound which is heavier than slag, and even heavier than matte. Clouds of magnetite crystals are suspended in the converter slag. Because this converter slag averages around 6% copper, it is poured back in the reverb for resmelting and settling to remove the copper. The trouble is, this practice returns quantities of magnetite in a cloud of crystals into the reverb. As they settle a viscous layer is formed at the interface of the slag and the matte, confusing the separation between the two. Submerged islands or rafts of mixed matte and slag with magnetite are tapped out the slag port, and magnetite settling to the bottom of the reverb builds up on the floor until the furnace becomes unworkable at times, requiring shut down and digging out. Extensive magnetic tests on the slag made by us indicates the magnetic material in the slag assays about 2% copper and contributes 0.2% to the copper assay of the slag.

5. In blowing the converters recourse is made to the color of the flame to determine the end point, that is the color of the flame changes when all the sulphur is eliminated from the copper, and the blister copper is ready to pour into anodes for shipment to the electrolytic refinery. If the converter man happens to be sleepy, or out of sorts, or at lunch he might not catch the end point and the pot full of blister copper is burned, or oxidized to black copper, which is unsuited for anodes.

5. (continued)

The logical thing would be to dump the burned pot into a place where it could be recovered and resmelted. However this is not so easy for the converter foreman. To "burn" a pot of copper is to committ the unforgivable sin. He would probably be fired. If the pot is not thoroughly burned, the copper might be still metallic, in which case there is no way of breaking it up to resmelt. If he thoroughly burns the pot, it might "freeze" in the converter, in which case he would most certainly get fired, and a railroad crane might not be able to lift the frozen pot of copper out of the converter stand. So what to do? Call in the slag train, dump it in a slag pot and pour it out on the dump? Pour some slag over it. Or pour it back in the reverber. Then what happens. The reaction of copper oxide with the copper sulphide starts a violent reaction in the reverb, realeasing thousands of cubic feet of gas as tiny bubbles in the underlying matte layer, causing the reverb to foam all over the converter floor, requiring the shut down of the reverb feed until it could be tapped out. Which is worse? If the reverb forman and converter forman are getting along, the burned copper pot goes out on the slag dump. If they are not, the burned copper goes into the reverb and the reverb forman is forced to dump 1,000 tons of matte over the dump. After all, as the saying goes, "We only work here." Its not "our copper" and the Company can afford it. Who would ever tell the head office these things?

So of the 45,000,000 tons of slag there is an undetermined quantity of highgrade matte in a free form. It has suspended in it varying quantities of magnetite crystals which cause it to be magnetic, at least more magnetic than the slag.

I originally started backwards, that is, I started with the smelter cleanup, then worked into the slag piles. Out of ignorance I started by crushing to some reasonable size, minus ½ inch, and used jigging, flotation, and magnetic separation as standard trial recovery methods. Still out of ignorance I assumed the slag would be more magnetic than the matte. I found the reverse is true and worked backwards to figure out how it got that way. After a year of questions the forgoing was arrived at as to how the copper got magnetic. Magnetic separation proved more reliable than any other method. A write up on this is attached, using magnetic drum separatinn at minus ½ inch, dated 11/21/69.

However, subsequent test indicated that a magnetic head pully on a conveyor could deflect the copper bearing material enough to effect separation without crushing. This material can be ripped and dug with a bulldozer, shoved into a feeder-hopper thence into a heavy conveyor with a magnetic head pulley, thence into a splitter box out of which 90 to 95% of the material would go out on the stacker to dump, the weakly magnetic split onto the concentrate conveyor, and the strongly magnetic split onto the scrap iron sorting conveyor out of which more copper bearing magnetite can be recovered. At the rate of 200 yards per hour this separation process should be accomplished at 25 cents per ton or less. A yard of this material will weigh about 2 tons. I think we can recover better than $1.00 per ton into a concentrate running 6% copper, for ship ment to a smelter.

I calculate the value of 6% copper concentrate as follows based on Magma's schedule at Superior, Arizona: Pay for copper at market price less 4.5 ¢ per lb. for 90% of assay; Gold at $32.20 per troy oz if over 0.03 oz; Silver - 95% at market price less ½¢/oz. Smelter base charge is $6.00/ton plus 10% of next $15 value up to $30.00 plus 5% of value over $30.00, total charge not to exceed $20.00.

On 6% Cu material = 120 lb Cu/ton x 90% (60% -4.5%) =120 x 0.90 x 55.5/100	= 60.06
Gold (no pay - assay 0.03 oz)	
Silver 1.3 oz x 0.95 x 1.60	1.97
	61.91
Less smelter charges: $6.00 + 1.50 + 1.60	-9.10
NET SMELTER	52.81
Less truck freight and royalty 7.00 + 5.28	-12.28
NET PLANT	40.53

RECOVERY by magnetic pulley 2.5% of feed as 6% Cu conc 1.01/ton

Available smelter capacity Magma and Inspiration 50 tpd
Feed to pull 50 tpd of concentrates = 50/0.025 = 2,000 tpd

Gross returns net plant = 50 x $40.53 = $ 2,026.50/day

COSTS:

Assuming plant rental purchase from Helmick, Phoenix, 10% of cost/month, 85% to apply on purchase, three months advance payment:

1-	42 in x 14 ft vibrating feeder	50 hp	18,500	1850
1-	30 in x 60 ft conveyor mag H. P.	15 hp	12,500	1250
3-	24 in x 60 ft conveyors	30 hp	26,250	2625
Misc	splitter box, mag head pulleys	5 hp	2,750	275
		100 hp	60,000 total	16000/mo

Assuming contract bulldozer and rubber tired loader Costs estimated total $55/hr for 10 hr day

Power, 100 KW at 1.3¢/KWH for 10 hrs. = $13/day

Summary:

Excavating equipment rental	$550.00/day x 25 days	=	13,750
Conveying equipment rental	240.00/day x 25	=	6,000
Power	13.00/day x 25	=	325
Labor	170.00/day x 25	=	4,250
Accounting	27.00/day x 25	=	675
	1,000.00/day x 25	=	25,000/mo
Gross receipts = 50 x 40.53 x 25	2,026.50/day x 25	=	50,662/mo
NET PROFIT	1,026.50/day x 25	=	25,662/mo

Some insteresting figures result.

Copper recovery/ton of slag = 3 lb./ton or 0.15% Cu

Reserves = 45,000,000 tons @ 2,000 tons/day = 27,500 days or for 25 day months, or 1,100 months or 90 years reserves. There is a minimum of 5,000,000 tons of better grade material in the trashy areas of the slag dumps which would be handled first; which would last 2,500 days or 100 months or 8 years.

There is hardly any small scale method of sampling this dump without finding a magnetic head pulley on a conveyor somewhere. Grab sampling over about 6 acres of the dump in trashy areas crushed to minus ½ inch and treated over lab mag separator yielded as follows:

Test C Bridge Area slag dump

	% Wt	%Cu	Cu units	
Heads (calc)	100.00	1.908	1.9078	
Mag Conc	24.50	4.12	1.0094	51.0% recovery
Mag Tails	75.50	1.19	.8984	

Hand magnet samples taken from this area somewhat duplicating a magnetic pulley recovery indicated 9 to 14% Copper grade in the concentrate. Fine crushing cuts grade considerably by pulling fine slag (relatively barren)into the concentrate.
Copper units recovered in this test were over 20# of copper/ton or about $6.73/ton, which at 2,000 tons per day = $13,500/day. However this is discounted as it represents areas containing old matte pits and brick trash and is higher grade than average. It would obviously be the first area to start on,however, so as to get the investment back in a hurry.

With a potential net profit of $20,000,000 in recovering only 0.15% of the 0.60% copper in the slag dump it is hardly wise to start with less than the simple plant recommended even for sampling.

Total exposure in a three months program (minimum rental purchase equipment time)= $75,000 if all equipment is run full speed full time mkys plus cost of getting power into area. This exposure can be cut to about $40,000 max by using local excavation equipment, and may be cut further by shopping for the conveyors.

SAMPLING PROGRAM

Prior to commitment for the full scale program it is suggested that a portable conveyor with magnetic head pulley be towed around the dump where it can be fed with a backhoe and the product dumped in a truck for weighing. In this manner an accurate sample split can be obtained.

A semi-commercial plant might be constructed with a 24" x 60' stacker conveyor, gasolene powered, with a magnetic head pulley. Feed to be trammed to it with a rubber tired loader, and tails removed by the same machine. Concentrates and scrap iron laying separate on the ground could be loaded separately.

I would be able to handle this my self had it not been for the accident to Pat. I am also in somewhat of a quandry as to who to begin with as a partner. My leases on the smelter sites do not cover enough ground and in order to get the additional ground a new proposal will have to be submitted with a program. If I turn to a contractor with the equipment needed, he would hav e to be completely trustworthy, otherwise I might find myself having set the deal up and be outside looking in.

I think we can start very small, but in all fairness, there should be a maximum of $80,000 in the till to carry on the program if our results prove out. This deal should make $200,000/year net as long as the copper price holds anywhere above 50¢/lb.

If you have any ideas on this long winded discourse, let me know.

Sincerely,

Thomas C. King

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine United Verde Pit

Date July 30, 1958

District Jerome

Engineer Travis P. Lane

Subject: Visit to mine

Owner: Phelps Dodge Corp.

The lease operation conducted in the Verde Pit by Mark Gemmill and partners was visited on July 8 in the company of Mark Gemmill. The working crew consisted of 6 men. A dozer was working at one end of the pit stripping slide waste material from a bench of good ore at about the old 500 ft. level; and at the other end of the pit mining was in progress in a face of copper-zinc ore with better than average gold value.

Shipments are being maintained at a rate of 6 cars weekly with grade of 6% cu or better.

DEPARTMENT OF MINERAL RESOURCES

STATE OF ARIZONA

FIELD ENGINEERS REPORT

Mine United Verde Pit

District Black Hills

Subject: Mine Visit

Date January 29, 1958

Engineer Lee Hammons

Owner: Phelps Dodge Corp.

Location: Jerome, Arizona

Operator: B. H. Gemmill, Big Hole Mining Co., Box 125, Jerome, Arizona.

Status: Active, working on 3 faces of high grade ore in the old pit, mining and shipping, 10 men working.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine United Verde

District Jerome

Subject: Present Status

Date March 28, 1957

Engineer Mark Gemmill

The mine is owned by Phelps Dodge Corp. and is being operated by Big Hole Mining Co. Lessee, R. H. Gemmill Supt. Box 125, Jerome.

Phelps Dodge Corp. closed down the mine in 1952. In 1954 the present operator secured a lease and has been mining segments of ore left in the walls of the pit. Ore is shipped to the Douglas Reduction Works. Regular shipments are being made of ore running about 6% copper.

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

UNITED VERDE MINE - YAVAPAI COUNTY 12-21-56
Jerome, Arizona COPPER
PHELPS DODGE CORP. - Owner

BIG HOLE MINING CO.- Lessee
Mark Gemmill, 423 Perry St., Prescott, Ariz. Agent
Dick (R.H.) Gemmill, Box 125, Jerome, Ariz. Supt.

1000 tons per month. - 8 men

L. A. S.

10-24-57

From the desk of

FRANK P. KNIGHT

Visited property. Mark Gemmill et al are still working at moving the large amount of debris washed into the pit by the cloudburst last August.

UNITED VERDE YAVAPAI COUNTY

In Jerome visited the Big Hole Mine, no activity due to bad weather.

E G. WILLIAMS Weekly report Nov. 27, 1963.

United Verde
Production thru 1962 $514,841,198 - major metal copper - J.W.Still's figures (corresponden file)

United Verde Extension production to 1938-$132,232,815, major metal copper J.W.Still's figures (correspondence file)

Visited Big Hole mine at Jerome.

EGW - WR - 9-18-64

Mark Gemmill visited and stated that the Big Hole Mine is active though they have had a lot of rain.

LAS WR 3/12/65

Visited Mark Gemmill at the Big Hole Mine. He is planning to leach a portion of the mine dump near the Opal portal as mining from the glory hole is becoming more difficult.

FTJ WR 11/19/65

UNITED VERDE

YAVAPAI COUNTY
JEROME DISTRICT

It is reported that the United Verde slag was found to contain too much sulpher to be used by the Arizona Cement Company.

L.A.SMITH
4-16-59 WR

Learned that part of the United Verde Extension dump is to be leached by a group headed by J. R. Sendon, address: Jerome, Arizona

TRAVIS P. LANE
8-1-1959

Weekly Report - 10-8-59 - Travis P. Lane, Field Engineer

Visited the Verde Pit. Work here was temporarily suspended because of rain.

Visited a copper leaching operation on a portion of the United Verde dump. A series of long narrow ponds or "vats" has been formed with dump material on top of the dump. Water is run into the vats, and is collected in a sump below the dump as it percolates thru the dump. From the sump it is pumped to a series of boxes, containing shredded cans, on top of the dump. The solution discharge from the boxes then flows into the vats on the dump, and the operation is thus cyclical. No one was present at the time of visit and apparently the "plant" is visited only two or three times a week. The principal in the enterprise is R.I. Francy, 2237 W. Northern Ave., Phoenix. He is the third person to undertake the project during the past year. George Sandon is engineer and operator. He performs the same service for a similar operation (for other people) on the big dump at the Yaeger Mine. I attempted to drive in to the Yaeger Mine, but because of heavy rain the dirt road was impassable.

Big Hole Mine is shipping 3 cars per week. Mining about half way up on the south wall of the United Verde pit. Have sizeable stockpile of good looking chalcopyrite ore.

Frank P. Knight - Memo - 4-14-60

This property active Feb. 1960, Sept. 1960, Feb. 1961-Oct. 1961, Feb. 1962, Oct. 1962

Visited Big Hole Mine - 6 - men working - E. G. Williams WR 10/2/63

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine: United Verde Pit

Date: July 30, 1958

District: Jerome

Engineer: Travis P. Lane

Subject: Visit to mine

Owner: Phelps Dodge Corp.

The lease operation conducted in the Verde Pit by Mark Gemmill and partners was visited on July 8 in the company of Mark Gemmill. The working crew consisted of 6 men. A dozer was working at one end of the pit stripping slide waste material from a bench of good ore at about the old 500 ft. level; and at the other end of the pit mining was in progress in a face of copper-zinc ore with better than average gold value.

Shipments are being maintained at a rate of 6 cars weekly with grade of 6% cu or better.

DEPARTMENT OF MINERAL RESOURCES
STATE OF ARIZONA
FIELD ENGINEERS REPORT

Mine: United Verde

Date: September 12, 1975

District: Verde (Jerome)

Engineer: Ken Phillips

Subject: Current status

According to information received from Donald Ross, Department of Revenue, the Big Hole Mining Company has ceased operations at the United Verde mine due to a termination of the contract with Phelps Dodge.

U.V.

March 29, 1957

To: Mr. Benton M. Lee,
Phoenix, Arizona.

Becchetti Copper Corp.
Mining Properties.

Per your request I have made a preliminary examination of a large group of mining claims near Jerome owned or controlled by the Bechetti Copper Corp.

Purpose.

The purpose of the examination was to determine whether or not further exploration and development, though admittedly speculative, is justified. To this my general answer is "Yes", provided the recommendations for such, which will be outlined later, are reasonably followed.

Area, Location, and History.

The general area lies from one to four miles south of Jerome and comprises over 1000 acres. It includes groups that have been known for some years and the Green Monster and the Verde Combination. These groups were heavily "promoted" in 1915 during the boom which followed the spectacularly rich discovery of the United Verde Extension. Most of the exploration done at that time seems to have had little rhyme or reason, and often failed to reach an apparent objective. There was little or no exploration by drilling, whereas, if the same amount of money had been spent by drilling, guided by geological study, the results might have been quite different.

Furthermore the expectancy at that time was for another strike like the U.V.X. and nothing under 5.0% copper could be considered at all. Today, resonably sized bodies of less than half that grade would be profitable.

Special Situations Justifying Exploration.

There are a good many spots throughout this 1000 acre terrain where copper minerals outcrop, either oxides or sulphides, and which warrant exploration. However there are three special situations where the chances seem greatly in favor of the chance-taker, and the rewards could be high. They are, to wit, as follows:

Silver Plate Situation:

Here we have a very prominent gozzan cropping on a hillside. The width is hard to determine because of the detritus overburden, but certainly is over 30 ft and probably not over 100. In length it seems to be cut off by a minor fault or change in formation at the east end.

U.V.

Toward the west it dies under detritus but appears to be at least 500 ft long.

The gozzan is a honeycombed silicious complex, with both limonite and hematite as residual minerals, and here and there some residual copper. Proverbially the yellow limonite results from the oxidation and leaching of chalcopyrite, whereas the brown hematite results from straight iron pyrite. The "vug" holes are voids which originally contained iron and/or copper sulphides. The gozzan outcrop has plenty of size to indicate an important ore body.

The following points seem certain:
(1) The gozzan is the top expression of a sulphide(primary) ore body containing copper.
(2) Such a primary deposit came from below.
(3) The mineralization expressed by the gozzan must extend downward - somewhere- in some recognizable form.

In this instance the older explorers had driven a crosscut tunnel to a point barely underneath the outcrop of the gozzan - and quit. (See attached sketch). Nothing resembling the mineralized zone has been cut in this tunnel. Evidence, while somewhat vague, indicates that the mineralized zone, expressed by the gozzan, dipped to the northwest, away from the course of the tunnel.

A short distance back of the present face of the tunnelthere is an area some 10 feet in width where copper sulphates are forming on the tunnel walls. There is a weakness or water course there,and this copper is coming from the mineralized zone overhead.

There is further evidence of this northerly dip. About 100 feet inside this tunnel a small vein, called the silver vein, was cut. In the tunnel it has a northerly dip, although on the surface above, where it has been worked, it has a southerly dip.

There is much evidence, therefore, that the downward extension of the mineralized zone, expressed by the gozzan, lies a s short distance ahead of the present tunnel face.

<u>The Cliff Situation.</u>

The Cliff is a thumb-like protuberance arizing from the top of a rather steep ridge between two gulches. Geologically it is an admixture of old schists and porphyryitic intrusions.

Above a certain horizon the "Cliff" has produced a considerable quantity of commercial ore. Mr. Bechetti , in the last few months has produced 179 tons of ore assaying 4.70% copper,by extending old workings and has recently discovered new ore missed by the previous miners.

U.V.

The mineralized area here is quite large but very mixed. In places primary sulphides outcrop, while at some lower horizon there may be patches of leached gozzan. The surface conditions would portend important orebodies somewhere underneath, but all attempts to find same have yielded only negative results. One long tunnel (Gorge Tunnel) was run but circumvented the heart of the zone for some unknown reason. Another tunnel (The Trail Tunnel) higher up, did penetrate the heart of the zone with nil results. Mr. Bechhetti put in down-angle diamong drill hole from the surface in the near by gulch. This hole only encountered some low grade iron pyrite but may have been to far to the east.

The situation is quite an enigma because this near surface primary ore must have some downward extension - somewhere. There are at least two possible answers: (1) The entire Cliff was laterally faulted from somewhere else, and if so, more proberly, from across its attending gulch. This would place it,originally, more in line with the gozzan trend of the Silver Plate. (2) The ore body could be mushroom shaped, and both the deeper explorations could have missed the stem of the mushroom. The answer, however can be obtained quite simply, and with comparitively small expense. (See Recommendations).

Thorium Vein.

The third most intriguing situation is a proved tonnage of thorium ore about 2 miles north of the Cliff. Here there is no need for exploration or development to prove tonnage. While no definate tonnage can be technically called "proved" or "insight" this vein or zone has been cut in four places, shows a width of about 25 ft, good continuity and persistance, and good thorium values wherever cut.

In one development examined a crosscut tunnel cut this thorium vein for 35 ft. The dip was about 42 away from the portal. Further in a winze was sunk again cutting through the vein. The thickness of the vein at right angles to its walls is about 25 ft.

The A.E.C.cut a large channel sample in 5 ft sections which averaged .65% thorium.

The problem here is not one of finding ore - a large tonnage is assured. But a reasonable amount of research work should be done to determine howw this ore might be concentrated into a marketable product, what the market value might be, who will buy such concentrates, and in what volumn. Other rare elements are evident in the ore and could add appreciably to its value.

Recommendations.

As hinted in Paragraph 2 above, an exploration program is advised provided it is set up and carried on in a conservative manner. Such a program should be in stages. The first stage is fully justified by present conditions. Each succeeding stage must be justified by the results of the preceding stage.

For the first stage I would recommend: Diamond drilling from the face of the present Silver Plate tunnel in a pyrmid-shaped pattern. Each hole should be about 200 ft in length. The first hole should be horizontal - dead ahead. Then 30 degrees to each side horizontal; and 30 degrees up and down on a vertical plane. This would total only 1000 feet of drilling and should not cost over $5000. As ore is encountered in each or any of these holes you will have factual information as to trend, width, and accurate value. If no ore is encountered in these holes something has happened that I cannot visualize, and you must then consider that it is a dud, or at the most, deserves further study with the hope that someone much smarter may come along.

On the "Cliff" Situation I would advise again "following the ore" by again drilling ahead from underground. You have commercial ore in upper levels and stopes. Drill from these spots , at several down angles, until you run out of ore. Establish a pattern - a trend. Then when you have proved enough tonnage below your present level to justify a lower level, run a lower aditTopographically that is easy. But don't run the adit first, looking blindly for ore. Find the ore by drilling - then run the adit to facilitate the mining operation. A few stages of thus going downward and you may well find yourselves only a bit above one of the old adits. Then you can use that - and capitalize on previous errors. In general: follow the ore downward with drill probing from some spot where you know it exists. And get the pattern below you.

On the Thorium no further expenditures are advised for this first stage, for exploration. But research and market investigation is advised.

Conclusion.

The above recommendations plus necessary overhead should not total over $15,000. Such an expenditure is speculative but seems fully justified provided the participating interest for such risk money is reasonable. May I say in closing that Mr. Bacchetti has done a remarketably fine job to date, with the comparitively small expenditures he has made.